

Soil resources inventory of lateritic terrain of Medak district, Andhra Pradesh for sustainable crop planning

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Abstract : Seven typifying pedons representing three physiographic units viz. upper plateau, lower plateau and valleys in lateritic landform of Medak district, Andhra Pradesh were characterized and classified. Soils of upper plateau are represented by Madhlal Tanda series (Clayey-skeletal Lithic Ustorthents) and Hanuman Naik Tanda series (Clayey-skeletal Lithic Rhodustalfs). Soils of lower plateau are Bilalpur (Clayey-skeletal Typic Rhodustalfs), Algol (Clayey-skeletal Kandic Paleustalfs) and Kaveli (Very-fine Typic Haplusterts). Ranjol (Very-fine Typic Haplusterts) and Potpalle (Very-fine Vertic Haplustepts) represent the soils of valley. The pH of soils ranged from 5.9 to 9.0, organic carbon from 2.4 to 26.3 mgkg⁻¹ and cation exchange capacity from 9.3 to 61.1 cmol kg⁻¹. Soils are low to medium in available nitrogen, low in available phosphorus and low to medium in potassium. On the basis of soil potential and constraints, suitable crop plans were suggested for sustainable management.

Additional key words : Dominant soil series, present land use, suggested land use

Introduction

Medak district forms a part of South Deccan Plateau locally known as Telangana plateau. It has been divided into three physiographic regions, viz. granite and granite-gneissic landform, basaltic landform and lateritic landforms (Reddy *et al.*, 2005). Of these, the lateritic landform is the most important landform from agriculture point of view. However, information on soils of this region is meager which acts as a major limitation in undertaking sustainable crop planning in the region. Keeping this in view, a soil resource inventory was carried out to characterize and map the soils and assess the problems and potential for planning sustainable land use.

Materials and Methods

The study area covers 84,644 ha, occupying 61,795 ha in Zaheerabad, 22,849 in Sadasivpet

agricultural division. The climate is semi-arid sub-tropical with the mean annual rainfall ranging from minimum of 853 mm in Sadasivpet to maximum of 918 mm in Zaheerabad agricultural division. More than 75 per cent of rainfall is received during the South West monsoon (June to September). Remaining 25 per cent of rainfall received during North East monsoon (October to December) and pre-monsoon period (March to May). The area qualifies for 'isohyperthermic' temperature and 'ustic' moisture regime (Reddy *et al.* 2005).

The natural vegetations are *Azadirachta indica* (Neem), *Tamarindus indica* (Tamarind), *Acacia spp.* (Babul), *Pongamia spp* (Karanj), *Annona squamosa* (Custard apple), *Zizyphus jujuba* (Ber), *Butea frondosa* (Palas), etc.

There are three different crop growing situations identified in the study area *i.e.* LGP of 90-120 days,

120-150 days and 150-180 days. About 40.7 % areas in Zaheerabad and 15.7 % in Sadasivpet agricultural divisions have LGP of 120-150 days, where as 82.3 % areas in Sadasivpet and 59.3 % areas in Zaheerabad have LGP of 150-180 days. Only limited areas (2%) in Sadasivpet agricultural division has LGP of 90-120 days (Reddy *et al.*, 2005).

Geocoded false colour composite (FCC's of IRS1B-LISS II) were used to delineate physiographic units with adequate ground truth on 1: 50,000 scale. The landform is characterized by upper plateau, lower plateau and broad valleys based on colour, tone, textural pattern and morphological expression of the relief features. The soils were studied in several transects. Physiography-soil relationship was established. Seven typifying pedons representing three physiographic units viz. upper plateau, lower plateau and valley were selected. Horizon-wise soil samples were collected from all seven typifying pedons and analysed for their physico-chemical properties following the standard procedures (Sarma *et al.* 1987).

Results and Discussion

Soils of upper plateau

Soils of upper plateau are very shallow to shallow comprising of Madhlal Tanda and H N.Tanda series. The soils of Madhlal Tanda series covers an area of 17537 ha and are very shallow (<25 cm), somewhat excessively drained, moderately eroded, slightly acid (pH 6.1), gravelly clay and gravelly sandy clay ferruginous soils with 40 to 60 per cent iron and quartz gravels on 3 to 8 per cent slopes (Table 1 and 2). These soils are high in available nitrogen, low in available phosphorus and medium in available potassium.

