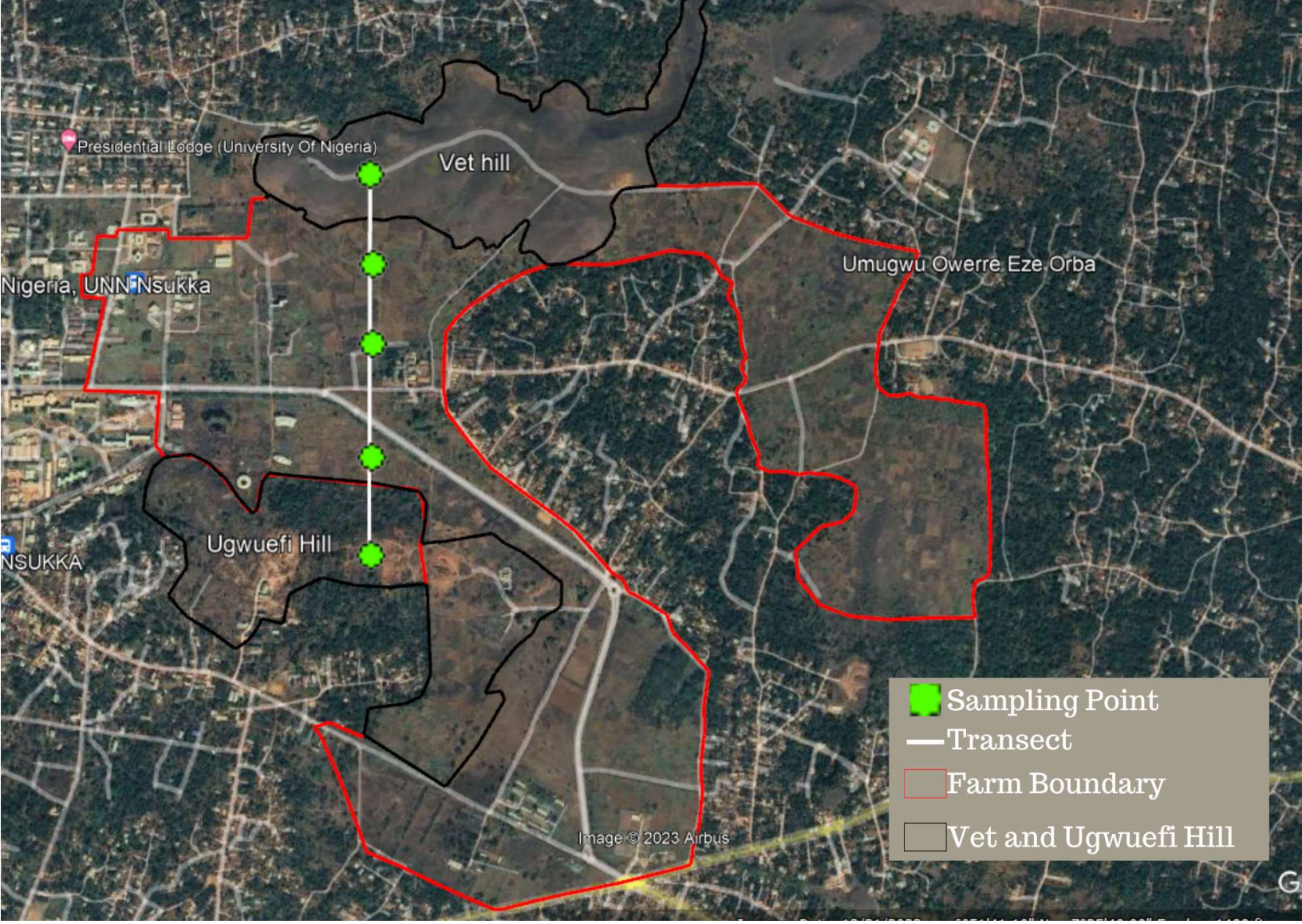

Field Trip Manual showing the Transect Covered

Contributed by Prof. C.L.A. Asadu and Mr. C.P. Umeugokwe

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Background information of the field trip location

The field trip location is at the University of Nigeria Teaching and Research Farm which offers an enriching experience in agricultural research, education, and practical training. Situated within the university's premises, the farm is flanked by two hills, Ugwuefi to the north and Vet hill to the south, creating a picturesque environment.

