LAND SUITABILITY EVALUATION OF MAMBE WET LAND SOILS IN LAVUN LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA FOR RICE PRODUCTION.

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ABSTRACT

The wetland soil of mambe in southern guinea savanna area of Niger State,Nigeria, was evaluated for rice (Oryzaspp) cultivation by FAO system. The land area is for this study is about 35 hectares; data were collected from three (3) pedons the convention of non – parametric method was used in the evaluation. The soil of the area was classified as TypicEpiaquepts / GleyicCambisol. The study revealed that the land qualities/ characteristics, mean annual temperature, soil drainage, soil physical characteristics, fertility, salinity and ion toxicity) were marginally suitable S3 (60) to highly suitable S1 (95). The only limitation is fertility (Available P) which is potentially suitable but currently unsuitable for rice production.

Key words; mambe,Rice,non-parametric,fertility

INTRODUCTION

Wetland soil contributes over 50% of the food supply while upland and other domestic production contributes 33.4% and 70.3% respectively (Ojekunle, 2011). Wetland holds a rich potential for food production because water is available and the soils are more fertile than upland (International Institute for Tropical Agriculture IITA, 1990). It has been estimated that 62% of the total rice production in West Africa come from the wetland (West Africa Rice Development Association WARDA, 2004), which highlights the significance role of lowland ecosystems in rice production.

Wetland soil can intensify rice production and alleviate constraints resulting from short or long term dry spells and enable enough food production even in drought years. The cultivation of wetlands will serve multiple purposes; by reducing the pressure exerted on forested regions and water supply as well as dry season food security will be improved (Ojekunle, *et al*, 2009).

Although, some work have been done in the Southern guinea savannah part of Nigeria on wetland soils for rice production, but detailed research aimed evaluating the suitability of this area has not been carried out; hence there is a need to evaluate wetland of this area for its suitability for rice research and production.

MATERIALS AND METHODS

The study area is in Mambe, Niger State Southern guinea savanna of Nigeria. Niger State is in the Tropical rain forest zone and is located between latitude 08^0 05.278'N and longitude 006^0 47.789'E. Theycover about 35 hectares of land; the rainfall area is bimodal regime and usually occurs in April to October with a break in August popularly known as "August Break". The dry season occur from the month of November to March and is usually accompanied by a dry cold harmattan which prevails during the month of December and January. The total annual rainfall range from 1200 to 1500 mm while the mean annual temperature is between 24^0C to 34^0C with high relative humidity throughout the year reaching maximum during the raining season (NCRI, 2019)

Field work

The field work was carried out by creating some accessible routes. The soils were analyzed by delineation and identification of the soil units, properties of soils obtained from auger borings was used to locate sites for representative pedons. Profile pits were dug (1.5 x 1.5 x 2m) to represent the major soil units. Three profile pits were dug and described in line with the procedure as recommended by FAO (1998). Soil samples were collected from the identifiable horizons of the profile pits for physical and chemical analysis. Undisturbed core samples were collected from each profile pits for bulk density determinations. All the profile pits were georeferenced using hand held Global Positioning System (GPS).

Laboratory Analysis

The laboratory analysis of the soil samples was carried out using appropriate procedure to determine both physical and chemical properties of the soil.The representative soil profiles were described and the horizons were designated in situ according to the guide lines of FAO(2006).Soil colour notation was described according to Munsellcolour chart(KIC,2000) From the result of the soil laboratory analysis and field morphological properties, the pedons was classified according to soil taxonomy (USDA 2010) with side by side correlation of the (WRB) soil map of the world legend. Dent and Young (1981), suitability guidelines were used to rate the soil suitability for rice production.

