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Soil survey and land capability evaluation for sustainable crop production in Abocho, Dekina local government area of Kogi state

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ABSTRACT

A survey of soils of Abocho, Dekina Local Government Area of Kogi State, was conducted to characterize, classify and assess the potentials of the soils for sustainable crop production. The area was reconnoitered and three representative profile pits were dug and described according to international procedures and standard methods. Soil samples were analyzed for their physical and chemical properties and the land was assessed for its capability to produce commonly cultivated crops. Results revealed well-drained and deep soils. Texture showed loamy sand overlying sandy loam except few portions with loamy sand throughout the profile depth. Soils were very strongly - strongly acid (4.5-5.5) with very low (subsurface) to moderate (surface) organic carbon (5.25-14.21 gkg^{-1}). Available phosphorous was moderate (8.93-16.42 $mgkg^{-1}$). There were generally low exchangeable bases and cations exchange capacity (CEC) values ranging from 2.67 to 6.05 cmolkg-^{1}. Typic Psammustepts and Typic Kandiustalfs were identified, based on the USDA soil Taxonomy and were correlated as Fluvisols and Lixisols respectively in World Reference Base. Land capability classification rated 67 % of the land area moderate (III) for arable crop production and 33 % for non-arable (V) with soil reaction and high sand fraction as constraints. Since the soils were low in fertility and highly acidic, the judicious use of lime and full complements of organic manure and fertilizers are recommended.

1.0 Introduction

The quest for a sustainable increase in food production in Nigeria has resulted in more land being opened up for large-scale production. The study of soil resources in detail through surveys and evaluation for various land utilization remains one of the strategies to achieve food security and a sustainable environment (Esu, 2004). Soil survey provides information on the types of soil that cover the earth's surface, their characteristics, and distributions for various purposes, such as agriculture, road construction, and regional planning.

Soil survey provides a systematic basis for studying crops and soil relationship to increase productivity and help in soil conservation and reclamation. This has effectively supported agricultural and natural resource management for more than a century (FAO, 1993).

Ojanuga *et al*. (2003) observed that no two spots along a soil continuum are the same in the combination or interaction of factors responsible for their formation. Soils are surveyed according to the land's physiographic features (Brady and Weil, 2005). Therefore, understanding the characteristics of soils in an area is very important and crucial for productive and sustainable management of such soils to better the lives of the inhabitants (Oluwatosin *et al*., 2006).

Land evaluation is an interpretation of soil survey reports. Esu (2010), described it as a very handy tool in assessing the potentials of land for specific purposes and responses of the soils to manipulative management for sustained agricultural production. The correct interpretation of soil and its environment is the basis for rational and sustainable land use for crop production. This is corroborated by Van Diepen *et al*., (1991) who described land evaluation as the various techniques to explain or predict the potential use of land.

Land Capability Classification System (LCC), as described by Klingebiel and Montgomery (1966) is a land evaluation system developed by the USDA to group soil mapping units based on their capability to produce commonly cultivated crops and pasture plants without deterio-

ration over a long period. The capability map is an interpretative soil map which helps planner/farmer use the land area more efficiently and sustainably (Akamigbo, 2010).
Abocho, in the Eastern part of Kogi State, is a rural agricultural-based community; however, the poor soil management practiced in the area; due to paucity of soil information may have contributed to food insecurity experienced by the agrarian people of the community.
This work was carried out to survey the soils (characterization and classification) and assess the potentials (land capability evaluation) and constraints that will need to be improved upon for sustainable production of both arable and non-arable crops in the area.