Within this location, there are two prominent soil series. The Nkpologu series is found on the nearly flat lower slopes of the farm, while the Uvuru series exists on the gently undulating plateaus and upperslope positions of the hills. This diversity in soil types offers an excellent opportunity for studying soil profiles along a transect.

The farm's environment, facilities, and strong commitment to agricultural research and education make it a significant center for exploring the relationship between soil science and practical land management practices. It provides an ideal setting for researchers, and students to appreciate various aspects of soil science and gain practical experience in managing agricultural land.

The location of the field trip

The farm is located at latitude (6°51'0"N and 6°52'12"N) and longitude (7°25'0"E and 7°26'18"E) on an elevation range of 419-496 m (Figure 1).

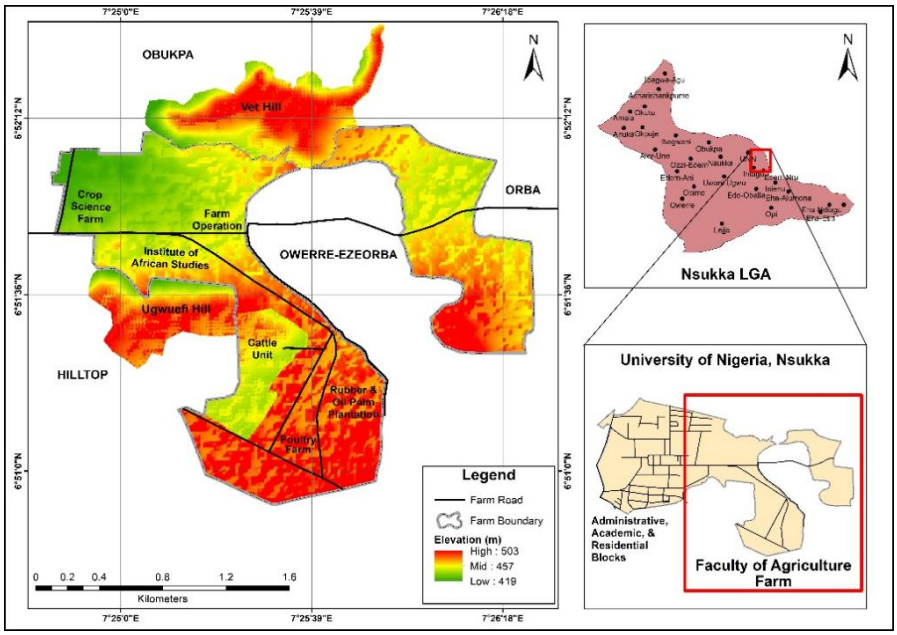

Figure 1: Map of University of Nigeria teaching and Research Farm

Climate

Figure 2 shows the climate of the study location. The climate in Nsukka is tropical. According to the Köppen-Geiger climate classification, it falls under the Aw category. In Nsukka, the average annual temperature is 25.7 °C, and the average yearly rainfall is 1504.67 mm. The driest month is December, with only 2.06 mm of rain, while the month with the highest precipitation is September, averaging around 270.24 mm. March is considered the warmest month, with minimum temperatures averaging 23.4 °C and maximum temperatures reaching 32.6 °C. On the other hand, October experiences the lowest average temperatures of the year, with temperatures hovering around 24.3 °C.

