

## Land capability evaluation and classification of Obosi Land in Anambra State Nigeria

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### Abstract

Land capability evaluation and classification of Obosi land was carried out on an approximately total area of 25.58km<sup>2</sup> using the map of the area. The aims of the study were to map out the soils of Obosi, classify them for suitability and sustainability for agricultural production and other land use development projects. Auger sample and profile pit samples were collected and examined. Using morphology and topography of the surveyed area, three mapping units; MUI-lowland areas, MUII- upland areas and MUIII-gullied areas were established. The result of the study indicated the textural class of the soils to be sandy loam, except for upland areas in Auger 1 were the textural class were loamy sand. The particle sizes range from 50gkg-1-90gkg-1 clay, 50-90gkg-1 silt, 130-590gkg-1 fine sand and 310-650gkg-1 sand. The pH of the soils varies from slightly acidity to slightly alkaline and was fairly uniform throughout the depths. The exchangeable bases, CEC, TEA, SAR and ESP of the soils were found to be low and below their critical level for crop production the base saturation value of the soils range from 22.28-99.21%. The low land areas and the upland areas were found to be suitable for arable crops. They fall under the suitability class S<sub>2</sub> (suitable) and the capability class 11. Their major constraint on agricultural production is low fertility status. The gullied areas MUIII were found within the uplands and low-land areas. They fall under the non-suitability class NS (not suitable) and the capability class vi. The prominent limitation of this unit is erosion hazard. The area cannot be used in their present state without serious reclamation activities. The soils were classified as mixed isothermic kandic argiudult using the USDA soil Taxonomy and correlated as eutric ferralsols by FAO-WAB classification. Generally the soils need to be upgraded in soil nutrients through soil organic matter application and reclamation processes to produce maximally.

**Keywords:** Land capability; Land evaluation; Characterization; Classification; Degradation; Erosion

### 1. Introduction

Soil is the natural medium for the growth of plants whether or not it has discernable horizon. Information on soil physical, chemical and biological properties including its classification can be delved from soil survey studies conducted at varying intensities. Consequently, the soil user uses such data in asserting the resources potential for environmental management including soil nutrients recycles. Soil properties are used in assessing soil health and such periodic assessments enhances wise decision on land use. Through soil survey, a pedologist predicts soil behavior from the understanding of the process and events operating within the space it occupies and ultimately contributes ideas for the development of techniques for improving the soil environment for sustaining agricultural production [1]. Soil survey help us to make adequate predication on the sustainable use of our soil in the face of a rapidly ever- increasing human population and its corresponding changing and increasing demands. During soil survey, soils are characterized, classified and delineated into mapping units for better land use planning either for agriculture or for non- agricultural uses; it therefore forms a pre-requisite for sustainable agriculture and sustainable development [2]. According to Ezeaku [3] soil survey provides information on how land resources can be put into better use apart from providing

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factual information of the surface of the lands. They show the spatial distribution of different kinds of soils on mass, the field characteristics, their physical and chemical properties and interpretation of the soils with many land uses. Lekwa [4] in his study reiterated that soil survey is fundamental to any successful agriculture. It ensures orderly delineation of soil boundaries into recognizable groupings which are later classified in form of their common properties such as depth, organic matter, particle size content, color, structure, nutrient content etc. This kind of study and classification enable the utilization of each parcel of land solely for those crops to which they are best suited from which maximum yield can be expected. Soil survey provides practical information on the properties of soil that will affect the intended use of the land with which interpretation and recommendation are made [5].

Land classification involves land use, land evaluation, land systems, present use, land capacity, land inventory and terrain evaluation. This system classifies land according to its present use, its suitability, for a specific crop under the existing forms of management, its capability for providing crops or combination of crops under optimum management and its sustainability for non- agricultural types of land use. Land classification group land according to their nature characteristics, present use, yield capacity and these classes are then assessed with reference to their suitability, for the different uses contemplated in the plan [2]. Land capability classification is a system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pasture plants without determination over a long period of time or primarily supportive to the planning of large farms and land use planning [3]. Therefore, the process of land suitability classification can be said to be appraisal and grouping of specific areas of land in terms of their suitability for defined uses [2].

