

Soil survey interpretation for land use planning in the Theries (red sand dunes) of coastal Tamil Nadu

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Abstract

Red sandy dunal soils (*theries*) of Tuticorin and Tirunelveli districts of Tamil Nadu were surveyed and eight soil series viz., Mettutheri, Thomilitheri, Valarmanntheri, Kattitheri, Vandaltheri, Kalitheri, Sukkantheri and Manalthomilitheri were identified. Eight typifying pedons representing the above series were evaluated, based on land capability classification, soil and land irrigability classification, productivity ratings, based on Storie index, Requier index, and fertility capability classification. Sandy texture and sloping topography are the major constraints of these soils. Among them, Thomilitheri and Kalitheri series are better suited for agriculture due to higher clay content, lesser slope gradient and better aggregation.

Additional keywords: Theri soils, fertility capability classification

Introduction

The coastal red sandy dunal soils of Tamil Nadu are locally called *theri* soils. They occur in the Tuticorin and Tirunelveli districts of Tamil Nadu, with an extent of 20,171 hectares (Jawahar 1996). Tuticorin district has the highest *theri* area (16,978 ha). *Theries* occur in seven belts viz., Kudiraimozhi, Tisaiyanvillai, Surangudi, Ovari, Udangudi, Nangaimozhi and Servaikaranmadam. The present study was carried out in all the *theri* belts to find out the potentials and constraints of the eight soil series, through soil survey interpretation and to suggest technologies for better land use management.

Materials and methods

Theries are located in southern coast of Tamil Nadu between 8°15'13" to 9°11'00" N latitudes and 77°49'44" to 78°28'22" E longitudes. The study area has a semi-arid tropical climate. The mean annual temperature is 29°C and the mean annual precipitation 606.7 mm is recorded at Sathankulam (Soil Survey Staff 1989, 1991). The soil temperature regime is 'isomegathemic' and moisture regime is 'ustic'.

One hundred and forty pedons were studied on random transects in the *theries*, eight distinct soil series were identified and tentatively named as Mettutheri (Mth), Thomilitheri (Tth), Valarmanntheri (Vmth), Kattitheri (Kth), Vandaltheri (Vth), Kalitheri (Klth), Sukkantheri (Sth) and Manalthomilitheri (Mlth). The typifying pedons were selected for the study of morphological and other soil characteristics. These soils were evaluated according to various interpretative systems such as Storie index rating (Storie 1964), land capability classification, soil irrigability classification and land irrigability classification (AISLUO 1970) productivity classification (Requier *et al.* 1970) and fertility capability classification (Sanchez *et al.* 1982).

Results and discussion

Morphology

The morphological characteristics of the eight soil series are presented in table 1. In general, all the *theri* soils are very deep with more than two metre depth and non-calcareous. Sukkantheri series had large amount of coarse fragments both on the surface and in the subsoils. Subsoils were heavier in texture (loamy sand to sandy clay) than the surface soils (sand to loamy sand). Structure of the soils varied from single grain to strong coarse angular blocky in subsoil with better aggregation.

Table 1. Morphological characteristics of the soil series in the theries

Morphological characters	Mettutheri	Thomilitheri	Valaramantheri	Kattitheri	Vandaltheri	Kalitheri	Sukkantheri	Manalthomilitheri
Depth of solum (m)	>2	>2	>2	>2	>2	>2	0.8	>2
Coarse fragments	Nil	Nil	Nil	Nil	Nil	Nil	2.5 cm dia to boulders	Nil
Texture								
Surface	ls	ls	ls	sl	s	ls	ls	lfs
Sub-surface	ls	scl	scl	ls	sc to s	cl	scl	scl
Structure								
Surface	sg	sg to fl sbk	sg	m2 sbk	sg	m2 sbk	fl pt	fl sbk
Sub-surface	sg	m2 sbk	m2 sbk	fl sbk	fl sbk	vc 3 abk x pr	m-c 2sbk	m-c2 sbk
Consistency								
Surface	so,po	so,po	so,po	vh,fr,ss,p s	so,po	h,fr,so,po	s,vfr,so,p s	s,vfr,so .po
Sub-surface	so,po	l,l,so,po	h,f,ss,p	l,l,so,po	ss,ps	eh,efi,s,ps	h,fr,ss,p	s,fr,s,p
Calcareousness	Nil	Nil	Nil	Nil	Nil	Nil	Nodules in sub-surface	Nil
Drainage	Somewhat excessive	Well drained	Excessively drained	Somewhat excessively drained	Somewhat excessively drained	Well drained	Imperfect	Somewhat excessively drained
Clay cutans	Nil	Nil	Nil	Nil	Nil	Patchy thin clay cutans	Patchy thin clay cutans	Nil

