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# Mapping and classification of a 100 hectare land at uzanu community, Edo state, Nigeria.

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## Abstract

This study was carried out at Uzanu Community in Etsako East Local Government Area of Edo State to identify some of the major soils of the project area, through a soil mapping process. The methodology involved mapping of the soils of a 100 hectare land using the rigid grid soil survey method at a detailed scale. Four mapping units were delineated from the ten transects of 100 m apart and 100 m interval examination points along transects which gave a total of 84 auger points. Four representative pedons were sunk, described and sampled. Soil samples were analyzed using standard methods. Soils were classified according to USDA soil taxonomy System of Soil Classification. Series classification was locally defined using guidelines provided by Smyth and Montgomery.

The results showed that Pedon 1 representing a mapping unit with area coverage of 14.2 hectares or 14.2 % of the entire research area was classified as Loamy Isohyperthermic Typic Plinthudult and locally as Origo series. The soils of mapping unit two, covering an area of 13.2 hectares or 13.2 % were classified as Loamy Isohyperthermic Ruptic-Ultic-Dystrudept and locally as Origo series. Pedon three soils, covering an area of 38 hectares or 38 % were classified as Loamy Isohyperthermic Typic Plinthudult and locally as Origo series while the soils of mapping unit four represented by pedon four, covering an area of 34.7 hectares or 34.7 % were classified as Coarse Loamy Isohyperthermic Ruptic-Ultic-Dystrudept and locally as Ekiti series

**Keywords**: Mapping, soil classification, series.

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## 1.0 Introduction

There is an increasing demand for information on soils as a means to produce food (Fasina *et al* 2007). Agriculture is the predominant economic activity in Uzanu community Edo State and because of agricultural development and increasing demand for experimental data in Nigeria, much work is carried out on soil mapping and classification. This provides the basic information necessary to create functional soil classification schemes, and assess soil fertility in order to unravel some unique soil problems in an ecosystem (Lekwa *et al.,* 2004). The coupling of soil mapping and classification provides a powerful resource for the benefit of mankind especially in the area of food security and environmental sustainability. Soil classification helps to organize our knowledge, facilitates the transfer of experience and technology from one place to another and helps to compare soil properties. According to Eswaram (1977), some different uses of soil classification data includes to aid in the correct identification of the soil and enable other scientists place the soils in their taxonomies or classification systems and to serve as a basis for more detailed evaluation of the soil as well as gather preliminary information on nutrient, physical or other limitations needed to produce a capability class. A soil mapping and classification study, therefore, is an important building block for understanding the soil and getting the best understanding of the environment (Esu,2005).

Owing to the fact that Uzanu community is an agrarian rural community in Edo State and not much study has been done on the soils of the area, mapping and classification will help reveal information that could be useful in the management and use of the soils on a sustainable manner. The objective of this research therefore, was to map and classify the soils of Uzanu community in Etsako East Local Government Area of Edo State.

**2.0 Materials and Method**

This study was carried out at Uzanu community in Etsako East Local Government Area of Edo State, Nigeria. The