Land evaluation is the process of assessment of land performance when for specified purposes involving the execution and interpretation of surveys and studies of land use, vegetation, land forms, soils, climate and other aspects of land in order to identify and made a comparison of promoting kinds of land use in terms applicable to the objectives of the evaluation [6]. It recognizes the fact that different kinds of use have different requirements, hence its main purpose is to predict the consequences of change or the ability of the land to support different forms of production, the input and management practices, need, the benefit to be achieved and the consequences of each change to the environment [7].

Man according to Berger, [8] owe his life to the soil and sun and makes his living from the soil and sun. Soil is the place for plant to grow, the factory that manufactures the plant which maintain human life and which also maintain the animal life essential for human life. It is upon this background that this study is designed to evaluate and classify Obosi land for alternative uses.

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## **2. Material and methods**

### **2.1. Study area**

Obosi is in Idemili-North Local Government Area of Anambra State. It is located approximately by longitude 060 38I and 060 50IE and latitude 050 50I and 060 12I N (Duze and Afolabi 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 Ojoto (Figure 1).

### **2.2. Climate**

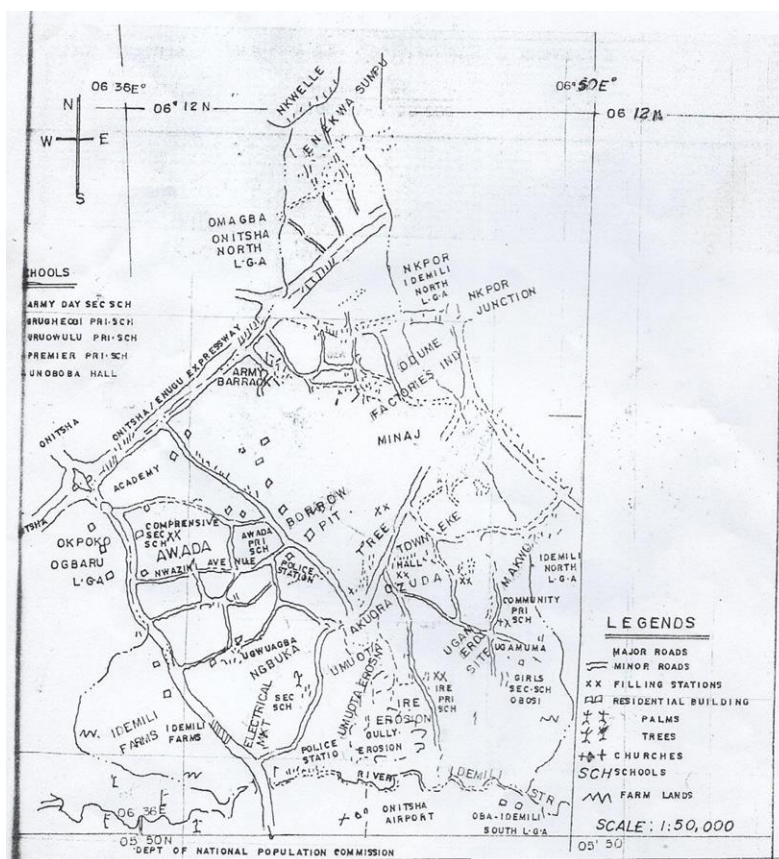
Obosi has an annual rainfall of 2000 – 3000mm per annum with an average amount of rainfall, 375mm. Generally, the mean annual rainfall amount is over 2000mm. The relative humidity of this area in January and July respectively falls between 75% and 95% with the mean annual temperature fluctuating between 250 – 27.50 [10].

### **2.3. Topography and Vegetation**

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 [9]. The town falls within the rain forest agro ecology of south eastern Nigeria. Most tropical crops, with the exception of those that require flooding thrive well in the area.

### **2.4. Soil**

The soil of the area is predominantly sedimentary, and belongs to the red – yellow ferralitic soils of the humid tropic [9] and USDA Typic Iso-thermic udult (ultisol)



**Figure 1** Map of Obosi Community

## 2.5. Soil Sampling

Out of an approximated total area of 39.78km<sup>2</sup> of Obosi land, 25.58km<sup>2</sup> (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 dogged 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.

## 2.6. Laboratory Analysis

All the 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 indicated below.

### 2.6.1. 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 Zerometric pH meter [11].

### 2.6.2. Particle size Analysis

This was carried-out using the hydrometer method of Bouyoucos [12].

### 2.6.3. Exchangeable Bases (Ca, Na, Mg, and K)

Calcium and Magnesium were determined by the complexometric titration method [13], while sodium and potassium were determined in 1N ammonium acetate leachate using the flame photometer.

