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SUITABILITY EVALUATION OF SOILS OF EPOLU RIVER, ESA OKE, OSUN STATE, FOR RICE PRODUCTION

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Abstract
The study evaluated the suitability of soils of Epolu River, Esa-Oke, Osun State for rice production. Three soil profile pits were dug along the toposequence namely: upper basin, mid basin, lower basin, and described following the FAO/UNESCO guideline for soil profile description. Soil samples were collected from 9 identified genetic horizons of the profile pits and were subjected to routine physical and chemical analyses. Land characteristics recognized on the field were combined with those determined in the laboratory to provide the land qualities in the study area. The land qualities obtained were matched with rice requirements to obtain the soil suitability classes. Results indicated that the soils were not deep, light reddish gray to brownish gray, varying from sandy clay loam to clay. The bulk density ranged from 0.49 g/cm^3 to 0.86 g/cm^3. The soils were acidic with pH ranging from 3.99 to 5.79. Soil organic matter varied from low to high, ranging from 0.2 to 3.22%. The available P varies from low to medium and ranged from 3.10 to 9.40 mg/kg. The high base saturation of greater than 50 % by NH_4OAc places all pedons in order Alfisols (USDA Soil Taxonomy) pedons 1 and 2 correlate as Luvisols while pedon 3 correlate as Fluvisols (FAO/ UNESCO). The soil temperature is isohyperthermic. The soils of pedons 1 and 2 belong to Ustalf due to histic moisture regime and are therefore classified as Isohyoperthermic Paleustalf and pedon 3 was an aquic moisture regime and order Psamment and is classified as Typicaquipssament. The soils were unsuitable for rice production. The major limitation of soil was low fertility and high soil acidity. The productive potential of the soil for rice production could be enhanced through the application of appropriate fertilizer.
Keywords: Pedon, Land quality, Alfisols, Fluvisols

1. Introduction

Rice (*Oryza sativa* L.) is a type of cereal and it is eaten as a staple food in many parts of Asia. It is grown in warm parts of the world, mainly Asia, Africa, northern Italy, and the west coast of North America. Rice is the primary staple food for about half of the world's population and it provides 20% of the calories consumed worldwide. Rice has become the main staple and major source of carbohydrates in the Nigerian people's diet across all socio-economic classes (Osinuga *et al.,* 2020). Nigeria is one of the leading rice importers in the world because rice is produced in the country by small-scale farmers (FAO, 2019). Total rise production has increased in the last two decades, but the rises have not met the ever-increasing population because farmer relies on rainfed agriculture, small-scale farming, inadequate irrigation facilities, lack of storage facilities, low input such as fertilizers, and lack of agricultural extension system (Ana, 2010; FAO, 2019).

Development in settlements and population growth have been increasing the human demand for land as well as an increase in the demand for food crops like rice, and maize among others (Aondoakaa and Agbakwuru, 2012). Recently, the price of grains (especially rice) has increased with the cost of cultivation and production (Balogun, 2001). Sadly, in terms of area and production, rice is one of the less important grains crops grown in Osun State, Nigeria. But in terms of economic importance, it is one of the most important crops. It is widely regarded as a superior food, which until recently was mainly consumed by city dwellers and middle and higher-income earners (Dawam, 2000).

In an attempt to improve agricultural production, many agricultural development projects have been established like Fadama programs sponsored by the World Bank in Nigeria. This makes it necessary to carry out strategies to improve food production. It is in this direction that a land suitability study is relevant. De Delta (1981) suggested that land/soil data should be made available and understandable to the users by providing interpretative ratings for specific land uses. The land qualities and land use requirements should be matched to enable farmers to maximize output in agricultural production by identifying the land qualities and the requirements for various land for effective management.

Olaleye (2001) reported that Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Manganese are important elements in rice production. Thus, land suitability studies assist in identifying soil nutrients for optimum yields of some crops. In the same direction, FAO (1978) also had land classifications to identify areas suitable for some crops' cultivation.

