

LAND SUITABILITY INVESTIGATION FOR SESAME PRODUCTION AT COLLEGE OF AGRICULTURE FARM, GARKAWA, MIKANG LGA, PLATEAU STATE.

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ABSTRACT

Land suitability investigation for Sesame production at the College of Agriculture Garkawa in Northern Guinea Savannah zone of Nigeria was carried out in April, 2022. A reconnaissance soil survey was undertaken, which helped in identifying the distribution of soils and delineated as soil unit one (SU1), soil unit two (SU2) and soil unit three (SU3) respectively. Three minipits represented in each soil unit at depths of 0-15cm, 15-30cm, 30-45cm and 45-60cm respectively. Soil samples were collected according to the pedogenic horizons. Particle size distribution of the soil revealed loamy texture for all the soil units, which suggests adequate drainage. Soil reaction was highly acidic with means of 5.1, 4.85 and 5.20 for soil units 1, 2 and 3 respectively. High levels of exchangeable bases (Ca, Mg, Na and K) were also observed with calculated average percentage of base saturation (BS) as 73, 74 and 77 for SU1, SU2 and SU3 respectively. Although the farm is moderately suitable for Sesame production, some few constrains associated with Sesame production were discovered on the farm. To bring the farmland to suitable and sustainable status for Sesame production, organic fertilizer application and lime application were recommended to boost the soil fertility and mitigate the effect of high acidity on the farm.

Keywords: Suitability, Investigation, Production.

INTRODUCTION

Land suitability is a measure of how well the quality of land unit matches the requirements of a particular form of land use. The first step in classifying is to decide which factors should be used to define each suitability class. The assessment of the suitability of land is needful as it defines the fitness of a tract land or tracks of land for specific and alternative kinds of use. It involves the selection of suitable land for suitable uses such as cropping, irrigation, forestry, grazing, recreation etc. As well as management alternative that are physically viable. It provides information and recommendations for deciding what best use to make of available land and lands. For example, which crop/crops to grow under what management techniques to derive maximum and sustainable returns?

Land suitability classification otherwise known as the FAO framework for land evaluation was introduced in 1976 on accounts of the need for same degree of uniformity in the system of land evaluation all over the world and for ease of transfer of knowledge (Buol *et al.*, 1975 Kparmwang *et al*; 1998a, 1998b, Nwaka and Kwari, 2000). It is a four category classification and its highest category comprises of two orders, namely: Suitable (S) and not Suitable (N). The suitable orders comprise of three classes which are qualified as highly Suitable (S1), Moderately Suitable (S2) and Marginally Suitable (S3). The not suitable order however comprises of two classes namely; Currently not suitable (N1) and Permanently Not Suitable (N2) (Dent and Young, 1975; Young, 1981); soil survey staff, 1990, 1999). There is no sub class for the highly suitable class but the number of subclasses for the moderately suitable and the marginally suitable classes are unlimited. The sub-classes reflect the kinds of limitations such as soil erosion hazards, moisture deficiency and nutrient deficiency. They are divided not suitability units on the basis of differences in detailed aspects of production characteristics or in minor aspects of their management. Land suitability classifications recognise the concepts of land characteristics and qualities which are matched to a defined land use or land utilization type with known requirements. (Dent and Young, 1975; Kparmwang *et al*; 1998a, 1998b; soil survey staff, 1990).

The land characteristics and qualities could be evaluated qualitatively or quantitatively, depending on the facilities available such as technical knowhow and the amount and kind of information available (F.D.A.L.R;

1982). Quantitative physical land evaluation provides quantitative estimates of the available production or other benefits to be expected such as crop yields. Certainly, it represents an improvement over qualitative land evaluation but its drawback is that it does not normally supply a basis for comparing different forms of production (Buol *et al*; 1973).

Sesame (*Sesamum indicum* L) also called beniseed is an oil crop grown in 15 states of Nigeria stretching from the North east, north central, the middle belt and Federal capital Territory of the Sudan and Guinea Savannas (Phillips, 1977; Ingawa *et al*; 1986). It is an important crop because the seed contains about 51% oil, 17-19% protein and 16-18% carbohydrate (Yermanos *et al*; 1972), Sesame oil is used for the manufacture of margarine, salad oil, cooking oil, soap, paints, lubricants and lamp fuel; it is a carrier for medicines and perfumes; Young leaves are used as a soup vegetable; Sesame cake is an excellent livestock feed (PROTA, 2007).