#### 2.6.4. 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.

$$\text{Base saturation} = \frac{\text{Total exchangeable bases}}{\text{Cation exchange capacity}} \times \frac{100}{1}$$

#### 2.6.5. Cation exchange capacity (CEC)

The apparent cation exchange capacity was determined using the ammonium acetate method [13].

#### 2.6.6. Sodium adsorption ratio (SAR)

This was determined by dividing the value of sodium in cmolkg<sup>-1</sup> by the square root of the sum of calcium and magnesium divided by two.

$$SAR = \frac{Na}{\sqrt{(Ca + Mg)/2}}$$

#### 2.7. Exchangeable sodium percentage (ESP)

This was obtained by dividing the value of exchangeable sodium (ENa) with the actual cation exchange capacity (ACEC) and multiplying it with 100.

$$ESP = \frac{ENa - \text{Value}}{ACEC} \times \frac{100}{1}$$

#### 2.8. Total exchangeable acidity (TEA)

This was calculated by summing up the values of exchangeable aluminium and that of the exchangeable hydrogen.

$$TEA = \text{Exch. Al}^{3+} + \text{Exch. H}^{+}$$

### 3. Results

Based on the criteria of relief, drainage and morphological properties the survey area was grouped into three mapping units. The units were grouped as; MUI -Lowland Area, MUII -Upland Area, MUIII -Gullied Land Area (Badlands). The soil mapping units are explained in figure 2.

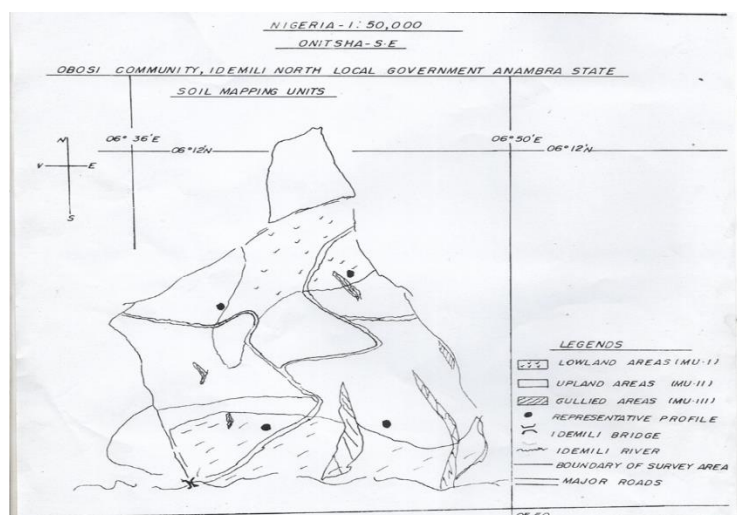


Figure 2 Soil mapping units of Obosi

### 3.1. Physical and chemical characteristics of low land area

Generally, the soils are dark reddish brown (2.5R3/4) at the surface and reddish brown in subsoil (2.5YR4/6). The soils have no lithic or paralithic layer, no cutan and no form of stone outcrop the textures of the soils are sandy loam well drained, friable and have weak structure. The particle size ranges as follows; clay 50-190gkg<sup>-1</sup>; silt 50-90gkg<sup>-1</sup>; fine sand 229gkg<sup>-1</sup>-590gkg<sup>-1</sup> and coarse sand 310 -550gkg<sup>-1</sup> (Table 1). The silt content of the soils is very low followed by the clay content. However, their distribution in the soil is relatively constant across the depths. The soil pH shows that the soils are moderately acidic to alkaline with pH range of 5.3-8.0 for pH in water and extremely acidic to alkaline with pH range of 4.5 -7.3 for pH in KCL. The pH is however, fairly uniform throughout the depths (Table1).