Studies relating to soil and site characteristics and crop requirements form the basis for soil suitability evaluation (Meena *et al.,* 2009). Land suitability is the ability of a particular land to tolerate and accommodate the production of crops in a sustainable way that can give optimal yield. Its evaluation provides information on the constraints and opportunities for the use of the land and also guides decisions on the potential and optimal utilization of resources, whose knowledge is an essential precondition for land use planning and development (Abdel-Rahman *et al.,* 2016). Moreover, such analysis allows the identification of the main limiting factors for agricultural production. This enables decision-makers such as land users, land use planners, and agricultural support services to develop crop management practices able to overcome such constraints and increase productivity.

Development in settlements and growth in population have been increasing the human demand for land as well as an increase in the demand for food crops like rice, and maize among others. In response to this, so many land uses are evident in the area of which agricultural land use is one of most notable apart from residential. From field observation, the crops grown in the area are maize, yam, pineapple, and plantain. However, the interest of any farmer lies mainly in how profitable it is to grow a particular crop and what amendments are necessary to optimize the productivity of the soil for the specified crop (Fasina and Adeyanju, 2007).

Land suitability of a particular land is a function of matching the land characteristics with the crop requirements (Mustafa *et al.,* 2011). Enhancing rice production could be met through a systematic survey of the soils, evaluating their potential for a wide range of land use options, and formulating land use plans which are environmentally benign, socially acceptable, and economically viable (Addeo *et al.,* 2001; Sathish and Niranjana, 2010). Therefore, information is needed on soil qualities and conditions of the area, as well as the fertility status of the soil, to ascertain the chemical properties of the soil for rice cultivation. The need for such information constitutes the problem of this research. Information obtained from such research will help in formulating meaningful guidelines in ensuring the sustainability of agricultural practice as well as rice cultivation not only in Esa-Oke but in the Southwest in general.

Therefore, the objectives of this study were to characterize, classify, determine suitability, and identify the types of limitations of soils of Epolu River, Esa-Oke, Osun State, Southwest Nigeria, for sustainable and profitable rice production.

2. Materials and Methods

Study area

The study was conducted in a section of the Epolu River floodplain at Osun State College of Technology, Esa-Oke. It lies approximately between latitudes 7° 44′38 N and 7° 44′38 N and

longitudes 4° 52′33 E and 4° 52′54 E. The climate of the area is humid tropical, with distinct dry and wet seasons. The wet season spans mid-March to late October, and the rainfall pattern is bimodal with peak periods in June/July and September/October. The dry season runs from early November to early March. The influence of the northeast trade wind, which loses all its moisture as it passes over the Sahara desert towards the equator, is felt in the study area as 'harmattan' (cold dry wind) between late December and early January. Atmospheric temperature is moderately high throughout the year, with a low range between the mean monthly minimum and maximum temperatures. Total annual rainfall is about 1500mm (NASA, 2019).

Vegetation and land use

At the time of this study, trees and arable crops were cultivated in the area. The land use at each topographic location was: upper basin: *Theobroma cacao* plantation, mid basin: *Theobroma cacao* plantation, *and lower basin: Theobroma cacao* and Citrus Sinensis plantation.

The soils of the study area are fine-grained biotite gneisses and schist in pedon 1 and 2 and alluvial and colluviums material in pedon 3 which are generally moist and poorly drained almost all year round. The soils of the upper basin occupy the highest points on the landscape as a result of which they are most freely and severely drained. The soil of the mid basin and lower basin are shallower with a water table of 90cm respectively.

Soil examination and sampling

The genetic horizons of each soil profile pit were identified, described, and sampled according to FAO (2006) guidelines for soil profile description. Core soil samples were taken for bulk density determination. Soil samples were collected from identified genetic horizons of each of the profiles, starting from the lowest horizon to the uppermost to prevent cross-contamination.

