Analysis of Soil Physiochemical Properties on Different Land_use in Mubi North Local Government Area, Adamawa State, Nigeria

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***Abstract*: Soil physiochemical properties provide basics assessing soil quality for various/different land uses which is fundamental step towards sustainable agricultural and land management. This research aimed at analysing of soil physiochemical properties on different land use in Mubi North Local Government Area, Adamawa State, Nigeria. The research was conducted during the rainy season (May to July 2020) with the objective of evaluating the effects of three-land use practice on soil physiochemical properties. Three major land use types: natural forest, grazing and cultivated lands were selected while a total of 15 soil samples were randomly collected from 0-20cm depth. All land use types were subjected to laboratory analysis and statistical tools such as Analysis of Variance (ANOVA) were used for hypothesis testing. The results reveal that, Soil pH values ranged from (6.10–6.44), moisture content ranged from (19.86-21.52 %), bulk density ranged from (1.58-1.70 gcm-3), and porosity range from (35.77-40%). The soils are deficient in nitrogen (0.24-0.24 %), potassium (0.24-0.66 Cmol/kg), calcium (2.84-3.10 Cmol/kg), organic carbon ranged from (0.45-1.46 %), magnesium (2.40-2.76 Cmol/kg) and low cation exchange capacity (6.71-7.43 Cmol/kg) due to low levels of organic matter (0.78-2.47 %,). Sand and clay particles, bulk density, silt, pH, total nitrogen, available magnesium, calcium, cation exchange capacity and exchangeable iron were significantly affected ($p<0.05$) by land use. In contrast, total porosity, bulk density, moisture content, organic carbon organic matter, potassium exchangeable Ca, and sodium were not significantly ($p<0.05$) affected by land use. The study also recommended the need for detailed soil survey and land use approach in order to know the appropriate land use that is most suitable for the study area, having known its capacity and constraints of the different land uses. Use of set-aside programmes, land use zoning policies that encourage productive and sustainable land use practices should be implemented for sustainable agricultural productivity in the study areas.**

***Keywords:* Soil, Land_use, Physiochemical Properties, Cultivation, Soil quality**

I. INTRODUCTION

Soils are important resources that have been exploited for thousands of years for several purposes resulting in their degradation (Eswaran *et al*., 2001; Junge and Skowronek, 2007). Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. (Kang and Fox 1981). Soil degradation is the physical, chemical and biological decline in soil quality. It can be the loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity, acidity or alkalinity, and the effects of toxic chemicals, pollutants or excessive flooding (Adaikwu, Obi and Ali, 2012).

Land use is categorized as follows: Pasture/range, Forest, Cropland, Urban and others. Land use and land management practices have a major impact on natural resources. More recent significant effects of land use include urban sprawl, soil erosion, soil degradation, salinization, and desertification (FAO, 1995). Soil degradation is one of the greatest challenges facing humanity. Its extent and impact on human welfare and the global environment is more severe now than ever before. Due to its enormous impact, soil degradation leads to political and social instability. It is associated with enhanced rate of deforestation, intensive use of marginal and fragile soil, accelerated runoff and erosion, pollution of natural waters, and emission of greenhouse gases into the atmosphere (Adaikwu, Obi and Ali, 2012).

In Nigerian Savanna region, nitrogen is reported as the most limiting nutrient for crop production (Muhr *et al*., 2001; Odunze, 2006) and this problem has been compounded in recent times by difficulties farmers faced in obtaining nitrogen fertilizers. These reasons made the effort by farmers to replenish soil fertility in the Nigerian Savanna area thereby encouraging continued degradation of soils. In the Southern guinea savanna, particularly Benue State which is regarded as the "Food Basket of the Nation", farming is the predominant economic activity. The continuous unguided use of the soils for agricultural production, pasture/range, forest, urban and others and other benefits had exposed the soils to different forms of degradation.

Land use changes, especially cultivation of natural lands in tropical areas have led to negative effects on soil organic matter components in which Nigeria is not exceptional (Fallahazade and Hajabbasi, 2011). With continuous cultivation, physical properties and productivity of soils commonly decline due to decrease in organic matter content and soil PH (Oguike and Mbagwu, 2009). Intensive cropping has also been recorded to lead to disaggregation in surface soil due to decrease in organic matter. But bush fallowing has been proved by Juo *et al*., (1995) as an inevitable method to restore the physico-chemical and biological properties of soil while Ewel (1986) considered it to be efficient for nutrient recycling and biomass accumulation because it consist of many plant species with different type of root system. Yemefack and Nounamo (2002) also put the role of fallow phase as to facilitate the repositioning of soil productivity. Yemefack and Nounamo (2002) in their work on the effect of fallow period on topsoil in Southern Cameroun stated that humus content increases and consequently increased the organic carbon and this correlated with the result of Kirchlof and Salako (2000) in Southern Nigeria. The system of mono cropping of trees has been discouraged because of the rate of nutrient uptake with fewer returns to the soil (Padley and Brown, 2000). In a homogenous plant community, the stage of development of plant communities affects both the nutrients uptake and nutrient return which causes differentiation of soil properties (Ogunkunle and Awotoye, 2011).

