



Soil-Site Suitability Evaluation of Sugarcane-growing Soils of Chittoor District in Andhra Pradesh

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ABSTRACT

Sugarcane-growing soils of Chittoor district in Andhra Pradesh were evaluated for their suitability for sugarcane crop. These soils belong to Alfisols, Entisols and Inceptisols. Texture and pH were major limitations in pedons 1, 2, 4, 8, 11, 14 and 16 while ESP was a major limitation in pedons 3, 4, 7, 10, 11, 12 and 17 and soil depth was a major limitation in pedons 3, 4 and 7. Texture, pH, organic carbon, sum of the basic cations and ESP were the general limitations in all the soils of the study area. The pedons 1, 5, 6 and 7 were moderately suitable (S2) while pedons 2, 3, 4, 8, 9, 10, 12, 13, 14, 15 and 16 were marginally suitable (S3) and Pedon 11 was temporarily not suitable (N1) for growing sugarcane crop. The suitability classes can be improved if the correctable limitations (soil fertility characteristics) were altered through soil amelioration measures.

Key words : Crop suitability, Land evaluation, Limitations, Potentials, Sugarcane crop.

Suitability evaluation criteria provides scientific database dealing the soil and climatic requirements of major crops grown in any area. Land suitability assessment is primarily based on land qualities, which can be derived from the available land characteristics. Degree of limitations are conceptually same as factor ratings, however they differ in their name and sometimes in the number of classes (Gabhane *et al.*, 2006). Every crop has specific requirement of soil for economic production. Information on soil constraints for crop growth and soil-site suitability for sugarcane crop in sugarcane-growing soils of Chittoor district in particular and Andhra Pradesh in general is very much lacking. Hence, an attempt was made to evaluate the soil-site suitability of different soils of Andhra Pradesh for sugarcane.

MATERIAL AND METHODS

Study area

The study area lies in between 12°37' and 14°8' N latitude and 78°33' and 79°55' E longitude. It represents semi-arid monsoonic climate with distinct summer, winter and rainy seasons. The annual precipitation was 893.63 mm of which 94.31 per cent was received during May to December. The mean annual soil temperature was 27.70°C with mean summer and winter temperatures of 31.77 and 26.99°C, respectively. The area qualifies

for isohyperthermic temperature regime. The soil moisture control section remains dry for more than 90 cumulative days or 45 consecutive days in four months following summer solistice and this qualifies for ustic soil moisture regime. The natural vegetation of the study area was *Parthenium hysterophorus*, *Calotropis gigantia*, *Tridax procumbens*, *Pongamia pinnata*, *Azardirachta indica*, *Lantana camera*, *Cyperus rotundus* and *Cynodon dactylon*. The soils were developed from weathered-gneiss, alluvium and weathered-gneiss mixed with kankar parent materials.

Methodology

After traversing the sugarcane-growing soils of Chittoor district, seventeen typical pedons were studied on defined landforms (plains and uplands) for their morphological characteristics following the procedure given by Soil Survey Staff (1951). Horizon-wise soil samples were collected from the typifying pedons and analysed for their physical, physico-chemical and chemical properties following the standard procedures. The soils were classified according to Soil Taxonomy (Soil Survey Staff, 2010). The selected pedons were evaluated for their suitability sugar cane using limitation method regarding number and intensity of limitations (Sys *et al.*, 1991).

The landscape and soil requirements for sugarcane (Sys *et al.*, 1993) were matched with generated data at different limitation levels. The number and degree of limitations suggested the suitability class of pedons for a particular crop. The potential land suitability (Table 3) sub-classes were determined after considering the improvement measures to correct the limitations (Sys *et al.*, 1991).

RESULTS AND DISCUSSION

Relevant soil characteristics are given in table 1 while, the site and weighted means of soil characteristics are given in table 2. The soils were developed from weathered-gneiss, alluvium and weathered-gneiss mixed with kankar parent material. The kind and degree of limitations for the sugarcane crop are presented in table 3. The soils with no or only four slight limitations were grouped under suitability class (S1); the soils with more than four slight limitations, and / or with more than three moderate limitations under moderately suitability class (S2); the soil with more than three moderate limitations, and / or one or more severe limitations under marginally suitable (S3) class; the soils with very severe limitations which can be corrected under N1 (currently not suitable); the soils with very severe limitations which cannot be corrected grouped under unsuitable class N2 (Sys *et al.*, 1991). This method also identifies the dominant limitations that restrict the crop growth in the sub-class symbol such as climate (c), topography (t), wetness (w), physical soil characteristics (s), soil fertility (f) and soil salinity / alkalinity (n). The suitability classes and sub-classes were decided by the most limiting soil characteristics. The studied soils vary in their suitability for different crops according to the criteria for the determination of the land suitability classes (table 3).