2.0 Materials and methods

2.1. Study Area
The study was conducted in Abocho within the Dekina Local Government Area of Kogi State. The study site (255.44 ha) lies between Latitudes 7° 33 ' and 7° 34 ' N and Longitudes 6° 57 ' and 6° 58 ' E with altitudes ranging between 396 and 335 meters above sea level (Global Positioning System). The soils are underlain by the cretaceous sediments and sandstone (Amhakhian and Achimugu, 2011 and Fatoye, 2018).
The climate is humid tropical, supporting guinea savanna vegetation. The mean annual rainfall is 1260 mm falling between April and October; annual air temperature of about 22 to 33° C in February and 17 to 30° C in December (Ifatimehin, *et al.*, 2010).
The area is tropical woodland within the guinea savanna ecological zone of Nigeria, cultivated to crops like sorghum, cassava, yam, groundnut, maize, vegetables, mangoes, cashew and oil palm as agriculture is the significant economic activity in the study area, though on subsistence basis (Ibitoye, 2014).
2.2. *Fieldwork*
The area was reconnoitered using footpaths and boundary demarcation to identify various physiographic features such as land use patterns and landforms. The boundary coordinates (latitudes and longitudes) and some notable elevation data of the land of the study site were recorded with a handheld Global Positioning System (GPS) receiver (*Garmin-etrex*). Arc map-10.3 software in GIS was used to analyze the geo-referenced data to produce the study's area topographic map (Fig. 1). The topographic map and other physiographic features (vegetation and landforms) observed in the area were used for auger investigation (colour, texture, and consistency) at depths of 0 – 15, 15 – 30, and 30 – 60 cm. Based on the auger investigation, three mapping units were delineated and one representative profile pit was dug in each mapping unit. The profile pits were demarcated into horizons and described for morphological attributes, following the procedures of the Soil Survey Staff (2014). Disturbed and undisturbed (core) soil samples were collected from identified horizons (from the bottom of the pits upwards to avoid cross-contamination of the soil samples) and analyzed for their physical and chemical properties.
2.3. Soil analysis and data interpretation

