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Characterization and classification of soils of Tekkali mandal of Srikakulam District, Andhra Pradesh

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Abstract : A Soil profiles from Telinelapuram (P1), Thirlangi (P2), Lingalavalasa (P3), Parasurampuram (P4), Ravivalasa (P5), Narsingapalli (P6) and Naupada (P7) villages belonging to Tekkali mandal of Srikakulam district, Andhra Pradesh were selected and described for their site and morphological characters. The soils were formed from granite-gneiss and mixture of granite-gneiss with calcareous parent material. The soils were moderately deep to deep. Argillans, clay cutans and iron nodules were found in profiles P3 (Lingalavalasa) and P6 (Narsingapalli) which also had argillic horizon in their subsurface. Pedons P1 (Telineelapuram), P2 (Thirlangi), P5 (Ravivalasa) and P7 (Naupada) had cambic horizon. A calcic horizon was noticed in deeper layers of P2 and P5. Pedon P4 (Parasurampuram) did not show any profile development or horizonation. The colour of the soils varied from yellowish brown to dark greyish brown. The textural classes were sandy loam to sandy clay loam. Soil structure varied from granular to sub-angular blocky in the surface horizon and sub-angular blocky to angular blocky in the subsurface. Generally, the clay content increased with increasing soil depth. The soil pH ranged from 6.32 to 8.65, indicating a slightly acidic to moderately alkaline environment. Calcium carbonate content ranged from 2.5 to 22.5 per cent. The cation exchange capacity (CEC) of the soil horizons varied from 6.55 to 19.15 cmol (p^+) kg^{-1} soil. The percentage base saturation of the soils ranged from 43.48 to 81.54 per cent. Pedons P1 and P7 were classified as *Typic Ustochrept*, P2 and P5 as *Calcic Ustochrept*, P3 and P6 as *Typic Haplustalf* and P4 as *Typic Ustorthents*.

Keywords: *Soil morphology, Soil characterisation, Soil classification, Srikakulam, Coastal soils*

Introduction

The most important basic natural resource that determines the ultimate sustainability of any agricultural system is the soil. Study of soil today has assumed an increased importance due to rapidly declining land area under agriculture, declining soil fertility and increasing soil degradation through unbridled population increase, urbanisation, improper land use policies and irrational use of agricultural inputs (Srinivasa Rao *et al.*, 2021). Appropriate management of the soil with minimal adverse environmental influence is necessary for strategic development and can be best utilised effectively and gainfully through a watershed approach (Ghose *et al.*, 2008). Sharma *et al.* (2018) linked the land resource data with climate and socio-economic conditions for integrated development of Jamnagar district of Gujarat. A thorough and proper understanding of the morphological, physical, and chemical characteristics of the soil gives greater insight into the dynamics of the soil.

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Materials and Methods

The study area, Tekkali mandal of Srikakulam district, was located between 18^0 12' 820" to 18^0 32' 876" N latitude and 83^0 29' 889" to 83^0 37' 727" E longitude. The climate is semiarid tropical with alternate wet and dry seasons. The average annual rainfall in the area is 927.1 mm, out of which as much as 675 mm (73%) is received during the July to November months. The mean annual temperature is 27.45°C**.** The soil moisture is ustic and the soil temperature regime is iso-hyperthermic. The slope of the area varied from 1 to 10 per cent (Table 1), and natural vegetation of the study area is dominated by *Cyperus spp, Cynodon spp, Ocimum tenuiflorum, Tetona grandis, Parthenium spp, Echinochloa spp, Mimosa spp, Phoenix sylvestris, Cassia, Star weed, Prosopis juliflora, Cressa truxillensis, Cocos nucifera, Bambusa, Calotropis.*

