ASSESSMENT OF THE PHYSICAL PROPERTIES OF SOIL AT THE JABI INDUSTRIAL AREA, ABUJA MUNICIPAL AREA COUNCIL, FCT.

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ABSTRACT
This study assessed the physical properties of soil at the Jabi Industrial Area, Abuja Municipal Area Council, FCT. Data was sourced from both primary and secondary sources, transect lines were superimposed at one hundred and fifty (150) meters long in the study area. Soil samples were collected at fifty (50) meters apart making three (3) sampling point for the industrial site, two samples were collected at each point, which are; top soil at 0-15 cm and sub soil at 15 to 30 cm deep, making six (6) sample for the study area, data were analyzed using descriptive statistics of Microsoft Excel and Statistical Package for Social Sciences (SPSS) and presented using frequency table, simple percentage, histogram among others. The result revealed the industrial area is characterized sandy loamy clayey with highest value of sand of 64.43 and lowest value of clay of 1.07. The soil of the control site as more pore space at the sub soil with higher value of 31.66%, organic matter is higher on top soil with 9.6, this is expected as leaves and straws with remains of plants and animal decomposed and disintegrate on top soil. the soil bulk density is higher on top soil of 0.89. The finding shows that industrial area recorded high value of bulk density in both top and sub soil. The result indicated that soil of the industrial area and control is affected by anthropogenic activities. Therefore, it was recommended that regulatory authorities' concern should as a matter of urgency intensify efforts in data gathering to bridge the gap that exists in this regard and effective monitoring of the Industrial Zone should not be compromised to avoid the industries developing from discharging untreated effluent into the FCT environment.

Key words. *Physical, Properties, Soil* and Industrial

INTRODUCTION
Industrial operations frequently put a great deal of strain on the quality of the water, which deteriorates wetland habitats, which primarily rely on subterranean water flow (Elias, 2017). Pollution of water and soil is one of the most prevalent environmental issues in today's world (Fatta et al., 2012). Seeping into soil and water bodies, industrial effluents are a major cause of environmental toxicity. In addition to lowering drinking water quality, it also negatively impacts soil microbiology and aquatic habitats. While industrial expansion and development are highly desirable, they unintentionally pollute the environment by releasing gaseous emissions, discharging liquid effluent, and producing a lot of waste, which includes poisonous and hazardous contaminants. There are major worries over the fact that over 80% of Nigerian industries dump untreated solid waste, liquid effluents, and gaseous emissions into the environment (Federal Ministry of Water Resources, 2021). Out of 200 randomly selected Nigerian businesses examined, just 18% claimed to even complete basic recycling before getting rid of rubbish (Federal Environmental Protection Agency, 2003). This scenario draws attention to the growing problem of industrial pollution, which endangers the health of people and the environment.
On the other hand, soil acts as a base for crop production (Toor & Adnan, 2020; Rehman et al.,

2020a; & Rehman et al., 2020b). It is therefore a necessary component that provides us with food, fiber, and shelter (Rehman et al., 2020a; Kalsoom et al., 2020; & Adnan, 2020a). It is a finite resource that is losing quality every day. In addition, both natural and human factors contribute to the degradation and deterioration of soil quality for agricultural purposes. Although there is a close relationship between the soil and the agriculture sector, heavy metals are the main cause of the degradation of most agricultural land (Toor et al., 2020a; & Toor et al., 2020b) (Adnan et al., 2020; & Hayat et al., 2020). These pollutants are produced by both the natural world and human activity. These pollutants have a major impact on the rhizosphere and phyllosphere microbiota of the plant (Kalsoom et al., 2020; Rehman et al., 2020a, & Rehman et al., 2020b).

