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RESEARCH ARTICLE

SOIL SUITABILITY EVALUATION FOR DRY SEASON VEGETABLE PRODUCTION IN THE LOWLANDS OF MOBA LGA, EKITI STATE, NIGERIA

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ABSTRACT

Agricultural land should be used according to its capacity for optimum production at this time when precision farming is gaining wide acceptance. The ensuing land evaluation will involve assessment of the constraints in relation to suitability classes and the available options to mitigate them to attain the potentials. The soils of five locations in Moba LGA, Ekiti State Nigeria were characterized and evaluated for suitability to produceokro, tomato, celosia, leafamaranth and jute mallow. The soils were Alfisols on nearly flat to flat land with agro-ecological features adequate for the vegetables but with soil constraints of shallow top soil, coarse texture and poor structure which rate Pedons 1,2 and 3 as marginally suitable (S3) for all the vegetables, Pedon 4 marginally suitable (S3) for okra, celosia, leaf amaranth and moderately suitable (S2) fortomato, celosia and amaranthus production. The low basic cation content and CEC are the most critical soil fertility limitations which rateall the pedons as not suitable but potentially marginally suitable. Mulching and manuring to maintain soil organic matter at high levels and improve the CEC will make the soils moderately suitable. The split application of appropriate N, P and K fertilizers and complementary manure are recommendations for attaining potential suitability rating in the site.

INTRODUCTION

The nutrition crisis in sub-Sahara Africais indicated by food insecurity and unbalanced diets at the household, state and national levels. The quality ofavailable food is punctuated by severe proteinand energy malnutrition, vitamin A, iron and micronutrient deficiency especially in children, pregnant women and lactating mothers, and high levels of obesity, diabetes and cardio-vascular diseases in adults. This is a current challenge and the poor nutritional status, based on high level consumption of street food, processed food and snacks (junks and fast food) rich in fat, sugar, and salt eaten just to fill the stomach rather than feed in a balanced way, is already taking its tollon the inhabitants' health. Dietary vegetable products fit into the description of new, high quality and cheap sources of protein, energy, vitamins and minerals (Ologunde *et al.*, 1992, Grubben and Denton, 2004) that have great potentials for feeding the rising human population associated with rapid urbanization and industrial growth in Nigeria.The vegetables are rich and comparatively cheaper sources of vitamins, carbohydrates, protein and minerals.The sources of leaf vegetables are variable beingin the form of wild plants regularly harvestedwhen farmers come across them and times of food scarcity, semi-wild plants protected during land clearing and weeding operations, and indigenous species in regular cultivation grown sole or intercropped with staple food crops in distant farms, and in mixtures with fruit trees in the homestead gardens (Okigbo, 1983). The other sources are cultivation of exotic subtropical and some indigenous in smallholder, labour intensive market gardens close to urban centres, or subsistence to commercial enterprises to ensure supply and consumption of vegetable during the early and late seasons when adequate water from rainfall sustains the plants. Unfortunately, the poor state of irrigation infrastructureprevents vegetable production during the dry season (late November-early March) which is reflected in the scarcity and high costs of fruit and leaf vegetables in Ekiti State. Moba Local Government Area (LGA) in Ekiti State is largely an agrarian society noted for dry season vegetable production forsale in the markets throughout the LGA, neighbouringtowns in the state, Osun, Ondo, Kwara and Kogi States. However, the cultivation of the vegetable cropsis not at optimal level and output has stagnated or even declined probably due to environmental constraints and economic reasons. The limitation of inadequate water supply during the dry season has restricted cultivation to the flood plains and inland valleys which contain residual soil moisture and supplemental small-scale irrigation such that the land is subjected to near permanent intensive cultivation. The soil as a vital agro-ecological component and basis for the expected optimal crop production has not been studied in terms of the characterization, capability and suitability inventory.

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The soilsin Moba LGA need to be understood to greater detail in order to maximize their potentials, and for proper management to avoid land degradation.Thus, it would be possible to predict the relationships that determine the use to which the land is best suited for, identify the inherent limitations and how to mitigate them to attain potential suitability.

