OSUN GEOGRAPHICAL REVIEW
Published by the Department of Geography, Osun State University, Osun State, Nigeria
ISSN: 2695 - 1959 Volume 7, 2025; 1 - 10

LAND USE INFLUENCE ON SOIL PHYSICOCHEMICAL PROPERTIES IN GWAGWALADA AREA COUNCIL, ABUJA, NIGERIA

I. O. Areo

Department of Rural Development, Faculty of Environmental Studies
University of Lay Adventist Kigali, Rwanda
Email: isaacareo@unilak.ac.rw

Abstract

The study is aimed at assessing the soil physiochemical properties of different land use in Gwagwalada Area Council of the Federal Capital Territory of Abuja. The specific objectives are to: examine the soil physiochemical properties of automobile land (mechanic), farm and construction land use surfaces in the study area; identify the variation in physiochemical properties of the selected land use in the study area; establish the most fertile soil and the poorest soil; and recommend the best soil conservation practices to reclaim and sustain the soil fertility in the study area. The study required primary and secondary data, purposive soil samples were taken from farm, construction, automobile shop and control sites within the study region. Three samples each were collected and twelve samples in all were taken from the field. Data analysis included both descriptive and inferential statistics. The results showed that, the soil is black in color on automobile land use sample, whereas it is dark gray on farm land, light gray on construction land, and light brown on control land samples. All the samples had significant difference in silt contents. In comparison to automobile land (8.7-9.2g/kg), control land (9.1-10.2g/kg), and farm land (9.8-10.4g/kg), it was much more abundant in construction land (8.8-11.2g/kg). The soil pH levels vary considerably control land (5.8-6.0), cultivated land (6.1-6.4), and building land (7.6-7.8), it had a much higher value in automotive land (7.6-8.5). At $p>0.05$, the analysis of variance (ANOVA) for physical attributes revealed a significant statistical difference between the various land uses. The study concludes that, various human activities within the environment affects the soils physio-chemical properties of various land use. The farm land is the most fertile soil in the research region because it has the greatest soil pH, electrical conductivity, nitrogen, calcium, magnesium, potassium, and sodium values, meanwhile, automobile land has the poorest soil. It is recommended that, to maximize soil fertility and reduce nutrient imbalances, the agriculture extension services should be extended to nutrient management strategy development for various land uses. Land owners should be enlightened on the ethical land conservation principles like: Crop rotation, incorporating organic matter, and decreased tillage are some agricultural strategies that can help preserve soil fertility and lessen erosion for heathy soil.

Keywords: Land Use,Soil pH, Bulk-Density, Organic- Matter and soil Management**.**

Introduction

The ways in which land is used and managed has a big influence on natural resources. Some of the more recent and significant effects of land use include desertification, salinization, soil erosion, and urban sprawl. Soil degradation as an environmental concern explains the decline in soil quality on a physical, chemical, and biological level. It could also be caused by erosion, declining soil fertility, declining structural condition, unfavorable flora changes, or acidic or alkaline conditions. (Garandi, *et. al.,* 2021).

Inadequate agricultural inputs, traditional farming methods, excessive grazing, continuous cultivation, and other environmental factors all contribute to the deterioration of soil physicochemical qualities, which in turn causes a decrease in soil pH and, ultimately, soil acidity (Achalu, Heluf, Kibebew, and Abi, 2012). The process of soil acidification is when the pH of the soil gradually decreases as a result of regular farming methods and excessive rains (Habtamu, 2011).

Analyzing changes in soil qualities brought on by land use is crucial for addressing the issues of agro-ecosystem transformation and sustainable land production. Use pertinent indicators with a well-defined ecological objective and high dispersion sensitivity to increase agricultural sectors' output and productivity on a long-term basis (Garandi, *et. al.,* 2021). According to Abdullahi and Areo (2024), soil physical properties including particle size analysis were products of the parent materials and not affected by the presence of the Gousa dumpsite.

Several studies have been conducted on the soil physiochemical properties in different places within Nigeria. For instance, Senjobi (2017), opined that land degradation is the root cause of compaction and erosion and it has a significant negative influence on the physical and chemical characteristics of soil, such as: infiltration, bulk density, organic matter, porosity, and aggregate stability leading to an impact on the environment, food production, and health. Furthermore, Adaikwu, Obi, and Ali (2012), stated that, soil degradation could be caused by erosion, harmful changes in salinity, acidity, or alkalinity, toxic chemicals, pollutants, excessive flooding, declining soil fertility, structural deterioration, unfavorable flora changes, or alkaline or acidic conditions. There has been considerable land degradation as a result of excessive land usage for all purposes at the expense of its appropriateness (Ahukaemere, Ndukwu, and Agim, 2012). A multitude of environmental problems, including as eutrophication, acidification, desertification, and climate change, as well as biodiversity loss and the greenhouse effect, are reportedly made worse by indiscriminate changes in land use (Paul, *et. al.,* 2019).

