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EFFECT OF CONTRASTING AGRICULTURAL LAND USE SYSTEM ON SELECTED PROPERTIES OF THE COASTAL PLAIN SANDS OF OMERELU, IKWERRE LOCAL GOVERNMENT AREA OF RIVERS STATE, NIGERIA

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This study investigated the effect of contrasting agricultural land use system on selected properties of the coastal plain sands of Omerelu in Ikwerre Local Government Area of Rivers State, Nigeria. Five (5) land use types were selected namely, Oil palm plantation, plantain plantation, cassava farm and Rubber plantation and Forested or uncultivated land. Soil samples were randomly collected from each land use type at a depth of 0-15 and 15 – 30cm and were processed for laboratory analysis. Results obtained indicated that bulk density was high (1.66 $\pm$ 0.01 gcm^3) and the bulk density (1.32 $\pm$ 0.02 gcm^3) was observed in the rubber plantation. Sand fractions dominated the particle size distributions, while clay contents were the least except in the plantain plantation (27.19 $\pm$ 0.74) gcm^3. It was also observed from the results that the different land use types affected the soil chemical properties in varying degrees and indicated in Fig. 1, 2, 3, and 4.

Keywords: Coastal Plain sand, Omerelu, Physical and chemical properties, Rivers State, Southern Nigeria

INTRODUCTION

There is a growing need for information relating to soil conditions, current status and changes due to land use types and management practices. Given the intense pressure on the ecosystem and the continuous decline especially in soil fertility due to demographic explosion, such information becomes necessary for appropriate soil planning and management (Onweremadu, 1994). The consequences of inappropriate land use are land degradation and soil quality deterioration through loss of vegetative cover, reduced infiltration capacity, low soil organic matter content, low fertility status and so on. Hence, the changes in soil properties are usually influenced by the type of land use system operating in an area (Peter and Anthony, 2016)**.** The physical and chemical features of soils differ spatially and temporally due to distinctions in topography, climate, physical weathering processes, vegetation cover, microbial activities, and several other biotic and abiotic variables (Peter and Anthony, 2016). Land-use alterations from forest cover to cultivated land may also reduce soil organic residues leading to deterioration of soil fertility, increase soil erosion rate and enhanced loss of soil organic matter and nutrients (Peter *et al*, 2022; Peter and Umweni. 2022). Again, changes in land cover density and intensification of agricultural crop cultivation, aggravate the leaching rate of soil organic matter and nutrient elements and at the same time, accelerate the rate of land degradation (Peter *et al*, 2022; Peter and Umweni. 2022). Soil is not merely significant for agriculture, but also valuable for living organisms (macro and micro) biological properties of the soils. The physical and chemical properties of soils greatly influenced other activities that occurred in the soil and hence, understanding of soil property is very essential (Peter *et al*, 2022; Peter and Umweni. 2022). There is a growing need for information relating to soil conditions as influenced by some changes due to land use types and management practices. Intense pressure on the land and other ecosystems coupled with the continuous decline in soil fertility due to population explosion made such information very necessary for appropriate management of soils under the different land use planning and management (Onweremadu, 1994). It has been reported that unsystematic changes in land use predisposes lands to several environmental problems amongst which include desertification, acidification, emitting of greenhouse gases resulting to climate change and biodiversity. Agricultural lands have been irreversibly damaged due to accelerated

land degradation and intensive land use, leading to a reduction in their productive capacity. Land degradation has serious impact on soil physical and chemical properties such as infiltration, bulk density, organic matter, porosity and aggregate stability resulting to compaction and erosion (Osuj 1984). Therefore, in an event to promote sustainable land utilization, long-term land use must be accompanied by conservation measures (Osuji, 1984, Senjobi and Ogunkunle, 2011). This will include proper soil conservation practices, detailed soil survey and land use planning through assessment and monitoring of soil resources thereby controlling any serious ecological problems and degradation of the land resources caused by the land use system adopted (Peter *et al,* 2022). Thus, the main objective of this study was to determine the effect of contrasting agricultural land use system on selected properties of the coastal plain sands of Omerelu, Ikwerre Local Government Area of Rivers State