Because of the impact on the ecosystem in most nations, the contamination of the environment by wastewater is considered a worldwide issue (Solomon, and Kehinde, 2017). The majority of Nigeria's companies and population engage in waste disposal and management practices that often result in increased environmental contamination, making the situation there no better. A significant contributor to soil and water contamination is sewage discharge, which is exacerbated in places with inadequate waste water treatment. This is the situation with the Jabi stream, a rushing stream that is adjacent to Federal Capital Territory Abuja's Idu industrial district. Some villages downstream rely on this receiving stream for their water supply, which is utilized for drinking, irrigation, aquatic life, and other household uses without any prior treatment. Jabi Lake, which stretches 1.78 kilometers from Jabi resettlement camp toward Kado, is a mixture of natural and artificial elements. Originally, the people living in the vicinity of the lake relied on it for their domestic water needs. However, this lake was made larger for commercial fishing after the country's capital were moved from Lagos to Abuja in 1991. (Sikiru, 2011).

The physical parameters under investigation are important because some of them could be fatal to aquatic plants, animals, soil, and eventually people, who are typically at the top of the food chain. The receiving stream removes waste at the point of discharge and provides a practical solution to clean the heavily loaded sewage. This study has been motivated by the requirement to determine the soil quality from the receiving stream. Additionally, the study will offer details on the sewage lagoon's effectiveness.

2.0 Material and Methods

2.1 Study Area

Jabi Lake or reservoir is located in the Federal Capital City (FCC), Abuja; it has the geographic coordinates of latitudes 8°30′00’’N and 9°20′00’’N, longitudes 6°20′00’’E and 7°33′00’’E. The lake spans from Jabi resettlement camp to Kado, which is about 1.78 km long and 0.55 km wide. The climate of the lake basin is characterized by temperate weather, being influenced by the surrounding conditions of the lake

AMAC climate is the hot, humid tropical type. It is such that their major elements have regimes that are transitional from those of the southern and northern parts of the country (NIMET). For a full description of climate characteristics in AMAC, some of the vital elements of climate within the FCT are discuss below.

The two major air masses dominate the climate of FCT just like other areas in the tropic. These are the tropical maritime air mass and tropical air mass (NIMET). The tropical maritime is formed over the Atlantic ocean to the southern part of the country making it warm and moist. This wind usually moves inland in a southwest to the northeast direction. On the other hand, the tropical continental air mass usually is developed over the Sahara Desert making it dry and warm blowing from contrary direction, northeast to southwest.

