International Journal of Development and Sustainability
ISSN: 2168-8662 – www.isdsnet.com/ijds
Volume 3 Number 4(2014): Pages 923-930
ISDS Article ID: IJDS13033003

ISDS JOURNALS

Short Communication

Variability in properties of soils under three land use types in a humid tropical environment

E.E. Ihem *, G.E. Osuji, E.U. Onweremadu, S.U. Onwudike, U.N. Nkwopara, B.N. Ndukwu, B.U. Uzoho

Department of soil science and Technology, Federal University of Technology, P.M.B 1526 Owerri, Nigeria

Abstract

Variability in properties of soils under three land use types in a humid tropical environment were studied in 2009. A transect soil survey sampling technique was used to align pedons in the three land units of a 5-year fallow land, 40-yesrs of an abandoned home and an extinct shrine. These land use types were geographically associated. A pedon was dug and described in each land use type followed by soil sample collection based on horizon differentiation. Soil samples were then subjected to routine analysis in the laboratory. Spatial changes were analyzed using coefficient of variation. Relationship among some soil properties was determined using correlation coefficient. Percent organic matter varied greatly in all the three land units: (CV= 89.2%) in abandoned home, (CV=87.0%), shrine and fallow land (CV=81.5%). Negative correlations were recorded between pH and OM (r= -0.688), TN (r= -0.784), TEB (r= -0.483) and ECEC (r= -0.477) at $P \leq 0.05$ for shrine location. Negative correlation was recorded between pH and ECEC (r= -0.625) at $P \leq 0.05$ in fallow land,

Keywords: Land use types, Pedons Humid tropics

Cite this article as: Ihem, E.E., Osuji, G.E., Onweremadu, E.U., Onwudike, S.U., Nkwopara, U.N., Ndukwu, B.N. and Uzoho, B.U. (2014), "Distribution of oil revenue to Niger delta of Nigeria in post-2000: Is the debate how fairly the federal government has redistributed oil revenue?", *International Journal of Development and Sustainability*, Vol. 3 No. 4, pp. 923-930.

* Corresponding author. *E-mail address:* eeihem2000@yahoo.com

1. Introduction

Soils vary in time and space (Onweremadu and Akamigbo, 2007). Variations could be as a result of changes in the lithological origin (Onweremadu, 2008), land use and landscape position (Onweremadu, 2007). Variability in physicochemical properties of soils of similar lithological and climatic origin can be ascribed to differences in soil management, and this affects soil quality (Brady and Weil, 2002). Land use practices had earlier been reported to influence soil properties (Asadu and Enete, 1997).

Soil management practices that may cause only very small changes in the total soil organic matter often cause rather pronounced alteration in aggregate stability, nitrogen mineralization rate and /or other soil properties attributed to organic matter. This results in the relatively small pool of active organic matter which may undergo a large percentage increase or decrease without having a major effect on the total organic matter. Changes in soil properties due to land use has significant influences on P, K, Ca, Mg, total nitrogen, organic matter and bulk density (Akamigbo, 1999; Onweremadu, 2009). Physical changes such as compaction which influences infiltration and run-off are common among land use types. The role of organic matter in binding soil properties increasing water infiltration and regulating soil temperature (Ofor, 2009). But, in Southeastern agroecology, demographic pressure, conflicting land use types and climate have interacted to alter natural resources including soils leading to deleterious changes in properties. These factors exist amidst on farmer – environment where traditional farming practices are still popular. Based on this we investigated degree of variability in selected soil physico-chemical properties of three geographically associated soils of Ikeduru, Imo State in southeastern Nigeria.

2. Materirals and methods

The study was conducted under three land use type in Uzoagba Ikeduru, southeastern (Latitude 5^{0} 30’ and longitude 7^{0} 5’E). Soils of the area are derived from the coastal plain sands. It belongs to the lowland area of eastern Nigeria. The study area has a humid climate with mean annual rainfall greater than 2500mm and annual temperature range of 26-30^{0}c. Rainfall pattern is bimodal, with July and September being peaks. Relative humidity is generally high through the year especially during wetter months. It has rainforest vegetation which is characteristically multi-storeyed. Subsistence agriculture, hunting and gathering from the wild are the major socio-economic activities. A traverse was cut through the 5-year fallow, the 40-year abandoned residence and the shrine which were geographically associated. Pedons were aligned along the transect, with each on a land use type. The pedons were dug and described according to the procedure of FAO (2006). After delineation into horizons, soil samples were collected from the. Soil samples were air-dried and passed through a 2-mm sieve prior to laboratory analysis. Soil texture was measured by hydrometer method (Gee and Or, 2002). Soil pH was determined electrometrically in a soil solution ratio of 1:2.5 (Hendershot et al., 1993); total nitrogen was estimated by micro-Kjeldahl digestion method (Bremner and Mulvaney, 1982), Organic Carbon was me assured by the method of Nelson and Sommers (1991) and organic matter estimated by multiplying organic carbon value by 1.724 (Van Bemmulier correlation factor), Available phosphorus was estimated by the Bray II method (Olson and Sommers, 1982), effective cation exchange capacity (ECEC) was determined by summation of the exchangeable bases (Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}) and exchangeable acidity (H^{+} and Al^{3+}).