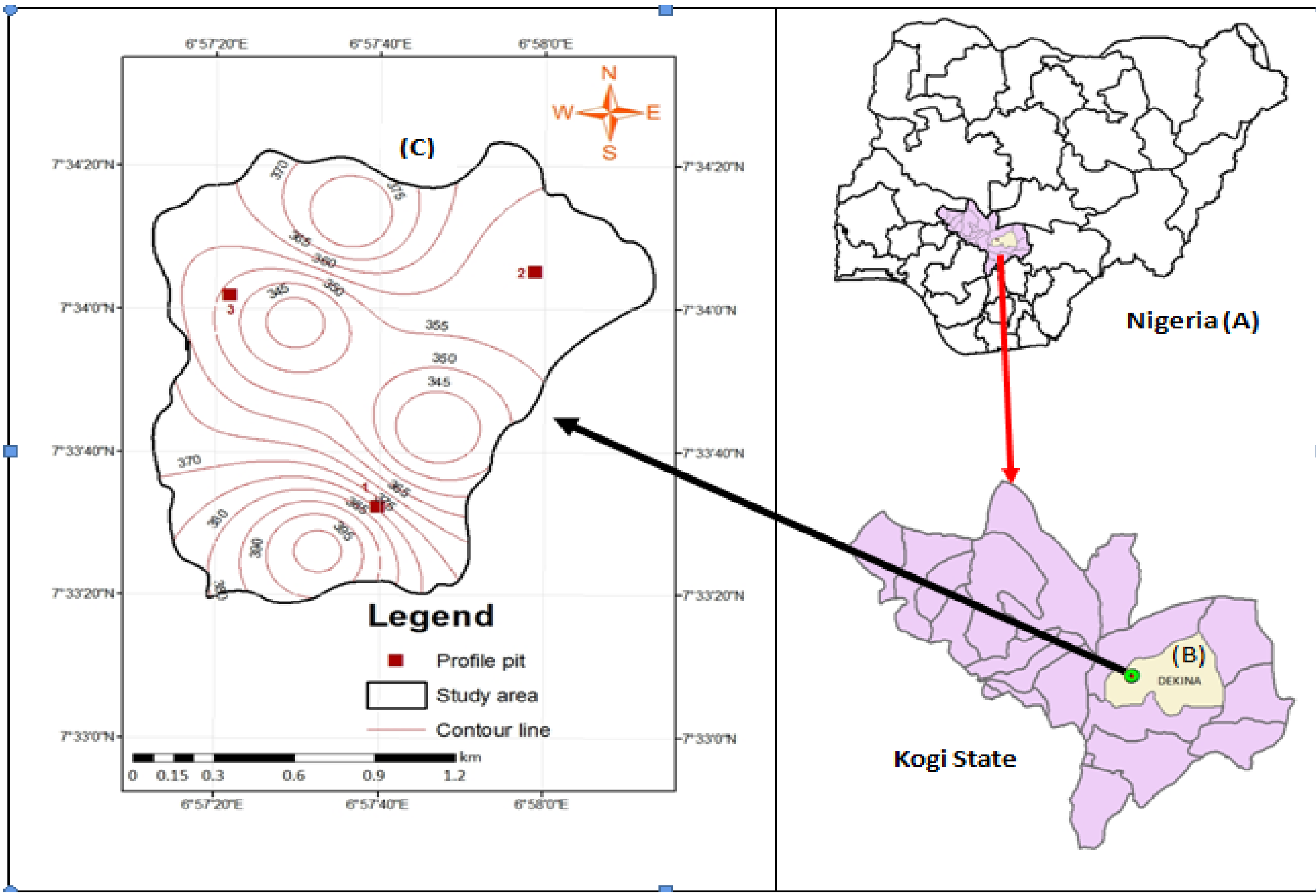

Fig.1: Map of Nigeria (A) showing the study area (B), and (C) topography of the study site with locations of profile pits

Two sets of soil samples; disturbed and un-disturbed were collected from each pedogenic horizon. The disturbed soil samples collected were air-dried under laboratory conditions and sieved through a-2 mm wire mesh sieve. The fine earth fractions (< 2 mm) were subjected to routine soil analyses. Following appropriate standard procedures described by Udo, *et al*. (2009), the following parameters were analyzed: Particle size distribution (Bouyocous method) using sodium hexametaphosphate as dispersant and selenium tablets as catalysts (Gee and Or 2002). Soil reaction (pH) was measured potentiometrically in a soil: water suspension (mixed at a ratio of 1:2.5 soil: water) using a glass electrode pH meter (Thomas, 1996). Organic carbon was determined from the sieved soil samples (further passed through 0.5 mm sieves) by the dichromate wet oxidation method (Udo, *et al*., 2009). Total nitrogen was determined on samples (also passed through 0.5 mm sieve) by the regular mico-Kjeldahl method described by Bremner (1996). Available phosphorus was extracted with Bray number II solution of HF and HCl and the P in the extract was determined spectrophotometrically. The cation exchange capacity (CEC) was determined by the summation method (buffered at pH 8.2) in which all exchangeable cations including exchange acidity (Al^{3+} and H^{+}). The exchangeable bases were extracted by saturating the soil with neutral 1M KCl. Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+} displaced by NH_4^{+} were measured by Atomic Absorption Spectrometer (AAS) (Udo, *et al*., 2009). Exchangeable acidity was extracted with 1N KCl and estimated in the extract by titration (Udo, *et al*., 2009). Base saturation was obtained by expressing the sum of exchangeable Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+} as percentages of the cation exchange capacity.

Undisturbed soil core samples were oven-dried at 105° C to a constant weight and bulk density calculated using the equation: $Bd = \frac{Mg}{V}$ ………………….. (1)

Where: Bd = bulk density(Mg m^{-3}); Mg = mass of oven-dried soil (g) and V = volume of the soil (m^{3})

Total porosity was determined from bulk density value given that particle density is 2.65 mgm^{-3} for mineral soils.

$$Pt = 1 - \left(\frac{Bd}{Pd}\right) \times 100 \quad (2)$$

Where: Bd is bulk density and Pd, Particle density.

Data were interpreted based on methods described by Chude, *et al*. (2011) and Hazelton and Murphy (2011).

2.4. Soil classification

Based on the morphological, physical, and chemical properties obtained, the soils were classified following the USDA Soil Taxonomy System (Soil Survey Staff, 2014) and were correlated with World Reference Base for soil resources (WRB, 2014).

2.5. Land Capability Classification

The land evaluation method used was the simplified form of the USDA system of land capability classification suggested by Young (1976) and modified by Oluwatosin *et al*. (2006) (Table 1). The classification was based on physical soil and land properties with organic matter, pH, and base saturation as the chemical property involved. The soils were placed into different classes; I - IV as arable and V - VIII as non-arable by matching the land use requirements (Table 3) with the land characteristics. The classification would depend more on the limitations' severity than the number of limitations (FAO, 1983).