Among these and several other studies, data is limited on land use influence on soil physicochemical properties in Gwagwalada Area Council, Abuja, Nigeria. However, it is on this premise that this current study aimed at assessing the soil physiochemical properties of different land use in Gwagwalada Area Council of the Federal Capital Territory, Abuja with the view of identifying the most fertile and poorest soils among the land use in the study area. Sequel to this aim, the following objectives were pursued: examining the soil physiochemical properties of automobile shop (mechanic), farm land and construction land use in the study area; assessing the variation of physiochemical properties of soil among the various land use; determining the most fertile soil and the poorest soil in the study area; and recommending the best soil conservation practices to sustain the soil fertility.

The study Area is Gwagwalada Area Council. It is located in the North-Central part of Nigeria and North West of FCT Abuja. (Figure 1). It located between Latitude 8° 56' N and 9° 34' N of the equator and Longitude 7° 04' E and 7° 08' E of the Greenwich Meridian. It is bordered in the South by Kwali Area Council, in the North by Niger State; Kuje Area Council in the East and AMAC in the North-East. The study area occupies a land area of about 1,043 km2. It produced a population figure of 157,770 (National Population Commission, 2006). See figures 1 and 2.

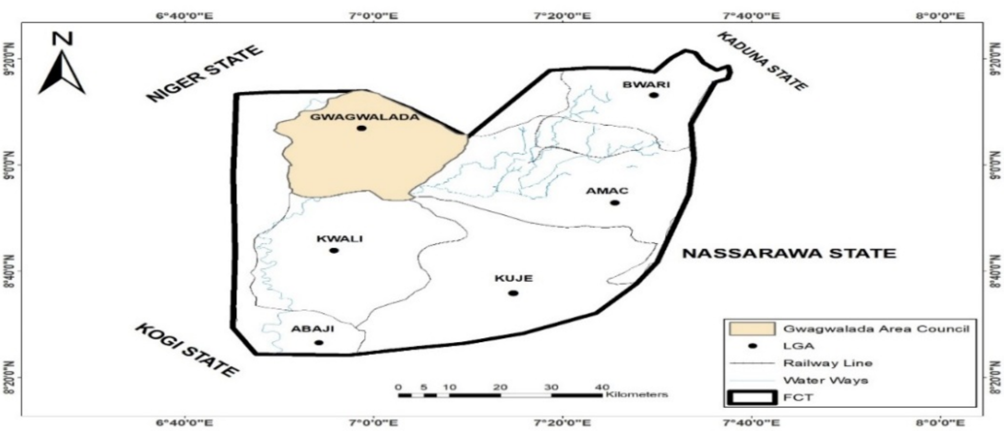

Figure 1: Gwagwalada Town.
Source: Department of Geography and Environmental Management University of Abuja (2024).

The dry season, which lasts from November to March, and the wet season, which lasts from April to October, define the climate of Gwagwalada Area Council. The length of the rainy season ranges from 180 to 190 days. The wettest months were July and September, with an average yearly rainfall of 1,632mm. The dry season, when there are few clouds, is when the Area Council records its greatest temperatures (Hassan and Okobia, 2008).

According to Dikedi (2012), the geology of the FCT and Gwagwalada are identical. While a small quantity of water can be found in the recently unweathered bedrock below the weathered layers, groundwater is mostly found in the variably weathered/transition zone and in fractures, joints, and cracks of the crystalline basement (Eduvie, *et. al.*, 2003).

Plant species including Danulio Oliver, AlbiziaZygia, Shea butter tree Butrospermum-paradoxium, and African Locust bean predominate in the vegetation. The area's prominent shrubs include Parkiaclappertoniana, Terminatia-pilisotigma, Amona, Nauclea, and Bombax contratum (Balogun, 2001).

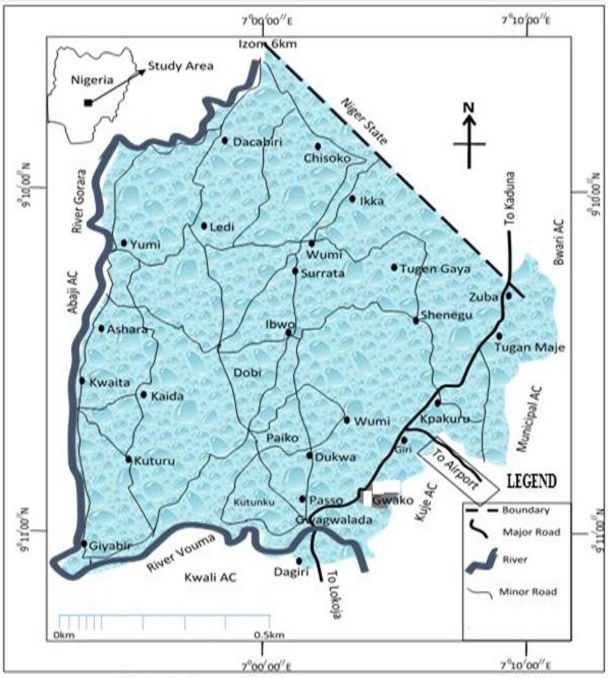

Figure 2: Administrative Map of Gwagwalada Area Council.
Source: Uniabuja GIS Lab., 2024.