Sesame thrives on moderately fertile and well-drained soils with PH ranging from 5.5 – 8.0, but most cultivars are sensitive to salinity. Growth and subsequent yield will be depressed on graveling or sandy soils due to their poor moisture retention. Sesame is very susceptible to water-logging. Sesame is a shallow-rooted crop and depth of planting is usually 2-5cm, but can be 10cm in loose soil (PROTA, 2007). Where Sesame is grown on a large scale, NPK Mixtures are commonly applied at planting. Application of both N and P is essential on poor soils, but K is Seldom required.

The production of Sesame has been remarkable in the middle belt of the Southern Guinea Savanna in Nigeria but not much work apart from Imoloame (2004) had been carried out on Sesame. The decline of groundnut (are oil seed crop) production in the area has given Sesame a place as an alternative crop useful as raw material in agro-allied and industries (IMO Loame *et al*; 2007). Since there is paucity of research on Sesame in Sudan Savannah agro-ecology, it was necessary to conduct this study with the objectives of determining the land characteristics that is suitable for its production.

MATERIALS AND METHODS

Description of the Study Area

The study was carried out in April, 2022 at the College of Agriculture farm in Garkawa, Northern Guinea Zone of Nigeria. Garkawa is located between Longitude 9°41 N and 9°45 E and latitude 8°51 N and 9°00 E. The climate of the area is characterised by high temperature range and seasonal rainfall, with a temperature range of between 32°C and 40° and an annual mean rainfall range between 1100-1400.

FIELD STUDIES

Prior to the commencement of the field studies, meteorological data on the study area were obtained from the meteorological station of the College. A reconnaissance soil survey was thereafter employed to gather information about some physical land characteristics such as drainage and topography. Also, the survey helped in identifying the areas where the soils were distributed. According to the soil of the College farm, three soil units were delineated on each unit at depths of 0-15cm, 15-30cm, 30-45cm and 45-60cm respectively. Soil samples from the respective soil units were collected according to the pedogenic horizons or depths. The same were analyzed for some physical and chemical properties using standard procedures. The obtained results are shown on Tables 1 and 2 for the three respective soil units.

The suitability classification was carried out using the agreed procedure by Kparmwang *et al*; (1998a). The principle of matching the land use requirements with land qualities as described by FAO / UNESCO (1988); Kparmwang *et al*; (1988a); Nwaka and Kwari (1993) was used to developed suitability class for Sesame. By this procedure, soils of the same generic classifications i.e. soils with similar characteristics and qualities were merged together as a soil unit.

RESULTS AND DISCUSSIONS

The results of some of the physical and chemical properties are seen displayed on Tables 1 and 2 for the three respective soil units. The data obtained for both land characteristics and qualities of the land units and requirements for their uses were matched to give Land suitability classes described by Voncir, (2002). The matching produces suitability classes for each quality. The extreme suitability classes for the individual qualities when combined together give the extent of limitation to productivity to be either minor, moderately or very severe. The extent of the combined limitations is used to produce the overall suitability class of the crop. Tables 7, 8 and 9 show that the land suitability classification of soil units 1, 2 and 3 respectively.

Although the soil distribution was adjudged and delineated according to the topography of the land as upper slope, middle slope and lower slope respectively, the farmland gives a highly suitable (SU1) terrain for Sesame production. Also, given that particle size distribution of the soils translates into loamy texture, oxygen availability and drainage highly favour sesame production, with good soil workability, all designated as S1 (Tables 7,8 and 9). Moreover, the maximum uniform depth of 60cm adopted in all the soil units indicates that the farmland can be highly suitable for sesame is shallow rooted crop. However, the overall suitability on the tables revealed that nutrient availability and nutrient retention capacity stand out as moderate limiting factors (S2) as percentage base saturation of the farm was found to be generally medium and so may not adequately sustain the production of Sesame. Similarly, the soil reaction of the farm pose a limitation to Sesame production as the reactions was discovered to be highly acidic in all the soil units with a mean of 5.05. the continuous use of nitrogenous fertilizers on the farm might be responsible for this low PH conditions.

