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J Kamalakar

Professor, Department of Soil science and Agricultural Chemistry, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

G Jayasree

Department of Soil science and Agricultural Chemistry, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

M Yakadri

Department of Agronomy, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

T Ramprakash

Department of Soil science and Agricultural Chemistry, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

S Narendar Reddy

Department of Crop Physiology, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Correspondence**J Kamalakar**

Professor, Department of Soil science and Agricultural Chemistry, Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Crop suitability evaluation of cultivated soils surrounding Ramkrishnapur open cast coal mine area of Mancherial district of Telangana state

J Kamalakar, G Jayasree, M Yakadri, T Ramprakash and S Narendar Reddy

Abstract

Six typical pedons from cultivated soils surrounding Ramkrishnapur open cast coal mine area of Mancherial district, Telangana state were evaluated for their suitability to major crops viz., cotton, rice, maize and redgram. The suitability classes ranged from highly suitable (S1) to permanently not suitable (N2) to these crops. All the pedons of Ramkrishnapur were moderately suitable (S2) except pedon 4 was marginally suitable (S3) for cotton. Pedon 1, 2, 3, 5 and 6 were moderately suitable (S2), pedon 4 was marginally suitable (S3) where as pedon 6 was highly suitable (S1) for cotton and redgram. Pedon 1, 3 and 5 were moderately suitable (S2), pedon 6 was marginally suitable (S3) and pedon 4 was not suitable (N2) for rice. Pedons 1, 2, 5 and 6 were highly suitable (S1) and the rest of the pedons were moderately suitable (S2) for maize crop. Drainage, texture, low organic carbon content and low CEC content were severe limiting factors in pedon 4. The limitation levels of land characteristics varied from crop to crop. Suitable conservation and remedial measures were suggested to improve the soil productivity on sustainable basis without deteriorating soil quality. Potential land suitability classes were also given based on the possible improvement of these soils.

Keywords: soil-site suitability, ramkrishnapur, soil taxonomy, limitation levels

Introduction

Land evaluation is the ranking of soil units on the basis of their capabilities (under given circumstances including levels of management and socio-economic conditions) to provide highest returns per unit area and conserving the natural resources for future use. The land suitability evaluation for field crops forms a pre-requisite for land use planning (Sys *et al.*, 1991) [10]. The population of India has increased from 456 million in 1961 to 700 million in 1980 to 1053 million in 2000 and is projected to reach 1387 million by 2020 and 1665 million by 2050. The per capita cultivable land in India is also reported to decline from 0.34 ha in 1961 to 0.14 ha in 2010 and is projected to further decline to 0.09 ha by 2050 (Lal, 2013). Performance of any crop is largely influenced by soil-site parameters as conditional by climate and topography and management level (Sehgal, 1991) [11]. Thus, it is essential to interpret the soil-site suitability for major crops grown in the area. However, each plant species requires specific soil and climatic conditions for its optimum growth. Production oriented crop cultivation on appropriate soils (taxonomic unit) appeared to be more beneficial (Bhaskar *et al.*, 1988 and Naidu *et al.*, 1988) [12, 13]. Information on soil site suitability for crops in cultivated soils surrounding open cast coal mine area in Ramkrishnapur of mancherial district, Telangana state keeping this in view an attempt has been made to evaluate the soil suitability for major crops viz., for cotton, maize, paddy and redgram on Inceptisols, Entisols and Alfisols.

Material Methods

Ramkrishnapur lies between 18°54' and 18°55' north latitudes and 079°23' and 079°28' east longitudes. The study area consists of sand stone and granite-gneiss parent material. The climate belongs to semi-arid monsoonic with distinct summer, winter and rainy seasons. The mean annual rainfall recorded for the last 10 years (2003-2013) is 1102.90 mm of which constitutes more than 83% was received during June to September. The mean annual temperature was 27°C with mean summer temperature 39°C and the mean winter temperature of 31°C. The maximum temperature recorded for last 10 years is 40°C and the minimum temperature 15°C in the month of December.