Areo (2023), asserted that; the relatively low levels of organic matter and CEC, particularly under grass land, would negatively affect crop yield and also increase the incidence of erosion and leaching of nutrients in the study area. This would further deplete the phosphorus in the soil and increase the chemical constraints of the cultivated lands. Some dominant tree species of the savannah woodlands yield high-quality timber, e.g. Anogeissus Leiocarpus, Daniela Oliveri, Khaya Senegalensis and pterocarpus Arenaceous (Areo, 2023; Ishaya, *et. al.*, 2016).

Theoretical Framework and Literature Review

Soil Conservation Theory according to fathers of soil conservations: Hugh (1928), Aldo (1949), Russell (1929), and King (1911), explains improving the principle of soil conservation, soil productivity and quality can be maintained by using sustainable management techniques. The hypothesis here measures that conserve soil are essential to preventing soil erosion, preserving soil fertility, and safeguarding soil structure and water holding ability; for sustainable agriculture and environmental protection, soil quality maintenance and improvement are crucial.

McHarg (1969) and Carl (1925) referred to as the "father of cultural geography" especially from their work in ecological planning and design have contributed to the development of land use theory. The management and distribution of land resources for various uses, such as agriculture, forestry, urban development, and conservation, are the main topics of land use theory. The significance of sustainable land use strategies that strike a balance between economic, social, and environmental factors is emphasized by this idea; for sustainable land management techniques that support food security, biodiversity preservation, and environmental sustainability, land use theory is crucial.

Researchers in the domains of soil science, agriculture, and environmental science have established the notion of land reclamation. Stewart (2004), Schlesinger (1998), and Lal (2013) are notable individuals in this field. According to soil development procedures, degraded lands can be restored for productive use, which is the main goal of land reclamation theory. This idea highlights the requirement for land reclamation techniques that enhance plant growth while restoring soil fertility, structure, and water-holding capacity. The notion of land reclamation is crucial for putting degraded areas back to productive use and raising community standards.

Furthermore, Russell (1929), popularized the idea of agroforestry in his book "Tree Crops: A Permanent Agriculture,". According to agroforestry theory, adding trees to agricultural systems can increase production and sustainability. This theory highlights the value of agroforestry techniques that enhance soil quality, save water supplies, and offer a variety of advantages, including food, fuel, and fodder. Promoting sustainable agricultural techniques that strike a balance between economic, social, and environmental factors requires an understanding of agroforestry theory.

Materials and Methods

This study adopted experimental investigation on the soil Physio-chemical properties on: automobile shop land use, farm land use, construction land use and controlled surfaces in the study area. The experimental investigation was carried out at Sheda Science Laboratory located at Abuja-Lokoja Express Way. The primary source of data is field based. Parameter tested include: Physical characteristics like; soil texture, color, bulk density, porosity, and moisture content. Particle size distribution is sometimes referred to as soil texture. Chemical characteristics: phosphorus, calcium, magnesium, potassium, nitrogen, sodium, iron, manganese, copper, and aluminum. Organic matter, pH levels, exchange capacity. Direct observations, measurements, and excavation were used to gather the primary data.

Secondary Data include: Academic journals, research papers, and conference proceedings, as well as databases from environmental or agricultural agencies, are significant sources of secondary data in this study.

Purposive sampling was considered to select the sample frame which include: Gwagwalada Town, Zone 4, Kutunku, and the control site at Phase III all within Gwagwalada Area Council. This is because land degradation is frequently seen in these areas and they are seen to have a detrimental impact on soil physio-chemical properties under various land use types.

GPS was used to obtain the coordinates of the sample points

Soil samples were collected from the vehicle repair shop (Automobile shop), construction site, farm, and control sites. Three 5m by 5m plots were set up in each defined and demarcated land use, and then soil samples were randomly taken with a soil auger from the 0–20 cm layer of the soil. All soil samples from the three research locations were meticulously labeled and stored in polythene bags before being put in a refrigerator to maintain a constant temperature for the samples. Twelve (12) samples in all were taken from the field. Three (3) from the Automobile shop, three (3) from the building site, three (3) from the farm, and three (3) from the control location. One composite sample was taken from each location, and each sample was properly labeled. Soil auger samples were obtained at depths ranging from 0 to 20 cm in order to assess the degree of soil profile variability at the four locations that were chosen. Using hand gloves, the soil sample was carefully sieved to get rid of any visible plant remnants, stones, roots, and large debris. Larger dirt clumps were broken down to ensure uniformity. Soil samples were softly scattered on a new plastic sheet. The soil samples were air dried in a location that was properly aired and protected from direct sunlight. The samples were constantly flipped to ensure uniform drying.