Table 1: Simplified conversion table of USDA land capability classification

	Arable				Non-Arable		
Limitations	I	II	III	IV	V-VI	VII	VIII
Slope (%)	1	3	5	10	18	35	Any
Rock outcrops and boulders	Very few	Few	common	many	Abundant	Dominant	Dominant
Wetness class	Nil	Nil	Slight	Slight	Moderate	moderate	Severe
Effective soil depth (cm)	> 100	> 80	> 60	> 30	> 20	> 20	< 20
Texture	SCL-C	SL- - C	SL - C	LS - C	LS - hc	LS - hc	any
Soil permeability	Moderate	R - S	R - S	R -S	Any	Any	any
pH	6 – 8	6 - 8	5 - 6/ 8 - 9	5 - 6/ 8 - 9	< 5/> 9	< 5/> 9	< 5/> 9
Organic carbon (%)	> 1	> 0.8	> 0.6	> 0.4	> 0.2	> 0.2	< 0.2

Source: Simplified USDA System by Young (1976), modified by Oluwatosin *et al*., (2006)
SCL = sandy clay loam, LS = loamy sand, C = clay, hc = heavy clay, SL = sandy loam
R- S = Rapid to slow.

2.6. Geo-spatial analysis

Arc map-10.3 software analyzed the geo-referenced boundary and elevation data by the (GPS) receiver in GIS to produce the study's area topographic map (Fig. 1). Based on the extent to which the pedons' properties meet the criteria for soil classification (Tables 1 and 2), and concerning the pedon' coordinates, the thematic layer was prepared according to the soil classes identified. All the scaled thematic layers were assigned weighted values and integrated into map algebra using kriging interpolation in Arc Map 10.3 software of GIS to produce a soil map of the site under study (Fig. 2).

3.0 Results and Discusion

3.1. Morphological characteristics

Some physiographic features of the land and morphological properties of the studied pedons are presented in Table 2. The landscape is situated between nearly level plain (AD2) of slope gradient 1 % and gently sloping terrain (AD1 and 3) of slope gradients 3 and 4 %). The study area had a ustic moisture regime, very deep (> 170 cm), well-drained, and exhibited no signs of flooding. Colour notations varied from dark-reddish brown (2.5YR 3/3) epipedons to shades of reddish-brown (2.5YR 4/6 - 2.5YR 4/8) endopedons. The horizons were bright and mottle-free; an indication of good surface drainage as evidenced by the chroma value colour notation greater than 2. This may be attributed to perhaps, the presence of sesquioxides in hydrated form, especially the goethite (Idoga and Azagaku, 2005; Esu, 2010).

The surface soil was weak and crumb-structured over moderate and sub-angular structured subsurface. The absence of cracks on the pedon's surfaces probably inferred that the soils have non-expanding clay minerals e.g. kaolinite in them (Survey Staff, 2014).

Consistency (moist) of the soils varied from friable to firm in the subsurface and wet conditions, non-sticky and non-plastic. Roots concentrated in the upper 30 cm of the soil surface. The friable consistency of the epipedons would allow good tillage operation and easy penetration of plant roots. Babalola, (1981) and Ojeniyi (2002) reported that a friable soil often has the optimum conditions for tillage operations, resulting in better seedbed preparation with good drainage, gaseous exchange, and heat conductance.

The soil's texture across the study area was loamy sand overlying sandy loam in all the pedons except pedon AD2 which had loamy sand texture throughout the profile

Table 2: Morphological properties of the soils of the study area

Pedon	Hori-zon	Depth (cm)	Colour (Moist)	Drainage	Slope (%)	Structure	Consistence Moist	Wet	Concretion	Root	Boundary	Texture
ID1	Ap	0 – 14	2.5YR 3/3,DRB	Good	4	2CCr	vfr	ns-np	-	cm	as	Loamy sand
N7.55 91°	BA	14 – 45	2.5YR 3/6,DRB	Good		2CCr	fr	ns-np	-	cf	gw	Loamy sand
E6.961 0°	Bt	45 – 87	2.5YR 4/6,RB	Good		2MSbk	fr	ss-np	-	ff	as	Sandy loam
370 m asl	BtC	87–182	2.5YR 4/8,RB	Good		2MSbk	fm	ss-np	-	vff	-	Sandy loam
ID2	Ap	0 – 20	2.5YR 3/6,DRB	Good	1	2CCr	vfr	ns-np	-	cm	cg	Loamy sand
N7.56 81°	B1	20 – 53	2.5YR 4/6, RB	Good		2MCr	fr	ns-np	-	cf	sh	Loamy sand
E6.966 4°	B2	53 – 106	2.5YR 4/8,RB	Good		2MCr	fr	ns-np	-	ff	as	Loamy sand
357 m asl	BC	106 - 204	2.5YR 4/8,RB	Good		2MSbk	fr	ns-np	-	-	-	Loamy sand
ID3	Ap	0 – 21	2.5YR 4/4,DRB	Good	3	1CCr	fr	ns-np	-	cf	cs	Loamy sand
N7.56 71°	Bt	21 – 66	2.5YR 4/6,RB	Good		2MSbk	fr	ns-np	-	ff	cs	Sandy loam
E6.956 0°	BtC	66 - 184	2.5YR 4/8,RB	Good		2MSbk	fm	ns-np	-	-	-	Sandy loam
347 m asl												

