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Environmental Land Degradation: It's Impact on Organic Matter Content in Obosi Land.

Nweke I. A[1], Ibeh, K.G.[2], Nworji M. J. [2]
[1] Department of Soil Science Chukwuemeka Odumegwu Ojukwu University, Anambra State
[2]Department of Forestry and Wildlife Management, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra State, Nigeria.

Abstract
The unwise use of natural resources by man due to ignorance, greed, population increase and poverty have led to degradation of man's natural environment. Thus, to inventory the causes of the general land degradation problem and prevalent soil erosion witnessed in Obosi land, auger samples and profile pit samples were collected and evaluated. Using the relief and morphology of the area, two soil mapping units were establish: Mu I low land area and Mu ll upland areas. Findings from the study showed higher silt/clay ration value in low land relative to up land areas. There was increase in clay content with horizon depth especially with regard to up land areas. All the horizon depth across the entire land area recorded higher value of sand and colour differentiation were not notice within the profile depths. The pH of the soils showed extremely acidic to extremely alkaline and available P was virtually absent in the horizon depths. The organic matter (OM) content of the soil was very low and below its critical level to support crops production in the area. Effective cation exchange capacity (ECEC) was equally observed to be low from the study. The result findings also show that prominent limitation and prevailing land degradation problems of the area is largely due to high erodibility of the soils, undulating topography of the area and massive de-vegetation of the entire area.
Keywords: *Land degradation, Obosi land, organic matter, phosphorous, cation exchange capacity*

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I. Introduction

Environmental land degradation is the deterioration in the environmental harmony, biodiversity, quality and services etc. It is the resultant effect of man's interaction with his environment, but that is negative impact. The United Nations (1997) noted environmental degradation as the deterioration of the natural environment through human activities and natural disasters. While Yiran et al. (2012) argued that environmental land degradation will remain a global issue for the 21st century because of its adverse impact on agronomic productivity, food security and quality of life. However, these environmental problems according to the arguments of Getachew and Demale (2000) are more prevalent in the rural areas, were the bulk of the populations live and interact with the environment and whose livelihood depends mostly on land (agriculture) and related activities. This is mainly rampant in the least developing countries such as Nigeria. Thus, the major environmental challenge of the 21st century is environmental land degradation. It adversely affects a sustainable relationship between eco systems and livelihood of people worldwide (Reynoids and Lambin 2007; Danjuma et al. 2014). No doubt damage to the environment is no respecter of frontier and damage done to one generation has the consequence of effecting the future generation (Izibili, 2005). Environmental land degradation implies that environmental resources such as land, soils and vegetation reduced to a lower rank taking into account the fulfilment of giving demand (Blaikie and Brookfield 1987). The problem of land degradation according to report of Nicholson (1990) is that it is occurring at a much faster rate, not leaving enough time for the environment to recover and regenerate. Solbrig and Young (1992) and Dregne et al. (1991) observe that regions across the world face unprecedented environmental degradation particularly in Savannah environment of the developing countries where the natural environment is perceived to be under greatest threat. Environmental degradation is the reduction in value in the environment to meet its ecological and socio-economic needs (Reed, 2007). It includes issues such as land degradation, deforestation, desertification, loss of biodiversity, land, water and air pollution, climate change, sea level rise and ozone depletion (Danjuma et al., 2014).

Environmental land degradation of varying types and degree are generally un-evenly distributed in south eastern part of Nigeria. Ranging from the less devastating such as sheet and rill erosion to highly dangerous types such as gullies, loss of bio-physical and chemical characteristics, and loss of biodiversity. In fact an environment in south east, Nigeria maybe occupied with one set or overlapping set of land degradation consequences. According to David (2008) loss of bio diversity of plants and pockets of reserved areas as well as reduction in soil fertility are quite alarming in Nigeria. This is moving at alarming rate in south east, Nigeria and Obosi in particular. The unwise use of the natural environment due to ignorance, poverty, industrialization, population increase and greed amongst others has led to the land degradation in Obosi town. The increase in population has forced the people to abandon the ancient production systems and resources management techniques that allowed them to produce enough food for themselves at minimal impact on the land. When forest are cleared the soils are exposed to erosion devastation, flood occur carrying soil particles/nutrients at an alarming rate and at the same time leaching processes occur, streams, lakes and rivers are filled up with silt. According to Omofonmwan and Osa-Edoh (2008), when tree canopy particularly leaves are removed, it affects the rainfall of the area as there is less leaf surface area for the transpiration of water, which in turn affect the relative humidity of the atmosphere. The continuous cultivation of crops on cleared area of land tend to exhaust the soil of its mineral and organic content (Nweke, 2015) and this gradually aggravate land degradation problems. The diversity and stability of Obosi soils has been reduced to a great extent due to pressure from an increasing population, infrastructural facilities, industrial expansion, urbanization and agricultural activities, soil erosion, flooding and infertility.

