

**LAND CAPABILITY CLASSIFICATION OF TWO TOPOSEQUENCE ON IGUZAMA  
COMMUNITY OF EDO STATE.**

**BY**

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**DEPARTMENT OF SOIL SCIENCE AND LAND MANAGEMENT**

**FACULTY OF AGRICULTURE**

**UNIVERSITY OF BENIN**

**BENIN CITY**

**OCTOBER, 2023**

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**A PROJECT REPORT SUBMITTED TO THE  
DEPARTMENT OF SOIL SCIENCE AND LAND MANAGEMENT,  
FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY**

**IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE  
AWARD OF BACHELOR OF AGRICULTURE DEGREE B. AGRIC  
(SOIL SCIENCE AND LAND MANAGEMENT)**

**OCTOBER, 2023**

## CERTIFICATION

This is to certify that this research project “**Land Capability Classification of Two Toposequence on Iguzama Community of Edo State**” was carried out by Mary Idigbeyose OMOERA of the Department of Soil Science and Land Management, Faculty of Agriculture, University of Benin City, Edo State, Nigeria.

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Dr. (Mrs) A.O. Bakare  
Head of Department

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Signature and Date

## **DEDICATION**

To God Almighty whose mercy and kindness has no end, I dedicate this work, for by His love and kindness have brought me this far and will see me through the end.

## ACKNOWLEDGEMENT

My utmost gratitude goes to God for his infinite love and kindness upon my life. He took care of everything and strengthened me even through my most difficult times during the course of my study. Thank you Father.

I want to acknowledge the Head of Department, soil science and land Management, Dr.(Mrs) A. O. Bakare, the Dean of the faculty of agriculture, Prof. E. R. Orhue and all the lecturers and staff of the department of Soil Science and Land Management, Faculty of Agriculture, University of Benin for their positive academic impact on my life.

My sincere appreciation also goes to my supervisor Miss Faith Okunsebor whose contribution and constructive criticism has enabled me complete this work successfully and Dr. A. S. Umweni for his assistance. Thank you so much for your support, direction and understanding. My sincere appreciation also goes to Mr. Kadiri, for his support during the work.

I am and will be forever grateful to my sister, brothers, and my father, Mr E OMOERA and his lovely wife. I appreciate all you did for me, my life would not have been the same without your support. Thank you for giving everything possible to achieve this success.

To my vibrant project partners Sandra, Rita, Bridget and Phillip thank you for your immerse help and support during the course of the project. My amiable course Rep Chisom, my wonderful friends Vera, Onyinye and Blessing thank you for your love, assistance and motivation throughout the course of study and project work. Also, to the entire class of 2021/2022 set, I am so priviledged to meet all of you.

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## ABSTRACT

This study was carried out at Iguzama community to assess the capability for arable crop production. The methodology involved rigid grid soil identification and mapping at a detailed scale. The survey produced four ( 4 ) mapping units(site A : upper and lower slope, site B: upper and lower slope) and each was represented by a pedon. The pedons were described appropriately. Samples were collected from each pedon and taken to the laboratory for analysis using standard procedure. The results revealed that the entire study area had a sandy top soil ( 0-20cm ) with sand fraction of particle size ranging from 660 gkg<sup>-1</sup> to 960 gkg<sup>-1</sup> , silt ranged from 10 gkg<sup>-1</sup> to 44 gkg<sup>-1</sup> and clay had values ranging from 30 gkg<sup>-1</sup> to 320 gkg<sup>-1</sup> . The nutrient reserve was equally low as expressed by the low potassium values ( K < 0.2 cmolkg ) which ranged from 0.01cmolkg<sup>-1</sup> to 0.29 cmolkg<sup>-1</sup> : and low Organic Carbon values ( 1.30gkg<sup>-1</sup> to 23.13gkg<sup>-1</sup> ) . The mean values for : sand fraction in the soils ranged within 787gkg<sup>-1</sup> to 886 gkg<sup>-1</sup> for silt 15 gkg<sup>-1</sup> to 26.8gkg<sup>-1</sup> and clay from 88gkg<sup>-1</sup> to 190gkg. The CV of pH for pedon 1a was 10.5% with a ranging of low variability as well as its sand fraction which had CV value of 6%. In pedon 1b the pH , AI , base saturation and sand fraction were ranked as low variability with CV values of 6.2 , 0.42%, 13.9 % and 11.5% respectively . The pH , ECEC , CEC and sand fraction of pedon 2a under site B were in low variability with CV values of 9.68% , 13.67% and 5.1% respectively. The silt fraction, base saturation and pH of pedon 2b had low variability with CV of 8.37%, 12.19 % and 4.4% . Based on morphological characteristics and laboratory results, the pedons were evaluated for their capability to support arable crop production and that 1.65ha or 41.25 % occupied by pedon 1a (lower slope), 2.64ha or 66% occupied by pedon 1b (upper slope), 6.4ha or 53.33% occupied by pedon 2a (lower slope) and 5.69ha or 47.416% occupied by 2b (upper slope) fell on aggregate class III based on the law of minimum. Therefore, they are suitable for cropping and intensive grazing. Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use.

## CHAPTER ONE

### INTRODUCTION

Soils vary in their physical, chemical, morphological and mineralogical characteristics where topography happens to be a major factor which controls most surface processes taking place.

Topography has an influence on soil chemical and physical properties and also on the pattern of soil distribution over landscape (Adegbite *et al.*, 2019).

African soils are characterized by rolling topography and soil properties changes due to the factor of slope which plays a vital role in influencing soil properties as one moves from crest position down to the valley bottom (Egbuchua, 2014 and Ibrahim *et al.*, 2020). Toposequence refers to a succession of sites from crest to the valley bottom which contains a range of soil profiles that are representative of the landscape and soils (Adegbite *et al.*, 2019). As a general rule, soil profile on the convex upper slope in a toposequence are more shallow and have less distinct sub surface horizons than soils at lower slope (Gisilanbe *et al.*, 2019). One of the features that influence morphological properties of the soil is the soil toposequence. The arrangement of soils on the surface of the land (its slope angle), causes the degree of soil detachment due to the intensity of rain water or the velocity of surface runoff through the action of erosion, changes in the soil horizon, soil texture and structure, infiltration rate and soil consistency. These important soil factors are essential in soil taxonomic classification and in rating the soils based on its capability in supporting agricultural production (Gisilanbe *et al.*, 2017).

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 deteriorating over a long period of time (Atalay, 2016). The first land capability classification (LCC) was developed, in USA, by Soil Conservation Service (now called the Natural Resource Conservation Service) in the late 1930's and early 1940's. The LCC is a three level classification, consisting of capability class, capability subclass, and capability unit (Gad, 2015). The land capability is determined by

different land characteristics such as the types of soil, which is critical for productivity, fundamental geology, topography, and hydrology. These characteristics limit the extent of land accessible for various purposes (Bizuwerk, Peden, Taddese, & Getahun, Citation2005) and (Girmay *et al.*, 2018) .Land capability classification is aimed at predicting the crop production potentials of the land improvement units and the use of the land resources (Adekiya *et al.*, 2022)

Land capability classification plays a crucial role in aiding communities in making informed land-use decisions and sustainable development plans. By assessing the inherent suitability of different areas for specific purposes, such as agriculture, forestry, or urban development, it helps minimize environmental degradation and optimize land utilization. This classification system takes into account factors like soil quality, slope, drainage, and climate to determine land capabilities. Consequently, it enables communities to protect ecologically sensitive areas, prevent soil erosion, and promote efficient land management. Therefore, this study will provide the data and necessary information that will aid the government, farmers and non government agencies in managing land resources in Iguzama community.

The objectives of the study were to:

1. Evaluate the land capability classes present in the study area;
2. Determine the areal extent of each capability class.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Land Capability

African soils are characterized by rolling topography and soil properties changes due to the factor of slope which plays a vital role in influencing soil properties as one moves from crest position down to the valley bottom (Egbuchua, 2014). Apart from parent material and climate, toposequence or topography is another important factor that plays important roles in the distribution of soil minerals. Toposequence determines the drainage and depth of a soil profile; for instance, soils on higher elevation are usually well-drained whereas soil on the lower slope is usually poorly drained and of fined texture (Atofarati *et al.*, 2012). Further, topography influences drainage, soil erosion, textural composition and other soil properties that affect crop development and productivity (Atofarati *et al.*, 2012). Soils on a hill or steep slope are usually very shallow and gravelly due to minimal rate of weathering and removal of soil by erosion while soil on a gentle slope allows ample infiltration of water and develops into deep profile (Esu, 2010). Topography of a landscape can influence soil physicochemical properties, biomass production, incoming solar radiation, precipitation and affect crop production. As topography gradually increases down the slope, there is a significant increase in soil moisture, soil organic carbon while bulk density, pH and soil temperature would be significantly lower at the higher elevations (Nahusenay and Kibebew, 2016). Glassman *et al.* (1980), as cited in Lawal *et al.* (2014) states that water velocity on a slope affect the deposition of materials in suspension, sand drops out of suspension first, while clay size particles can be carried further away from the upland before they are deposited on the floodplains. This process of geological sorting of suspended soil materials as they travel along a slope brings about variations in soil texture as we move from upland to lowland. Normally, topography influences morphological, chemical and

physical properties of soil. In essence, topography affects the pattern of soil distribution over landscape even when the soils are derived from the same parent material (Esu *et al.*, 2008). This gives rise to a succession of soil types, known as a catena from the hilltop to the valley bottom (Milne, 1935 cited in Ewato and Enaruvbe, 2010). The catenary differentiation of soils is of pivotal importance to the management of soils in different topographic positions in the landscape. Consequently, understanding the roles of topography in a landscape will help in assessing productive values of soils and most importantly, in developing strategies for its conservation and reducing uniform soil management which could result to uneven distribution of input in an agricultural field situated on a topography (Oku *et al.*, 2010).

