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Updated classification of some southwestern Nigeria soils.

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Abstract

Seven pedons from the uplands of the Ife, Ondo and Shagamu areas representing more humid parts of southwestern Nigeria were classified in the local classification systems of Smyth and Montgomery; Moss; the FAO/UNESCO legend and *Soil Taxonomy*. The pedons from the Shagamu area derived from sedimentary parent material and belong to the Agege, Iju and Owode series. The pedons from the Basement Complex area belong to the Iwo, Balogun and Ondo series. In the FAO/UNESCO legend, all pedons belong to either Ferric Acrisols or Orthic Acrisols. All seven pedons also belong to the Ultisols of *Soil Taxonomy*. These soils are further divided into Oxic Paleustults, Typic Rhodustults and Oxic Haplustults. In these soils when soil pH values are below 5.8 or base saturation values are below 50% by neutral aceatate methods, base saturation by sum of cations are likely to be below 35%. Such relationships will be useful in the identification of Ultisols and Alfisols in the absence of laboratory data for sum of cations.. Even though the upland soils of southwestern Nigeria were traditionally considered Alfisols, the present study suggests the probable occurrence of Ultisols in the more humid areas.

Introduction

The soils of southwestern Nigeria have been studied, classified and mapped at varying levels. Smyth and Montgomery (1962) have outlined the scheme for the identification of 46 soil series underlain by metamorphic rocks of Central Western Nigeria, now made up of Ogun, Oyo and Ondo States. Moss (1957) provided the guidelines for the identification of another 60 soil series found over the sedimentary rocks in Western Nigeria in particular and Nigeria in general. The Upland soils of southwestern Nigeria were classified in *Soil Taxonomy* primarily as Alfisols (Table 1).

TABLE 1 – BASE STATUS AND *SOIL TAXONOMY* CLASSIFICATION OF SOME UPLAND SOUTHWESTERN NIGERIAN SOILS

*Series/ Source**	*Location*	*% Base ECEC*	*Saturation pH7*	*Sum*	*Classification in Soil Taxanomy*
		Soils Over Crystalling Rocks			
Iwo[a]	Ife		42-72		Oxic Tropudalfs
Iwo[b]	Ife		40-69		
Iwo[b]	Ife		59-80		
Iwo[c]	Ife			34-48	
Iwo[c]	Ife			34-46	
Iwo[d]	—			40-69	
Egbeda[b]	Ife		59-72		
Egbeda[b]	Ife		80-97		
Egbeda[d]	—		73-77		
Itagunmodi[a]	Ife		51-74		Tropetic Eutrorthox
Oba[e]	Ife		31-55		Ustoxic Dystropepts
Apomu[e]	Ife		28-47		Ustoxic Dystropepts
Iwo[b]	Ondo		24-56		
Ondo[b]	Ondo		23-87		
Ondo[b]	Ondo		18-40		
Ondo[d]	—		23-56		
Owena[b]	Ondo		53-79		
Fagbo[b]	Ondo		16-45		
---[a]	Ore		45-93		Oxic Tropudalfs
Iwo[f]	Ibadan	92.98			Oxic Paleustalfs
Egbeda[g]	Ibadan		51-92		
Egbeda[f]	Ibadan	96-98			Oxic Paleustalfs
Egbeda[h]	Ibadan	83-91			
Egbeda[h]	Ibadan	87-91			Oxic Paleustalfs
Ibadan[f]	Ibadan	75-87			Oxic Paleustalfs
Gambari[f]	Ibadan	89-96			Typic Plinthustalfs
Iregun[f]	Ibadan	94-97			Oxic Haplustalfs
Iregun[f]	Ibadan	99-98			Oxic Haplustalfs
		SOILS OVER SEDIMENTARY ROCKS			
Alagba[i]	Benin		8-37		Tropeptic Haplorthox
Alagba[j]	Benin		35-90		Paleudults
--[a]	Agege		17-40		Oxic Dystropepts
-- --[a]	Ilutitun		13-67		Typic Haplorthox
Alagba[h]	Shagamu		89-95		Oxic Paleustalfs

TABLE 1 (Contd.)

Agege[i]	Iperu	18-81	Typic Eutrustox
Alagba[l]	Iperu	63-93	
Alagba[k]	Iperu	36-96	
Owode[l]	Iperu	26-100	
---[l]	Ikenne	63-89	
---[l]	Ikenne	65-96	
---[l]	Ikenne	54-80	
---[l]	Ikenne	49-89	

*Source: a = Harpstead, 1972; b = Ojanuga, 1975
c = Ojanuga 1978; d = Ojanuga, 1977;
e = Ojanuga et al., 1976; f = Moormann *et al.* 1975;
g = Ashaye and Ogunfowora, 1971;
h = Gallez et al., 1975; i = Ogunwale et al., 1975; j = Juo et al. 1974;
j = Ogunwale and Ashaye 1975;
k = National Soil Correlation Committee, 1976;
l = Ashaye, 1969.