Key: Colour: DBR=Dark reddish brown, RB=Reddish brown. **Structure**: 1=Weak, 2=Moderate, 3=Strong. M=Medium, C=Coarse. Cr=Crumb, Sbk=Sub-angular blocky. **Root:** ff=fine few, fvf=fine very few, fc=fine common, cf=coarse few, mf=medium few, cm=common medium. **Boundary:** a=abrupt c=clear, g=gradual, w=wavy, s=smooth. **Consistence:** fr = friable, fm = firm, vfm = very firm, ns-np = non sticky-non plastic, ss-sp = slightly sticky-slightly plastic depths.

The dominance of sand mineral fraction across the landscape may be partly attributed to parent material (Amhakhian and Achimugu; 2011) and partly to geological processes involving sorting of soil materials by biological activities, clay migration through eluviation and illuviation, or surface erosion by runoff or their combinations (Malagwi, *et al.,* 2000 and Akinbola, *et al*., 2009).

3.2. Physical properties of the soil

The particle-size distribution (Table 3) showed a high sand fraction which decreased down the soil depth (847 – 645 gkg^1). Conversely, there was a progressive increase in clay content down the pedal depth (75 - 217 gkg^1). The silt fraction did not show any definite pattern of distribution with depth. Higher sand content in the surface horizons could also be attributed to colloidal clay particles translocation from the surface to the underlying horizons by percolating water during heavy downpour: eluviation – illuviation pedogenic process (Malagwi, *et al*., 2000). The high sand fraction in the study area indicates an observable high infiltration rate and low water-retention capacity of the soils, thereby resulting in moisture stress. This is in line with Ogban and Babalola, (1995) who reported that high sand fraction soils would need supplementary water at dry season's peak to support good crop growth. This is because, the ground supply may not recharge through capillary action from the wetter zones at lower depth or groundwater table during this period (Ogban and Ibia, 2006).

Therefore, acceptable management practices such as incorporating organic manure into the soil, cultivation of cover crops, and minimum tillage would improve the native properties of the soils for sustainable crop production in the area.

The increased clay content observed in the subsoil could be attributed to high and intense rainfall experienced in the area, leading to clay migration via the network of pores of the coarse texture of the upper horizons through the process of eluviation - illuviation (Malagwi, *et al*., 2000).

Bulk density increased from the surface (1.37 mgm^{-3}) down the depth (1.68 mgm^{-3}) while a decreasing trend was observed for porosity. This could be attributed to a decrease in an organic matter down the depth. Bulk density values within the range of 1.0 and 1.6 mgm^{-3}, as Wild (1993) and Chude *et al*. (2011) reported, were ideal for agronomic activities in most mineral soils. Soils with low bulk densities are usually associated with high total porosity (Payne, 1988). Russell (1988) and Payne (1988) reported that root penetration and seedling emergence were difficult when bulk density exceeded 1.6 mgm^{-3}

The soil's weathering potential was assessed by the silt/clay ratio and silt/silt+clay ratio. This was used to evaluate clay migration, stage of weathering of the soils. The silt/clay ratio ranged from 0.28 – 1.38, indicating that the soils are relatively young with a high degree of weathering potentials. Yakubu and Ojanuga (2009) and Ayolagha and Opene, (2012). reported that soils with a silt/clay ratio less than 0.20 indicate a low degree of weathering. The decrease in silt/clay ratio with depth is an indication that the endopedons are more weathered than the epipedons. The Silt/silt + clay ratios indicated that the soils of the study area were severally weathered. The silt/silt + clay ratios of the soils were less than 0.7; ranging from 0.28 to 0.69 across the study area. According to Yakubu and Ojanuga (2009), silt: silt + clay ratio of 0.7 indicates moderate weathering, < 0.7 for severe weathering, and > 0.7 for incipient weathering. Therefore this finding agreed with the finding of, Yakubu and Ojanuga (2009), and Ayolagha and Opene, (2012).