MATERIALS AND METHODS

This study was carried out in Omerelu, Ikwerre LGA in Rivers State were selected for this study. The area consists of a semi developed residential area with flat to gentle slope (0 - 4 %). It has moderate drainage facility, though with evidence of sheet erosion in certain areas. The dry season is short, usually lasting for 4 months, from November to March, with little rains during this period while the longer wet season exists during the remaining months. The mean annual rainfall of the study area ranged from about 2000 mm to 3000mm (FAO, 1984). Annual maximum temperature ranges from 25°C - 29°C, while relative humidity varies between 75% and 95% depending on the season of the year. The vegetation of the area consisted of secondary rain forests adversely altered due to anthropogenic activities. Some plants conspicuously grown in the wild in the study area include oil palm (*Elaeis guineensis},* raffia palm (*Raphia hokeri},* mango (*Magnifera indica)* etc. some of the common community crops cultivated in the study area include maize (*Zea mays),* yam (*Dioscorea spp),* cassava (*Manihot esculentus),* fluted pumpkin (Telfairia accidentalis), okro, pepper, egg plants amongst others.

Land use selection

Five different locations (land use types) were selected for this study. They include oil palm plantation, cassava cultivated farm, plantain plantation, rubber plantation and uncultivated area. Each of them was selected because they distinctly represent the five major land use system that were predominantly practiced in the study area under the traditional farming system.

Sampling techniques

Soil samples were collected at random from the five different forms of land use type. Six soil samples were taken at depths of 0-15 cm and 15- 30 cm from each land use group. The undisturbed soil samples (using core sampler) were carefully collected on the field and transferred immediately to the laboratory for processing while disturbed soil samples were obtained at random from each of the two soil depths from various land use types, they were bulked, thoroughly mixed and a representative sub-sample was taken, air dried, passed through a 2 mm sieve, and stored in plastic bags for laboratory analysis.

Data Analysis

Randomized complete design plan was used to analyze the data collected. The data were recorded on data recording sheets. The means were separated using least significant difference (LSD) at 5% probability level.

Laboratory Analysis

Soil particle size was determined by the hydrometer method according to Yanyan, *et al.*, (2022). Bulk density was determined by the clod method as described by *Liu, et al., (2020).* Soil reaction (pH) was determined using glass electrode pH metre (Wenxiang *et al.,* 2022). Electrical conductivity was carried out using electrical conductivity meter; while soil organic matter content was determined by He *et al.,* (2022) method. Total nitrogen was determined by the Micro Kjeldal digestion method (Tristan, *et al.*, 2022). Available Phosphorus was also determined using the method described by (Xue, *et al.,* 2022)