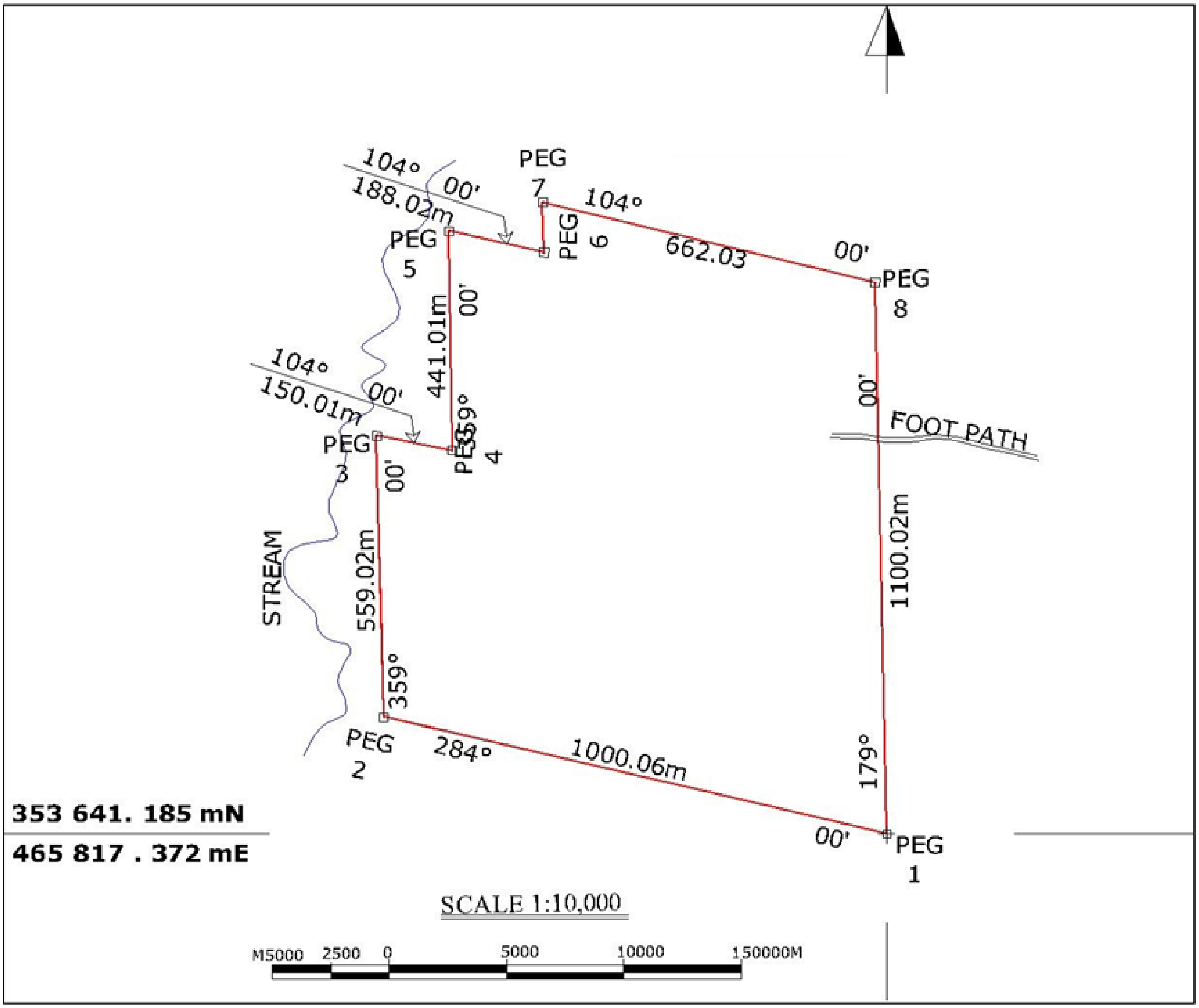



Fig 1: Location Map of the 100 hectare land at Uzanu community, Edo State

site is located at latitude 07˚11'41.3" N and Longitude 006˚37'40.6" E. The site was defined by points UZ1 to UZ8 appropriately georeferenced as in the attached Location map of 100 hectares. Location Maps 2 and 3 also define aerial views generated from LandSAT and Google imageries of the same area.

The area is characterized by a tropical climate with an annual average rainfall amount of 1200 – 1500 mm, mean annual temperatures ranging from 27˚c to 32˚c and mean annual relative humidity ranging from 30.5 % to 94.0 % (weppa wanno farms, 2013). The area lies within the northern belt of derived savanna-forest transition. ( Remison, 2005). The dry season begins in November and ends by March. The