Sample preparation for laboratory analysis

A topo sequence was selected for this study. The toposequence was delineated into three physiographic units namely upper basin, mid basin, and lower basin. One profile pit was dug at each identified physiographic unit and was established, described, and sampled, following the guideline for soil profile description (FAO, 2006). The soil samples were air-dried, crushed gently, and passed through a 2 mm sieve. The fraction less than 2 mm was retained for laboratory analysis. The soil samples were analyzed for the following:

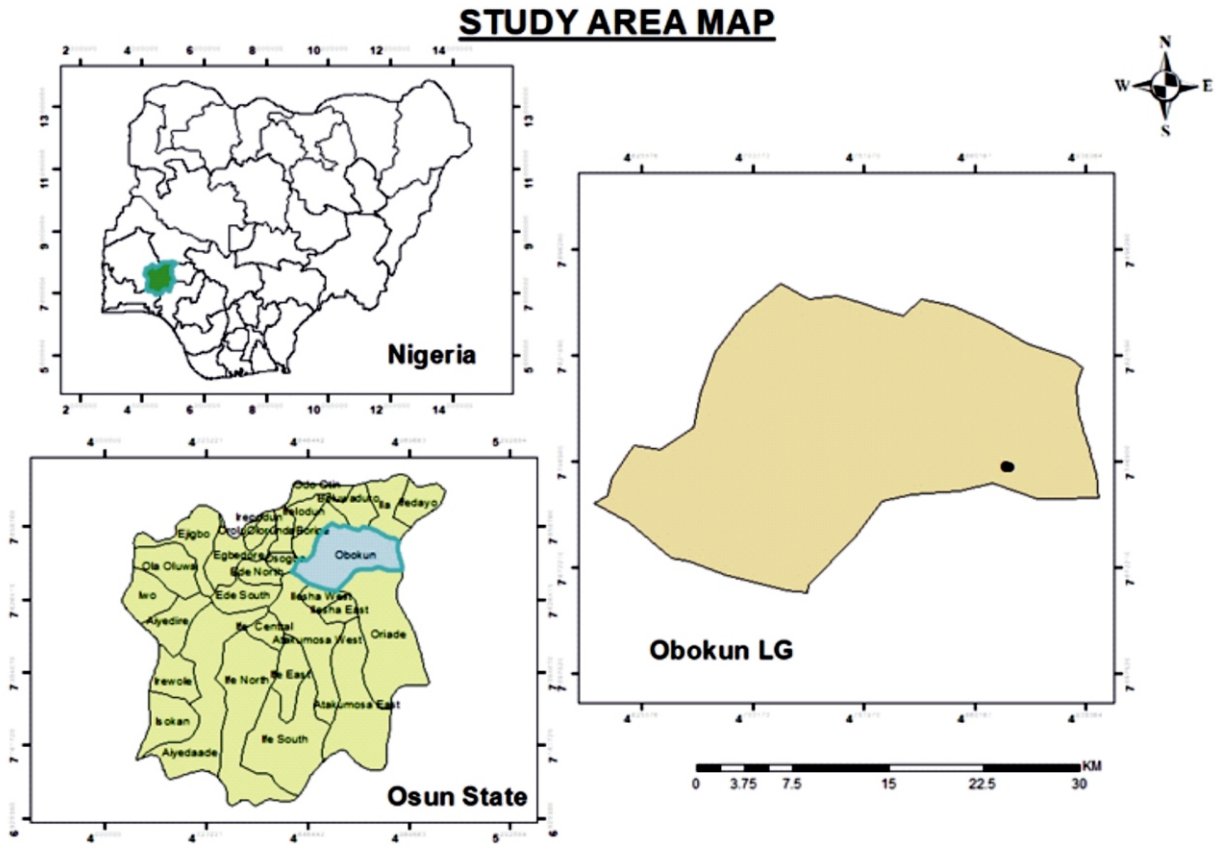

FIGURE 1: MAP OF THE STUDY AREA

Particle size distribution analysis was carried out using the modified hydrometer method (Gee and Or, 2002). The soil pH was determined in distilled water and 1.0 M KCl (Thomas, 1996). Organic carbon was determined using the Walkley-Black method (Nelson and Sommers, 1982). Available phosphorus was determined by the Bray-1 method (Kuo, 1996). Total nitrogen was determined using the micro-Kjeldahl digestion method (Bremner, 1996). Exchangeable acidity ($H^+ + Al^{3+}$) was extracted with 1.0 M KCl and titrated with sodium hydroxide (McLean, 1965). Exchangeable bases were extracted with 1.0 N ammonium acetate (NH_4OAC) at pH 7, the Ca^{2+} and Mg^{2+}content were determined with atomic absorption spectrophotometer while K^+ and Na^+ were determined with a flame photometer (Thomas, 1982; Jones, 1998). Data obtained from field and laboratory analyses were used to classify the soil into its appropriate order, sub-order, great group, and sub-group following the guideline in the USDA keys to soil taxonomy (Soil Survey Staff, 2014 and IUSS Working Group WRB, 2015) while local soil classification was carried out using the method of Smyth and Montgomery (1962). The suitability of the soils for rice production was assessed using the parametric method (Sys *et al.,* 1993). Land characteristics recognized on the field were combined with those determined in the laboratory to make the preferred land qualities which were used as the basis for the land assessment. Each pedon was assigned to a suitability class by matching the