A reconnaissance soil survey was conducted in the area of Tekkali mandal during April to June, 2021, using toposheets of 1:50,000 scale as per the procedure outlined by AIS&LUS (1970). Auger bores, mini pits, and road cuts of 15 profiles located on uplands and plains were studied. Soil correlation exercise resulted in seven representative profiles. These seven soil profiles were exposed, morphological characters were studied (AIS&LUS, 1970) and horizon-wise soil samples were collected. In each horizon, bulk density was determined by the core sampler method. Representative soil samples were dried in the shade and sieved through a 2 mm sieve, and the fine earth fraction was analysed in the laboratory for physical and chemical properties by following standard procedures. Soil reaction (pH) and electrical conductivity (EC) were estimated by the procedures outlined by Jackson (1973). The organic carbon content was estimated by the Walkley and Black (1934) wet digestion method. Calcium carbonate content of soil samples was determined by the rapid titration method (Piper 1966). Exchangeable bases and cation exchange capacity (CEC) were determined by a centrifuge extraction procedure using the neutral normal ammonium acetate method. The soil profiles were classified according to the USDA soil taxonomy (Soil Survey Staff, 2014).

Results and Discussion

Soil morphology

The soil profiles were dug to a depth of 0.74 to 1.02 m. The soils were moderately deep to very deep. In profiles 1, 2 and 5, calcareous parent material was found with an increase in depth (Table 2). The soils varied in depth according to their location and topography. The surface horizons in all the profiles were designated as Ap due to the disturbance by mechanical means such as tillage. The sub-surface Bw horizons in profiles 1, 2, 5 and 7 exhibited alteration of material from its original condition, by structural development and presence of cambic horizon (Bw). Profiles 3 and 6 had argillic horizons (Bts) in their subsurface due to the illuviation of clay particles. Profile 4 exhibited Ap, A1, and A2 horizon sequence and did not show any profile development. All seven profiles had shown a diffuse wavy boundary due to pedo-turbation. The colour of the profiles 1, 4 and 6 varied from reddish yellow to strong brown with a hue of 7.5 YR, value from 3 to 8, chroma from 2 to 8. Profiles 2, 5, and 7 exhibited a very pale brown to greyish brown hue, ranging from 5 YR to 10 YR. The value and chroma values ranged from 3 to 8 and 1 to 4, respectively. Profile 3 exhibited a red colour with a hue of 2.5YR, a value range of 5 to 7, and a chroma range of 4 to 6. This wide variation in soil colour is due to variation in chemical, mineralogical composition, as well as textural make-up of soils that were influenced by topographic position and moisture regime (Srinivasan *et al*., 2020). Textural class varied from sandy loam to sandy clay. These variations were caused by the nature of the parent material, in-situ weathering, translocation of clay and the age of soil development.

The variation in soil structure ranged from sub-angular blocky to angular blocky and granular structures, which is due to the movement of clay and soluble minerals to lower layers, as well as overburden pressure. Profiles 1, 2, 5, 6, and 7 showed a range from slightly hard to hard, friable to very firm, and slightly sticky to sticky and plastic consistency, and the variation might be due to mixed types of mineralogy. Profiles 3 and 4 exhibited non-sticky and non-plastic to slightly sticky and slightly plastic wet consistency, friable to firm

Table 1: Site characters of profiles in study area Tekkali mandal of Srikakulam district

S. No.	Pedon location	Latitude, longitude	Slope %	Physiography	Drainage	Crops grown
1.	Telinilapuram	18.342°, 84.155°	3-5	Gently sloping plains	Moderate	Rice, ground nut, pulses, and sunflower
2.	Thirlangi	18.593°, 84.201°	1-3	Plateau	Moderate to Poor	Ragi, rice, groundnut, sun hemp, and sesame
3.	Lingalavalasa	18.619°, 84.161°	3-5	Gently sloping plains	Good	Rice, sunhemp, sunflower, and mango
4.	Parsurampuram	18.573°, 84.183°	5-10	Foot hill	Good	Red sandalwood, pulses, banana, and cashew
5.	Ravivalasa	18.576°, 84.248°	1-3	Plains	Moderate to Poor	Rice, sesame, coconut, banana, pulses, and sunflower
6.	Narsingapalli	17.6071°, 82.876°	3- 5	Gently sloping plains	Good	Rice, sunhemp, sesame, pulses, and cashew
7.	Naupada	18.569°, 84.314°	1- 3	Coastal plains	Moderate	Aquaculture, rice, coconut, and cashew