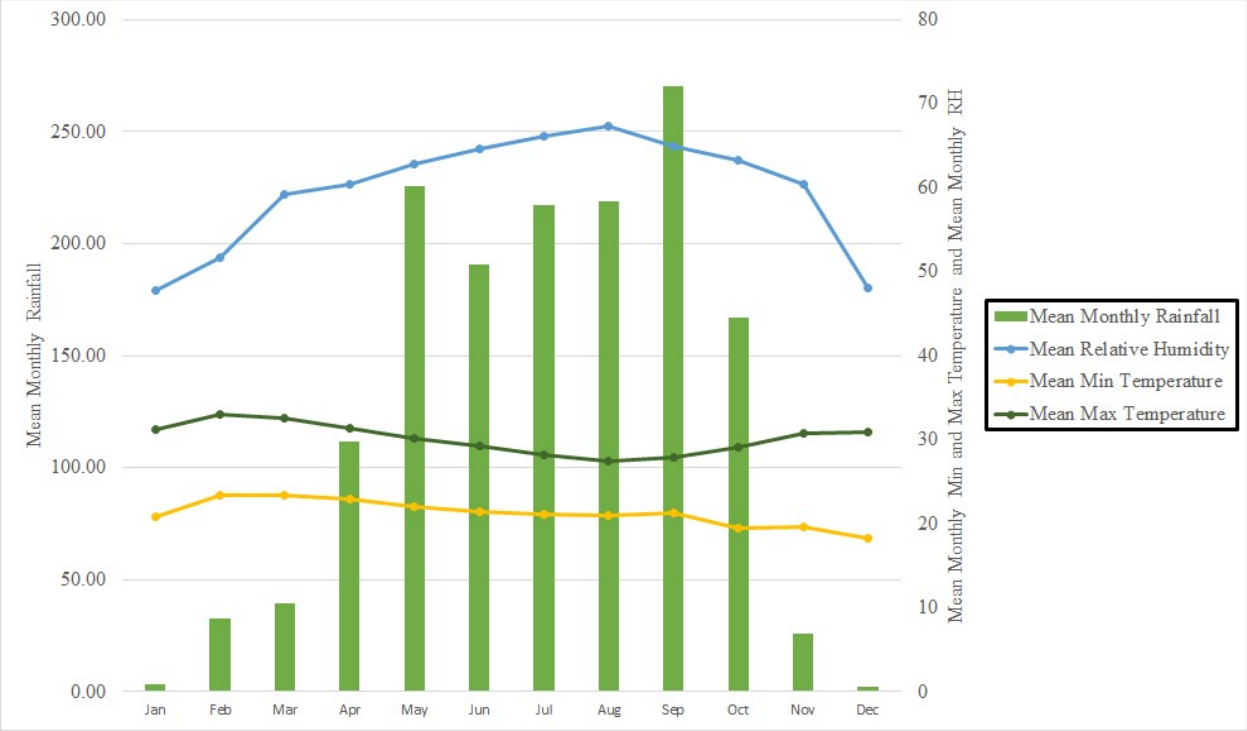

Figure 2: Climate of the location

Source: Faculty of Agriculture, UNN Meteorological station

Profile Pit Locations

The soils along a transect form the foundation of this field manual, focusing on the prominent soil series, Uvuru and Nkpologwu, found in the study area. The selection of profile pit locations was aided by satellite imagery, as depicted in Figure 3. Two profile pits were chosen for the Uvuru series, one for each of the two hills, while three profile pits were selected for the Nkpologwu series separated at 150 m intervals. The location of the sampling points was georeferenced using GPS.

Following the guidelines outlined by the FAO (2006) for soil description, the profile pits were thoroughly examined and characterized. The description process includes assessing various soil properties and features. Soil samples collected from these pits were further analyzed using standard laboratory methods.