Alfisols should have more than 35% base saturation by sum of cations at 1.8 meters below the soil surface or 1.25 meters below the upper boundary of the argillic horizon (Soil Survey Staff, 1975). Base saturation by sum of cations are determined by dividing the NH_4OAc-extractable bases by the CEC obtained by summing the $BaCl_2$-triethanolamine extractable acidity at pH 8.2 and NH 0Ac-extractable bases (Soil Survey Staff, 1972). Earlier workers apparently used base saturation values by neutral acetate or effective CEC in distinguishing Alfisols and Ultisols (Table 1). The base saturation values by effective CEC are usually higher than the sum of cations method (Coleman and Thomas, 1967 and Juo *et al.*, 1976). Although the base saturation values by the effective CEC method or by the neutral method may be more relevant to exchange reactions, the *Soil Taxonomy* criteria for differentiating between Alfisols and Ultisols are based on the base saturation by sum of cations (Sanchez and Buol, 1974 and Soil Survey Staff, 1975).

Some of the soils from the Ife, Ondo and Shagamu areas classified as Alfisols have less than 50% base saturation by the neutral acetate method especially in their subsoils (Table 1). Although base saturation data by sum of cations are not available, some of the above soils could have less than 35% base saturation by sum of cations and thus belong to Ultisols. Besides, annual rainfall of southwestern Nigeria varies from 1,000 to 2,500mm and could result in appreciable variation of base status. Alfisols in Nigeria are generally reported in areas with an annual rainfall of 1,600mm or less (Lal et *al.*, 1975). The annual rainfall of the Ibadan area ranges from 1,000 to 1,300mm (Soladoye,

1965) and the soils of the area are primarily classified as Alfisols (Table 1). However, the annual rainfall of the area south of Shagamu and Ijebu-Ode varies from 1,500 to 1,750mm (Table 2) and some of the soils from the above area are likely to be Ultisols; similarly, the Ife-Ondo area has annual rainfall of 1,300 to 1,500mm, and within the area, soils of the Ondo area have been found to be more leached than those of the Ife area due to higher rainfall (Ojanuga, 1975) and need to be critically examined for classification purposes.

Consequently some of the soils grouped under the FAO/UNESCO legend as Luvisols (FAO. 1973; Moormann *et al.*, 1975 and National Soil Correlation Committee, 1976) might turn out to be Acrisols when base saturation values are less than 50% by ammonium acetate in at least some part of the B horizon (FAO, 1970). The objective of this study was to examine some of the soils with relatively low base saturation in order to classify them properly according to current systems of classification.

TABLE 2 – CLIMATIC DATA FROM SELECTED STATIONS IN SOUTHWESTERN NIGERIA

	Jan.	*Feb.*	*Mar.*	*April*	*May*	*June*		*Aug.*	*Sep.*	*Oct*	*Nov*	*Dec.*	*Yearly Total*
						Shagamu							
Mean rainfall (mm)	9	32	75	129	189	326	178	131	192	194	96	12	1563
						Ijebu-Ode							
Mean rainfall (mm)	6	34	112	153	200	241	276	144	182	166	55	13	1582
						Lagos							
Mean rainfall (mm)	30	44	98	148	274	463	283	75	151	201	68	24	1859
						Ibadan							
Mean rainfall (mm)	3	30	103	129	151	185	146	112	195	183	37	8	1282
						Ondo							
Mean rainfall (mm)	10	35	108	156	170	212	232	130	232	193	73	17	1568
						Ife							
Mean rainfall (mm)	8	27	105	171	164	162	181	123	222	190	31	5	1389
Average minimum temp.	23.5	23.3	23.2	22.4	22.8	22.8	22.6	22.7	22.3	21.3	20.9	23.6	
Average maximum temp. (C)	33.8	32.1	31.5	30.0	28.4	27.5	28.8	31.0	32.9	33.4	32.5	34.7	
Average mean temp. (C)	28.9	27.7	27.4	26.2	25.6	25.2	25.7	26.9	27.6	27.4	26.7	29.2	

Material and Methods

The study area lies approximately within longitudes 3°30'E and 5°00'E and latitudes 6°30'N and 8°00'N. The southern part consists of the Ona and Osun flood plains underlain by alluvium dating from late Pleistocene to the present time. These flood plains are bordered by the Coastal Plain Sands towards the Atlantic Ocean. Its elevation ranges from 10 to 40 meters. The northern part is covered with pediments, alluvial and colluvial deposits derived from metamorphic rocks. The elevation of the pediments gradually increases from south to north to a maximum of 300 meters. The land is mainly gently to strongly undulating.