Assessing land-use induced changes in soil properties is essential for addressing the issue of agro-ecosystem transformation and sustainable land productivity. The selection of suitable indicators with well-established ecological function and high senilities to distribution is of paramount importance in enhancing production and productivity of the agricultural sectors on sustainable basis. However, practically oriented basic information on the status and management of soil physicochemical properties there changes on different land used as well as their effect on soil quality to give recommendations for optimal and sustainable utilization of land resources remain poorly understood particularly in Mubi North Local Government. It is against this background that this study is carried out in order to evaluate the effects of different soil physicochemical properties on different land use on soils of Mubi North of Adamawa State with a view to recommending better management strategies that will enhance suitable use of the soil resources under continuous cultivation (rain fed and irrigated agriculture) in the area.

It has been observed from research that, the causes of land degradation are cultivation on steep and fragile soils with inadequate investments in soil conservation or vegetation cover, erratic and erosive rainfall patterns, declining use of fallow, limited recycling of dung and crop residues to the soil (Hurni, 1988; Belay, 2003). Changes in land use and soil management can have a marked effect on the soil physiochemical and biological properties. Several studies in the past have shown that deforestation and cultivation of virgin tropical soils often lead to depletion of nutrients (Gebeyaw, 2015).

In addition, lack of agricultural inputs, traditional farming methods, overgrazing and continuous cultivation practice, coupled with environmental factors aggravates the degradation of soil physicochemical properties that results in the reduction of pH in the soil system ultimately brings soil acidity (Nega, 2013). Thus, soil acidification is a process by which soil pH decreases over time due to high rainfall and traditional farming system. Thus, soil acidity is expanding both in scope and magnitude in Nigeria and severely limits crop productivity and sustainability.

In Mubi North Local Government Area, rapid deforestation and other emerging land use changes are continuously on the increase. There are several repercussions of such land use changes and intensification; the most important being accelerated soil erosion and deterioration of soil nutrient status, altered hydrological regimes and sedimentation of wet-lands, including loss of biodiversity.

However, the information on the effect of land use changes, on soil quality to give recommendations for optimal and sustainable utilization of land resources is scanty. On this note, studies are indeed required to understand the effect of emerging land management practices on soil nutrient sustainability. Gol (2009) pointed out that land management practices provide essential information for assessing sustainability and monitoring environmental impacts. As a result of this, this study is initiated to investigate the influence of different land uses on the fertility status of the current land practices Mubi North Local Government Area in order to suggest possible ways through which the inherent land use systems can be ecologically sustainable for agricultural productivity.

Research Questions

The study seeks to find solution to the following questions:

i. What are the physical properties of soil for different land uses in the study area?
ii. What are the chemical properties of soil for different land uses in the study area?
iii. What are the variation and the influences of physiochemical properties of the soil on different land uses in the study area?

Aim and Objectives

The aim of the study is to analyse the soil physiochemical properties of different land use Mubi North Local Government Area. The aim was achieved through the following specific objectives;

i. To determine the soil physical properties of the different land use surfaces in the study area.
ii. To determine the soil chemical properties of the different land use surfaces in the study area.
iii. To access the variability and compare the influences of physiochemical properties of soil on different land use surfaces in the study area.

Research Hypotheses

The research has the following hypothesis;

Ho: there is no significant variation among the properties of soil and various land use surface.

Hi: there is significant variation among the properties of soil and various land use surface.

II. LITERATURE REVIEW

Soil is the foundation of for nearly all land uses (Herrick, 2000). Together with water, soil constitutes the most important natural resources of our physical environment. The wise use of this vital resource is essential to promote sustainable development, feed the growing world population through agricultural activities and maintain environmental health (Arshad and Martin, 2002; Chimdi *et al.*, 2012). The manner in which soils are managed has a major impact on agricultural productivity and sustainability (Chimidi *et al.*, 2012). In the past few decades alone, the global grain production growth rate has dropped from 3% in the 1970s to 1.3% in the early 1990s, which is one of the key indicators of declining soil quality on a global scale (Steer, 1998). No agriculture system can be claimed to be sustainable without ensuring the sustainability of soil quality (Arshad and Martin, 2002). Indeed, the maintenance of enhancement of soil quality is considered a key indicator of sustainable agricultural system (Wosen and sheleme, 2011).