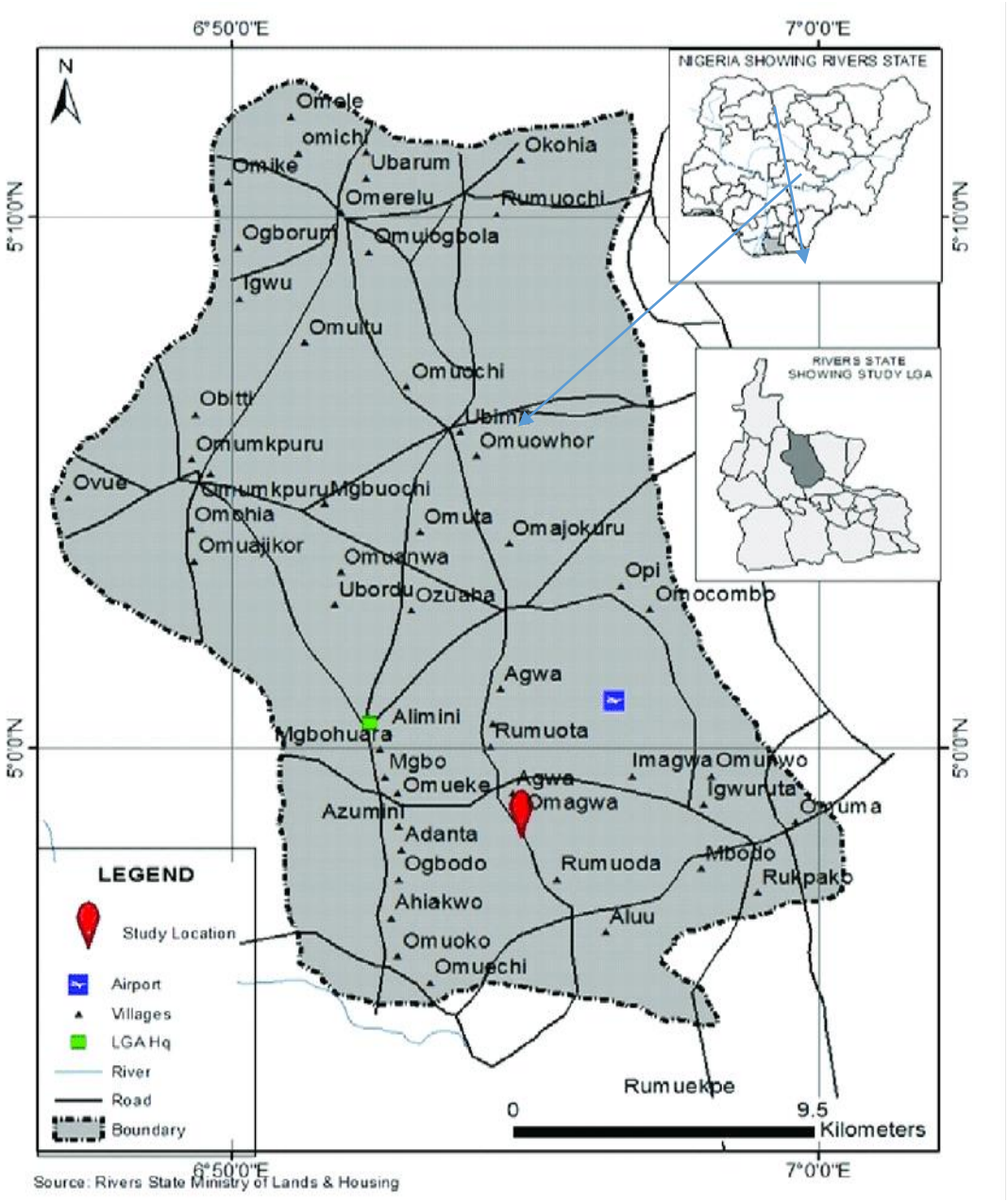

Fig. 1 Map of Ikwerre Local Government Area

RESULTS AND DISCUSSION

Soil Particle Size Distribution

Particle size distribution is commonly used in soil classification as well as for estimating various related soil properties. (Hill 1980). There were considerable differences in the soil particle size distributions under the (5) five land use patterns. The soil of uncultivated land had the highest sand content (69.23%) among the soils of the five land use systems suggesting that collapsing gully increased the sands content that are concentrated in alluvial fan. Sand contents in the soils of plantain plantation (46.32%), rubber plantation (55.64%) cassava plantation (60.50%) and oil plant plantation were lower than that of uncultivated land. It seems that tillage can reduce the sand content. The high sand content in uncultivated land and low sand content in oil palm plantation, contradict the finding of Peter and Anthony, (2017) who reported that highest value of sand was recorded in Oil palm plantation, while the least was recorded in the uncultivated land. However, the sandy nature of soils across the various Land use types may be as a result of the parent material, the Coastal plain sand. This is similar to the finding of Peter and Onweremadu (2015) and Peter and Nwidae, (2025) who reported that Ogoni sands are well drained and derived from the Coastal plain sand of marine deltaic deposits.