The soil moisture regime has been computed as ustic and the soil temperature regime as iso-megathermic. The natural vegetation comprises of *Acacia auriculiformis*, *Azadiracta Indica*, *Prosopis juliflora*, *Tectona grandis*, *Pithakalobia dacli*, *Tamrindus Indica*, *Pongamia pinnata* etc. The six pedons were studied in detail and the morphological characteristics were presented in table 2. The detailed morphological description of these six pedons was studied in the field as per the procedure outlined in U.S.D.A. soil survey manual Soil Survey Staff 1998^[8]. Later, horizon-wise soils samples were collected and characterized for important physical, physico-chemical properties and available nutrient status using standard procedures. The soils were classified taxonomically (Soil Survey Staff, 2014)^[9] of USDA. These pedons were evaluated for their suitability using limitation method regarding number and intensity of limitations (Sys *et al.* 1991)^[10]. The landscape and soil requirements for the selected crops were matched with generated data at different limitation levels: no (0), slight (1), moderate (2), severe (3) and very severe (4). The number and degree of limitations suggested the suitability class of pedons for a particular crop (Sys *et al.* 1991)^[10]. The potential land suitability (table 3) subclasses were determined after considering the improvement measures to correct these limitations (Sys *et al.* 1991)^[10]. Considering limitations and potentials of the soils based on that a suitable land use plan has also been suggested.

Results and Discussion

Details of pedons and relevant soil characteristics are given in table 1 and site characteristics and weighted means of soil characteristics are given in table 2. These soils are developed from granite-gneiss. The kind and degree of limitations of the soils for the major five crops are presented in table 3. The soils with no or only four slight limitations are grouped under highly suitable 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)^[10]. This method also identifies the dominant limitations that restrict the crop growth shown in the sub-class symbol such as climatic (c), topographic (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 (Table 3).

Pedon 1, which is grouped under Typic Haplustepts is moderately suitable for cotton, rice and maize, whereas, it is highly suitable for maize. The major limitations were wetness (drainage), physical soil characteristics (texture) and soil fertility characteristics (CEC) wetness (drainage) was major limiting factor. Whereas, for all four crops soil fertility characteristics was a major limitation factor it can be improved by the application of farm yard manure, green manuring and soil test based fertilizer recommendation should be followed to avoid nutrient imbalance and to supply the right nutrients at right time. Pedon 2, which is grouped under Typic Haplustalfs was moderately suitable for cotton and redgram, highly suitable for maize and it is marginally suitable for rice. The major limitations were wetness, texture,

