

SOIL PROFILE CHARACTERISTICS PUNDER CULTIVATED AND UNCULTIVATED AREAS OF GARKIDA, ADAMAWA STATE, NIGERIA

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ABSTRACT

An assessment was conducted on the effect of Land use on Profile characteristics of soils of Garkida, Gombi Local Government Area of Adamawa State. Two (2) profile pits each were dug under the different land use (Cultivated and Uncultivated) and samples were taken from identified genetic horizons. The soils were described for their physical and chemical properties. All soil samples collected were analyzed in the laboratory using standard laboratory procedures. The results revealed that the texture was predominantly Sandy loam for cultivated field, and Loamy sand for uncultivated field. The soil pH was also slightly acidic for both land uses (pH means of 6.93 and 6.60 cultivated and 6.92 and 6.66 uncultivated). The mean bulk density values for the cultivated site were 1.63 and 1.75g/cm³, while 1.65 and 1.55g/cm³ were obtained at the uncultivated site. The organic carbon, organic matter, total nitrogen and available phosphorus were general found to be low for both cultivated and uncultivated land uses. The TEB (Total exchangeable bases) for the cultivated site were 15.91 and 9.50 Cmol (+)/kg, while that of the uncultivated were 9.01 and 10.23Cmol(+)/kg, and termed medium to high. It is recommended that, the incorporation of crop residue, addition of organic manures and provision of adequate drainage will improve the physical and chemical properties of the soils, which will enhance sustainable crop production.

Key words: Characteristics, Cultivated, Land Use, Profile, Uncultivated

1.0 INTRODUCTION

Land use is defined as the arrangement, activity and input people undertake in a certain land cover type to produce, change or maintain it [1]. It involves the management and modification of natural environment or wilderness into built environment such as fields, pastures and settlements [1]. 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 [2]. 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.

Lands have been utilized intensively for all purposes at the expense of their suitability, which have resulted in massive land degradation [3]. It has been reported that unsystematic changes in land use predisposes it to several environmental problems amongst which include desertification, acidification, eutrophication, greenhouse effect that cause climate change and biodiversity loss [4].

Given the central role of soil resources in subsistence crop production and the fact that soil as a resource in the human time scale, is a major medium for sustainable agriculture [5]. The profile characteristic of soils has recently received more attention, as surface characteristics of tropical soils has failed to bring about detail information on soils. Also detailed information on soils of the study area is scarce, yet the need to generate soil data in order to improve crop production exists.

In the light of this, the paper is aimed at assessing the effect of land use on profile characteristics of soils at Garkida in Gombi Local Government Area of Adamawa state, and suggests management practices for optimum and sustainable cropping systems.

2.0 MATERIALS AND METHODS

2.1 The study area

The study was conducted at Garkida, in Gombi Local Government area of Adamawa state. The area lies between latitude 10.16° and 11° N and longitude 12.74° and 13.54° E. Northern Guinea Savanna Ecological Zone of Nigeria. The area is characterized by an annual rainfall of 700-1000mm, an annual mean temperature of 32° C, and a relative humidity of 13.6%

2.2 Soil sampling and handling

Two (2) profiles pits each using the targeted survey approach were located and dug in each of the two (2) land use types (cultivated and uncultivated fields) and soil samples were then taken from identified genetic horizon. The collected Soil samples were then properly labeled in polythene bags and taken to the laboratory for analysis. In the laboratory, each sample was separately air dried ground and passed through a 2mm sieve for laboratory analysis as described by [6]. Particle size distribution, Bulk density, Soil pH, EC, Organic carbon, Total nitrogen, Available phosphorus, and Exchangeable bases (Ca, Mg, Na and K) in the soil samples were all determined following standard

laboratory procedure as described by [6], while TEB was calculated by summing up the values obtained for all the bases (Ca+Mg+Na+K).

2.3 Data analysis

The Data generated from laboratory analysis were subjected to simple correlation analysis using SPSS (version 17).

3.0 RESULTS AND DISCUSSION

3.1 Soil Physical Properties

Table 1 and 2, represent the physical properties of soils of the study area for cultivated and uncultivated fields respectively. The results for particle size distribution obtained for cultivated field (Table 1), indicated that the mean values obtained for Pit 1 and 2 for percentage (%) sand, clay and silt fractions, were 61.50 and 69.20%, 9.20 and 4.00%, and 29.30 and 26.80% respectively. In the uncultivated field (Table 2), the results shows that the mean values for Pit 1 and 2 for percentage (%) sand, clay and silt fractions, were 83.20 and 71.60%, 7.80 and 13.88%, and 9.00 and 14.52% respectively. The higher mean value of percentage sand content obtained for both cultivated and uncultivated fields could be attributed to the secondary products of weathering [7]. Also the results revealed that the textural class in the cultivated and uncultivated is predominated by Sandy Loam and Loamy Sand respectively.