Table 1: Effects of Land Use on Physical Properties of Soils

Land Use Type	Bulk Density (μgcm^{-3})	Particle Size Distribution (%)			Textural Class
		Sand	Unit	Clay	
Oil palm plantation	1.62 ± 0.03b	62.87 ± 0.90	20.03 ± 0.35	17.10 ± 1.25	SL
Plantain plantation	1.34 ± 0.01e	46.32 ± 1.06	26.49 ± 0.33	27.19 ± 0.74	CL
Rubber plantation	1.32 ± 0.02e	55.64 ± 0.67	23.50 ± 0.96	20.86 ± 1.01	CL
Cassava plantation	1.53 ± 0.01	60.50 ± 0.50	26.01 ± 1.01	13.49 ± 1.33	Sl
Uncultivated land	1.66 ± 0.01	69.23 ± 0.68	16.23 ± 0.68	14.01 ± 0.26	SL

Key: SL = sandy, CL = clay Loam

Soil Ph

Figure 1 shows that the values of pH ranged from 4.93 to 5.14. It is clear that the alluvial fan soil had a lower pH value, which might be due to that the percent material of soils are acidic. However, no obvious differences in pH value were observed in the five land types, indicating that land uses have no significant effect on pH. The soil organic matter content was much higher in the plantain plantation and rubber plantation than in the other (3) three land types (Fig. 2); uncultivated land contained the lowest soil organic matter content and were no significant differences among the oil palm plantation and the cassava plantation.