There are centuries-old reports of agrarian peoples comparing the relative productivity of land and soil as they used them for crop production (Warkentin, 1995). Early delineation of landscape, based on productive potential was largely a process of trial and error. Location of the best soils and some of the factors associated with good soil productivity became indigenous knowledge that was passed to succeeding generations. Delineating the natural productive potential of soils became more precise and a matter of record as taxonomic, survey and mapping systems were fully developed in the last century.

Productive changes within a field or soil type due to management were recognized later, especially with the advent of post-WW-II agricultural development (Schoenholtz, Van and Burger, 2000). Changes in soil productivity were positive due to drainage, tillage and addition of time and fertilizer and negative due to soil erosion, loss of organic matter and physical structure and other degrading processes. Both positive and negative processes occurred simultaneously, making it difficult to associated changing yields with certain cultural practices. Differences in soil due to natural or human-induced change were measured indirectly using relative crop yield, but factors such as draft requirements for tillage, or the cost of inputs require to achieve a certain yield were equally important (Warkentin, 1995). Farmers manipulate soils intensively. Therefore a comparative measure of soil quality has traditionally included more than a simple measure of yield.

Foresters usually define soil productivity as the ability of a soil to produce biomass per unit area per unit times (Ford, 1983). On the other hand, agronomist and farmers most often define soil quality as the suitability of soil to function for different uses (Warkentin, 1995), which illustrates a broader concept and the fact that agriculture has traditionally been more soil-interactive than silviculture. Soil quality includes a measure of a soil ability to produce plant biomass, maintain animal health and production, recycle nutrients, store carbon, partition rainfall buffer anthropogenic acidity, remediate added animal and human wastes, and regulate energy transformations (Schoenholtz *et al.*, 2000).

Evaluating and measuring the quality of the soil resource was promoted by this increasing awareness that soil serves multiple functions in maintaining worldwide environmental quality (Doran and Parkin, 1994). Public awareness was raised when the National Academy of sciences published soil and water quality; An Agenda for Agriculture (National Research Council, 1993). In response, a group within the soil science society of America set about to define soil quality, examines its rationale and justification and identifies methods for evaluating it (Karlen *et al.*, 1997).

Physical Properties as Indicators of Soil Quality

Productive soil has attributes that promote root growth accept, holes and supply water, cycle mineral nutrients, promote optimum gas exchange; promote biological activity and accept hold and release carbon (Burger and Kelting, 1999). All of these attributes are in part, a function of soil physical properties and processes. Some of these soil physical properties are static in time and some are dynamic over varying time scales. Some are resistant to changes by different management practices, while some are change easily in positive and negative ways if change, some properties and processes will recover at varying rates while others irreversible. All of these factors will determine the extent to which each soil property or processes is useful for measuring soil quality and monitoring the maintenance of soil quality through time.

Basic physical indicators that have been proposed by researchers as soil quality indicators include soil texture, soil structure, soil bulk density and soil colour.

Chemical Properties as Indicators of Soil Quality

Soil chemical indicators are used mostly in the context of nutrient relations and may therefore also be referred as indices of nutrient supply (Power *et al.*, 1998). They express to some extent, the dichotomy between the need for simplicity and practicability, which tends to favour static parameters (that is point in time) that are easily and routinely measured, but are hierarchically several levels measured from soil function and the desire remove from accurately represent the dynamic process that underlie site productivity, which tend to involve more laborious and or costly assays (Schoenholtz *et al.*, 2000).

The soil chemical properties cited in recent literature pertaining to soil quality in agricultural, grassland and forest soil is provided here include; soil organic matter soil ph, soil colloids, cation exchange capacity (cec).

Concept of Land

This is a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface climate, the soils and the terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), the near surface sedimentary layers and associated ground water reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (UN 1994,FAO/UNEP, 1994). Agricultural land is the land that is arable and regularly tilled for the production of annual field crops, with or without irrigation (UN 1994, FAO/UNEP 1994). It provides direct benefits for humanity through the production of food, fibre, forage and fodder, bio-fuel as well as timber. It does not however include deserts, barren land, non-managed wetlands, forests and built-up areas (FAO, 1995).

