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Suitability assessment of soils developed in coarse-grained granite and gneiss in humid rainforest area of Southwestern Nigeria, for maize and cassava production

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ABSTRACT

Suitability evaluation of soils developed in coarse-grained granite and gneiss in the humid rainforest area of southwestern Nigeria was carried out for maize and cassava production, using the parametric method. A soil profile pit was established on each of the four physiographic units of two toposequences. Eight profile pits were established and described following the FAO guidelines for soil profile description and thereafter sampled. The physical and chemical properties of the soil samples were determined in the laboratory, using standard methods. The land qualities of the soils were matched with the crop requirements for maize and cassava to obtain the soil suitability classes. Results showed the soils were rated presently not suitable (N1), permanently not suitable (N2), moderately suitable (S2), and marginally suitable (S3) for maize and cassava production. Major agronomic constraints were nutrient availability, nutrient retention and slope. In addition, soils of Jago series were limited by drainage, texture, high bulk density, shallow depth and low fertility. The soils were closely related but not homogenous. They varied in their potentiality with physiographic units for maize and cassava production. As a result, agronomic constraints in each physiographic unit calls for specific management practices to ensure sustainable use of the soil resources.

Keywords: Suitability; parametric; maize; cassava; Southwestern Nigeria
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Introduction

Soil is a life-supporting system upon which human beings have been dependent from the dawn of civilization. It is a non-renewable natural resource, hence comprehensive information on its potentials, limitations and capabilities, is required for a variety of purposes; such as project area development, soil conservation in catchment areas, sustainable agriculture, reclamation of degraded lands, etc. Land evaluation is the process of estimating the potential of a piece of land for alternative uses (FAO, 1983). Land suitability evaluation assesses the ability of a portion of land to tolerate the production of crops in a sustainable manner (Nsor & Akpan, 2020). It tells the farmer or any land user the suitability or limitations of the land for specific uses. This is achieved by matching land qualities/characteristics with the requirements of the envisaged land use (Udoh *et al*., 2011). Results of land evaluation should reflect not only the possible yield, but more importantly, the ease or difficulty of ensuring the sustained use of the parcel of land for a particular purpose (Baja, 2009).

Globally, maize (*Zea mays*) and cassava (*Manihot esculenta)* are crops of economic importance. They are considered crops of strategic importance and important staple food crops playing dominant roles in the rural economy of southwestern Nigeria. Maize is the most important cereal crop in Sub-Saharan Africa. Worldwide production of maize is about 785 million tons (IITA, 2013). The world's largest producer, the United States, produces 42% while the whole of Africa produces 6.5% and the largest African producer is Nigeria with nearly 8 million tons (IITA, 2014). Cassava is an important staple crop for more than 700 million people in the developing world, about 500 million of whom reside in Africa (El-sharkway, 2012).

Bulk of the production is in Africa and Nigeria is ranked as the largest producer of cassava worldwide, harvesting over 35 million tons of fresh roots from 3.1 million hectares of land (FAO, 2018). The crop plays a vital role in the food security of the rural economy of Nigerians because of its ability to tolerate drought and give reasonable yield in soils of low fertility (Ezedinma *et al*., 2006), hence the name 'poor man's crop'. In order to achieve success in the large-scale production of these crops by governments and individuals, detailed soil information is needed. However, there is paucity of information on the extent to which the land qualities of soils developed in coarse-grained granite and gneiss in the humid rainforest area of southwestern Nigeria can satisfy the agronomic requirements of maize and cassava. Therefore, this study aimed at evaluating the suitability and limitations of these soils for the sustainable productivity of maize and cassava.

Materials and Methods

The study was conducted at the Teaching and Research Farm, Obafemi Awolowo University, Ile–Ife, Southwestern Nigeria. The area lies approximately between latitudes 7° 32′ N and 7° 33′ N, and longitudes 4° 32′ E and 4° 40′ E. The climate of the area is characterized by bimodal rainfall regime with precipitation of over 1400 mm per annum, high relative humidity of 73.8% and 6.6 hours of sunshine. The peak of the maximum temperature is usually between February and March (32.2°C – 34.4°C) just before the onset of rains, while the lowest minimum temperatures are between July and September (27.1°C – 27.9°C) during the peak periods of rainfall. The wind speed is 114.6 kmd^{-1} while potential evaporation is 4.3 mmd^{-1}. The mean monthly soil temperature at 50 cm depth in Ile–Ife for June, July, and August is 27.7°C, and for December, January, and February is 29.4°C. Vegetation of the area is tropical rain forest consisting mainly of trees, cacao, oil palm and cassava.