The soils of H. N. Tanda series covers an area of about 8177 ha on 3 to 8 per cent slope. These soils are ferruginous, shallow (25-50 cm), well drained, moderately acid (pH 6.1), and gravelly clay surface, slightly acidic, clay sub-soil and hard compact argillic horizon underlain by hard lateritic layer. The pedon had 35 to 60 per cent iron and quartz gravels. These

soils are high in available nitrogen, low in available phosphorous and potassium and are moderately eroded.

Soils of lower plateau

The soils of lower plateau are moderate to well developed and are slightly deep (50-75 cm) to very deep (>150 cm) because of colluvial deposits. The dominant series mapped are Bilalpur, Algol and Kaveli.

The soils of Bilalpur series covers an area of 8535 ha. They are slightly deep (50-75 cm), well drained, red ferruginous soils with moderately acid (pH 5.9), gravelly clay surface soil and sub-soil layers with hard compact argillic horizon. The pedon had 35 to 50 per cent iron and quartz gravels (Table 1). These soils are high in available nitrogen, low in available phosphorus and potassium.

The soils of Algol series cover about 2924 ha and are very deep (>150 cm), well drained, ferruginous, slightly acidic with gravelly sandy clay surface and, gravelly clay sub-soil with hard compact argillic horizons. The sub-soil had 50 to 75 per cent iron and quartz gravels (Table 1). These soils are high in available nitrogen and low in available phosphorus and potassium.

Kaveli soils cover an area of 12,759 ha and occur on nearly level lower plateaus. Soils are very deep (>150 cm), moderately well drained with shrink-swell potential. These soils are moderately alkaline (pH 8.3) and occur on 0 to 3 per cent slopes. The soils are medium in available nitrogen, low in available phosphorus and high in available potassium.

Soils of Valley

The soils of valley are deep (100-150 cm) to very deep (>150 cm) and slightly eroded. The dominant series of valleys are Ranjol and Potpalle.

The soils of Ranjol series covers an area of 11,955 ha and are very deep (>150 cm), moderately well to imperfectly drained, calcareous, clayey with shrink-swell potential. These soils are moderately to

Table 1: Morphological and physical properties of dominant soil series

Depth (cm)	Horizon	Colour (M)	Gravel (Vol %)	Particle-size distribution (%)		
				Sand	Silt	Clay
Soils of Upper Plateau						
Madhlal Tanda series: Clayey-skeletal Lithic Ustorthents						
0-21	A	5YR3/4	50	36.3	16.3	47.2
0-21+	R			Hard laterite		
H. N. Tanda series: Clayey-skeletal Lithic Rhodustalfs						
0-11	Ap	5YR3/3	15	36.3	16.3	47.2
11-37	Bt	2.5Y3/4	60	21.0	16.0	63.0
37+				Hard laterite		
Soils of Lower plateau						
Bilalpur series: Clayey-skeletal Typic Rhodustalfs						
0-17	A	5YR3/4	15	34.3	15.0	50.7
17-40	Bt1	2.5YR3/6	25	22.2	11.5	66.3
40-64	Bt2	2.5YR3/6	60	26.7	12.9	60.4
64+	R			Hard laterite		
Algol series: Clayey-skeletal Kandic Paleustlfs						
0-13	Ap	2.5YR4/4	45	49.9	14.4	35.7
13-55	Bt1	2.5YR3/6	50	25.5	7.6	66.9
55-104	Bt2	2.5YR3/4	60	17.5	7.3	75.2
104-150	Bt3	2.5YR3/4	60	24.5	6.9	68.3
Kaveli series: Very-fine, Calcareous Typic Haplusterts						
0-17	Ap	10YR3/3	-	3.6	25.4	71.0
17-50	Bss1	10YR3/3	-	2.1	25.3	72.6
50-83	Bss2	2.5Y3/2	-	1.9	26.0	72.1
83-117	Bss3	2.5Y4/4	-	1.8	20.0	78.2
117-150	Bss4	2.5Y5/4	-	2.0	20.7	77.2
Soils of valley						
Ranjol series: Very-fine, calcareous Typic Haplusterts						
0-19	Ap	10YR3/3	-	13.8	17.0	69.2
19-54	Bw	2.5Y3/2	-	14.2	16.0	69.7
54-88	Bss1	10YR3/2	-	14.3	14.8	70.9
88-120	Bss2	2.5Y4/4	-	21.1	16.8	62.1
120-150	Bss3	2.5Y4/4	-	14.6	18.6	66.8
Potpalle series: Very-fine Vertic Haplustepts						
0-19	Ap	7.5YR3/4	-	3.4	27.0	69.8
19-53	Bw1	7.5YR3/4	-	2.1	24.1	73.8
53-85	Bw2	7.5YR3/4	-	1.9	25.8	72.3
85-112	Bw3	10YR3/3	-	2.5	23.7	73.8