Concept of Land Use

Land use is defined as the arrangement, activity and input people undertake in a certain land cover type to produce, change or maintain it (FAO 1984, FAO, 1997). It involves the management and modification of natural environment or wilderness into built environment such as fields, pastures and settlements (FAO, 1984). It is also often used to refer to the district land zoning which is a device of land use planning used by local governments in most developed countries (FAO, 1997). Land use could be derived from the practice of designating permitted uses of land based on mapped zones and which separates one set of land use from another. Land zoning may be use-based and may regulate building height, coverage and similar characteristics or their combinations.

Effects of Land Use on Soil Properties and Soil Erodibility

Land use changes affect many natural resources and ecological processes such as surface runoff, erosion and changes to soil resilience (Fu, *et al.*, 2000). The increasing intensity of land use may cause erosion and soil compaction through changes in soil physical and chemical properties (Qygard *et al.*, 1993; Islam and Weil, 2000; Chen, *et al.*, 2001; Caravaca *et al.*, 2002; Wang, *et al.*, 2006; Misir *et al.*, 2007).

Properties

Physical properties vary from one land use type to another and include morphological properties such as colour, texture, structure and consistency. Soil texture shows proportional distribution of soil particle size fractions and affects soil water characteristics, erosion potential and nutrient budgets. For instance, it has been noted that land use changes affect soil texture through modification in the sand, silt and clay contents (Lal, 1996). Its influence on bulk density include increase in value of soils under continuous cultivation and residential layouts relative to those under natural forest as evidenced by low compaction in the later than the former (Kim, *et al*., 2010). Also due to compaction from certain land use types, pore volumes are reduced resulting to depressed infiltration and soil porosity (Charma and Murphy, 2007). Land use equally affects soil moisture content. In studies by Charma and Murphy (2007), soil moisture content was reported to vary in the order: arable land use > oil palm/cocoyam > grassland > forest land. They attributed the variation to differences in soil textural attributes. Influence of land use on soil hydraulic conductivity includes depression in value due to increased soil compaction and which affected water drainage down the soil (Taylor and Ashcroft, 1972). In studies of the influence of land use on soil properties; saturated hydraulic conductivity (Ksat), bulk density, and water 7 stable aggregates, higher values of hydraulic conductivity (Ksat) were reported in the top soils of natural forests compared to those of grassland soils (Gol, 2009).

Chemical Properties

Effect of land use on soil chemical properties especially soil organic matter quantity and quality varies. It has been reported that the conversion of forests into other land uses caused a decline in soil organic carbon (Allmaras *et al.*, 2000). This manifested as a depression in soil aggregation or structure (Kourtev *et al.*, 2003) and other chemical and physical soil properties (Dexter, 1998). Organic carbon serves as an important tool in determining soil health, quality and stability against degradation. Onasanya (1992) and Akamigbo (1999) reported that organic carbon has significant positive influence on soil pH, colour, buffering capacity, water holding capacity, base saturation and cation exchange capacity.

III. MATERIALS AND METHODS

Mubi North is among the twenty one local government areas of Adamawa State. Mubi north lies between latitude 9^{0}26"1' and latitude 10^{0}10"1' N and between longitude 13^{0}11"00' and 13^{0}44"01' E (Ministry of Land and Survey Yola, Adamawa State). The entire town and its environs bordered with Maiha Local Government Area on the south, Hong Local Government on the west, Michika Local Government on the north and Cameroun Republic to the east (Adebayo, 2004).

Mubi North Local Government Area has an estimated population of one hundred and fifty one thousand, five hundred and fifteen (151,515) people and the area of about 321.8 square kilometres (National and State Provisional Total Census, 2006). Mubi North Local Government Area is made of four districts namely: Mubi (which is the Local Government Headquarter), Mayo-bani, Ba'a and Mijilu. It is made up of eleven wards which include: Yelwa, Sabon Gari, Kolere, Lokuwa, Vimtim, Digil, Bahuli, Muchalla, Mujilu, Betso, and Mayo-Bani.

There are a lot of economic activities in Mubi North. A large number of the people from the town do go out for one form of business activity ranges from retailing to wholesaling. The remaining population are students and civil servants. Farming is another major economic activity in this place.

Some people especially, for those who can neither read nor write use farming as their main stay for annual income.

