

## SOIL MAPPING AND CLASSIFICATION: A CASE STUDY OF ANEBETTE, EDO STATE, NIGERIA

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### ABSTRACT

Remote sensing and semi-detailed rigid grid soil survey of some soils in Anebette was conducted in June, 2019 on a 22,817-hectare land in order to obtain comprehensive soil data for classification. Six soil mapping units P1, P2, P3, P4, P5 and P6 were identified on the basis of land forms and surface texture. According to USDA Soil Taxonomy System, soil units P1, P2, P3, P4, P5 and P6 were classified as Rhodic Kandudalf, Vertic Kandudalf, Typic Ferrudalf, Lithic Kanhapludalf, Typic Udifluvent and Vertic Dystrudept, respectively and correlate with Nitic, Vertic Lixisol (Rhodic, Dense), Lixic Ferralic Nitisol (Rhodic, Dystric), Plinthic Lixisol (Skeletal, Ferric), Nitic Pisoplinthic Lixisol (Rhodic, clayic), Haplic Fluvisol (Arenic, Dystric) and Stagnic Vertic Cambisol (Clayic, Dystric) in WRB system of Classification. From the results and the soil map of the area, the mapping and classification of the soils were clearly spelt out. The study has brought out clearly relevant soil information that can guide decision on the use and management of soils of the area on a sustainable basis.

**Keywords:** Agricultural Landscape, Classification, Mapping Units, Rhodic, Plinthic.

### INTRODUCTION:

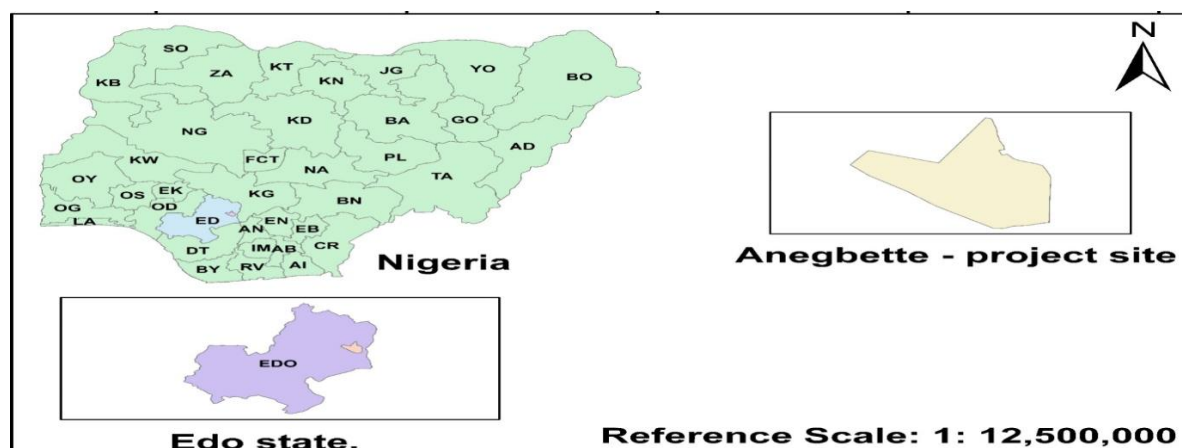
There is an increasing demand for information on soils as a means to produce food (Fasina *et al* 2007). Agriculture is the predominant economic activity in Nigeria and because of agricultural development and increasing demand for experimental data in Nigeria, much work is carried out on soil mapping 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, soil classification and characterization 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. A soil mapping study, therefore, is a major building block for understanding the soil, classifying it and leads to sustainable management of the environment (Esu, 2005).

Owing to the fact that Anebette is an agrarian 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, is to map and classify some soils of Anebette community.