Method of Data Analysis

The data were generated and presented using descriptive statistics, such as mean, in order to address objective one (soil chemical characteristics).

Table 1: Location of Study Site

S/N	Land Use	Study Area	Coordinates
1	Automobile Shop	Gwagwalada Town	8.9508°N, 7.0767°E
2	Construction	Zone 4	8.9620°N, 7.0637°E
3	Farm	Kutunku	8.9351°N, 7.0391°E
4	Controlled Site	Phase III	8.9589°N, 7.0678°E

Source: Field Survey, 2024.

Table 2: Instruments Required for the Study

S/N	Instruments	Model	Uses
1	pH meter	Hanna benchtop model, the HI98103 Checker pH Tester.	The pH meter is used to measure the acidity or alkalinity of the sampled soil for the study.
2	Conductivity meter	Oakton brand, the Oakton CON 510 Benchtop Conductivity Meters.	the conductivity meter is used to measure the electrical conductivity of the soil, which is an indicator of soil fertility.
3	Spectrophotometer	Thermo Fisher Scientific, thermo Scientific GENESYS series.	The spectrophotometer is used to measure the concentration of nutrients such as nitrogen, phosphorus, and potassium in the sampled soil.
4	Soil thermometer	REOTEMP Soil Thermometer model with 8-inch Probe.	The soil thermometer is used to measure the temperature of the soil, which is an important factor that affects the biological activity in the soil.
5	Glassware and chemicals	Kimble Chase brands.	Glassware such as beakers, pipettes, and test tubes, and chemicals such as reagents for nutrient analysis are used for the analysis.
6	Oven	Whirlpool, single and double wall ovens.	The oven is used for drying the soil samples before analysis.
7	Weighing balance	The Mettler Toledo Precision Balance.	The weighing balance is used for weighing soil sampled and reagents.
8	Notebook and pen	Moleskine high-quality notebook and pen.	A notebook and pen are needed for recording the measurements, results and observations during the analysis.
9	Masking tape	Paper type	For labeling of soil samples
10	Gloves and lab coats	Ansell latex hand gloves and fabric lab coat.	Gloves and lab coats are used to protect the researcher from harmful chemicals during the analysis.
11	Soil auger	Agricultural Measurement Solutions (AMS) Regular Soil Auger brand.	The soil auger is used to bore holes in soil. It is also used to take samples from the required depths.
12	Trowel and shovel	Iron and steel brands.	They are used to collect shallow soil samples, up to a depth of about 6 inches.
13	Soil probe	The Oakfield T-100 Soil Probe.	Soil probe is useful in this study for taking samples from a specific location in the field.
14	Piston sampler	AMS Piston Soil Probe.	It is a tool used to collect undisturbed soil samples for the study. The sampler consists of a hollow tube that is pushed into the soil using a hydraulic ram.
15	Global Positioning System (GPS)	GARMIN III model	Used for picking coordinates of selected sites.

Source: Field Survey, 2024.

Through the use of range and standard deviation, objective two was addressed. Histograms were employed for visualization. To determine if there is a significant difference in the soil physiochemical parameters at the four soil sample sites, a one-way analysis of variance was conducted. with a probability of 5% for significantly different characteristics (p 0.05).

Table 3: Physical Properties of Land Use Soil

Soil parameters	Automobile		Farm		Construction		Control		p-value
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	
Colour	Dark	-	Dark gray	-	Light gray		Light Brown	-	-
Sand g/kg	28.2-30.5	29.2±1.3	53.0-58.2	53.1±2.2	57.3-61.2	59.2±1.7	19.0-22.2	20.4±1.1	0.29
Silt g/kg	8.7-9.2	8.3±1.5	9.8-10.4	10.2±1.5	8.8-11.2	9.6± 1.1	9.1-10.2	9.7±1.3	0.32
Clay g/kg	15.2-18.4	16.3±1.1	26.0-28.6	27.0±1.6	18.4-20.2	19.3±1.7	14.1-16.3	15.2±1.2	0.13
BD g/kg	2.0-2.5	2.2±0.4	1.6-1.9	7.2±1.3	1.8-2.1	1.9± 1.4	0.6-1.1	0.8±0.2	0.29
Porosity g/kg	13.4-14.5	13.2±1.2	42.3-46.2	44.1±1.2	22.6-24.2	23.1±1.2	10.2-10.6	9.2±1.1	0.31
MC g/kg	14.5-16.2	15.5±1.5	22.1-23.4	23.8±1.1	18.3-19.7	18.9±1.6	12.0-12.8	11.1±1.4	0.03

Source: Lab. Report, 2024.