The mean Bulk density values recorded for Pit 1 and 2 (cultivated field) were 1.63 and 1.75 g/cm³ respectively, while mean values for Pit 1 and 2 (uncultivated) were 1.65- 1.55g/cm³ respectively. The soils investigated had almost equal distribution of BD values for both land uses. The values obtained for this study are within the range reported in an earlier finding by [8], who recorded values of 1.50-1.80 g/cm³ while working on soils in Borno state. A good plant growth is best at bulk densities below 1.40 g/cm³ for clay, and 1.60 g/cm³ for sandy soils [9].

Table 1: Physical Properties of Cultivated Field

Cultivated Physical Properties						BD	
SN	S. Name	Depth (cm)	%Sand	%Clay	%Silt	g/cm3	Texture
1	PIT1	0-25	56.00	10.00	34.00	1.54	Sandy Loam
2		25-40	74.00	0.80	25.20	1.95	Loamy Sand
3		40-163	58.00	14.00	28.00	1.49	Sandy Loam
4		163-200	58.00	12.00	30.00	1.52	Sandy Loam
MEAN			61.50	9.20	29.30	1.63	
1	PIT2	0-23	74.00	0.60	25.40	1.99	Loamy Sand
2		23-41	62.00	8.00	30.00	1.58	Sandy Loam
3		41-78	70.00	1.40	28.60	1.86	Sandy Loam
4		78-149	68.00	6.00	26.00	1.64	Sandy Loam
5		149-200	72.00	4.00	24.00	1.70	Sandy Loam
MEAN			69.20	4.00	26.80	1.75	

Table 2: Physical Properties of Uncultivated Field

Un-Cultivated Physical Properties						BD	
SN	S. Name	Depth (cm)	%Sand	%Clay	%Silt	g/cm3	Texture
1	PIT1	0-26	90.00	5.60	4.40	1.69	Sand
2		26-62	90.00	5.40	4.60	1.70	Sand
3		62-100	64.00	16.40	19.60	1.48	Sandy Loam
4		100-173	84.00	5.20	10.80	1.69	Loamy Sand
5		173-200	88.00	6.40	5.60	1.67	Loamy Sand
MEAN			83.20	7.80	9.00	1.65	
1	PIT2	0-27	82.00	5.20	12.80	1.69	Loamy Sand
2		27-43	82.00	5.00	13.00	1.69	Loamy Sand
3		43-96	66.00	16.40	17.60	1.49	Sandy Loam
4		96-135	68.00	18.40	13.60	1.47	Sandy Loam
5		135-200	60.00	24.40	15.60	1.42	Sandy Clay Loam
MEAN			71.60	13.88	14.52	1.55	

3.2 Soil Chemical Properties

The data for Chemical properties for the cultivated and uncultivated fields were shown in Table 3 and 4 respectively. The results obtained for cultivated field (Table 3), indicated that the mean values obtained for Pit 1 and 2 for soil reaction (pH) were 6.93 and 6.60 respectively, while in the uncultivated field (Table 4), the results shows that the mean values for Pit 1 and 2 for pH were 6.92 and 6.66 respectively. The soil reaction (pH) of both cultivated and uncultivated fields are similar and classed as slightly acidic [10].