strongly alkaline. Soils are medium in available nitrogen, low in available phosphorus and high in available potassium.

Potpalle series covers an area of 11,276 ha and

are very deep (>150 cm), imperfectly drained, with high shrink-swell potential, mildly to moderately alkaline clay surface. These soils are medium in available nitrogen and available phosphorus and high

Table 2 : Chemical properties of dominant soil series

Depth	OC (%)	pH 1:2.5	Exchangeable Bases (cmol (+) kg ⁻¹)					Acidity cmol (+) kg ⁻¹ BaCl ₂ (pH 8.2)	CEC cmol(+) kg ⁻¹		Base Sat. %	ESP %
			Ca	Mg	Na	K	Sum		NH ₄ OAc	ECEC		
Soils of Upper Plateau												
Madhlal Tanda series: Clayey-skeletal Lithic Ustorthents												
0-21	1.35	6.1	9.9	4.8	0.1	0.2	15.0	14.5	15.5	15	97	-
H.N. Naik.Tanda Series												
0-11	2.63	5.9	10.4	3.2	0.1	0.1	13.8	14.5	20.3	14.3	68	-
11-37	1.73	6.3	12.2	4.2	0.1	0.1	16.6	14.7	24.3	16.6	68	-
Soils of Lower plateau												
Bilalpur series: Clayey-skeletal Typic Rhodustalfs												
0-17	1.39	6.2	9.7	2.7	0.1	0.1	12.6	12.5	16.6	12.6	76	-
17-40	1.35	5.9	12.5	2.5	0.1	0.1	15.2	14.8	20.3	15.2	75	-
40-64	1.32	6.0	11.6	2.5	0.1	0.2	14.4	12.9	18.0	14.4	80	-
Algol series: Clayey-skeletal Kandic Paleustlfs												
0-13	0.97	6.2	6.4	2.3	0.1	0.1	8.9	10.3	9.3	8.9	96	-
13-55	0.84	6.4	10.8	3.4	0.1	0.1	14.4	12.6	18.1	14.4	80	-
55-104	0.34	6.5	9.7	2.6	0.1	0.1	12.5	10.2	15.9	12.5	79	-
104-150	0.47	6.5	9.7	2.4	0.1	0.1	12.3	9.5	14.5	12.3	85	-
Kaveli series: Very-fine (calcareous) Typic Haplusterts												
0-17	0.72	8.3	-	-	4.8	0.6	-	-	61.1	-	**	7.8
17-50	0.56	8.3	-	-	6.8	0.3	-	-	58.8	-	**	11.5
50-83	0.59	8.9	-	-	16.9	0.3	-	-	53.6	-	**	31.5
83-117	0.35	8.9	-	-	23.3	0.4	-	-	51.5	-	**	45.2
117-150	0.25	9.0	-	-	22.5	0.4	-	-	56.5	-	**	39.8
Soils of valley												
Ranjol series: Very-fine (calcareous) Typic Haplusterts												
0-19	1.07	8.3	-	-	0.1	0.5	-	-	27.7	-	**	0.4
19-54	0.71	8.1	-	-	0.2	0.5	-	-	27.7	-	**	0.7
54-88	0.63	8.1	-	-	0.4	0.3	-	-	27.9	-	**	1.4
88-120	0.34	8.2	-	-	0.6	0.3	-	-	24.2	-	**	2.5
120-150	0.24	8.3	-	-	0.7	0.3	-	-	34.0	-	**	2.0
Potpalle series: Very-fine, Vertic Haplustepts												
0-19	1.23	7.4	30.7	9.2	0.2	0.6	40.7	9.8	39.0	-	100	0.5
19-53	1.00	7.8	33.0	9.8	0.3	0.3	43.4	10.0	39.2	-	100	0.8
53-85	0.87	7.7	36.5	8.3	0.5	0.3	45.6	10.6	44.4	-	100	1.1
85-112	0.83	7.9	38.0	10.0	1.4	0.3	51.7	9.2	49.5	-	100	2.8
112-150	0.74	8.0	40.9	11.0	1.4	0.3	53.0	10.6	51.6	-	100	2.7