The locations of the seven pedons are shown in Fig. 1. Pedon 1 is located at about 2km north of Imegun on a flat interfluvial surface. Pedon 2 is located 2km northwest of Ita-epinni also on a flat interfluvial surface. Pedons 1 and 2 are likely to have been formed from alluvial-coastal materials. Pedon 3 is located on an upland about 1.2km west of Aiyepe along the old Aiyepe-Shagamu road. Pedon 4 is also on an upland and is about 1km north of Oguru. Pedons 3 and 4 are from sedimentary parent material. Pedon 5 is from the southern foot of the inselberg (Oke Aladura) at the University of Ife Campus. Pedon 6 is from the Department of Soil Science section of the Teaching and Research Farm of the University of Ife. Pedon 7 is located about 8km from Ondo, along the Ondo-Ife road.

Four pedons from the sedimentary area and three pedons from the metamorphic area were described according to FAO guidelines (FAO, 1977) as shown in Table 3. Samples from each genetic horizon were collected for laboratory analysis.

Particle-size analysis was carried out by the hydrometer method (Bouyoucos, 1962). Soil pH was determined in water and KCL using a ratio of 1:1, with a pH meter. Organic carbon was determined by Walkley-Black wet oxidation method (Soil Survey Staff, 1972). Exchangeable Ca, Na and K were determined in the amonium acetate extract using a flamephotometer. Cation exhange capacity (CEC) at pH7 was determined using IN ammonium acetate according to the method 5 Al of Soil Survey Staff (1972). $BaCl_2$-triethanolamine extractable acidity at pH 8 was determined by the method described by Peech *et al.*, (1962). Aluminium and hydrogen were extracted with IN KCl and determined volumetrically (Soil Survey Staff, 1972; Yuan, 1959). CEC by the sum of cations was computed by adding the sum