The objectives of this study therefore are to

- Characterize and classify the soils of the flood plains and inland valley systems in Moba Local Government Area,Ekiti State;
- determine the capability and evaluate the suitabilty evaluation of soils for the production of vegetable crops: leafamaranth, celosia, okra, tomato etc;
- Determine thesoil and environmental constraints for optimum production of the vegetable crops; and.
- Recommend the appropriate management technologies for soil quality improvement and optimum vegetable production in the study area.

MATERIALS AND METHODS

The study was carried out in Moba LGA, Ekiti State, Nigeria with latitudes 7.99 N and 5.12 E. Moba LGA experiences a tropical climate with distinct wet and dry seasons. The dry season spans from November to early March and the rainy season from late March or early April to October with a break in August. Themean annual rainfall is about 1,367mm, and the average number of rainy days is about 112 days per annum. The temperature is almost uniform throughout the year with very little deviation from the mean annual temperature of 27^0C. February and March are the hottest months with mean temperature of 28^0C and 29^0C respectively.The mean annual sunshine hours is about 2000 hours with mean daily sunshine of about 5 hours, and mean annual radiation is about 130kcal/cm per year. The geology of the study area is dominated by crystalline rocks, which form part of the basement complex of South Western Nigeria.

Field sampling: Five (5) villages were selected viz: Otun, Ira, Osan, Erinmopeto represent the farming communities in Moba LGA. In each location, site parameters such as vegetation, land use, land forms were recorded and a representative profile pit was dug in the valley bottom. The profile pits were described using the guidelines of the USDA Soil Taxonomy (Soil Survey Staff, 2003) and soil samples were collected from the various horizons. The field study was carried out during the peak period of the dry season to ensure freedom from ground water disturbance.

Soil sample preparation and analysis: The soil samples were air-dried, crushed to pass through a 2mm sieve and stored until needed for analysis. A little quantity of each soil was further crushed and passed through 0.55mm sieve for the determination of organic matter and total N. The soil samples were analyzed for particle size distribution, pH (H2O), organic matter, total N, available phosphorus, exchangeable cations (calcium, potassium, magnesium and sodium) and exchangeable acidity~~.~~ using the procedures described in the Laboratory Manual of Department of Soil Science lab manual SRE (2019).The effective CEC was taken as the sum of the exchangeable cations and the exchangeable acidity while base saturation was calculated as the sum of the bases (TEB) divided by ECEC.

Soil classification: The soils were described and classified according to the USDA Soil Taxonomy (Soil Survey Staff, 2014) and the Reference Soil Groups of World Resource Base (IUSS-ISRIC-FAO, 2006). The morphological properties examined include texture, colour, clay eluviation and illuviation, consistence, pore content, mottling, horizon boundaries, content of mineral fragments, depth to water table, and presence of roots and other biological activities, etc. The other general information on the soil considered were types of parent materials, drainage characteristics, soil moisture condition, atmospheric temperature, annual rainfall, slope, evidence of erosion, human influence, etc. The field observations were complemented by the results of the laboratory analyses to classify each pedon.

Land Suitability Evaluation Procedure: The land evaluationtechnique developed by Sys (1985)was adopted. The pedons were placed in suitability classes by matching their characteristics with land use requirements of the vegetable crops(Table 1). The suitability is indicated by its most limiting characteristics. The principle of limiting conditions is the simplest method with the logic to its creditbeing that if four important land qualities rate S1, S2, S3 andS4 for a pedon, the overall suitability is indicated by the quality assessed by the least characteristics. Thus, it is of little use having excellent conditions with respect to temperature regime, moisture availability, absence of salts and toxicities if rooting conditions are limiting by soil depth of 10cm (FAO, 1983).The method of limiting conditions can always be followed where there is an assessment of not suitable (N) since the qualities under consideration are restricted to those assessed as very or moderately important.

RESULTS

Classification of soil in the study area: The classification of the soil of the study site is presented in table 2. The soils are Alfisolsbased on the presence of argillic B horizon in the pedons and high base saturation (>35%) and that have one or more horizons within 50cm or the mineral soil surface andaquic conditions(artificial drainage)for some time in a normal year. Pedons 1, 3 and 4 are classified asTypicPlinthaqualf that have one or more horizons of an iron-rich and humus- poor mixture of clay with quartz and other minerals. Pedons 2 and 5 are TypicKandiaqualf due to the characteristics associated with wetness and evidence of plowing and mixed horizon as shown below.