## **2.2 Land Capability Classification**

Land is an indispensable resource for the most essential human activities: it provides the basis for agriculture and forest production, water catchment, recreation, and settlement (FAO,2006). The range of uses that can be made of land is limited by environmental factors including climate, topography and soil characteristics, and is to a large extent determined by demographic, socio-economic, cultural and political factors such as population density, land tenure, markets, institutions, and agricultural policies. Land capability classification is a scientific appraisal of the physical characters of the land, inherent soil qualities and management practices. The main objective of land capability classification is to understand potentiality, capability and suitability for the optimum utilization of land (Aweto, 2010). The land use capability classification is a system under which lands are classified as per their potential ability to produce the yield. This system of classifying the land is based on the potential ability of different kinds of soil for agricultural purposes (Oku, *et al.*, 2010). It is also a practical grouping of soil based on various soil limitations which show the risk or damage. Land classification is mainly for the use of soil according to various limitations and providing adequate protection from erosion and other means of deterioration (Abrams *et al.*, 2007). Land capability measurement offers a scientific judgment

for the conservation of land under specific ecological conditions. Land capability in one hand helps to find out efficiency of land for particular uses and on the other it helps to prevent improper use of land which leads to erosion hazards and deterioration of land quality (FAO, 2014). So, for the sake of optimum productivity, the capability of each and every bit of land should be measured considering its inherent pedo-geomorphic characters as well as limitations due to environmental hazards. Besides, capability classification enables the farmers to use the land properly for sustainable production under required management measures (Brady, 2009). The major factors determining the land capability are the soil characteristics including texture of the top soil, effective soil depth, permeability of top and sub-soil and associated land features, e.g. the slope of land, extent of erosion, degree of wetness and susceptibility to overflowing and flooding. The grouping of soils into different capability classes is mainly done on the basis of their capability to produce common cultivated crops and the pasture plants without deteriorating the land, for a long period (Aweto, 2010). The land-capability classification is based on the intensity of hazards and the limitations. The land- capability classes are from the best and most easily farmed land to the land which has no value for cultivation, grazing or forestry, but may be suitable for wildlife, recreation or for watershed protection (FAO, 2014). Overall, all the lands fall into two broad categories, i.e. one suitable for cultivation and for other land uses; and other land category is not suitable for cultivation, but may be suitable for other. The classification comprises three main categories, the class, the division and the unit, each of which can be supplemented by information on the principal type of limitation applying. The three categories provide a flexible array of information suited to national, regional, local or farm planning requirements (Adewumi *et al.*, 2015). Although arable land is strictly defined as land fit for ploughing or tillage, its meaning is slightly restricted in the current context to indicate land fit for the growth of a range of crops. Land suited to arable uses is included in Classes 1-4, and that not suited to arable use in Classes 5-7. Land is grouped in any class only because it has a similar

overall degree of limitation; within any class therefore there may be very different management requirements. This is also true of the division which is a ranking of land within the class. There are no divisions within Class 1 and 2; Classes 3 and 4 each have two divisions and Classes 5 and 6 three divisions (FAO, 2006). The unit is based both on the degree of limitation applying and upon the specific type of limitation. The function of the unit is to supply information concerning detailed types of limitations, suitability for cropping and management problems.

### **2.3 Land Capability Classes**

The classes of Land suited to arable cropping (Adewumi *et al.*, 2015).

#### **CLASS I** (Land capable of producing large numbers of crops)

In this class, Cropping is highly flexible and includes the more exacting crops such as harvested vegetables (Pumpkins, Scent leaf). The level of yield is consistently high. Soils are usually well-drained deep loams, sandy loams, silty loams, or their related humic variants, with good reserves of moisture. Sites are level or gently sloping and the climate is favourable. There are no or only very minor physical limitations affecting agricultural use (FAO, 2014).

#### **CLASS II** (Land capable of producing moderate numbers of crops).

Cropping is very flexible and a wide range of crops can be grown though some root and winter harvested crops may not be ideal choices because of difficulties in harvesting. The level of yield is high but less consistently obtained than on Class 1 land due to the effects of minor limitations affecting cultivation, crop growth or harvesting (Aweto *et al.*, 2010). The limitations include, either singly or in combination, slight workability or wetness problems, slightly unfavourable soil structure or texture, moderate slopes or slightly unfavourable climate. The limitations are always minor in their effect however and land in the class is highly productive (FAO, 2006).

### **CLASS III**

Land in this class is capable of producing good yields of a narrow range of crops, principally cereals and grass, and/or moderate yields of a wider range including potatoes, some vegetable crops and oil-seed crops(FAO,2014). The degree of variability between years will be greater than is the case for Classes 1 and 2, mainly, due to interactions between climate, soil and management factors affecting the timing and type of cultivations, sowing and harvesting. The moderate limitations require careful management and include wetness, restrictions to rooting depth, unfavourable structure or texture, strongly sloping ground, slight erosion or a variable climate. The range of soil types within the class is greater than for previous classes (FAO,2014).

### **CLASS IV**

The land is suitable for enterprises based primarily on grassland with short arable crops (e.g. barley, oats, forage crops). Yields of arable crops are variable due to soil, wetness or climatic factors. Yields of grass are often high but difficulties of production or utilization may be encountered. The moderately severe levels of limitation restrict the choice of crops and demand careful management. The limitations may include moderately severe wetness, occasional damaging floods, shallow or very stony soils, moderately steep gradients, erosion, moderately severe climate or interactions of these which increase the level of farming risk (FAO,2006).

### **CLASS V**

The agricultural use of land in Class 5 is restricted to grass production but such land frequently plays an important role in the economy of African lands. Mechanized surface treatments to improve the grassland, ranging from ploughing through rotavation to surface seeding and improvement by non-disruptive techniques are all possible. Although an occasional pioneer forage crop may be grown, one or more severe limitations render the land unsuited to arable

cropping. These include adverse climate, wetness, frequent damaging floods, steep slopes, soil defects or erosion risk. Grass yields within the class can be variable and difficulties in production, and particularly utilization, are common (Wilson,2010).

#### **CLASS VI**

The land has very severe site, soil or wetness limitations which generally prevent the use of tractor-operated machinery for improvement. Some reclamation of small patches to encourage stock to range is often possible (Wilson, 2010). Climate is often a very significant limiting factor. A range of widely different qualities of grazing is included, from very steep land with significant grazing value in the lowland situation to moorland with a low but sustained production in the uplands. Grazing is usually insignificant in the arctic zones of the mountain lands but below this level grazings which can be utilized for five months or longer in any year are included in the class. Land affected by severe industrial pollution or dereliction may be included if the effects of the pollution are non-toxic. Land capable only of use as rough grazing (Sharu ,2013).

#### **CLASS VII**

Land with extremely severe limitations that cannot be rectified. The limitations may result from one or more of the following defects: extremely severe wetness, extremely stony, rocky land, bare soils, scree or beach sand and gravels, toxic waste tips and dereliction, very steep gradients, severe erosion including intensively hagged peat lands and extremely severe climates (exposed situations, protracted snow-cover and short growing season). Agricultural use is restricted to very poor rough grazing (Tan,2010).

#### **CLASS VIII**

Soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for aesthetic purposes (FAO,2014).