3.3. Chemical properties of the soils

Table 3: Physical properties of the soils of the study area

Pedon	Horizon	Depth (cm)	Sand	Silt gkg^{-1}	Clay	Textural Class	BD mgm^{-3}	TP (%)	Silt/ Clay	Silt/ Silt+Clay
ID1	Ap	0 – 14	848.00	60.00	92.00	Loamy sand	1.39	48.00	0.65	0.39
	BA	14 – 45	816.00	77.00	107.00	Loamy sand	1.44	46.00	0.71	0.42
	Bt	45 – 87	795.00	84.00	121.00	Sandy loam	1.51	43.00	0.69	0.41
	BtC	87–182	745.00	68.00	187.00	Sandy loam	1.57	41.00	0.36	0.27
ID2	Ap	0 – 20	871.00	49.00	80.00	Loamy sand	1.37	48.00	0.61	0.37
	B1	20 – 53	869.00	36.00	95.00	Loamy sand	1.47	46.00	0.31	0.24
	B2	53 – 106	845.00	48.00	107.00	Loamy sand	1.61	39.00	0.38	0.27
	BC	106 - 204	818.00	67.00	115.00	Loamy sand	1.68	37.00	0.28	0.22
ID3	Ap	0 – 21	846.00	38.00	116.00	Loamy sand	1.40	47.00	0.33	0.27
	Bt	21 – 66	787.00	68.00	145.00	Sandy loam	1.49	44.00	0.47	0.32
	BtC	66 - 184	725.00	80.00	195.00	Sandy loam	1.56	41.00	0.41	0.29

The soils studied fall within the very strongly to strongly acid class (Chude, *et al*., 2011), with pH (H_2O) values ranging from 4.5 to 5.34 (Table 4). The acid nature of the soil can be ascribed to a high rate of leaching of bases which is prevalent in the humid tropics. Chude, *et al*. (2011) and Sasseville, 2013 had established a pH range of 5.5 - 7.0 (slightly acid to neutral reaction) as optimal for overall satisfactory availability of plant nutrients. This implies that the soil of the study site would need to be limed to reduce its acidity and make nutrient elements readily available for absorption by plant roots.

The organic carbon content of the pedon's surface horizons ranged from 10.60 to 14.21 gkg^{-1} and decreased with soil depth. The surface soil organic carbon is considered moderate based on soil nutrient interpretation of Chude, *et al*. (2011) that soil organic carbon between 15 and 20 gkg^{-1} is moderate for crop production. The subsurface horizons were generally lower in organic carbon than the surface horizons. The reasons for this may be adduced to the fact that the surface horizons are the points where decomposition and humification of organic materials take place.

The soils' available phosphorous content varied from 8.93 to 16.42 $mgkg^{-1}$ in all the horizons with irregular distribution across the depths. The available P values in the location are considered moderate as they are within the range recommended for most commonly cultivated crops (Enwezor., *et al.*, 1989).

Generally, there was a low accumulation of bases in the horizons of the soil. The low level of bases in these soils could suggest that leaching is a marked pedogenic process, resulting from the area's high sand proportion (Amusan, *et al*., 2006). The cations exchange capacity (CEC) was generally low with values ranging from 2.67 to 6.05 $cmolkg^{-1}$. The low CEC could be attributed, as observed by Nnaji, *et al*., (2002) that, low CEC of soil is because of clay type content, high rainfall intensity, and previous land use. Base saturation was high and reflected the concentration of basic cations at the exchange complex site (Atofarati, *et al.*, 2012).