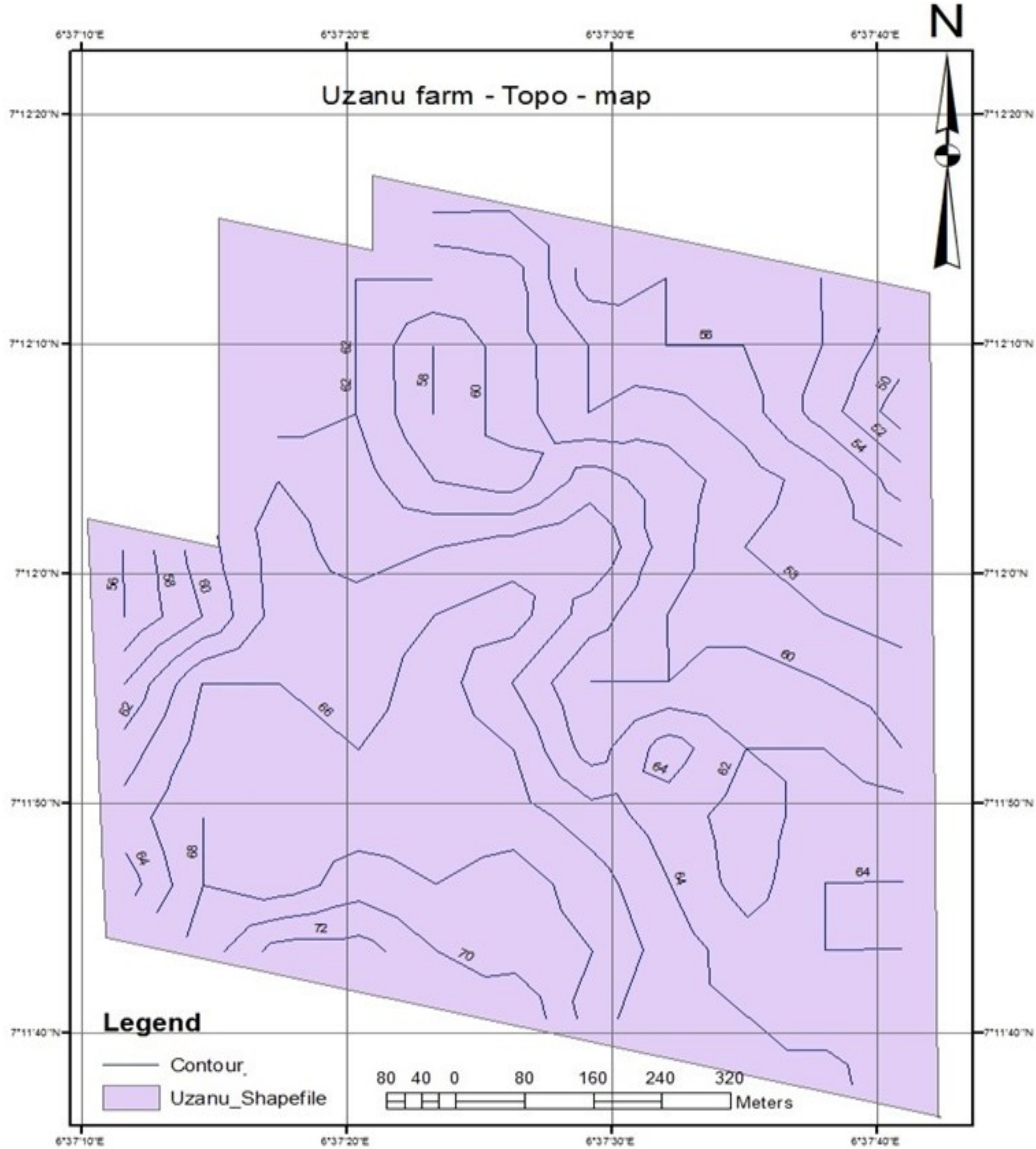



Fig. 2: Topographical Map of Study Area

rainfall pattern is bimodal with peaks in July and August. However, there is a short spell in mid-August which is accompanied by few thunder storms.

The soils are derived from Agwu – Nkporo shale Group.

The topography of the site has a gradual slope of 2 – 6 % and rock outcrops visible in some parts of the study area.