Table 2: Soil Morphological characteristics of profiles

Horizon	Depth(m)	Colour		Texture	Structure			Consistence			Effervescence	Pores		Concreations			Roots		Boundary	Other features
		Dry	Moist		S	G	T	Dry	Moist	Wet		Size	Qty	Conca/conir	size	Qty	Size	Qty		
P1. Telinelapuram																				
Ap	0.00-0.22	7.5YR4/4	7.5YR3/2	scl	c	1	sbk	sh	fr	ss&sp	-	c	c	-			c	c	d-w	Calcium carbonate nodules
Bw1	0.22-0.34	7.5YR6/4	7.5YR5/3	sc	m	2	abk	sh	fi	ss&sp	e	f	c	conca	f	f	f	c	d-w	
Bw2	0.34-0.55	7.5YR7/4	7.5YR6/4	sc	m	2	abk	h	fi	ss&sp	es	f	f	conca	f	f	f	f	d-w	
Bw3	0.55-0.88	7.5YR7/6	7.5YR6/6	sc	m	2	abk	h	fi	ss&sp	es	f	f	conca	f	f	f	f	d-w	
C	0.88-1.02+	7.5YR6/6	7.5YR5/6	sc	f	2	abk	vh	vfi	s&p	es	-	-	conca	f	c	-	-	d-w	
P2. Thirlangi																				
Ap	0.00-0.16	10YR5/1	5YR3/1	scl	m	2	sbk	sh	fr	ss&sp	-	c	m	-	-	-	c	c	d-w	Calcium carbonate nodules
Bw1	0.16-0.28	10YR6/2	10YR5/2	sc	m	2	abk	sh	fi	ss&sp	e	c	c	conca	f	f	c	c	d-w	
Bw2	0.28-0.47	10YR6/2	10YR5/3	sc	f	2	abk	h	fi	s&p	e	f	f	conca	f	f	f	c	d-w	
Bw3	0.47-0.72	10YR6/3	10YR5/2	sc	f	2	abk	h	vfi	s&p	es	f	f	conca	f	f	f	f	d-w	
Ck	0.72-0.97+	10YR6/3	10YR5/2	sc	f	2	abk	vh	vfi	s&p	ev	-	-	conca	c	c	f	f	d-w	
P3. Lingalavalasa																				
Ap	0.00- 0.15	2.5YR 7/4	2.5YR5/4	sl	c	1	sbk	sh	fr	ns& np	-	c	m	-	-	-	c	m	d-w	Argillans and clay cutans in subsurface.
Bt1	0.15-0.34	2.5YR6/4	2.5YR5/6	scl	m	2	sbk	h	fi	ss& sp	-	f	v	-	-	-	f	c	d-w	
Bt2	0.34-0.50	2.5YR7/6	2.5YR6/6	scl	m	2	abk	h	fi	ss& sp	-	f	f	-	-	-	f	f	d-w	
Bt3	0.50-0.70	2.5YR7/6	2.5YR6/6	scl	f	2	abk	h	fi	ss& sp	-	f	f	-	-	-	f	f	d-w	