NB: BD = Bulk Density, MC = Moisture Contents

Results and Discussion

Physiochemical Properties of Land Use Soils in the Study Area

The findings of the physical characteristics of the soils in the automobile shop, farmed, construction, and control land uses in the research region are displayed in Table 3. The research showed that, the soil in the automobile shop land is black in color, while the soil in farm land is dark gray, the soil in construction land is light gray, and the soil from control land is light brown. The various land use results showed that, there was a significant difference in the sand concentration of the soils (P 0.05). In comparison to control land (19.0-22.2g/kg), automobile shop land (28.2-30.5g/kg), and farm land (53.0-58.2g/kg), and that a substantially higher amount is found in construction land (57.3-61.2g/kg). The virous land use all had significantly different soil silt contents (P 0.05). In comparison, the automobile shop land (8.7-9.2g/kg), control land (9.1-10.2g/kg), and farm land (9.8-10.4g/kg), it was much more abundant in construction land (8.8-11.2g/kg). This is in agreement with the study of Areo (2023), which established that, silt content of the soils under tree land was on the average higher than that of the grassland, although their means were not significantly different. Among the various land use, there were significant differences in the clay concentration of the soils (P 0.05). In comparison, the control land (14.1–16.3g/kg), automobile shop land (15.2–18.4g/kg), and construction land (18.4–20.2g/kg), it was much more abundant in farm land (26.0–28.6g/kg). This conclusion agrees with Abdullahi and Areo (2024), but at conflict with that of Garandi, *et. al.,* (2021), who claimed that farm land had lower clay concentration than nearby soils that were covered by natural forest. The lack of clay in the top layers of cultivated fields may be the result of erosion that targets only clay on the surface. Between the various land uses, there were significant differences in the soils' bulk density (BD) content (P 0.05). In comparison to control land (0.6-1.1g/kg), cultivated land (1.6-1.9g/kg), and construction land (1.8-2.1g/kg), it was much more abundant in vehicle land (2.0-2.5g/kg). This conclusion is consistent with study findings published by Wakene (2001), who claimed that soil compaction and OM degradation are to blame for the greatest BD in abandoned land. Among the various land uses, there was a significant difference in the porosity of the soils (P 0.05). In comparison to control land (10.2-10.6g/kg), automobile shop land (13.4-14.5g/kg), and construction land (22.6-24.2g/kg), it was much more abundant in farm land (42.3-46.2g/kg). Among the various land uses, there were significant differences in the moisture content (MC) of the soils (P 0.05). In comparison to control land (12.0-12.8g/kg), automobile shop land (14.5- 16.2g/kg), and construction land (18.3-19.7g/kg), it was much more abundant in farm land (22.1-23.4g/kg).

Chemical Properties of land use Soils in the Study Area

The chemical characteristics of soils in the research area's automobile, farmed, construction, and control land uses are displayed on Table 4. The result showed that, the soil pH levels vary considerably (P 0.05) among the various land uses. In comparison to control land (5.8-6.0), farm land (6.1-6.4), and construction land (7.6-7.8), it had a much higher value in automotive land (7.6-8.5). This suggests that the soils are typically acidic as a result of chemicals

Table 4: Chemical Properties of Land Use Soils

Soil parameters	Automobile		Farm		Construction		Control		p- value
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	
pH	7.6-8.5	8.1±1.2	6.1-6.4	6.1±1.2	7.6-7.8	7.1±1.3	5.8-6.0	5.2±1.3	0.25
EC dS/cm	3.0-3.2	2.9±1.0	4.3-4.7	4.4±1.2	3.4-3.6	3.2±1.2	4.1-4.2	4.5±1.2	0.04
TN g/kg	0.3-0.4	0.2±0.3	0.9-1.8	1.1±0.01	0.5-0.7	0.4±0.01	0.6-1.2	1.2±1.1	0.44
Ca cmol/kg	0.1-0.3	0.2±0.1	1.2-2.8	1.3±0.2	0.2-0.4	0.3±0.01	1.0-1.5	1.1±0.01	0.38
Mg cmol/kg	0.1-0.2	0.01±0.1	1.7-2.2	1.8±1.4	0.1-0.3	0.1±0.02	1.2-1.8	1.3±0.2	0.24
K cmol/kg	0.2-0.3	0.1±0.02	0.8-1.9	1.0±.001	0.2-0.4	0.2±0.01	0.3-0.8	0.4±0.01	0.42
Na cmol/kg	0.1-0.2	0.01±0.1	0.7-2.9	1.1±0.01	0.2-0.3	0.2±0.01	0.4-0.6	0.4±0.01	0.05
OM g/kg	0.3-0.4	0.2±0.3	2.7-3.8	3.1±1.0	0.2-0.5	0.3±0.02	1.2-1.6	1.3±0.2	0.40

Source: Lab. Report, 2024.