**Table 1** pH and physical parameters of low land areas (mapping units) Auger samples.

Description	Depth cm	pH H <sub>2</sub> O	KCl	Clay		Silt	Find sand		Coarse sand	Textural class
				→	←		gkg <sup>-1</sup>	←		
Auger 1	0-20	6.7	6.0	90	50	350	510	Sandy loam		
	20-40	7.4	7.1	110	50	330	510	Sandy loam		
	40-60	7.1	6.4	110	50	420	420	Sandy loam		
	60-80	6.9	6.2	190	50	290	470	Sandy loam		
	80-100	6.9	6.2	190	70	290	450	Sandy loam		
	100-120	7.1	6.7	190	70	320	420	Sandy loam		
Auger 2	0-20	7.5	7.1	140	90	290	480	Sandy loam		
	20-40	7.5	6.8	140	90	190	580	Sandy loam		
	40-60	7.6	7.2	140	70	210	580	Sandy loam		
	60-80	7.4	6.9	140	90	160	610	Sandy loam		
	80-100	7.6	7.1	120	90	130	640	Sandy loam		
	100-120	7.7	7.2	120	70	160	650	Sandy loam		
Auger 3	0-20	4.8	4.2	140	70	210	560	Sandy loam		
	20-40	6.4	6.0	140	70	200	590	Sandy loam		
	40-60	6.2	5.8	140	70	220	570	Sandy loam		
	60-80	6.3	5.7	140	90	180	590	Sandy loam		
	80-100	4.9	4.2	140	70	200	590	Sandy loam		
	100-120	6.4	5.9	160	70	240	580	Sandy loam		
Auger 4	0-20	6.6	6.1	150	90	360	400	Sandy loam		
	20-40	5.4	5.1	150	90	340	420	Sandy loam		
	40-60	6.7	6.2	150	90	340	420	Sandy loam		
	60-80	6.5	6.0	170	90	340	400	Sandy loam		
	80-100	7.2	6.5	170	90	370	370	Sandy loam		
	100-120	5.4	4.9	170	90	330	410	Sandy loam		

The exchangeable bases result in Table 2, showed that recorded values of exchangeable sodium (Na<sup>+</sup>) across the depths are fairly constant and of moderate value. The value ranges from 0.11-0.14cmo1kg<sup>-1</sup>, while the sodium adsorption ratio (SAR) and exchangeable sodium percent (ESP) vary irregularly with depth from 0.08-0.14 and 1.83-3.89% respectively (Table 2). The potassium (K<sup>+</sup>) content of the soil is very low compared to other exchangeable bases and fairly constant through the profile depth. The values ranged from 0.02- 0.07cmo1kg<sup>-1</sup>. The value obtained for calcium (Ca<sup>2+</sup>) is

relatively low to moderate and vary irregularly with the profile depth from 0.8-1.6cmolkg<sup>-1</sup>. Calcium forms the bulk of the exchangeable bases in the soils. The Magnesium (Mg<sup>2+</sup>) value is relatively high, but the distribution throughout the profile horizons is not well defined. The value ranges from 0.1-2.4cmolkg<sup>-1</sup> and constant in 35 -90cm, B horizon, 90-130cm Bt1 horizon and 130-200cm Bt2 horizons. The CEC of the soil is low and varies irregularly with the depth from 3.2- 6.0cmolkg<sup>-1</sup> and constant in 40-80cm (4.0cmolkg<sup>-1</sup>) AB horizon, 0 -35cm (4.0 cmolkg<sup>-1</sup>) A horizon and 130-200 cm (4.0 cmolkg<sup>-1</sup>) Bt2 horizon. Total exchangeable acidity (TEA) value is relatively high except for its value obtained in 0-35cm A horizon. Constant values of 3.20cmolkg<sup>-1</sup> and 1.6cmolkg<sup>-1</sup> were recorded in 40-80cm AB horizon, 80-130cm Bt1 and 90 -130cm Bt1, as well as 130-200cm Bt2 horizons. Generally the value obtained for base saturation indicated high but its distribution is irregular throughout the profiles studied. The value ranges from 37.5 -99.21%.

**Table 2** Chemical properties of low land areas (mapping unit 1) profile pit samples.

Description	Depth cm	Horizon	Exchangeable bases cmolkg <sup>-1</sup>				CEC cmolkg <sup>-1</sup>	TEA cmolkg <sup>-1</sup>	Base Sat. %	SAR	ESP %
			Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>+</sup>	Mg <sup>+</sup>					
Profile A CSSO	0-40	A	0.11	0.05	1.2	1.6	3.2	2.0	80.0	0.10	3.44
	40-80	AB	0.11	0.02	1.0	0.1	4.0	3.2	69.0	0.11	2.75
	80-130	Bt1	0.14	0.06	0.8	1.1	5.6	3.2	37.5	0.14	2.50
	130-200	Bt2	0.11	0.07	0.8	2.4	6.0	2.4	56.33	0.09	1.83
Profile B Urowulu	0-35	A	0.11	0.06	1.4	1.8	4.0	0.6	84.24	0.09	2.75
	35-90	B	0.11	0.06	1.2	2.4	3.8	2.0	99.21	0.08	2.89
	90-130	Bt1	0.14	0.06	1.2	1.2	3.6	1.6	72.22	0.13	3.89
	130-200	Bt2	0.11	0.05	1.6	1.2	4.0	1.6	74.25	0.09	2.75