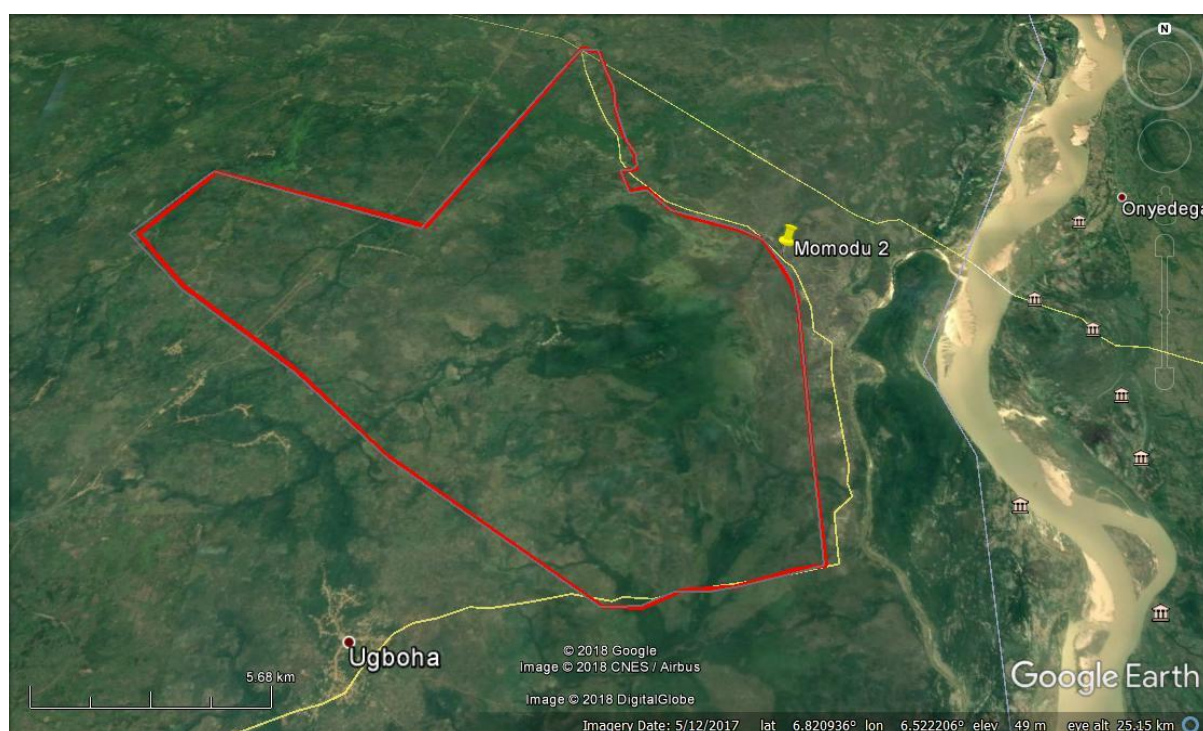
### MATERIALS AND METHODS

#### Study Area

Anebette is one of the major towns in Etsako Central local government area of Edo State. The land mass is about 22,817 hectares. It is bounded on the south by Illushi and Delta states, Ugboha on the south west, north by Augiere, Iyereoku, Azukala and Fugar and on coordinates 6.75833 to 6.97778 N and 6.37 to 6.578611 E as shown in the location map 1 and google imagery (map 2) below.



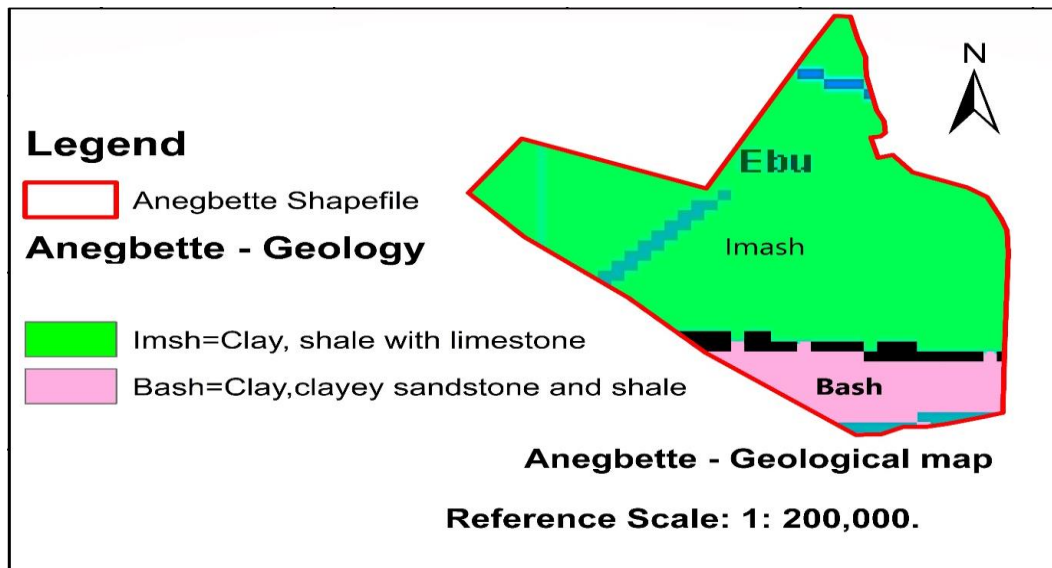
Map 1: Map of Nigeria Showing Project Area



