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Characterization and suitability assessment of soils underlain by mica-schist for yam and cocoyam production in rainforest area Southwestern, Nigeria

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Abstract
This study was conducted to assess the suitability of the soils underlain by mica-schist for sustainable production of yam and cocoyam. The study was carried out in 2014, in an area located approximately between 7°32' N and 7°33' N and longitudes 4°32' E and 4°40' E within the Teaching and Research Farm (T&R-F) of Obafemi Awolowo University (OAU), Kajola, Ile-Ife, Nigeria. Four profile pits were established, described and sampled with one at different physiographical units following the guideline for soil profile description according to FAO/UNESCO (2006) guideline. The soil samples collected were analyzed for particle size distribution, pH, total nitrogen, available phosphorus, exchangeable bases, and organic matter using standard method. Land characteristics obtained were matched with the crop requirements for yam and cocoyam to obtain the soils' suitability classes using parametric method. The result showed that all the soils are well drained and deep. The texture of the soils ranged from sandy loam to sandy clay loam at the surface and sandy clay loam to clay at subsurface. Soil reaction ranged from highly acidic to slightly acidic (4.2 – 5.8 water and 3.8 – 5.4 pH KCl) with low to moderate amounts of organic matter (1.2% to 2.9%) and available nitrogen (0.07 – 0.2 %). Available phosphorus varied from 2.0 – 10.6 mg/kg in all the horizons in the profiles with the highest values at the surface soil horizons, an indication that soil organic matter contributes significantly to the available P in these soils. The exchangeable bases were low and the relative abundance of the exchangeable bases followed the order: Ca> Mg > Na>K at the exchangeable site. Suitability evaluation of the soils was carried out using parametric approach. The result showed that all the soil mapping units were permanently not suitable (N2) for cocoyam and yam production for actual suitability evaluation. With the appropriate fertility management, the soils of mapping unit 2 was classified as moderately suitable (S2) for yam production while soils of mapping units 1 and 3 were classified as marginally suitable (S3) for yam production. Soils of mapping unit 4 was classified as presently not suitable (N1) for yam production. After improvement for cocoyam production, soils of mapping unit 1 and 2 were classified as marginally suitable (S3) while soils of mapping units 3 and 4 were presently not suitable (N1). The soils were limited by wetness, texture, shallow depth and low fertility (N, P and K). Therefore, Combined application of organic fertilizer with guided inorganic fertilizers (N-P-K) should be encouraged for optimum productivity.

Keywords
Characterization, Suitability, yam, Cocoyam, Rainforest, 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. (Adegbenro *et al.* 2022). Healthy soil is important to blossoming agriculture. Esu (2004) noted that one of the ways to accomplish sustainable agriculture in a sustainable environment is to examine soil properties and in particular through soil characterization and land evaluation for several land utilization types. Soils of southwestern Nigeria are dominantly formed in basement complex rocks areas and the landscape is characterized by undulating topography (Obi et al., 2009). Soils derived from fine-grained biotite gneiss and schist are very extensive in southwestern Nigeria (Smyth and Montgomery, 1962) and are highly vital on the account of their suitability for both arable and tree crops. Moreso, the world's population is increasing and the pressure on land is increasing on farmland with the result that fallow periods are becoming shorter in some areas, while intensive agriculture is fast replacing the age-old peasant system. In order to meet the increasing demand for food, the farming community has to produce more, in order to increase food production and provide food security; crops need to be grown in areas where they are best suited in order to get optimum yields, and this can be done with the aid of land suitability analysis (Gelleh et al, 2018). Based on a study, land suitability analysis is a method of land evaluation, which measures the degree of appropriateness of land for a certain use (Halder, 2013). Poor knowledge and appraisal of suitability of parcels of land for agricultural production is a major problem of agricultural development in Nigeria. The result is poor farm management practices, low yield and unnecessarily high cost of production (Aderonke and Gbadegesin, 2013).