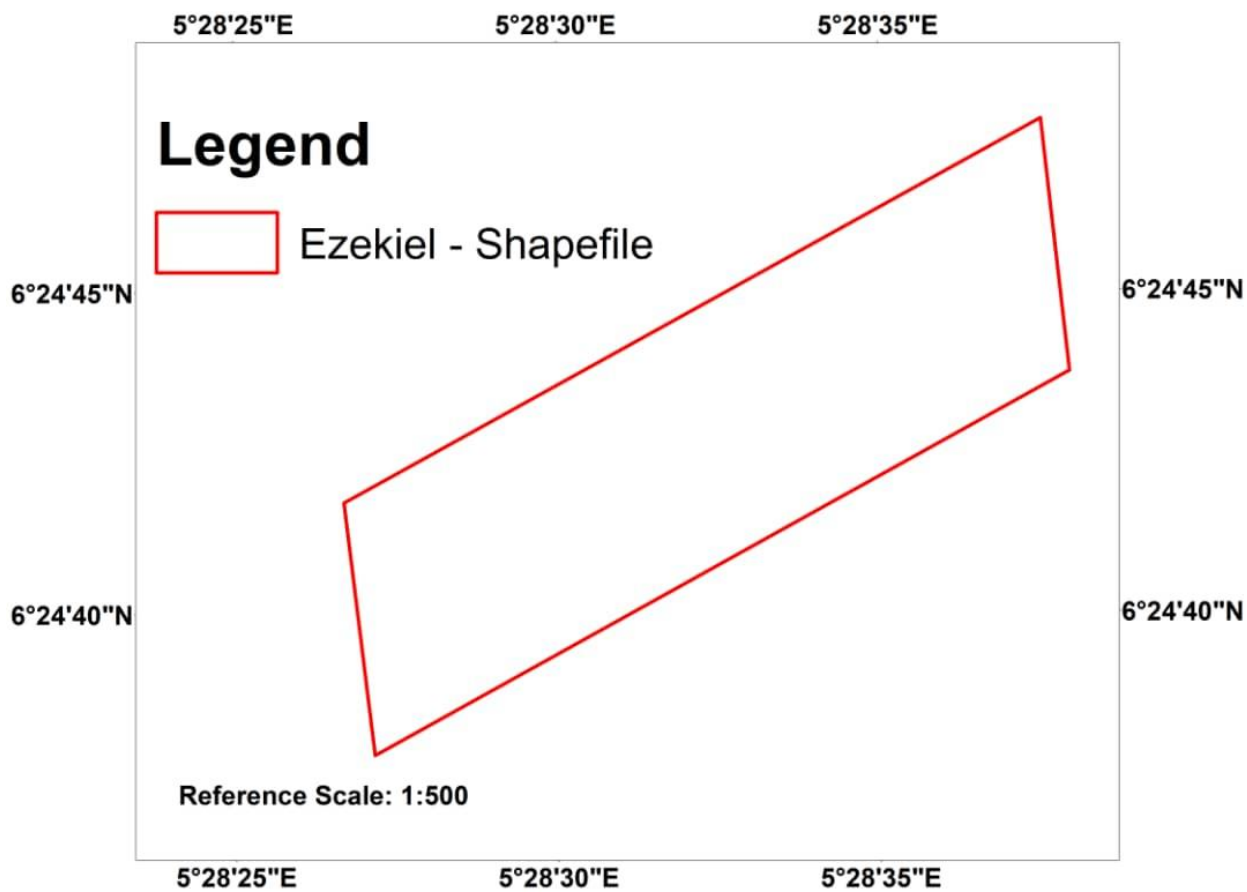
## CHAPTER THREE

### MATERIALS AND METHODS

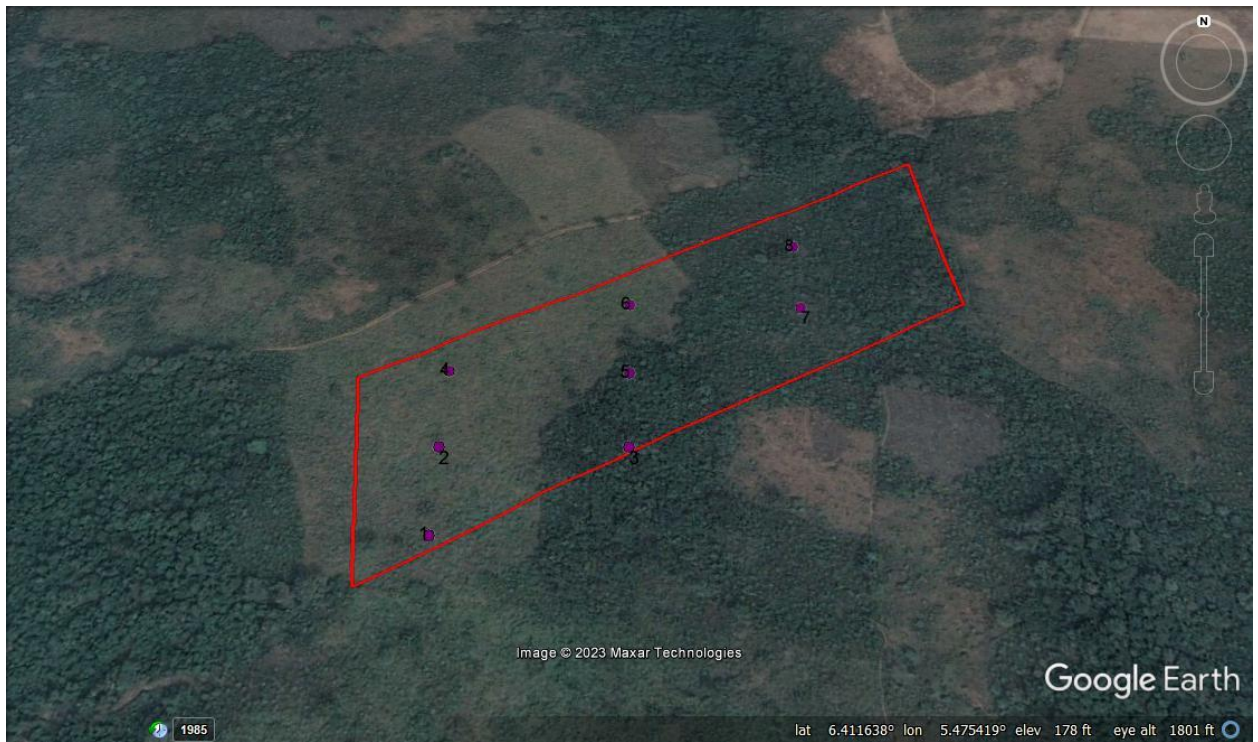
#### 3.1 Study Area

This study was carried out in two locations at Iguzama Community in Ovia North East Local Government area of Edo State , Nigeria . As shown in the location maps ( figures 1 and 3 ) .Site A is a 4 hectare land and lies within Latitude  $6^{\circ} 24'40''\text{N}$  and  $6^{\circ} 24'45''\text{N}$ ; and Longitude  $5^{\circ} 28'25''\text{E}$  and  $5^{\circ} 28'35''\text{E}$ . Site B is a 12 hectare land which lies within latitude  $6^{\circ} 24'30''\text{N}$  and  $6^{\circ} 25'0''\text{N}$  : and Longitude  $5^{\circ} 28'30''\text{E}$  and  $5^{\circ} 29'0''\text{E}$  . The soils were formed from Coastal Plain sand, a derivative of sedimentary rock that has undergone intense weathering process arising from high rainfall and temperatures (NGSA , 2008) .

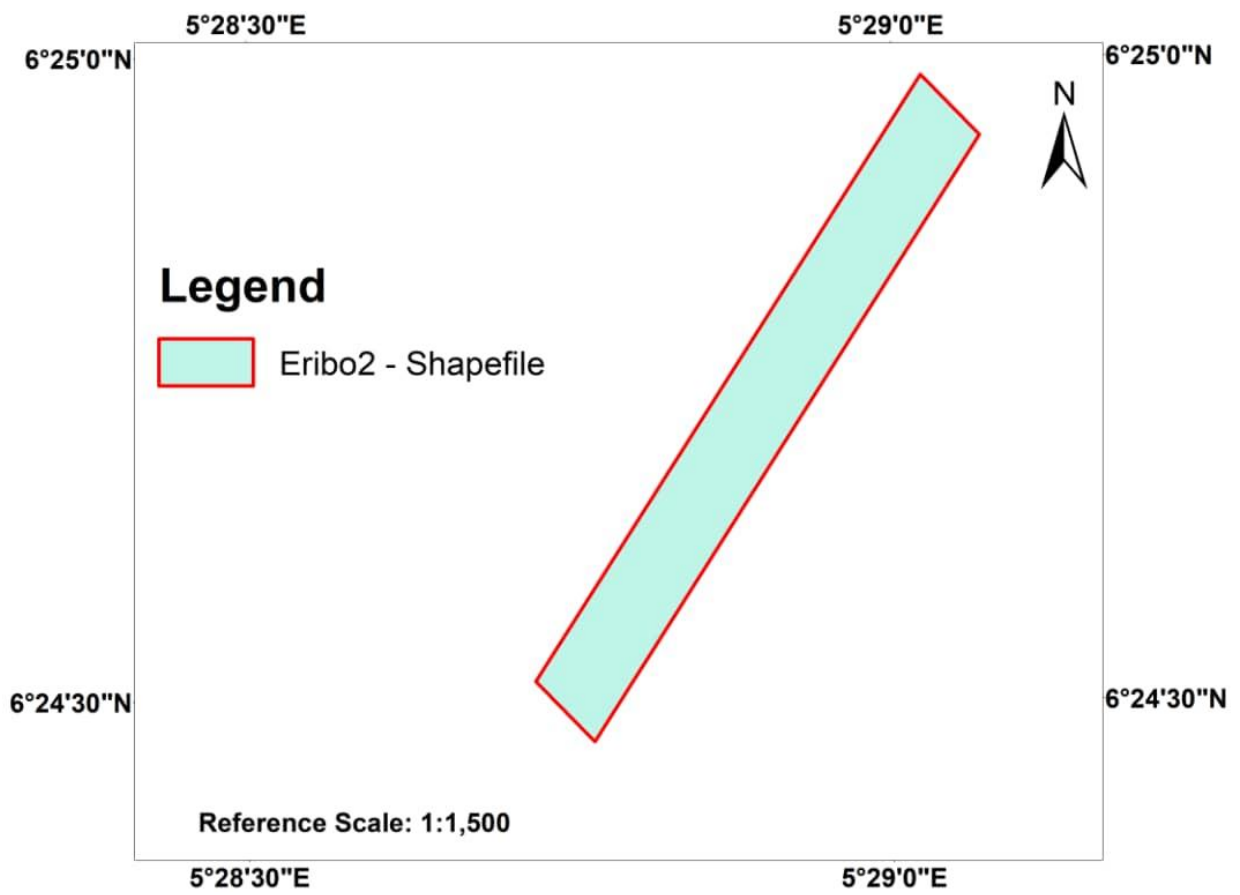
The vegetation (Figures 2 and 4) is a secondary forest and includes a young oil palm plantation, cassava, yam, and a section of old fallow land. The topography is a terrace with a height differentia of 2.59 -0.69 % in site A and 0.2 - 5.9 % in Site B.