The mean EC values recorded for Pit 1 and 2 (cultivated field) were 0.72 and 0.41dS/m respectively, while mean values for Pit 1 and 2 (uncultivated) were 0.39 and 0.28dS/m respectively. Irrespective of the higher mean EC values recorded in the cultivated field, the soils EC values obtained from both fields are low and regarded as Non - saline in nature [11]. In Pit 1 and 2 in the cultivated Field (Table 3), the soils mean OC recorded were 1.00 and 0.96g/kg respectively, while mean values of OC in Pit 1 and 2 within the uncultivated field (Table 4) were 0.95 and 1.04g/kg. Also the content of organic matter is almost similar to that of OC in both fields. The values obtained for both organic carbon and organic matter in this study were generally found to be low [12]. This seemingly low level content of organic carbon and organic matter is attributed to the prevailing dry conditions, where the biomass production is low and rate of mineralization high [13]. The mean TN values recorded for Pit 1 and 2 (cultivated field) were 0.17 and 0.24g/kg respectively, while mean values for Pit 1 and 2 (uncultivated) were 0.20 and 0.27g/kg respectively. Irrespective of the higher mean TN values recorded in the uncultivated field, the soils TN content obtained from both fields are low in the study area [10]. This low levels of the total and available nitrogen obtained in soils of the study areas could be attributed to rapid rate of organic matter decomposition, high rate of leaching, soil erosion, volatilization and de-nitrification among other factors [14]. The results obtained for cultivated field (Table 3), indicated that the mean values obtained for Pit 1 and 2 for AP were 5.07 and 5.12mg/kg respectively, while in the uncultivated field (Table 4), the results shows that the mean values for Pit 1 and 2 for AP were 4.46 and 5.74mg/kg respectively. The values of soil AP obtained in both fields are almost similar and could be regarded as low [12]. This low level of AP obtained in this study could be attributed to the nature of the parent

material and its propensity to sorption on mineral surface [15]. The results obtained for cultivated field (Table 3), indicated that the mean values obtained for Pit 1 and 2 for exchangeable bases e.g Ca, Mg, Na and K soil content, were 2.97 and 1.65cmol(+)/kg, 12.03 and 7.25cmol(+)/kg, 0.30 and 0.16cmol(+)/kg, and 0.60 and 0.44cmol(+)/kg respectively. In the uncultivated field (Table 4), the results shows that the mean values for Pit 1 and 2 for Ca, Mg, Na and K soil content, were 2.82 and 1.65cmol(+)/kg, 5.54 and 8.17cmol(+)/kg, 0.16 and 0.17cmol(+)/kg, and 0.50 and 0.24cmol(+)/kg respectively. The results from both fields could be regarded as low for Ca and Na, medium for K and high for Mg content [10]. This seemingly high value of soil Mg content obtained in both field could be attributed to the nature of the parent material [15].

Table 3: Chemical Properties of Cultivated Field

S N	S. Name	Depth(cm)	pH	EC	O C	O M	T N	AP	Ca	Mg	Na	K	TE B
			Ran ge	(dS/ m)	(g/Kg)			(mg/ Kg)	(cmol(+)/Kg)				
1	PIT1	0-25	6.90	0.63	1.1 2	1.9 3	0.2 3	5.65	2.1 8	13. 84	0.3 0	0.4 9	16. 82
2		25-40	7.10	0.59	1.0 1	1.7 4	0.1 2	5.23	3.1 6	21. 75	0.2 6	1.1 0	26. 27
3		40-163	6.60	0.64	0.9 5	1.6 3	0.2 0	4.65	3.1 6	7.9 1	0.2 6	0.2 6	11. 58
4		163- 200	7.10	1.02	0.9 1	1.5 6	0.1 2	4.73	3.4 0	4.6 1	0.3 9	0.5 6	8.9 7
MEAN					1.0 0	1.7 2	0.1 7	5.07	2.9 7	12. 03	0.3 0	0.6 0	15. 91
1	PIT2	0-23	6.40	0.25	1.0 2	1.7 5	0.3 1	4.90	1.4 6	8.5 7	0.1 7	0.3 3	10. 53
2		23-41	6.60	0.81	0.9 7	1.6 7	0.2 3	6.57	0.9 7	1.9 8	0.1 7	0.3 1	3.4 3
3		41-78	6.80	0.33	1.0 0	1.7 2	0.1 6	5.23	2.9 1	7.2 5	0.1 7	0.6 4	10. 98
4		78-149	6.80	0.39	0.9 1	1.5 6	0.2 6	4.06	2.6 7	5.9 3	0.1 3	0.1 8	8.9 1
5		149- 200	6.40	0.28	0.9 3	1.6 0	0.2 4	4.82	0.2 4	12. 53	0.1 3	0.7 4	13. 64
MEAN					0.9 6	1.6 6	0.2 4	5.12	1.6 5	7.2 5	0.1 6	0.4 4	9.5 0