In Nigeria, yam (*Dioscorea spp.*) and cocoyam 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. Yams are a staple tuber crop for many of the poorest in West Africa, South East Asia, the Caribbean and Oceania. In many of these areas' yams are also culturally important. Up to 95% of the world's yams are produced in West Africa (FAO, 2009). Nigeria is one of the leading producers of yam in in the world, accounting for about 65% to 67.5% of the world production (Apu et al., 2020). Yam is one of the main staple crops grown in Nigeria. Its demand for domestic consumption, ceremonial purpose, pharmaceutical needs, economic growth and export for foreign exchange return is on the increase alongside with its low production (Samson and Ityavnongo, 2021). Cocoyam (*Colocasia esculentus)* otherwise known as Taro is an herbaceous perennial plant belonging to the family Araceae and grown primarily for their edible roots. They are actually of two species namely Colocasia which is basically cultivated as food crops and Xanthosoma species which is comprised of a large spherical corm from which a few large leaves emerge. According to research, the global production of cocoyam has been estimated to be approximately 60 per cent in Africa and 40 per cent in Asia, with little quantities in the Caribbean and Oceania, over an area of 983 million hectares with an average yield of 5.314mt/ha (FAO, 1991). In a lot of developing countries, roots and tubers such as cocoyam, yam, cassava, and sweet potatoes are important crops that generate income and provide food security for the populace. In Nigeria, cocoyam is cultivated mainly predominantly as annuals, mainly for their edible starchy storage underground stems known as corms and cormels. Cocoyam corms are good sources of carbohydrates with starch that is easily digestible and it's nutritionally superior to its major competitor roots and tubers like cassava and yam in terms of digestibility, contents of crude protein and essential minerals, such as Ca, Mg, and P. The country maintains the lead among cocoyam producing nations, with an annual production of 4.55 million metric tonnes in 2012, representing 61.2 and 43.1% total production in West Africa, respectively (ODNRI, 1989). Also, in Nigeria cocoyam ranks third after cassava and yam among staple root and tuber crops in terms of importance, total output and production area. It has high economic potential not only as food but also as an agro-industrial raw material for pharmaceutical and livestock industries. This crop is very important and can generate income and provide food security for the populace. Cocoyam is actually under exploited in Osun State in as much as it has enormous health benefits over its competitor root crops such as cassava and yam which are eventually given more emphasis. These health benefits are in terms of certain minerals such as Ca, Mg, and P. Also, it aids digestion more than its

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competitor crops which include cassava and yam. The State can increase the production of this root and tuber crop in order to provide food security especially for the teaming population within Osun State and the country at large. This can, however, be done with the aid of a land suitability analysis in order to identify most suitable land for the production of cocoyam within the state. The rationale for the choice of land suitability for yam and cocoyam production emanated from the fact that the production of these root and tuber crops within the State has not been given much attention for long despite its nutritive and economic value; emphasis is rather placed more on the production of maize and cassava. Several studies have been done on characterization and suitability of southwestern soils for different crops (Adegbenro et al, (2022); Ujoh and Igbawua, (2019); Ikusemoran and Hajjatu (2010); Awoniyi and Omonona, (2006);), however there is dearth of information on characterization of soils derived from fine-grained biotite gneiss and schist in the rainforest region of southwestern Nigeria and their suitability for yam and cocoyam production. Therefore, the objectives of this study were to characterize and assess soils underlain by mica schist with a view to encourage sustainable production of yam and cocoyam in the area.

Materals and methods

The study was conducted in 2012 on soil underlain by mica schist (Smyth Montgomery 1962) at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. It is a region within the southwestern part of Nigeria, which lies between latitudes 7°32' N and 7°33' N and longitudes 4°32' E and 4°40' E. The elevation of the area ranged from 265 to 296 meters above mean sea level. The area has hot, humid tropical climate with distinct dry and bimodal rainy season. The mean annual rainfall is 1400mm and temperature is 27.9°C (Okusami and Oyediran, 1981). The vegetation of the area consists of cacao, oil palm and citrus. Four profile pits were established, described and sampled with one at different physiographical units following the guideline for soil profile description according to FAO/UNESCO (2006) guideline. Soils samples were taken from the identified genetic horizons of each of the soil profiles, starting from the lowest to the uppermost, in order to prevent contamination. Data collected from the analyses were subjected to descriptive and inferential statistics.