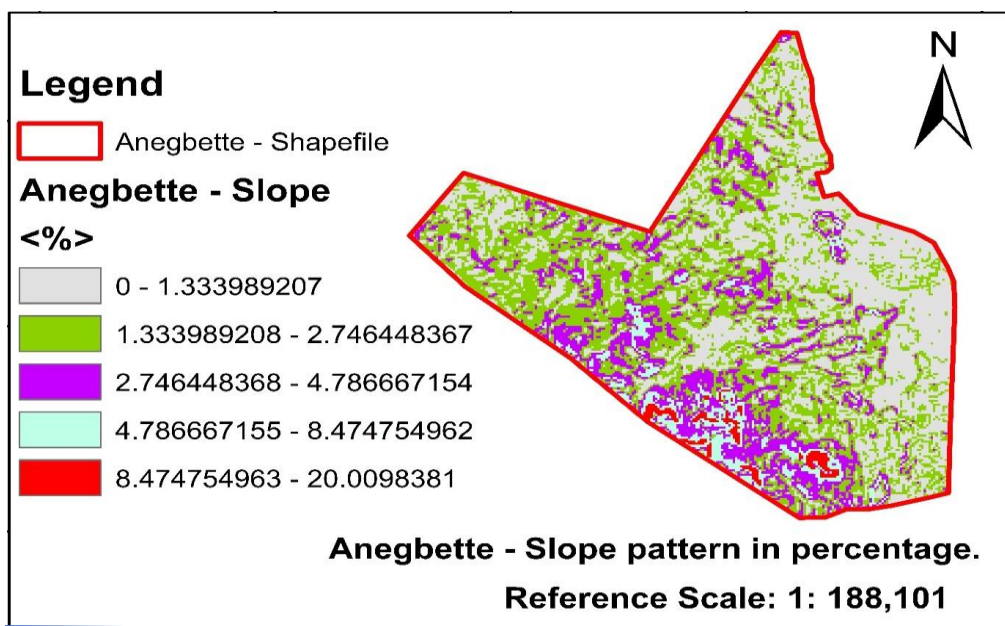
Map 2: Google Imagery of the Project Site.

Rainfall in the area is about 1200 mm/year. Temperature can be as high as 34 - 35 °C for most days in the dry season. Relative humidity ranges between 60 - 80 % for dry and

rainy season periods, respectively. Major crops are rice, cassava and oil palm. Map 3 and 4 below also shows the geology and slope pattern of the research area.