Physico-chemical characteristics

The physical and chemical characteristics of the soil series are presented in table 2. The pH values of all the soil series are low and the average BSP value is 48.5 due to leaching of bases, medium acidity and absence of carbonates. The high leaching environment is also evident from the low EC values, which are always less than 0.15 dS m⁻¹.

The CEC is low in these soils, because of low clay content, low organic carbon content and presence of low activity clays. As a result, the nutrient holding capacity of the soils is also low. The ESP values of the soils are also very low.

Table 2. Physical and chemical characteristics of the soil series in the *theries*

Characteristics	Mettutheri	Thomilitheri	Valaramanntheri	Kattitheri	Vandaltheri	Kalitheri	Sukkanntheri	Manalthomilitheri
pH								
Surface	4.99	7.28	6.05	5.63	5.98	6.21	5.07	6.12
Sub-surface	5.11	5.73	5.94	5.71	5.54	6.03	5.25	6.03
EC dS m ⁻¹								
Surface	0.03	0.11	0.04	0.11	0.01	0.12	0.03	0.04
Sub-surface	0.03	0.07	0.05	0.07	0.07	0.05	0.02	0.04
CEC cmol(p+) kg ⁻¹								
Surface	2.63	2.13	2.38	4.86	1.79	3.36	3.14	3.77
Sub-surface	2.41	7.79	5.66	2.67	1.67	15.22	11.59	8.08
BSP								
Surface	74.30	61.08	58.87	32.80	82.68	43.84	50.48	41.19
Sub-surface	73.44	14.71	40.72	84.46	76.35	19.52	11.96	35.99
ESP								
Surface	3.31	4.08	2.44	1.19	4.86	2.59	1.85	1.54
Sub-surface	3.61	0.75	1.02	4.34	5.21	0.57	0.50	0.72

Land capability classification

The land capability classes of the *theri* soils are presented in table 3. The sandy and single grain nature with low CEC of the soils and steep slope were the major limitations which regulated Mth and Mlth soils to non-arable category (Table 3). The Klth and Thth series are grouped into 'III e' due to moderate erosion and sandy surface soil.

Land irrigability classification

The land irrigability classes were '5 st' (unsuitable to sustained use under irrigation at present) for Mth, Vmth, Kth, Vth and Mlth due to sandy texture and sloping topography, '3 st' (lands having severe limitations for irrigation) for Thth and Klth and '4 sd' (lands that are marginal for sustained use under irrigation) for Skth due to sandy texture and poor subsurface drainage. The sandy texture of the soils and unfavourable topography are the major constraints in the *theries* for irrigation.

Table 3. Comparative statement of various interpretative groupings of the *theri* soil series

Soil Series	Land capability class	Soil irrigability class	Land irrigability class	Productivity class	Fertility class	Storie index rating
Mettutheri	VI es	E	5 st	Extremely poor (class 5) 1.47%	S dehk	Extremely poor (grade 6) 0.17%
Thomilitheri	III e	B	3 st	Average (class 3) 28.92%	SC dhk	Good (grade 2) 69.45%
Valarmanntheri	III es	E	5 st	Poor (class 4) 7.86%	SL dehk	Extremely poor (grade 6) 2.34%
Kattitheri	III es	E	5 st	Poor (class 4) 7.86%	S dehk	Extremely poor (grade 6) 0.51%
Vandaltheri	V s	E	5 st	Poor (class 4) 1.47%	S dehk	Extremely poor (grade 6) 0.38%
Kalitheri	III e	B	3 st	Average (class 3) 28.92%	SL dk	Good (grade 2) 69.45%
Sukkantheri	V w	D	4 sd	Poor (class 4) 13.77%	SC dhk	Poor (grade 4) 29.37%
Manalthomilitheri	VI se	E	5 st	Extremely poor (class 5) 1.47%	S dk	Extremely poor (grade 6) 1.27%

