Influence of Land use on Soil Physico-chemical Properties in Otite, Guinea Savannah zone, Nigeria

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Abstract: Influence of land use types on the soil physico-chemical properties in Federal College of Education, Otite, Southern Guinea Savanna Zone, Nigeria was examined. The following arable land uses were selected: maize/ cowpea intercrop, Yam/Cassava sole crop and Fallow. An area of almost flat land of 50m by 30m was selected under each of the three land use types. For individual land use type, surface soil samples were collected at the depth of 0 – 30cm and analyzed for some physical and chemical properties. The result shows that nine properties (Total N, Ca, Mg, K, Na, CEC, Sand, Clay and Silt) are significantly different (P=0.01). However there is no significant difference in pH, Organic matter and bulk density for the land uses studied. This study established that land use types affect soil properties in the study area.
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Key Words: Soil, Properties, Land use

Introduction

There is an increased need for information on soil and fertility. Soil can be referred to as top layer of the earth surface which serves as medium for plant growth in food production while soil fertility can be referred to as the inherent capacity of soil to supply nutrients to plant on adequate amount and in suitable proportions (Brady, 1974).

Variation in the soil properties due to Land use, human management and their consequence to the production capacity have been the subject of research in the past (Fasina, 2005; Babalola and Fasina, 2006). Many Nigeria soils show nutrients (Fertility) deficiency problems after only a short period of Land use, (Cultivation) because of their nature as well as prevailing environmental conditions. Farmers have been putting suitable efforts to furnish the soil with additional nutrients and other necessary needed nutrients provider to improve yield of crops, soil structure so that it will not be limited to the natural system of supply only. An assessment of variation in soil properties, Land use in association with Land management activities is vital for the selection and establishment of appropriate sustainable practices under different agro-system. Variations in properties have been found to influence the yield of crops and over all soil productivity. Therefore, maintaining adequate soil organic manure is required for sustainability of Land use system.

In Guinea savannah zone of Nigeria, farmers practice intercropping and intensive cropping system with wide range of crops consisting major crops and minor crops, with crops like cassava, maize, yam as major crops while melon, cowpea, soya bean, vegetable crops as minor crops. Such practices have been reported to lead to nutrient loss (Fasina, 2005; Babalola and Fasina, 2006; Agboola and Shittu, 2002). Therefore the need for this study arose. The objectives of the study are:

1. To identify the characteristics of the soil of the study area.
2. To evaluate the influence of different land use on the soil physico-chemical properties in the study area.

Material and Methods

Description of Study Area: The study area is located within the federal college of Education Otite in Okehi Local Government Kogi State. The campus covered the total land area of 408.214 hectares and located at latitude 7'50°N, longitude 6'03°E within southern guinea savanna zone of Nigeria.

It has tropical climate characterized with distinct wet and dry season; the temperature of the area range between 24^0C to 38^0C with moderate relative humidity. The average mean of annual rainfall in this study is 127mm with 4 months with less than 25mm of rainfall. The raining season spans between 5 to 6months which usually commences from late march/early April to October. The planting period starts in late March/April with maize, cowpea and melons as early crops and later intercropped with cassava. The growing season ends in September with October marking the beginning of final harvest for crops.

Land Use and Farming System: The most important land use in the study area is arable crop farming in intercrop and sole crop system. The major food crops grown are White yam (*Disocorea rotundata*), Yellow yam (*Disocorea cayanesis*), Maize (*Zea may*),

Cassava (*Manihot spp*), leafy vegetables and in dry season irrigated vegetable production is practiced along River Osara especially the Osara Dam area.

Inter cropping system is practiced with maize/Cowpea, Maize-melon-yam, yam-cassava, Melon-Bambara groundnut, Maize-groundnut.

Sole Cropping system is practiced with crops like Cassava, Beniseed and Yam.

Fallow and shifting cultivation are also practiced in the study area.

Soil Sampling Method: An area of land, dimension 50m by 30m was selected each under the following:

(a) Maize/Cowpea Intercrop.
(b) Yam sole crop.
(c) Fallow land under grasses used for grazing occasionally.

Eight surface soil samples at depth 0-30cm from each land units were collected. All together twenty-four surface soil samples were collected. Also core samples were also collected for bulk density determination. Soil colour was determined with munsell soil colour chart and Texture by feel method at sampling.

Laboratory Method: Soil samples were analyzed following the IITA (1979). Before the soil analysis in the laboratory the soil samples were air dried, grinded and sieved to separate the fine earth fraction (≤2mm) from coarse fragments, the gravel content were determined as the percentage of particle with diameter (>2mm). Bulk density was determined using the core method. Particle size analysis was carried out by hydrometer method (Day, 1965). The soil pH determine electrometrically in water ratio (1:1 soil to water) and a 0.01M $CaCo_3$ solution, moisture content was determined gravimetrically. Exchangeable cation's were extracted using NH_4OAC, Na and K were determined in the flame Photometer and Ca, and Mg on the atomic absorption spectrometer. Exchangeable acidity (Al and H) were determined by titration of the soil solution extraction in KCl, effective cation exchangeable capacity (ECEC) was determine as the summation of exchangeable base and exchangeable acidity (ECEC = EB + EA). Organic matter content was determined, this was determined by analyzing organic carbon using dichromate wet oxidation method of Walkey and Black (1934) and the value for organic matter was obtained by multiplying the carbon value for factor of 1:729.

Data Analysis: The variability of soil properties between the different land use types was assessed by using Analysis of Variance.