Exch. Ca+Mg not determined as soil is calcareous, ** Base saturation is assumed as 100 %

in available potassium and are salt affected in small patches.

Suggested land use and management

The interpretation of soils for various land use suggested on the basis of the morphology, physico-

chemical properties and climatic situation in the laterite terrain (Table 3). The study revealed that the soils of Madhlal Tanda series (upper plateau) have very limited potential for agricultural uses. However, such area can be utilized in a better way for development of forest, pasture and grassland. The soils

Table 3 : Interpretation of soils for various land use

Series	LCC*	Description	Major constraints	Present land use	Suggested land use
Madhlal Tanda	IVes	Fairly good land for sustainable agriculture	Very shallow rooting depth, surface crusting, very low water holding and retention capacity with high stones, low available P and K, moderate to severe erosion	Scrub, rocky land sorghum, sunflower, pigeon pea, pearl millet	Afforestation with improved forest tree species. Pasture and grass land development
H. N. Naik Tanda, Bilalpur	IIIes	Moderately good cultivable land for sustainable agriculture	Shallow to slightly deep rooting depth, surface crusting, gravelly sub-surface, low AWC, low available P and K, moderate erosion	Sorghum, safflower, sunflower, pulses, linseed etc.	Under rainfed, horse gram, black gram, green gram. Pasture and silvi-pasture can be developed
Kaveli, Ranjol, Potpalle	IIIws	Moderately good cultivable land for sustainable agriculture	Impeded sub-surface drainage, sodicity, high shrink- swell potential, severe soil tillage problem, moderate erosion	Sorghum, pulses, sunflower, maize, safflower etc for rainfed condition Rice, cotton, chillies, sugarcane, vegetable, sunflower, and coriander under irrigated condition	Under rainfed sunflower, safflower, maize, sorghum, soybean Under irrigation, rice, cotton, chillies, sugarcane Horticultural crops like guava, banana, turmeric, ginger
Algol	IIs	Good cultivable land for sustainable agriculture	Surface crusting, subsoil gravelliness, low AWC, moderate erodability, low N,P,K.	Eucalyptus plantation Sorghum, pulses, sunflower	Sunflower, castor, Bengal gram, green gram, groundnut, maize Horticultural crops: custard apple, ber, drumstick

* Land capability classification (LCC) based on criteria outlined by Klingebiel and Montgomery (1961).
Suggested land use proposed by Reddy et al.(2005) and criteria suggested by Naidu et. al.(2006).

of H. N. Naik. Tanda (upper plateau) and Bilalpur (lower plateau) have moderate potential for agriculture and can be utilized for raising selected crops. Pasture and silvipasture can be successfully developed under such land. The soils of Kaveli series (lower plateau) and Ranjol and potpalle series (valley) and Algol series (lower plateau) have good potential for raising a variety of crops. However, growing of salt sensitive crops are to be avoided because of moderate alkalinity problem in Kaveli soils. Suggested reclamation measures are to be adopted to overcome sodicity problems.

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