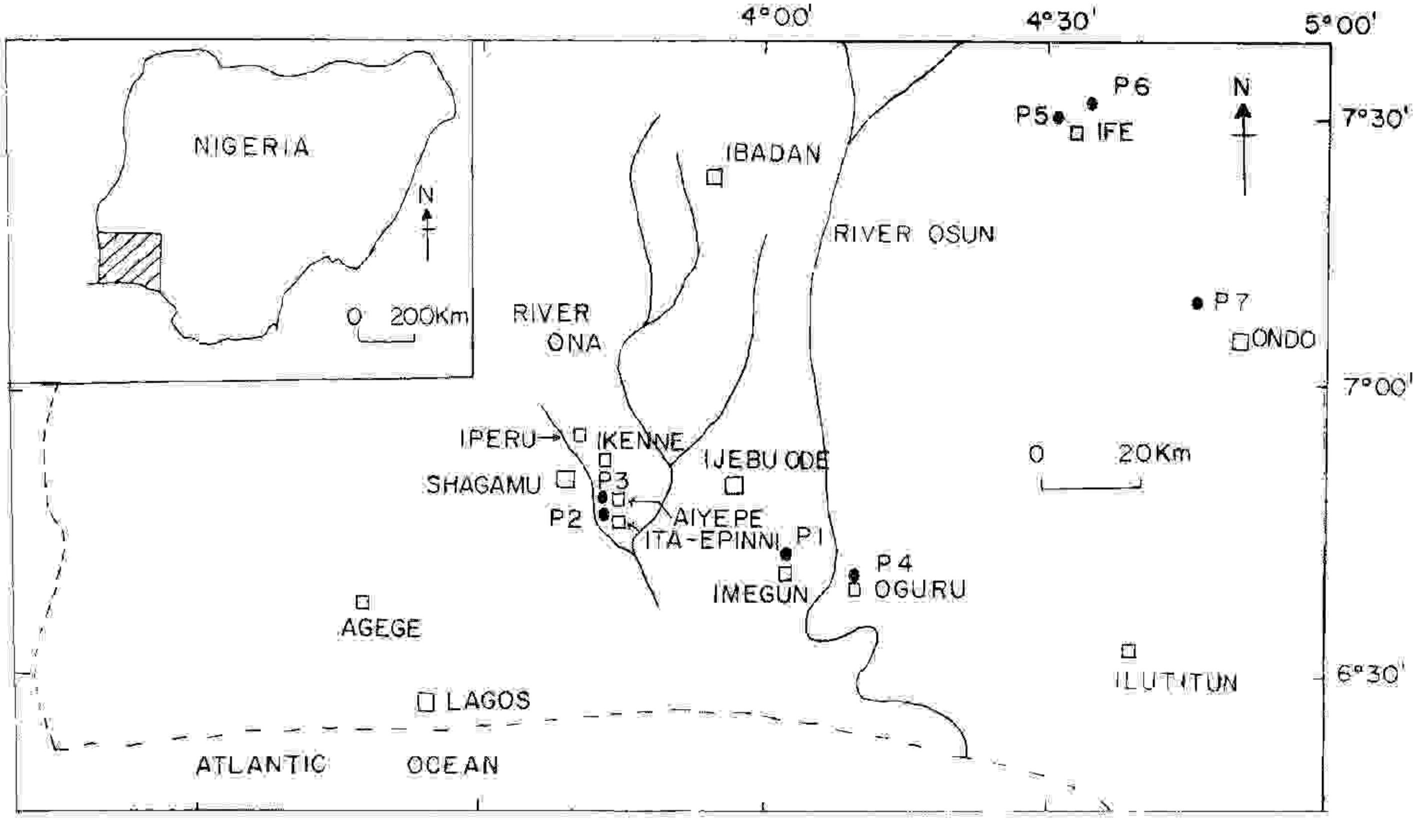

Fig. 1: Location of the seven pedons (P_1 - P_7) studied in southwestern Nigeria.

TABLE 3 — MORPHOLOGICAL PROPERTIES OF SEVEN SOUTH–WESTERN NIGERIAN SOILS

Horizon	*Depth cm*	*Colour (moist)*	*Texture*[a]	*Structure*[b]	*Consistence*[c] *(wet)*	*Clay skins*	*Boundary*[d]	*Others*
					Pedon 1			
A	0 - 15	10 YR 4/1	scl	3 f,m,c	gr ss ps		cl	
A3	15 - 52	10 YR 4/4	c	3 m, c	sbk s p		g s	
B21	52 - 110	7.5 YR 5/6	c	3 c	sbk vs vp	patchy cutans	g s	
B22gcn	110 - 160	10 YR 5/2	gc	3 m, c	sbk s p	patchy cutans	g s	red, orange & brown mottles; nodules
					Pedon 2			
Ap	0 - 17	10 YR 2/1	sl	1 f,m,c	gr ss sp		g s	
A3	17 - 43	7.5 YR 5/3	s	1 m	sbk s0 p0		g s	
B21t	43 - 88	10 YR 4/4	c	2 c	sbk s p		g s	
B22t	88 - 124	10 YR 4/4	c	2 c	sbk s p		g s	
B23gcn	124 - 170	5 YR 6/1	gsc	2 c	sbk s p	patchy cutans		red & orange mottles; concretions
					Pedon 3			
A1	0 - 8	5 YR 3/1	scl	2 f,m,c	gr ss sp		g s	
A3	8 - 28	7.5 YR 3/2	ls	1 m	sbk s0 p0		g s	
B21t	28 - 65	5 YR 4/8	sc	2 c	sbk s p	broken cutans	d s	
B22t	65 - 117	5 YR 4/8	sc	2 c	sbk s p	broken cutans	g s	
B23t	117 - 145	5 YR 4/8	sc	2c	sbk s p	broken cutans	g s	
B24tg	145 - 180	5 YR	sc	2 c	sbk s p	contn. cutans		orange mottles; fe concretions
					Pedon 4			
Al	0 - 12	5 YR 3/2	sl	2 m,f	gr ss sp		g s	
A3	12 - 42	5 YR 3/6	scl	2 m	sbk s p		g s	
B21t	42 - 92	5	scl	2 m	sbk s p	patchy cutans	g s	
B22tg	92 - 133	2.5 YR 3/6	scl	2 c	sbk s p	broken cutans	d s	red & gray mottles
B23tg	133 - 185	2.5 YR 3/6	scl	2 c	sbk s p	broken cutans		red & gray mottles

TABLE 3 (Contd.)