land requirements for rice production (Table 1) characteristics with the characteristics of the pedon (Tables 2, 3, and 4). A numerical rating of the land characteristics on a normal scale from a maximum (normally 100) to a minimum value (20) was employed. If a land characteristic was optimal for the considered land utilization type, the maximal rating of 100 was attributed; if the land characteristic was unfavorable, a minimal rating of 20 was applied (Sys *et al.,*1993). A land index was calculated from the individual ratings using the square root method:

$$I = A \times \sqrt{\frac{B}{100} \times \frac{C}{100} \times \ldots \times \frac{F}{100}}$$

where:
I = land index
A= overall lowest characteristic rating
B, C...F = lowest characteristic ratings for each land quality group (Udoh et al. 2006).

Statistical Analysis
The correlation coefficient was used to establish the relationship between the soil requirement of rice and the results obtained from the laboratory. The data set was run using Gretl software where it was discovered that the data set is normally distributed and the data set is devoid of outliers.

Table : Land/soil requirements for suitability evaluation of rice

Land Qualities		S11	S12	S2	S3	N1	N2
		96-100	86-95	61-85	41-60	21-40	0-20
Climate (C)	Annual rainfall (mm)	1200-1500	1000-1200	800-1000	800	?800	?800
	No dry months	0-2	2-3	4-5	6-7	?7	?7
	Mean annual temp (°C)	?25	22-25	20-22	18-20	?18	?18
	Relative humidity (%)	?75	70-75	65-70	60-65	?60	?60
Topography (T)	Slope gradient (%)	0-2	3-6	7-15	16-25	?25	?25
Wetness (W)	Drainage	Wd	Id	Md	Pd	Vpd	Vpd
	Flooding	Fo	Fo	F1	F1	F2	F2
Soil physical properties (S)	Soil depth (cm)	?100	75-100	60-75	50-60	?50	?50
	Surface texture	C, SCL	CL	SC, CL	SL, L	LS	S
	Gravel at 0-20 cm (%)	?2	2-4	5-15	16-30	30-35	?35
Chemical fertility	pH in distilled water	7.5-8.0	7.0-7.5	5.5-7.0	5.0-5.5	4.0-5.0	?4.0
	Organic matter (%)	?5	3-5	2-3	1-2	?1	-
	Total Nitrogen (%)	?0.5	0.4-0.5	0.2-0.4	0.1-0.2	?0.1	?0.1
	Available P (mg/kg)	?10	7-10	4-6	2-4	?2	?2
	Exchangeable K (cmol/kg)	?0.6	0.4-0.6	0.2-0.4	0.1-0.2	0.05-0.1	?0.05
	CEC (cmol/kg)	?16	12-16	8-12	5-8	?5	-
	Base saturation (%)	?75	75	50-75	35-50	?35	?35