Map 3: Geologic Map for Anegbette



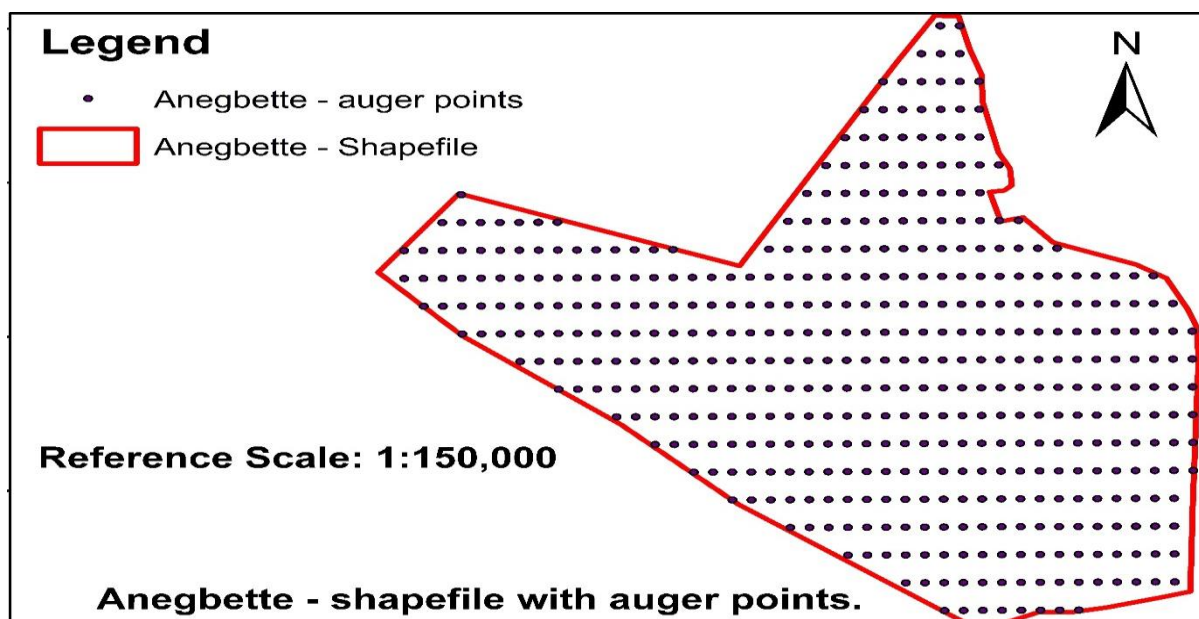
Map 4: Slope Pattern for Anegbette

#### Identification of Soil Mapping Units:

Remote sensing and GIS Technologies were employed in accessing the site while rigid grid format consistent with one soil auger observation per 50 hectares was used to ensure uniformity of spread of observation points across the accessible land scape. The google image provided by the Local Government Area was georeferenced and imported into the ArcMap environment for the production of the shapefile for the site. Auger points were then generated from the ArcMap and loaded into the

GPS for field auger point location. Local bush paths and community road network were exploited in this exercise of mapping. At each auger point, borings were made to 120 cm or to an impenetrable layer and described largely on the basis of morphological features – texture by feel, colour, consistence, depth, etc. Similar points in soils, geology, drainage and topographical details were put together to produce six (6) mapping units. Each unit was represented by a profile pit, constructed to standard specifications, described according to

FAO (1977b) standards, sampled and taken to the laboratory for the determination of both chemical and physical properties.



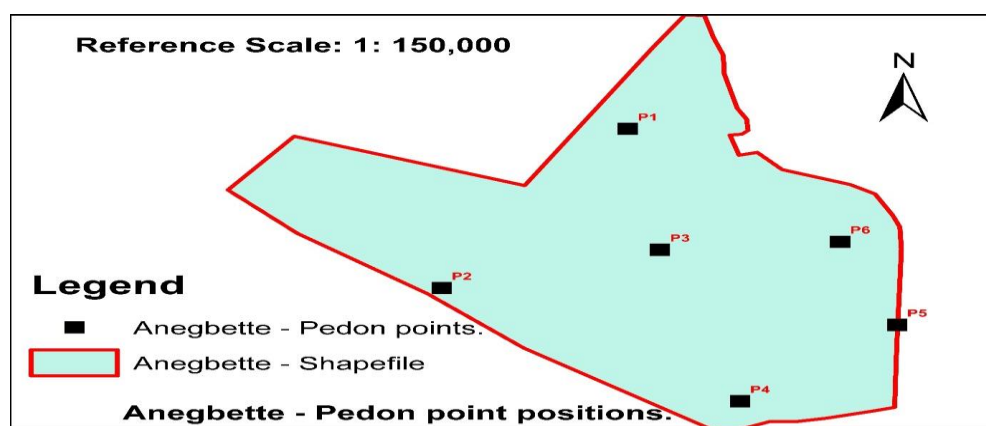
Map 5a: Auger points for Anebbette

Representative pedons for each of the six mapping units are as georeferenced below and

specific positions in the landscape indicated on the map.

Table 1: Pedon point coordinates

| Pedons (P) | Coordinates in decimal degrees. |         |
|------------|---------------------------------|---------|
|            | N                               | E       |
| P1         | 6.90003                         | 6.49599 |
| P2         | 6.82422                         | 6.44263 |
| P3         | 6.84242                         | 6.50523 |
| P4         | 6.77024                         | 6.52820 |
| P5         | 6.80662                         | 6.57323 |
| P6         | 6.84624                         | 6.55689 |



Map 5b: Anebbette profile points.

## RESULTS AND DISCUSSION

The results of physical and chemical analysis of the soils in the area as shown in Table 2 and 3 below indicates that pH (in H<sub>2</sub>O) range was 7.7 - 4.9 from top to last horizon of pedon 1 and decreased from top to bottom for pedons 2 – 6; Organic Carbon was 15.22 – 1.53 gkg<sup>-1</sup> for pedon 1 and decreased from top to last horizon for pedons 2 – 6. Total Nitrogen was 0.76 – 0.12 gkg<sup>-1</sup> from first to last horizon for pedon 1 and decreased from top to bottom for pedons 2 – 6 respectively. Available Phosphorus was 1.87 – 44.37 mgkg<sup>-1</sup> for pedon 1 and irregular for pedons 2 – 6. Sodium was irregular for pedons 1 to 6. Potassium was irregular for pedon 1, it dropped from 0.36 – 0.05cmolkg<sup>-1</sup> for pedon 2 and irregular for pedons 3 – 6. Calcium was irregular for pedon 1, decreased from 3.35 – 0.85 cmolkg<sup>-1</sup> for