NB: pH = Soil Acidity or Alkalinity, EC = Electrical Conductivity, TN = Total Nitrogen, Ca = Calcium, Mg = Magnesium, K = Potassium, Na = Sodium, OM = Organic Matter.

released onto the soils, especially the construction, agricultural, and automobile-related fields. It could also be brought on by the iron and aluminum ions' abundance and the resulting net pH decrease in the soil (Garandi, *et. al.,* 2021).

The soils' electrical conductivity (EC) differed substantially among the various land uses at (P 0.05). In comparison to automobile shop land (3.0-3.2dS/cm), construction land (3.4-3.6dS/cm), and control land (4.1-4.2dS/cm), it had a much higher value in cultivated land (4.3-4.7dS/cm). The soils' total nitrogen (TN) content differed considerably among the various land uses at (P 0.05). Compared to automobile shop land (0.3-0.4g/kg), construction land (0.5-0.7g/kg), and control land (0.6- 1.2g/kg), it was much more abundant in farm land (0.9-1.8g/kg). Among the various land use, the calcium (Ca) concentration of the soils differed substantially (P 0.05). In contrast to automobile shop land (0.1-0.3cmol/kg), construction land (0.2-0.4cmol/kg), and control land (1.0- 1.5cmol/kg), its concentration was much higher in farm land (1.2-2.8cmol/kg). Among the various land use, there were significant differences in the soils' magnesium (Mg) concentration (P 0.05). In contrast to automobile shop land (0.1-0.2cmol/kg), construction land (0.1-0.2cmol/kg), and control land (1.2-1.8cmol/kg), its concentration was much higher in farm land (1.7-2.2cmol/kg). The soils' potassium (K) concentration differed considerably across the various land uses at (P 0.05). In contrast to automobile shop land (0.2-0.3cmol/kg), construction land (0.2-0.4cmol/kg), and control land (0.3-0.8cmol/kg), its concentration was much higher in farm land (0.8- 1.9cmol/kg). Among the various land uses, the sodium (Na) concentration of the soils differed substantially (P 0.05). In contrast to automobile land (0.1-0.2cmol/kg), construction land (0.2- 0.3cmol/kg), and control land (0.4-0.6cmol/kg), its level was much higher in cultivated land (0.7- 2.9cmol/kg). Among the various land uses, there were significant differences in the soils' Organic Matter (OM) contents (P 0.05). In contrast to automotive land (0.3-0.4g/kg), construction land (0.2-0.5g/kg), and control land (1.2-1.6g/kg), its concentration was substantially higher in cultivated land (2.7-3.g/kg). The research agrees with Abdullahi and Areo (2024). The result showed that the concentration of pH in the top and subsoil samples across the land use.

Variations in Physical Properties of Soil on Land Use

The analysis of variance (ANOVA) for physical parameters in Table 5 demonstrated significant statistical variation among the various land use at p>0.05. The farm land use was statistically comparable to the control land use and reported the biggest variance in soil physical attributes. In terms of soil physical qualities, the automobile shop land use was statistically comparable to the construction land use. The result, however, showed that, all of the soil physical characteristics used for the study exhibit significant variances at p>0.05.

Table 5: Mean Variation of Physical Properties over Different and Land Use

Land Use	Sand g/kg	Silt g/kg	Porosity g/kg	Clay g/kg	BD g/kg	MC g/kg	p- Value
Automobile	1.2	0.10	2.4	1.8	1.1	2.3	0.01
Farm	0.6	2.0	1.5	0.7	0.1	1.1	0.19
Construction	1.0	0.3	1.7	0.9	2.2	2.0	0.02
Control site	1.1	1.4	0.3	0.2	1.5	1.5	0.15
Mean ± SE	0.6	2.20	1.2	0.01	0.7	1.2	

Source: Compiled SPSS Output, 2024.

Table 6: Mean Variation of Chemical Properties of Soil over Different Land Use

Land Use	pH	EC dS/cm	TN g/kg	Ca cmol/kg	Mg cmol/kg	K cmol/kg	Na cmol/kg	p-value
Automobile	0.1	0.1	0.2	0.1	0.2	0.1	0.01	0.11
Farm	0.5	1.6	2.9	1.2	0.8	0.2	1.3	0.41
Construction	1.0	0.2	0.1	1.1	0.2	0.1	0.2	0.21
Control site	0.3	1.0	0.5	0.2	0.4	1.2	1.1	0.25
Mean ± SE	0.4	1.40	0.4	1.2	0.03	0.3	1.0	

Source: Compiled SPSS Output, 2024.

Variations in Physiochemical Properties of Soil on Land Use

The farm land use also recorded the highest variation in soil chemical properties and was statistically similar to the control land use, while the construction land use recorded the least in soil chemical properties and was statistically similar to the automobile land use. Table 6 analysis of variance (ANOVA) for chemical properties also reveals highly statistical variation among the different land uses at $p>0.05$.