3.4. Classification of Soils of the study area

Table 4: Some chemical properties of the soils

Pedon	Horizon	Depth (cm)	pH (H_2O)	pH (KCl)	OC (gkg^{-1})	Total N (gkg^{-1})	Av.P ($mgkg^{-1}$)	Exchangeable bases Ca^{2+}	Mg^{2+}	K^+	Na^+ ($cmolkg^{-1}$)	Exch. Acid H^+	Al^{3+}	CEC	BS (%)
ID1	Ap	0 – 14	5.34	3.95	14.21	0.94	16.42	3.01	0.79	0.18	0.15	1.16	0.68	4.81	85.82
	BA	14 – 45	5.20	4.30	8.80	0.73	15.82	3.50	1.40	0.20	0.16	1.20	0.56	6.05	86.94
	Bt	45 – 87	5.03	4.05	6.45	0.42	16.01	2.02	0.58	0.07	0.04	1.24	0.72	3.22	84.16
	BtC	87–182	4.75	3.40	6.06	0.18	10.15	1.21	0.39	0.05	0.34	1.28	0.84	2.67	62.92
ID2	Ap	0 – 20	5.12	4.75	10.60	0.82	14.10	2.760	0.84	0.18	0.10	1.16	0.76	4.86	79.84
	B1	20 – 53	4.91	4.52	8.37	0.65	13.82	3.15	1.25	0.20	0.13	1.11	0.61	5.74	82.23
	B2	53 – 106	4.85	3.41	7.73	0.53	13.33	1.40	0.80	0.06	0.04	1.20	0.84	3.48	65.80
	BC	106 - 204	4.50	3.36	5.25	0.14	8.93	1.00	0.60	0.04	0.02	1.32	0.92	3.00	67.00
ID3	Ap	0 – 21	5.18	4.15	12.10	0.88	15.85	3.20	1.20	0.19	0.15	1.16	0.70	5.38	88.10
	Bt	21 – 66	5.15	4.08	8.03	0.46	15.06	3.40	1.60	0.21	0.17	1.18	0.62	5.89	91.00
	BtC	66 - 184	4.80	3.65	6.42	0.10	13.91	1.80	0.40	0.10	0.04	1.2	0.76	3.77	67.37

Key: OC = organic carbon; N = nitrogen; Av. P = available phosphorus; CEC = cation exchange capacity; BS = base saturation

The soils across the study area represented by pedons AD1 – 3 were classified (Soil Survey Staff, 2014) and correlated (WRB, 2014). Movement and accumulation of clay evidenced in sub-surfaces of pedons AD1 and 3 (Table 2) signified illuviation-a marked pedogenic process. The development of argillic properties coupled with high base saturation of greater than 50% by CEC determined at pH 7.0 (NH_4OAc) at a depth of 100 cm below the upper boundary of the argillic horizon (Soil Survey Staff 2014) has placed pedons AD1 and 3 in the study area into the soil Order Al**fisols**. However, Pedon AD2 showed poor pedogenic horizon development as evidenced by the non-significant increase in clay fraction down the profile. This classified it into the soil Order Inceptisols.

The prevalent ustic soil moisture regime (soils, dry for more than 90 cumulative days but less than 180) of the area has placed AD 1 and 3 into the sub-order Ustalfs and AD 2 into Ustepts.

Kandic horizons were established in pedons AD 1 and 3 due to the following requirements observed: coarse-textured surface horizons over vertically continuous subsurface horizons; CECs within subsurface B horizons that are less than 12 cmol (+) kg–1 clay; a regular decrease in organic carbon content with increasing depth; and all these in addition to the requirement of clay content increase-with-depth (Soil Survey Staff 2014). Therefore, the soils were placed into the great group **Kandiustalfs**. These were correlated as **Kandic Lixisols** in World Reference Base (WRB, 2014). However, high sand fraction across the profile depth of AD 2 put the soils into the great group **Psammusteps** (Soil Survey Staff, 2014) and was correlated as Fluvsols in World Reference Base.

3.5. Land capability classification (LCC) of soils of the study area

Table 5 shows the indices of land capability assessment of the study area. The results show that about 67 % (pedons AD1 and 3) of the land area is fairly good (III) for arable. The high acidity identified in these pedons limits their full potentials for arable crops' production. Contrarily, a high sand fraction of the remaining 33 % (pedon AD2) cannot be easy either culturally or mechanically corrected because it is more permanent. This makes it unsuited to arable cultivation and consequently, limits its use mainly to pasture or forestland.

Acceptable management practices such as liming, incorporating organic manure into the soil, and split application of fertilizer would improve the native properties of pedons AD1 and 3 for sustainable arable cropping.