pedon 2 and irregular for pedons 3 – 6. Magnesium was irregular for pedon 1, decreased from 0.35 – 0.06 cmolkg<sup>-1</sup> for pedon 2 and irregular for pedons 3 to 6. Exchangeable acidity (EA) decreased from 0.02 – 0.48cmolkg<sup>-1</sup> and irregular for pedons 2 to 6 respectively. Effective cation exchange capacity (ECEC) was irregular for pedon 1 but decreased from 4.18 – 1.11 cmolkg<sup>-1</sup> for pedon 2 and irregular for pedons 3 – 6 respectively. Base Saturation (BS) was 99.63 – 60.33 % for pedon 1 but irregular for pedons 2 – 6 respectively as shown in table 3.

Texture was sandy loam to clay for pedon 1, sandy loam to clay for pedon 2, sandy loam to sandy clay for pedon 3, sandy loam to clay for pedon 4, sand to sandy loam for pedon 5 and clay to sand for pedon 6 respectively as shown in table 2.

**Table 2: Physical Analysis Results for Anegbette Profile Samples**

| Pedon | Depth<br>Cm | Particle size determination |            |            | Texture |
|-------|-------------|-----------------------------|------------|------------|---------|
|       |             | Sand(g/kg)                  | Silt(g/kg) | Clay(g/kg) |         |
| P1/1  | 0-9         | 580                         | 240        | 180        | SL      |
| P1/2  | 9-47        | 320                         | 280        | 400        | C       |
| P1/3  | 47-93       | 360                         | 260        | 380        | CL      |
| P1/4  | 93-135      | 430                         | 290        | 280        | CL      |
| P1/5  | 135-155     | 430                         | 150        | 420        | C       |
| p2/1  | 0-30        | 790                         | 100        | 110        | SL      |
| p2/2  | 30-78       | 450                         | 70         | 480        | C       |
| p2/3  | 78-122      | 390                         | 70         | 540        | C       |
| p3/1  | 0-36        | 630                         | 190        | 180        | SL      |
| p3/2  | 36-62       | 550                         | 180        | 270        | SCL     |
| p3/3  | 62-93       | 670                         | 110        | 220        | SL      |
| p3/4  | 93-124      | 470                         | 140        | 390        | SC      |
| p3/5  | 124-156     | 610                         | 80         | 310        | SCL     |
| p3/6  | 156-183     | 470                         | 110        | 420        | SC      |
| P4/1  | 0-14        | 730                         | 110        | 160        | SL      |
| P4/2  | 14-55       | 490                         | 70         | 440        | SC      |
| P4/3  | 55-83       | 370                         | 170        | 460        | C       |
| P4/4  | 83-125      | 280                         | 170        | 550        | C       |
| P5/1  | 0-21        | 890                         | 50         | 60         | S       |
| P5/2  | 21-78       | 870                         | 70         | 60         | S       |
| P5/3  | 78-120      | 890                         | 50         | 60         | S       |
| P5/4  | 120-160     | 870                         | 50         | 80         | LS      |
| P5/5  | 160-195     | 800                         | 70         | 130        | SL      |
| P6/1  | 0-40        | 260                         | 260        | 480        | C       |
| P6/2  | 40-66       | 340                         | 180        | 480        | C       |
| P6/3  | 66-99       | 250                         | 239        | 520        | C       |
| P6/4  | 99-110      | 880                         | 40         | 80         | S       |