Table 1: Land Qualities/ Characteristics of Pedons in the Study Area

Land qualities/characteristics	Pedon 1	Pedon 2	Pedon 3
Climate (C)	1900	1900	1900
Annual rainfall Mm	2200	200	2200
Average Temp. ^{0}C	27-28	27-28	27-28
Wetness (W)	2	2	2
Drainage			
Topography (t)			
Slope %	0-1	0-1	0-1
Soil physical characteristics (s)			
Soil depth cm	94	114	110
Clay %	57.5	47.75	56.25
Fertility (f)	4.6	5.6	5.78
pH	5.55	5.45	5.35
Total N %	0.18	0.16	0.12
Organic carbon %	2.1	1.89	1.52
Available P mgkg^{-1}	2.86	3.16	4.6
Exch. K cmolkg^{-1}	0.125	0.13	0.39
Exch. Ca cmolkg^{-1}	1.95	2.36	1.38
Exch. Mg cmolkg^{-1}	1.35	1.65	0.76
CEC soil cmolkg^{-1}	5.8	5.15	75
Base saturation %	6.6	81.5	31.0
Salinity (n)			
Electrical conductivity mSm^{-1}	0.036	0.13	1.27
Active Fe Mgkg^{-1}	5.15	3.58	7.05
Fe %	0.051	0.08	0.0705

Key: Drainage: 2 = poorly drained

RESULTS AND DISCUSSION

The morphological properties of the study area are presented in Appendix 1 while the physical, chemical properties as well as the primary nutrient of the area are shown in appendix 2,3 and 4 respectively.

Land qualities/ characteristics of the study area and land use requirements for rice cultivation.

The determination of land suitability classes using the FAO framework (1976), involves the matching of land qualities/characteristics with the land use requirements. The five land quality groups used in this study are shown in table1, and the land requirements for the four suitability classes (S1, S2. S3 and N1) for rice cultivation are shown in Table 2.

Table 2: Factor Rating of Land Requirements for Wetland Rice

Land qualities group	Land characteristics	Unit	S_1 95%(1)	$S_2$85% (2)	S_3 60% (3)	N_1 40% (4)
Climate (C)	Mean annual rainfall	Mm	>1500	1100-1500	500-1100	>500
Water availability	Average temp	^{0}C	29-32	21-29	18-21	<18
Wetness (w)	Soil drainage	-	Very poorly	poorly	Imperfectly	Well
Oxygen availability			drained	drained	drained	drained
Topography (t)	Slope	%	0-2	2-4	4-6	>6
Soil						
physical						
Characteristic						
Water rotention	Clay	%	50-25	25-15	15-5	<5>5
capacity						
Rooting condition	Soil depth	Cm	>50	50-25	25-15	<15
Fertility(f)						
Nutrient	pH	-	5.5-7.5	5.2-5.5	<5.2	Any
Availability						
	Organic carbon	%	3.2	2.1	>1	<1
	Total N	%	>0.02	0.2-0.1	0.1-0.5	<0.05

	Available P	$Mgkg^{-1}$	<20	20.15	15-10	<10
	** Exch. K	$Cmolkg^{-1}$	>0.2	0.1-0.2	<0.1	<0.1
	** Exch. Ca	$Cmolkg^{-1}$	10-15	5-10	1-5	<1
	** Exch. Mg	$Cmolkg^{-1}$	12-6	6-3	<3	Any
Nutrient retention	CEC (soil)	$Cmolkg^{-1}$	>16	10-16	5-10	<5
Salinity (n)						
	Electrical	mSm^{-1}	0-4	4-6	6-8	>8
	Conductivity (EC)					
Toxicity (n)	Active Fe	%	<0.75	0.75-1.0	1.0-1.25	>1.25

Source: Sys *et al.,* (1991), Mongkolsawat*et al.,* (1997),
** Tanka and Yoshida (1970),
** Moorman and Dudal (1965),
*** (Lass (1999)

Climate parameters considered were mean annual rainfall and average temperature. In Niger State, annual rainfall is not a limiting factor in rice production, the result of matching land characteristics in (table 5) with the requirements for rice cultivation (table 6) rated the land has highly suitable S1 (90) for rice cultivation. The average temperature was moderately suitable S2 (85) for rice cultivation. Base saturation (BS) was currently unsuitable to highly suitable. The pH of the study area was highly acidic, which is quite suitable for rice production. This corresponds with the findings of Moorman (1973), that rice is grown on a wide range of pH. The salinity (n) of the study area was assessed and in the three pedons, it was highly suitable S1 (95) for rice cultivation. Toxicity of the place is low and the soil is highly suitable S1 (95) for rice cultivation.