Bt4	0.70-0.90+	2.5YR7/6	2.5YR6/6	scl	f	2	abk	h	fi	ss& sp	-	f	f	-	-	-	f	f	d-w	
P4. Parasuramapuram																				
Ap	0.00-0.12	7.5YR6/6	7.5YR5/6	sl	c	1	gr	sh	fr	ns&np	-	c	c	-	-	-	c	c	d-w	
A1	0.12-0.24	7.5YR6/6	7.5YR5/8	sl	m	2	sbk	h	fr	ss&sp	-	f	c	-	-	-	f	c	d-w	
A2	0.24-0.34	7.5YR7/8	7.5YR6/6	sl	f	2	sbk	h	fr	ss&sp	-	f	f	-	-	-	f	f	d-w	
C	0.34-0.74+	7.5YR7/6	7.5YR6/4	sl	f	2	sbk	h	fi	ss&sp	-	f	f	-	-	-	f	f	d-w	
P5. Ravivalasa																				
Ap	0.00-0.14	10YR7/3	10YR5/3	scl	c	1	sbk	sh	fi	ss&sp	-	c	m	-	-	-	c	m	d-w	Calcium carbonate nodules
Bw1	0.14-0.28	10YR6/3	10YR5/2	scl	c	2	abk	sh	fi	s&p	e	f	c	-	f	f	f	c	d-w	
Bw2	0.28-0.52	10YR6/3	10YR5/2	scl	m	2	abk	h	fi	s&p	es	f	f	conca	f	f	f	f	d-w	
Bw3	0.52-0.72	10YR7/3	10YR6/3	scl	f	2	abk	h	vfi	s&p	es	f	f	conca	c	c	f	f	d-w	
Ck	0.72-0.94+	10YR8/4	10YR7/3	scl	f	2	abk	h	vfi	s&p	ev	f	f	conca	c	c	f	f	d-w	
P6. Narsingapalli																				
Ap	0.00-0.21	7.5YR8/6	7.5YR7/6	sl	c	1	sbk	h	fr	ss&sp	-	c	m	-	-	-	c	m	d-w	Cutans and argillans in sub surface.
Bt1	0.21-0.43	7.5YR6/6	7.5YR5/6	scl	f	2	abk	h	fr	ss&sp	-	f	c	-	-	f	f	c	d-w	
Bt2	0.43-0.64	7.5YR7/8	7.5YR5/8	scl	f	2	abk	h	fr	ss&sp	-	f	f	-	c	f	f	f	d-w	
Bt3	0.77-0.94+	7.5YR7/6	7.5YR6/6	scl	f	2	abk	h	vfi	ss&sp	-	f	f	-	f	f	f	f	d-w	
P7. Naupada																				
Ap	0.00-0.23	10YR6/2	10YR4/1	sl	c	1	sbk	sh	fr	ss&sp	-	c	m	-	f	c	c	m	d-w	
Bw1	0.23-0.45	10YR5/2	10YR4/2	sl	m	1	b	sh	fi	sp	-	f	f	-	c	c	f	c	d-w	
Bw2	0.45-0.60	10YR6/3	10YR3/2	scl	f	2	b	h	fi	sp	-	f	f	-	c	f	f	f	d-w	
Bw3	0.60-0.92+	10YR5/2	10YR4/2	scl	f	2	b	h	fi	sp	-	-	-	-	c	f	-	-	d-w	