**Table3: Chemical Analysis Results for Anegette Profile Samples**

| Pedon | Depth   | pH<br>(1:2)      | Cond.  | Org.<br>C | Total<br>N | Avail.<br>P | Ca                | Mg   | K    | Na   | EA   | ECEC | BS    |
|-------|---------|------------------|--------|-----------|------------|-------------|-------------------|------|------|------|------|------|-------|
|       | Cm      | H <sub>2</sub> O | µ/cm   | g/kg      | g/kg       | mg/kg       | .....coml/kg..... |      |      |      |      |      | %     |
| P1/1  | 0-9     | 7.7              | 216.00 | 15.22     | 0.76       | 1.87        | 4.95              | 0.32 | 0.07 | 0.03 | 0.02 | 5.39 | 99.63 |
| P1/2  | 9-47    | 5.0              | 22.10  | 4.05      | 0.34       | 0.39        | 0.60              | 0.23 | 0.06 | 0.02 | 0.18 | 1.09 | 83.49 |
| P1/3  | 47-93   | 5.0              | 25.30  | 2.25      | 0.18       | 2.30        | 0.65              | 0.07 | 0.06 | 0.03 | 0.22 | 1.03 | 78.64 |
| P1/4  | 93-135  | 5.1              | 28.00  | 1.89      | 0.14       | 14.62       | 0.73              | 0.08 | 0.05 | 0.02 | 0.26 | 1.14 | 77.19 |
| P1/5  | 135-155 | 4.9              | 28.00  | 1.53      | 0.12       | 44.37       | 0.53              | 0.11 | 0.07 | 0.02 | 0.48 | 1.21 | 60.33 |
| P2/1  | 0-30    | 6.0              | 97.80  | 6.94      | 0.58       | 4.13        | 3.35              | 0.35 | 0.36 | 0.02 | 0.10 | 4.18 | 97.61 |
| P2/2  | 30-78   | 5.2              | 15.53  | 3.96      | 0.33       | 0.17        | 1.25              | 0.18 | 0.07 | 0.03 | 0.19 | 1.72 | 88.95 |
| P2/3  | 78-122  | 5.5              | 9.12   | 0.45      | 0.04       | 0.44        | 0.85              | 0.06 | 0.05 | 0.04 | 0.11 | 1.11 | 90.09 |
| P3/1  | 0-36    | 5.9              | 42.60  | 23.69     | 1.48       | 3.08        | 4.05              | 0.28 | 0.17 | 0.12 | 0.10 | 4.72 | 97.88 |
| P3/2  | 36-62   | 5.0              | 20.00  | 12.70     | 0.91       | 0.28        | 2.65              | 0.43 | 0.12 | 0.05 | 0.90 | 4.15 | 78.29 |
| P3/3  | 62-93   | 4.9              | 13.81  | 3.87      | 0.32       | 1.61        | 0.65              | 0.15 | 0.05 | 0.03 | 0.14 | 1.02 | 86.27 |
| P3/4  | 93-124  | 4.8              | 31.60  | 5.67      | 0.47       | 0.06        | 0.62              | 0.05 | 0.07 | 0.02 | 0.18 | 0.94 | 80.85 |
| P3/5  | 124-156 | 4.9              | 13.62  | 3.06      | 0.26       | 0.33        | 0.66              | 0.07 | 0.22 | 0.03 | 0.20 | 1.18 | 83.05 |
| P3/6  | 156-183 | 4.9              | 21.10  | 1.71      | 0.12       | 0.44        | 0.80              | 0.17 | 0.13 | 0.04 | 0.17 | 1.31 | 87.02 |
| P4/1  | 0-14    | 5.9              | 145.50 | 14.23     | 0.65       | 11.91       | 2.11              | 0.15 | 0.12 | 0.06 | 0.10 | 2.54 | 96.06 |
| P4/2  | 14-55   | 5.0              | 32.50  | 5.94      | 0.11       | 0.95        | 0.52              | 0.13 | 0.04 | 0.03 | 0.36 | 1.08 | 66.67 |
| P4/3  | 55-83   | 5.2              | 21.20  | 4.05      | 0.28       | 0.79        | 0.96              | 0.10 | 0.05 | 0.04 | 0.29 | 1.44 | 79.86 |
| P4/4  | 83-125  | 5.4              | 9.60   | 1.08      | 0.23       | 0.39        | 1.14              | 0.22 | 0.05 | 0.03 | 0.27 | 1.71 | 84.21 |
| P5/1  | 0-21    | 6.4              | 52.70  | 5.40      | 0.04       | 16.85       | 3.17              | 0.60 | 0.07 | 0.09 | 0.08 | 4.01 | 98.00 |
| P5/2  | 21-78   | 6.6              | 20.70  | 0.09      | 0.03       | 4.68        | 3.20              | 0.30 | 0.06 | 0.04 | 0.05 | 3.65 | 98.63 |
| P5/3  | 78-120  | 6.4              | 18.24  | 0.03      | 0.01       | 4.36        | 2.04              | 0.55 | 0.12 | 0.02 | 0.04 | 2.77 | 98.56 |
| P5/4  | 120-160 | 6.4              | 18.35  | 0.05      | 0.02       | 3.64        | 1.90              | 0.35 | 0.04 | 0.02 | 0.05 | 2.36 | 97.88 |
| P5/5  | 160-195 | 5.5              | 16.80  | 0.00      | 0.02       | 3.01        | 0.26              | 0.08 | 0.02 | 0.01 | 0.21 | 0.58 | 63.79 |
| P6/1  | 0-40    | 4.0              | 177.50 | 47.74     | 1.06       | 0.41        | 0.32              | 0.11 | 0.05 | 0.03 | 0.56 | 1.07 | 47.66 |
| P6/2  | 40-66   | 4.1              | 31.50  | 5.40      | 0.04       | 0.48        | 0.28              | 0.14 | 0.06 | 0.02 | 0.55 | 1.05 | 47.62 |
| P6/3  | 66-99   | 4.3              | 26.30  | 1.80      | 0.14       | 0.57        | 0.42              | 0.17 | 0.05 | 0.03 | 0.92 | 1.59 | 42.14 |
| P6/4  | 99-110  | 4.5              | 31.50  | 1.53      | 0.03       | 0.30        | 0.47              | 0.15 | 0.04 | 0.02 | 0.64 | 1.32 | 51.52 |