Land qualities/characteristics of the study area and land use requirements for vegetable production: The determination of the land suitability classes using the FAO Framework (1976) involves matching of the land qualities/characteristics with the land use requirements of the crops under study. The five land quality groups used in this study are shown in Table 3 and the land requirements for the four suitability classes (S1, S2, S3 and N) for vegetable production are shown in Table1.

Climate (C): Climate parameters considered were annual rainfall, length of dry season, mean annual temperature and relative humidity. In Moba LGA Ekiti State, the annual rainfall is not a limiting factor to the production of vegetable crops. The result of matching the land characteristics with the requirements for vegetable cultivation rated the land as 100% suitable based on annual rainfall amount (1,334mm)which is

Table 1. Land and soil requirement for Okra, Tomatoes, Celosia, Amaranthus and Corchorus production

	OKRA				TOMATO				CELOSIA, AMARANTHUS AND CORCHORUS			
Land qualities	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N
Climate rainfall (mm)	1400-1800	1000-1400	600-1000	<600	600-1800	500-400	500-400	400-300	600-1800	600-500	500-400	400-300
Temperature (ºC)	26-20	20-30	30	30	25-30	25-20	20-15	15-10	20-25	20-18	18-15	15-18
Relative humidity length of dry season	3-4	4-5	5-6	6	3-4	4-5	5-6	6	3-4	4-5	5-6	4
Topography slope (%)	0-4	4-8	8-16	>30	>2	2-4	4-8	8-16	>2	2-4	4-8	8-16
Wetness drainage	Good	Moderate	Moderate	Imperfect	Good	Moderate	Imperfect	Poor	Good	Moderate	Imperfect	Poor
Soil physical properties												
Texture surface	L.SCL.S.CL	SL.SC.S.C	L.FLS	FS.LCS	CL.LS.CL	SCL.SL	SL.LS	FS.LCS	SS.CLL	SCL.SL	SL.LS	FS.LCS
Surface coarse fragment (vol%)	>5	5-25	25-45	<50	>15	15-30	30-50	50-80	>5	5-25	25-45	45-70
Depth impermeable layer (cm)	>100	75-100	50-75	<50	>90	70-90	40-70	<40	>70	60-70	50-60	10-50
Fertility CEC (mol/kg cl)	>24	16-24	12-16	<12	>15	12-15	8-12	<8	>20	15-20	10-15	>10
Base saturation% (0-150cm)	>50	35-50	20-35	<16	>50	35-50	20-35	<20	>50	35-50	20-35	>20
Organic matter, %	>1.5	0.8-1.2	0.5-0.8	<0.5	>1.5	0.8-1.5	0.08	0.08	>2	1.2-2	0.8-1.2	>0.8
Soil pH	5.5-6.5	5.0-6.0	<5->7.0	<4->8	5.5-6.5	5.0-6.0	<5-7.8	<4->8	5.5-6.5	5.0-6.0	<5->7.0	<4->8
Exch. Sodium (ESP), %	<5	5-10	>10	>15	<5	5-10	10-14	>15	<5	5-10	>10	>15

Key: C=clay, CS=Clay sand, S=sand, FS=fine sand, LS=loamy sand, CL=clay loam, LFS=loamy fine sand; S1, S2, S3 and N= Highly, Moderately, Marginally and Not suitable respectively.
Source: Aruleba and Fasina (2006)

Table 2. Soil Classification of the Study Site

Pedon1		Pedon2	Pedon3	Pedon4	Pedon5
Alfisol	Order	Alfisol	Alfisol	Alfisol	Alfisol
Aqualf	Sub-order	Aqualf	Aqualf	Aqualf	Aqualf
TypicPlinthaqualf	Great group	TypicKandiaqualf	TypicPlinthaqualf	TypicPlinthaqualf	TypicKandiaqualf