The vegetation includes riparian forest along the stream course; scattered trees, Oil palm; and some old and new farms cultivated to sweet potatoe, rice, yam, cassava etc


Fig 3: Google imagery of project area

Moreover, the series of rock outcrops visible in some areas may have led to the sparsely populated vegetation in the area and their roots spreading on the soil surface as against areas without rock outcrops which are densely populated and this is an indication that vegetation increases as soil depth increases in the area as shown below.

**Field Studies**

The perimeter map of the land was used as a base map. Field survey was conducted in a selected area measuring 100 hectares using the rigid grid systematic soil survey method with transverses cut at intervals of 100 m from a pre-determined base line with the transverses running in both vertical and horizontal directions at right angles to each other, making a total of 10 traverses. Auger points were placed at 100 m interval along the traverses, giving a total of 84 auger/examination points at depth intervals of 0 - 30 cm, 30 - 60 cm, 60-90 cm and 90-120 cm respectively. Auger samples were also described morphologically on the field (soil colour, texture by feel, presence or absence of mottles, mottle colour, presence or absence of concretions, etc). Areas with similar properties and characteristics such as texture and topographic positions on the landscape were grouped to produce the various soil mapping units. Four mapping units were eventually delineated. Profile pits of 2 m x 2 m x 2 m dimension were dug at representative points in each mapping unit, described according to FAO (1976) and identified layers and horizons were sampled from bottom upward.

**Laboratory Analysis**

Soils collected from each horizon were air-dried and passed through a 2 mm sieve. The sieved samples were analysed for some physical and chemical properties. Particle size distribution was determined by the hydrometer method (Bouyoucos, 1962) 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 (Murphy and Riley, 1962). 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 ($NH_4OAC$ 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 Kjedhal method (Bremner and Mulvaney, 1982). Exchangeable Acidi-

Table 1: summary of morphological properties of the soils

| Horizon | Depth (cm) | Colour(moist) | Texture | RootsAbundance | Structure | Boundary form |
|---|---|---|---|---|---|---|
| A | 0-10 | 10YR 2/2 | Loam | Medium-Many | Medium Sub-Angular blocky | Smooth-Clear |
| $Bt_1$ | 10-30 | 10YR 4/4 | Clay Loam | Medium-Many | Medium Sub-Angular blocky | Smooth-Diffuse |
| $Bt_2$ | 30-56 | 10YR 5/6 | SiltyClay Loam | Medium-Common | Thin Sub-Angular blocky | Smooth-Diffuse |
| C | 56-106 | 10R 5/6 2.5R 6/8 | Clay | Medium- Few | Thin Sub-Angular blocky | - |
| A | 0-12 | 10YR 42/2 | Loam | Fine –Many | Medium Sub-Angular blocky | Smooth-Gradual |
| $Bw_1$ | 12-27 | 7.5YR 4/3 | Clay Loam | Medium –Many | Thin Sub-Angular blocky | Smooth-Clear |
| $Bw_2$ | 27-57 | 10YR 5/3 2.5YR 3/6 | Clay | Medium-Common | Fine or Thin Sub-Angular blocky | Smooth-Diffuse |
| C | 57-120 | 10YR 5/3 2.5YR3/6 | Clay | Fine Common | Medium Sub-Angular blocky | - |
| A | 0-13 | 10YR, 3/2 | Loam | Fine-Many | Fine or Thin Sub-Angular blocky | Smooth-Clear |
| $Bt_1$ | 13-30 | 10YR, 4/4 | Clay Loam | Medium Many | Fine or Thin Sub-Angular blocky | Wavy-Clear |
| $Bt_2$ | 30-60 | 10YR, 7/4 | Clay | Medium Common | Fine or Thin Sub-Angular blocky | Wavy-Diffuse |
| C | 60-90 | 10YR, 7/4 2.5YR, 6/8 | Clay | Fine Common | Coarse-Sub-Angular Blocky | - |
| $A_p$ | 0-15 | 5YR, 3/2 | Sandy Clay Loam | Fine-Few | Very Fine Sub-Angular blocky | Smooth-Clear |
| $B_w$ | 15-32 | 5YR, 5/6 2.5YR, 3/6 | Clay | Fine- Few | Fine or Thin Sub-Angular blocky | - |

ty 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. ECEC clay was obtained by dividing ECEC soil by percentage clay and multiplying the quotient by 100.