Laboratory analysis

The soil samples were air dried, crushed gently in a ceramic mortar and passed through 2 mm sieve to separate gravel content and obtain the less than 2 mm fractions for laboratory analyses. Particle size distribution was evaluated by the modified Bouyoucos hydrometer method (Bouyoucos, 1962) as reported by Gee and Or (2002). Soil pH was determined in 1:1 soil water suspension using a glass electrode pH meter (Mclean 1965). Soil organic carbon (SOC) was determined by the Walkley Black method (Walkley and Black, 1934) using the chromic acid digestion (Allison, 1965) as reported by Nelson and Sommers (1996). Exchangeable cations were extracted using 1. 0 N NH_4OAC (pH. 7.0) and read using flame photometer for Na and K, and atomic absorption spectrophotometer for calcium and magnesium (Rhoades, 1982). Total exchangeable acidity and Al were determined by titration method using 1.0 M KCl (Sims, 1996) and titrated with 0.05N NaOH solution (Black, 1975). The organic carbon was determined by the Walkley-Black method (Nelson and Sommers, 1996), total nitrogen was determined by the kjeldahl digestion and distillation method (Bremner, 1996) while the available phosphorus was determined by the Bray-1 method (Kuo, 1996).

Suitability evaluation

The FAO framework for soil suitability evaluation was used for the study (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 basis for the land assessment. A numerical rating of the land characteristics in 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. The index of suitability (actual and potential) was calculated using the square root method:

$$IP = A \times \sqrt{[(B/100) \times (C/100) \times \ldots \times (F/100)]} \quad [1]$$

where: IP = land index A =overall lowest characteristic rating B, C…F = lowest characteristics ratings for each land quality group (Udoh *et al.*, 2006). For actual (current) aggregate suitability, all the lowest characteristic ratings for each land quality group were substituted into the aggregate suitability equation above. However, in the case of potential aggregate suitability, it was assumed that the corrective fertility measures

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would no longer have fertility constraints. Therefore, other qualities except fertility (f) were used to calculate the potential aggregate suitability

Results and Discussion

Characteristics of the soil

Table 1 showed that the profiles were very deep and were all considered suitable for yam and cocoyam production. The texture of the surface ranged from loamy sand to clay and sandy clay to clay at subsurface. The sand particles seemed to be the most dominant size fraction with a range from 36% to 85 % but decreased with depth. The high sand particles fraction could have been responsible for the well-drained nature of the soils (Smyth and Montgomery, 1962; Amusan, 1991; Usman *et al.*, 2020). The clay content varied from 2 to 52 % which increased with depth of the in all the profiles except the soils at the valley bottom. This is an evidence of illuviation. The contents of silt in the soils were comparatively lower than those of the sand fraction.

There was no consistent pattern of distribution of silt in all the profiles, the values ranged between 5 to 17 %. The low silt content of the soils irrespective of their location is in line with the reports of several researchers who worked in similar environment in the basement complex area of Southwest Nigeria (Okusami and Oyediran, 1985). The silt/clay ratios of 0.22 to 0.25, 0.20 to 0.24, 0.20 to 0.25 and 7.50 to 17.00 were observed in mapping unit 1,2, 3 and 4 respectively. The soils of the study area were characterized by low degree of weathered when compared with the findings of Van Wambeke (1962), who reported that 'old' parent materials usually have silt/clay ratios below 0.15 while silt/clay ratios above 0.15 indicate 'young' parent material. Also, Asomoa (1985) reported that soils with silt/clay ratios of less than 0.25 were at an advanced stage of weathering while those with ratios greater than 0.25 indicated a low degree of weathering. However, soils of Jago had silt/ clay ratio above 0.15 and 0.25 indicating that the soil was relatively young.

Table 1. *Physical properties of the soils*

Horizon	Depth (cm)	Particle Size Distribution (%)			Textural Class	Silt/Clay ratio	Colour (moist)
		sand	silt	clay			
Profile 1: Upper Slope							
AP	0-18	79	5	20	SC	0.25	5YR3/4
AB	18-56	39	11	50	C	0.22	7.5YR 4/4
Bt	56-110	36	12	52	C	0.23	5YR 4/8
Bt2	110-144	41	11	48	C	0.23	5YR 5/6
BC	144-186	44	10	46	C	0.22	5YR 4/8
Profile 2: Mid slope							
AP	0-13	63	6	32	SCL	0.20	7.5YR 4/2
AB	13-25	49	9	42	SC	0.20	7.5YR 4/4
Bt	25-49	42	11	47	C	0.23	5YR 5/8
BC	49-116	42	11	46	C	0.24	5YR 4/8
Profile 3: Lower Slope							
AP	0-20	64	7	29	SCL	0.24	7.5YR 3/2
AB	20-63	50	9	41	SC	0.20	5YR 4/6
B2	63-106	50	10	40	SC	0.25	5YR 4/8
2B	106-162	52	9	39	SCL	0.23	5YR 4/8
Profile 4: Valley bottom							
Ap	0-8	82	17	1	LS	17.0	10YR 5/6
AB	8- 19	83	15	2	LS	7.50	10YR 5/6
BCg	19-25	85	13	2	LS	13.0	10YR 4/3