Table 3. Land qualities/characteristics of the study site

	profile 1	profile 2	profile 3	profile 4	profile 5
annual rainfall	1334	1334	1334	1334	1334
length of dry season (months)	3-4	3-4	3-4	3-4	3-4
mean temperature	25	25	25	25	25
soil depth, cm	0-18	0-20	0-58	0-30	0-30
pH H_2O	5.27	5.79	6.9	5.56	5.18
coarse fragment, %	40	32.3	35.1	30.8	30.6
Texture	Loamy	loamy sand	loamy sand	loamy sand	loamy sand
organic matter, %	1.39	1.05	1.22	1.65	1.31
exchangeable K	0.56	0.56	0.51	0.59	0.45
available P	9.3	9.6	21.2	13.8	11.4
exchangeable Mg	3.2	2.91	2.63	3.05	1.82
Base saturation	85.4	94.33	90.03	97.82	93.76
ECEC of the soil	6.85	5.3	6.02	6.44	4.97
Relative Humidity%	78	78	78	78	78
wetness (drainage)	Moist-Partially Drained	Moist-Partially Drained	Moist-Partially Drained	Moist-Partially Drained	Moist-Partially Drained
total N	0.28	0.31	0.11	0.21	0.15
organic carbon g/kg	1.39	1.05	1.22	1.65	1.31

Table 4. Suitability class scores of the pedons in the study area

	Pedon 1			Pedon 2			Pedon 3			Pedon 4			Pedon 5		
	Okra	Tomato	Celosia	Okra	Tomato	Celosia	Okra	Tomato	Celosia	Okra	Tomato	Celosia	Okra	Tomato	Celosia
Climate (C)															
Annual rainfall	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Rel/length of dry season	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Mean annual temp.	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Topography (t)															
Slope (%)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Wetness															
Drainage	S2(80)	S2(80)	S2(80)	S2(80)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)
Soil physical characteristics															
Texture and structure	S1(100)	S1(100)	S1(100)	S2(80)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S1(100)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)
Vol. of coarse fragment	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S2(80)	S3(60)	S3(60)	S2(80)	S2(80)
Soil depth	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Soil fertility (f)															
CEC	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)	N(20)
Base saturation	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Organic matter content	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Exchangeable K	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)	S2(80)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Available P	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)
Total N	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S2(90)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)	S1(100)
Aggregate suitability															
Potential	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)	S3(60)
Actual (current)	N(20) FSW	N(20)FS	N(20)FS	N(20)FSW	N(20)FS	N(20)FS	N(20)FS	N(20)FS	N(20)FS	N(20)FSW	N(20)FSW	N(20)FSW	N(20)FSW	N(20)FSW	N(20)FSW

highly adequate for the production of the vegetables. The length of dry season (3-4 months or 120days), mean annual temperature and relative humidity are optimum (rated 100%) for all the vegetables.

Topography and soil wetness: The topography of Moba LGA is generally suitable for vegetable production and the pedons evaluated have slope< 0.4% such that all the pedons were rated as highly suitable (100%). In terms of soil wetness (drainage), all the pedons were moderately suitable (S2) for okra while Pedon 3 was highly suitable (S1). Pedons 1, 2 and 3 were highly suitable (S1) for tomato, leaf amaranth, celosia while Pedon 3 and 4 were moderately suitable for tomato, leaf amaranth, celosia etc.

Soil physical characteristics: Soil physical characteristics evaluated were texture/structure, volume of coarse fragments and soil depth. The matching of these land qualities with the requirements for vegetables shows that based on the texture/structure, Pedon 1 was highly suitable (S1) for all the vegetables; Pedon 2 was moderately suitable (S2) for okra and marginally suitable for tomato, leaf amaranth, celosia etc; and Pedon 3 was marginally suitable (S3) for all the vegetables. Pedon 4 was marginally suitable (S3) for tomato, leaf amaranth,celosia etc and highly suitable (S1) for okra production. However, volume of coarse sand was generally sub-optimum for vegetables production in the study area compared to soil texture for optimum vegetable performance indicated asloam or sandy clay loam or loam sand (Aruleba and Fasina, 2006). Pedons 1, 2 and 3 were rated marginally suitable (S3) for all the vegetables, Pedon 4 was marginally suitable for okra, celosia, leaf amaranth and moderately suitable (S2) for tomato, celosia and leaf amaranth.