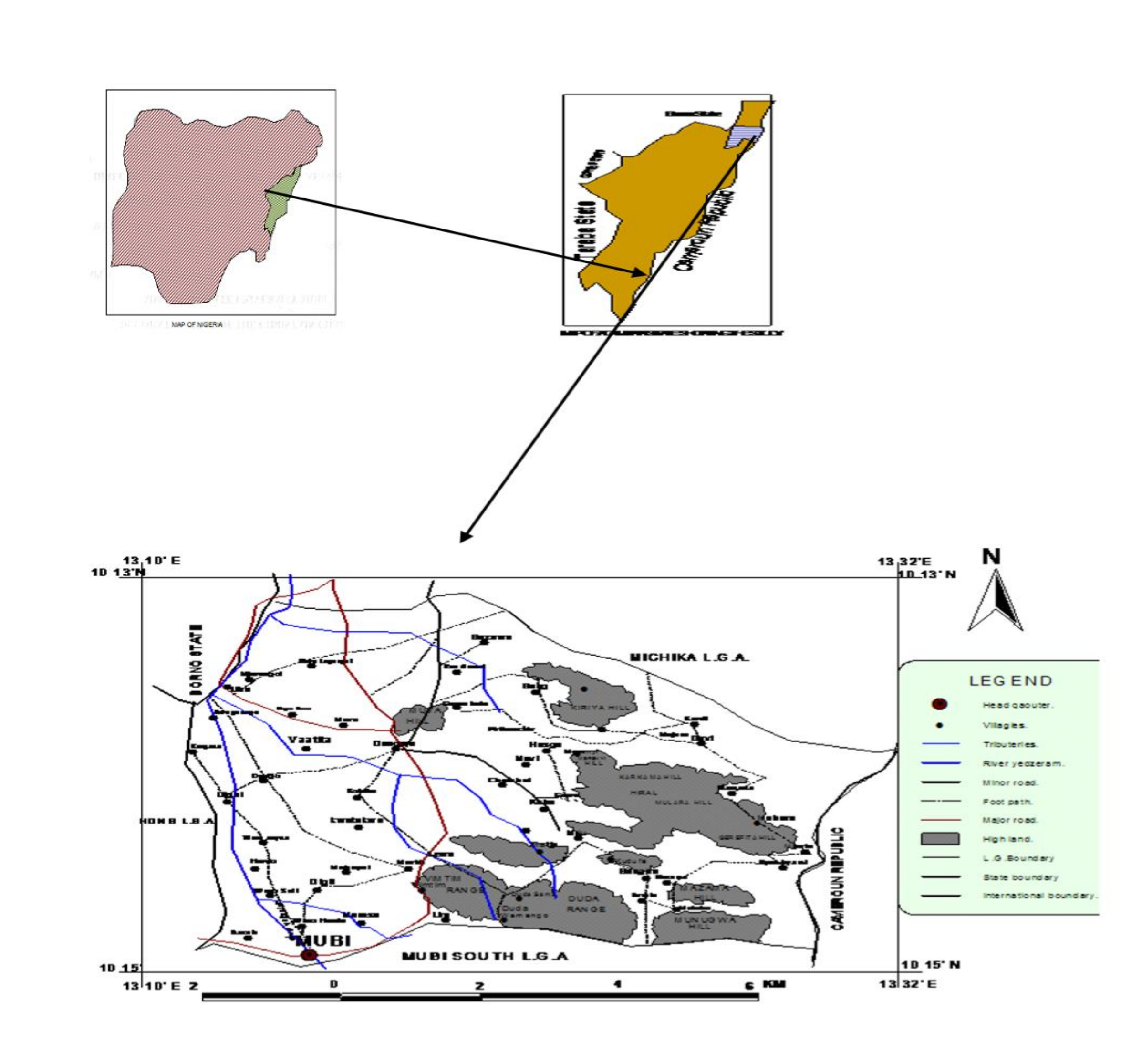

Figure 1: The Study Area.

Source; GIS LAB. ADSU by Author

Sample and Sampling Technique

Field survey and soil sampling was carried out using the quadrate approach. In each identified and delineated land use cover, five plots of 5m by 5m were established, after which soil samples were randomly collected from the 0-20cm layer of the soil using a soil auger. In all soil samples covering the three study sites collected was carefully labelled and store in polythene bags and placed in a cooler to keep the samples at moderate temperature. A total of 15 samples were collected from the field five (5) cultivated lands, (five) 5 forested area and the (five) 5 from grazing land.

The data needs of this study were the physical and chemical properties of three land use (secondary forest, grazing and cultivated land) of the study area. For the purpose of this research, data were collected in primary sources. The primary source is basically on the field work.

The following are the specific variable;

i. Physical properties: soil structure, colour, particle size distribution (soil texture), bulk density, porosity as well as moisture content.
ii. Chemical properties: organic matter, pH values, exchange capacity, phosphorus, calcium, magnesium, potassium, Nitrogen, sodium, iron manganese, copper and Aluminum.