Results and Discussion

Characteristics of the Soil in the Study Area

Data on the physico-chemical properties of the soil of each land unit is presented in table 1. Bulky density values range between 1.07 to 1.54g/cm^3 with average mean between 1.08 to 1.32 g/cm^3. The Sand content values range from 50% to 63.75%. The Clay percentage range from 16% to 20% with average mean 16.75% to 33.25%, the texture is Sandy Loam in the study area. The structure ranges from medium angular blocky to coarse angular blocky while consistence is medium friable when dry. The colour is 10YR. The pH of the soil in the study area is moderately acidic with values ranging from 5.00 to 6.00; the average mean of pH is between 5.52 to 5.94 can be due to bush burning practices, leaching of nutrients and nature of the parent material. Cation exchange capacity ranges from 3.18 to 5.87cm/kg-^{1}, the values are on the average, generally low in comparison with values reported for Nigeria soils (Ogunwale and Ashaye, 1975; Ojo Atere *et al*., 1978; Fasina, 2005; Ogunkunle, 1993 and Babalola, 2005). Considering the critical values of K-0.20 Cmol/kg of soil and Mg-0.15cm Cmol/kg of soil for most crops, the exchangeable bases in the area can be said to be adequate. Available P is medium for all the Land use types the value ranges from 4.64 to 5.02 ppm. The total N values are low; the values are in agreement with some values recorded for Nigeria soils (Ogunwale and Ashaye, 1975, Fasina, 1986 Aiboni, 2001). The organic matter content on the average is generally low this could be due to continuous cropping of the land; the Land under fallow is having higher organic matter content than others, this is understandable as fallow ensures return of plant residues thereby building up the organic matter content of soil obtained from the fallow field.

Influence of Land Use Types on Soil Properties

Results presented in table 2 shows that nine (N, Ca, Mg, K, Na, CEC, Sand, Clay and Silt) out of twelve properties under consideration are significantly different (P=0.05) in the three land use types this established the fact that land use patterns have on influence on soil properties similar results have been reported for derived savannah and rain forest zone of Nigeria (Fasina, 1986; Babalola, 2005; Ogunkunle and Eghaghara, 1992; Ogunkunle and Erinle, 1994). However there is no significant difference in the pH, O.M and Bulk Density. Properties in which significant differences was recorded are the ones related to management; hence differences in soil properties across the land use could be due to management practices in each of the land units.

Table 1: Soil Physico-Chemical Properties of the Study Area

Soil Properties	pH	O.M%	Total N	Avail P	Ca	Mg	K	Na	CEC	Bulk Density g/cm3	Sand	Clay	Silt	Colour	Texture	Structure	Consistence
maize/cowpea intercrop																	
1	5.73	1.02	0.16	4.64	2.87	0.36	0.52	0.19	3.94	1.31	55	18	27	10YR	SL	Ccr	Mfr
2	5.91	1.11	0.18	4.69	2.87	0.39	0.52	0.18	3.96	1.33	53	17	30	10YR	SL	Ccr	Mfr
3	5.91	1.11	0.16	5.01	2.8	0.41	0.5	0.2	3.91	1.32	55	18	27	10YR	SL	Ccr	Mfr
4	5.04	1.12	0.17	4.73	1.99	0.39	0.56	0.2	3.41	1.33	55	18	27	10YR	SL	Ccr	Mfr
yam/cassava sole crop.																	
1	5	0.86	0.12	5	2	0.24	0.51	0.21	2.96	1.54	64	20	16	10YR	SL	Mab	Mfr
2	5.6	1	0.12	5.03	2.23	0.23	0.51	0.21	3.18	1.49	64	19	17	10YR	SL	Mab	Mfr
3	5.81	0.99	0.12	5.03	2.34	0.24	0.5	0.22	3.3	1.54	64	20	16	10YR	SL	Mab	Mfr
4	5.65	0.92	0.11	5.02	2.31	0.26	0.51	0.21	3.29	1.53	63	19	18	10YR	SL	Mab	Mfr
Bush fallow/ Grassland shrubs.																	
1	5.89	1.44	0.2	4.89	4.23	0.98	0.56	0.29	6.06	1.08	50	16	34	10YR	SL	Fab	Mfr
2	5.99	1.46	0.21	4.57	4	0.95	0.57	0.28	5.8	1.08	51	16	33	10YR	SL	Fab	Mfr
3	6	1.56	0.21	4.55	4	0.95	0.56	0.29	5.8	1.1	51	16	33	10YR	SL	Fab	Mfr
4	5.89	1.44	0.21	4.55	4.01	0.95	0.56	0.3	5.82	1.07	50	17	33	10YR	SL	Fab	Mfr

SL – Sand Loam, Ccr – Coarse Crumbs, Mab- Medium Angular Blocky, Fab – Fine Angular Blocky, Mfr – Medium friable

Table 2: Variance Ratio Test of Soil Properties

Soil properties	F value	Remark
pH	2.07	NS
O.M%	0.70	NS
Total	183.00	**
Exchangeable Ca	44.61	**
Exchangeable Mg	1558.45	**
Exchangeable K	11.69	**
Exchangeable Na	24.70	**
CEC	102.78	**
Bulk density	716.38	NS
Sand	289.17	**
Clay	42.33	**
Silt	318.09	**

NS = Not Significant
** = Significant at the 0.01 Level.

Conclusion

Soil physic-chemical properties in the area have been identified and the present condition of the soil in the study area can be said to be moderately adequate for crop production; however farmers in the area should consider management practices that will ensure organic matter build up and discourage Loss of Nitrogen. Also the study established that the three prominent land use practices have influence on the soil physic-chemical properties in the area.

Further studies is recommended on soil variability in relation to soil types and crop yield, when combined with the results of this study will help to establish appropriate management practices for farmers in the study area.

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