Soil Chemical Fertility: The current and potential suitability was assessed under current (or actual) soil fertility(chemical fertility) properties that are easily altered (exchangeable K, total N and available P) and compared to the requirements for potential fertility (Ogunkunle 1993, Aruleba and Fasina 2006). Under potential fertility are chemical properties which are not easily altered: cation exchange capacity (CEC), base saturation and organic matter content. The CEC imposed serious limitation on the suitability of the soils for all the vegetables. All the soils were not suitable (N20) for vegetable production in terms of CEC (<12cmol/kg) (Aruleba and Fasina, 2006).The matching of the land quality/characteristics with the requirements for vegetable production shows that exchangeable K content is sub-optimal to vegetable production in some soils. Thus, Pedons 1, 2 and 3 were moderately suitable (S2)for all the vegetables while Pedons 4 and 5 were highly suitable (S1) for all the vegetables. The available P was optimum (>22mg/kg) for Pedons 1, 2 and 3 (highly suitable S1) but sub-optimum in Pedons 4 and 5 which were rated marginally suitable (S3) for vegetables due to available P deficiency.For total N, Pedons 1, 2 and 3 were marginally suitable (S3) while pedons 4 and 5 were highly suitable (S1) for vegetable production.

Land suitability classes in the study area: The individual scores of the land characteristics (Table1) after matching the land qualities with the crop requirements (Table 3) are shown in Table 4.

Major limitations to land suitability for vegetable production: The aggregate suitability scores in Table 6 shows that in Moba LGA, three of the five land qualities, annual rainfall amount, topography (slope) and wetness are optimum or nearly so for vegetable production. Also, the mean annual temperature and relative humidity as aspects of climate are optimum for vegetable productionin the LGA. Furthermore, soil depth and other soil physical characteristics are optimum for vegetable cultivation in the LGA. One of the most serious limiting characteristics to vegetable production is soil texture and the volume of the coarse sand for optimum performance of vegetable crop,loam, sandy clay loam texture is required (Aruleba and Fasina, 2006). But in the area of the study, most of the pedons have loamy sand texture. Although, the limitation is not very severe;it is of ageneral nature thereby considering the entire area assub-optimal for vegetable production.

Furthermore, soil fertility is another land quality that severely limits vegetable productionin the LGA. Both the potential fertility (for example, CEC) and current fertility, particularly exchangeable K are serious constraints to vegetable production in the LGA. The CEC is generally below the critical level (<24cmol/kg) (Aruleba and Fasina 2006) in the entire LGA, thereby rendering the land not suitable for vegetable production. Exchangeable K and organic matter content are sub-optimum in some of the pedons which rendered the soils of the study site moderately suitable for vegetable production. With heavy rainfall and coarse sand texture having poor nutrient holding capacity as expressed by low CEC, the rate of leaching is high. This explains the low organic matter content and exchangeable K observed in the soils.

CONCLUSION

The result of the study shows that in spite of the optimal or near optimal mean annual rainfall and temperature, relative humidity and depth, soil drainage and total nitrogen; there is no highly suitable land for vegetables in Moba LGA. The soils in the LGA aremostly marginally for vegetables. The most severe limitations to vegetables production in Moba LGA are soil texture, soil fertility particularly CEC, exchangeable K and total nitrogen. In order to raise the productivity of the land to optimum vegetable production, management techniques to be adopted should enhance the nutrient and moisture holding capacity of the soil. Application of organic and inorganic fertilizers would enhance land productivity. Finally, during the rainy season, to avoid yield reduction arising from flooding as a result of excessive rainfall, appropriate drainage facilities should be put in place to take care of excessive moisture and the rising water table while during the dry season farming or vegetable production, provision of irrigation facilities would be appropriate to supplement the ground water for optimum vegetable production.