2.1. Data analysis

Soil data were subjected to coefficient of variation measured in percentage while relationship among soil properties in the land use types were estimated using correlation coefficient whose significance was tested at 5 and 1% levels.

2.2. Field studies

Three pedons, sited in a shrine, on a five year fallow and in a home abandoned for about fourthly year were dug to average depth of meter. These pedons were described according to the procedure of FAO(2006).After horizon demarcation, soil sample were taken from the component horizon ,air dried and passed through a 2-mm sieve prior to laboratory analysis.

2.3. Analytical procedure

Texture determination was by hydrometer method (Gee and Or, 2002). Soil pH determine electrometrically in a soil solution ratio of 1:2.5 (Hendershot et al., 1993). Total nitrogen was estimated by micro-kjeldahl digestion method (Bremner and Mulvaney, 1982). Organic matter was measured by multiplying organic carbon value by 1.724 (Van Bemmulier correlation factors). Available phosphorus was estimated by the Bray 2 method (Olson and Sommers, 1982).

Effective cation exchange capacity (ECEC) was calculated by the summation of exchangeable bases (Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}) and exchangeable acidity (H^{+} and Al^{3+}).

3. Results and discussion

The physical and chemical properties of the studied soils are presented in Tables 1 and 2, respectively. The soils were generally sandy which could be attributed to the coarse nature of coastal plain sands from which they were derived. Akamigbo and Asadu (1986) observed that textures of soils in southeastern Nigeria are related to their parent materials.

Low clay and silt contents characterized studied sites, showing the possibility of strong weathering and leaching of clay particles away from surficial horizons. Soils of the studied sites were generally acidic ranging from (4.06-4.13) in shrine, (4.06-4.15) in fallow land, and (4.07-4.39) in abandoned. This reflected the acidic parent material (coastal plain sands) from which they were formed, coupled with uptake of basic cations by plants and leaching away of basic cations by infiltration water.

Soils of the shrine contained highest value (0.099%) of organic matter. This could be attributed to the existence of equilibrium (biocycle) between the forest vegetation and the soil, the nutrient's recycling resulting from the litter–fall, and subsequent decomposition of which enhances the soil organic matter. The same trend was followed in total nitrogen content and distribution.

Table 1. Physical Properties of the studied pedons

Pedon location	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	TC
Shrine	0 - 20	83.68	12.76	3.56	LS
	20 - 40	76.68	17.76	5.56	SL
	40 - 60	72.68	24.76	2.26	SCL
	60 - 80	63.68	30.76	5.56	SCL
	80 - 100	74.68	21.76	3.56	SL
Fallow land (5 years)					
	0 - 20	84.68	11.76	3.56	LS
	20 - 40	79.68	14.76	5.56	LS
	40 - 60	80.68	16.76	2.56	SL
	60 - 80	77.68	20.76	1.56	SL
Abandoned home (40 years)					
	0 - 20	80.68	14.76	4.56	LS
	20 - 40	78.68	17.76	3.56	SL
	40 - 60	70.68	26.76	2.56	SCL
	60 - 80	65.68	31.76	2.56	SCL
	80 - 100	65.68	32.76	1.56	SCL