Table 5: Land capability indices of the study area

Mapping Unit			
Limitations	ID1	ID2	ID3
Slope angle(s) (degree)	II	I	I
Rock outcrops and boulders (r)	I	I	I
Wetness class (w)	I	I	I
Effective soil depth (d) (cm)	I	I	I
Texture and structure (s)	II	V	II
Soil permeability (p)	I	I	I
pH (h)	III	IV	III
Organic carbon (c) (%)	II	I	I
Land Capability Classes	IIIh	Vs	IIIh

III =moderately arable
VI = non-arable

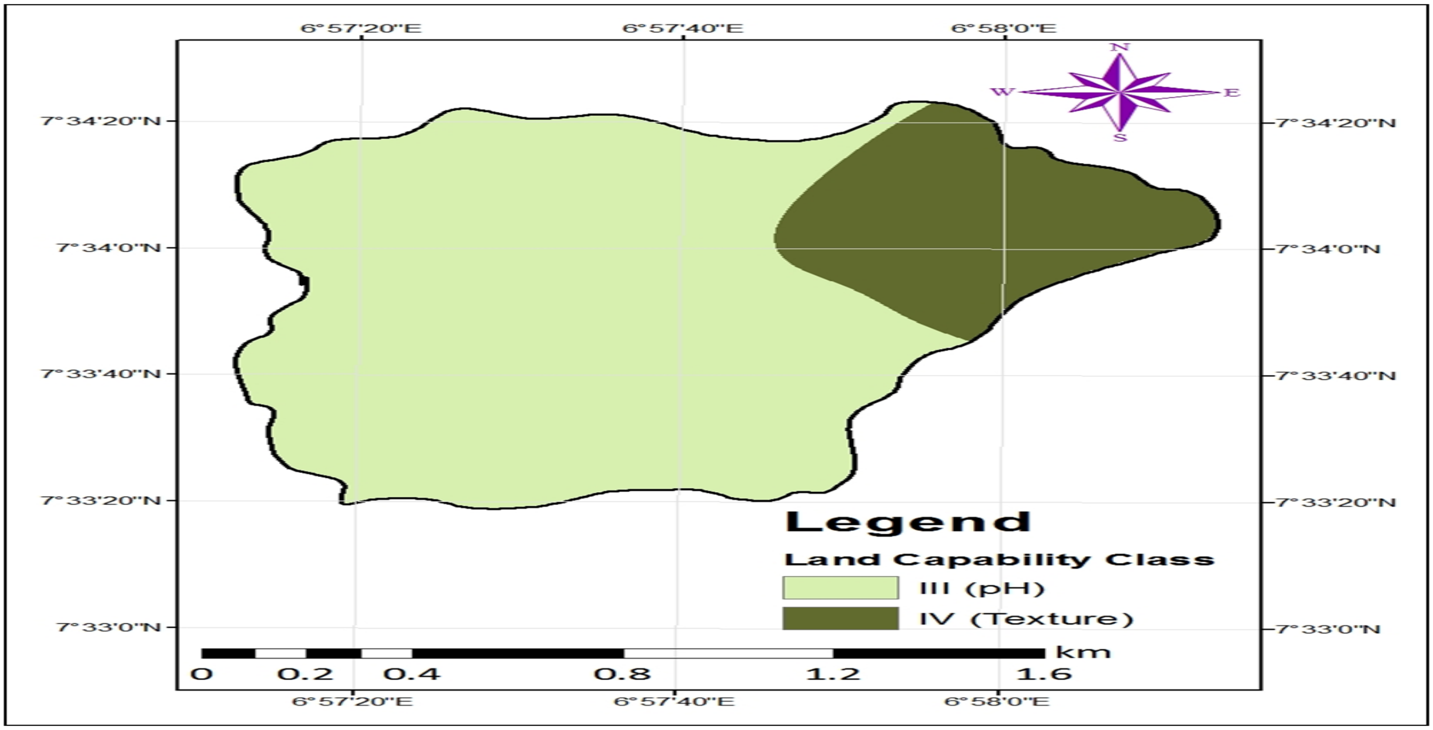

Fig. 2: Land capability classification map of the study area

4.0 Conclusion

The study inventoried the soils of Abocho, Dekina Local Government Area of Kogi State and assessed the soils' potentials for sustainable crop production. The finding revealed high sand fraction, high acidity, and low exchangeable bases. Two soil types, Typic Psammustepts (Fluvisols) and Typic Kandiustalfs (Lixisols) were identified. The soil's potentials (Land capability classification) rated 67 % of the land area moderate or fairly good (III) for arable cropping and 33 % for non-arable (V) with soil reaction and high sand fraction as constraints. Since the soils are highly acidic, low infertility, and with high sand fractions, the judicious use of lime and full complements of organic manure and split application of fertilizers are recommended.

5.0 Recommendation

Following the results of this study, Organic amendments application could be recommended to enable arable crops uptake of the augmented chemical properties, as advocates of organic farming in Sudan Savannah of Nigeria.

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