IV. METHODS OF DATA ANALYSIS

i. Laboratory Analysis

The samples collected were taken to the laboratory air dried and sieved for analysis. The treated soil samples were subjected to analysis based the following: Physical properties: Soil colour, Soil Structure, Soil Texture, Bulk Density and Moisture Content. Chemical properties: Cation Exchange Capacity (CEC). Organic Matter, Nitrogen (N), Phosphorus (P), Calcium (Ca) and Magnesium (Mg), Sodium and Potassium, Iron (Fe)

ii. Statistical Analysis

The result of the soil analysis obtained was subject to simple descriptive statistics of tables, averages and one-way analysis of variance (ANOVA). The one-way analysis of variance was performed to obtain if the properties of soil varied significantly among the various land covers and compare the influence of the uses types on the measured soil properties in the study area.

V. RESULTS AND DISCUSSION

Table 1: Soil Physical Properties under different land use at depth of 0-20cm

Land Surface	colour	Bulk density (g/cm^3)	porosity %	sand %	silt %	clay %	moisture content %
Cultivated Land	Pale Redclay	1.58	40.07	69.61	9.38	21.00	21.52
Grazing Land	Dark Gray	1.70	35.77	70.81	8.89	20.20	20.28
Forested Land	light Brown	1.68	36.52	71.77	11.08	17.14	19.86

CL=Cultivated Land, GL=Grazing Land, FL=Forest Land.

Source: Authors Analysis (2020)

The physical properties of the soils studied in the three-land cover is presented in Table 1. The result from Table 1 indicate that soil in the cultivated land are generally pale red in color and those of grazing land are dark gray while in the forested area, the soil are light brown in color. Clay content in the surface layer (0-20 cm) of the soils varied significantly ($P <0.05$) among the land use types (Table 1). Its content was significantly high in cultivated land (21.00%) as compared to the forest (17.14%) and grazing lands (20.20%). Similarly, previous authors reported lower clay content in cultivated land than the adjacent soils under natural forest. The reason for low clay in surface layers of cultivated lands might be due to selective removal of clay from the surface by erosion. The silt content was significantly ($P < 0.001$) higher in cultivated land(9.38%) than the other land uses (Table 1), implying cultivated land is more susceptible to erosion than the adjacent forest(11.08%) and grazing lands(8.89%). On the other hand, sand showed non-significant ($P > 0.05$) difference among the land uses (Table 1).

The bulk density values ranges from 1.58 to 1.70gkm^3. Bulk density in grazing land was higher with about 1.70gkm^3 as compare with secondary forestland and cultivated land, which has value of relatively 1.68gkm^3 and 1.58kgm^3 respectively.

Table 2: Soil chemical Properties under different land use surfaces.

Chemical parameters/soil properties

Land Surface	pH (1:1)	O.C %	O.M %	N %	P (mg/kg^{-1})	K →	Na cmol/kg^{-1}	Mg	Ca ←	CEC	Fe ppm
Cultivated Land	6.10	0.45	0.78	0.38		0.24	0.24	2.54	2.84	6.93	0.33
Grazing land	6.24	1.46	2.47	0.54		0.28	0.24	2.76	3.10	7.43	0.41
Forested land	6.44	1.15	1.98	0.49		0.66	0.24	2.40	2.88	6.71	0.31

O.C= Organic Carbon, O.M= Organic Matter, N= Nitrogen, P= Phosphorus, K= Potassium, Na= Sodium, Mg= Magnesium, Ca= Calcium, CEC= Cation Exchange Capacity, Fe= Iron

Source: Authors Analysis (2020)

As indicated in Table 2, the soils of the area are milky acidic with a pH ranges between of 6.10 to 6.44. The acidic nature of the studied soil is attributed to the high rainfall resulting to the leaching of some basic cations especially calcium from the surface horizon of the soil in the study area. As reported by Ndukwu *et al*., 2009) Low pH values of the various land use types could be ascribed to inorganic fertilizer application and severe base leaching by the high tropical rainfall (Lal, 1996; Ndukwu *et al*., 2009). It could also be due to the abundance of iron and aluminum ions and the resultant net reduction in the soil pH (Olson and Sommers, 1990). The general low levels could be as a result of management practices involving high burning and intensive land use as well as the reduction in fallow period (Akinrinde and Obigbesan, 2000 ;Anikwe 2010). Soil organic carbon ranged from 0.45-1.46% (Table 2). Low organic carbon content could be due to rapid decomposition and depletion of plant materials. Reduction in soil organic carbon due to conversion of forests into more intensive land uses have been reported (Anikwe, 2003; Ndukwu *et al*., 2009; Anikwe, 2010). The general low levels could be as a result of management practices involving high burning and intensive land use as well as the reduction in fallow period (Akinrinde and Obigbesan, 2000 ;Anikwe 2010).