S11 (96-100) – No limitation, S12 (86-95)- Slight limitation, S2 (61-85) – Moderate limitation, S3 (41-60) – Severe limitation, N1 (20-40) – Very severe limitation that can be corrected, N2 (0-19) – Very severe limitation that cannot be corrected**.**
Source: Modified from Sys *et al.,* 1993, FAO, 2007, Ajiboye *et al.,* 2011, Osinuga *et al.,* 2020

3. Results and discussion

Characteristics of the soils

Morphological characteristics of the soils

The summary of the morphological description of the soils is presented in Table 2. The soils occupied a low topographical position and were developed from fine-grained biotite gneiss and schists for pedon 1 and 2 while alluvium and local colluviums for pedon 3 (Smyth and Montgomery, 1962). The color of the surface horizons ranged from reddish gray (7.5R 5/1) in Profile 01 and Profile 03 to light reddish gray (7.5R 7/1) in Profile 02. The color of the subsoil ranged from light reddish gray (7.5R 7/1) in profile 03 to brownish gray (7.5R 5/1) in profile 01. Buol *et al*., (2003) reported that the reddish color in the subsurface horizon of most profiles could be due to the oxidation of iron oxides (responsible for the reddish color in subsoil horizons). The structure of surface soils was mostly weak and the structure of sub-surface soils was sub-angular blocky. The weak structures in the studied soils were probably due to tillage operation and continuous cultivation in the area. Roots concentration was common in the surface horizons of all the pedons examined and decreased with soil depth.

The soils had sandy clay loam, sandy loam, and loam sand at the top soil underlain by sandy clay to sandy loam at the subsurface. The soils received both alluvium and colluvium. The soil of pedon3 was poorly drained with reddish coloration. The variation in soil color was primarily due to the physiographical position of each profile and the drainage of the soil

Table 2: Morphological description of the soils

zon	Depth (cm)	Colour (moist)	Texture[a]	Structure[b]	Consistence[c]	Concretion[d]	Boundary[e]	Note
						Upper slope (profile 01)		
	0-18	7.5R 5/1	ngrsc	1cr	mfr	Vf	Ds	Few fine roots
	18-45	10R 6/3	ngrl	2sbk	mvpl	Vf	C	No roots
	45-83	2.5YR 7/4	sgrc	1sbk	mvpl	Gr	-	No roots
						Mid basin (profile 02)		
	0-15	7.5R 7/1	ngrs	1cr	mfr	Rdpl	D	Many fine roots
	15-40	10R 6/3	ngrs	2sbk	mst	Rdpl	C	No roots
	40-90	10R 6/3	ngrs	2sbk	mst	Rdpl	C	No roots
						Lower basin (Profile 03)		
	0-15	7.5R 5/1	sgrs	1cr	mfr	Vf	D	Many fine roots
	15-42	7.5R 6/2	sgr	1cr	mfr	Vf	C	Few fine roots
	42-90	7.5R 7/1	Sgr	2sbk	mvpl	Vf	-	Few fine roots

[a]Texture: gr =gravelly, sgr = slightly gravelly, vgr = very gravelly, ngr = non gravelly c = clay, s = sandy or sand, l = loam or loamy

[b]Structure: 1 = weak, 2 = moderate, 3 = strong, m = medium, cr = crumb, sbk = subangular blocky, pl = platy

[c]Consistence: m = moist, w = wet, fr = friable, st = sticky, nst = non sticky, pl = plastic npl = non plastic vpl = very plastic

[d] Concretion: vf = very few, gr = gravel, rd = rounded, st = stone, fr = frequent, vfr = very frequent, cr = saprolite

[e]Boundary: c = clear, d = diffuse, g = gradual, s = smooth, w = wavy.