*2.1 Soil Map*

Based on both morphological and laboratory results, similar soils where put together into a map format delineated and digitized

*2.2 Soil Classification*

The data generated from both profile description (morphological description) and laboratory analysis of the soil samples were used to classify the soils according to USDA soil taxonomy (Soil survey staff, 2014) and locally into series.

**3.0 Results**

*3.1 Morphological Properties*

In pedon one, soil colour was very dark brown (10YR 2/2) in A horizon, but ranged from dark yellowish brown (10YR,4/4) to yellowish brown (10YR5/6) in B to C horizon with light red (2.5YR,6/8) mottles. Texturally, A horizon was Loam; while B horizon ranged from clay loam to clay. Structure varied from medium sub-granular blocky to thin sub-angular blocky in A to C horizons. Boundary Form was Smooth-Clear in A horizon and ranged from Smooth-clear to Smooth-Diffuse in B horizon. The soils of pedon two had a very dark greyish brown colour (10YR,4/2) in the A horizon but ranged from dark grey (7.5YR,4/3) to brown (10YR,5/3) in B to C horizons with dark red(2.5YR,3/6) mottles. Texture was loam in A horizon while that of B to C horizons ranged from clay loam to clay. Structure varied from medium sub-Angular blocky to medium sub-Angular blocky in A to C horizons. Boundary form was Smooth-Gradual in A horizon and smooth- diffuse in B horizon.

In pedon three, the soils had a very dark brown colour (10YR, 2/2) in A horizon, but ranged from dark yellowish brown (10YR,4/4) to yellowish brown (10YR, 5/6) in B to C horizons with light red (2.5YR,6/8) mottles. Structure varied from fine or thin Sub-Angular blocky to coarse Sub-Angular blocky in A to C horizon. Boundary Form was Smooth-clear in A horizon and wavy-Diffuse in B horizon.

In mapping unit four, the soils had a very dark redish brown colour (5YR, 3/2) in A horizon and yellowish red (5YR,5/6) in B horizon with dark red (2.5YR,3/6) mottles. Structure varied from very fine Sub-Angular blocky in A horizon and fine or thin Sub-Angular blocky in B horizon. Boundary Form was Smooth-clear in A horizon.