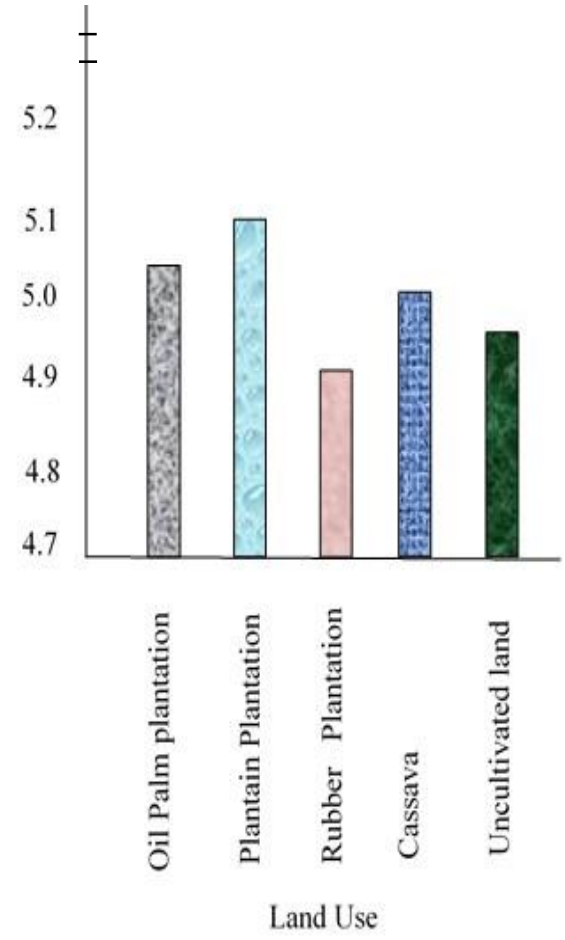

Fig. 2. Soil pH

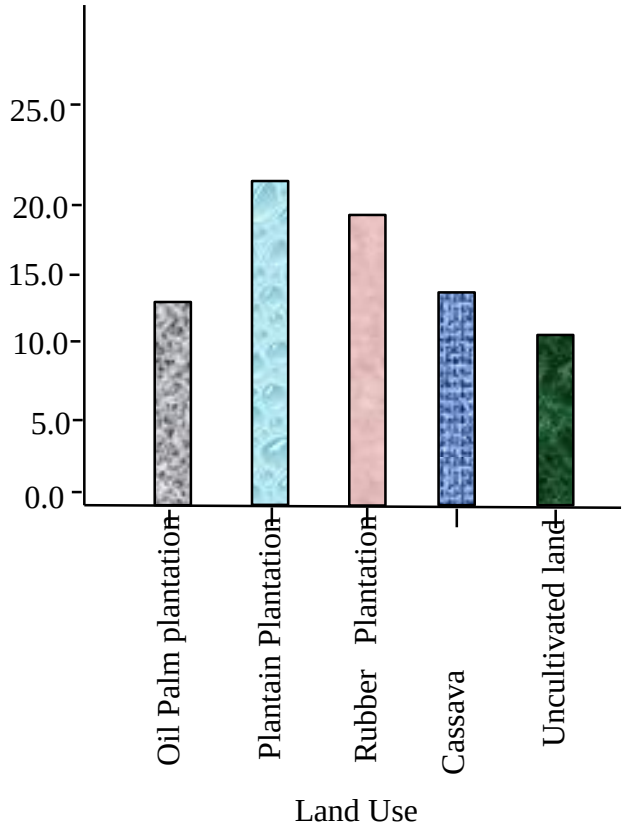

Fig. 3 Organic Matter

Soil total nitrogen

The total nitrogen contents in different land types ranged from 0.46 (uncultivated land) to 1.10g kg^{-1} (plantain plantation) (Fig. 3) the contents of total nitrogen in plantain plantation and rubber plantation were significantly higher than those in the other land types. Compared ultra the uncultivated land, all the other land types showed increased contents of total nitrogen.

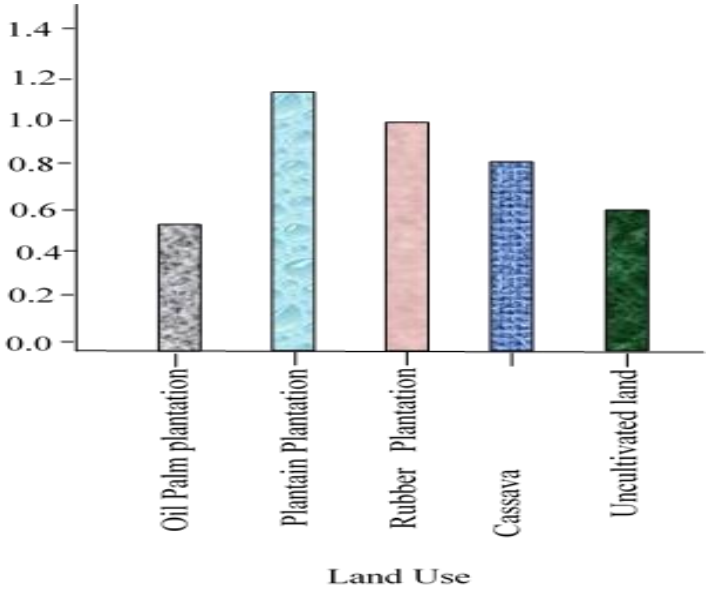

Fig. 4. Total nitrogen

Available Phosphorus

The content of available phosphorous in plantain plantation land was significantly higher than those of other land use types. Taken together the results show that the content of available phosphorus in the agricultural lands were significantly different.