Physical characteristics of the soils

Some selected physical properties of the soils within the study area are shown in Table 3. Particle size distribution data showed that the texture of the surface soils of the three profiles in the study area were sandy clay loam, sandy loam, and loam sand. The content of sand particles was greater than silt

and clay in the surface soils. The subsoil horizons in profiles 01, 02, and 03 had more clay than the surface horizons since clay content increased with depth in these profiles. Clay eluviation from the topsoils to the subsoils and differential sorting of materials are factors that could be accountable (Smyth and Montgomery, 1962). The sand particles appeared to be the most dominant size fraction with a range of 36 to 80%. The clay particles ranged from 8 to 52% while the silt was the least with a range of 12 to 18 % in the soils examined. The bulk density ranged from 0.49 g/cm^3 in the AP horizon to 0.86 g/cm^3 in the B horizon. Bulk density is a reflection of texture and structure (aggregation). Usually, soils with low bulk density are known to be associated with high total porosity, while root penetration becomes a problem when bulk density exceeds 1.6 g/cm^3 (Russell, 1976). The bulk density increased with depth in the study area.

Chemical properties of the soils

Table 4 shows the chemical properties of the soils. The soils were acidic with a pH range of 3.99 to 5.79 in distilled water ($pH_{(H2O)}$) and 3.17 to 5.06 in KCl (pH_{KCl}). The low pH of the soils could be a result of high rainfall in the area which made the soils fragile and susceptible to leaching (Udo *et al.,* 2009). Enwezor *et al.* (1981) stated that the leaching of Ca and Mg was largely responsible for the development of soil acidity. It had also been noted that phytocycling and upward movement of bases due to intense evaporation during the dry season in the humid tropics were further suggested to account for the relatively higher pH of the surface horizons (Amusan, 1991). Adepetu (1986) classified the percentage of soil organic matter (SOM) in Southwestern Nigeria into low (0 - 1.5%), medium (1.5 – 2.5%), and high (>2.5%). The soil organic matter contents were low in the surface horizon of profile 03 and were higher in the surface horizons of profiles 01, and 02 respectively. The high organic matter content at the topsoil of most soil profiles could be attributed to more decomposable plant materials in the surface soils (Lal, 1991). This high content of organic matter at the surface soil was not unexpected since it is at the soil surface that litters accumulate which subsequently decays and mineralizes to yield organic matter (Olayinka, 2009). It was also observed that SOM content in profile 01 was higher than in other profiles examined; this is because profile 01 was under cacao plantation. Visual field observation indicated that greater canopy cover was found within the cacao plantation compared to other of the profile locations, which possibly explained the higher OM content in profile 01 than in other profiles. In all the soil profiles that were examined, organic matter decreased with depth. This agrees with the findings of other workers (Smyth and Montgomery, 1962; Ogunkunle, 1993; Akinbola *et al*., 2006). The low organic matter in profile 03 (lower basin) could be attributed to the erosion effect and continuous cultivation which is common in the area.

Table 3: Physical characteristics of the soils

Horizon	Depth (cm)	Sand	Silt	Clay	Bulk density (gcm^{-3})	Textural class
		←	%	→		
			Upper basin (profile 01)			
AP	0-18	62	16	22	0.49	Sandy clay loam
AB	18-45	48	16	36	0.73	Sandy clay
Bg	45-83	36	12	52	0.74	Clay
			Mid basin (profile 02)			
AP	0-15	66	16	18	0.65	Sandy loam
AB	15-52	56	18	26	0.86	Sandy clay loam
B	53-90	48	16	36	0.76	Sandy clay
			Basin floor (Profile 03)			
AP	0-18	80	12	08	0.67	Loam sand
AB	18-42	80	12	08	0.69	Loam sand
B	42-90	72	14	14	0.83`	Sandy loam