Most Fertile and Poorest Soil in the Study Area

The numerous chemical soil characteristics taken into account for identifying the richest and least fertile soils in the research region are shown in Figure 3. The following soil factors are taken into account: pH, Electrical Conductivity, Total Nitrogen, Calcium, Magnesium, Potassium, and Sodium. Ishaya and Areo (2018), opined that, this account for farming activities that covers large areas down to the middle and towards the eastern part of F.C.T. The graph showed that the cultivated land in the study area has the most fertile soil because it has the highest soil pH, electrical conductivity (EC), total nitrogen (TN), calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na) values, while the automobile land in the study area has the poorest soil. As a reclamation measure, Areo (2022) suggested a continuous conservation principle as employed in the form of plant gardening along River Wupa.

Conclusion and Recommendations

i. The study came to the conclusion that various human activities within the environment affects

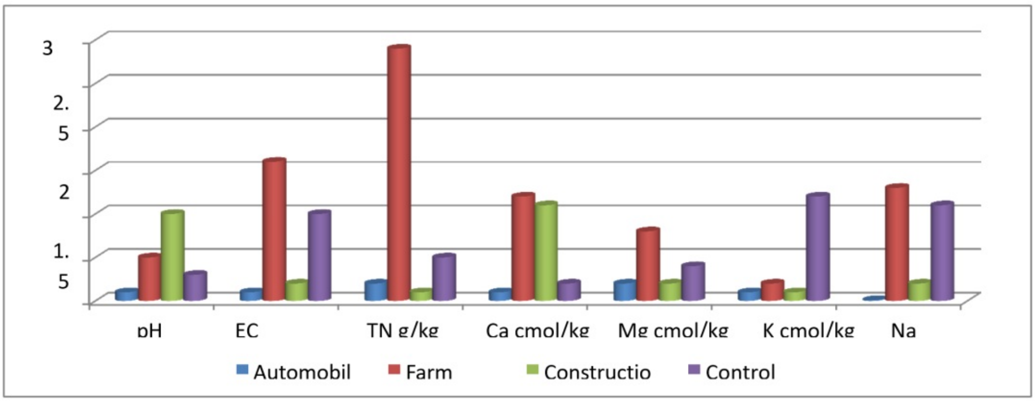

Figure 3: Most Fertile Soil in the Study Area
Source: Compiled SPSS Output, 2024.

Site 1: Control Land

Site 2: Automobile Land

Site 3: Construction Land

Site 4: Farm Land

the soils physio-chemical properties of various land use; The soil is black in color on automotive land, whereas it is dark gray on farm land, light gray on construction land, and light brown on control land; The physical and chemical properties of the soil from the various land use varies significantly at (P 0.05). The values fully confirmed that, among the various land use examined, the farm land is the most fertile soil while the poorest soil is the automobile shop land in the study area.

Based on the findings of this study, the following recommendations were made:

i. Every land use type calls for a different approach to soil management, which every land owner should adopt. Crop rotation, incorporating organic matter, and decreased tillage are some agricultural strategies that can help preserve soil fertility and lessen erosion.

ii. To enhance food security and SDG goals on maximum soil fertility and reduce nutrient imbalances, the government should create specialized nutrient management strategies for various land uses. This will aid in preventing nutrient depletion in urban and woodland regions as well as over-fertilization of agricultural areas.

iii. To track changes over time and inform adaptive management techniques, routine monitoring of soil physiochemical characteristics across various land uses should continue. Spend money on research to better understand regional soil properties and how they vary in response to changes in land use.

iv. The relevance of sustainable land use practices and their effect on soil health should be made clear through public awareness to farmers, landowners, urban planners, and the general public to encourage educational initiatives that advance ethical land management techniques.

References

Abdullahi, S. E, & Areo, I. O (2024). Assessment of Physicochemical and Heavy Metal Properties of Soil in and around Gousa Dumpsite, Federal Capital Territory, Nigeria. Ethiopian Journal of Environmental Studies & Management, 17(4), 477-498.

Isaac O. Areo. (2022). Assessment of Tree Species Composition in the Riparian Axis of River Wupa, AMAC, Abuja. AFRICAN JOURNAL OF GEOGRAPHICAL SCIENCES, 3(1). Retrieved from https://ajgs.com.ng/Journal/index.php/ AJGS/article/view/3

A. Leopold (1949). An almanac for Sand County. Press of Oxford University.

Achalu Chimdi, A. C., Heluf Gebrekidan, H. G., Kibebew Kibret, K. K., & Abi Tadesse, A. T. (2012). Response of barley to liming of acid soils collected from different land use systems of Western Oromia, Ethiopia.

Achalu Chimdi, and Lechisa Takele. (2019). In the west Showa Zone of Ethiopia's Ginde beret district, soil depth and diverse land use regimes have an impact on the dynamics of soil fertility. 3(6): 489-494. Agriculture, Forestry, and Fisheries.