Pedons 1, 8 and 9 were classified taxonomically under Ultic Haplustalfs. Although they were grouped under same taxonomical, they differ in their suitability to sugarcane crop *i.e.* moderately suitable (S2) (pedon 1) and marginally suitable (S3) (pedons 8 and 9). These pedons showed limitations *viz.*, soil fertility characteristics (sum of the basic cations, pH and organic carbon), physical soil characteristics (texture and depth), wetness and alkalinity for growing sugarcane crop. Organic carbon, wetness and alkalinity were slight limitations for all the three pedons. Texture was a moderate

limitation for pedons 1 and 8 and not a limitation for pedon 9. However, pH was severe limitation for pedons 8 and 9 and moderate limitation for pedon 1. Similarly, moderate limitation of texture in Yerpedu mandal of Chittoor district and fertility and alkalinity limitations in soils of Cauvery delta region of Tiruvavur district in Tamil Nadu were reported by Leelavathi *et al.* (2010) and Kannan *et al.* (2011), respectively in Ultic Haplustalfs, which were moderately suitable for growing sugarcane crop.

Pedon 2 which was classified under Typic Dystrustepts was marginally suitable (S3) for sugarcane crop. Wetness, sum of the basic cations, organic carbon and ESP were the slight limitations. Texture was a moderate limitation and pH was the severe limitation in this pedon.

Though pedons 3, 4, 7, 11 and 12 were classified under Typic Ustorthents they differ in their suitability to sugarcane crop. Pedon 7 was moderately suitable (S2) whereas, pedons 3, 4 and 12 were marginally suitable (S3) and pedon 11 temporarily not suitable (N1) for growing sugarcane crop. Pedon 7 had slight limitations of soil fertility characteristics (sum of basic cations, pH, and organic carbon) and moderate limitation of physical characteristics (texture and soil depth) and alkalinity. Wetness was a slight limitation in pedons 4 and 11 and not a limitation for pedon 12. Texture and organic carbon were moderate limitations for pedons 4 and 12. Severe limitations of soil depth and sum of the base saturation cations in pedon 4, alkalinity in pedons 11 and 12 and pH in pedon 3 were observed. Previous studies of Kadu *et al.* (2003) also indicated that alkalinity in the soils of central India, limiting the growth of crops (rice, sugarcane and groundnut) due to low availability of soil water as affected by poor hydraulic conductivity.

Pedons 5 and 6, grouped under Typic Haplustepts were moderately suitable (S2) for growing sugarcane crop. Slight limiting factors for growth of sugarcane in these soils were wetness, physical soil characteristics (texture and soil depth) and alkalinity. pH in pedons 5 and 6 and organic carbon in pedon 6 were found to be important soil related constraints limiting crop growth. These findings were in agreement of those of Kharche and Pharande (2010) who reported that Typic Haplustepts were moderately suitable (S2) for

Table 1. Relevant soil characteristics of the pedons.