LS= Loamy Sand, SL=Sandy Loam, SCL=Sandy Clay Loam

Table 2. Chemical Properties of the Studied pedons

Pedon Location	Depth (cm)	pH (KCl)	OM (%)	TN (%)	AV. P (mg/kg)	ECEC (Cmol/kg)	B,sat (%)	Al.sat (%)	TEA	TEB	Ca: Mg ratio
Shrine	0 -20	4.06	2.65	0.09	32.20	0.74	41.50	18.00	0.43	0.31	R_1=3.0
	20-40	4.13	2.20	0.07	27.30	0.76	36.84	33.00	0.48	0.28	R_2=0.50
	40-60	4.13	1.55	0.03	25.20	0.47	61.46	28.00	0.18	0.29	R_3=0.40
	60-80	4.13	0.86	0.02	19.60	0.55	45.65	9.00	0.30	0.25	R_4=0.10
	80-100	4.12	1.17	0.02	21.00	0.61	51.06	8.00	0.30	0.31	R_5=0.10
Fallow land (5 years)	0 - 20	4.06	2.13	0.06	21.00	0.63	39.59	48.00	0.38	0.25	R_1=0.20
	20 - 40	4.15	1.58	0.04	18.20	0.82	22.89	67.00	0.63	0.19	R_2=0.10
	40 - 60	4.14	1.34	0.03	16.80	16.81	40.52	12.00	0.48	0.33	R_3=0.10
	60 - 80	4.10	0.96	0.02	16.10	0.66	31.61	13.00	0.45	0.21	R_4=0.80
Abandoned (40 Years)	0 - 20	4.39	1.75	0.04	18.90	0.80	71.29	-	0.23	0.57	R_1=0.90
	20 - 40	4.32	1.17	0.03	16.80	0.72	54.10	-	0.33	0.39	R_2=1.30
	40 - 60	4.17	0.86	0.03	15.40	0.61	50.82	46.00	0.30	0.31	R_3=0.30
	60 - 80	4.07	0.72	0.02	14.00	0.96	74.07	3.00	0.25	0.71	R_4=0.40
	80 - 100	4.13	0.62	0.01	12.60	0.60	45.00	17.00	0.33	0.27	R_5=0.50

OM=Organic Matter, TN=Total Nitrogen, Av.P=Available Phosphorous, ECEC=Effective Cation Exchange Capacity, B,Sat=Percent Base Saturation, Al.Sat=Percent Aluminium Saturation, TEB=Total Exchange Base and TEA=Total Exchange Acid.

The abandoned home had the least nitrogen probably because there was little or no nitrification process taking place there for a very long time. Similarly , the shrine soils contained the highest value of available phosphorus , while the least was recorded in abandoned home. The shrine soils had more of the available phosphorus probably because of abundance of organic matter in the undisturbed natural ecosystem since it has phosphorus as a component (Brady and Weil, 2002). The same trend was found in exchangeable bases which had high values in shrine soils when compared to other land use types.

Table 3. Variability of Selected Soil Properties

Soil property	CV (%)	Ranking
	Shrine	
Sand	19.50	Low variation
Clay	63.40	high variation
pH	2.40	low variation
%TN	140.00	high variation
OM	87.00	high variation
TEB	5.90	low variation
ECEL	38.30	moderate variation
	Fallow land (5 years)	
Sand	6.30	low variation
Clay	42.20	moderate variation
pH	0.20	low variation
%TN	112.50	High variation
OM	81.50	high variation
TEB	40.00	moderate variation
ECEL	27.10	moderate variation
	Abandoned home (40 years)	
Sand	19.60	low variation
clay	65.90	high variation
pH	6.20	low variation
%TN	88.90	high variation
OM	89.20	high variation
TEB	82.90	high variation
ECEC	40.90	Moderate variation

Table 4. Correlation of selected soil properties with significant difference at $p \leq 0.05$

Pedon Location	properties correlated	r	r^2
Shrine	pH vs OM	-0.688*	0.0473
	pH vs TN	-0.784*	0.615
	pH vs TEB	-0.483^{ns}	0.233
	pH vs ECEC	-0.477^{ns}	0.228
	OM vs TN	0.975**	0.951
	OM vs TEB	0.413^{ns}	0.171
	OM vs ECEC	0.717*	0.514
	OM vs Av.P	0.983**	0.966
	TN vs Av.P	0.957**	0.916
	TN vs ECEC	0.761*	0.579
Fallow (5 years)	pH vs OM	-0.056^{ns}	0.003
	pH vs TN	-0.175^{ns}	0.031
	pH vs TEB	-0.008^{ns}	0.00006
	pH vs ECEC	-0.625*	0.391
	OM vs TN	0.744	0.554
	OM vs TEB	0.109^{ns}	0.012
	OM vs ECEC	0.230^{ns}	0.053
	OM vs Av.P	0.987**	0.974
	TN vs Av.P	0.965**	0.931
	TN vs ECEC	0.043^{ns}	0.002
Abandoned Home (40 years)	pH vs OM	0.937**	0.878
	pH vs TN	0.897*	0.805
	pH vs TEB	0.040^{ns}	0.002
	pH vs ECEC	-0.023^{ns}	0.0005
	OM vs TN	0.961**	0.924
	OM vs TEB	0.284^{ns}	0.081
	OM vs ECEC	0.188^{ns}	0.035
	OM vs Av. P	0.965**	0.931
	TN vs Av. P	0.993**	0.986
	TN vs ECEC	0.142^{ns}	0.020

Keys;
*r = correlation coefficient, r^2 = coefficient of determination, OM = organic. matter, ns = non – significant, * = significant at P= 0.05 ** = significant at P= 0.01.*