SC = Sandy Clay – C = Clay – SCL = Sandy Clay Loam – LS = Loamy sand

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The chemical properties of the soils studied are presented in Table 2. The pH of the soils was slightly acidic ranging from 4.2 – 5.8 and 3.8 – 5.4 in water and KCl solution respectively. The higher pH could be attributed to higher rate of phytocycling (Amusan, 1991). The pH difference (pH KCl - pH H_2O) is negative in all horizons of the soils and this suggests that silicate clay mineralogy is dominant over oxidic mineralogy (van Ray and Peech, 1972) or negatively charged (Mekaru and Uehara, 1972). The organic matter content was low (0.4 – 1.74 %). The soil organic matter ranged from 1.3% to 2.9% with the highest values observed at the surface horizons. The soil organic matter content of all profiles was low to medium and this may be due to the prevalence of tropical conditions where the degradation of organic matter occurs at faster rates coupled with low vegetation cover, thereby leaving less organic carbon in the soils (Nayak *et al.*, 2002). The value decreased with depth. The higher SOM content .at the surface of most of the profiles could be attributed to more decomposable plant materials on the surface soil (Lal, 1991). The total nitrogen content was low and varied from 0.07 – 0.20 % and the values decreased with depth. The values were low to medium compared with the critical value of plant nutrient of 0.20 % and in close association with organic matter. Available phosphorus varied from 2.0 – 10.6 mg/kg in all the horizons in the profiles with the highest values at the surface soil horizons, an indication that soil organic matter contributes significantly to the available P in these soils. The available P values were all considered low in most of the horizons as they were below the 10 mg/kg critical limit recommended for most commonly cultivated crops in the area (Obigbesan, 2009). The low value of available P might be due to the fixation of phosphorus by iron and aluminum sesquioxides under well-drained and acidic conditions of the soils.

Table 2. *Chemical properties of the soils*

Horizon	Depth	pH		H	OM	TN	AP	Na	K	Mg	Ca	H	Al	TEA	TEB	ECEC
	cm	H_2O	KCl		%		mg/kg	Cmol/kg								
							Profile 1: Upper slope									
AP	0-18	5.8	5.4	-0.4	2.9	0.20	10.6	0.1	0.3	2.6	4.7	1.1	0.3	1.4	5.2	6.6
AB	18-56	5.5	5.1	-0.4	2.8	0.14	3.7	0.2	0.4	2.9	6.9	0.6	0.3	0.9	7.6	8.4
Bt	56-110	5.5	5.4	-0.2	2.3	0.12	3	0.2	0.1	1.7	6.7	0.7	0.3	1.0	7.1	8.1
Bt2	110-144	5.6	5.4	-0.3	2.2	0.11	2	0.2	0.2	2.6	5.3	0.3	0.3	0.6	5.7	6.3
BC	144-186	5.5	5.1	-0.4	2.1	0.11	2	0.2	0.2	2.3	5.5	0.6	0.2	0.8	6.1	6.9
							Profile 2: Mid slope									
AP	0-13	5.7	5.1	-0.6	2	0.11	6.3	0.2	0.3	2	6.2	0.8	0.2	1.0	7.0	8.0
AB	13-25	5.3	4.7	-0.6	2.3	0.12	7.7	0.2	0.4	2.3	6	0.7	0.2	0.9	6.8	7.6
Bt	25-49	5.1	4.9	-0.3	1.5	0.08	3.2	0.2	0.3	2.3	5	0.3	0.3	0.6	5.6	6.2
BC	49-116	5.2	5.1	-0.1	1.3	0.07	2.6	0.2	0.4	2.3	6.5	0.5	0.3	0.8	7.2	7.9
							Profile 3: Lower slope									
AP	0-20	4.7	4.2	-0.5	2.3	0.12	8.7	0.2	0.4	3.5	5.4	0.4	0.3	0.7	6.2	6.9
AB	20-63	4.7	4.5	-0.2	2.4	0.12	10.2	0.2	0.3	5.2	7.6	0.3	0.3	0.6	8.3	8.9
B2	63-106	4.8	4.7	-0.1	1.7	0.1	5.8	0.2	0.3	2.9	5	0.2	0.3	0.5	5.6	6.2
2B	106-162	4.2	3.8	-0.4	2	0.1	7	0.2	0.1	2	4.1	0.7	0.4	1.1	4.5	5.6
							Profile 4: Valley bottom									
Ap	0-8	5.4	5.2	-0.2	2	0.1	6.7	0.2	0.2	1.8	3.8	1.6	0.4	2.0	4.2	6.2
AB	8- 19	5.5	5.2	-0.3	1.5	0.08	3.9	0.2	0.1	1.7	5	1.0	0.4	1.4	5.4	6.8
BCg	19-25	5.5	5.0	-0.5	2.3	0.12	7.9	0.1	0.1	2.4	3.8	0.9	0.3	1.2	4.2	5.4