coarse fragments and soil fertility characteristics was major limiting factor rice cultivation, for rice cultivation because it does not allow in maintaining standing water and requires irrigation at frequent intervals. Pedon 3, which is grouped under Typic Haplustepts was moderately suitable for cotton, rice, maize and redgram. The major limitations were drainage, texture and soil fertility characteristics. Pedon 4, which is grouped under Typic Ustrothents was moderately suitable for maize marginally suitable for cotton and redgram whereas, permanently not suitable for rice. The limitations included drainage under wetness, texture and coarse fragments under physical soil characteristics and cation exchange capacity and pH under soil fertility characteristics. Pedon 5, which is grouped under Typic Haplustepts was moderately suitable for cotton, rice and redgram. Whereas, highly suitable for maize. The limitations included drainage under wetness, texture and coarse fragments under physical soil characteristics. Pedon 6, which is grouped under Typic Haplustalfs was moderately suitable for cotton, highly suitable for maize and redgram whereas, marginally suitable for rice. The limitations included drainage under wetness, texture, cation exchange capacity and coarse fragments under physical soil characteristics and soil fertility characteristics (Satyavathi and Suryanarayan Reddy, 2004)^[7] were reported in Telangana region of Andhra Pradesh. All the cultivated areas surrounding open cast coal mine area pedons of Ramakrishnapur were moderately suitable for cotton crop. Patil *et al.*, (2010)^[5] and Madhavi, (2014)^[3] also reported that soils in Lendi water shed of Chndrapur district and Environmental impact assesment (Eia) of coal opencast mining on soil and land resource environs in Telangana region. The cultivated soil pedons 1, 3 and 5 were moderately suitable whereas, the pedons 2 and 6 were marginally suitable and pedon 4 was permanently suitable for rice. Leelavathi *et al.*, (2010)^[2] and Selvaraj and Naidu (2013)^[6] also reported that the soils of Yerpedu and Renigunta mandals in Chittoor district. The cultivated pedons 1, 2, 5 and 6 were highly suitable for maize cultivation. Whereas, pedon 3 and 4 were moderately suitable for maize. Narsaiah (2016) also reported that classification, constraints analysis and crop suitability evaluation of soil and land resources in part of Warangal district in Central Telangana Zone. The cultivated soil pedons surrounding open cast coal mine pedons 1, 2, 3 and 5 were moderately suitable, whereas, pedon 6 was highly suitable and the pedon 4 was marginally suitable for redgram. Narsaiah (2016) also reported that classification, constraints analysis and crop suitability evaluation of soil and land resources in part of Warangal district in Central Telangana Zone. Wetness (drainage), texture, coarse fragments and cation exchange capacity and pH are limitations in all the pedons poor drainage can be improved by soil conservation measures, growing leguminous crops in rotation and application of organic manures. The pH can be reduced by application of organic manures and soil amendments like sulphur / pressmud / spent wash. Texture is a limitation in pedon 4, light textured soils which also had low water holding capacity, can be improved by addition of tank silt (Pond Mud) along with careful soil and water management practices like mulching or addition of bulky organic manures / green leaf manuring. Similar observations were made and recommendations were suggested by Selvaraj and Naidu (2013)^[6] and Niranjan *et al.*, (2013)^[14] in Renigunta mandal and Pulivendula region of Andhra Pradesh.

Table 1: Depth wise Soil characteristics used for assessing crop suitability evaluation.

Pedin No	Location	Horizons	Depth (cm)	Physical characteristics (s)% of < 2 mm soil			CaCO ₃ (%)	Physico-Chemical characteristics				Salinity and alkalinity (n)	
				Texture				CEC [cmol (p+) kg ⁻¹ soil]	BS (%)	pH (1:2.5 H ₂ O)	OC (%)	EC (dSm ⁻¹)	ESP
				Sand	Silt	Clay							
Pedin 1	Amaravadihi, Mancherial.	Ap	0-15	63.4	17.1	19.5	nd	13	80.50	7.04	3.8	0.18	2.3
		Bw1	15-40	59.6	19.8	20.6	nd	14.9	83.20	7.29	3.2	0.12	2.0
		Bw2	40-75	59.2	14.8	26	nd	17.3	86.80	7.34	2.7	0.10	2.3
		Bw3	75-105+	56.6	14.6	28.8	2.8	18.9	90.40	7.38	2.5	0.13	2.6
Pedin 2	Sheshupalli, Mancherial	Ap	0-10	69.6	15.2	15.2	nd	8.2	54.41	7.16	4.3	0.14	1.2
		Bt1	10-30	62.7	16.5	20.8	nd	11.8	55.34	7.21	3.9	0.27	0.8
		Bt2	30-60	56.8	17.1	26.1	nd	13.3	57.23	7.35	3.1	0.17	1.5
		BC	60-90+	66.8	12.8	20.4	nd	14.4	58.35	7.48	2.8	0.12	2.1
Pedin 3	Kythanpalli, Mancherial	Ap	0-12	67.1	14.4	18.5	nd	11.2	82.50	7.19	4.1	0.15	0.9
		Bw1	12-28	66.2	13.2	20.6	nd	12.5	87.76	7.28	3.7	0.24	0.8
		Bw2	28-55	62.3	12.6	25.1	2.6	13.9	88.80	7.34	2.8	0.17	1.4
		BC	55-90+	60.6	11.2	28.2	4.5	15.3	91.40	7.45	2.4	0.22	1.3
Pedin 4	Doragari palli, Mancherial.	Ap	0-11	53.3	18.2	28.5	2.4	17.6	68.27	7.31	3	0.17	0.6
		A1	11-38	75.3	9.1	15.6	2.6	12.8	69.54	6.73	1.9	0.18	0.8
		BC	38-72	74.8	10.5	14.7	4.8	10.6	70.25	7.48	1.6	0.16	0.9
		Cr	72-90+	73	9.2	17.8	6.7	10.9	71.46	7.91	1.4	0.19	1.8
Pedin 5	Doragari palli, Mancherial	Ap	0-10	68.4	11.2	20.4	nd	15.2	85.45	7.13	4.4	0.13	3.3
		Bw1	10-30	66.2	10.2	23.6	1.5	16.7	87.52	7.26	4.2	0.13	4.2
		Bw2	30-60	66.3	6.5	27.2	3.4	18.1	90.21	7.36	3.4	0.17	3.3
		BC	60-90+	62.8	8.6	28.6	6.2	19.1	92.14	7.43	2.5	0.14	2.6
Pedin 6	Mancherial	Ap	0-16	74.5	11.2	14.3	nd	6.9	54.01	7.06	4.7	0.19	1.4
		Bt1	16-33	69	10.2	20.8	nd	9.8	59.65	7.12	4.3	0.15	2.0
		Bt2	33-65	58	10.8	31.2	nd	20.4	62.02	7.28	4.1	0.13	1.0
		BC	65-110+	59	13.4	27.6	3.1	14.2	64.27	7.37	2.7	0.11	2.1