**Soil Classification.**

Based on the laboratory results and morphological information from the field, the various pedons were classified according to Soil survey staff, (2010) and World Reference Base for soil resources (WRB, 2006). Pedons 1 - 4 had argillic/argic subsurface layers and base saturation percentages higher than 35% at the appropriate depths and therefore qualified to be in the Alfisol order and Lixisol RSG (WRB). Prevailing soil moisture regime was Udic and was subsequently placed in the Udalf subgroup. The

presence of Kandic, Ferric and Kanhaplic layers placed them in the Kandiudalf, Ferudalf and Kanhapludalf great groups, respectively. The subgroup was determined according to the presence of bright overwhelming red colour (evidence of good drainage) – Rhodic, high clay content – vertic, hard concretionary layers – lithic and typical expression of the great group characteristics – typic, for P1, P2, P3 and P4, respectively. Same procedure was followed for P5 and P6 placing them as Entisols and Inceptisols, respectively. The corresponding nomenclature in WRB is as detailed in table 2 below.

**Table 4: Soils of Anegette project area.**

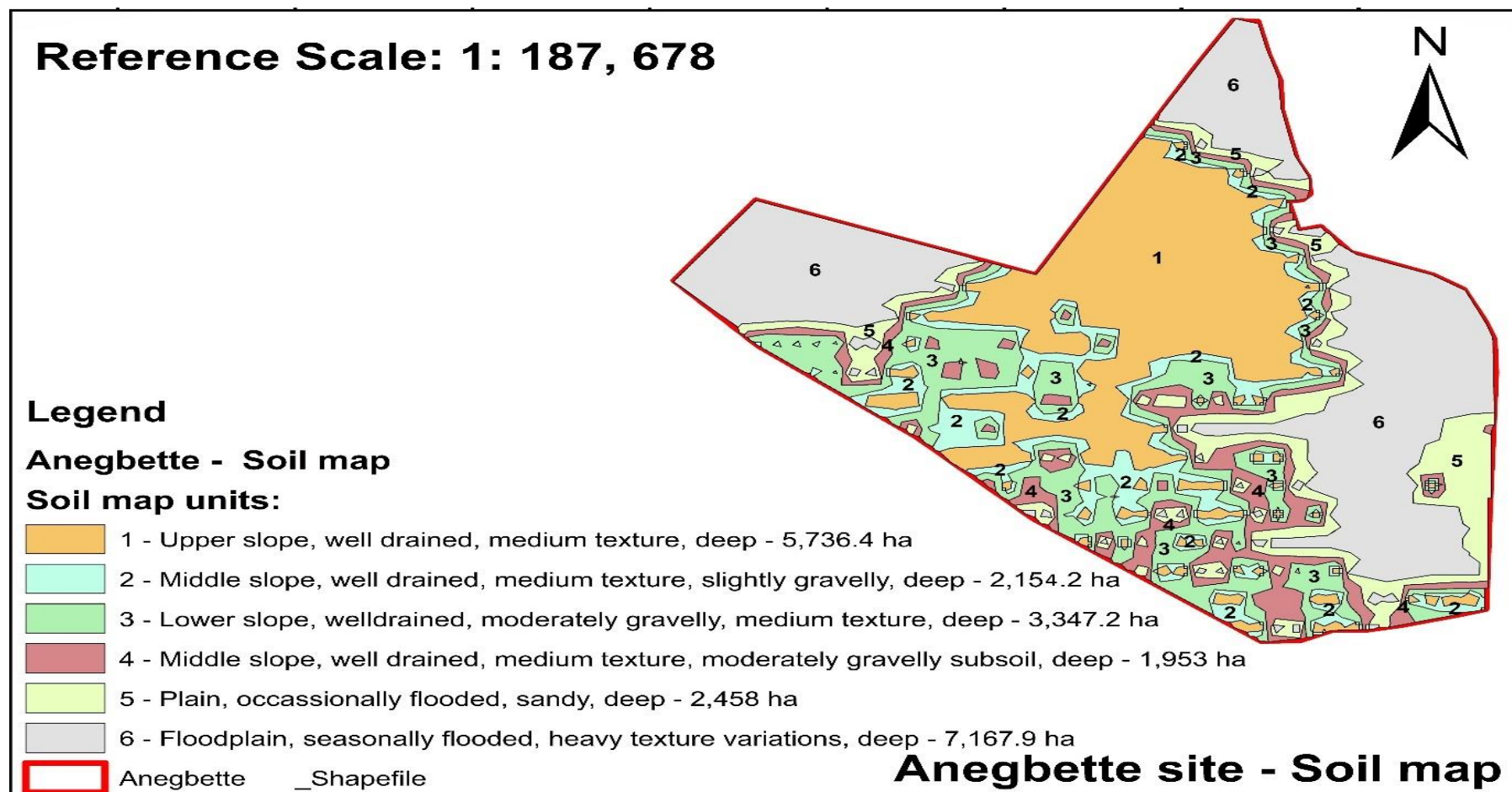
| Pedons  | Soil name                 |                                             | Area     | coverage. |
|---------|---------------------------|---------------------------------------------|----------|-----------|
|         | USDA Soil Taxonomy (2010) | WRB (2006)                                  | (ha)     | (%)       |
| P1      | Rhodic Kandiudalf         | Nitic-Vetic Lixisol (Rhodic, Dense)         | 5,736.4  | 25.1      |
| P2      | Vertic Kandiudalf         | Lixic-Ferralic Nitisol (Rhodic, Dystric)    | 2,154.2  | 9.4       |
| P3      | Typic Ferrudalf           | Plinthic Lixisol (Skeletal, Ferric)         | 3,347.2  | 14.7      |
| P4      | Lithic Kanhapludalf       | Nitic-Pisoplinthic Lixisol (Rhodic, clayic) | 1,953    | 8.6       |
| P5      | Typic Udifluent           | Haplic Fluvisol (Arenic, Dystric)           | 2,458    | 10.8      |