					Pedon 5						
AI	0 - 28	5 YR 3/1	sl	2ftoc, gr,	sbk	ss	sp		c	s	
AB	28 - 62	2.5 YR 3/4	gscl	3,2 m	sbk	s	p		g	s	
IIB21t	62 - 97	2.5 YR 3/6	gsc	1,2 m	sbk	s	p	patchy cutans	g	s	
IIB22t	97 - 130	2.5	gsc	1	sbk	s	p	patchy cutans	g	s	
IIB23t	139 - 160	2.5 YR 3/6	gsc	2 m,c	sbk	s	p	patchy cutans	g	s	
IIB24t	160 - 180	2.5 YR 4/6	gsc	2 f,m	sbk	s	p	patchy cutans	g	s	
					Pedon 6						
Ap	0 - 23	5 YR 3/2	sl	1 c	sbk	ss	sp		c	s	
B21t	23 - 67	5 YR 4/6	gsc	2 m,c	sbk	s	p	patchy cutans	g	s	
B22t	67 - 120	5 YR 5/6	gsc	2 m,c	sbk	s	p	patchy cutans	g	s	
C1	120 - 150	5 YR 5/6	gsc	2 m,c	abk	s	p	patchy cutans	g	s	red & orange streaks
C2	150 - 180	10 YR 7/8	sl	2 m,c	abk	s	p	patchy cutans			purple & white streaks
					Pedon 7						
A1	0 - 8	5 YR 4/1	sol	1 m,o	gr	ss	sp		g	s	
A3	8 - 24	5 YR 5/4	scl	2 m,c	sbk	ss	sp		g	w	
B21t	24 - 54	5 YR 4/8	gc	2 m,c	sbk	s	p	patchy cutans	g	w	
B22t	54 - 88	2.5 YR 4/8	gc	2 m,c	abk	s	p	broken cutans	d	s	
B23t	88 - 122	2.5 YR 4/6	c	2 c,	abk	s	p	broken cutans	d	s	weakly mottled
B24t	122 - 152	2.5 YR 4/6	c	2 c	abk	s	p	broken cutans			moderately mottled

a scl = sandy clay loam; Sc = sandy clay; c = clay; sl = sandy loam; g = gravelly; S = sand; ls = loamy sand.

b 1 = weak; 2 = moderate; 3 = strong; f = fine; m = medium; c = coarse; gr = granular; sbk = subangular blocky; abk = angular blocky.

c s0 = nonsticky; ss = slightly sticky; s = sticky; vs = very sticky; p0 = non-plastic; sp = slightly plastic; p = plastic; vp = very plastic.

d cl = clear; g = gradual; d = diffuse; s = smooth; w = wavy.

of exchangeable Ca, Mg, Na, and K and $BaCl_2$-triethanolamine extractable acidity. Effective CEC was obtained by adding the exchangeable Ca, Mg, Na, and K and IN KCl extractable Al + H.

Results and Discussion

Local Classification

Pedon 1 is probably derived from Pleistocene alluvial material and occurs on a small flat topped tableland. The B horizon is brown clayey (Table 3). The soil has brownish yellow and yellowish red mottles below 110cm and belongs to the Agege series (Moss, 1957). Pedon 2 is possibly formed from alluvium and belongs to the Iju series. This is a moderately well drained soil on a gently sloping interfluvial surface. The sandy top soil is underlain by brown clay. The soil is mottled below 120cm with dark red and gray colours and also contains many nodules. Pedons 3 and 4 are well drained soils with mottles starting from 145cm and 92cm respectively. These soils are on the upper slope sites bordering flood plains and belong to Owode series. They are derived from coastal plain sands of Eocene age. The B horizons are sandy clay loam or heavier.

Pedons 5, 6 and 7 are from metamorphic areas of the Precambrian Basement Complex and belong to the Balogun, Iwo and Ondo series, respectively (Smyth and Montgomery, 1962). Pedon 5 is derived from colluvial material of granitic-gneiss adjoining an inselberg and has no mottling to a depth of 2 meters. The soil has a sandy loam A horizon underlain by a dark red sandy clay material with appreciable angular quartz gravel. Pedon 6 is derived from micaceous schist and has a dark reddish brown sandy loam surface horizon underlain by orange gravelly sandy clay. The C horizon has white and purplish mica streaks along with quartz veins. Pedon 7 is derived from medium grained rocks. The subsoil is clayey with brown, red and gray mottles below 54cm.

Classification in the FAO/UNESCO legend of the soil map of the world

All of the seven pedons have ochric A horizons and argillic B horizons. They have texturally contrasting A and B horizons and do not belong to Nitosols. They have less than 50% base saturation by ammonium acetate method in major part of the B horizons and belong to the Acrisols. Pedons 1, 4 and 7 have mottles in the B horizons and qualify for Ferric Acrisols. Pedons 2, 3 5 and 6 do not have plinthite, gley or appreciable organic matter. They also lack enough mottles or nodules in the upper B horizons and are Orthic Acrisols. Soils similar to pedon 6 have been classified earlier as Orthic Acrisols (Ojanuga, 1977) and some other soils of the Ife-Ondo area were considered Nitosols. Ferralsols were reported in the Shagamu area (Ogunwale *et al.*, 1975). The present study reveals the inclusion of Acrisols in the more humid upland soils of southwestern Nigeria mapped as Dystric Nitosols or Ferric Luvisols (FAO, 1973).