Two toposequences underlain by coarse-grained granite and gneiss were identified and selected (Smyth & Montgomery, 1962). A soil profile pit was established on each physiographic unit (upper slope, mid slope, lower slope and valley bottom) along each of the two toposequences, making a total of eight soil profile pits (Table 1A). The profile pits were described following the FAO (2006) guidelines for soil description and thereafter sampled. Core soil samples were collected from each identified genetic horizon and used for the bulk density determination and the estimation of the soil porosity. Soil samples were taken from the identified genetic horizons of the profile pits, starting from the lowest to the uppermost, in order to prevent contamination.

Laboratory analyses

The soil samples collected were air-dried, crushed gently and sieved through a 2 mm sieve to separate gravel from the earth fraction. The gravel content (material > 2 mm) was determined and expressed as a percentage of the total weight of the soil. The less than 2 mm fraction was retained for analyses. The particle size analysis was determined using the hydrometer method (Gee & Or, 2002). Soil pH was determined in both water and 1.0 M KCl solution employing 1:1 soil/solution mixture and the reading was taken with a digital pH meter after equilibration, using a glass electrode digital pH meter (Thomas, 1996). Electrical conductivity was determined in the saturated extract using a conductivity meter (Clay *et al*., 2012). Total exchangeable acidity and Al were determined by titration method using 1.0 M KCl (Sims, 1996) and titrated with 0.05 N NaOH solution (McLean, 1965). The exchangeable cations were extracted with a neutral 1.0 N ammonium acetate solution.

TABLE 1A

Legend for the soils in the study area

Profile No.	Soil Classification		Soil Series	Slope class
	USDA Soil Taxonomy	FAO/UNESCO		
01	Typic isohyperthermic paleustalts	Lixisol	Iwo	Gentle slope
02	Typic isohyperthermic paleustalts	Lixisol	Iwo	Gentle slope
03	Plinthic isohyperthermic paleustalts	Plinthic Lixisol	Gambari	Gentle slope
04	Typic isohyperthermic paleustalts	Lixisol	Oba	Nearly level
05	Typic isohyperthermic paleustalts	Lixisol	Iwo	Gentle slope
06	Typic isohyperthermic paleustalts	Lixisol	Iwo	Gentle slope
07	Typic isohyperthermic paleustalts	Lixisol	Oba	Gentle slope
08	Typic aquicpsamment	Fluvisol	Jago	Nearly level

The concentration of the exchangeable potassium and sodium in the extract was determined using a Flame Photometer while the exchangeable calcium and magnesium were determined using Atomic Absorption Spectrophotometer (Rhoades, 1982). The cation exchange capacity of the soils was determined by the $BaCl_2$-TEA method at pH 8.2 (Sumner & Miller, 1996; Soil Survey Staff, 2014). The organic carbon was determined by the Walkley-Black method (Nelson & Sommers, 1996). Total nitrogen was determined by the kjeldahl digestion and distillation method (Bremner, 1996) while available phosphorus was determined by the Bray-1 method (Kuo, 1996). The micronutrients (Fe, Mn, Cu and Zn) were determined in 0.05 N Sodium Ethylene-Di-Amine-Tetra-Acetic acid (NaEDTA) extract and evaluated using the Atomic Absorption Spectrophotometer (Udo & Ogunwale, 1986).

Land suitability using parametric approach

Land characteristics recognized on the field were combined with those determined in the laboratory to make the preferred land qualities used for the suitability assessment. The following are the land qualities and corresponding land characteristics used for the evaluation:

(i) Climate (c): annual rainfall, mean temperature;
(ii) Wetness (w): drainage;
(iii) Topography (t): slope percent;
(iv) Soil physical characteristics: soil depth, texture, gravel content, bulk density;
(v) Nutrient availability (f): pH, total nitrogen, available P, extractable K, extractable Fe, Cu, Zn, Mn;
(vi) Nutrient retention capacity (n): CEC, base saturation and organic matter.