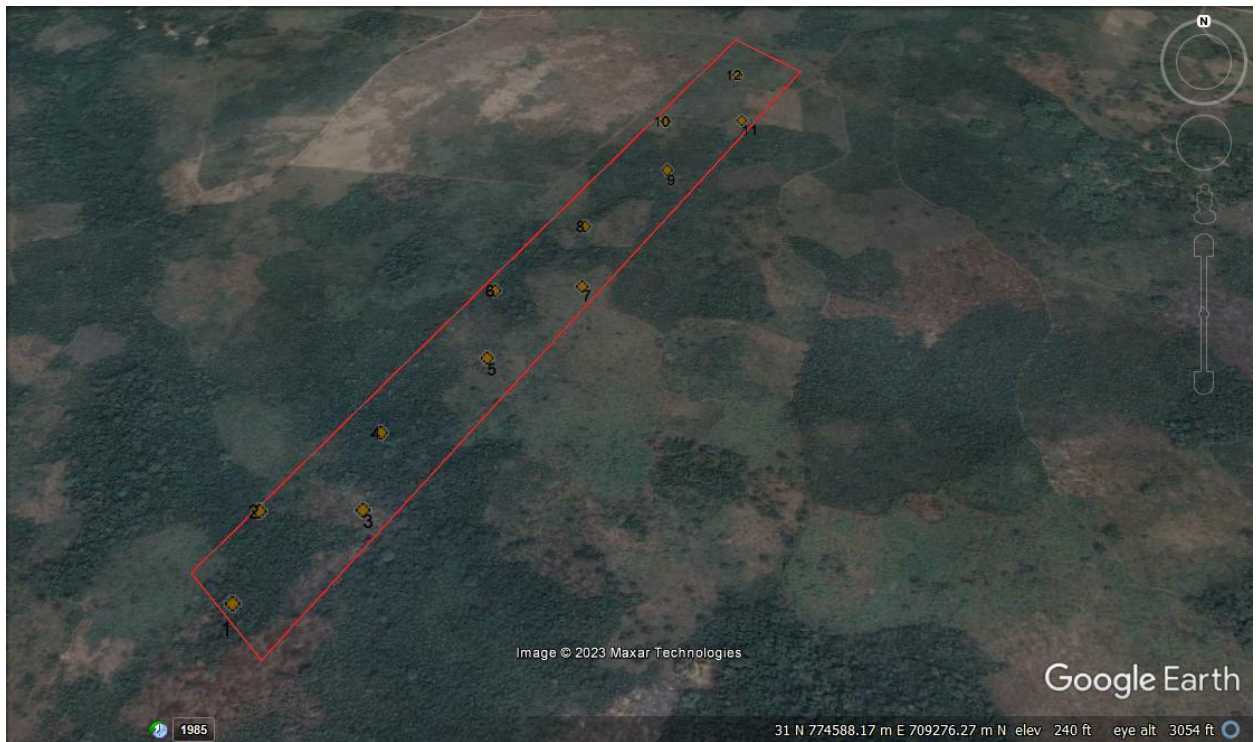
**Figure 1: Site A(4 hectares) study area shapefile (location map)**



**Figure 2: Google imagery of 4 hectares study area (site A)**



**Figure 3: Site B(12 hectare) study area shapefile ( location map)**



**Figure 4: Google imagery of 12 hectares study area (site B)**

### **3.2 Materials/Equipment Used**

The materials used includes soil auger, spade, cutlass, measuring tape, munsell color chart, hand gloves, , markers and writing pen and polythene bags to store the samples collected.

### **3.3 Field Studies**

Perimeter survey maps of the two sites were produced which served as the base maps. The survey process was carried out using the rigid grid method at a detailed scale on the Land. Transverses were cut at intervals running in both vertical and horizontal direction. Soils were described by hand augering to a depth of 120 cm as there was no limitation by bedrock or other limiting layers. At each observation point information on soils such as slope position, soil drainage , soil color , soil texture , soil structure (topsoil), soil consistence , surface cracks and surface stoniness ( if present ) were recorded . It was observed that topography (as expressed in slope) was the dominant soil forming factor in both sites. Areas with similar soil properties and within the same slope range or position, were put together to form the various mapping units ; four(4) mapping units were delineated ( two mapping units in site A, and two mapping units in site B). Each mapping unit was represented by a pedon that was appropriately described according to FAO ( 2006 ) and identified horizons and layers were sampled from bottom to top . The samples were properly bagged, labelled and taken to the laboratory for analysis .

### **3.4 Soil Physico - Chemical Analysis Procedure**

#### **Soil sample preparation**

The soil samples collected were taken to the laboratory, air dried for a period of 2 weeks . The samples were then pounded and sieved using a 2 mm sieve to remove dirt and plant debris.

## **Laboratory Analysis**

The soil samples from each horizon were air - dried and passed through a 2mm sieve, the sieved samples were analysed for some physical and chemical properties . Particle size distribution was determined by the hydrometer method (Gee and Or , 2002) after the removal of organic matter content with hydrogen peroxide and dispersion with sodium hexametaphosphate ( International Institute for Tropical Agriculture -IITA , 1979 ) . Available P was determined by Bray - 1 method ( Olsen and Sommers , 1982 ) . The pH was determined with glass electrode pH meter in soil : soil and water at ratio 1 : 1 ( Maclean , 1982 ) . Exchangeable Bases ( Na , K , Ca and Mg ) were extracted with neutral normal ammonium acetate ( NH<sub>4</sub>AC at pH 7.0 ) ; Na and K were determined by flame photometer while Ca and Mg were determined by atomic absorption spectro photometer (Thomas , 1982) . Total N was determined by Macro Kjeldhal method (Bremner , 1996 ) . Exchangeable Acidity was determined by titration method (Anderson and Ingram , 1993 ) . Organic Carbon was determined by Walkley Black method (Page , 1982 ) . Effective Cation Exchange Capacity ( ECEC ) was obtained by the summation of Exchangeable Bases and Exchangeable Acidity ( Tan , 1996 ) . Base Saturation was calculated by dividing the sum of Exchangeable Bases ( Na , K , Ca and Mg ) by the ECEC and multiplying the quotient by 100 .

### **3.5 Land Capability Assessment**

Land capability assessment of soils of the study areas at Iguzama community was done using the qualitative method according to the FAO (2007) frame work for rain fed agriculture and appropriate guideline provided by USDA ( 1961 ) . Pedons were placed in capability classes by comparing their land qualities and characteristics with the requirements obtained from the guideline. Land capability classes were based on both degree and number of limitations affecting kind of use, risks of soil damage if mismanaged , needs for soil management , and risks of crop

failure . The aggregate capability class of a pedon is indicated by the most limiting characteristics of that pedon; this was according to the principle of the law of the minimum which states that performance is always determined by the least favourable factor (FAO , 1984 ). The capability class which shows the most severe limitation after evaluation using the appropriate guideline for the different mapping units became the aggregate capability class.

### **3.6 Statistical Analysis**

Data generated by gen stat (version 8.1) statistical was used to determine variability of soil properties within pedons. Coefficient of variation (cv) was ranked according to the procedure of wilding et al., (1994) where  $cv < 15 \% = \text{low variation}$ ,  $cv \geq 15 \% \leq 35 \% = \text{moderate variation}$ ,  $cv > 35 \% = \text{high variation}$ .

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

The physical as well as chemical characteristics of the sites as expressed in the laboratory results on the table 1, table 3, table 5 and table 7 along with their interpretations using the general guideline table provided by the USDA (1961) for land capability classification is discussed in this section . Each pedon would be discussed separately.