### 3.2. Physical and chemical characteristics of upland area

The surface soil of this unit shows dark reddish horizon (2.5YR3/4) with dull reddish brown (2.5YR4/4) subsoil. The textural class of the soils varies from loamy sand to sandy loam, however, with greater percentage of sandy loam class. The soil is well drained and has a weak structure. There is completely absence of mottles, cutan, lithic or paralithic layers and stone outcrops. Their particle size in Table 3 varies irregularly with depth with clay ranging from 50 -190gkg<sup>-1</sup> and virtually constant across the depths. Silt 50-90gkg<sup>-1</sup> and virtually constant across the depths. Fine sand vary from 220-590gkg<sup>-1</sup> and coarse sand 310-550gkg<sup>-1</sup>. The silt is the least in the soil's mineral matter followed by clay, while sand forms the bulk. The soil pH in water indicated moderate to slightly acidic to alkaline of which the range is 5.3 – 8.0. While the pH in KCl showed extremely acid to mere neutral and the range value is from 4.5 -7.3 (Table 3). The Table 4 indicated that the sodium varies irregularly with depth and virtually constant ranging from 0.10-0.11 cmolkg<sup>-1</sup>. The value of potassium equally varies irregularly from 0.03-0.11 cmolkg<sup>-1</sup> and the value recorded is generally low. The calcium is of moderate value and varies from 1.2-5.6cmolkg<sup>-1</sup>; while magnesium ranges from its lowest value (0.4cmolkg<sup>-1</sup>) in 15-40cm, AB horizon to its highest value (3.6cmolkg<sup>-1</sup>) in 65-98cm Bt1 horizon. The cation exchange capacity (CEC) varies irregularly with depth and ranges from 7.4-11.2 cmolkg<sup>-1</sup> constant value were recorded in 35-65 cm, AB horizon, 65-98cm Bt1 horizon, 40-80cm Bt1 of profile D. Total exchangeable acidity (TEA) vary from 0.6-1.8cmolkg<sup>-1</sup>. The distribution of base saturation through the horizons is irregular and range from 22.38-96.54gkg<sup>-1</sup>. Sodium adsorption ratio (SAR) recorded values were almost constant throughout the horizons and varied from 0.06-0.10 while exchangeable sodium percent ranged from 0.98-1.49% (Table 4).

**Table 3** pH and physical parameters of upland areas (mapping units) Auger sample

Description	Depth cm	pH H <sub>2</sub> O	KCl	Clay	Silt	Find sand	Coarse sand	Textural class
				→	→	gkg <sup>-1</sup> ←	←	
Auger 1	0-20	6.2	5.8	100	70	340	490	Loamy sand
	20-40	6.3	5.9	140	90	220	550	Sandy loam
	40-60	7.1	7.3	80	50	330	540	Loamy sand
	60-80	6.8	6.4	100	70	290	540	Loamy sand
	80-100	6.7	6.0	100	70	320	510	Loamy sand
	100-120	6.6	6.2	100	70	280	530	Loamy sand
Auger 2	0-20	6.6	5.7	50	50	590	310	Sandy loam
	20-40	6.7	6.1	150	70	320	460	Sandy loam
	40-60	5.6	5.4	190	70	320	420	Sandy loam
	60-80	6.9	6.0	150	90	250	510	Sandy loam
	80-100	6.5	6.3	190	50	310	450	Sandy loam
	100-120	5.3	4.5	190	50	270	490	Sandy loam
Auger 3	0-20	7.5	6.6	190	90	340	380	Sandy loam
	20-40	7.1	6.7	110	70	300	520	Sandy loam
	40-60	7.1	6.7	190	50	290	470	Sandy loam
	60-80	7.4	6.7	190	70	290	450	Sandy loam
	80-100	8.0	7.3	190	70	300	440	Sandy loam
	100-120	7.4	6.6	190	90	270	450	Sandy loam