Classification in Soil Taxonomy

The mean annual soil temperature of the study area exceeds 22°C and the soils thus have an isohyperthermic regime. The uplands of southwestern Nigeria are primarily under an ustic moisture regime. Further studies will be necessary to separate the areas with an ustic regime from those with an udic moisture regime. All the seven pedons have ochric epipedons and characteristic clay increase in the subsoil to qualify for argillic horizons.

The base saturation by sum of cations of the argillic horizons of all of the pedons generally decrease with depth and are below 35% at 1.8 meters below the surface of the soil or 1.25 meters below the upper boundary of argillic horizon (Table 4). These soils belong to Ultisols and suborder Ustults (Table 5). Most of the pedons have appreciable exchangeable Al characteristic of Ultisols (Soil Survey Staff, 1975). The higher base saturation in the upper horizons of these Ultisols is due to base cycling by vegetation.

Pedons 1, 2, 3, and 7 have clay distribution such that the percentages of clay do not decrease from its maximum amount by more than 20% of the maximum within 1.5 meters of the soil surface. The sedimentary parent materials have already undergone at least one cycle of mineral weathering and have very little weatherable minerals (Ogunwale and Ashaye, 1975). Pedon 7, derived from fine-grained rocks has high clay content in the subsoil and is believed to have low weatherable minerals. Even though no petrographic analysis was done on the fine sand fractions of pedons 1, 2, 3, and 7, the upper 50cm of the argillic horizons are likely to have few weatherable minerals. Hence, the above four pedons belong to the Paleustults and the subgroup Oxic Paleustults as these soils have less than 24 milliequivalents CEC per 100g clay by NH_4OA_c.

Clay contents in Pedons 4 and 5 decrease by more than 20% from their maximum within 150 cm of the soil surface and have other critieria to qualify for Typic Rhodustults. The above two pedons have dark red argillic horizons with darker epipedons. Pedon 6 is an Oxic Haplustult as the colour value when moist is 4 or more in some part of the argillic horizon. Harpstead (1972) postulated that one of the profiles from Ife area, nearer to pedon 6, could belong to Ultisols but he was unable to confirm it for want of base saturation data by sum of cations.

Although, earlier workers classified the upland soils of southwestern Nigeria primarily as Alfisols, the present work indicates that some of the soils from the more humid parts are Ultisols as revealed by base saturation data.

Based on analysis of samples, a linear relationship was established between base saturation by neutral acetate (%BSpH7) and base saturation by sum of cations (%BSSUM):

$$\%BSSUM = \%BSpH7\,(0.638) + 1.05 \ldots\ldots\ldots\ldots (1)$$

with an r value of 0.780 (37 samples). This relationship may be useful in estimating the base saturation values by sum of cations from the base saturation values by neutral acetate. A base saturation value of 53% by neutral acetate equals 35% by sum of cations (Equation 1). For some of the West African soils (Juo et *al.*, 1976) and Brazillian soils (Oliverra, 1974 quoted by Lepsch *et al.*, 1977), a 50% base saturation by neutral acetate method corresponds to 35% base saturation by sum of cations. In the absence of base saturation data by sum of cations, Lepsch *et al.*, (1977) used the above relationship in distinguishing Ultisols of Sao Paulo State, Brazil. Some of the soils from Ife, Ondo and Shagamu areas examined by earlier workers (Table 1) have less than 50% base saturation by the neutral acetate method in their subsoils and could belong to Ultisols. . . . .

A significant relationship between soil pH in water (pH H_2O) and percent base saturation by sum of cations (%BSSUM) (r = 0.807) was characterized by the equation:

$$\%BSSUM = pH\ H_2O\,(21{\cdot}79) - 92.34 \ldots\ldots\ldots (2)$$

Such an exercise using data from large number of soil samples from the area will be useful in estimating the base saturation percentage for classification purposes. When subsoil pH values of the study area are below 5.8, base saturation values by sum of cations are likely to be below 35% (Equation 2) and the soils may qualify for Ultisols.