Depth (m)	Physical characteristics				Fertility characteristics					Salinity and alkalinity	
	Mechanical composition			CaCO ₃ (%)	CEC [cmol (p+) kg ⁻¹ soil]	BS (%)	Sum of basic cations [cmol (p+) kg ⁻¹ soil]	pH (1:2.5 soil H ₂ O)	OC (%)	EC (dS m ⁻¹)	ESP
	Sand (2- 0.05)	Silt (0.05 - 0.002)	Clay (<0.002)								
	— % of <2 mm soil —										
P1 Neruvoi : Fine -loamy, kaolinitic, isohyperthermic Ultic Haplustalf											
0.00-0.20	69.32	7.08	23.60	3.0	8.52	90.38	7.17	7.64	0.69	0.01	6.22
0.20-0.47	54.88	24.13	20.99	1.0	8.05	89.94	6.52	7.63	0.18	0.03	8.94
0.47-0.65	32.70	39.18	28.13	1.0	9.50	63.16	5.39	7.37	0.15	0.08	6.42
0.65-0.87	63.90	24.82	11.28	0.5	4.54	75.99	3.12	7.39	0.06	0.24	7.27
0.87-1.06	62.35	25.88	11.76	0.5	4.67	61.88	2.61	7.43	0.08	0.06	6.00
1.06-1.30	62.38	22.57	15.05	2.5	5.60	71.07	3.55	7.40	0.03	0.06	7.68
1.30-1.60+	46.25	39.60	14.14	2.0	5.38	94.05	4.58	8.21	0.08	0.05	8.92
P2 Palamangalam : Sandy, smectitic, isohyperthermic Typic Dystrustept											
0.00-0.22	78.35	7.22	14.43	1.0	10.41	66.28	6.49	8.19	0.56	0.14	3.94
0.22-0.40	74.65	4.61	20.74	1.0	15.52	67.33	9.69	8.12	0.13	0.17	4.90
0.40-0.52	78.70	4.26	17.04	1.0	11.82	54.74	6.11	8.12	0.09	0.03	3.05
0.52-0.71	93.98	4.02	2.01	5.5	1.36	58.09	0.69	8.04	0.03	0.13	7.35
0.71-1.00	94.04	3.97	1.99	2.5	1.30	65.38	0.73	7.92	0.03	0.08	9.23
1.00-1.30+	68.18	9.09	22.73	3.0	14.10	53.19	7.02	8.03	0.11	0.13	3.40
P3 Gollapalle: Fine-loamy, smectitic, isohyperthermic Typic Ustorthents											
0.00-0.23	56.90	10.78	32.33	4.5	28.12	65.50	17.51	8.05	0.41	0.06	3.24
0.23-0.38	78.35	11.81	9.84	2.0	6.52	72.24	3.87	7.80	0.32	0.10	12.88
0.38-0.59	57.77	9.38	32.84	1.0	28.80	61.01	15.51	7.64	0.12	0.07	7.15
P4 Vonaruaripalli : Fine-loamy, smectitic, isohyperthermic Typic Ustorthent											
0.00-0.15	85.76	4.07	10.17	0.5	6.95	81.73	4.38	7.51	0.30	0.14	18.71
0.15-0.28	86.11	9.92	3.97	0.5	3.04	78.62	1.98	7.58	0.22	0.02	13.49
0.28-0.48	74.07	4.32	21.61	0.5	17.46	87.29	12.76	7.55	0.18	0.13	14.20
P5 Digavapokalavaripalli : Fine-loamy, smectitic, isohyperthermic Typic Haplustept											
0.00-0.20	56.18	7.97	35.86	1.0	31.71	62.13	18.59	7.88	0.68	0.08	4.51
0.20-0.41	69.16	8.81	22.03	0.5	14.32	62.01	8.31	8.08	0.20	0.10	3.98
0.41-0.60	69.92	8.02	22.06	1.5	16.64	78.91	12.36	7.91	0.14	0.03	4.63
0.60-0.83	81.15	4.19	14.66	2.5	6.25	81.92	4.73	7.94	0.13	0.16	6.24
0.83-1.10	72.21	4.28	23.52	2.5	19.65	78.32	14.07	7.81	0.16	0.20	6.72
P6 Gattivaripalli : Fine-loamy, smectitic, isohyperthermic Typic Haplustept											
0.00-0.22	66.19	10.57	23.24	2.0	16.83	64.35	9.92	7.67	0.33	0.03	5.41
0.22-0.48	71.34	8.19	20.47	1.5	13.75	75.93	9.15	7.43	0.12	0.24	9.38
0.48-0.73	72.70	6.30	21.00	3.5	11.62	69.36	7.26	7.35	0.20	0.02	6.88
0.73-1.00	69.01	10.33	20.66	2.5	12.38	67.93	7.49	7.42	0.09	0.18	7.43
P7 KVM Palli : Sandy, mixed, isohyperthermic, Typic Ustorthent											
0.00-0.23	79.41	6.18	14.41	3.5	13.35	62.70	7.66	7.80	0.48	0.03	5.32
0.23-0.59	87.81	4.06	8.13	4.0	5.17	84.33	3.72	7.98	0.03	0.41	12.38

Table 1 cont...