| P6      | Vertic Dystrudept         | Stagnic-Vertic Cambisol (Clayic, Dystric).  | 7,167.9  | 31.4      |
| Total = |                           |                                             | 22,816.7 | 100 %     |

**Soil map of research area.**

Soils of Anegette as presented in table 4 coupled with the soil map of the area clearly

explains the names of the different soils in the area, position on the landscape, depth to water and other characteristics in the area.

The scaled distribution of the various soils present in the project area is shown in the soil map (Map 6) below and subsequently described.



Map 6: Soil Map for Anegbette

## CONCLUSION

Soil mapping and classification of some soils in Anegbette was an attempt to accomplish the fundamental purpose of giving the soils of the area an identity of both local and international significance. Soil mapping was done at a semi-detailed rigid grid method. Six mapping units were created on the basis of similarity of soils and morphological details. Soil samples were collected and analysed using standard methods. The results shows that the soils of mapping unit 1 were classified according to USDA soil taxonomy as Rhodic Kandiudalf and Nitic-Vetic Lixisol (Rhodic, Dense) according to WRB. Vertic Kandiudalf according to USDA and Lixic-Ferralic Nitisol (Rhodic dystric) WRB for pedon 2. Pedon 3 was Typic Ferrudalf, USDA and Plinthic Lixisol (Skeletal Ferric), WRB. Pedon 4 was Lithic Kanhapludalf, USDA and Nitic-Pisoplinthic Lixisol (Rhodic, Clayic), WRB. Pedon 5 was Typic Udifluent, USDA and Haplic Fluvisol (Arenic, Dystric), WRB. Pedon 6 was Vertic Dystrudept, USDA and Stagnic-Vertic Cambisol (Clayic, Dystric), WRB. Three soil orders (Alfisols, Entisols and Inceptisols) were found in the study area with Alfisols covering an area of 15,648.8 ha, Entisols covering an area of 7,167.9 ha and Inceptisols covering an area of 22,816.7 ha. The study has brought out clearly relevant soil information that can guide decision on the use and management of soils of the area on a sustainable basis.

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