moist consistency, and slightly hard to hard dry consistency. Slight to strong effervescence with dilute HCl was observed in profiles 1, 2 and 5, while the remaining profiles did not show any effervescence due to negligible $CaCO_3$ content.

Physical and chemical characteristics

The sand content of various horizons of the profiles varied from 52.40 to 72.00 per cent (Table 3). In general, the total sand content decreased with depth. All seven profiles showed relatively higher sand content, which might be attributed to the dominance of physical weathering (Dinesh & Grewal, 2017). The silt content varied from 7.50 to 16.50 per cent. In general, silt content showed an irregular trend with depth in all the profiles. Irregular distribution of silt with depth might be due to variation in weathering of parent material or in-situ formation. The clay content of the profiles ranged from 15.50 to 33.00 per cent and increased with depth; however, it is more conspicuous in profiles 3 and 6 due to the presence of an argillic horizon in the subsurface. Similar observations were also made by Himabindu *et al.* (2018). The texture variation among profiles may be due to variation in parent material and the differential degree of weathering.

The soil pH of the various horizons in all seven profiles studied ranged from 6.32 to 8.65, exhibiting slightly acidic to moderately alkaline conditions. The neutral to slightly alkaline nature of the soils is due to fluvial deposits of bases as well as the presence of $CaCO_3$ (Mahapatra *et al.,* 2019). In general, soil pH increased with depth, which could be due to the continuous removal of basic cations by crop plants or the leaching of basic cations to deeper layers along with percolating water, as well as the release of organic acids in surface layers during the decomposition of organic matter. Increase of soil pH with depth due to the presence and increasing trend of $CaCO_3$ with soil depth. The EC ranged from 0.07 to 0.89 dS m^{-1}. All the profiles studied were non-saline in nature.

The organic carbon (OC) content ranged from 0.08 to 0.75 per cent, with a medium level in most surface layers and a low level in subsequent layers. The OC showed a decreasing trend with soil depth. The low organic matter content in the soils might be due to the prevalence of semiarid conditions, where the degradation of organic matter occurs at a faster rate, coupled with low vegetation cover, thereby leaving less organic carbon in the soils (Srinivasan *et al.,* 2020). Calcium carbonate content ranged from 2.5 to 22.5 per cent. The $CaCO_3$ content in profiles 1, 2 and 5 followed an increasing trend with soil depth. The increase in calcium carbonate content with depth was attributed to the leaching of bicarbonate from the upper layer during the rainy season and its subsequent precipitation as carbonate in the lower layer. High $CaCO_3$ content might be due to the presence of calcareous parent material and a semiarid climate (Gurumurthy, 2022).

The cation exchange capacity of the soil horizons varied from 6.55 to 19.15 cmol (p^+) kg^{-1} soil. In general, the CEC increased with depth and followed the trend of clay content. Higher clay content in subsurface layers is responsible for the increasing trend of CEC with soil depth. Similar observations were also reported by Himabindu *et al.* (2018). This wide variation in CEC between and within soil profiles can be attributed to the difference in soil texture, clay mineralogy, and organic matter content.

The exchangeable calcium was the most dominant cation, which ranged from 2.40 to 11.00 cmol (p^+) kg^{-1} soil. All the profiles exhibited an increasing trend in exchangeable calcium content with depth. Magnesium was the second dominant cation on the exchange complex of the soils studied. The exchangeable Mg, Na and K values varied from 0.41 to 3.60, 0.22 to 1.70, and 0.10 to 0.80 cmol (p^+) kg^{-1} soil, respectively. The bivalent cations, like Ca^{2+} and Mg^{2+}, are relatively less mobile, yet among the two, Mg^{2+} ions are more mobile than Ca^{2+} ions. As such, Mg^{2+} ions are leached out earlier than the Ca^{2+} ions, leading to the dominance of Ca^{2+} on the exchange complex. The amount of base cations was in the order of $Ca^{2+}>Mg^{2+}>Na^{+}>K^{+}$. Exchangeable potassium was low in the soils, which might be due to the less predominant micaceous minerals in the study area (Gurumurthy, 2018). The base saturation of the soils ranged from 43.48 to 81.54 per cent. Profiles 4 and 6 showed relatively low base saturation due to coarse texture and absence of $CaCO_3$, resulting in very low base saturation, while high