The available P across the profiles examined varied from low to medium. Adepetu (1986) classified the soil test value of available phosphorus into low (0-8 ppm), medium (8-15 ppm), and high (> 15 ppm). It could be observed that the available phosphorus content of the soils varied from 3.10 to 9.40 ppm in all the soil profiles examined with the highest value at the surface horizons in profiles 01 and 02 while it showed an irregular trend in profile 03, an indication that organic matter contributes significantly to the available phosphorus in these soils. The available P values are considered low in profile 03, as they were below the critical limit recommended for most commonly cultivated crops in the area (Uponi and Adeoye, 2000; Aduayi *et al*., 2002; Obigbesan, 2009). Total nitrogen (TN) values were low, they ranged between 0.04 - 0.14 g/kg. the value was below 4.5g/kg established for productive soils (Federal Fertilizer Department, FFD, 2012). The low content could be ascribed to rapid microbial activities and crop removal, leading to nitrate loss in the soil environment (Aiboni *et al.,* 2007). The ECEC of the soils was generally low (2.98 – 5.66 cmol /kg) with a value of less than 10 cmol /kg (FFD, 2012).

Soil Classification

The soils of pedon 1 and 2 are characterized by high base saturation of greater than 50 % by CEC determined at pH 7.0 (NH4OAc) and low CEC (< 16 cmol/kg) placed the soil into Alfisols in the USDA soil taxonomy and the soils belong to suborder Ustalf due to the ustic moisture regime because the soil was dry for 90 or more cumulative day in a year. The soil temperature regime of Southwestern Nigeria is Isohyperthermic (Amusan and Ashaye, 1991). Pedon 1 and 2 were therefore classified as isohyperthermicpaleustalf. (Soil survey staff, 2010) and luvisols (FAO-UNESCO). Pedon 3 was classified as Entisols (recently formed soil) with evidence of fluctuating water table. The soil moisture regime was Aquic. It belongs to sub-order Psamment because of loam sand at the surface and sandy loam at the subsurface. Hence, classified as Typicaquipsamment (USDA 2014) and Fluvisols (FAO-UNESCO) –. Classification at the local level (Smyth and Montgomery, I962) for Pedons 1, 2, and 3 as Egbeda, Makun, and Jago series respectively.

Soil Suitability Evaluation for Rice Production

Table 1 shows land use requirements for rice production. The factor rating of land use requirement for rice was matched with the properties of the soils (Table 5) to obtain the actual (A) suitability class score of each land unit for rice (Table 6). A numerical rating of the land characteristics on a normal scale from a maximum (100) to a minimum value of 20 was used. A maximal rating of 100 was attributed if land characteristics were optimal for rice production and if unfavorable, the least rating was applied. The potential (B) suitability class scores were obtained after soil fertility had been corrected and attributed to 100. The aggregate suitability class score (land index) for each land unit was calculated using the square root equation method.

The results for the actual suitability rating (A) shows that pedon 1, 2, and 3 were unsuitable (N2) for rice production (Table 6). Nevertheless, after the fertility constraints would have been removed with adequate and proper fertilizer application, the soils are moderately suitable for rice production. The potential suitability (B) reflects what is expected after limiting constraints have been removed. The major limitation of the soils was poor fertility.

Table 4: Chemical properties of soil

Horizon Designation	Depth (cm)	PH H_2O	PH KCl	ECEC	OC	OM	TN	Avail p	Ca^{2+}	Mg^{2+}	K^+ Na+	EA H^+ Al^{3+}
				(cmol/kg)	%	%	%	mg/kg	(cmol/kg)			(cmol/kg)
					Upper basin							
AP	0-18	5.06	4,62	1.87	3.22	0.14	9.40	1.48	0.49	0.11	0.2	0.7	2.98	69.80
AB	18-42	4.01	3.22	0.62	1.07	0.07	5.60	1.37	0.46	0.11	0.11	0.2	0.7	2.95	69.49
Bg	43-90	3.99	3.17	0.20	0.34	0.04	6.10	1.39	0.47	0.11	0.11	0.3	0.7	3.08	67.53
					Mid basin							
AP	0-15	5.79	5.06	1.56	2.68	0.14	8.30	1.47	0.64	0.13	0.13	0.1	0.1	2.57	92.22
AB	15-52	4.41	3.67	0.47	0.81	0.07	4.60	1.07	2.04	0.19	0.14	0.1	0.1	3.64	94.51
B	52-90	4.05	3.22	0.39	0.67	0.07	7.20	1.06	2.03	0.21	0.13	0.3	0.6	4.33	79.21
					Basin floor							
AP	0-18	4.46	3.72	0.819	1.41	0.11	3.90	1.49	2.08	0.23	0.16	0.3	1.4	5.66	69.96
AB	18-42	4.42	3.68	0.195	0.34	0.04	5.30	1.07	2.04	0.21	0.14	0.4	0.6	4.46	77.57
B	42-90	5.12	4.24	0.117	0.20	0.07	3.10	1.07	2.01	0.20	0.14	0.3	0.6	4.32	79.20