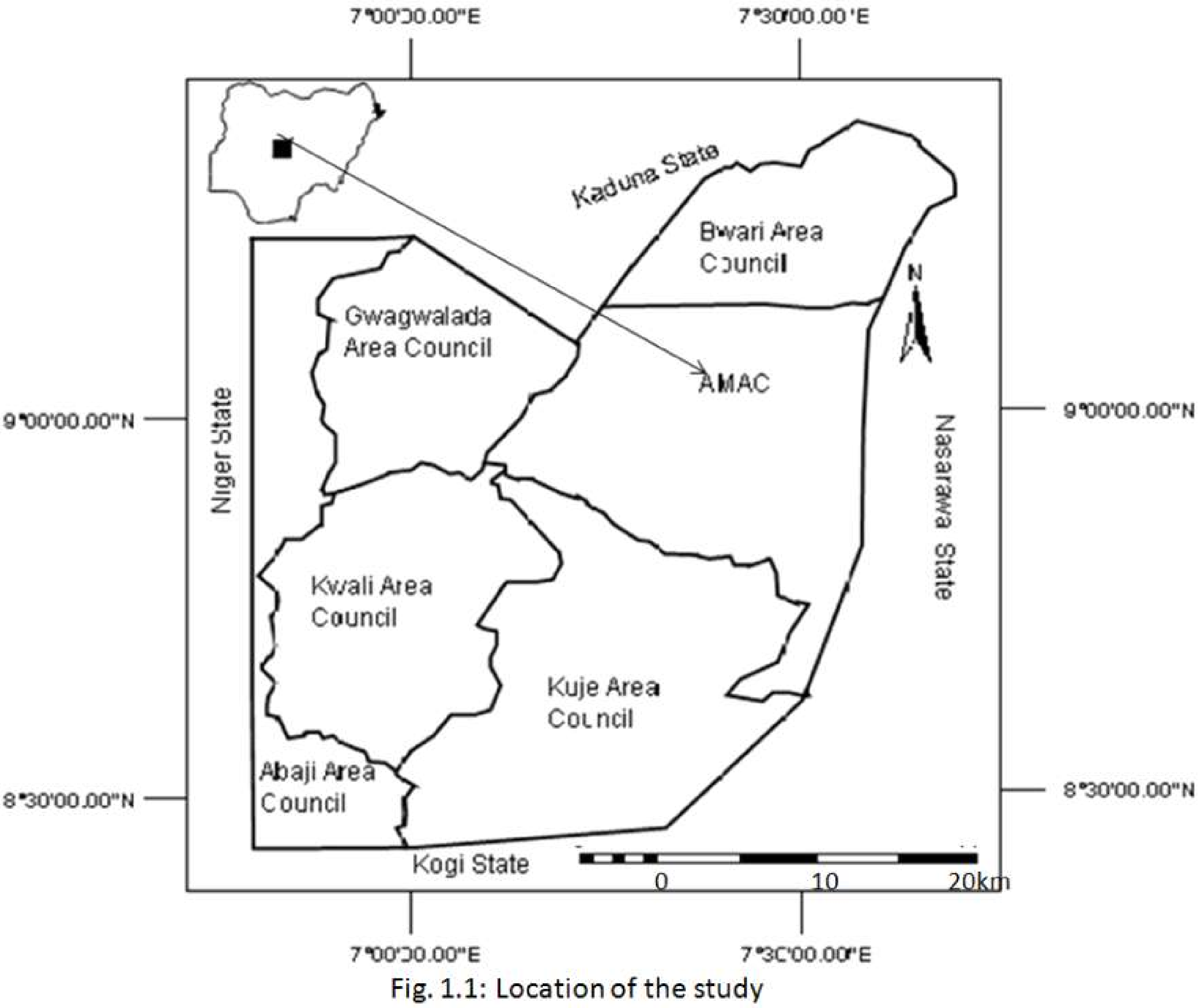

Figure 1: Map Showing Abuja Municipal Area Council
Source: ArchMap, 10.1

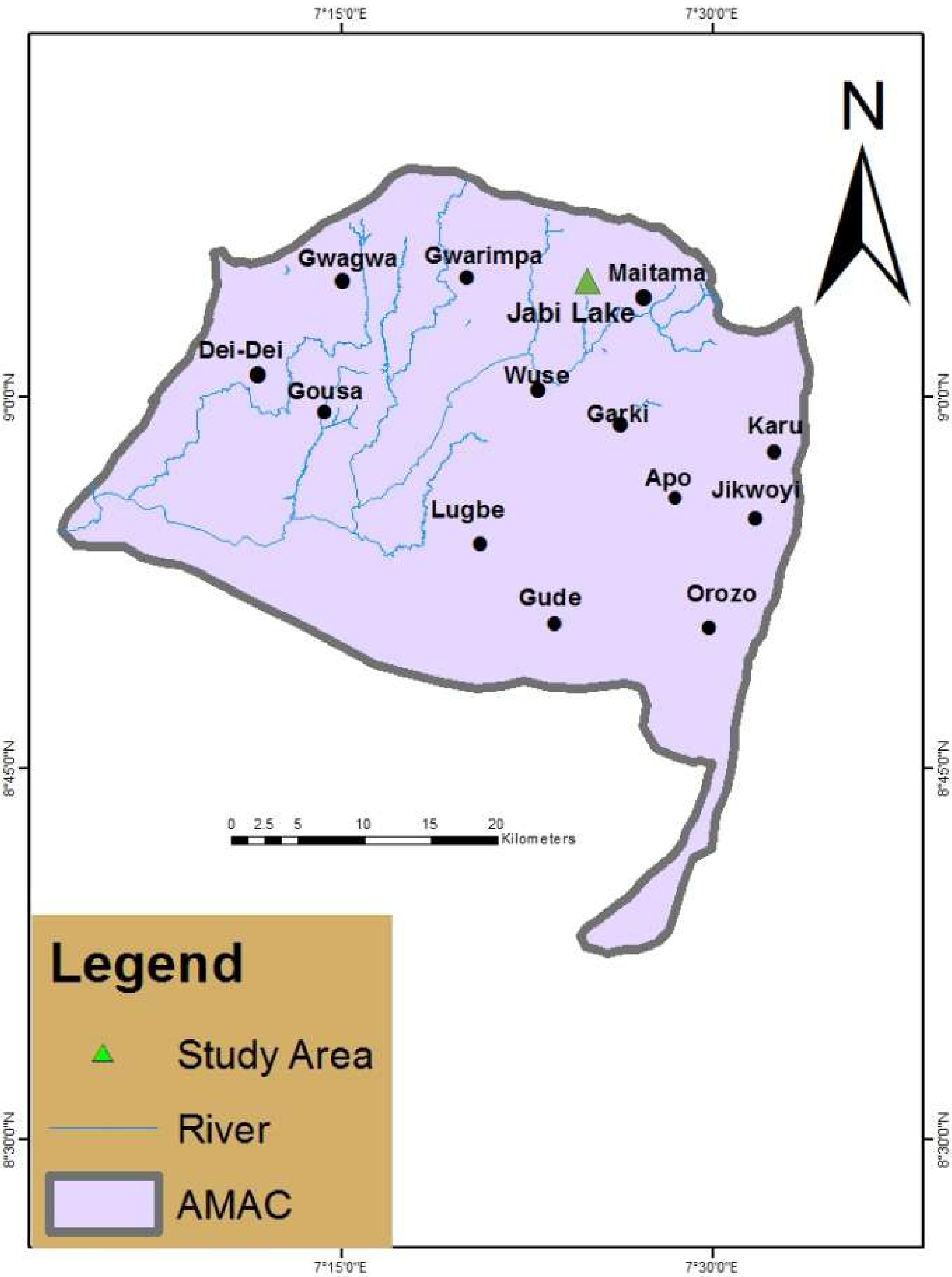

Figure 2: AMAC Showing the Study Area
Source: FCDA, 2021.

The study area is predominately underlain by Precambrian migmatites, gneises, granites and schist of the crystalline basement complex. Schist belt outcrops are found along the south western merging of the area and apart from the schist belt. Quaternary alluvium deposits are found in the Usman River channel and this is a source of fine sand which is used for building purposes (Balogun, 2001).

There is a mark difference between the highest and lowest elevation within the area council the highest elevation is 213.3m to the North and 142.2m to the Southern part of the area. Slope within this area are generally long and so gentle that is always refer to gentle undulating. The geomorphology of the area determines the choice for urban form, structure and development of infrastructure (FCDA, 1980). Within the Abuja Municipal Area council is located the famous Aso rock, Katempe Hill and Asokoro rock outcrops that provide good scenery for tourism and recreation (Balogun, 2001). The most important and largest river within the study area is river Usuma which is a tributary of river Gurara. This river quite shallow for all part of the year except during the peak of the raining season at the month of July, August, and September. The Iku River which is another significant river takes its source from Abuja hill. This river is also source of water supply to Suleja area and also a tributary of Usuma River. Flash flooding is a characteristic of all streams in this area particularly during the raining season. It is obvious that flooding is a major environmental hazard in this area and flood vulnerability is likely to increase with increase constructional activities within the area (Balogun, 2001).

The soil in the study area comprises mainly of sand, silt, clay, and gravel. Earlier before the impact of population growth and urbanization the incidence of soil erosion is quite small because of the then protective vegetation cover. The resent uncontrolled clearance over the decades as a result of population growth and urbanization result to accelerated erosion with evidence along footpaths and roads in the area (Balogun, 2001). The vegetation can be classified as park Savanna with scattered trees and tall grasses. There also exist some wooden areas along interfluves between the Usuma River and its tributaries within the area. According to Balogun (2001) the FCT is located within the northern boundary of the Guinea Savannah. The major type of vegetation is found in the country, i.e. forest and savannah are also recognizable within it. The two types of forest found in the FCT are rainforest and riparian vegetation complex. On the other hand, 3 types of savannahs namely woodlands, park savannah and shrubs cover 79% of the FCT land mass.