Physical and chemical properties

Table 2. Chemical properties of the soils

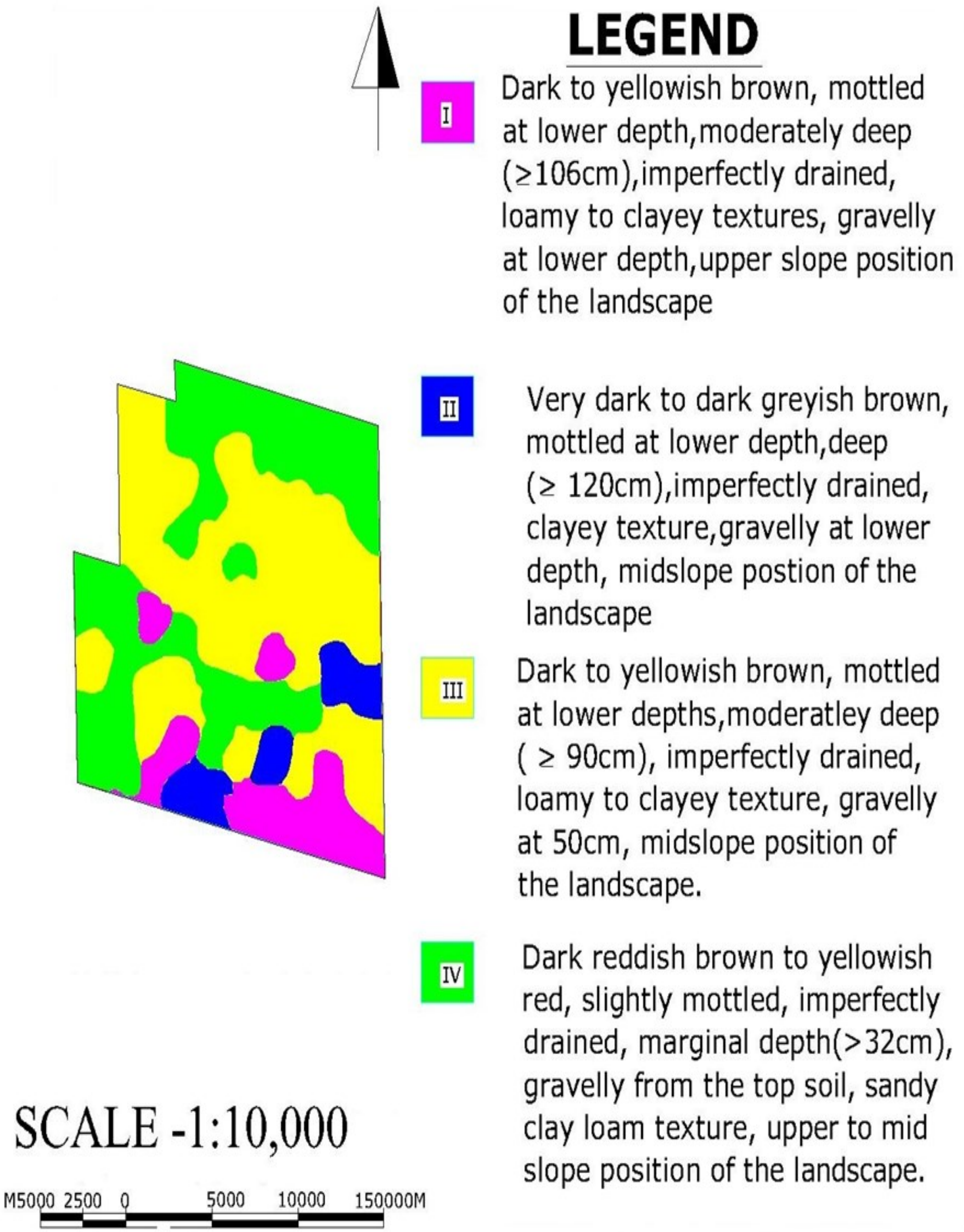
| Horizon | Depth | pH | EC | Org. C | N | P | Na | K | Ca | Mg | Al+ | H+ | CEC | ECEC (soil) | ECEC (clay) | BS | Clay | Silt | Sand | Textural |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cm | $H_20$ | µS/cm | $gkg^{-1}$ | $gkg^{-1}$ | $mgkg^{-1}$ | | | | | $Cmolkg^{-1}$ | | | | | (%) | | $gkg^{-1}$ | | |
| A | 0-10 | 3.90 | 157.70 | 16.28 | 1.29 | 1.09 | 0.51 | 0.08 | 0.63 | 0.15 | 7.20 | 1.90 | 9.03 | 10.47 | 49.86 | 13.09 | 210 | 490 | 300 | L |
| $Bt_1$ | 10-30 | 4.00 | 25.50 | 6.83 | 0.64 | 5.28 | 0.29 | 0.10 | 0.36 | 0.08 | 4.00 | 1.80 | 13.4 | 6.63 | 21.39 | 12.52 | 310 | 450 | 240 | CL |
| $Bt_2$ | 30-56 | 4.00 | 28.20 | 6.65 | 0.70 | 3.46 | 0.52 | 0.14 | 0.38 | 0.13 | 7.00 | 1.00 | 16.40 | 9.17 | 23.51 | 12.76 | 390 | 450 | 160 | SiCL |
| C | 56-106 | 4.40 | 21.40 | 2.08 | Trace | 0.00 | 0.53 | 0.08 | 0.50 | 0.21 | 8.40 | 0.40 | 18.30 | 10.12 | 21.53 | 13.04 | 470 | 350 | 180 | C |
| A | 0-12 | 4.9 | 63.00 | 15.05 | 0.53 | 2.73 | 0.33 | 0.15 | 0.09 | 0.82 | 1.80 | 0.40 | 8.78 | 4.59 | 18.36 | 52.07 | 250 | 410 | 340 | L |