OC= Organic carbon, OM= Organic matter, TN= Total nitrogen, Avail p= Available phosphorus, EA= Exchangeable acidity
ECEC=Effective cation exchange capacity, BS = Base saturation

Table 5: Summary of the land characteristics of the soil profile for rice production

Land characteristics	Pedon 1	Pedon 2	Pedon3
Topography (t)	10	5	2
Slope (%)			
Climate			
Annual Rainfall during the growing season (mm)	1500	1500	1500
Mean annual temperature (°c)	20.26	20.26	20.26
Length of dry season (Month)	5	5	5
Relative humidity (%)	74.12	74.12	74.12
Flooding	No	No	No
Drainage	Well drained	Well drained	Poor drained
Texture	SCL	SL	LS
Chemical fertility			
Base saturation	91.2	95.9	92.9
pH in distilled water	5.06	5.79	4.46
Organic matter (%)	3.22	2.68	1.41
Total Nitrogen (%)	0.14	0.14	0.11
Available P	9.40	8.30	3.90
Exchangeable K (cmol/ Kg)	0.09	0.13	0.23
ECEC (cmol/ kg)	2.28	2.47	4.26

SCL= Sandy Clay loam, SL= Sandy Loam, LS= Loam Sand

Table 6: Land Suitability ratings of the study area for rice production

P1 = Pedon 1, P2 = Pedon 2, P3 = Pedon 3
A = actual suitability when characteristics (f) are not corrected by fertilizer application.
P = potential suitability after the correction of characteristics (f) by fertilizer application.

	P1				P2	
P3		A	B		A	B
Land qualities						
A B						
Topography (T)	70	70	90	90	100	100
Climate (C)						
Mean annual rainfall	96	96	96	96	96	96
Mean annual temperature	85	85	85	85	85	85
Length of dry season	85	85	85	85	85	85
Relative humidity	95	95	95	95	95	95
Wetness (W)						
Drainage	100	100	100	100	60	100
Texture	100	100	60	100	50	100
Soil depth	95	100	95	100	95	100
FERTILITY CHARACTERISTICS (F)						
Base saturation	100	100	100	100	100	100
PH in distilled water	41	100	61	100	30	100
ORGANIC matter %	86	100	85	100	41	100
Total of %	41	100	41	100	41	100
Available P (mg/kg)	95	100	90	100	50	100
Exchangeable k (ml/kg)	41	100	41	100	60	100
ECEC	40	100	40	100	41	100
Suitability index	6	57	7	65	2	69
Suitability class	N2	S2	N2	S2	N2	S2

Aggregate suitability scores: S1(75-100); S2(50-74), S3(25-49); N1(12-24); N2(0-12).

Conclusion

Classification and suitability evaluation of rice soils help to identify production constraints and prospects. Epolu River soils are unsuitable for rice production despite its climate. The slope and soil wetness are highly unsuitable. The major constraints to the optimum performance of rice are soil texture and some chemical fertility (N, P, and CEC). Emphasis should be on management techniques that will enhance the nutrient and moisture-holding capacities of these soils.

Recommendation

The pH value can be enhanced by the application of lime. The productive potential of the soil for rice production could be enhanced through the application of appropriate fertilizer.

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