The monumental effect of these problems is decline in soil organic matter content. Pimentel et al. (1995) and Stoking (1993) noted that vast areas of land in the tropics that were once fertile have been rendered unproductive as a result of erosion induced soil degradation, loss of soil organic matter (SOM) and decreased cation exchange capacity (CEC) and increased aluminium (Al) and manganese (Mn) toxicity. The amount and type of organic matter (OM) is indicative of soil productivity (Mitchell et al., 1996). Improper land management results to increased erosion by water and wind. Soil erosion is a leading cause of soil degradation due to the loss of organic matter which is the binding agent in soil. The exposure of soil organic matter during soil erosion increases CO_2 emissions, soil erosion cause carbon to accumulate with soil sediments and be removed from the soil carbon pool (Al-Kaisi, 2001). The removal of carbon from the soil lead to decrease in fertility status and aggregate stability of soils (Nweke and Nnabude, 2014). Soil organic matter consist of soluble and insoluble organic substances present in the soil of which the quantity varies from soil to soil because it is being affected by environmental factors such as temperature and humidity prevailing in the location. It is the soil organic matter that protect the soil aggregates and the pore spaces against erosive forces of water and wind and against mechanical damages. Organic matter improves soil properties and Magdoff (1993) noted that the types of crops grown, the amounts of roots, biomass yield and efficiency of harvest and the management of residues affect soil organic matter. The essence of this study therefore, is to show that land degradation in Obosi might have resulted from organic matter depletion in its soils.

II. Materials and methods

Obosi is in Idemili-North Local Government Area of Anambra State. It is located approximately on longitude 06^0 38' and 06^0 50'E and latitude 05^0 50' and 06^0 12' N (Duze et al, 1981). It is bounded in the East by Nkpor and Umuoji, in the North by Nkwelle –Ezunaka and Onitsha, in the West by Ogbaru and in South by Ota (Figure 1). Obosi has two climatic seasons in a year, the rainy season and the dry Season. The rainy season last from April to October with about 2000 – 3000mm average per annum, while the dry season is from November to March with an average amount of rainfall, 375mm. There is usually a break in August (the August break). Generally, the mean annual rainfall amount is over 2000mm. The relative humidity of this area in January and July respectively falls between 75% and 95% with the mean annual temperature fluctuating between 25^0 – 27.5^0 (Oboli, 1980).