| $Bw_1$ | 12-27 | 4.6 | 16.40 | 7.44 | 0.51 | 2.28 | 0.27 | 0.07 | 0.61 | 0.49 | 1.80 | 0.70 | 13.98 | 3.94 | 10.65 | 36.55 | 370 | 350 | 280 | CL |
| $Bw_2$ | 27-57 | 4.7 | 11.30 | 5.60 | 0.24 | 1.37 | 0.53 | 0.07 | 0.75 | 0.31 | 2.60 | 0.30 | 15.66 | 4.56 | 10.13 | 36.40 | 450 | 310 | 240 | C |
| C | 57-120 | 4.8 | 20.30 | 2.98 | 0.60 | 1.46 | 0.31 | 0.08 | 0.72 | 0.28 | 1.80 | 0.80 | 14.32 | 3.99 | 8.49 | 34.84 | 470 | 310 | 220 | C |
| A | 0-13 | 4.5 | 105.60 | 13.30 | 0.56 | 3.28 | 0.51 | 0.06 | 1.05 | 0.30 | 2.20 | 0.80 | 5.33 | 4.92 | 21.39 | 35.00 | 230 | 330 | 440 | L |
| $Bt_1$ | 13-30 | 4.5 | 21.20 | 7.18 | 0.11 | 1.27 | 0.27 | 0.06 | 0.48 | 0.30 | 4.00 | 0.60 | 3.73 | 5.71 | 18.42 | 19.44 | 310 | 210 | 400 | CL |
| $Bt_2$ | 30-60 | 4.5 | 14.60 | 5.60 | 0.14 | 1.46 | 0.51 | 0.06 | 0.44 | 0.20 | 4.20 | 0.80 | 4.42 | 6.21 | 15.15 | 19.48 | 410 | 230 | 360 | C |
| C | 60-90 | 4.7 | 16.40 | 4.90 | | 2.18 | 0.44 | 0.09 | 0.54 | 0.25 | 2.00 | 0.10 | 5.38 | 3.42 | 7.95 | 34.60 | 430 | 270 | 300 | C |
| $A_p$ | 0-15 | 4.5 | 27.40 | 14.88 | 0.77 | 4.19 | 0.52 | 0.13 | 1.03 | 0.36 | 2.20 | 0.10 | 16.10 | 4.34 | 14.00 | 47.00 | 460 | 230 | 875 | SCL |
| $B_w$ | 15-32 | 4.6 | 19.20 | 9.80 | 0.71 | 2.19 | 0.48 | 0.99 | 0.59 | 0.45 | 0.30 | 0.60 | 9.85 | 8.11 | 18.86 | 30.95 | 340 | 230 | 430 | C |