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(Onyekwere *et al.*, 2001). The exchangeable bases were low, ranging from 4.2 to 8.3 cmol/kg. Smyth and Montgomery (1962) reported that the soils of the upland area of central western Nigeria have low exchange capacity in keeping with the essentially kaolinitic nature of their clay content. Relatively low amounts of exchangeable bases were present in all the profile pits examined. The exchangeable calcium for the soil varied from 3.8 to 6.9 cmol/kg while the exchangeable magnesium (Mg^{2+}) content varied from 1.7 to 5.2 cmol/kg soil. The soil Ca and Mg were higher than critical levels of 1.5 and 0.28 cmol/kg for Ca and Mg, respectively in soils of southwestern Nigeria (Enwezor *et al.*, 1990; Uponi and Adeoye, 2000). This implied that soils in this region can supply adequate amount of Ca and Mg needed for optimal growth of yam and cocoyam. Exchangeable potassium (K) contents ranged between 0.1 and 0.4 cmol/kg. The soil K levels were low to moderate compared to the critical level of 0.3 cmol/kg soil. This indicates that the soil K content were low and would therefore need the use of K supplying fertilizer. The sodium content ranged from 0.1 – 0.2 cmol/kg. Uwitonze (2016), reported that when the value of Na content is < 1 cmol/kg, it cannot be detrimental to plant roots. The cations occur in the order: Ca> Mg >K >Na at the exchangeable site. The low values of exchangeable bases of the soils may be attributed to high rainfall intensity, intensity of weathering, leaching and lateral translocation of bases (Solarin, 2000). Amhakhian and Osemwota (2011) shown that exchangeable cations were lost from the exchangeable complex in the following order Ca<Mg<K<Na.

Suitability evaluation of the soils for cocoyam production

The suitability ratings of the land characteristics (Table 5) were obtained by comparing their values with the land requirement for yam and cocoyam production

Table 3. *Land requirements for cocoyam (A) and yam (B) productions*

	Land Qualities		S1 (>95%)	Soil S2 (85%)	S3 (50%)	N1 (<50%)	N2 (<25%)
A)	Climate (c)	Annual Rainfall (mm)	≥ 2000	1300 - 2000	1000 – 1299	<1000	
		Annual Temperature (^{0}C)	21 – 25	25 – 30	30 – 35	>35	
	Topography (t)	Slope (%)	0 – 4	4 – 6	2 – 4	0 - 2	
	Drainage (w)		WD	MD	IMD	PD	VPD
	Physical properties (s)	Texture	L	SL	SCL	C	
		Soil depth (cm)	>40	31 – 40	21 – 30	<20	
	Nutrient availability (f)	pH	7.5 – 5.2	5.2 – 4.1	3.9 -	4.1	<3.9
		Nitrogen (%)	>0.6	0.3 – 0.5	0.1 – 0.2	<0.1	
		Phosphorus (mg/kg)	60 - 43	6 - 42	4 - 5	<4	-
		Potassium (cmol/kg)	>0.05	0.03 – 0.04	0.01 – 0.002	<0.01	
	Nutrient retention (n)	O.M.	>1.3	0.8 – 1.3	0.4 – 0.7	<0.4	
B)	Climate (c)	Annual Rainfall (mm)	1000 – 1800	750 – 600	600 – 550	550 - 500	<500
		Annual Temperature (^{0}C)	25 – 35	30 – 35	15- 20	>15	<15
	Topography (t)	Slope (%)	0 – 4	4 – 8	8 – 16	>16	
	Drainage (w)		WD	MD	ID	PD	VPD
	Physical properties (s)	Texture	L, SCL	SL	SC	C	
		Soil depth (cm)	>40	31 – 40	21 – 30	<20	
	Nutrient availability (f)	pH	7.5 – 5.2	5.2 – 4.1	3.9 – 4.1	<3.9	
		Nitrogen (%)	>0.6	0.3 – 0.5	0.1 – 0.2	<0.1	
		Phosphorus (mg/kg)	>25	6 - 25	<6	-	-
		Potassium (cmol/kg)	> 2.0	< 2.0	<1.0	>0.5	<0.5
	Nutrient retention (n)	O.M.	>1.5	> 0.8	> 0.5	< 0.3	