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Appendix

Table 1. The morphological properties of some soils in the lowlands of Moba LGA, Ekiti State

Profile No	horizon design	Depth	Colour	boundary	textural class	structure	constriction	Consistency	roots	drainage	mottles
PP1	O	0-18	10YR 3/1	Ds	L	SAB		Fr	many	WD	
	A	18-42	10YR 7/5	Gw	SCL	COL		Fr	many	WD	
	Bt_1	42-72	7.5YR 4/5	Ds	SCL	FG		Fm	few	WD	
	Bt_2	72-104	7.5YR 7/6	Gw	SCL	MAB	Few	Fm		WD	few
	C	104-147	2.5YR 5/3	Ds	SCL	MAB	Few	Sticky		WD	few
PP2	O	0-20	2.5YR 4/6	Dw	LS	FSAB		Fr	many	WD	
	A	20-30	10YR 5/4	Ds	SCL	SB		Fm	few	WD	
	Bt_1	30-50	7.5YR 5/6	Gs	SCL	COL	Few	Sl.sticky		WD	
	Bt_2	50-150	7.5YR 6/5	Ds	SC	MAB	Few	Stick		WD	Few
PP3	O	0-58	5YR 3/4	Dw	LS	FIGR		Fr	few	WD	
	A	58-91	10YR 6/5	Ds	SCL	COL	Few	Sl.sticky	few	WD	V.few
	B	91-150	7.5YR 7/5	Cw	SL	MAB	Few	Sticky		WD	few
PP4	O	0-30	5YR 5/1	Ds	LS	FICR		Lo	many	WD	
	A	30-50	7.5YR 5/5	Cw	SCL	PL		Fr	few	WD	
	B	50-150	7.5YR 7/5	Dw	SCL	CO.AB	Few	Sticky		WD	few
PP5	O	0-30	10YR 5/4	Cw	LS	FICR		Lo	many	WD	
	A	30-60	7.5YR 6/5	Gs	SL	MAB		Sl.sticky	few	WD	
	B	60-150	5YR 7/6	Gw	SCL	MAB		Sticky		WD	Few

Boundary: ds=diffuse smooth, gw=gradual wavy, gs=gradual smooth, dw=diffuse wavy, cw=clear wavy; Textural class: L=loamy, LS=loamy soil, SCL=sandy clay loam, SC=sandy clay; Structure: SAB=sub angular blocky, COL=columnar, FG=fine grain, MAB=medium angular blocky, FSAB=fine sub angular blocky, FICR=fine crumb; Concretion: F=few, A=absent; Roots: f=few, m=many; Consistency: f=friable, Lo=loose, Sl.Sticky=slightly sticky, S=sticky; Drainage: WD=well drain; Mottle: f=few, M-many; Stoniness: s=stony, ES=extremely stony, fs=fairly stony, vs=very stony

Field study, 2018

Table 2. Some physical properties of soils in the lowlands of Moba LGA, Ekiti State

Profile No	Horizon design	Depth cm	Clay	Silt	Silt/clay ratio	Fine sand g/kg	Coarse sand	Total sand	Texture
PP1	O	0-18	10.28	2.32	0.23	47.4	40	87.4	Loamy
	A	18-42	31.28	1.32	0.04	36.4	31.4	67.4	Sandy clay loam
	Bt_1	42-74	38.28	1.32	0.034	36.9	22.5	60.4	Sandy clay loam
	Bt_2	74-104	36.28	1.32	0.036	33.9	28.5	62.4	Sandy clay loam
	C	104-147	39.28	1.32	0.033	32.8	28.6	60.4	Sandy clay loam
PP2	O	0-20	22.28	0.32	0.014	45.1	32.3	77.4	Loamy sand
	A	20-30	25.27	0.33	0.013	40.6	34.8	74.4	Sandy clay loam
	Bt_1	30-50	31.27	0.33	0.01	42.7	25.5	68.4	Sandy clay loam
	Bt_2	50-150	40.28	1.32	0.03	36.3	22.1	58.4	Sandy clay
PP3	O	0-58	13.28	1.32	0.099	50.3	35.1	85.4	Loamy sand
	A	58-91	13.28	1.32	0.054	44.5	29.9	74.4	Sandy clay loam
	B	91-139	29.28	0.32	0.01	39.8	30.6	70.4	Sandy loam
PP4	O	0-30	21.25	1.35	0.06	46.6	30.8	77.4	Loamy sand
	A	30-50	32.28	2.32	0.071	43.6	21.8	65.4	Sandy clay loam
	B	50-150	29.28	0.32	0.01	45.1	25.3	70.4	Sandy clay loam
ate									
PP5	O	0-30	11.28	8.32	0.74	49.8	30.6	80.4	Loamy sand
	A	30-62	20.28	10.32	0.05	40.9	28.5	69.4	Sandy loam
	B	62-144	21.28	1.32	0.062	47.8	29.6	77.4	Sandy clay loam