Adaikwu A.O, Obi ME, Ali A (2012). Assessment of degradation status of soil in selected areas of Benue State, Southern Guinea savanna of Nigeria. Nig. J. Soil Sci. 22(1):171-180.

Ahukaemere, C. M., Ndukwu, B. N., & Agim, L. C. (2012). Soil quality and soil degradation as influenced by agricultural land use types in the humid environment. International Journal of Forest, Soil and Erosion (IJFSE), 2(4), 175-179.

Areo, I.O. (2023a). Soil Nutrient Status, Comparative Analysis for under Grass-land and Trees in University of Abuja, Mini Campus, Gwagwalada Abuja. African Journal of Geographical Sciences,4(1): 2023 (ISSN: 2786-9741.

Balogun, O., & Balogun, O. Y. (2001). The Federal Capital Territory of Nigeria: a geography of its development. Ibadan university press.

Carl, F. C., & Cori, F. (1925). The fate of sugar in the animal body. I. The rate of absorption of hexoses and pentoses from the intestinal tract. J. Biol. Chem, 66, 691.

Dickins, A. H., Hugh, W. E., & Kon, G. A. R. (1928). CCXIII.—The chemistry of the three-carbon system. Part XVII. cyclo Hexylideneacetone and cyclo hexylidenemethyl ethyl ketone. Journal of the Chemical Society (Resumed), 1630-1638.

Dikedi, P. N. (2012). Geoelectric probe for groundwater in Giri Nigeria. Global Journal of Science Frontier Research Physics & Space Science, 12(2), 42-47.

Eduvie, M. O., Olabode, T., & Yaya, O. O. (2003). Assessment of groundwater potentials of Abuja environs.

Garandi, I.D., Hyelnacha, B.A., Baba, M.S., and John, N. (2021). Analysis of Soil Physiochemical Properties on Different Land-use in Adamawa State, Nigeria's Mubi North Local Government Area. Volume V, Issue IX, September 2021, International Journal of Research and Innovation in Social Science (IJRISS).

Habtamu. A. (2011). (M.Sc. Thesis) Haramaya University, Ethiopia. Pages 11–30. Land Use/Land Cover Change and Impacts of Jatropha on Soil Fertility: The Case of Mieso and Bati Districts, Ethiopia

Hassan, S. M., & Okobia, L. E. (2008). Survey of ambient air quality in some parts of the Federal Capital Territory, Abuja, Nigeria. J. Geogr. Dev, 2, 3-17.

Hugh B.H. (1928). conserve the soil. McGraw-Hill.

Ishaya, S. Areo, I. O., and Adakayi, P.E (2016); Assessment of River Usuma Water Quality for Live Stock Consumption in Gwagwalada Town of the Federal Capital Territory of Nigeria. Abuja Journal of Geography and Development (University of Abuja Geography Department) Vol. 4 No. 1 Pp 40-51.

Ishaya, S., & Areo, I. O. (2018). Assessment of land use and land cover change in Kwali Area Council using geo-informatics techniques. American-Eurasian Journal of Sustainable Agriculture, 2(2), 117-124.

King. F. H. (1911). Farmers over the last 40 centuries: Japan, Korea, and China practice organic farming. Hawaii's University Press.

Lal, R. (2013). Intensive agriculture and the soil carbon pool. Journal of Crop Improvement, 27(6), 735-751.

McHarg, I. L. (1969). Design with nature (pp. 7-17). New York: American Museum of Natural History.

National Population Commission. (2006). Nigeria demographic and health survey 2006. National Population Commission, ICF International.

Paul, F., Rastner, P., Azzoni, R. S., Diolaiuti, G., Fugazza, D., Le Bris, R., ... & Smiraglia, C. (2019). Glacier shrinkage in the Alps continues unabated as revealed by a new glacier inventory from Sentinel-2. Earth System Science Data Discussions, 2019, 1-28.

Russell, A. S. (1929). CCCXIV.—The order of removal of metals from amalgams. Journal of the Chemical Society (Resumed), 2398-2401.

Senjobi, B. A., Oyegoke, C. O., Osinuga, O. A., & Martins, O. (2017). Effects of chemical fertilizers and herbicides on accumulation of some heavy metals in wetlands under different land use types in Odeda, Southwest Nigeria. Moor Journal of Agricultural Research, 18(1).

Schlesinger, A. M. (1998). The disuniting of America: Reflections on a multicultural society. WW Norton & Company.

Stewart, A. (2004). On risk: perception and direction. Computers & Security, 23(5), 362-370.

Wakene, N. (2001) Assessment of Important Physicochemical Properties of Dystric Udalf (Dystric Nitisols) under Different Management Systems in Bako Area, Western Ethiopia. Unpublished MSc Thesis, Alemaya University, Ethiopia.