Depth (m)	Physical characteristics				Fertility characteristics					Salinity and alkalinity	
	Mechanical composition			CaCO ₃ (%)	CEC [cmol (p+) kg ⁻¹ soil]	BS (%)	Sum of basic cations [cmol (p+) kg ⁻¹ soil]	pH (1:2.5 soil H ₂ O)	OC (%)	EC (dS m ⁻¹)	ESP
	Sand (2- 0.05)	Silt (0.05 - 0.002)	Clay (<0.002)								
	— % of <2 mm soil —										
P8 RKVB Peta: Fine-loamy, kaolinitic, isohyperthermic Ultic Haplustalf											
0.00-0.24	69.74	8.07	22.19	4.0	8.93	88.69	7.41	8.21	0.44	0.02	5.71
0.24-0.55	75.31	11.22	13.47	3.5	5.16	87.21	4.16	7.99	0.19	0.01	6.59
0.55-0.85	68.22	10.59	21.19	1.5	8.44	87.68	6.97	8.00	0.13	0.01	5.09
0.85-1.17	44.47	26.74	28.79	3.5	9.87	85.41	7.77	8.13	0.18	0.03	6.69
1.17-1.52	56.70	14.43	28.87	4.0	9.52	77.94	6.85	8.30	0.19	0.01	5.99
1.52-1.86	72.67	2.10	25.22	4.5	8.62	71.35	5.82	8.35	0.18	0.02	3.83
1.86-2.00	64.89	6.58	28.52	5.5	9.34	65.74	5.75	8.30	0.14	0.01	4.18
2.00-2.30+	69.96	7.51	22.53	6.0	8.77	79.25	6.40	8.37	0.18	0.01	6.27
P9 Karvetinagaram : Fine-loamy, kaolinitic, isohyperthermic, Ultic Haplustalf											
0.00-0.21	59.30	13.57	27.13	6.0	8.78	81.44	6.73	8.45	0.60	0.03	4.78
0.21-0.43	57.77	14.08	28.15	5.5	9.28	71.88	6.26	8.59	0.27	0.06	4.42
0.43-0.64	43.51	17.38	39.11	8.0	15.63	93.35	13.58	8.79	0.21	0.03	6.46
0.64-0.92	41.33	25.14	33.53	3.5	13.52	92.09	11.47	8.63	0.18	0.02	7.25
0.92-1.22	71.44	6.59	21.97	2.0	8.05	63.23	4.58	8.34	0.19	0.02	6.34
1.22-1.60+	66.82	12.44	20.74	1.0	8.42	69.95	5.30	8.37	0.14	0.02	7.01
P10 Velavadi : Fine-loamy, kaolinitic, isohyperthermic Typic Haplustalf											
0.00-0.16	73.83	14.09	12.08	0.5	4.81	79.83	3.28	8.17	0.62	0.05	11.64
0.16-0.37	79.26	6.22	14.52	0.5	5.47	84.46	4.12	8.51	0.11	0.18	9.14
0.37-0.59	64.51	8.35	27.14	1.0	9.00	86.33	6.99	8.21	0.08	0.03	8.67
0.59-0.86	47.61	28.21	24.18	2.0	9.38	89.02	7.65	8.19	0.05	0.03	7.46
0.86-1.12	64.55	10.43	25.03	2.5	9.62	85.03	7.54	8.20	0.08	0.04	6.65
1.12-1.50+	44.39	16.48	39.13	0.5	15.84	87.25	12.68	8.22	0.02	0.03	7.20
P11 Natteri : Sandy, smectitic, isohyperthermic Typic Ustorthent											
0.00-0.21	75.54	4.08	20.39	4.0	14.66	81.45	10.16	8.84	0.30	0.03	12.14
0.21-0.39	74.64	14.79	10.57	6.0	8.85	91.75	6.69	8.87	0.10	0.03	16.16
0.39-0.56	73.18	18.57	8.25	6.0	5.10	86.86	3.65	8.64	0.03	0.03	15.29
0.56-0.78	83.12	6.33	10.55	6.5	9.75	76.82	6.08	8.68	0.03	0.02	14.46
0.78-1.10	71.44	6.59	21.97	6.0	15.47	75.50	9.38	8.86	0.01	0.03	14.87
P12 Nagalapuram : Sandy, smectitic, isohyperthermic Typic Ustorthent											
0.00-0.24	72.13	5.97	21.90	4.0	16.34	86.78	12.88	7.04	0.34	0.01	7.96
0.24-0.58	74.19	13.90	11.91	4.0	9.00	60.00	4.46	6.90	0.04	0.01	10.44
0.58-0.81	73.96	12.02	14.02	4.0	11.24	78.91	6.98	6.91	0.04	0.03	16.81
0.81-1.08	72.37	15.79	11.84	3.5	9.30	87.20	6.55	7.54	0.02	0.02	16.77
1.08-1.52+	72.21	15.88	11.91	4.5	9.82	85.13	6.85	7.22	0.01	0.02	15.38
P13 Brahamanakava: Fine-loamy, smectitic, isohyperthermic Vertic Haplustept											
0.00-0.21	61.08	13.74	25.19	6.5	19.39	82.47	15.31	8.27	0.42	0.02	3.46
0.21-0.48	45.31	15.63	39.06	5.5	33.34	79.69	25.41	8.25	0.14	0.02	3.48
0.48-0.65	44.31	19.20	36.49	7.0	32.47	85.77	26.21	8.30	0.14	0.02	5.05
0.65-0.89	33.79	36.78	29.43	5.5	28.13	78.03	20.71	8.39	0.10	0.02	4.41
0.89-1.09	34.30	35.84	29.87	6.0	26.47	78.39	19.41	8.53	0.09	0.02	5.06
1.09-1.40	37.41	26.25	36.35	5.5	29.65	74.64	20.22	8.62	0.06	0.02	6.44
1.40-1.80+	34.75	33.61	31.64	6.5	26.50	79.81	19.10	8.78	0.03	0.03	7.74