Table 3: Physical and physico-chemical characteristics

Horizon	Depth (m)	%Coarse fraction (>2.0mm)	Sand (%)	Silt (%)	Clay (%)	$CaCO_3$ (%)	pH	E.C (dS m^{-1})	O.C (%)	CEC cmol (p^+) kg^{-1}	Exchangeable bases (cmol (p^+) kg^{-1} soil)				% BS
											Ca^{2+}	Mg^{2+}	Na^+	K^+	
P1. Telinelapuram															
Ap	0.00-0.22	10.04	62.60	12.50	24.90	-	7.32	0.22	0.60	12.17	3.80	2.40	1.26	0.50	65.41
Bw1	0.22-0.34	15.61	62.40	12.50	25.10	2.5	7.58	0.26	0.42	13.48	4.80	2.60	1.04	0.74	68.10
Bw2	0.34-0.55	17.28	59.50	12.50	28.00	5.0	7.70	0.31	0.30	15.43	5.20	3.00	1.68	0.74	68.83
Bw3	0.55-0.88	19.17	62.30	10.50	27.20	6.5	8.02	0.50	0.30	14.57	5.90	2.60	1.70	0.50	73.44
C	0.88-1.02+	26.00	61.00	12.50	26.50	6.5	7.98	0.38	0.29	15.43	6.50	2.80	1.42	0.80	74.66
P2. Thirlangi															
Ap	0.00-0.16	8.23	59.50	10.00	30.50	5.0	7.23	0.31	0.75	15.48	6.40	3.40	1.56	0.21	74.26
Bw1	0.16-0.28	13.41	57.00	12.50	30.50	7.5	7.92	0.53	0.30	16.74	7.20	3.60	1.56	0.24	75.27
Bw2	0.28-0.47	19.50	52.40	15.00	32.60	9.5	7.98	0.74	0.15	17.83	7.60	3.60	1.56	0.29	73.19
Bw3	0.47-0.72	21.21	54.50	12.50	33.00	10.5	8.37	0.74	0.15	17.83	8.10	3.40	1.44	0.26	74.03
Ck	0.72-0.97+	44.31	59.00	10.00	31.00	22.5	8.65	0.89	0.08	16.74	8.30	3.60	1.51	0.24	81.54
P3. Lingalavalasa															
Ap	0.00- 0.15	4.51	66.00	15.00	19.00	-	6.32	0.15	0.75	9.13	3.40	0.65	0.36	0.22	50.71
Bt1	0.15-0.34	4.37	62.00	13.00	25.00	-	6.57	0.16	0.53	12.17	4.40	0.85	0.52	0.24	49.38
Bt2	0.34-0.50	3.60	53.00	16.50	30.50	-	6.40	0.16	0.30	13.48	4.80	1.20	0.76	0.21	51.71
Bt3	0.50-0.70	7.82	57.40	13.00	29.60	-	6.55	0.14	0.30	13.48	4.80	1.60	0.85	0.26	55.71
Bt4	0.07-0.90+	14.13	57.30	12.50	30.20	-	6.58	0.13	0.09	14.57	4.60	2.00	0.80	0.29	52.78
P4. Parasuramapuram															
Ap	0.00-0.12	14.01	72.00	12.50	15.50	-	6.43	0.09	0.30	8.30	2.40	0.85	0.32	0.12	43.48
A1	0.12-0.24	21.22	68.70	15.00	16.30	-	6.68	0.07	0.15	8.30	2.60	1.05	0.38	0.14	50.24
A2	0.24-0.34	18.50	66.70	15.00	18.30	-	7.15	0.08	0.15	9.13	2.40	1.05	0.42	0.10	44.46
C	0.34-0.74+	39.52	70.90	12.50	16.60	-	7.02	0.09	0.08	10.17	3.10	1.35	0.42	0.18	49.66