Ratings were done following the guideline stated by Sys (1985) and land indices were calculated using the equation developed by Storie (1932 and 1978);

Where: $Si = A \times = \frac{B}{100} \times \frac{C}{100} \cdots\cdots \frac{n}{100}$

S_i= Index of suitability
A = Index of the most limiting characteristics
B = Index of topography
C = Index of moisture availability
n = Index of nth characteristic

The index of suitability (S_i) was then converted to suitability class using Sys (1978) conversion Table. The land characteristics and corresponding suitability used for assessing maize and cassava are presented in Tables 1 (b & c) and 2 (a & b), respectively.

Land Index	Symbol	Definition
75 – 100	S1	Highly suitable
50 – 75	S2	Moderately suitable
25 – 50	S3	Marginally suitable
12.5 – 25	N1	Presently not suitable
0.00 – 12. 5	N2	Permanently not suitable

Source: Sys (1985)

The index of suitability (maize) for soil profile 1 (Iwo series), for example, was calculated as follows:

Actual: S_i =

The index of suitability (maize) for soil profile 1 (Iwo series), for example, was calculated as follows:

Actual: S_i = 85x1x1x1x1x0.95x0.95x0.85x1x1x0.85x0.85x1x1x1x1x1x0.95x0.95 = 43 (S3)

Potential: S_i = 85x1x1x1x1x0.95x0.95x0.85x1x0.95x0.95 = 59 (S2)

The index of suitability (cassava) for soil profile 1 (Iwo series) was calculated as follows:

Actual: S_i = 85x1x1x1x1x0.95x0.85x0.85x0.95x1x0.95x0.95x1x1x1x1x1x0.95x0.95 = 45 (S3)

TABLE 1B

Summary of land characteristics of the mapping units for rainfed maize production in the study area

Land characteristics	Profile 01	Profile 02	Profile 03	Profile 04	Profile 05	Profile 06	Profile 07	Profile 08
Climate (c)								
Annual rainfall (mm)	1400	1400	1400	1400	1400	1400	1400	1400
Temperature (°C)	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9
Topography (t)								
Slope (%)	4–6	5.0	2–4	2	5	2–4	2–4	1.0
Drainage (w)								
Wetness	WD	WD	MD	ID	WD	WD	MD	PD
Soil physical properties (s)								
Texture	SCL	SL	SL	SCL	SL	SL	SL	LS
Gravel (%)	31.5	49.7	28.3	13.4	15.4	21.3	28.8	12.7
Soil depth (cm)	200	182	160	180	187	150	200	67
Bulk Density (gcm^{-3})	1.23	1.45	1.42	1.50	1.54	1.64	1.27	1.22
Nutrient availability (f)								
pH	5.75	6.45	6.5	5.8	5.2	6.5	5.9	6
Total N (%)	0.6	0.5	0.5	0.2	0.4	0.7	0.6	0.6
Avail P (ppm)	11.65	8.05	13.5	11.4	15.9	12.5	19.2	9.4
Exchang K cmol(+)/kg soil	0.21	0.19	0.20	0.18	0.29	0.42	0.24	0.19
Toxicity (t)								
Fe (ppm)	122.85	79.25	183.60	192.17	52.76	58.79	29.47	149.22
Mn (ppm)	352.96	307.32	219.58	350.08	4.89	219.06	125.83	58.13
Zn (ppm)	2.29	2.69	2.85	3.27	2.87	12.55	6.22	17.67
Cu (ppm)	0.89	0.48	2.01	2.01	2.54	3.50	1.87	2.96
Nutrient retention capacity (n)								
OM (%)	2.6	3.3	2.9	1.2	3.3	7.7	4.8	5.3
CEC (cmol(+)/kg soil)	17.27	19.27	16.83	14.75	12.38	15.57	14.43	18.07
Base Saturation (%)	18.94	10.85	12.04	18.67	17.62	33.18	27.93	20.32

WD = Well drained; MWD; = moderately well drained; MD = moderately drained; ID = imperfectly Drained; PD = poorly drained; L = loamy;
SC= sandy clay; LS =loamy sand; SL = sandy loam S = sand; SCL=sandy clay loam; OM = organic matter; CEC = cation exchange capacity

TABLE 1C

Summary of land characteristics of the mapping units for cassava production in the study area