**Table 4** Chemical properties of upland areas (mapping unit 11) profile pit samples.

Description	Depth cm	Horizon	Exchangeable bases				CEC cmolkg <sup>-1</sup>	TEA cmolkg <sup>-1</sup>	Base Sat. %	SAR	ESP %
			Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>+</sup>	Mg <sup>+</sup>					
Profile C Ire	0-35	Ap	0.11	0.08	5.6	1.6	8.0	1.0	22.38	0.06	1.38
	35-65	AB	0.10	0.05	2.6	2.0	7.8	0.6	60.90	0.07	1.28
	65-98	Bt1	0.11	0.07	2.4	3.6	7.8	0.8	79.23	0.06	1.41
	98-133	Bt2	0.11	0.09	5.3	2.0	8.2	0.6	91.46	0.06	1.34
	133-200	Bt3	0.11	0.11	5.2	2.4	8.1	0.6	96.54	0.06	1.36
Profile D Burrow pit Awada	0-15	Ap	0.11	0.06	3.6	2.0	11.2	0.8	51.24	0.07	0.58
	15-40	AB	0.10	0.04	2.0	0.4	8.4	1.8	30.24	0.09	1.19
	40-80	Bt1	0.10	0.05	1.2	1.0	7.8	1.8	30.13	0.10	1.28
	80-115	Bt2	0.11	0.05	2.4	0.6	7.4	0.8	42.70	0.09	1.49
	115-200	Bt3	0.11	0.03	2.4	1.8	8.5	1.0	51.06	0.08	1.29

### 3.3. Land evaluation

The soils of Obosi land were evaluated using qualitative land evaluation approach. During the survey, it was gathered that the soil pH ranges from extremely acidic to moderately alkaline; potassium in cmolKg<sup>-1</sup> is very low; CEC is low to medium; Calcium and Magnesium in cmolKg<sup>-1</sup> were high. The soil particle size analysis revealed that the textures of the entire area were loamy sand to sandy loam. Based on the above statistics the units were evaluated as shown on Table 5 below.

**Table 5** Land evaluation of Obosi land.

Mapping Units	Evaluation
Lowland Area (MUI)	Suitable for arable crop production
Upland Area (MUII)	Suitable for arable crop production
Gullied Area (MUIII)	Not suitable for arable crop production may be used for forestry, rough pasture or recreation

### 3.4. Land capability classification

The soil fertility of Obosi land is comparable to that of any tropical ferralsols. The soils are poor in fertility, highly weathered and have low cation retention. The soil of the area has a deep rooting depth, loose sandy loam to loamy sand in texture, well drained and highly permeable.

The soils were moderately pore with a good water holding capacity (WHC) and lack any form of toxic substances or salinization. However, the most outstanding limitation to their crop productivity and other uses is the soil's fertility limitation; the relief of the area and the degree of the soil's exposure to erosion. Information from the field work and soil samples analysis shows that Obosi soils have no class I land in its capability classification. Mapping units MUI and MUII falls under the capability class II while the Gullied lands, MUIII falls under capability classes VI-VII depending on the ageing or level of development of the gully.

**Table 6** Capability classification of Obosi land.

Mapping Units	Land Capability
Lowland Area (MUI)	Class II
Upland Area (MUII)	Class II
Gullied Area (MUIII)	Class VI-VII

## 4. Discussion

Obosi land was mapped out into three units; lowland area (MUI), upland areas (MUII) and gullied land area (MUIII) using their morphology and relief as the basis. The land has soils of sedimentary parent material and soils of these units were highly weathered and very deep. This agrees with the observations made about soils of south-eastern, Nigeria by Akamigbo and Asadu [14] when they said that profile on soils derived from false bedded sand stones are deep to very deep. The soil color varies from brownish to reddish probable due to the oxidation of iron compound. The soils have no cutan lithic or paralitic layer(s). The soils were mainly sandy loam texture in the lowland while it is loamy sand to sandy loam texture in the upland. There is remarkable increase in the clay content along the vertical cross section of all depths. Soil texture is a basic indicator of soil physical and chemical properties. The dominance of sand probable indicates fragility and low content of colloidal materials, hence the soil aggregates are weak and easily break down under saturation, a factor that relates to the ease of erodibility of the soils of the area. It is a well-known fact that good structural aggregates are developed when clay, silt and sand particles in combination with the binding agents acted upon by the physical, chemical and biotic forces. Thus, the effects of soil structure on pore size distribution cause it to influence greatly aeration, drainage, water movement and transmission processes in soil. The extremely acidity to alkaline nature of the soils (pH in water 4.8-8.0 and 4.2-7.3 in KCl) can be attributed to the leaching of the exchangeable bases from the exchange site and in part to the nature of the parent material coupled with high annual rainfall condition. The difference in the variation of the two pH values (water and KCl) varies from 0.7-0.07 of which is an indication of a net negative charge in the exchange complex. The value recorded for the exchangeable bases are low, with the exception