Source: Field study, 2018

Table 3. The chemical properties of soils in the lowlands of Moba LGA, Ekiti State

Profile No	Horizon design	Depth cm	pH H_2O	OC g/kg	Available P mg/kg	T N (%)	Ca	Mg	K	Na	EA	Mn	Fe	Cu	Zn	ECEC	BS %
							Cmol/kg					mg/kg				Cmol/kg	
PP1	O	0-18	5.27	1.390	9.30	0.280	1.20	3.2	0.56	0.89	1.00	25.1	225.40	4.70	10.8	6.85	85.40
	A	18-42	5.19	0.640	5.90	0.200	1.12	2.8	0.49	0.72	1.50	13.1	19.10	4.80	9.1	6.63	77.37
	Bt_1	42-74	4.90	0.210	6.40	0.150	0.86	1.5	0.25	0.56	2.20	10.5	28.30	3.80	8.5	5.37	59.03
	Bt_2	74-104	5.37	0.760	4.10	0.120	0.90	2.3	0.15	0.35	3.00	10.2	10.60	4.20	10.6	6.70	55.22
	C	104-147	5.04	0.550	3.50	0.080	1.00	1.6	0.09	0.15	3.60	3.8	10.20	1.95	9.8	6.44	44.09
PP2	O	0-20	5.79	0.305	9.60	0.305	0.78	2.91	0.56	0.75	0.30	10.9	25.70	1.60	10.6	5.30	94.33
	A	20-30	5.31	0.226	9.40	0.226	0.62	2.08	0.42	0.56	0.70	1.2	23.40	1.40	8.2	4.38	84.01
	Bt_1	30-50	5.11	0.159	7.00	0.159	0.56	1.56	0.27	0.35	1.00	1.0	22.12	1.50	9.5	3.74	73.26
	Bt_2	50-150	5.66	0.087	5.60	0.087	0.57	1.35	0.21	0.27	1.20	0.8	15.29	1.20	7.1	3.60	66.67
PP3	O	0-58	6.90	0.105	21.20	0.105	1.43	2.63	0.51	0.85	0.60	18.2	19.70	5.31	9.1	6.02	90.03
	A	58-91	6.70	0.089	15.00	0.089	1.05	1.90	0.42	0.67	0.40	5.3	25.50	3.60	10.0	4.47	91.05
	B	91-139	6.63	0.062	5.57	0.062	0.82	1.65	0.28	0.34	0.20	4.9	18.60	2.30	8.4	3.29	93.92
PP4	O	0-30	5.56	0.210	13.80	0.210	1.72	3.05	0.59	0.94	0.14	52.0	29.10	1.30	9.2	6.44	97.82
	A	30-50	5.44	0.130	12.95	0.130	1.62	1.23	0.37	0.65	0.15	17.0	20.14	1.70	10.6	4.02	96.27
	B	50-150	4.58	0.090	9.60	0.090	0.92	2.4	0.15	0.32	0.20	9.0	18.30	1.80	9.5	3.99	94.98
PP5	O	0-30	5.18	0.152	11.40	0.152	1.86	1.82	0.45	0.53	0.31	67.0	21.11	1.30	10.9	4.97	93.76
	A	30-62	5.09	0.090	10.60	0.090	0.82	2.55	0.26	0.42	0.25	40.0	28.12	1.70	6.6	4.30	94.19
	B	62-144	5.05	0.030	9.90	0.030	1.22	1.79	0.10	0.33	0.20	16.0	16.10	1.80	8.4	3.44	94.50

Source: Field study, 2018

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