Table 4:Chemical Properties Un-Cultivated Field													
S N	S. Name	Depth(cm)	pH	EC	OC	O M	T N	AP	Ca	M g	Na	K	TE B
			Ran ge	(dS/ m)	(g/Kg)			(mg/ Kg)	(cmol(+)/Kg)				
1	PIT1	0-26	7	0.32	0.9	1.	0.	3.979	2.9	7.	0.1	0.	11.
					58	65	33	5	13	91	3	72	67
					0.9	1.	0.		1.6	4.	0.1	0.	6.9
					48	63	11	4.816	99	61	3	51	6
					0.9	1.	0.	3.979	3.3	5.	0.1	0.	9.7
3	PIT1	62-100	7.5	0.7	58	65	32	5	98	93	3	28	4
					100-173	6.4	0.26	07	91	08	4	84	93
4	PIT1	173-200	6.2	0.38	0.7	1.	0.	4.481	3.8	3.	0.1	0.	7.9
					88	36	17	4	83	3	3	64	5
MEAN					0.9	1.	0.		2.8	5.	0.1	0.	9.0
					5	64	20	4.40	2	54	6	50	1
1	PIT2	0-27	6.7	0.14	1.0	1.	0.		1.4	3.	0.1	0.	5.7
					57	82	21	4.816	56	96	74	13	1
					1.0	1.	0.	5.652	1.6	9.	0.1	0.	12.
					47	81	29	5	99	89	74	33	09
					1.1	1.	0.	5.652	0.9	9.	0.1	0.	10.
3	PIT2	43-96	6.9	0.17	27	94	3	5	71	23	74	41	78
					96-135	7	0.14	27	94	2	4	13	89
4	PIT2	135-200	6.4	0.19	0.8	1.	0.	6.154	1.2	7.	0.1	0.	9.4
					28	43	38	4	14	91	74	18	8
MEAN					1.0	1.	0.		1.6	8.	0.1	0.	10.
					4	79	27	5.74	5	17	7	24	23

3.3 Correlation Analysis

A correlation analysis was carried out to know the relationship that exist between the physico-chemical properties for pits samples under cultivated and un-cultivated fields. The correlation results (Table 5) showed that pH with all the other parameters is non-significant. There was a positive correlation between EC and Sodium (0.560), OC and Organic matter (1.000), Magnesium with K (0.549), Magnesium with TEB (0.972) and Na and Silt (0.519), which were all significant at both 1% and 5% level of significance, while the positive correlation of EC and %Silt (0.488) was only significant at 5% level of significance. There was an observed negative correlation between % Sand with %Clay (-0.558), %Sand and %Silt (-0.813), and Clay and Bulk

density (-0.894) at both 1 and 5% level of significance. K and Clay (-0.514) and Sand and Bulk density (0.507) was negatively and positively correlated respectively at 1% level of significance.

Table 5 : Correlation of Physical and Chemical Properties of Profile Samples under Cultivated and Un cultivated field

	pH	EC	OC	OM	TN	AP	Ca	Mg	Na	K	TEB	%Sand	%Clay	%Silt	BD
pH	1.000														
EC	NS	1.000													
OC	NS	NS	1.000												
OM	NS	-NS	1.000**	1.000											
TN	NS	NS	NS	NS	1.000										
AP	NS	NS	NS	NS	NS	1.000									
Ca	NS	NS	NS	NS	NS	NS	1.000								
Mg	NS	NS	NS	NS	NS	NS	NS	1.000							
Na	NS	0.560**	NS	NS	NS	NS	NS	NS	1.000						
K	NS	NS	NS	NS	NS	NS	NS	0.549**	NS	1.000					
TEB	NS	NS	NS	NS	NS	NS	NS	0.972**	NS	NS	1.000				
%Sand	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.000			
%Clay	NS	NS	NS	NS	NS	NS	NS	NS	NS	-0.514*	NS	-0.558**	1.000		
%Silt	NS	0.488*	NS	NS	NS	NS	NS	NS	0.519**	NS	NS	-0.813**	-NS	1.000	
BD	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.531	NS	0.507*	-0.894**	NS	1.000

DF=17 r = 0.456 at 5% level of significant

r = 0.575 at 1% level of significant

4.0 CONCLUSION AND RECOMMENDATIONS

From the results of the soils studied from both the cultivated and uncultivated fields, it was found that there is little or no difference in both physical and chemical properties of the studied soils. Also most of the essential nutrient required for the growth and development of crops are generally low. Generally the studied soils can be regarded as fertile and good for agricultural production, if well managed.

In line with the above findings, it is recommended that good soil management practices should be adopted for food sufficiency and security. These management practices should include the provision of adequate drainages, incorporation of crop residue, addition of organic manures, and inorganic fertilizers containing especially N, and P. Proper and periodic monitoring of the physical and chemical properties of such soils is very necessary, so that appropriate preventive measures could be embarked upon as and when due, for optimum agricultural productivity.

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