Table 1 cont....

Depth (m)	Physical characteristics				Fertility characteristics					Salinity and alkalinity	
	Mechanical composition			CaCO ₃ (%)	CEC [cmol (p+) kg ⁻¹ soil]	BS (%)	Sum of basic cations [cmol (p+) kg ⁻¹ soil]	pH (1:2.5 soil H ₂ O)	OC (%)	EC (dS m ⁻¹)	ESP
	Sand (2- 0.05)	Silt (0.05 - 0.002)	Clay (<0.002)								
	— % of <2 mm soil —										
P14 Kasturikandriga : Sandy, siliceous, isohyperthermic Typic Ustipsamment											
0.00-0.24	80.71	6.43	12.86	0.5	8.15	80.61	6.12	8.44	0.35	0.02	5.52
0.24-0.48	81.33	10.37	8.30	5.5	7.36	77.72	5.25	8.15	0.14	0.02	6.39
0.48-0.90	80.05	11.97	7.98	0.5	6.07	55.68	3.04	8.13	0.10	0.01	5.60
0.90-1.38	91.92	2.02	6.06	1.0	4.78	58.79	2.50	8.25	0.07	0.01	6.49
1.38-1.60	92.04	5.97	1.99	0.5	1.05	55.24	0.53	8.14	0.15	0.02	4.76
1.60-2.00+	87.94	8.04	4.02	1.0	2.10	54.29	1.05	8.12	0.12	0.02	4.29
P15 Vemur : Fine -loamy, kaolinitic, isohyperthermic Typic Haplustalf											
0.00-0.20	73.68	4.05	22.27	2.5	8.68	66.82	5.35	8.40	0.40	0.03	5.18
0.20-0.54	73.03	6.22	20.75	3.5	8.54	76.23	6.24	8.51	0.15	0.02	3.16
0.54-0.80	41.97	29.02	29.02	2.0	10.49	55.48	5.42	8.45	0.12	0.02	3.81
0.80-1.02	43.16	25.26	31.58	3.5	12.95	58.22	7.01	8.36	0.17	0.02	4.09
1.02-1.50+	44.39	21.39	34.22	2.0	13.72	59.40	7.39	8.32	0.09	0.02	5.54
P16 Perumallapalli (West) : Coarse-loamy, kaolinitic, isohyperthermic, Typic Ustifluent											
0.00-0.20	76.27	10.79	12.94	1.0	10.75	78.42	7.87	8.01	0.27	0.03	5.21
0.20-0.49	74.24	10.74	15.03	3.5	10.03	57.13	5.43	8.09	0.22	0.01	2.99
0.49-0.77	74.64	4.61	20.75	2.5	15.42	69.97	10.16	8.28	0.27	0.01	4.09
0.77-1.12	76.10	10.86	13.04	1.0	10.53	62.96	6.19	8.63	0.11	0.01	4.18
1.12-1.27	93.94	4.04	2.02	0.5	1.54	84.42	1.10	8.62	0.10	0.02	12.99
1.27-1.50+	87.88	10.10	2.02	0.5	1.45	70.34	0.94	8.62	0.09	0.01	5.52
P17 Perumallapalli (East) : Fine-loamy, smectitic, isohyperthermic Vertic Haplustept											
0.00-0.22	63.89	14.04	22.07	1.0	21.22	69.79	13.98	8.42	0.30	0.01	3.91
0.22-0.53	37.08	32.41	30.51	2.0	30.40	65.07	17.48	9.25	0.22	0.03	7.57
0.53-0.75	36.26	33.86	29.88	5.5	25.79	80.88	16.04	9.48	0.17	0.07	18.69
0.75-1.07	34.08	34.02	31.90	3.0	31.45	62.89	13.36	9.57	0.10	0.08	20.41
1.07-1.50	37.60	34.43	27.97	2.5	22.98	74.85	11.72	9.61	0.08	0.08	23.85