Present and potential productivity ratings

The present productivity ratings were extremely poor for Mth and Mlth, 'poor' for Vmth, Kth and Vth and Skth and 'average' for Tth and Klth (Table 3). Coarse texture, very low organic matter content, CEC, mineral reserves place the Mth and Mlth series in the 'extremely poor' category. The productivity class of Tth and Klth was better because of slightly more organic matter content, high fertility and CEC status. Among the eight series, Mth and Mlth have got high potential for development. The addition of clay (Murugesan 1990), organic manure (Gupta *et al.* 1986), and better fertility practices (Janakiraman 1993) could improve the soil productivity greatly.

Storie index rating

The Mth, Vmth, Kth, Vth and Mlth qualify for 'extremely poor' class, Skth for 'poor' class and Tth and Klth for 'good' class. These indicate that Mth, Vmth, Kth, Vth and Mlth are unsuitable for cultivation. Skth can be put to use for agriculture with severe limitations and Tth and Klth series are fit for agricultural use.

Fertility capability classification

The Mth, Vmth, Kth, Vth have same modifiers namely, ustic moisture regime (d), low CEC (e), medium acidity (h) and low exchangeable K (k) (Table 3). However, the Vmth has a better class for its subsoil loamy texture. The modifiers for Tth and Skth 'd', 'h' and 'k' indicate that the CEC of the soil is slightly higher than the above soils. The Klth and Mlth are in a better placement

than the above series with 'd' and 'k' modifiers indicating the improvement in texture and soil reaction. Among the two series, Klth has a better class for its subsurface loamy texture.

All the above interpretative systems (Table 3) indicate that Mettutheri, Valarmanntheri, Kattitheri and Vandaltheri are not suitable for any agricultural use. The Sukkantheri and Manalthomilitheri series can be brought to use by overcoming the limitations like drainage and erosion hazards through appropriate management. Among these soils, Thomilitheri and Kalitheri series are rated the best for agricultural use. Careful soil management techniques and conservation practices coupled with selection of suitable plant or silvimix can help in transformation of the *theries* to a considerable productive areas.

References

- All India Soil and Land Use Survey Organisation (1970). 'Soil Survey Manual'. (Indian Agricultural Research Institute : New Delhi.)
- Gupta, G.N., Gupta, J.P., and Murthy, K.N.K. (1986). Water retention and transmission characteristics of some Aridisols. *Journal of Indian Society of Soil Science* **34**, 169-172.
- Janakiraman, M. (1993). Pedogenesis and soil resource inventory of *theri* land (Sirappur). Tamil Nadu Agricultural University, M.Sc. (Ag.) Thesis, Coimbatore, Tamil Nadu.
- Jawahar D. (1996). Studies on the sand dunes (*theries*) in the coastal belt of V.O. Chidambaranar and Nellai Kattabomman districts. Tamil Nadu Agricultural University Ph.D. Thesis, Coimbatore, Tamil Nadu.
- Murugesan, K. (1990). Effect of soil breeding with Vertisol and nitrogen levels on the properties of a coarse textured red soil and rice crops performance. Tamil Nadu Agricultural University, M.Sc. (Ag.) thesis, Coimbatore, Tamil Nadu.
- Requier, J., Bramao, D.L., and Cornet, J.P. (1970). A new system of soil appraisal in terms of actual and potential productivity. *FAO. AGRL, TESA/70/6*, Rome.
- Sanchez, P.A., Conto, W., and Buol, S.W. (1982). The fertility capability soil classification system : interpretation, applicability and modification. *Geoderma* **27**, 283-309.
- Soil Survey Staff (1989). Soils of Turnelveli Kattabomman District, Tamil Nadu, Soil Survey and Land Use Organisation, Report No. 2, Palayamkottai, Tamil Nadu.
- Soil Survey Staff (1991). Soils of V.O. Chidambaranar District, Tamil Nadu, Soil Survey and Land Use Organisation, Report No. 3, Palayamkottai, Tamil Nadu.
- Storie, R.E. (1964). 'Hand book of Soil Evaluation'. (U.C. Berkeley : California, U.S.A.).