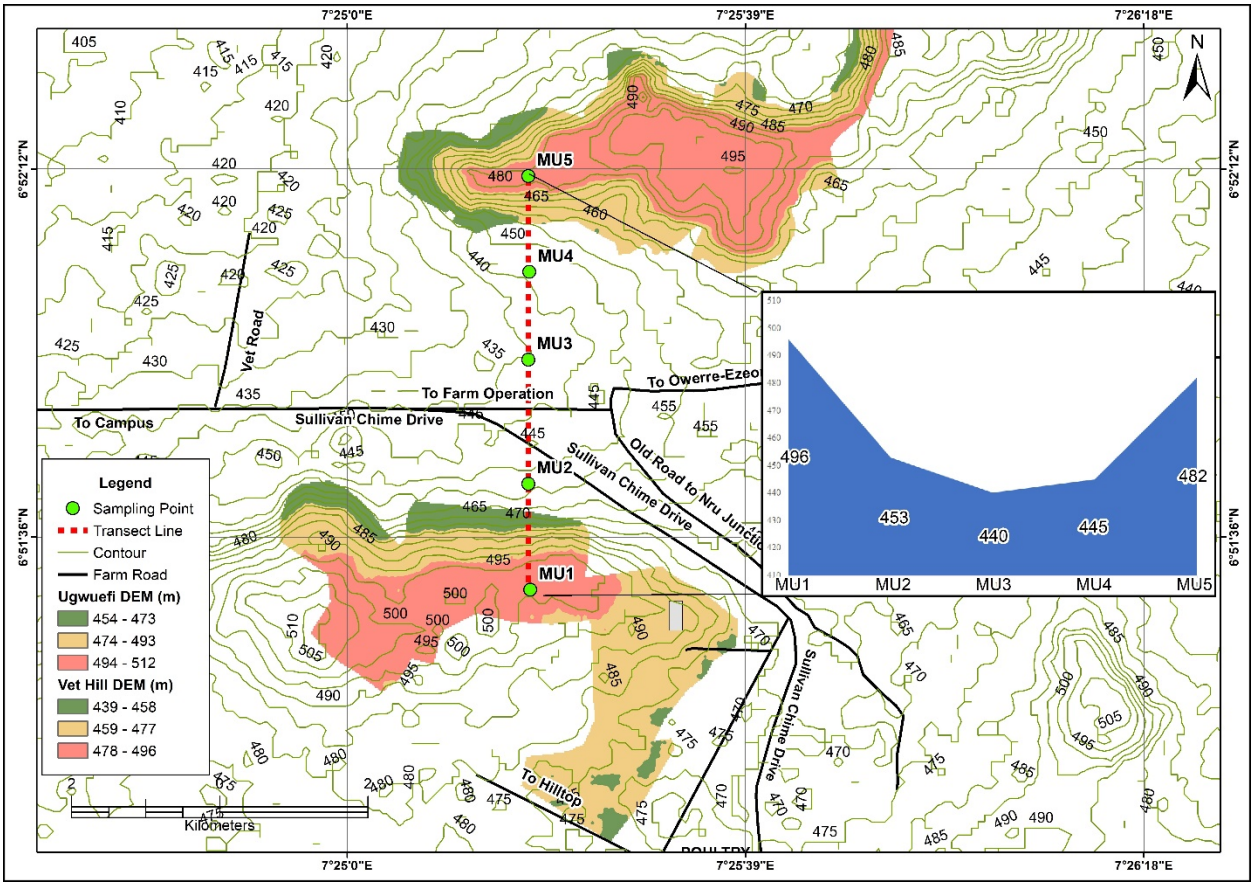

Figure 3: Map of the study area showing the transect

Overview of the soil characteristics and features

Uvuru series (MU 1 and 5)

The Uvuru series is characterized by soils that contain significant amounts of iron concretions and angular fragments of ferruginised shales. These soils often exhibit gravel layers that extend beyond the usual sampling depth of 40 inches. Beneath the gravel layer, layer of mottled clay or red clay with decomposing shale fragments are usually found.

The presence of iron concretions and ferruginised shales in the Uvuru series indicates the influence of iron-rich minerals in the series. The gravel layers suggest the presence of coarse fragments that may affect soil drainage and root penetration. The mottled clay or red clay layers, along with the decomposing shale fragments, provide additional context about the composition and structure of the soil in this series (Asadu et al. 2022). Tables 1 and 2 and Plate 1 show the typical characteristics of Uvuru series. The textural class is sandy clay loam. The soils are very slightly acidic, low in TN, exch. Ca, Na, K, as well as base saturation; low to moderate OC, moderate Mg, moderate to high CEC and Av. P and high EA.

Table 1: Typical physical properties of Uvuru series

Horizon (cm)	BD ($g\ cm^{-3}$)	%TP	KSat ($cm\ hr^{-1}$)	WHC	Clay	Silt	FS	CS	TC
					→	$g\ kg^{-1}$	←		
0-10	1.67	36.98	37.42	28.03	230	70	490	210	SCL
10-40	1.50	43.40	20.51	25.75	290	70	430	210	gSCL
40-60	1.53	42.26	30.30	32.21	350	70	340	340	gSCL

BD = bulk density, TP = total porosity, KSat = hydraulic conductivity, WHC = water holding capacity, FS = fine sand, CS = coarse sand, TC = textural class, and SCL = sandy clay loam, g = gravelly.

Table 2: Typical chemical properties of Uvuru series

Horizon (cm)	pH		OC	TN	Ca	Mg	Na	K	CEC	EA	Av.P	BS
	H_2O	KCl	$g\ kg^{-1}$		→		$cmol\ kg^{-1}$	←			$mg\ kg^{-1}$	%
0-10	4.5	3.7	1.49	0.08	0.40	0.40	0.05	0.10	20.40	5.10	28.91	15.70
10-40	4.6	3.6	1.15	0.07	0.40	0.40	0.05	0.10	22.80	6.00	19.59	13.67
40-60	4.6	3.6	0.72	0.07	0.20	0.40	0.03	0.07	25.60	5.60	13.60	11.11

OC = organic carbon, TN = total nitrogen, CEC = cation exchange capacity, EA = exchangeable acidity, Av. P = available phosphorus, and BS = base saturation.