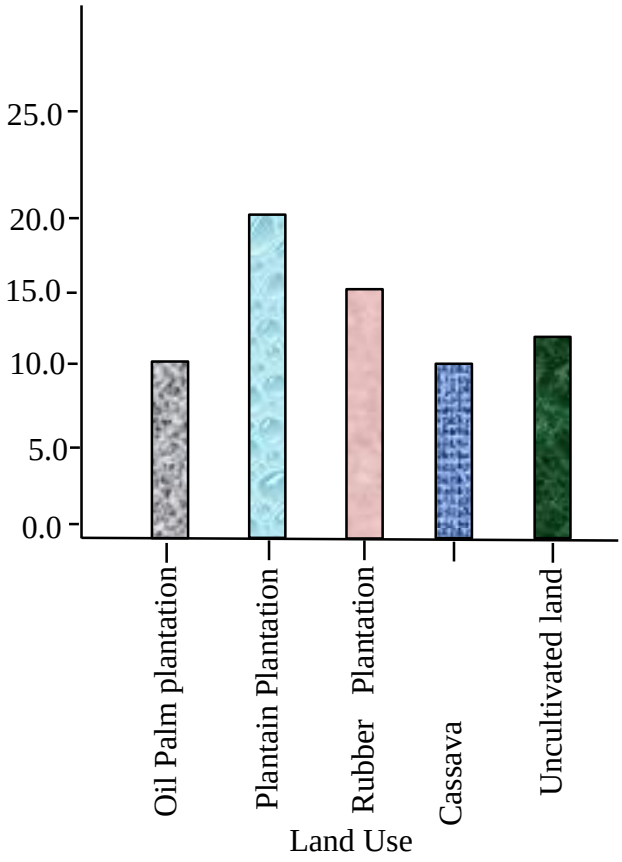

Fig. 5. Available Phosphorus (mg kg)

DISCUSSION

Physical Properties of Soil

Soil physical properties are important indicators to evaluate agricultural management practices. Soil bulk density is an important indicator of soil physical properties and it affects soil fertility and crop productivity, especially in the alluvial fan farmland of collapsing gully. This study showed that uncultivated land has the highest soil bulk density and the soil bulk density of plantain plantation was lower than that of other lands. The result shows that the difference between agricultural tillage and non-agricultural tillage were significant. Land use in collapsing gully alluvial farm especially in the soil after cultivation, which might be due to the increase of soil organic matter after cultivation. These results are in accordance with the bulk density reduction observed in response to increase organic matter input in a study (Peter and Umweni, 2022). Organic matter is a binding force between particles and within aggregates and thus affects soil compatibility (Peter and Umweni, 2022). Therefore, the cultivation of Plantain plantation and cassava plantation can significantly reduce soil bulk density. Particle size distribution affects the movements and retention of water, solutes, heat and air in soil. In land degradation processes, a decrease in water – holding capacity; losses in soil nutrients, and the diminution of soil structure are indicative of the selective removal of the particle size fractions (Senjobi and Ogunkule, 2011)

Soil Chemical Properties

The increase of pH was more obvious in the cultivation layers of the plantain plantation (fig 2A). The pH decrease in the

rubber plantation soil might be due to the long-term cultivation that causes the accumulation of litter of the harvested crops and the dead roots in the cultivation layer. In the present study, the soil of =uncultivated land had the lowest content of organic matter and the content of organic matter was improve remarkably through land uses. This is because the alluvial fan soil was covered by abundant vegetation, which resulted in an overall larger accumulation of organic matter. Yet after cultivation, the decomposition of the litter produced a large amount of organic matter in the surface layer. Therefore, the accumulation of organic matter was greater than that in the uncultivated. However, some of the organic matter content in the way of land uses may be taken away by the rain (Gol 2009). Fig 3 shows that the total nitrogen content was increased by the land uses: Although it was decreased in some land type. The decrease of might be due to the absorption of some nutrients by plants. The contents of available phosphorous in the plantain plantation and rubber plantation were significantly higher than those of other land use types which might be caused by local manner of fertilizer application. The trends of soil property changes vary across the different land types (Peter and Umweni, 2022). The changes in soil properties are mainly attribute to the management of activities such as cultivation and fertilizer application (Zhang 2012). Therefore, it can be speculated that the changes of physic – chemical properties observed in my study were the results of different cultivations and fertilization.

CONCLUSION

This study was designed to determine the effects of different land use on the physic-chemical properties. The results showed that the physical properties in alluvial fan soil were improved such as smaller bulk density. The chemical properties of the soil, such as soil pH organic matter, total nitrogen, available phosphorus were increased significantly. In general, the results demonstrate that land uses can assist the improvement of some soil physical and chemical properties.

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