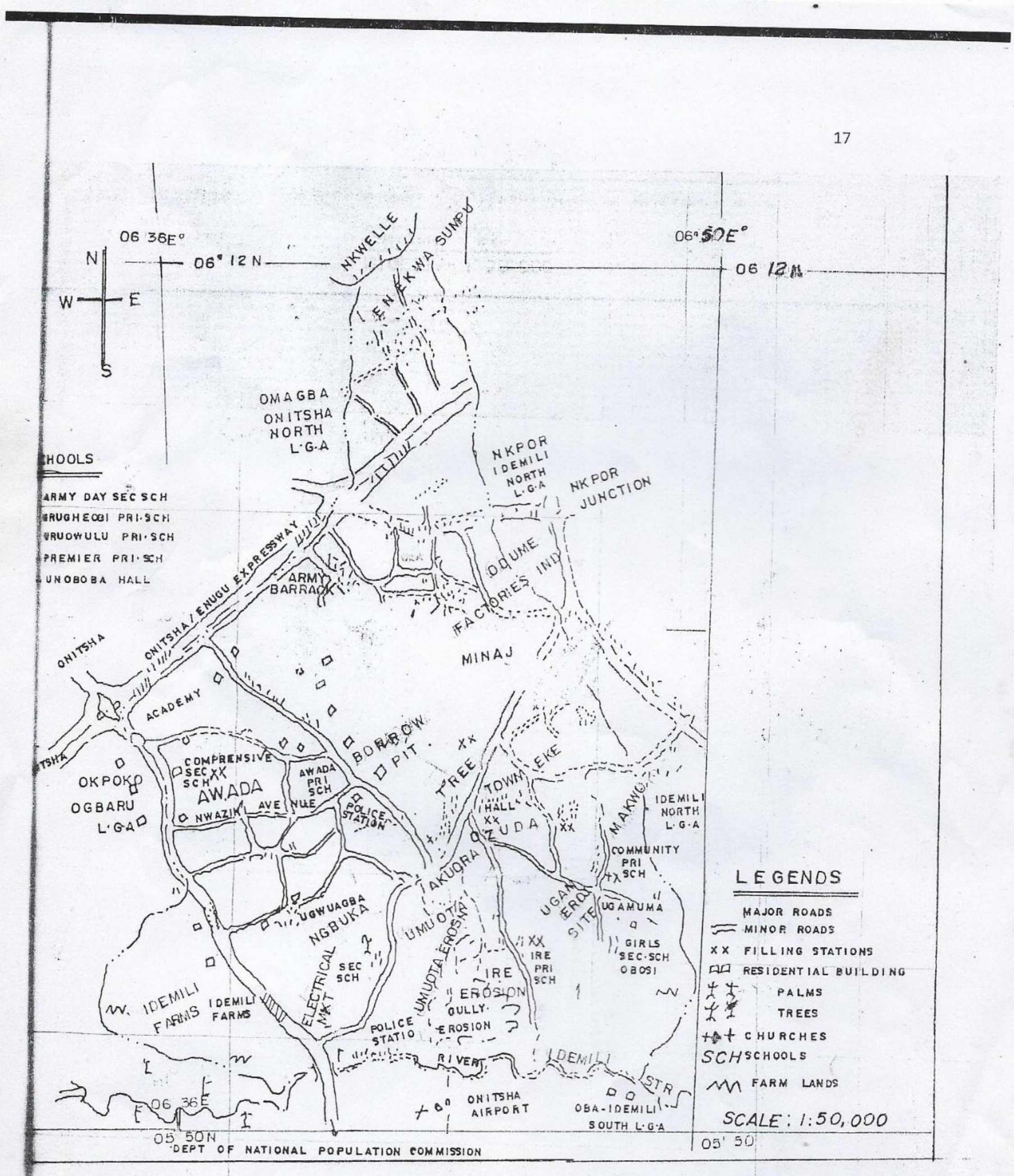

Fig 1 : Map of Obosi Community

Obosi has an uneven landform, which rise in elevation as one enters the town either through Nkpor junction, or Idemili bridge end off Owerri road. This gives an impression that most parts of Obosi land are located on plateau or on a hilly area. However, the entire land configuration of the area lies within an average elevation of below 200m (Duze et at, 1981). The town falls within the rain forest agro ecology of south eastern Nigeria. Most tropical crops, with the exception of those that requires flooding, thrives well in the area. The soil of the area is predominantly sedimentary, and belongs to the red – yellow ferralitic soils of the humid tropic (Duze et al, 1981) and USDA Typic Iso-thermic udult (ultisol)

Soil sampling

Out of an approximated total area of 39.78km^2 of Obosi land, 25.58km^2 (about 65% of the entire area) was covered by the survey work. The entire north east to south east of Obosi land comprising of Odume, army Barracks, Awada, Umuota, Ire, Ugamuma, Urowulu and Nmakwum was covered. A conventional soil survey approach using flexible grid survey type was employed. The transverse used were the major roads and footpaths. The sampling points were sited at the areas where there appeared to be difference in the soil. As a result of the physical similarities of the soils, the land form and the congested activities on the land observed during the field work, four profile pits were dug and seven auger points was established and sampled. A total of sixty samples were collected for analysis. The samples from the profile pits were subjected to a routine analysis, while soil samples collected from auger boring points were subjected to soil pH and mechanical analysis only.

Laboratory analysis

Soil samples collected were air dried, sieved with 2mm sieve and then subjected to standard methods of soil analysis at the Department of Soil Science Laboratory University of Nigeria Nsukka as explained below;
Soil pH Determination: The pH values were determined in both distilled water and in 0.1N potassium chloride solution using a soil/liquid ratio of 1:2.5. The pH values were read using a Beckman Zerometic pH meter (Peech, 1965).