CONCLUSION AND RECOMMENDATIONS

The results of this investigation show that both physical land characteristics visa-vis the soil physical and chemical properties present a suitable ground for Sesame production safe for the occurrence of relatively low plant nutrients and its retention as limiting factors. Given that Sesame is sensitive to salinity as reported by PROTA, (2007) it is desirable for the soil pH to be raised by liming so that the farm can attain its sustainable sustainability potential for Sesame production. Moreover, to upgrade the fertility of the farmland so as to suit Sesame production, addition of organic fertilizers be done. This will also help mitigate the effect of low pH and improve the structure of the soil.

Table 1: Physical Properties of College of Agriculture Garkawa Farm

Pedon	Depth	Sand	Silt	Clay	BD	PD	Total Porosity(%)
SU1	0-15	41.00	31.0	22.40	0.89	2.43	63
	15-30	33.00	29.80	21.90	0.88	2.40	63
	30-45	32.60	30.10	28.40	0.89	2.38	63
	45-60	40.00	32.00	26.50	0.87	2.18	60
Mean		36.65	30.73	24.80	0.88	2.35	62
SU20	0-15	38.50	28.80	23.00	0.84	2.41	65
	15-30	36.00	27.70	24.00	0.78	2.35	67
	30-45	31.20	26.80	25.60	0.79	2.25	65
	45-60	30.00	25.30	23.50	0.80	2.45	67
Mean		33.93	27.15	24.00	0.80	2.37	66
SU3	0-15	43.10	34.20	22.20	0.88	2.30	62
	15-30	39.50	33.10	24.40	0.86	2.41	64
	30-45	38.30	30.50	22.40	0.79	2.35	66
	45-60	35.40	29.60	23.50	0.78	2.20	65
Mean		39.08	31.85	23.13	0.83	2.23	64

Source=Field study, 2022

Table 2: Chemical Properties of College of Agriculture Garkawa Farm

Pedon	Depth	PH	EC	OC	TN	AVP	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	TEB	TEA	CEC	EECC	BS(%)
SU1	0-15	5.4	0.0042	2.00	0.19	10.11	2.34	2.00	0.80	0.44	5.58	2.09	6.91	7.67	73
	15-30	5.1	0.060	1.90	0.19	9.98	2.14	2.11	0.84	0.39	5.48	2.01	6.80	7.49	73
	30-45	4.9	0.039	1.71	0.18	8.71	2.12	1.81	0.81	0.39	5.21	1.98	6.71	7.19	72
	45-60	5.0	0.040	1.43	0.18	8.56	2.09	1.78	0.74	0.37	4.98	1.74	6.60	6.72	73
Mean		5.1	0.045	1.76	0.19	9.34	2.17	1.95	0.80	0.40	5.31	1.96	6.76	7.25	73
SU2	0-15	4.7	0.049	1.18	0.20	8.94	3.09	1.93	0.79	0.38	6.19	2.23	6.80	8.42	74
	15-30	4.8	0.058	1.03	0.19	8.14	2.99	1.74	0.78	0.31	5.82	2.06	6.74	7.88	74

	30-45	5.0	0.060	1.00	0.15	7.93	2.89	1.81	0.76	0.28	5.74	1.89	5.99	7.63	75
	45-60	4.9	0.056	1.00	0.15	7.88	2.40	1.66	0.68	0.26	5.00	1.86	5.89	6.86	73
Mean		4.85	0.056	1.05	0.17	8.22	2.84	1.79	0.75	0.31	5.69	2.01	6.36	7.70	74
SU3	0-15	5.7	0.053	1.45	0.17	8.45	3.10	1.90	0.77	0.33	6.10	1.80	6.45	7.90	77
	15-30	5.5	0.061	1.42	0.16	8.35	2.78	1.66	0.76	0.28	5.48	1.81	6.33	7.29	75
	30-45	4.8	0.059	1.40	0.16	7.81	2.66	1.64	0.75	0.22	5.27	1.44	6.31	6.71	79
	45-60	4.8	0.058	1.40	0.15	7.75	2.48	1.63	0.74	0.20	5.05	1.43	5.96	6.48	78
Mean		5.2	0.058	1.42	0.17	8.05	2.76	1.71	0.76	0.26	5.46	1.62	6.26	7.10	77

Source: Field study, 2022.