of calcium and magnesium which is low to moderate value. The result probably, might be due to high weathering intensity and low OM content. This is because soils with low OM content lack the capacity to hold cations in the exchange site. From the result, it was observed that exchange complexes were dominated by Ca and Mg. This might be attributed to Ca been the least lost from the soil exchange site. According to Brady and Weil [15] it is the most abundant cation in exchange complex of nearly all soils that are not so acidic as to have high aluminum saturation. The value recorded was equally found to be above critical value reported by Landon [16] to effectively support crop production in tropical soils. The low CEC content of the soils suggest the influence of low OM in the soils. This simply suggests the inability of the soils to withstand heavy leaching and drainage. Generally the total exchangeable acidity (TEA) of the soils studied were rated low indicating absence of the possibility of aluminum toxicity. The relatively increased value ( $2.4-3.20\text{cmol kg}^{-1}$ ) observed in profile A compared to other profiles studied may suggest solubilisation of  $\text{Al}^{3+}$  that may not translate into high acidity of  $\text{H}^+$  in that soil. The high basic saturation observed in most of the horizons may be associated with the weatherable minerals in the soil or due to high surface content of soil organic matter. The sodium adsorption ratio (SAR) and exchangeable sodium percent (ESP) are two parameters by which soil sodicity are evaluated. Soil sodicity influence water movement, root growth and proliferation. The low values of SAR and ESP observed in this study implies easy permeability, high infiltration rate and transmission of water.

The high rainfall of the southern Nigeria is generally heavy and aggressive. The greatest threat to the environmental settings of south-eastern Nigeria according Igwe [17] is the gradual but consistent dissection of the land slope by erosion. Investigation on the causative factors of gully erosion in Anambra state, Nwabine and Oti [18] stated that Obosi, Oyi, Amaenyi, Ajali, Umuchu, Nanka and their environs were prone to agents of erosion as a result of their soils low plasticity index (0.20%); their soils low moderate swelling and shrinking potentials, the high intensity rainfall and the friable nature of the soils of the area. Gully development is always linked to man's unwise action on land such improper agricultural activities, industrialization, construction activities, deforestation etc. All these activities leave the land unprotected and vulnerable. Hence [19] emphasized that gully widen through lateral erosion where water undercutting causes subsequent slumping of the sides. In personal communication with Ekwugo [20] a member of Obosi works committee and 70 years of age, he observed that Obosi gully erosion problem is associated to the town's location and the type of soil in Obosi. Slope is an important element among the factors that affects soil erosion. The topographic configuration of the town of an area can constitute a natural environmental problem. Akamigbo [21] noted that soils on steep slopes are susceptible and vulnerable to erosion, leaching and landslides. Land use option for this kind of soils according to Igwe [17] should be that based on integrated watershed management with arable farming, agro-forestry and intensive afforestation. Thus, regular cultural practices such as organic matter application to the soil is advised while mulching, crop rotation and well managed agro-forestry are some of the ways of keeping the soil un-eroded.

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## 5. Conclusion

The decline in soil fertility of Obosi land, which is highly attributed to leaching and erosion of top soil by intense rainfall of the humid tropical region can be replenished through the timely combined use of organic and in-organic fertilizers. The soils of this area need to be amended with organic matters like compost manure, poultry droppings, cow dung, agricultural wastes and farm-yard manure to improve on the soils cohesion, its colloids, its water holding capacity, its soil nutrients, as well as improve on the soil aggregation and structural stability to resist erosion. The combination of mineral fertilizer and organic manure is highly recommended for any meaningful farming venture in the area. In addition to the traditionally grown crops in the area (yam, cassava, cocoyam, pumpkin, amaranths, pepper etc), an intensified cultivation of groundnut, beans, soya beans and crop rotation system should be incorporated in their farming to ensure steady vegetation cover of the land. This will assist greatly in replacing lost nutrients checking leaching and reducing soil erosion menace.

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## Compliance with ethical standards

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The authors from onset agreed to work together towards the publication of this article, so there is no conflict of interest with regard to the publication of this article.

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