The exchangeable bases were lower in the fallow land while the shine soil recorded the highest, followed by the abandoned home. Results of r and r^2 indicated that chemical properties of shrine and fallow land showed a negative correlation between pH vs OM (-0.688 r and 0.473 r^2); pH vs TN(-0.784 r and 0.615 r^2); pH vs TEB(-0.483 r and 0.233 r^2) and pH vs ECEC (-0.477 r and 0.228 r^2). On the other hand, OM vs TN (0.975 r and 0.951 r^2); OM vs TEB (0.413 r and 0.171 r^2); OM vs ECEC (0.717 r and 0.514 r^2) and OM vs Av. P (0.983 r and 0.966 r^2); showed a positive correlation with TN, TEB, ECEC and Available P. This indicates agronomic relevance of organic matter in supplying essential requirements for optimum performance. On the aspect of negative correlation of soil $_P$H to other properties , the agronomic implication is that when soil are limed ,these element will become available in soil for plant use.

4. Conclusions

Result showed that soil of the studied site had higher percent total sand with textural cases varying from sand to loamy sand .The study revealed that there were increase of some soil properties (OM,AP,TN,ECEC) in shrine soil than in other soil .The characteristic of these parameter showed poor association of abandoned home and soil properties , hence , it was aptly conclude that abandoned home does not favour agricultural production .The study revealed also that the soil PH in the three study sites were generally low , however application of time will help to make the plant nutrient available .This , together with organic forming in the study sites will boast the fertility and productivity of the study sites.

References

Akamigbo, F.O.R. (1999), "Influence of land use on soil properties of the humid tropical Agroecology of southeastern Nigeria", *Niger. Agric. J.*, Vol. 30, pp. 59-76.

Akamigbo, F.O.R. and Asadu, C.L.A. (1986), "The Influence of Toposequence on some Soil Parameters in selected areas of Anambra State, Southeastern Nigeria", *J. soil sci.*, Vol. 6, pp. 35-46.

Asadu, C.L.A. and Enete, A.A. (1997), "Food crop yields and soil properties under population pressure in sub-Saharan Africa: The case of cassava in southeast Nigeria", *Outlook on Agriculture*, Vol. 26, pp. 29-34.

Brady, N.C. and Weil, R.R. (2002), *Elements of the nature and properties of soils. Abridged ed. of: The nature and properties of soil*, 13th ed.

Bremner, J.M. and Mulvaney, C.S. (1982). *Total in: methods of soil analysis, page, A.L, R.H. Miller and D.R keeping (Eds,) of soil part 2*, Amer. Soc. Of Agron- Madison Wiscousin, pp. 595-624.

FAO (Food and Agricultural Organization) (2006), *Guideline for Social Description*, 4th ed, Rome.

Gee, G.W and Or, D (2002), Particle size analysis. In: *methods of soil analysis*, Dane, J.H and G.C Topp (Eds.) part 4, physical methods, soils science Amer. Book series 5, ASA and SSSA, Madison, Wiscousin. 255-293.

Hendershot, W.H., Lalande, H. and Duquette (1993), Soil Reaction and Exchangeable Acidity, In: *Soil Sampling and Methods of Analysis Carter*, M.R (Ed). Can Socio. Soil Sci, Lewis Publishers London 141-145.

Nelson, D.W and Sommers, L.E (1991), Total carbon organic carbon and organic matter, In: Sparks, D. L (Ed) *methods of soil Analysis*, part 3, chemical methods, No. 5, ASA and SSSA, maddian, WI, pp. 061-1010.

Olson, S.R. and Sommers, L.E. (1982), Phosphorus In: Page A.L, Miller, R.H and Keeney, D.R (Eds). *Methods of Soil Analysis*, part 2 Amer. Soc. Agron. Madison; Wiscousin 403-430.

Onweremadu, E.U. (2007), Availability of selected soil nutrients in relation to land use and landscape position, *Int. .J. Soil Sci*., Vol. 2 No. 2, pp. 128-134.

Onweremadu, E.U. and Akamigbo, F.O.R. (2007), “Spatial changes in the distribution of exchangeable cations in soil of a forested hilly landscape”, *Res. J. for.*, Vol. 1 No. 2, pp. 55-65.

Onweremadu, E.U. (2008), “Hydrophobicity of soils formed over different lithologies”, *Malay .J. Soil Sci*., Vol. 12, pp. 19-30.

Onweremadu, E.U. (2009), “Magnesium content of two soil groups in southestern Nigeria in relation to selected pedological properties”, *AM Eurasian J. sustain Agric.*, Vol. 1 No. 1, pp. 1-7.