Table 3: Land Unit Characteristics and Qualities for Suitability Classification in SU1

Land Quality	Diagnostics factor	Unit	SU1
Oxygen availability (g)	Drainage	Class	Well drained
Nutrient availability(a)		pH	5.1
Rooting Condition (r)	Depth	Cm	50
Soil workability(w)	Texture	Class	L
Soil workability (K)	Structure	Class	Mod. dev. Structure
Erosion hazard (e)	Slope	%	0-2
Nutrient retention cap. (n)	BS	%	73

Key: L=loam; Mod: moderately, Dev.: developed

Cap = capacity, BS = base saturation; SU = soil unit

Source: Field Study, 2022

Table 4: Land Unit Characteristics and Quality for Suitability Classification of Soil Unit 2

Land Quality	Diagnostics factor	Unit	SU2
Oxygen availability (g)	Drainage	Class	Well drained
Nutrient availability(a)		pH	4.85
Rooting Condition (r)	Depth	Cm	50
Soil workability(w)	Texture	Class	L
Soil workability (K)	Structure	Class	Mod. dev. Structure
Erosion hazard (e)	Slope	%	0-2
Nutrient retention cap. (n)	BS	%	74

Key: CL = Clay loam, L = Loam; Mod. Dev = Moderately Developed; Cap: Capacity, BS = base saturation

Source: Field Study, 2022

Table 5: Land Unit Characteristics and Quality for Suitability Classification of Soil Unit 3

Land Quality	Diagnostics factor	Unit	SU3
Oxygen availability (g)	Drainage	Class	Well drained
Nutrient availability(a)		pH	5.2
Rooting Condition (r)	Depth	Cm	50
Soil workability(w)	Texture	Class	L
Soil workability (K)	Structure	Class	Mod. dev. Structure
Erosion hazard (e)	Slope	%	0-2
Nutrient retention cap. (n)	BS	%	77

Key: L = Loam; Mod. Dev = Moderately Developed; Cap: Capacity, BS = base saturation

Source: Field Study, 2022

Table 6: Rating of Land Use Requirement

Land Quality	Diagnostic Factor	Unit	Factor rating			
			S1	S2	S3	N
Oxygen availability (g)	Drainage	Class	Well drained	Mod. well drained	Poorly drained	Very poorly drained
Nutrient availability (a)	Reaction	PH	6-7	5.5-6	5-5.5,7-8	<5.6,>8
Nutrient Retention (r)	Base saturation	%	>70	50-70	30-50	<30
Rooting condition (r)	Depth	Cm	>120	50-120	30-50	<30
Soil workability (w)	Texture	Class	SL, L	SCL, SiL	LS, CL, SCL	SC, SiL, C
Soil workability (K)	Structure	Class	Mod. Well. Dev. Structure	Mod. Dev. Structure	Weakly Dev. Structure	Structure less
Erosion Hazard (e)	Slope	%	0.2	2-4	4-6	>6

Key: < = Less than; > = Greater than; Mod. = Moderately; SL = Sandy loam; L = Loam; Si. L. = Silty loam; C = Clay; Dev=developed; Si. CL = Silty clay loam; LS = Loamy Sand; S1 = Highly suitable; S2 = Moderately Suitable; S3 = Marginally Suitable; N = Not Suitable

Source: Field Study, 2022.