2.2 Sample procedure and collection

Data was collected directly from the field, pictorial evidence, direct observation of events happening on the site and laboratory

Soil sampling

Transect lines were superimposed at one hundred and fifty (150) meters long in the study area. Soil samples were collected at fifty (50) meters apart making three (3) sampling point for the industrial site, two samples were collected at each point, which are; top soil at 0-15 cm and sub soil at 15 to 30 cm deep, making six (6) sample for the study area. Soil samples were collected using soil auger from the site and were packed and represented concerning each site. The samples collected were further stored in clean polythene bags before laboratory analysis. During data collection, a soil auger, GPS, notepad, and camera were utilized. Quality assurance was closely adhered to during data collection, and soil samples were checked for contamination of any kind.

Data Presentation and Analysis

The data obtained was subjected to descriptive and inferential statistics. The descriptive statistics measures of central tendency, as mean, range, standard deviation and frequency.

3.0 Data Presentation and Analysis

Physical Characteristics of Soil Samples Within Industrial Area

Table 1: Soil Properties of the Study Area

Sample Code	Depth (cm)	Particle Size %			Porosity (%)	Name of Textural class	Organic content (%)	Bulk density (g/cm^3)
		Sand	Silt	Clay				
TPS 1	0 -15	61.92	19.04	7.08	33.33	Sandy-loam	3.2	1.99
TPS 2	0-15	50.3	26.88	14.59	46.66	Sandy-loam	18.8	1.68
TPSS 3	0-15	24.51	44.69	26.37	30.00	Loam	9.6	1.05
SSS 1	16-30	64.43	17.2	6.07	27.66	Sandy-loam	4.0	1.97
SSS 2	16-30	51.11	28.2	11.2	37.33	Sandy-loam	5.2	1.98
SS 3	16-30	23.98	44.42	16.2	31.66	Loam	3.2	1.01

The soil of the industrial area is characterized by sandy loamy clayey with highest value of sand of 64.43 and lowest value of clay of 1.07. The result shows that topsoil of the industrial area recorded highest value in both samples soil with 33.33% on sample one and 46.66% on sample two while lowest values were recorded at the sub soil. The result shows top soil of sample two of the industrial area recorded highest value of organic content of 18.8 while the lowest value of 3.2 was recorded at top soil of sample one. The result shows that sub soil of sample one of the industrial areas recorded highest value of bulk density of 0.9 while subsoil of sample 2 recorded lowest value of bulk density of 0.82, however top soil generally as higher bulk density value.

Comparison of the soil properties at Industrial area with the Control site

The result indicated that the soil of the control plot is loamy sandy clay with highest value of 44.6 and 44.42 recorded for silt on top and sub soil. The soil of the control site as more pore space at the sub soil with higher value of 31.66%, organic matter is higher on top soil with 9.6, this is expected as leaves and straws with remains of plants and animal decomposed and disintegrate on top soil. The soil bulk density is higher on top soil of 0.89.

The result shows that soil in the industrial area is characterized by sandy loamy clayey while that of control is characterized with loamy sandy clay. The finding shows that industrial area recorded highest value of porosity of 39.005 on top soil, generally the value of porosity if higher in the soil of the industrial area compared to the control site. The finding shows that industrial area recorded high value of bulk density in both top and sub soil. The result indicated that soil of the industrial area and control is affected by anthropogenic activities.

Discussion of Findings

The research area's significant sand concentration was noted in the outcome. Because of the high sand concentration of the soil, nutrients, especially phosphorus and nitrogen, may seep out. Water below earth may get contaminated as a result of this. Anthony and Denis reported a similar outcome (2014). This suggests that industrial processes like construction, construction and movement of vehicles on daily bases has affected the soil properties of the study area there by exposing the soil of the study area to erosion. More also the finding shows that sand is higher on the top soil as compare to the sub soil of the study area, according to Brandy and Weil, (2002), sand content decreases with increasing soil depth, these is applicable to the soil samples probably because weathering activities as been acting naturally without it been affected by both man and animal.