Sandy Clay Loam; SCL= Sandy Clay Loam; CL= Clay Loam; WD= Well drained; MD= Moderately drained; ID= Imperfectly drained.

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(Table 3) using the ratings for the limited characteristics in Table 5. Aggregate suitability ratings (potential and actual) were computed using the linear parametric approach. The result showed that all the soil mapping units were permanently not suitable (N2) for cocoyam and yam production for actual suitability evaluation. With the appropriate fertility management, the soils of mapping unit 2 was classified as moderately suitable (S2) for yam production while soils of mapping units 1 and 3 were classified as marginally suitable (S3) for yam production. Soils of mapping unit 4 was classified as presently not suitable (N1) for yam production. After improvement for cocoyam production, soils of mapping unit 1 and 2 were classified as marginally suitable (S3) while soils of mapping units 3 and 4 were presently not suitable (N1).

Table 4. *Qualitative land suitability classes for the different land indices*

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

Table 5. *Suitability evaluation of the soil units for cocoyam (A) and yam (B) productions*

	Land Qualities		Soil 1	Soil 2	Soil 3	Soil 4
A)	Climate (c)	Annual Rainfall (mm)	85	85	85	85
		Annual Temperature (0C)	85	85	85	85
	Topography (t):	Slope (%)	95	85	40	25
	Drainage (w)		100	100	85	25
	Soil physical properties (s)	Texture	40	50	50	85
		Soil depth (cm)	100	100	100	25
	Fertility (f)	pH	95	95	85	95
		Nitrogen (%)	40	40	40	40
		Phosphorus (ppm)	50	50	85	85
		Potassium (cmol/kg)	40	40	40	40
	Nutrient retention (n)	Organic matter (%)	100	100	100	100
	Index	a	09	10	08	02
		b	32	39	22	5
	Class	a	N2csf	N2ctsf	N2ctwsf	N2ctwsf
		b	S3csf	S3ctsf	N1ctwsf	N1ctwsf
B)	Climate (c)	Annual Rainfall (mm)	100	100	100	100
		Annual Temperature (0C)	100	100	100	100
		Relative humidity (%)	100	100	100	100
	Topography (t):	Slope (%)	75	75	100	100
	Drainage (w)		100	100	50	25
	Soil physical properties (s)	Texture	50	85	85	85
		Soil depth (cm)	100	100	100	50
	Fertility (f)	pH	100	100	50	100
		Nitrogen (%)	50	50	50	50
		Phosphorus (ppm)	50	50	85	85
		Potassium (cmol/kg)	25	25	25	10
	Nutrient retention (n)	Organic matter (%)	100	100	100	100
	Index	a	8	10	8	3
		b	43	69	46	16
	Class	a	N2tsf	N2tsf	N2wsf	N2wsf
		b	S3tsf	S2tsf	S3wsf	N1wsf

a = actual suitability when nutrient characteristic (f) is not corrected by fertilizer application
b = potential suitability after correction of nutrient characteristic (f) by fertilizer application.

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Conclusions

Soils of the studied area were characterized and evaluated for yam and cocoyam production. The soils were moderately acidic to highly acidic. The soils are deficient in macro nutrients, their values were below the critical level required for optimum yam and cocoyam production. Land suitability evaluation result revealed that currently, the soils are permanently not suitable (N2) for cocoyam and yam production. Potentially, that is, with good management practices, the soils would be presently not suitable (N1), marginally suitable (S3) and moderately suitable (S2). The soils were limited by wetness, texture, shallow depth, low soil organic matter and low fertility (N, P and K). Therefore, combined application of organic fertilizer with guided inorganic fertilizers (N-P-K) should be encouraged for optimum productivity in the area. In addition, the application of acidifying fertilizer should be avoided

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