sugarcane crop in Mula command area of Maharashtra.

Pedons 10 and 15, classified under taxonomic unit of Typic Haplustalfs were marginally suitable (S3) for growing sugarcane crop. These soils have wetness and texture as slight limitations. Moderate limitations of sum of basic cations in pedon 10, moderate limitation of organic carbon in pedon 15 and severe limitation of pH in both pedons restricted the soils to be classified as marginally suitable (S3). Similar limitations of organic carbon and pH were reported in Typic Haplustalfs, which were marginally suitable for sugarcane crop in Vadamalapeta mandal of Chittoor district (Kumar and Naidu, 2012).

Pedon 13, which was grouped under Vertic Haplustepts was marginally suitable (S3) for growing sugarcane crop. Slight limitation of wetness and moderate limitation of organic carbon were observed in these pedons. pH was the severe limitation which limiting the crop growth. Similar limitations of pH and alkalinity in Vertic Haplustepts of sugarcane growing soils of Ahmadnagar district in Maharashtra were reported by Ashokkumar and Prasad (2010).

Pedon 14, which was classified under Typic Ustipsamment, was marginally suitable (S3) for growing sugarcane crop. The slight limiting factors were sum of basic cations and alkalinity. Moderate limitations of organic carbon (0.34 per cent) and

Table 2. Site and soil characteristics of pedons (weighted mean).

Pedon No.	Landform	Physical soil characteristics (s)			Soil fertility characteristics (f)			Salinity and alkalinity (n)			
		Wetness (w) drainage	Texture	Soil depth (m)	Ca CO ₃ (%)	Apparent CEC [c mol (p+) kg ⁻¹]	BS(%)	pH 1:2.5 soil H ₂ O	OC(%)	EC (dSm ⁻¹)	ESP
1	Plain	Moderately well drained	sl	1.60	1.23	33.78	79.67	7.64	0.59	0.09	8.94
2	Plain	Moderately well drained	sl	1.30	2.29	69.37	60.94	8.18	0.51	0.11	9.23
3	Upland	Moderately well drained	scl	0.59	2.62	87.69	65.62	8.03	0.40	0.07	12.88
4	Upland	Moderately well drained	sl	0.48	0.24	80.80	83.20	7.54	0.31	0.05	18.71
5	Plain	Moderately well drained	scl	1.10	1.59	75.45	73.30	7.92	0.58	0.11	6.72
6	Upland	Moderately well drained	scl	1.00	2.38	55.34	69.58	7.64	0.30	0.12	9.38
7	Upland	Moderately well drained	ls	0.52	3.78	63.62	74.76	7.50	0.44	0.24	12.38
8	Plain	Moderately well drained	scl	2.30	3.02	38.31	81.07	8.20	0.43	0.02	6.69
9	Plain	Moderately well drained	scl	1.60	5.29	39.97	77.41	8.47	0.55	0.03	7.25
10	Plain	Moderately well drained	scl	1.50	1.50	33.16	85.87	8.29	0.44	0.07	11.64
11	Plain	Moderately well drained	sl	1.10	5.69	61.81	81.31	8.84	0.27	0.03	16.16
12	Plain	Well drained Well drained	sl	1.52	4.07	75.56	79.20	7.03	0.33	0.02	16.81
13	Plain	Well drained Moderately well drained	cl	1.80	6.02	88.99	79.37	8.27	0.38	0.02	5.06
14	Plain	Well drained Well drained	ls	2.00	1.75	76.06	60.12	8.43	0.34	0.01	6.49
15	Plain	Moderately well drained	scl	1.50	2.91	41.16	63.35	8.42	0.35	0.02	5.18
16	Plain	Moderately well drained	sl	1.50	2.15	74.32	68.48	8.03	0.26	0.01	5.21
17	Plain	Moderately well drained	cl	1.50	2.80	99.66	70.42	8.52	0.29	0.05	20.41

Topography (Slope) : 0-1%, 3-8%, Flooding : Fo

Table 3. Limitation levels of the land characteristics and land suitability classes for sugarcane crop.