Land characteristics	Profile 01	Profile 02	Profile 03	Profile 04	Profile 05	Profile 06	Profile 07	Profile 08
Climate (c)								
Annual rainfall (mm)	1400	1400	1400	1400	1400	1400	1400	1400
Temperature (^{o}C)	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9
Topography (t)								
Slope (%)	4–6	5	2–4	2	5	2–4	2–4	1
Drainage (w)								
Wetness	WD	WD	MD	ID	WD	WD	MD	PD
Soil physical properties (s)								
Texture	SCL	SL	SL	SCL	SL	SL	SL	LS
Gravel (%)	31.5	49.7	28.3	13.4	15.4	21.3	28.8	12.7
Soil depth (cm)	200	182	160	180	187	150	200	67
Bulk density (gcm^{-3})	1.23	1.45	1.42	1.50	1.54	1.64	1.27	1.22
Nutrient availability (f)								
pH	5.8	6.5	6.5	5.8	5.2	6.5	5.9	6.0
Total N (%)	0.6	0.5	0.5	0.2	0.4	0.7	0.6	0.6
Avail. P (ppm)	11.65	8.05	13.5	11.4	15.9	12.5	19.2	9.4
Exchang. K (cmol/kg) s	0.21	0.19	0.20	0.18	0.29	0.42	0.24	0.19
Toxicity (t)								
Fe (ppm)	122.85	79.25	183.6	192.17	52.76	58.79	29.47	149.22
Mn (ppm)	352.96	307.32	219.58	350.08	4.89	219.06	125.83	58.13
Zn (ppm)	2.29	2.69	2.85	3.27	2.87	12.55	6.22	17.67
Cu (ppm)	0.89	0.48	2.01	2.01	2.54	3.50	1.87	2.96
Nutrient retention (n)								
OM (%)	2.6	3.3	2.9	1.2	3.3	7.7	4.8	5.3
CEC (cmol/kg)	17.27	19.27	16.83	14.75	12.38	15.57	14.43	18.07
Base saturation (%)	18.94	10.85	12.04	18.67	17.62	33.18	27.93	20.32

WD = Well drained; MWD; = moderately well drained; MD = moderately drained; ID = imperfectly Drained; PD = poorly drained; L = loamy;
SC= sandy clay; LS =loamy sand; SL = sandy loam S = sand; SCL=sandy clay loam; OM = organic matter; CEC = cation exchange capacity

TABLE 2A

Land requirements for rain-fed maize production

Land characteristics	S1 (100)	S12 (95)	S2 (85)	S3 (60)	N1 (40)	N2 (20)
Climate (c)						
Annual rainfall (mm)	800–1200	700–800	600–700	500–600	<500	-
Temperature (°C)	>25	22–25	20–22	18–20	16–18	<16
Topography (t)						
Slope (%)	0–2	2–4	4–8	8–16	16–20	>20
Oxygen availability (w)						
Drainage	Well drained	Moderate	Imperfect/ rapid	Poor/excessive	Poor/very excessive	Poor/very excessive
Soil physical properties (s)						
Texture	CL	SC, SCL, L	SL, LS	LS, FS	CM, S, CS	-
Gravel (%)	<15	15-40	40-60	60-75	75-90	>90
Soil depth (cm)	>90	50-90	30-50	20-30	10-20	<10
Bulk density (gcm^{-3})	<1.0	1.0-1.21	1.22-1.51	1.51-1.63	1.63-2	>2
Nutrient availability (f)						
pH	5.5–6.5	5.0–5.5	4.5–5.0	4.0–4.5	<4.0	-
Total N (%)	>0.15	0.08–0.15	0.08–0.04	0.02–0.04	<0.02	any less
Avail.P (ppm)	>22	13–22	6–13	3–6	<3	any less
Exchang. K (cmol(+)/ kg)	>0.5	0.3–0.5	0.2–0.3	0.1–0.2	<0.1	any less
Toxicity (t)						
Fe (ppm)	>20	15–20	8–15	4–8	<4	-
Mn (ppm)	>50	30–50	25–30	12–25	<12	any less
Cu (ppm)	>0.7	0.5–0.7	0.0–0.5	-	-	-
Zn (ppm)	>1.5	1.0–1.5	0.0–1.0	-	-	-
Nutrient retention (n)						
Organic matter (%)	>3	1–3	0.8–1	0.4–0.8	<0.4	-
CEC (cmol/kg)	>10	8–10	6–8	3–6	<3	Any
Base Saturation (%)	>35	>15	<15	-	-	-

CL = clay loam; S = sand; SC = sandy clay; SCL = sandy clay loam; L = loam; CS = coarse sand; SL = sandy loam; LS = loamy sand;

FS = fine sand; CM = Massive. Source: Oluwatosin & Ogunkunle (1991); Sys (1985).