Table 2: Site and soil characteristics of studied profiles for crop suitability classification (Weighted average)

Pedin No	Soil	Drainage	Physical characteristics (s)			CaCO ₃ (%)	Soil fertility characteristics (f)				Salinity and alkalinity (n)	
			Texture	Coarse fragments Volume (%)	Soil depth (cm)		CEC [cmol (p+) kg ⁻¹ soil]	Sum of basic Cations [cmol (p+) kg ⁻¹ soil]	BS (%)	pH (1:2.5)	Ece (dSm ⁻¹)	ESP (%)
1	Typic Haplustepts	Moderately well drained	scl	5.75	0-105	0.84	14.81	11.14	83.11	7.14	0.13	2.32
2	Typic Haplustalfs	well drained	scl	6.00	0-90	0.00	11.68	5.60	55.91	7.19	0.17	1.51
3	Typic Haplustepts	Moderately well drained	scl	4.72	0-90	2.53	12.80	10.04	86.96	7.24	0.20	1.19
4	Typic Ustorthents	Excessively drained	sl	18.74	0-90	4.23	13.33	10.16	69.43	6.99	0.17	1.01
5	Typic Haplustepts	Moderately well drained	scl	5.44	0-90	3.53	16.96	13.34	88.18	7.21	0.15	3.27
6	Typic Haplustalfs	Well drained	scl	7.30	0-110	1.09	12.48	4.25	58.65	7.08	0.14	1.62

Table 3: Limitation levels of the land characteristics and land suitability classes for major crops.

Pedin No	Soil	Crop	Wetness (w) drainage	Physical soil characteristics (s)			CaCO ₃ (%)	Soil fertility characteristics (f)				Alkalinity (n) Esp	Actual land suitability sub-class	Potential land suitability sub-class	
				Texture	Coarse fragments (Vol. %)	Soil depth (cm)		CEC	BS	Sum of basic cation	pH 1:2.5				EC
1	Typic Haplustepts	Rice	2	2	2	0	0	2	0	0	1	0	0	S2wf	S2s
		Maize	1	1	1	0	0	2	0	0	1	0	0	S1f	S1
		Cotton	2	2	1	0	0	2	0	0	1	0	0	S2sf	S2s
		Redgram	2	1	1	0	0	2	0	0	1	0	0	S2wf	S2f
2	Typic Haplustalfs	Rice	3	2	2	1	0	2	1	1	1	0	0	S3w sf	S3s
		Maize	0	1	1	1	0	2	1	0	1	0	0	S1f	S1
		Cotton	1	2	1	1	0	2	1	1	1	0	0	S2sf	S2s
		Redgram	1	1	1	1	0	2	1	1	1	0	0	S2f	S1
3	Typic Haplustepts	Rice	2	2	2	1	0	2	0	0	1	0	0	S2wsf	S2ws
		Maize	1	1	1	1	0	2	0	0	1	0	0	S2f	S1
		Cotton	2	2	1	1	0	2	1	0	1	0	0	S2wsf	S2s
		Redgram	2	1	1	1	0	2	0	0	1	0	0	S2wf	S2f
4	Typic Ustorthents	Rice	4	3	3	1	1	2	0	0	0	0	0	N2wsf	N2wsf
		Maize	0	2	1	1	0	2	1	0	0	0	0	S2sf	S2
		Cotton	3	2	2	1	0	2	1	1	0	0	0	S3wsf	S3wsf
		Redgram	3	1	1	1	0	2	1	0	0	0	0	S3wf	S3wf
5	Typic	Rice	2	2	2	1	1	1	0	0	1	0	0	S2wf	S2w