Table 7: Matching Landuse Requirement with Land Qualities for Sesame in SU1

Land Requirement/Land Quality	Suitability Ratings of Land unit
Oxygen availability (g)	S1
Nutrient availability (a)	S2
Nutrient Retention capacity (n)	S2
Rooting condition (r)	S1
Soil workability (w)	S1
Soil workability (K)	S1
Erosion hazard (e)	S1
Overall suitability	S2an

Table 8: Matching Landuse Requirement with Land Qualities for Sesame in SU1

Land Requirement/Land Quality	Suitability Ratings of Land unit
Oxygen availability (g)	S1
Nutrient availability (a)	S2
Nutrient Retention capacity (n)	S2
Rooting condition (r)	S1
Soil workability (w)	S1
Soil workability (K)	S1
Erosion hazard (e)	S1
Overall suitability	S2an

Table 9: Matching Landuse Requirement with Land Qualities for Sesame in SU1

Land Requirement/Land Quality	Suitability Ratings of Land unit
Oxygen availability (g)	S1
Nutrient availability (a)	S2
Nutrient Retention capacity (n)	S2
Rooting condition (r)	S1
Soil workability (w)	S1
Soil workability (K)	S1
Erosion hazard (e)	S1
Overall suitability	S2an

REFERENCES

- Buol, S.W; Sanchez, P.A.,Cate, R.B., Jr, and Granger, M.A.(1973). Soil fertility capability. A technical soil classification system for fertility management In: Bornemiza, E. and Alvarado, A. (Eds.) soil management in tropical America,NC state University, Raleigh NC pp 126-145.
- Dent, D.L. and Young, A. (1981). Soil Survey and Land Evaluation. George Allen and Unwin, London.167pp
- FAO/UNESCO (1988). Soil map of the world, Revised Legend World map soil resources report no.60, FAO Rome
- Imoloame EO (2004). Effects of Seed Rate and Method of Sowing on the Weed Infestation, Growth and Yield of Sesame (*sesamum indicum* L). weed infestation, yield and yield component as influenced by sowing method and seed rate in a Sudan Savanna agro-ecology of Nigeria. Africa journal of Agriculture Research Vol.2 (10) pp 528-533
- Ingawa, SA, Misari, SM., Kaigama, B.K.(1986). Sesame Production and Marketing in Nigeria. A report of an exploratory investigation. Institute for Agricultural Research. Cropping Scheme meeting on Legumes and oil seeds Research, Ahmadu Bello University Zaria pp 24-28.
- Kparmwang T., Abubakar, A.S.; Chude, V.o.; Raji, B.A. and Malgwi, W.B.(1998b). Suitability Assessment of the Microtopographical Land Features of the River Galma Fadama at Zaria using the principles of limited condition and Arithmetic modeling In: Proc. Of the 24th annual conference held at the Abubakar Tafawa Balewa University, Bauchi 7th -11 December, 1988.
- Kparmwang T.; Abubakar, A.S.; chude, V. O.; Raji, B.A. and Malgwi, W.B. (1998a). The Inherent Fertility and Management of the Microtopographical land features of the River Galma Fadama at Zaria In: Proc. Of the 24th Annual conference of the Soil Science Soc. Of Nigeria held at Abubakar Tafawa Balewa University Bauchi.
- Nwaka, G. I. C and Kwaari J. D. (1993). Mapping and Land Evaluation Studies of Soil of Jere Bowl (unpublished).
- Philips, T.A (1977). Sesame: An Agricultural Notebook. New Ed. Longman Group Ltd London pp61-63.
- PROTA (2007). Vegetable oils. PROTA Foundation, Backhuys Publishers, CTA Wageningen, Netherland pp153
- Soil Survey Staff (1990). Keys to Soil Taxonomy. Fourth edition SMSS Tech. Monograph No.6 Black, Virginia 422pp
- Soil Survey Staff (1999). Soil Survey Manual. Soil Conservation Service. USDA Handbook No.18 U.S. Government Printing Office Washington D.C.
- Voncir, N. (2002). Genesis and Classification of the Gubi Soil Series, Bauchi. Unpublished Doctoral Thesis, Department of Soil Science, ATBU Bauchi Nigeria.
- Yermanos. D Heenstreet MJ, Saleed W, Huszar (1972). Oil contents and composition of the seed in the world collection of sesame introduction. J of Agric. And chem. Soc.49(1) 20-23
- Young, A. (1976). Tropical soils and soil Survey. Cambridge University Press London. New York Melbourne.