TABLE 2B

Land requirements for rain-fed cassava production

Land characteristics	S11 (100)	S12 (95)	S2 (85)	S3 (60)	N1 (40)	N2 (20)
Climate (c)						
Annual rainfall (mm)	>1000	900-1000	800-900	600-800	500-600	<500
Temperature (°C)	>25	22-25	20-22	18-20	16-18	<16
Topography (t)						
Slope (%)	<2	2-4	4-8	8-16	16-20	>20
Oxygen availability (w)						
Drainage	WD	MWD	MD	ID	PD	PD
Soil physical properties (s)						
Texture	L	SL	SCL	SC	S	-
Gravel (%)	<10	10-15	15-35	35-55	>55	-
Soil depth (cm)	>100	80-100	60-80	50-60	35-50	<35
Bulk density (gcm^{-3})	<1.0	1.0-1.21	1.22-1.51	1.51-1.63	1.63-2	>2
Nutrient availability (f)						
pH	6.1 – 7.3	5.1 – 6.0	4.0 – 5.0	3.0 - 4.0	<3.0	-
Total N (%)	>0.15	0.08-0.15	0.04-0.08	0.02-0.04	<0.02	-
Avail.P (ppm)	>15	10-15	8-10	5-8	3-5	-
Exchang. K (cmol(+)/kg)	>0.25	0.20-0.25	0.15-0.20	0.10-0.15	<0.10	-
Toxicity (t)						
Fe (ppm)	>100	10-100	1.0-100	<1.0	-	-
Mn (ppm)	>250	100-250	10-100	5-10	<5	-
Zn (ppm)	>1.5	1.0- 1.5	0.0 - 1.0	-	-	-
Cu (ppm)	>0.7	0.5 – 0.7	0.0 – 0.5	-	-	-
Nutrient retention (n)						
Organic matter (%)	>3	1-3	0.8-1	0.4-0.8	<0.4	-
CEC (cmol/kg)	>10	8 – 10	6 – 8	3 – 6	<3	Any
Base Saturation (%)	>35	>15	<15	-	-	-

WD = well drained; MWD; = moderately well drained; MD = moderately drained; ID = imperfectly drained; PD = poorly drained; L = loamy;
SC = sandy clay; LS = loamy sand; S = sand; SCL = sandy clay loam, SL = sandy loam. Source: Sys (1985) and Ande (2011).

Results and Discussion

Land characteristics and qualities

The summary of the land characteristics/ land qualities in the study area for maize and cassava production are presented in Tables 1b and 1c, respectively. The climatic conditions of the area in terms of the amount of rainfall, rainfall distribution and temperature are favourable for the cultivation of the two crops. The soils were fairly deep (150 cm to 200 cm), except profile 08 (67 cm) which had a shallow depth of as a result of groundwater table. All the mapping units were well drained with the exception of the profile 08 that occupied the valley bottom. The slope of the area is low to moderately steep slope of about 1 to 6% but the gravel content was high. This might constitute a problem to root penetration/development and subsequently affect the yield on these soils (Fasina & Adeyanju, 2006). The fertility of the soils was low.

Suitability evaluation using the parametric approach

Suitability evaluation was carried out using the parametric method (Sys *et al*., 1993). The parametric method attributes a numerical rating to the limitation levels as follow: no limitation (highly suitable) 100%, low limitation (highly suitable) 95%, moderate limitation (moderately suitable) 85%, severe limitation (marginally suitable) 60% and very severe limitation (not suitable) 40%. The suitability of the soils was assessed for maize and cassava following the guidelines of Sys (1978; 1985). Suitability classes were defined with regard to the type and intensity of the limitations. They were generally related to the specific value of the land index. Soils were placed in classes according to their suitability for the production of specific crop.