	Haplustepts	Maize	1	1	1	1	0	1	0	0	1	0	0	S1	S1
		Cotton	2	2	1	1	0	1	0	0	1	0	0	S2ws	S2s
		Redgram	2	1	1	1	0	1	0	0	1	0	0	S2w	S2w
6	Typic Haplustalfs	Rice	3	2	2	0	0	2	0	0	1	0	0	S3wf	S3wf
		Maize	0	1	1	0	0	2	1	1	1	0	0	S1f	S1
		Cotton	1	2	1	0	0	2	1	1	1	0	0	S2sf	S2sf
		Redgram	1	1	1	0	0	2	1	1	1	0	0	S1f	S1

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

Conclusion

The crop suitability of cultivated soils surrounding open cast coal mine area of Ramakrishnapur in Mancherial district ranged from highly suitable (S1) to permanently not suitable (N2) for the major crops viz., cotton, rice, maize and redgram. The limitations observed in these soils were physical characteristics like wetness, texture and coarse fragments and fertility characteristics like high pH and low CEC. Remedial measures were suggested to achieve potential productivity of these soils without deteriorating the soil quality and to sustain crop yields.

References

- Lal R. Soil and Sanskriti. Journal of the Indian Society of Soil Science. 2013; 61:267-274.
- Leelavathi GP, Naidu MVS, Ramavatharam N, Karuna Sagar G. Soil-site suitability evaluation for commonly growing crops in Yerpedu mandal of Chittoor district, Andhra Pradesh. Agropedology. 2010; 20:133-138.
- Madavi B. Environmental impact assessment (EIA) of coal opencast mining on soil and land resource environs in Telangana Region. Ph.D (Ag) thesis is submitted to Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, 2014.
- Narsaiah E. Classification, constraint analysis and crop suitability evaluation of soil and land resources in part of Warangal district in Telangana, Ph.D (Ag) thesis is submitted to Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, 2014.
- Patil GB, Nagaraju MSS, Jagdish Prasad, Srivastava R. Characterization, evaluation and mapping of land resources in Lendi watershed, Chandrapur district of Maharashtra using remote sensing and GIS. Journal of the Indian Society of Soil Science. 2010; 58:442-448.
- Selvaraj S, Naidu MVS. Land characterization and soil-site suitability for the major crops for Renigunta mandal in Chittoor district, Andhra Pradesh. Indian Journal of Soil Conservation. 2013; 41:41-46.
- Satyavathi PLA, Suryanarayan Reddy. Soil-site suitability for six major crops in Telangana region of Andhra Pradesh. Journal of the Indian Society of Soil Science. 2004; 52:220-225.
- Soil Survey Staff. Keys to Soil Taxonomy. Eighth edition, National Resource Conservation Centre, USDA, Blacksburg, Virginia, 1998.
- Soil Survey Staff. *Keys to soil taxonomy* (12th edition), USDA, Natural Resource Conservation Service, Washington, DC, 2014.
- Sys C, Van Ranst E, Debaveye J. *Land evaluation*, Part 2 Methods in Land Evaluation. Agricultural Publications No.7, Belgium, 1991.
- Sehgal. 1991.
- Bhaskar *et al.* 1988.
- Naidu *et al.* 1988.
- Niranjan *et al.* 2013.