Particle size Analysis: This was carried-out using the hydrometer method of Bouyoucous (1951).
Organic carbon and organic matter: This was determined by Walkley and Black method (1934). The percentage organic matter content was calculated by multiplying the organic carbon value by the conventional "Van Bernmeler" factor of 1.724.
Exchangeable Bases (Ca, Mg Na and K): Calcium and Magnesium were determined by the complexiometrix titration method (Jackson, 1958), while sodium and potassium were determined in IN ammonium acelate leachate using the flame photometer.
Exchangeable Acidity: The exchangeable hydrogen and aluminium were determined by titrimetric method using potassium chloride extract (Mclean, 1965)
Base Saturation: This was calculated by dividing the sum of bases (Ca, Mg, Na and K) by the Cation Exchange Capacity (CEC) and multiplying the quotient by 100.

$$\text{Base Saturation} = \frac{\text{Total Exchangeable Bases}}{\text{Cation Exchange Capacity}} \times \frac{100}{1}$$

Available phosphorus. This was determined by using Bray II method (Bray and Kurtz, 1945).
The effective cation exchange capacity was obtained by summing of the exchangeable bases (cations) and the exchangeable acidity determined from IN KCL extract.

III. Results

The survey area was grouped into mapping units based on the criteria of relief, drainage and morphological properties. And this units were; MU.I Lowland Areas and MU. II Upland Areas.

Impact of land degradation on the physical characteristics of Obosi soil

The result presented in Table 1 showed the physical characteristics of the low land areas of soil mapping unit I. The textural class of the entire land area is sandy loam. The particle size range from 50gkg^{-1} – 90gkg^{-1} for silt size, clay size range from 90gkg^{-1} - 170gkg^{-1} and total sand vary from 740gkg^{-1} - 860 gkg^{-1}. The three particle sizes vary irregularly with the horizon depth and increased with increasing horizon depth and constant in some horizon depths in some cases. The silt content is generally low, followed by the clay content, though their distribution in the soil is relatively constant across the horizon depths. The silt/clay ratio of the low land area varies irregularly from 0.26 – 0.75 and their distribution across the horizon depths are fairly constant. The lowland area is represented by auger samples 1, 2, 3 and 4 and profile pit A at Community Secondary School Obosi (CSSO) and profile pit B at Urowulu

Table 1: Physical characteristic of lowland areas mapping unit I auger sample

Horizon Depth (cm)	Silt ←	Clay gkg^{-1}	Total sand →	Silt/clay ratio	Textural class
			Auger Sample 1		
0-20	50	90	860	0.56	Sandy loam
20-40	50	110	840	0.45	Sandy loam
40-60	50	110	840	0.45	Sandy loam

60-80	50	190	760	0.26	Sandy loam
80-100	70	190	740	0.37	Sandy loam
100-120	70	190	740	0.37	Sandy loam
			Auger Sample 2		
0-20	90	140	770	0.64	Sandy loam
20-40	90	140	770	0.64	Sandy loam
40-60	70	140	790	0.50	Sandy loam
60-80	90	140	770	0.64	Sandy loam
80-100	90	120	770	0.75	Sandy loam
100-120	70	120	810	0.58	Sandy loam
			Auger Sample 3		
0-20	70	140	770	0.50	Sandy loam
20-40	70	140	790	0.50	Sandy loam
40-60	70	140	790	0.50	Sandy loam
60-80	90	140	770	0.64	Sandy loam
80-100	90	140	770	0.64	Sandy loam
100-120	70	160	770	0.44	Sandy loam
			Auger Sample 4		
0-20	90	150	760	0.60	Sandy loam
20-40	90	150	760	0.60	Sandy loam
40-60	90	150	760	0.60	Sandy loam
60-80	90	170	740	0.53	Sandy loam
80-100	90	170	740	0.53	Sandy loam
100-120	90	170	740	0.53	Sandy loam

The physical characteristics of the upland areas, soil mapping unit II in Table 2 indicated silt size to range irregularly across the horizon depths from 50 gkg^{-1} - 90 gkg^{-1}, clay size varies irregularly with horizon depth from 50gkg^{-1} - 190 gkg^{-1} and total sand irregularly with horizon depth from 720 gkg^{-1} - 900 gkg^{-1}, while silt/clay ratio range irregularly with horizon depth 0.26 – 1.0. The distribution of the particle sizes and the silt/clay ratio in the soil were fairly constant across the horizon depth. The textural class of the soil vary from loamy sand to sandy loam, with greater sandy loam class. For example, the entire auger samples 6 and 7 were sandy loam class. The upland area is represented by augers 5, 6 and 7 and profile pit C at Ire and profile D at Awada Burrow pit.