Nkpologwu series (MU 2, 3 and 4)

The Nkpologwu soils are characterized by reddish-brown upper layers that are slightly clayey and coarse sandy, transitioning into red coarse sandy clay at around 12 to 36 cm deep (Asadu et al. 2022). The parent material of these soils is a mixture of sand from sandstone and colluvial clay, giving them their unique composition.

One notable feature is that they tend to be structureless and do not contain any gravel or stones. Additionally, Nkpologwu soil series also tend to have sandy clay loam textures down the depth and are extremely acidic to very slightly acidic.

The Nkpologwu series exhibits characteristics such as low total nitrogen (TN), calcium (Ca), sodium (Na), potassium (K), and base saturation (PBS). The organic carbon (OC) content is generally low to moderate, with higher values occurring on the surface. Additionally, the series displays a moderate cation exchange capacity (CEC) and moderate to high exchangeable acidity (EA) and available phosphorus (Av. P) (Tables 3 and 4). Furthermore, Plate 2 provides a visual representation of the typical soil profile of the Nkpologwu series.

Table 3: Typical physical properties of Nkpologwu series

Horizon (cm)	BD ($g\ cm^{-3}$)	%TP	KSat ($cm\ hr^{-1}$)	WHC	Clay	Silt	FS	CS	TC
					→ $g\ kg^{-1}$ ←				
0-6	1.36	48.68	23.27	32.99	230	70	320	380	SCL
6-21	1.70	35.85	17.00	23.36	210	50	360	370	SCL
21-60	1.61	39.25	28.33	30.99	270	70	340	320	SCL
60-117	1.39	47.55	37.88	36.19	350	70	190	290	SCL
117-200	1.53	42.26	36.06	33.06	230	50	430	290	SCL

BD = bulk density, TP = total porosity, KSat = hydraulic conductivity, WHC = water holding capacity, FS = fine sand, CS = coarse sand, TC = textural class, and SCL = sandy clay loam.

Table 4: Typical chemical properties of Nkpologwu series

Horizon (cm)	pH		OC	TN	Ca	Mg	Na	K	CEC	EA	Av. P	BS
	H_2O	KCl	$g\ kg^{-1}$		→ $cmol\ kg^{-1}$ ←						$mg\ kg^{-1}$	%
0-6	4.9	4.0	1.41	0.08	0.60	0.40	0.05	0.10	15.20	4.80	35.44	19.33
6-21	4.9	4.1	1.25	0.08	0.60	1.00	0.05	0.10	16.00	6.00	25.18	22.58
21-60	4.0	3.5	0.98	0.08	0.60	0.20	0.03	0.07	20.40	5.10	12.12	15.00
60-117	3.9	3.5	0.55	0.08	0.20	0.40	0.02	0.06	18.00	6.40	11.90	9.60
117-200	4.6	3.7	0.31	0.06	0.40	1.00	0.01	0.04	16.40	4.70	11.90	23.58

OC = organic carbon, TN = total nitrogen, CEC = cation exchange capacity, EA = exchangeable acidity, Av. P = available phosphorus, and %BS = percentage base saturation.

Plate 1: Typical soil profile of Uvuru series

Plate 2: Typical soil profile of Nkpologwu series

Field Activities to led by Pedologists attending

- Guided observations at each pit
- Soil sampling techniques and demonstrations
- Data collection and documentation
- Discussing the observed soil profiles and their implications
- Relating the findings to the conference theme and broader research
- Facilitating group discussions and Q&A sessions

Conclusion

This field trip to the University of Nigeria Teaching and Research Farm will provide an enriching opportunity for agricultural research, education, and practical training. The farm's location, nestled between the scenic hills of Ugwuefi and Vet hill, offers a picturesque environment for studying two prominent soil series: Nkpologwu and Uvuru. It will contribute to our knowledge of soil science and its practical applications in managing agricultural land. Furthermore, it will serve as a valuable resource for researchers, educators, and students in the field of agriculture.

References

Asadu, C.L.A., Umeugokwe, C.P., Ajoagu, G.M., Ofem, K.I., Kefas, P.K., and Udosen, C.I. (2022). Monograph on existing soil series in Nigeria and their correlation.