P5. Ravivalasa															
Ap	0.00-0.14	6.98	66.00	7.50	26.50	2.5	7.32	0.39	0.53	14.57	6.80	1.60	1.02	0.42	67.54
Bw1	0.14-0.28	4.37	62.44	10.00	27.56	8.0	7.47	0.59	0.42	16.48	8.20	2.50	0.78	0.34	71.72
Bw2	0.28-0.52	2.32	63.74	10.00	26.26	9.5	7.81	0.61	0.30	17.83	10.60	1.80	0.78	0.24	75.27
Bw3	0.52-0.72	9.52	61.00	12.50	26.50	9.5	8.22	0.79	0.15	19.15	11.00	1.40	1.32	0.53	74.41
Ck	0.72-0.94+	28.12	64.50	10.00	25.50	18.5	8.36	0.72	0.15	17.83	10.60	2.00	1.08	0.56	79.87
P6. Narsingapalli															
Ap	0.00-0.21	12.30	69.50	12.50	18.00	-	6.38	0.07	0.60	6.55	2.40	0.41	0.22	0.10	47.79
Bt1	0.21-0.43	10.30	69.50	8.00	22.50	-	7.14	0.15	0.30	8.65	3.02	0.92	0.22	0.18	50.17
Bt2	0.43-0.77	15.60	67.00	9.50	23.50	-	7.18	0.22	0.30	10.65	3.60	1.06	0.30	0.18	48.26
Bt3	0.77-0.94+	14.72	65.40	12.00	22.60	-	7.63	0.20	0.15	10.65	3.55	1.06	0.33	0.15	47.79
P7. Naupada															
Ap	0.00-0.23	4.80	64.10	12.50	23.40	-	6.53	0.41	0.53	12.65	3.85	1.06	0.85	0.33	48.14
Bw1	0.23-0.45	8.12	61.60	15.00	23.40	-	6.95	0.48	0.23	13.30	4.22	1.25	0.85	0.33	50.00
Bw2	0.45-0.60	11.30	61.54	12.50	25.96	-	7.19	0.55	0.15	14.57	3.80	1.80	1.22	0.56	50.65
Bw2	0.60-0.92+	20.86	64.70	10.50	24.80	-	7.36	0.53	0.15	15.48	4.82	1.60	0.85	0.44	49.81

base saturation in profiles 2 and 5 was due to the presence of $CaCO_3$. Similar results were reported by Meena *et al*. (2014).

Soil Classification

Based on morphological features, physical, chemical, and mineralogical properties of the profiles, the soils of Tekkali mandal were classified up to family level as per the guidelines of Keys to Soil Taxonomy (Soil Survey Staff 2014). Profiles 1, 2, 5 and 7 were classified as Inceptisols at the order level due to the presence of a cambic horizon at their subsurface. At the great group level, these four profiles were classified as "Ustochrepts", considering the prevailing ustic soil moisture regime. They were classified as *Fine loamy, mixed, isohyperthermic Typic Ustocrept* (P1), *Fine loamy, mixed, isohyperthermic Calcic Ustochrept* (P2), *Fine loamy, kaolinitic, isohyperthermic Typic Haplustalf* (P5), *Fine loamy, mixed, isohyperthermic Typic Ustocrept* (P7), respectively, at the family level based on differentiating characteristics.

Profiles 3 and 6 were classified as Alfisols at the order level because of the presence of an argillic horizon. At the great group level, they were named as "Haplustalf" due to the absence of a natric / petrocalcic horizon or duripan / plinthite, and the colour hue of the argillic horizon was no redder than 2.5 YR. At the sub-group level, these profiles were classified as "Typic Haplustalfs". At the family level, they were classified as *Fine loamy, kaolinitic, isohyperthermic Typic Haplustalf*, and *Fine loamy, kaolinitic, isohyperthermic Typic Haplustalf*, respectively. Profile 4 was classified as Entisol at the order level because it did not show profile development and exhibited no diagnostic horizon. It is an unconsolidated sediment on a foot hill slope. The profile was further classified as 'orthent' at the suborder level, considering the shallow depth and skeletal nature of the profile. It was classified as *Loamy, mixed, isohyperthermic Typic Ustorthent* at the family level.

Conclusion

Based on the morphological and physico chemical properties of seven soil profiles of Tekkli mandal of Srikakulam district, three soil orders were identified, viz., Entisols, Inceptisols and Alfisols. Major limitations of these soils were texture, drainage, rainfall and soil fertility. Hence, proper soil fertility and water management, good agronomic practices may be adopted to enhance soil health and productivity.

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