pH was extremely acidic in A horizons of pedons 1, very strongly acidic in pedons 2,3 and 4; in B horizon, it ranged from extremely acidic in pedon 1 and very strongly acidic in pedons 2,3 and 4. Organic carbon varied from high to low in all the pedons, decreasing generally with depth. Nitrogen was generally low throughout the area under consideration. Available Phosphorus varied from high, medium to low. Sodium ranged from low to medium to low. Potassium was low in all the pedons. Calcium varied from medium to low in some pedons and low to medium in other pedons. Generally, Magnesium was low, but was medium in some layers. Exchangeable acidity (Hydrogen and Aluminum) was low, as a result of the low pH values of these soils. Cation Exchange Capacity (CEC) was low in pedon 3, but ranged from low, medium to high in pedons 1, 2, and 4. Ratio of eluvial to illuvial clay of Pedons 1 and 3 established the presence of argillic horizons in these pedons. Base Saturation was less than 35% in pedons 1 and 3; strongly suggesting that they belong to the Ultisol soil order of the USDA soil taxonomy, but var-

Summary of the Soil Classification for the four Pedons.

| Pedon | USDA | Series | Areal extent (ha) | Areal coverage(%) |
|---|---|---|---|---|
| 1 | Loamy Isohyperthermic Typic Plinthudult | Origo | 14.2 | 14.2 |
| 2 | Loamy Isohyperthermic Ruptic – Ultic – Dystrudept | Origo | 13.2 | 13.2 |
| 3 | Loamy Isohyperthermic Typic Plinthudult | Origo | 38 | 38 |
| 4 | Loamy Isohyperthermic Ruptic – Ultic – Dystrudept | Ekiti | 34.7 | 34.7 |

From the above summary table of soil classification, two soil orders were conspicuous in the study area; Inceptisol and Ultisol. The order Ultisol covers the largest area of 52.1 hectares in the study site while that of Inceptisol covered 47.9 hectares in the study area.




**Fig, 4: Soil Map of the study area.**

ied in other pedons. Other details of these results are shown in table two

Soil classification

The soils in the research area were designated as pedons: 1, 2, 3 and 4. Pedons 1 and 3 classification was done according to USDA soil taxonomy (Soil Survey Staff, 2014). The main feature of this pedons was the presence of an argillic horizon. Argillic horizons are subsurface horizons with significantly higher percentage of clay than the overlying soil material, these horizons also possesses ECEC (Clay) value that is greater than $12cmol^{-1}$ per clay as well as the ratio of illuvial to eluvia that is greater than 1.2 which further strengthens and establishes the presence of an argillic horizon**.** Based on the morphological features, the physical and chemical parameters for this pedon, classification according to the USDA Soil taxonomy (Survey Staff, 2014) places these soils in the order Ultisols**.** The presence of an Udic moisture regime and because the soil moisture controls section (SMCS) are moist for as long as 90 days consecutively, placed this soils in the suborder Udult. The presence of two horizons in 106 cm of the mineral soil surface in which plinthite forms a continuous phase in one-half of the volume of the soils, placed the great group as plinthudult. The soils belong to the subgroup Typic Plinthudult because they possess the central concept of the great group. The dominant soil texture here was loamy soil and an Isohyperthermic temperature regime which qualifies the family as Loamy Isohyperthermic Typic Plinthudult. The soils are locally classified as Origo series (Smith and Montgomery, 1962). Therefore, according to USDA soil taxonomy, these soils were classified as “Loamy Isohyperthermic Typic Plinthudult” and locally as Origo series.

Pedons 2 and 4 had the presence of a cambic B horizon as the main morphological feature.

Cambic horizon is a diagnostic subsurface horizon with loamy texture and has few evidences of illuviation to meet the requirement of an argillic horizon and it is characterized by the alteration of mineral materials which qualifies the soils in the order Inceptisols. The suborder is Udepts because they have an Udic moisture regime. They belong to the great group Dystrudepts because of the low effective cation exchange capacity (ECEC, clay) and base saturation of less than 60 percent (by $NH_4OAC$) in all sub-horizons between depths of 12 and 57 cm below the soil surface (Soil Survey Staff, 2014). The sub group is Ruptic – Ultic – Dystrudepts - that is, other Dystrudepts that have in each pedon a cambic horizon that includes 10 to 50 percent (by volume) illuvial parts that otherwise meet the requirements for an argillic horizon. The family category consists of an Isohyperthermic temperature regime and a loamy surface texture which placed the family class of these soils as Loamy Isohyperthermic Ruptic – Ultic – Dystrudept and locally defined as Origo series (Smith and Montgomery, 1962).

## 4.0 Conclusion

The mapping and classification of some soils at Uzanu community, Edo State was an attempt to accomplish the fundamental purpose of giving the soils of the research farm an identity of both local and international significance and languages that constitute the very basis of transfer of knowledge by putting research findings beyond the realm of individual and/or local verification and authentication. Apart from contributing to knowledge, it also helps to upgrade most scientific works that have been carried out by mere assumptions on the accuracy of the location of the experimental site.

The study revealed that the soils were highly leached, as evident in the low pH values, as well as the low values of exchangeable bases and acidity which placed the soils of pedons 1 and 3 in the soil order, Ultisols; Pedons 2 and 4 in Inceptisols.

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