In this study, soils were identified by using field observable and inferrable properties such as parent material, drainage, colour, texture, concretions and gravels. Placements into soil categories identified in *Soil Taxonomy* and FAO/UNESCO legend were based upon precise and rigidly defined soil properties. Morphologically similar pendons of a soil series can differ significantly in soil properties used in classification. Mausbach *et al.*, (1980) have shown that coefficient of variation from several hundred morphologically matched pairs representing the central concepts of phases of series from different parts of USA averaged 9% for pH, 25% for base saturation, 59% for extractable acidity and more than 100% for organic carbon. Such variations among the similar pedons might lead to classifying them in different classes of the above two classification systems. According to *Soil Taxonomy*, pedons of same series should not range across the limits between two classes of any category. Hence, there is a need to study a large number of pedons for the proper classfication of the soils in the study area due to short distance variations in parent material (Moss, 1957; Ojanuga and Writh, 1977; and Smyth and Montgomery, 1962), vegetation and man's activities (Moormann and Kang, 1978).

Conclusion

Although, earlier workers primarily classified the upland soils of southwestern Nigeria as Alfisols, the present study indicates the presence of Ultisols in some of the more humid parts, when appropriate criteria of *Soil Taxonomy* are applied in classifying the soils. Soils of such humid areas belong to Acrisols according to the FAO/UNESCO legend. A thorough study of other soil series in the present work will improve the knowledge of the classification of these soils.

TABLE 4 – PHYSICAL AND CHEMICAL PROPERTIES OF SEVEN SOUTHWESTERN NIGERIAN SOILS

Depth cm	Horizon	Sand	Silt	Clay	pH H_2O	pH KCl	Org. C %	Exchangeable Ca	Mg	Na	K	Al	H	Ext. acidity	ECEC	CEC NH_4OAc	Sum	Base Saturation ECEC	NH_4OAc	Sum
		——%——						meq/100g										——%——		
									Pedon 1											
0-15	Ap	72	16	12	5.5	5.0	0.85	2.15	0.52	0.24	0.05	tr	0.05	5.0	3.1	6.9	8.0	98	43	37
15-52	A3	64	14	22	4.5	3.8	0.26	0.25	0.23	0.07	0.03	1.22	0.18	7.0	2.0	5.2	7.6	29	11	8
52-110	B21t	49	11	40	4.4	3.6	0.17	0.20	0.19	0.22	0.09	2.31	0.21	10.2	3.2	88.6	10.9	22	8	6
110-160	B22gcn	52	14	34	4.6	3.6	0.20	0.20	0.10	0.07	0.05	2.37	0.13	10.2	2.9	5.1	11.0	14	8	4
									Pedon 2											
0-17	Ap	88	6	6	6.2	6.1	0.91	2.85	1.70	0.01	0.33	tr	0.05	4.5	4.9	7.5	9.4	99	65	52
17-43	A3	85	7	8	6.31	6.6	0.17	1.00	0.26	0.06	0.06	tr	0.05	1.8	1.4	4.5	3.2	97	31	43
43-88	B21t	55	7	38	5.2	4.5	0.15	2.70	0.60	0.14	0.16	tr	0.05	6.6	3.7	5.7	10.2	99	63	35
88-124	B22t	54	8	38	4.8	3.8	0.15	1.50	0.53	0.10	0.06	1.25	0.12	8.9	3.6	11.1	11.1	62	41	20
124-170	B23gcn	58	9	33	4.2	3.8	0.12	1.00	0.49	0.10	0.14	1.56	0.05	8.5	3.3	4.6	10.2	52	38	17
									Pedon 3											
0-8	Al	74	17	9	5.7	5.6	1.59	2.80	1.50	0.15	0.16	tr	0.05	6.5	4.7	8.4	11.1	99	55	42
8-28	A3	78	11	11	5.2	4.8	0.56	1.10	0.34	0.15	0.06	tr	0.05	5.2	1.7	3.5	6.9	97	47	14
28-65	B21t	50	11	39	4.8	3.9	0.53	0.80	0.56	0.42	0.14	1.12	0.19	8.1	3.2	3.4	9.9	59	54	38
65-117	B22t	46	12	42	4.9	3.9	0.26	0.50	0.37	0.14	0.05	1.56	0.12	9.9	2.7	5.2	11.0	39	20	10
117-145	B23t	51	9	40	5.1	4.0	0.17	0.46	0.32	0.22	0.10	1.43	0.13	9.0	2.7	6.0	10.1	41	18	11
145-180	B24tg	59	8	33	4.9	3.9	0.32	0.40	0.30	0.16	0.10	1.70	0.19	8.4	2.9	4.3	9.4	34	22	10

TABLE 4 (Contd.)