The Nitrogen content of the soils of the study sites ranges from 0.38-0.54% (Table 2). The low N content in the soils could be as a result of rapid rate of organic matter decomposition, excessive leaching of nutrients down the soil profile, and crop removal and erosion during the rainy season. Most savannah soils of Nigeria have very low total N content

(0.04 – 0.05%) as against the normal range of 1-6% N (Adetunji and Adepetu, 1990). The soil is considered suitable for agriculture even though they are low in N content but due to moderate organic matter content in the soils, N would be supplied through decomposition of organic matter. It has been indicated that total N constitutes the bulk of soil organic carbon in the tropics (Akamigbo 1999; Igwe, *et al*., 1999; Noma, *et al*., 2005; Anikwe, 2010).

The Cation Exchange Capacity (CEC) is low in all soils of the study area and ranged from 6.71-7.43 cmolkg-1(Table 4.2). The low CEC was because of the combined effect of the organic matter, total exchangeable bases and exchangeable acidity of the soils. The CEC of the soils were low. The CEC values are less than 12 Cmol/kg soil considered minimum values for fertile soil (kparmwang *et al.,* 2001). Soil CEC has been classified into low, medium and high with values as < 6, 6-12 and > 12 cmolkg-1 respectively (Adepetu *et al.,* 1979). This shows that for the soils studied, CEC is low attributable to their high weather ability and low organic matter content (Noma *et al*., 2005).The low CEC of the soils implies that with continuous cultivation (rainfed and irrigated agriculture), the soils would undergo rapid degradation physically and chemically. The incorporation of organic matter and addition of bases under fertilizer programme would raise CEC of these soils.

Ca ratio ranged from 2.84-3.10. According to Landon (1991), Ca/Mg values less than 12.0 indicate low fertility. This shows that soils under the land uses are of low fertility probably due to intense land use practice and excessive loss of Ca through leaching by the high tropical rainfall (Landon 1991, Onweremadu 2007). Addition of lime and organic manure can be used to supply Ca and improve soil fertility under the land use types (Uzoho, *et al*., 2007).

Variability and Comparison of the Influence of some Physiochemical Properties of Soils under Different Land Use

The data presented on table 1 and table 2 we deduce that there is a significant difference in soil properties except in soil porosity, bulk density, potassium and sodium on different land use. It indicates land use land cover change is active determinant of soil properties. If geology, climate and soil type are significant factors for change in soil properties, we could not have found this much difference in soil properties within this small difference of depth.

ANOVA comparisons firmly show that there is a significant difference (P<0.01) of soil OC and OM content in different land use/land cover types. The difference is very strong between forestland and grazing land. They are relatively highest on soils of grazing land (the overall mean being 1.46% for OC and 2.47% for OM) and forestlands (the overall mean being 1.15% for OC and 1.98% for OM) than soils in cultivated lands (0.45% for OC and 0.78% for OM). It implies there is more supply of litters and return of OM to the soils under grazing land and forestland system and low OC on cultivated lands is due to removal of biomass from the field. In agreement to this, OC content of soils in the study area is dominated forestland was higher than the carbon content of soils of open fields. This might be because it is on the top soil where more biological processes take place. By scientific community, it is frequently cited that clay soil has high organic carbon. But cultivated lands of the study area have clay soil and in parallel low organic carbon. This might be due to relatively more tillage practices on cropland. Tillage practice is responsible for reduction in organic matter of the soil (FAO 2005).

In the study area, TN content of the surface soil is mostly greater than 0.1% and of course, there is a variation of it among different land uses types. ANOVA showed there is significant difference (P< 0.01) in TN among land use types. Low TN is observed on cultivated lands. This is due to more tillage and no addition of fertilizer that replaced the removed TN by continuous tillage. The result of this study agrees with several studies conducted in elsewhere (e.g.Yifru and Taye 2010; Eyayu *et al.,* 2009).

Potassium content of soils in the study area have slightly lower available potassium with the average value of 0.66Cmole/kg less than Potassium content of tropical soils with the average value of 1.65Cmole/kg (Hartemink, 2006). The ANOVA analysis revealed that there is no significant difference (P<0.01) of AK among land use types. It is low in the three land use types.

The overall pH value of the studied area ranges from moderately acidic (pH 6.10 on cultivated land) to neutral (pH 6.44 on forestland). ANOVA comparisons revealed that there is a significant variation (at 0.01 probability level) in pH value of soils found on different land use type. The soils of the study area have average CEC than. In tropical region, soils of bush vegetation and permanent cropping have CEC of 12.5 Cmole/kg and 8.8 Cmole/kg respectively on the top 15cm depth (Hartemink 2006). But CEC of soil of the study area ranges from 6.71in forestland and 7.43 on the grazing lands of the Area. The ANOVA tested yield significant difference at 0.01 probability levels among land use types.