The determination of the scores for rating involved matching of land characteristics/land qualities and crop requirements (Tables 1b & 2a with Tables 1c & 2b, for maize and cassava, respectively) to produce the suitability classes (Tables 3a and 3b) for the different mapping units in the study area. The conditions under which this evaluation was made were based on the fact that suitability management of the selected land use type and the least favourable of the rated land qualities controls/determines the overall suitability of each mapping unit. The assessment of the soils for crop production involved the use of properties that are permanent in nature and that cannot be changed or modified without exorbitant cost. Such properties include soil depth, slope, drainage, texture and amount of coarse fragments. These properties are known to constitute some sort of hindrance to crop production.

TABLE 3A

Suitability ratings of the soils for rain-fed maize production using a parametric approach

Soil Profile No.				Climate (c)		Physical properties (s)				Nutrients availability (f)				Toxicity (t)				Nutrient retention (n)			Suitability	
		Topography Slope (T)	Drainage (w)	Rainfall	Temp	Depth	Texture	Gravel	Bulk density	pH	N	P	K	Fe	Cu	Mn	Zn	CEC	BS	OM	Index	Class
01	a	85	100	100	100	100	95	95	85	100	100	85	85	100	100	100	100	100	95	95	43	S3tsfn
	P	85	100	100	100	100	95	95	85	-	-	-	-	-	-	-	-	100	95	95	59	S2tsn
02	a	85	100	100	100	100	85	85	80	100	100	85	80	100	85	100	100	100	85	95	23	N1tsfn
	p	85	100	100	100	100	85	85	80	-	-	-	-	-	-	-	-	100	85	95	40	S3tsn
03	a	95	95	100	100	100	85	95	80	100	100	95	85	100	100	100	100	100	85	95	32	S3tsfn
	p	95	95	100	100	100	85	95	80	-	-	-	-	-	-	-	-	100	85	95	47	S3tsn
04	a	85	85	100	100	100	95	100	75	100	100	85	80	100	100	100	100	95	95	60	16	N1tsfn
	p	85	85	100	100	100	95	100	75	-	-	-	-	-	-	-	-	95	95	60	28	S3tsn
05	a	85	100	100	100	100	85	95	60	95	100	95	85	100	100	60	100	95	95	95	16	N1tsfn
	p	85	100	100	100	100	85	95	60	-	-	-	-	-	-	-	-	95	95	95	35	S3tsn
06	a	95	100	100	100	100	85	95	40	100	100	85	95	100	100	100	100	95	95	100	22	N1tsfn
	p	95	100	100	100	100	85	95	40	-	-	-	-	-	-	-	-	95	95	100	28	S3tsn
07	a	95	95	100	100	100	85	95	85	100	100	85	85	100	100	100	100	95	95	95	38	S3tsfn
	p	95	95	100	100	100	85	95	85	-	-	-	-	-	-	-	-	95	95	95	53	S2tsn
08	a	100	40	100	100	95	85	100	85	100	100	60	80	100	100	100	100	100	95	100	13	N1wsf
	p	100	40	100	100	95	85	100	85	-	-	-	-	-	-	-	-	100	95	100	26	S3wsf

a = actual suitability, p = potential suitability

TABLE 3B

Suitability ratings of the soils for rain-fed cassava production using a parametric approach

Soil Profile No.				Climate (c)		Physical properties (s)				Nutrients availability (f)				Toxicity (t)				Nutrient retention (n)			Suitability	
		Topography Slope (T)	Drainage (w)	Rainfall	Temp	Depth	Texture	Gravel	Bulk density	pH	N	P	K	Fe	Cu	Mn	Zn	CEC	BS	OM	Index	Class
01	a	85	100	100	100	100	95	85	85	95	100	95	95	100	100	100	100	100	95	95	45	S3tsf
	p	85	100	100	100	100	95	85	85	-	-	-	-	-	-	-	-	100	95	95	53	S2ts
02	a	85	100	100	100	100	85	40	80	100	100	85	85	95	85	100	100	100	85	95	11	N2tsfn
	p	85	100	100	100	100	85	40	80	-	-	-	-	-	-	-	-	100	85	95	19	N1tsn
03	a	95	95	100	100	100	95	85	80	100	100	95	95	100	100	95	100	100	85	95	40	S3sfn
	p	95	95	100	100	100	95	85	80	-	-	-	-	-	-	-	-	100	85	95	43	S3sn
04	a	95	85	100	100	100	85	95	75	95	100	90	85	100	100	100	100	95	95	60	19	N1twsfn
	p	95	85	100	100	100	85	95	75	-	-	-	-	-	-	-	-	95	95	60	27	S3twsn
05	a	85	100	100	100	100	95	95	60	95	100	100	100	95	100	40	100	95	95	95	14	N1tsf
	p	85	100	100	100	100	95	95	60	-	-	-	-	-	-	-	-	95	95	95	40	S3ts
06	a	95	100	100	100	100	95	85	20	100	100	95	100	95	100	95	100	95	95	100	12	N2tsfn
	P	95	100	100	100	100	95	85	20	-	-	-	-	-	-	-	-	95	95	100	14	N1tsn
07	a	95	95	100	100	100	95	85	85	95	100	100	95	95	100	90	100	95	95	95	41	S3tsf
	p	95	95	100	100	100	95	85	85	-	-	-	-	-	-	-	-	95	95	95	53	S2ts
08	a	100	40	100	100	85	90	95	85	95	100	85	85	100	100	80	100	100	95	100	13	N1wsf
	p	100	40	100	100	85	90	95	85	-	-	-	-	-	-	-	-	100	95	100	24	N1ws