Table 3: Suitability Class Scores of the Study Area for Rice Cultivation

Land qualities/characteristics	Pedon 1	Pedon 2	Pedon 3
Climate (C)			
Annual rainfall	S1 (95)	S1 (95)	S1 (95)
Average Temp.	S2 (85)	S2 (85)	S2 (85)
Wetness (w)	S2 (85)	S2 (85)	S2 (85)
Drainage	S2 (85)	S2 (85)	S2 (85)
Topography (t)	S1 (95)	S1 (95)	S1 (95)
Slope	S1 (95)	S1 (95)	S1 (95)
Soil physical characteristics			
Soil depth	S1 (95)	S1 (95)	S1 (95)
Clay	S1 (95)	S1 (95)	S1 (95)
Fertility (f)			
pH	S3 (60)	S1 (95)	A1 (95)
Total N	S2 (85)	S2 (85)	S2 (85)
Organic carbon	S1 (95)	S2 (85)	S2 (85)
Available P	S1 (95)	S2 (85)	S2 (85)
Exch. K	S2 (85)	S2 (85)	S1 (95)
Exch. Ca	S3 (60)	S3 (60)	S3 (60)
Exch. Mg	S3 (60)	S3 (60)	S3 (60)
CEC (soil)	S3 (60)	S3 (60)	S3 (60)
Base saturation	S3 (60)	S3 (60)	S3 (60)
Salinity (n)			
Electrical conductivity	S1 (85)	S1 (95)	S1 (95)
Toxicity (c)			
Active Fe	S1 (95)	S1 (95)	S1 (95)

Aggregate suitability classification = S2-f= moderately suitable for rice production with fertility (Available P) as limitation.
Keys: S1 = highly suitable
S2 = moderately suitable
S3 = marginally suitable
N_1 = potentially suitable but currently unsuitable

Topography and Soil Wetness (t and w)

The topography of the area is generally suitable for rice cultivation (0 – 1%). The three pedons were rated as highly suitable (95%) for rice cultivation. In terms of soil wetness, (drainage) the three pedons were rated moderately S2 (82-5%) suitable for rice cultivation.

Soil Physical Characteristics

Soil physical characteristics evaluated were the soil depth and percentage clay. Matching the land qualities (table 5) with the requirements for rice cultivation (table 6), the land is highly suitable S1 (95%) in terms of depth and percentage clay for rice cultivation.

Soil Fertilization

The fertility of the area were assessed, these include Cation Exchange Capacity (CEC), base saturation and organic matter content. Others are exchangeable K, total N and available P. the result of matching the land qualities/characteristics (Table 5) with requirement for rice (Table 6) showed that available P is one of the major constraints to rice cultivation in the area. Available P for the three pedons in the study area was not suitable for rice production N1 (40). In terms of total nitrogen, the three pedons were moderately suitable S2 (85) for rice cultivation. CEC, Exchangeable Mg, Ca and K of the study area were marginally suitable S3 (60) to highly suitable S1 (90) for rice production, while organic carbon was marginally suitable to highly suitable.

Soil Classification

The soils are weakly developed with Cambic B-horizon and an Orchicepipedon. They are classified as Inceptisol (USDA) or Cambisol (FAO/UNESCO). The pedon showed aquic moisture regime indicated by its wetness of some period in the year, isohyperthermic temperature and redoximorphic features. They are classified as Aquepts. The soils within the units indicated low chroma (2 or less) signifying either long period of saturation or water near the surface horizons. They are classified as TypicEpiaquepts (USDA) or Gleyic-Cambisol (FAO/UNESCO)

CONCLUSION AND RECOMMENDATION

The suitability of the study area for rice cultivation method with the standard factor rating of land use requirements for wetland rice (Climate, wetness, topography, physical characteristic, fertility, salinity and iron toxicity). The results revealed that apart from fertility (Available P) which is potentially suitable but currently unsuitable N1 (40) for rice cultivation, all other factors are marginally suitable S3 (60) to highly suitable S1 (95) for rice cultivation. Low fertility (Available P) could be due to high soil acidity, Uzoho, et al., 2004. The fertility limitation can be amendment.

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