The mean values for sand fraction in the soils ranged within 787gkg<sup>-1</sup> to 886 gkg<sup>-1</sup> for silt 15 gkg<sup>-1</sup> to 26.8gkg<sup>-1</sup> and clay from 88gkg<sup>-1</sup> to 190gkg<sup>-1</sup> . The CV of pH for pedon 1a(lower slope) was 10.5% with a ranging of low variability as well as its sand fraction which had CV value of 6%. In pedon 1b(upper slope) the pH , AI , base saturation and sand fraction were ranked as low variability with CV values of 6.2 , 0.42%, 13.9 % and 11.5% respectively . The pH , ECEC , CEC and sand fraction of pedon 2a(lower slope) under site B were in low variability with CV values of 9.68% , 13.67% and 5.1% respectively. The silt fraction, base saturation and pH of pedon 2b(upper slope) had low variability with CV of 8.37%, 12.19 % and 4.4%

#### 4.1 Pedon 1a (lower slope)

##### Characterization

The physical and chemical properties of the soil in Pedon 1a (lower slope) are presented in Table 1. The slope percentage is 2.59 -6.09%. The soil pH ranged from 4.86 to 6.22, with values decreasing and increasing irregularly down the profile. The total organic carbon in this Pedon ranged from 1.3 gkg<sup>-1</sup> to 23.13 gkg<sup>-1</sup> with the highest value in the surface layer. Total nitrogen (N) values ranged from 0.10 gkg<sup>-1</sup> to 1.93 gkg<sup>-1</sup> decreasing down the profile with the highest at the surface area. The value of available phosphorus ranged from 1.72 m gkg<sup>-1</sup> to 44.47 m gkg<sup>-1</sup> with values decreasing down the profile. Exchangeable bases: Calcium (Ca) values ranged from

0.43 cmolkg<sup>-1</sup> to 2.58 cmolkg<sup>-1</sup> with the upper layer having the highest value. Magnesium (Mg) values ranged from 0.08 cmolkg<sup>-1</sup> to 0.38 cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Sodium (Na) values ranged from 0.19 cmolkg<sup>-1</sup> to 0.34 cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Potassium (K) values ranged from 0.05 cmolkg<sup>-1</sup> to 0.19 cmolkg<sup>-1</sup> with highest values at the top layer. Hydrogen (H) values ranged from 0.1 cmolkg<sup>-1</sup> to 0.26 cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Aluminium (Al) values ranged from 0 cmolkg<sup>-1</sup> to 1.2 cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Electrical conductivity of the soil ranged from 46.3 dsm<sup>-1</sup> to 109.7 dsm<sup>-1</sup> with values decreasing and increasing down the profile. The Effective Cation Exchange Capacity (ECEC) values ranged from 2.03 cmolkg<sup>-1</sup> to 3.58 cmolkg<sup>-1</sup>, with values increasing and decreasing irregularly down the profile. The percentage Base saturation (BS) of the soil ranged from 37.93 % to 97.21 % decreasing and increasing in an irregular pattern down the profile. The ECEC CLAY values ranged from 14.71 cmolkg<sup>-1</sup> to 119.33 cmolkg<sup>-1</sup> with values decreasing down the profile. The CEC value range from 36 cmolkg<sup>-1</sup> to 94 cmolkg<sup>-1</sup> with alternate increase and decrease down the profile. In particle size distribution, Clay values ranged from 30 gkg<sup>-1</sup> to 140 gkg<sup>-1</sup> with values increasing down the profile. Silt values ranged from 10 gkg<sup>-1</sup> to 40 gkg<sup>-1</sup> with alternate increase and decrease down the profile and Sand values ranged from 830 gkg<sup>-1</sup> to 960 gkg<sup>-1</sup>. The textural class ranged from Sand (S) to Loamy sand (LS). Pedon 1a (lower slope) has horizon design of Ap, AB, BA, B1 and B2 with depth of 0-13cm, 13-33cm, 33-69cm, 69-121cm and 121-180cm respectively. The mean value for this pedon range from 0.11 (potassium) to 886 (sand), the SE value range from 0.06 (potassium) to 53.20 (sand) and the CV rank from the LV which is 60% (sand) to the HV which is 156.20 (Avail.p)



**Table 2: Land capability classification for pedon 1a (lower slope)**

<b>LAND CHARACTERISTICS</b>	<b>CAPABILITY CLASS</b>
Topography	
Slope %	2.59 -6.09(III)
Wetness (w)	
Flooding	No(Fo)(I)
Drainage	Good(I)
Physical condition (s)	
Surface Texture	S(III)
Subsurface Texture	LS(III)
Soil depth (m)	>1.5(I)
Fertility (t)	
Apparent ECEC (cmolkg <sup>-1</sup> )	2.03-3.58(III)
Base Saturation	37.93-97.21(II)
O.C (0.15cm)	23.13(I)
Aggregate Class	III (t, s, f)
Size (ha)	1.65
% coverage	41.25

## Appendix 1

**Table 3: Land Capability Classification System – General Guidelines**

CHARACTERISTICS	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS V	CLASS VI	CLASS VII	CLASS VIII
TOPOGRAHY								
Slope(%)	<2	<6	<12	<25	<25	<25	<55	<55
WETNESS(W)								
Flooding	No(Fo)	No(Fo)	No(Fo)	No(Fo) to slight	No to severe	No to severe	No to very severe	No to very severe
Drainage (i)	Good	Moderate or better	Somewhat imperfect or better	Moderate or better	Poor or better	Poor or better	Very poor or better	Very poor or better
PHYSICAL CONDITIONS (s)								
Surface Texture	SL to Co	LfS to Co-60s	fS to 60v	C- cS to C+60v	cS to Cm	cS to Cm	cS to Cm	cS to Cm
Surface coarse fragments(vol. %)	None	<15	<35	<55	<55	<55	<75	<75
Surface stoniness(%)	None	<0.01	<0.1	<0.3	<15	<15	<75	<75
Rockiness (%)	None	<2	<10	<25	<50	<50	<75	<75
Sub-surface texture	L to C-60	SCL to C-60v	LfS to C+60v	fS to C-60v	cS to Cm	cS to Cm	cS to Cm	cS to Cm
Sub-surface coarse fragments(vol. %)	<15	<35	<55	<75	<75	<75	<75	<75
Soil Depth (m)	>1.5	>1.0	>0.50	>0.25	>0.25	>0.25	>0.10	>0.10
FERTILITY (f)								
Apparent ECEC (cmol/kg)	>16	>16	>16	Any	Any	Any	Any	Any
Base saturation	>80	>50	>35	>15	>15	>15	>15	>15
O.C(g/kg)(0-15cm)	>15	>10	>6	>4	>4	>4	>4	>4

Source: USDA (1961)

SiCm: silt clay massive  
 C+ 60, v: very fine clay, vertisol structure  
 C+ 60, S: very fine clay, blocky structure  
 C- 60, v: clay vertisol structure  
 SCL: sandy clay loam  
 SL: sandy loam  
 LfS: loamy fine sand  
 LmS: loamy medium sand  
 Si: silt  
 SiL: silt loam  
 C- 60, s: clay, blocky structure

SiCL: silty clay loam  
 CL: clay loam  
 LsC: loamy coarse sand  
 fS: fine sand  
 mS: medium sand  
 cS: coarse sand  
 SL: sandy loam  
 L: loam  
 Cm: clay massive  
 Co: clay, oxisol structure  
 SiCs: siltclay, blocky structure

The following observations were made on consideration of pedon 1a (lower slope), based on the qualifications of the land characteristics. The slope percentage is 2.59 -6.09% which puts it in class ( III ). The surface texture was sandy(S) and this can be associated with class ( III ). Sub - surface texture was observed to be loamy sand (LS) which also puts it in class ( III ). No flooding was noticed, as well as drainage was good this qualified the pedon as class ( I ). Soil depth ( m ) is greater than 1.5 which according to the guideline was rated as class ( I ) which is suitable for a wide range of plants and may be used safely to cultivate crops , pastures , range and wildlife . ECEC ranges from 2.03cmolkg<sup>-1</sup> to 3.58cmolkg<sup>-1</sup> which qualified as class ( III ). The base saturation varied from 37.93 -97.21 % and was rated as class ( II ). Total organic carbon at 0-13cm was 23.13gkg<sup>-1</sup>, qualifying as class ( I ) .

The aggregate class to which pedon 1a (lower slope) belongs to is determined by applying the law of minimum which states that performance is determined by the least favourable property (FAO , 1984 ) . By this principle , the least favoured characteristics in pedon one are ECEC, surface texture, sub surface texture and slope . Therefore pedon 1a (lower slope) which occupies 1.65ha or 41.25 % of the total 4ha of land has an aggregate class of III and the soils in this class have moderate levels of limitations that restrict the choice of plants and reduce productivity in relation to Class 1 or Class 2. Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use. These soils may be well suited to only one or two of the common crops or the harvest produced may be low in relation to inputs over a long period of time.