Soil	Wetness (w) drainage	Physical soil characteristics (s)			Soil fertility characteristics (f)			Alka-linity (n) ESP	Actual land suitability sub-class	Potential land suitability sub-class
		Tex- ture	Coarse fragments (Vol. %)	Soil depth (m)	CaCO ₃ (%)	Sum of basic cations [cmol (p+) kg ⁻¹]	pH 1:2.5			
Ultic Haplustalf	1	2	0	0	0	1	2	1	S2fswn	S2s
Typic Dystrustept	1	2	0	0	0	1	3	1	S3fswn	S2s
Typic Ustorthent	1	1	0	2	0	0	3	2	S3fswn	S2s
Typic Ustorthent	1	2	0	3	0	3	2	3	S3fswn	S3s
Typic Haplustept	1	1	0	1	0	0	2	1	S2fswn	S1s
Typic Haplustept	1	1	0	1	0	0	2	1	S2fswn	S1s
Typic Ustorthent	1	2	0	2	0	1	1	2	S2fswn	S2s
Ultic Haplustalf	1	2	0	0	0	1	3	1	S3fswn	S2s
Ultic Haplustalf	1	1	0	0	0	1	3	1	S3fswn	S1s
Typic Haplustalf	1	1	0	0	0	2	3	2	S3fswn	S1s
Typic Ustorthent	1	2	0	1	0	0	4	3	N1fswn	S2s
Typic Ustorthent	0	2	0	0	0	0	1	3	S3fswn	S2s
Vertic Haplustept	0	0	0	0	0	0	3	1	S3fswn	S1
Typic Ustipsamment	0	2	0	0	0	1	3	1	S3fswn	S2s
Typic Haplustalf	1	1	0	0	0	1	3	1	S3fswn	S1s
Typic Ustrifluent	0	2	0	0	0	1	3	1	S3fswn	S2s
Vertic Haplustept	1	0	0	0	0	0	3	3	S3fswn	S1w

Limitations : 0- No; 1-Slight; 2-Moderate; 3-Severe, 4-Very severe
 Suitability classes : f-Soil fertility limitations; s-Physical soil limitations; w-Wetness limitations; n-Salinity (and / or alkalinity) limitations.

texture (Is) and severe limitation of pH were not favourable for the growth of sugarcane crop in this soil.

Pedon 16, grouped under Typic Ustifluvents was marginally suitable (S3) for sugarcane crop. The slight limitations for crop growth were sum of basic cations and alkalinity. However, organic carbon, texture (moderate limitations) and pH (severe limitation) were found to be important constraints for growing sugarcane in this soil.

All the above said limitations can be managed by adopting management practices such as, lowering soil pH by application of amendments like sulphur or locally available spent wash or pressmud compost. Alkalinity can be reclaimed by applying gypsum to replace sodium on the exchange complex with calcium ions and the replaced sodium can be leached out of the root zone. Texture can be improved by mixing soil with tank silt year after year. Organic carbon in these soils can be improved by the application of FYM or green manuring with legumes. Wetness / drainage can be improved by improving drainage conditions.

In conclusion, the soil-site suitability evaluation of study area revealed that pH was a very severe limitation in pedon 11, severe limitation in pedons 2, 3, 8, 9, 10, 13, 14, 15 and 16 and a moderate limitation in pedons 1, 4, 5 and 6. Alkalinity was a severe limitation in pedons 4, 11 and 12. Texture was a limitation in all the pedons except in pedon 13. Organic carbon was a moderate limitation in pedons 4, 6, 11, 12, 13, 14, 15 and 16. Shallow depth was a major limitation in pedons 3, 4 and 7. Crop suitability evaluation revealed various limitations for growing sugarcane crop in the study area. By correcting these limitations by following above said management practices, sustainable yields in sugarcane crop can be achieved.

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