In the cultivated lands of the study area, the soil constitutes on the average 21.00% clay, 69.61% sand and 9.38 % silt. While in the forestlands, the soil constitute on the average 71.77 % sand, 17.14 % s clay and 11.08% silt. ANOVA further ensures soil texture is significantly changing within land uses in the study area. This finding is different from the general accepted knowledge that 'soil texture is the property of soil which is not subject to easy modification' (Brady 2002). Similar studies, for example, Agoumé and Birang (2009) concluded that LUCC significantly determine soil texture on their study in Cameron.

Soil color helps to indicate OM content, water content, and oxidation states of iron and manganese oxides in the soil. In the study area, there is a difference in soil colour between different land uses. the cultivated land are generally pale red in color and those of grazing land are dark gray while in the forested area, the soil are light brown in color. On forestland, the soil has relatively dark gray and at the same time, the soil has high organic matter content. On cultivated land, soil has pale red color. It seems that there is oxidation of iron on cropland use. The soil has dark gray color on grazing land. In agreement to this Study, Maranon et al (1997) have found that vegetation cover type was among the principal factors of soil color change and soil color is correlated with texture, organic carbon content and Cation Exchange.

The soil in the study area is pale red, dark gray and light brown in colour, the bulk density value of the soil ranges from 1.58-1.70g/cm^3 in the entire samples tested. However, higher in grazing land than forest land and cultivated land with 1.68g/cm^3 and 1.58g/cm^3 respectively. The result of bulk density was not significant ($p>0.05$).The porosity of the soil did not vary significantly under land uses. The soil porosity decrease from cultivated to forest and grazing land with a percentage of 40.07%, 36.52% and 35.77% respectively. The soils in the study area are majorly sandy in nature, which also varied significantly on the different land uses in the study area. Sand content were higher in forested land with 71.77% followed by grazing land with 70.81% and lower in cultivated land with 69.61%.The silt content of the soil varies significantly in the forest land use with 11.08%, 9.38% in grazing land and lower values of 8.89% were recorded under cultivated land surface in the study area.

The clay content also varied significantly in the various land uses. Higher values are seen in cultivated land 21.00%, grazing area with 20.20% and 17.14% in the forestland. The moisture content did not vary significantly in the various land use surfaces ($p>0.05$). It was higher in cultivated land 21.52%, 20.28% in grazing land and19.86 in forestlands. The soils in the study area are mildly acidic with a pH range of 6.10 to 6.44. The pH value was higher in forest land with 6.44, grazing land with 6.24 and cultivated land with 6.10. the content of pH varied significantly among the various land uses ($p<0.05$), the content of organic carbon, organic matter and nitrogen somehow followed a similar pattern highest recorded in grazing land for all of them, followed by forested land and lower in cultivated lands. All of them varied significantly in the various land use in the study area. The proportion of cation exchange capacity varied significantly under the three different land uses. The cation exchange capacities are higher in grazing land with 7.43cmolkg^{-1} followed by cultivated land with 6.93cmolkg^{-1} and 6.71cmolkg^{-1} in forestland. Iron also varied significantly in the different land uses in the study area with higher values in grazing (0.41ppm), cultivated land (0.33ppm) and lastly forestland (0.31ppm).

V. RECOMMENDATIONS

The study concludes that: based on the outcome of the study/research, it was found that the different land use system differs in their soil properties due to conversion of one land use to another and its environment. It is also seen from the study that changes in land use cover have significant impact on the availability of nutrients in the soil as noticed in cultivated land, which indicates that the soils there are with low vegetation and spares cover result in low O.C and Nitrogen. The secondary forest has high values of OC and N content. Moreover, the variation in the distribution of exchangeable bases depends on the elements present, particle size distribution, degree of weathering, soil management and the intensity of cultivation and the parent material from which the soil were been formed.

Therefore, there should be a detailed soil survey and land use approach in order to know the appropriate land use that is most suitable for the land, having known its capacity and constraints. Use of set-aside programmes, land use zoning policies that encourage productive and sustainable land use practices should be implemented. The planting of trees with controllable heights will help in carbon sequestration and the maintenance of nutrient in the soil for continuous energy fluxes and proper afforestation of land can reverse some of the degradation processes and cause enhancement or sequestration and nutrient in the soil. Use of aerial photographs or satellite imageries (topographic maps and Land sat images), with Geographic Information System (GIS) combination at large scale to monitor land uses, so as to have updated information of these lands.

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