a = actual suitability, p = potential suitability

Chemical properties that are usually considered (e.g. fertility) can be changed by minor improvement (Sys, 1985).

The actual suitability implies the suitability of the soils for crop production in its present condition when correctable limitations (i.e. in this case, nutrient availability – N. P, K, Mn, Cu, Fe, Zn) are not corrected. Potential suitability assesses performance when fertilizers are added to correct fertility limitations during cropping. This presentation is necessary since the difference between actual and potential suitability is simply a management factor.

The results showed that none of the studied soils was highly suitable (S1) for maize and cassava production at both actual (a) and potential (p) suitability evaluation. The actual (a) suitability revealed that soils of Iwo series (profiles 1, 2, 5 & 6) were classified as marginally suitable (S3, profile 1) and permanently not suitable (N2, profiles 2, 5 & 6) for maize production while the soils were classified as marginally suitable (S3, profile 1), presently not suitable (N1, profile 5) and permanently not suitable (N2, profiles 2 & 6) for cassava production.

Potentially, the soils were classified as moderately suitable (S2, profile 1) and marginally suitable (S3, profiles 2, 5 and 6) for maize production, but the soils were moderately suitable (S2, profile 1), presently not suitable (N1, profiles 2 and 6) and marginally suitable (S3, profile 5) for cassava production. The soils were limited by nutrient availability (low copper content), texture (sandy loam to sand clay loam), high gravel content (15.4 to 49.7%), high bulk density (1.23 – 1.64 g/cm^3), slope (4 – 6%) and fertility (low P and K). The actual and potential suitability showed that soils of Gambari series (profile 3) were marginally suitable (S3) for maize and cassava production. The soils were limited by nutrient availability (low copper content), texture (sandy loam), high gravel content (28.3%), high bulk density (1.42 g/cm^3), low fertility (P and K) and low nutrient retention (low SOM and base saturation).

The actual suitability indicated that soils of Oba series were presently not suitable (N1, profile 4) and marginally suitable (S3, profile 7) for maize and cassava production, respectively. Potentially, the soils were marginally suitable (S3, profile 4) and moderately suitable (S2, profile 7) for maize and cassava production, respectively. The soils are limited by nutrient availability (low copper and zinc content), texture (sandy clay loam), high bulk density (1.5 g/cm^3), low fertility (P and K), low nutrient retention (low SOM) and slope which make the soils susceptible to erosion. The soils of Jago series (profile 8) were rated presently not suitable (N1) for actual suitability for maize and cassava production. Potentially, the soils were marginally suitable (S3) for maize production, but presently not suitable (N1) for cassava production. The soils were limited by wetness (poorly drained), texture (sandy loam), high bulk density (1.5 g/cm^3), shallow depth (less than 67 cm) and low fertility (P and K).

Conclusion and Recommendation

The study showed that the climatic characteristics such as mean annual temperature, mean annual rainfall and sunshine hours, and soil texture were generally optimum for maize and cassava cultivation. The soils are closely related but not homogenous, they varied in their potentiality with different physiographic units for maize and cassava production. To enhance the sustainable use of these soil resources for maize and cassava production, the constraints need to be adequately addressed through mulching and application of organic materials or incorporation of plant residues and mineral fertilizer application. However, soils of Jago series should be considered for alternative uses.

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