Table 2: Physical characteristics of upland areas mapping unit II auger samples

Depth (cm)	Silt ←	Clay gkg^{-1}	→ Total sand	Silt/clay ratio	Textural class
			Auger Sample 5		
0-20	70	100	830	0.70	Loamy sand
20-40	90	140	770	0.64	Sandy loam
40-60	50	80	870	0.63	Loamy sand
60-80	70	100	830	0.70	Loamy sand
80-100	70	100	830	0.70	Loamy sand
100-120	50	80	870	0.63	Loamy sand
			Auger Sample 6		
0-20	50	50	900	1.0	Sandy loam
20-40	70	150	780	0.47	Sandy loam
40-60	70	190	740	0.37	Sandy loam
60-80	90	150	760	0.60	Sandy loam
80-100	50	190	760	0.26	Sandy loam
100-120	50	190	760	0.26	Sandy loam
			Auger Sample 7		
0-20	90	190	720	0.47	Sandy loam
20-40	70	110	820	0.64	Sandy loam
40-60	50	190	760	0.26	Sandy loam
60-80	70	190	740	0.37	Sandy loam
80-100	70	190	740	0.37	Sandy loam
100-120	90	190	720	0.47	Sandy loam

The soils (low and upland areas) are generally dark reddish brown at the surface soil and dull reddish brown in the subsoil. There is no lithic or paralithic, cutan or any form of stone out crop encountered. The soils are well drained, friable and have weak structure. The sand particle size fraction a countered for over 80% by weight of the particle sizes of the soils and decreased with increasing horizon depth though irregularly and constant across the soil depths. Generally, there was increase in clay content with horizon depth and this resulted in clay accumulation in the subsurface horizons, though it was fairly constant across the horizon depths. There was higher silt/clay ratio value in lowland area compared to the value obtained from upland area.

Impact of land degradation on the chemical characteristics of Obosi soil

The chemical characteristics of low land and upland areas are represented in Table 3. The result presented showed that the soil pH of Obosi soils is strongly acidic with a range of 4.8 to strongly alkaline of 8.0 in water and extremely acidic with a range of 4.0 to mere neutral of 7.4 in KCl. The organic matter content of the Obosi soils is very low and varies irregularly with profile depth with a value range of 0.40 to 1.34 gkg^{-1}. There was increase in organic matter content of profile pit C and D compared to that of profile pit A and B (lowland area). In both low and upland areas, the organic matter content decreased irregularly with increasing horizon depth and was constant (0.55 gkg^{-1}) in profile pit C, Bt_1 (65 – 98 cm) and Bt_2 (98 – 135 cm). The available phosphorus (P) was totally absent in all the horizon depths considered in profile pit A and B in lowland areas of Obosi soils. In upland areas of profile pit C and D, the available P recorded was low ranging from 0.94 – 14.93 m gkg^{-1}, but was entirely absent in many horizon depths of profile pit C and D considered. The Ca/Mg ratio and Ca + Mg/Al^{3+} + H^+ ratio varies irregularly with depth from 0.33-10 and 0.34 to 12.67 respectively. There was much increase in the value recorded for both ratios in profile pit C and D in all the horizon depth considered compared to their recorded values in horizon depths of profile pit A and B except for the value (10) of Ca/Mg ratio obtained from profile pit A, horizon AB (40 – 80cm depth). The effective cation exchange capacity (ECEC) values varies irregularly with horizon depth with range of 3.96 $cmolkg^{-1}$ to 8.42$cmolkg^{-1}$. The recorded value of ECEC obtained in horizon depths of profile pit C was higher compared to its value recorded in horizon depths of profile A, B, and D respectively. The value obtained for base saturation is generally high, but its distribution is irregular throughout the studied profiles. The value ranges from 22.38% to 99.21% across the entire land area of Obosi. Higher value of the parameter (BS%) was more pronounced in horizon depths of profile pit B in lowland area and profile pit C in upland area compared to other horizon depths of profile A and D.