Food and Agriculture Organization of the United Nations (2006). Guidelines for Soil Description (4th ed.). Rome, Italy: FAO.

Appendix

General site information for Uvuru Series

Profile name	UNTRF1
Described by	Umeugokwe, Chigozie Pascal
Date	20/07/2023
Location	06° 51' 31.12" N; 07°25' 17.85" E
Elevation	497 m
Climate	MAR: 1505 mm; MAT: 26 °C
Parent material	Upper Coal Measure
Taxonomic classification	Arenic Kanhapludults (USDA) Arenic Acrisols (FAO)
Landform	Mountainous
Micro-topography	Gently sloping
Topographic position	Crest
Vegetation/land use	Grasses with few scattered tress
Erosion	Slight
Drainage	Well drained
Moisture status	Slightly moist throughout
Depth to water table	None encountered
Depth to impenetrable layer	Yes (at 60 cm)
Surface stoniness	None
Rock outcrop	Yes
Biological activities	Presence of roots in A and AB horizons.

Horizon description

Horizon	Depth (cm)	Thickness (cm)	Description
A	0-10	10	Very dark reddish brown (2.5YR 2/3) loamy sand; weak medium crumb structure; friable (moist) and slightly plastic (wet); many and fine roots; perfectly drained; abrupt smooth boundary.
AB	10-40	30	Dark reddish brown (2.5YR 3/6) loamy sand; weak medium crumb structure; friable (moist) and slightly plastic (wet); very few and fine roots; perfectly drained; abrupt smooth boundary.
BC	40-60	20	Red (10R 4/6) gravelly; structureless coarse granular structure; loose (moist) and plastic (wet); few and very fine roots; perfectly drained.

General Information on soil use and Management:

Though Uvuru series is typically gravelly, acidic and low in organic matter and most nutrients, it deep enough for arable crop production but being located either on the hills or on slopes erosion control measures such as contouring, ridging across the slope, year-round vegetative cover, and no bush burning are recommended. Mechanical cultivation should be avoided. Liming and integrated organic and inorganic manure application s based on the soil information will improve the productivity of the series.

General site information of Nkpologwu series

Profile name	UNTRF2
Described by	Umeugokwe, Chigozie Pascal
Date	20/07/2023
Location	06°51' 53" N; 07°25' 17" E
Elevation	435 m
Climate	MAR: 1505 mm; MAT: 26°C
Parent material	False-Bedded Sandstone
Taxonomic classification	Arenic Kanhapludults (USDA); Arenic Acrisols (FAO)
Landform	Plain
Micro-topography	Level or nearly level
Topographic position	Lower slope
Vegetation/land use	Grasses /Arable land
Erosion	Slight
Drainage	Well drained
Moisture status	Ustic
Depth to water table	None encountered
Depth to impenetrable layer	None encountered
Surface stoniness	None
Rock outcrop	None
Biological activities	Presence of roots in all the horizons

Horizon description

Horizon	Depth (cm)	Thickness (cm)	Description
Ap	0-6	6	Very dark reddish brown (2.5YR 2/3) loamy sand; weak coarse crumb structure; friable firm (moist) and plastic (wet); many and fine roots; perfectly drained; abrupt wavy boundary.
AB	6-21	15	Dark reddish brown (2.5YR 3/6) loamy sand; weak coarse crumb structure; friable (moist) and plastic (wet); few and very fine roots; perfectly drained; abrupt smooth boundary.
B1	21-60	39	Red (10R 4/6) loamy sand; moderate coarse crumb structure; friable firm (moist) and plastic (wet); few and very fine roots; perfectly drained; abrupt smooth boundary.
B2	60-117	57	Reddish brown (2.5 YR 4/8) sandy clay loam; moderate medium granular structure; friable firm (moist) and very plastic (wet); very few and very fine roots; perfectly drained; distinctnesswavy boundary.
B3	117-200	83	Red (10R 4/8) sandy clay loam; moderate medium granular structure; friable firm (moist) and very plastic (wet); few and very fine roots; perfectly drained.

General Information on soil use and Management:

The Nkpologwu soil series is very deep though with generally low nutrient contents typical of soils of southeastern Nigeria. With adequate soil nutrient management protocols, both arable and tree crops can perform well on the soil series. It can withstand mechanical cultivation.