## 4.2 Pedon 1b (upper slope)

### Characterization

The physical and chemical properties of the soil in Pedon 1b (upper slope) are presented in Table 3. The slope percentage is 0.79 -2.6%. The soil pH ranged from 5.26 to 6.14, with values increasing and decreasing irregularly down the profile. The total organic carbon in this Pedon ranged from 2.44gkg<sup>-1</sup> to 14.01 gkg<sup>-1</sup> with the highest value in the surface layer. Total nitrogen (N) values ranged from 0.19 gkg<sup>-1</sup> to 1.17 gkg<sup>-1</sup> with values decreasing down the profile the highest value at the surface area . The value of available phosphorus ranged from 1.3mgkg<sup>-1</sup> to 13.14mgkg<sup>-1</sup> with values decreasing and increasing irregularly down the profile. Exchangeable bases : Calcium (Ca) values ranged from 0.4 cmolkg<sup>-1</sup> to 1.7 cmolkg<sup>-1</sup> with values decreasing and increasing irregularly down the profile . Magnesium (Mg) values ranged from 0.1cmolkg<sup>-1</sup> to 0.25cmolkg<sup>-1</sup> with the values increasing and decreasing down the profile . Sodium ( Na ) values ranged from 0.14 cmolkg<sup>-1</sup> to 0.43 cmolkg<sup>-1</sup> with values decreasing and increasing irregularly down the profile . Potassium (K) values ranged from 0.01 cmolkg<sup>-1</sup> to 0.29 cmolkg<sup>-1</sup> with values decreasing down the profile. Hydrogen (H) values ranged from 0.1cmolkg<sup>-1</sup> to 0.2cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Aluminium (Al) values ranged from 0 cmolkg<sup>-1</sup> to 1cmolkg with alternate decrease and increase in values down the profile. Electrical conductivity of the soil ranged from 25.50 dsm<sup>-1</sup> to 97.8 dsm<sup>-1</sup> with values decreasing down the profile. The Effective Cation Exchange Capacity (ECEC) values ranged from 1.94 cmolkg<sup>-1</sup> to 2.78 cmolkg<sup>-1</sup>, with values decreasing and increasing irregularly down the profile. The percentage Base saturation (BS) of the soil ranged from 61.09 % to 89.32 % with values decreasing and increasing irregularly down the profile. The ECEC CLAY values ranged from 7.13cmolkg<sup>-1</sup> to 36.88cmolkg<sup>-1</sup> with values decreasing down the profile. The CEC value range from 64cmolkg<sup>-1</sup> to 163.42cmolkg<sup>-1</sup> with values increasing down the profile. In particle size distribution, Clay values ranged from 32gkg<sup>-1</sup> to 310gkg<sup>-1</sup> with values

increasing down the profile. Silt values ranged from  $10\text{gkg}^{-1}$  to  $44\text{gkg}^{-1}$  with values decreasing down the profile and Sand values ranged from  $680\text{gkg}^{-1}$  to  $924\text{gkg}^{-1}$  with values decreasing down the profile. The textural class ranged from Sand (S) to Sandy clay loam (SCL). Pedon 1b (upper slope) has horizon design of Ap, Bt1, Bt2, Bt3 and Bt4 with depth of 0-15cm, 15-39cm, 39-76cm, 76-127cm and 127-169cm respectively. The mean value for this pedon range from 0.16(mg and H) to 787.00(sand), the SE value range from 0.06(Mg) to 103.30(clay) and the CV rank from the LV which is 0.42% (Al) to the HV which is 833.1%(org carbon).

**Table 3: Physical and chemical Properties of Pedon 1b (upper slope)**

Pedon ID	Hori zon Desi gn.	Horizon Depth  (cm)	pH	EC	Org. C	Org. matter	Total N.	Avail P	Ca	Mg	Na	K	H	Al	ECE C	CEC	ECECC LAY	BS	SAND	SILT	CLAY	TC
2			H2O	µS/cm	gkg <sup>-1</sup>		gkg <sup>-1</sup>	mgkg <sup>-1</sup>	←————— cmolkg <sup>-1</sup> —————→				←————— gkg <sup>-1</sup> —————→									
	Ap	0-15	6.14	97.80	14.01	24.15	1.17	13.14	1.70	0.25	0.43	0.29	0.1	0.00	2.78	64.00	86.88	75.68	924.00	44.00	32.00	S
	Bt1	15-39	5.5	46.20	5.86	10.11	0.49	2.63	0.60	0.10	0.24	0.11	0.18	0.86	2.09	100.00	13.06	89.32	800.00	40.00	160.00	SL
	Bt2	39-76	5.34	34.80	3.58	6.18	0.30	1.30	0.50	0.10	0.14	0.02	0.18	1.00	1.94	107.36	10.21	84.22	790.00	20.00	190.00	SL
	Bt3	76-127	5.26	32.50	2.93	5.05	0.24	1.80	0.40	0.15	0.19	0.01	0.2	1.00	1.95	130.10	8.13	75.66	740.00	20.00	240.00	SCL
	Bt4	127-169	5.66	25.50	2.44	4.21	0.19	2.38	0.97	0.18	0.19	0.01	0.16	0.70	2.21	163.42	7.13	61.09	680.00	10.00	310.00	SCL
Mean			5.58	47.00	5.80	9.90	0.48	4.20	0.83	0.16	0.24	0.09	0.16	0.71	2.19	113.00	25.00	77.20	787.00	26.80	186	
SE			0.35	29.20	4.79	8.26	0.40	5.00	0.53	0.06	0.11	0.12	0.04	58.50	0.35	36.90	34.60	10.73	90.30	14.53	103.30	
CV			6.20	61.60	833.1	83.10	84.40	117.60	63.50	40.20	47.5	136.90	23.50	0.42	15.80	32.60	138.00	13.90	11.50	54.20	55.40	
Ranking			LV	HV	HV	HV	HV	HV	HV	HV	HV	HV	MV	LV	MV	MV	HV	LV	LV	HV	HV	

NOTE: LS-loamy sand, SL-sandy loam, SCL-sandy clay loam, S-sand, EC-Electrical conductivity, T.N-Total nitrogen, Org.C- Organic carbon, Avail.P – Available phosphorus, T.C-Textural class, BS – Base Saturation, ECEC – Effective Cation Exchange Capacity

**Table 4: Land capability classification for pedon 1b (upper slope)**

<b>LAND CHARACTERISTICS</b>	<b>CAPABILITY CLASS</b>
Topography	
Slope %	0.79 -2.6(II)
Wetness (w)	
Flooding	No(Fo)(I)
Drainage	Good(I)
Physical condition (s)	
Surface Texture	S(III)
Subsurface Texture	SCL(II)
Soil depth (m)	>1.5(I)
Fertility (t)	
Apparent ECEC (cmolkg <sup>-1</sup> )	1.94-2.78(III)
Base Saturation	61.09-89.32(II)
O.C (0-15cm)	14.01(II)
Aggregate Class	III
Size (ha)	2.64
% coverage	66

The following observations were made on consideration of pedon 1b (upper slope), based on the qualifications of the land characteristics. The slope percentage is 0.79 -2.6% which puts it in class (II) . The surface texture was sand and this can be associated with class (III). Sub surface texture was observed to be sandy clay loam which also puts it in class (II). No flooding was noticed, as well as drainage was good this places qualified the pedon as class (I). Soil depth ( m ) is greater than 1.5m which according to the guideline was rated class (I) which is suitable for a wide range of plants and may be used safely to cultivate crops , pastures , range and wildlife . ECEC ranges from 1.94cmolkg<sup>-1</sup> to 2.78cmolkg<sup>-1</sup> which qualifies as class (III). The base saturation varied from 61.09 - 89.32 % and was rated class (II). Total organic carbon at 0 15cm was 14.01gkg<sup>-1</sup> qualifying as class ( II ) .

The aggregate class to which pedon 1b (upper slope) belongs to is determined by applying the law of minimum ( FAO , 1984 ) . By this principle, the least favoured characteristics in pedon one are ECEC and surface texture. Therefore pedon 1b (upper slope) which occupies 2.64 ha or 66 % of the total 4ha of land has an aggregate class of III and the soils in this class have moderate levels of limitations that restrict the choice of plants and reduce productivity in relation to Class 1 or Class 2 . Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use. These soils may be well suited to only one or two of the common crops or the harvest produced may be low in relation to inputs over a long period of time.

### **4.3 Pedon 2a ( lower slope)**

#### **Characterization**

The physical and chemical properties of the soil in Pedon 2a (lower slope) are presented in Table 5. The slope percentage is 0.2 - 2.1%. The soil pH ranged from 5.18 to 6.38, with values decreasing and increasing irregularly down the profile. The total organic carbon in this Pedon