Table 3: Chemical properties of the profile pits

Horizon	Depth (cm)	pH H_2O	pH KCl	OM gkg^{-1}	P $mgkg^{-1}$	Ca/Mg	Ca+Mg/ Al^{3+}+H^+	ECEC	BS
				Profile pit A at CSSO lowland area mapping unit I					
A	0-40	4.8	4.0	0.49	-	0.75	1.40	4.96	80.00
AB	40-80	4.9	4.2	0.39	-	10	0.34	4.43	69.00
Bt_1	80-130	4.9	4.1	0.47	-	0.73	0.53	5.70	37.50
Bt_2	130-120	4.8	4.1	0.40	-	0.33	1.33	5.78	56.33
				Profile pit B at Urowulu lowland area					
A	0-35	5.3	4.4	1.03	-	0.78	5.33	3.97	84.24
AB	35-90	4.9	4.0	0.47	-	0.50	1.80	5.77	99.21
Bt_1	90-130	5.1	4.2	0.04	-	1.0	1.50	4.20	72.22
Bt_2	130-200	5.2	4.3	0.32	-	1.33	1.75	4.56	74.25
				Profile pit C at Ire upland area mapping unit II					
AP	0-35	7.8	7.2	1.03	-	3.5	7.20	7.39	22.38
AB	35-65	7.1	6.7	1.34	3.74	1.3	7.67	5.35	60.90
Bt_1	65-98	7.8	7.3	0.55	4.64	0.67	7.50	6.98	79.25
Bt_2	98-135	7.9	7.3	0.55	2.80	2.65	12.17	8.10	91.46
Bt_3	135-200	8.0	7.4	0.40	-	2.17	12.67	8.42	96.54
				Profile pit D at Burrow pit Awada upland area mapping unit II					
AP	0-15	6.9	6.5	1.19	-	1.8	7.0	6.57	57.24
AB	15-40	5.3	4.4	1.11	14.93	5.0	1.33	4.34	30.24
Bt_1	40-80	5.2	4.3	0.63	0.94	1.2	1.22	4.15	30.13
Bt_2	80-115	5.3	4.4	0.71	-	4.0	3.75	3.96	42.70
Bt_3	115-200	6.3	5.5	0.47	-	1.33	4.20	5.34	51.06

IV. Discussion

The major aim of this study was to show that land degradation is the major constraint to sustainable crop production in Obosi land as it affects greatly the store house of plant nutrients of which is organic matter. The soils are morphologically more striking due to their dark reddish-brown colour and generally weak structure. The redness rating of soils according to Singh and Gilkes (1991) increased linearly with increasing amount of haematite. There was no colour differentiation within the profile depths (pedon), this could be due to high percolation, limited ferrolysis, organic matter and manganese content. All the horizon depths across the entire land area recorded higher value of sand and indeed the dominant size fraction in all the depths considered. This indicates that the soils might probably been derived from sedimentary rocks. Bradly and Weil (2002) noted that sand stone parent material usually give rise to soils with high sand particle content. There was an irregular decrease in sand particle size fraction with increasing soil depth, the silt content of the soils were comparatively lower than those of the sand and clay fractions. The higher clay content observed in the sub-soil horizon depths can be attributed to faunal activities and illuviation. The higher content in subsoil according to Malgwi et al. (2000) can as well be attributable to sorting of soil materials by biological and agricultural activities, clay migration or surface erosion by run-off or a combination of these. There was higher clay content noticed in all the pedons considered except horizon 40 – 60cm and 0-20 in auger sample 5 and 6 respectively. Hence, the existence of argillic horizons. Clay dispersion is influenced by humidity and amount of water percolation. Ojo-Afere and Ogunwele (1982) noted that higher values of pedogenic clay are always known to be located in areas of high rainfall, while pedon with lower values are located in area of lower rainfall. This is true for Obosi land is located in area with high rainfall cutting across May – September with torrential rainfall in May – July, hence, high clay content observed. Also, the amount of clay dispersable at any given time increases with increasing water content (Perfect et al., 1990; Kay and Dexter, 1990; Nweke and Nnabude, 2015). The silt/clay ratio used for the evaluation of pedogenesis of in situ weathering profiles (Azeez, 1998; Mohr et al., 1972 and Stewart et al., 1970) was found to be less than 1 in all the horizon depths considered in this study except for silt/clay ratio of 0-20cm of auger sample 6 in upland area. The low silt/clay ratio indicated ferrolytic pedogenesis, however, the nature of the silt/clay ratio obtained probably showed that these soils have not been subjected to severe weathering and may still have some weatherable minerals. Silt/clay ratio of > 0.26 in all the soils confirmed the young age of the soils. Asomoa (1973) asserted that young parent materials usually have silt/clay ratio greater than 0.25. The pH of the soils showed strongly acidic to extremely alkaline in water and extremely acidic to more neutral in KCl. This kind of soil pH could be attributed to their parent material and the high leaching prevailing in the area. The available P was found to be absent in virtually all the depths considered, this may perhaps be due to absence of roots at such depths. The process of N and P accumulation according to Abagyeh (2015) bears a close relationship to the accumulation of organic matter because the two occur in fixed ratio, CEC and clay content.