The result shows that top soil is more porous than the sub soil, this could be losing of soil from human activities as the area is prone to high rate of man influence form several industrial activities. The value obtained is lower than value recorded by Morteza et. al., (2012) of ranged value 41.89 to 48.79, which implies that value recorded in the study area differ from study of Morteza et. al., (2012). This implies that industrial activities break the soil and create more pore spaces than the control plot, this implies that soil in the study area is generally affected by anthropogenic activities, an industrial area is made up of several human activities. The value obtained is lower than value recorded by Morteza et. al., (2012) of ranged value 41.89 to 48.79, which implies that value recorded in the study area differ from study of Morteza et. al., (2012).

The result indicated that soil of the industrial area is compacted. This is dues to human influences as vehicle movement are likely to increase the compactness of soil. According to Scholefield et. al., (1985), when soil is moist, human trampling compresses the soil beneath the hoof and Warren et. al., (2016); Taboada and Lavado, (1993), also stated that soils that are moist are tramped by humans and collapse when they have larger soil pores. This results in increase in bulk density by compaction in the soil surface (Willatt and Pullar, 1983; Greenwood and McKenzie, 2001).

This demonstrates that industrial operations significantly impacted on soil textural activities. This will have a significant impact of the soil, as soil with high sandy particles are more vulnerable to erosion compare to those with high loam and clay. As an extra factor to the treatments used, Ayani (2010) reported that the spatial variation in the textural class of the soil in the field had contributed to the differences on the results of other soil parameters (such as different microbial activities, pH buffering capacity, infiltration rate, and accretion).

In all of the studied horizons, the soils had substantial levels of organic matter, with values greater than 2.0 percent. In terms of organic matter concentration, this soil falls into category S, which is considered highly appropriate for crop cultivation, according to FEPA (1991). As a result, there is more interaction with the soil solution and other colloids. Because of the strong friction and cohesion bonds that form between the particles and soil water, Edem and Udoinyang (2013) reported that a high concentration of organic matter in problem soils is likely unsaturated, highly toxic, and capable of causing irritation to the eyes, lungs, and throat in addition to causing discomfort to the kidneys and lungs.

The result indicated that soil of the industrial area and control is affected by anthropogenic activities. But a study by Davoud et. al., (2015) which recorded 0.73 to 0.89 in Mediterranean Rangeland is similar to the value recorded in the study area. This in total differ from the result obtained by Morteza et al., (2012), which ranged between 1.33 to 1.51. According to Scholefield et. al., (2015), when soil is moist, human trampling compresses the soil beneath the hoof and Warren et. al., (2016); Taboada and Lavado, (2013), also stated that soils that are moist are tramped by human and collapse when they have larger soil pores. This results in increase in bulk density by compaction in the soil surface (Willatt and Pullar, 2013; Greenwood and McKenzie, 2001).

Conclusion and Recommendation

Based on the analysis obtained on the soil properties of the soil sampled it can be concluded that the industrial activities effect on soil properties as there are depletion of value of different soil properties compare to the control site such as; soil textural class, organic content, porosity. The finding shows that soil texture on the industrial area are sandy clay loam while control plot recorded higher loamy, Bulk density in the soil increases with increasing soil depth and with increasing clay content, bulk density is higher on industrial area than the control site probably because of anthropogenic activities, soil with high bulk density have porosity problem owing to the compaction thus root penetration may be affected. The following recommendations are proffered to improve the disposal of sludge and its application for crop production:

1. The regulatory authorities' concern should as a matter of urgency intensify efforts in data gathering to bridge the gap that exists in this regard.
2. Effective monitoring of the Industrial Zone should not be compromised to avoid the industries developing from discharging untreated effluent into the FCT environment.
3. There is a need for local government and Federal governments to embark on a mass orientation program aimed at properly educating the public and owners of industries within the study area on the need to sustain a high-quality environment. This should cover the negative effects of polluted effluents sources on the short- and long-term effects.
4. The government through Abuja Environmental Protection Bord should enforce compulsory conduction of environmental impact assessment for any industries that will be set up within the industrial zone, to minimize effect on soil properties.
5. Abuja Environmental Protection Board should ensure environmental auditing of the industries within the study area to ensure efficient compliance with environmental protection.

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