ranged from  $1.71\text{gkg}^{-1}$  to  $9.12\text{gkg}^{-1}$  with the highest value in the surface layer. Total nitrogen (N) values ranged from  $0.15\text{gkg}^{-1}$  to  $0.76\text{gkg}^{-1}$  with values decreasing down the profile. The value of available phosphorus ranged from  $2.46\text{mgkg}^{-1}$  to  $5.61\text{mgkg}^{-1}$  with values decreasing and increasing down the profile. Exchangeable bases: Calcium (Ca) values ranged from  $0.42\text{cmolkg}^{-1}$  to  $1.6\text{cmolkg}^{-1}$  with values decreasing and increasing irregularly down the profile. Magnesium (Mg) values ranged from  $0.19\text{cmolkg}^{-1}$  to  $0.3\text{cmolkg}^{-1}$  with values decreasing and increasing irregularly down the profile. Sodium (Na) values ranged from  $0.1\text{cmolkg}^{-1}$  to  $0.24\text{cmolkg}^{-1}$  with values decreasing and increasing irregularly down the profile. Potassium (K) values ranged from  $0.01\text{cmolkg}^{-1}$  to  $0.08\text{cmolkg}^{-1}$  with values decreasing down the profile. Hydrogen (H) values ranged from  $0.04\text{cmolkg}^{-1}$  to  $0.23\text{cmolkg}^{-1}$  with alternate decrease and increase in values down the profile. Aluminium (Al) values ranged from  $0.08\text{cmolkg}^{-1}$  to  $1.12\text{cmolkg}^{-1}$  with alternate decrease and increase in values down the profile. Electrical conductivity of the soil ranged from  $33.8\text{dsm}^{-1}$  to  $61.9\text{dsm}^{-1}$  with values decreasing down the profile. The Effective Cation Exchange Capacity (ECEC) values ranged from  $1.9\text{cmolkg}^{-1}$  to  $2.24\text{cmolkg}^{-1}$ , with values decreasing and increasing irregularly down the profile and surface layer having the highest value. The percentage Base saturation (BS) of the soil ranged from 39.79% to 94.64% with values decreasing and increasing irregularly down the profile. In particle size distribution, Clay values ranged from  $80\text{gkg}^{-1}$  to  $190\text{gkg}^{-1}$ . Silt values ranged from  $10\text{gkg}^{-1}$  to  $20\text{gkg}^{-1}$  and Sand values ranged from  $800\text{gkg}^{-1}$  to  $900\text{gkg}^{-1}$  with values decreasing down the profile. The textural class ranged from Sand (S) to Sandy loam (SL). Pedon 2a (lower slope) has horizon design of Ap, Bw1, Bw2, Bw3 and Bw4 with depth of 0-11cm, 11-27cm, 27-59cm, 59-101cm and 101-175cm respectively. The mean value for this pedon range from 0.03(potassium) to 842.66(sand), the SE value range from 0.03(potassium) to 46(clay) and the CV rank from the LV which is 5.16% (sand) to the MV which is 66.30%(cal)

**Table 5: Physical and chemical Properties of Pedon 2a (lower slope)**

Pedon ID	Horizon Design.	Horizon Depth (cm)	pH	EC	Org. C	Org. matter	Total N.	Avail P	Ca	Mg	Na	K	H	Al	ECE C	CEC	ECECC LAY	BS	SAND	SILT	CLAY	TC		
3			H2O	µS/cm	gkg <sup>-1</sup>		gkg <sup>-1</sup>	mgkg <sup>-1</sup>	←—————			—————→			←—————			—————→						
									cmolkg <sup>-1</sup>															
	Ap	0-11	6.38	61.90	9.12	15.72	0.76	5.61	1.60	0.20	0.24	0.08	0.04	0.08	2.24	71.44	28.00	94.64	900.00	20.00	80.00	S		
	Bw1	11-27	5.58	47.70	5.86	10.11	0.49	2.55	0.75	0.30	0.14	0.03	0.16	0.52	1.90	80.00	15.83	64.25	860.00	20.00	120.00	LS		
	Bw2	27-59	5.26	41.20	4.15	7.16	0.35	3.05	0.46	0.19	0.19	0.02	0.19	1.10	2.16	84.32	15.43	40.14	850.00	10.00	140.00	LS		
	Bw3	59-101	5.18	39.10	3.09	5.33	0.26	2.63	0.42	0.28	0.1	0.02	0.23	1.00	2.04	103.16	11.03	39.79	800.00	15.00	185.00	SL		
	Bw4	101-175	5.26	33.80	1.71	2.95	0.15	2.46	0.50	0.25	0.19	0.01	0.16	1.12	2.23	100.90	11.74	42.71	800.00	10.00	190.00	SL		
Mean			5.53	44.70	4.80	8.30	0.40	3.26	0.75	0.24	0.17	0.03	0.16	0.76	2.11	88.00	16.40	56.00	842.00	15.00	143.00			
SE			5.00	10.81	2.86	4.93	0.24	1.33	0.49	0.05	0.05	0.03	0.07	0.46	0.14	15.50	6.83	23.70	42.70	5.00	46.00			
CV			9.00	24.20	59.70	59.70	58.60	40.90	66.30	19.80	31.10	86.70	45.50	59.40	6.80	13.67	41.60	42.10	5.10	33.30	32.20			
Ranking			LV	MV	HV	HV	HV	HV	HV	MV	MV	HV	HV	HV	LV	LV	HV	HV	LV	MV	MV			

NOTE: LS-loamy sand, SL-sandy loam, SCL-sandy clay loam, S-sand, EC-Electrical conductivity, T.N-Total nitrogen, Org.C- Organic carbon, Avail.P – Available phosphorus, T.C-Textural class, BS – Base Saturation, ECEC – Effective Cation Exchange Capacity

**Table 6: Land capability classification for pedon 2a ( lower slope)**

<b>LAND CHARACTERISTICS</b>	<b>CAPABILITY CLASS</b>
Topography	
Slope %	0.2 – 2.1(II)
Wetness (w)	
Flooding	NO(FO)(I)
Drainage	Good (I)
Physical condition (s)	
Surface Texture	S(III)
Subsurface Texture	SL (III)
Soil depth (m)	>1.5 (I)
Fertility (t)	
Apparent ECEC	1.9 – 2.24(II)
Base Saturation	39.79 – 94.64(II)
O.C (0-15cm)	9.12(III)
Aggregate Class	III
Size (ha)	6.4
% coverage	53.33

The following observations were made on consideration of pedon 2a (lower slope) , based on the qualification of the land characteristics . The slope percentage is 0.2 - 2.1% which puts it in class (II). Considering surface texture it was found to be sand and this can be associated with class (III). Sub - surface texture was found to be sandy loam which placed it in class (III) . No flooding was noticed , as well as drainage was good this qualified the pedon as class (I) . Soil depth ( m ) is greater than 1.5m which according to the guideline was rated class (I) which is suitable for a wide range of plants and may be used safely to cultivate crops , pastures , range and wildlife . ECEC ranges from 1.90cmolkg<sup>-1</sup> to 2.24cmolkg<sup>-1</sup> which qualified as class (II) . The base saturation varied from 39.79 - 94.64% and was rated as class (II). Total organic carbon at 0-11cm was 9.12gkg<sup>-1</sup> qualifying as class (III).

The aggregate class to which pedon 2a (lower slope) belongs to is determined by applying the law of minimum ( FAO , 1984 ) . By this principle, the least favoured characteristics in pedon one are surface texture, sub surface texture and total organic carbon. Therefore pedon 2a (lower slope) which occupies 6.4ha or 55.33 % of the total 12ha of land has an aggregate class of III and the soils in this class have moderate levels of limitations that restrict the choice of plants and reduce productivity in relation to Class 1 or Class 2. Soil conservation practices and sound management are needed to overcome the moderate limitations to cropping use. These soils may be well suited to only one or two of the common crops or the harvest produced may be low in relation to inputs over a long period of time.

#### **4.4 Pedon 2b (upper slope)**

##### **Characterization**

The physical and chemical properties of the soil in Pedon 2b (upper slope) are presented in Table 7. The slope percentage is 2-5.9%. The soil pH ranged from 5.26 to 5.82, with values decreasing and increasing irregularly down the profile. The total organic carbon in this Pedon ranged from

2.04gkg<sup>-1</sup> to 19.22 gkg<sup>-1</sup> with the highest value in the surface layer. Total nitrogen (N) values ranged from 0.17gkg<sup>-1</sup> to 1.64 gkg<sup>-1</sup> decreasing down the profile with the highest at the surface area . The value of available phosphorus ranged from 1.72 mgkg<sup>-1</sup> to 6.48 mgkg<sup>-1</sup> with values increasing and decreasing down the profile. Exchangeable bases: Calcium (Ca) values ranged from 0.36 cmolkg<sup>-1</sup> to 1.5 cmolkg<sup>-1</sup> with the upper layer having the highest value . Magnesium (Mg) values ranged from 0.18cmolkg<sup>-1</sup> to 0.5 cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Sodium (Na) values ranged from 0.1cmolkg<sup>-1</sup> to 0.24 cmolkg<sup>-1</sup> . Potassium (K) values ranged from 0.01 cmolkg<sup>-1</sup> to 0.12 cmolkg<sup>-1</sup> with highest values at the top layer. Hydrogen (H) values ranged from 0.08cmolkg<sup>-1</sup> to 0.22 cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Aluminium (Al) values ranged from 0.10cmolkg<sup>-1</sup> to 1.25cmolkg<sup>-1</sup> with alternate decrease and increase in values down the profile. Electrical conductivity of the soil ranged from 29.1dsm<sup>1</sup> to 63.2 dsm<sup>1</sup> with values decreasing down the profile. The Effective Cation Exchange Capacity (ECEC) values ranged from 1.79 cmolkg<sup>-1</sup> to 2.54 cmolkg<sup>-1</sup> with values increasing and decreasing irregularly down the profile . The percentage Base saturation (BS) of the soil ranged from 33.08 % to 92.92 % decreasing and tincreasing in an irregular pattern down the profile. The ECEC CLAY values ranged from 5.59cmolkg<sup>-1</sup> to 36.28cmolkg<sup>-1</sup> with values decreasing down the profile. The CEC value range from 84.66cmolkg<sup>-1</sup> to 167.02cmolkg<sup>-1</sup> increasing down the profile. In particle size distribution, Clay values ranged from 70gkg<sup>-1</sup> to 320gkg<sup>-1</sup>. Silt values ranged fr om 10gkg<sup>-1</sup> to 30 gkg<sup>-1</sup> and Sand values ranged from 660gkg<sup>-1</sup> to 900gkg<sup>-1</sup>. The textural class ranged from Sand (S) to Sandy clay loam (SCL). Pedon 2b (upper slope) has horizon design of Ap, Bt1, Bt2, Bt3 and Bt4 with depth of 0-17cm, 17-34cm, 34-78cm, 78-116cm and 116-183cm respectively. The mean value for this pedon range from 0.14(Na) to 792(sand), the SE value range from 0.06(Na) to 79.50(clay) and the CV rank from the LV which is 4.4% (pH) to the HV which is 104.50%(TotalN).