The low variations in the quantity of P, organic matter and ECEC may be associated with leaching process, flooding and drying prevailing in the area. As well as the composition of parent material and their weathered environment. The available P value was found to be very low compared with its critical level of 20 mgkg^{-1} (Tanaka and Yoshioha, 1970). The low content of organic matter observed with pedal depth in Obosi soils may be associated with bio-cycling of nutrients and atmospheric litter decomposition and weathering. The low content of ECEC of the soils may be due to intensive leaching, weathering and ferrolysis hence low inherent fertility status. The increase in value with decrease in depth could be associated to clay content and organic matter build up. Greenland et al. (1975) noted that it is not possible to obtain crop yield where soil OC is below 1% and that soils having below 2% OC are characterized by lack of cohesion and instability. Organic matter content has been shown by Asadu and Akamigbo (1990) to contribute an average of 70% of the CEC of the ultisols and oxisols. The high base saturation observed from the study may be associated with weatherable minerals in the soils. The Ca/Mg ratio recorded in this study indicated to be non-optimal to most crops. Hazelton and Murphy (2007) and NSS (1990) reported that Ca/Mg ratio of 3-6 in the topsoil is optimal for most crops. In the present study the ratio under all horizon depths (except AB, 40 – 80) ranged 0.33 – 5.0 which according to Hazelton and Murphy (2007), exchangeable Mg may be low. The ratio of Ca + Mg to Al^{3+} + H^+ considered among the horizon depths are indicators to infer nutrient balance. Higher values of Ca + Mg/Al^{3+} + H^+ ratio indicate lower values of acidic cations in the soil which shows good nutrient availability. This scenario is however influenced by organic matter content, low activity clay and pH of the soils. The high rainfall of the south-eastern Nigeria is generally heavy and aggressive of which affects Obosi land seriously leading to loss of land and houses through soil erosion. More so the topographic configuration of the terrain of an area according to Akamigbo, (1996) can constitute a natural environmental degradation problem and soils on steep slopes are susceptible and vulnerable to erosion, leaching and landslides. All these summed up the environmental land degradation problems encountered in Obosi land that seriously affect the productivity of the soil and general wellbeing of the people.

V. Conclusion

The soils are suitable for crop production but will require adequate management practices for optimum and sustainable productivity. This is because the result findings have shown that the soils have low organic matter content and ECEC, high base saturation, phosphorus fixation is very high in this area, it is found only in trace amount in few horizons. Hydrogen ions from the bulk of the exchangeable acidity. The Obosi soils need a high addition of organic matter to upgrade the loose soil colloids and improve their nutrient retention and release to crops for a better yield. The obvious soil degradation of the area is both man-made and natural. Therefore, soils of this area are recommended to be amended with organic materials such as crop washes, animal wastes, compost, vermicompost, alley cropping agro-forestry etc. to manage the soils sustainably. This will improve on the soil's cohesion, its colloids, water holding capacity, its soil nutrients and improve on the soil aggregation. This will tend to resist leaching and erosion of the soil by intense rainfall of the humid tropical region.

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