								Pedon 4												
0-12	A1	74	13	13	5.2	4.8	1.44	2.35	2.00	0.19	0.16	0.18	0.07	10.4	5.1	11.0	15.1	95	43	31
12-42	A3	64	3	33	4.6	3.9	0.62	0.40	0.32	0.19	0.07	2.00	0.25	10.9	3.2	6.0	11.9	30	16	8
42-92	B21t	46	5	49	4.7	3.8	0.50	0.25	0.28	0.12	0.05	2.43	0.19	11.3	3.3	9.8	12.0	21	7	6
92-133	B22tg	66	13	21	4.9	2.9	0.27	0.41	0.14	0.05	0.05	1.93	0.13	9.9	2.7	4.6	10.6	24	14	6
133-185	B23tg	64	13	23	4.9	3.9	0.18	0.25	0.14	0.07	0.04	1.75	0.18	9.1	2.4	4.8	10.2	31	10	5
								Pedon 5												
0-28	A1	72	17	11	5.5	5.2	0.85	3.40	2.00	0.10	0.39	tr	0.05	7.5	5.9	7.4	11.4	99	53	54
28-62	AB	56	7	37	4.9	3.8	0.44	1.20	0.57	0.07	0.31	1.0	0.12	10.2	3.3	8.0	12.2	66	26	17
62-97	IIB21t	50	6	44	5.0	3.8	0.35	0.90	0.48	0.07	0.26	2.31	0.20	11.8	4.2	7.9	13.5	41	22	13
97-130	IIIB22t	52	10	38	5.3	3.8	0.32	1.20	0.47	0.07	0.17	1.70	0.13	10.7	3.2	9.7	12.6	51	20	15
130-160	IIB23t	58	16	26	5.5	4.0	0.18	1.10	0.46	0.06	0.15	1.70	0.13	9.1	3.6	8.6	10.9	49	21	16
160-180	IIB24t	66	15	19	4.8	3.9	0.15	0.85	0.45	0.05	0.21	1.43	0.13	10.9	3.1	11.3	12.5	50	14	13
								Pedon 6												
0-23	AP	70	20	10	6.2	6.0	2.52	5.17	2.15	0.84	0.84	tr	0.05	6.1	8.4	14.8	14.4	99	56	58
23-67	B21t	58	14	28	6.0	6.4	0.15	2.15	0.50	0.19	0.49	tr	0.05	5.5	3.4	10.7	8.8	99	31	38
67-120	B22t	56	14	30	5.9	5.7	0.18	1.75	0.49	0.10	0.38	tr	0.05	5.9	2.8	7.3	8.6	98	37	32
120-150	C1	58	15	27	5.6	6.3	0.26	1.35	0.57	0.10	0.35	tr	0.05	6.3	2.4	6.1	8.7	98	39	27
150-180	C2	60	25	15	5.9	4.9	0.18	1.15	0.54	0.06	0.33	tr	0.05	5.9	2.1	6.4	8.0	98	33	26
								Pedon 7												
0-8		66	13	21	5.0	4.5	2.04	1.10	1.66	0.06	0.03	tr	0.14	7.36	2.99	8.25	10.21	95	35	28
8-24		66	9	25	5.0	4.0	0.20	0.25	0.66	0.05	0.01	0.55	0.17	10.33	1.69	10.25	11.30	57	10	9
24-54		54	9	37	5.0	4.0	0.16	0.25	0.64	0.06	0.02	0.88	0.07	8.35	1.92	10.50	9.32	51	9	10
54-88		22	9	69	5.2	4.1	0.16	0.25	1.26	0.05	0.01	0.69	0.07	9.34	2.33	4.25	10.91	67	37	14
88-122		22	9	69	5.3	4.1	0.12	0.35	0.78	0.07	0.02	0.88	0.07	14.29	2.17	3.75	15.51	56	33	8
122-152		18	13	69	5.4	4.1	0.08	0.40	1.07	0.12	0.02	0.88	0.07	7.36	2.56	3.00	8.97	63	54	18

TABLE 5 – CLASSIFICATION OF SOME SOUTHWESTERN NIGERIAN SOILS

Pedon No.	*Soil Series*	*FAO/UNESCO (Soil Units)*	*Soil Taxonomy (Soil Family)*
1	Agege	Ferric Acrisol	Oxic Paleustult, clayey, kaolinitic, isohyperthermic
2	Iju	Orthic Acrisol	Oxic Paleustult, clayey, kaolinitic, isohyperthermic
3	Owode	Orthic Acrisol	Oxic Paleustult, clayey Kaolinitic isohyperthermic
4	Owode	Ferric Acrisol	Typic Rhodustult, clayey, kaolinitic, isohyperthermic
5	Balogun	Orthic Acrisol	Typic Rhodustult, clayey, kaolinitic, isohyperthermic
6	Iwo	Orthic Acrisol	Oxic Haplustult, fine-loamy, kaolinitic, isohyperthermic
7	Ondo	Ferric Acrisol	Oxic Paleustult, clayey, kaolinitic, isohyperthermic

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