**Table 7: Physical and chemical Properties of Pedon 2b (upper slope)**

Pedon ID	Horizon Design.	Horizon Depth (cm)	pH	EC	Org. C	Org. matter	Total N.	Avail P	Ca	Mg	Na	K	H	Al	ECE C	CEC	ECECC LAY	BS	SAND	SILT	CLAY	TC
4			H20	µS/cm	gkg <sup>-1</sup>		gkg <sup>-1</sup>	mgkg <sup>-1</sup>	←————— cmolkg <sup>-1</sup> —————→					←————— gkg <sup>-1</sup> —————→								
	Ap	0-13	6.22	109.70	23.13	39.87	1.93	44.47	2.58	0.38	0.34	0.19	0.1	0.00	3.58	94.00	119.33	97.21	960.00	10.00	30.00	S
	Ap	0-17	5.82	63.20	19.22	33.13	1.64	6.48	1.50	0.50	0.24	0.12	0.08	0.10	2.54	101.26	36.28	92.92	900.00	30.00	70.00	S
	Bt1	17-34	5.26	36.50	5.70	9.83	0.47	2.71	0.46	0.19	0.10	0.02	0.22	0.98	1.96	84.66	15.08	38.87	850.00	20.00	130.00	SL
	Bt2	34-78	5.34	34.30	4.23	7.30	0.35	5.00	0.43	0.27	0.10	0.01	0.19	1.11	2.10	114.60	10.50	38.16	790.00	10.00	200.00	SCL
	Bt3	78-116	5.26	32.00	3.09	5.33	0.26	2.71	0.42	0.18	0.10	0.01	0.17	1.25	2.12	125.60	9.22	33.08	760.00	10.00	230.00	SCL
	Bt4	116-183	5.34	29.10	2.04	3.51	0.17	1.72	0.36	0.19	0.14	0.01	0.19	0.90	1.79	167.02	5.59	39.12	660.00	20.00	320.00	SCL
Mean			5.40	39.00	6.90	11.80	0.58	3.72	0.63	0.27	0.14	0.03	0.17	0.87	2.10	119.00	15.30	48.00	792.00	18.00	190.00	
SE			0.24	13.79	7.04	12.14	0.61	1.96	0.49	0.14	0.06	0.05	0.05	0.45	0.28	26.20	79.50	51.60	11.60	46.50	50.30	
CV			4.4	35.3	102.70	102.70	104.50	52.50	76.60	51.00	44.60	142.00	31.40	51.80	13.20	31.10	12.19	25.00	91.50	8.37	95.70	
Ranking			LV	HV	HV	HV	HV	HV	HV	HV	HV	HV	HV	HV	HV	HV	LV	MV	HV	LV	HV	

NOTE: LS-loamy sand, SL-sandy loam, SCL-sandy clay loam, S-sand, EC-Electrical conductivity, T.N-Total nitrogen, Org.C- Organic carbon, Avail.P – Available phosphorus, T.C-Textural class, BS – Base Saturation, ECEC – Effective Cation Exchange Capacity

**Table 8: Land capability classification for pedon 2b (upper slope)**

<b>LAND CHARACTERISTICS</b>	<b>CAPABILITY CLASS</b>
Topography	
Slope %	2-5.9(II)
Wetness (w)	
Flooding	NO (FO) (I)
Drainage	Good (I)
Physical condition (s)	
Surface Texture	S(III)
Subsurface Texture	SCL (II)
Soil depth (m)	>1.5(I)
Fertility (t)	
Apparent ECEC	1.79 – 2.54(II)
Base Saturation	33.08 – 92.92(III)
O.C (0-15cm)	19.22(I)
Aggregate Class	III
Size (ha)	5.69
% coverage	47.416

The following observations were made on consideration of pedon 2b (upper slope) based on the qualifications of the land characteristics. The slope percentage is 2 - 5.9 % which puts it in class (II). The surface texture was sand(S) and this can be associated with class (III). Sub - surface texture was observed to be sandy clay loam which placed it in class (II). No flooding was noticed , as well as drainage was good this places both in class (I). Soil depth ( m ) is greater than 1.5m which according to the guideline was rated class ( I ) which is suitable for a wide range of plants and may be used safely to cultivate crops , pastures , range and wildlife . ECEC ranges from 1.79cmolkg<sup>-1</sup> to 2.54cmolkg<sup>-1</sup> which qualified as class (II). The base saturation varied from 33.08 -92.92 % and was rated as class (III). Total organic carbon at 0-17cm was 19.22gkg<sup>-1</sup> qualifying as class (I).

The aggregate class to which pedon 2b (upper slope) belongs to is determined by applying the law of minimum (FAO , 1984 ) . By this principle, the least favoured characteristics in pedon one are surface texture and base saturation. Therefore pedon four which occupies 5.69ha or 47.42 % of the total 12ha of land has an aggregate class of III and the soils in this class have moderate levels of limitations that restrict the choice of plants and reduce productivity in relation to Class 1 or Class 2. Soil conservation practices and sound management are needed to needed to overcome the moderate limitations to cropping use. These soils may be well suited to only one or two of the common crops or the harvest produced may be low in relation to inputs over a long period of time.

Table 9: Summary of land capability classification for pedon 1a(lower slope), 1b(upper slope), 2a(lower slope) and 2b(upper slope)

LAND CHARACTERERISTICS	CAPABILITY PEDON 1b	CLASSES	CAPABILITY PEDON 1b	CLASSES	CAPABILITY PEDON 2a	CLASSES	CAPABILITY PEDON 2b	CLASSES
Slope(%)	2.59-6.09(III)		0.79-2.6(II)		0.2-2.1(II)		2-5.9(II)	
Surface texture	S(III)		S(III)		S(III)		S(III)	
Sub-surface texture	LS(III)		SCL(III)		SL(III)		SCL(III)	
Soil Depth	>1.5 (I)		>1.5 (I)		>1.5 (I)		>1.5 (I)	
Drainage	Good(I)		Good(I)		Good(I)		Good(I)	
Flooding	No(Fo)(I)		No(Fo)(I)		No(Fo)(I)		No(Fo)(I)	
ECEC (cmol/kg)	2.03-3.58(III)		1.94-2.78(III)		1.9-2.24(II)		1.79-2.54(II)	
Base saturation (%)	37.93-97.21(III)		61.09-89.32		39.79-94.64(I)		33.08-92.92(III)	
Organic carbon (g/kg) (0-15cm)	23.13(I)		14.01(II)		9.12(III)		19.22(I)	
Aggregate class	III		III		III		III	
Area covered (ha)	1.65		2.64		6.4		5.69	
% Coverage	41.25		66		53.33		47.416	

## CHAPTER FIVE

### 5.0 CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

This project work is an attempt to evaluate the area of land under study of Iguzama community in terms of its suitability for arable crop production.

The objective of this study was to determine the suitability of the area for arable crop production through the identification of the land capability classes, as well as establishment of the areal extent of each capability class.

The results obtained for physical chemical morphological properties of the study area indicated that surface texture was sand, sub surface texture ranged from sandy loam to sandy clay loam, the soil depth was greater than 1.5, the drainage was good and no flooding was observed, the ECEC range from 1.79cmolkg<sup>-1</sup> to 3.58cmolkg<sup>-1</sup> and the base saturation ranged from 33.08 to 97.21%.

The results obtained for the four pedons revealed that pedon 1a (lower slope) occupied 1.65 ha or 41.25 % of the total land, pedon 1b (upper slope) occupied 2.64 ha or 66% while pedon 2a (lower slope) occupied 6.4 ha or 53.33 % and pedon 2b (upper slope) occupied 5.69ha or 47.416% are well drained with no problem of flooding in the area. While the above characteristics of the pedons holds true, fertility (ECEC and base saturation) are seen as major constraints. This put the pedons 1a (lower slope), 1b (upper slope), 2a (lower slope) and 2b (upper slope) in aggregate class (III). The slope position did not affect the capability class of the study area (site A and B). Therefore, they are only suitable for cropping and intensive grazing.

Based on the findings of this study the study area can be used to cultivate common arable crops that can be sustained and also for intensive grazing. Moderate limitations need to be consciously managed to prevent soil and land degradation. The limitations can be conquered by specialized management practices with high level of knowledge , expertise , inputs , investment and technology .Moreover, land suitability assessment should be carried out to determine the specific arable crop that can be sustained by the land before embarking on any agricultural project .

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