



Characterisation and Classification of Soils in Warangal District of Central Telangana Zone

V. Rajagopal¹, P. Prabhu Prasadini¹, S. Pazanivelan² and N. Balakrishnan³

¹National Institute of Abiotic Stress Management, Baramati, Pune - 413115,

²Department of Bioresources Management, PG Programme on Environmental Science and Technology, College of Agriculture, Rajendranagar, Hyderabad - 500 030.

³Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641 003

A newly formed agroclimatic zone of Warangal district represents fourteen different traditional soil types studied for morphological, physical, chemical and physico-chemical properties and classified based on USDA taxonomical system. Moderately shallow to deep soils were observed with the angular blocky in the surface and sub angular blocky structure in sub surface soil. The texture varied from sandy loam, sandy clay loam to clay loam. Bulk density and particle density of soils varied from 1.32 to 1.71 and 2.42 to 2.61 Mg m⁻³, respectively and the bulk density increased with depth. The soil organic carbon content of surface soils was high in Malyal and Warangal research station profiles whereas in other profiles, it was medium and decreased with depth. Soil reaction ranged from 6.31 to 8.71. It was slightly acidic to alkaline. The soils of Nallabelli and Regonda were alkali soils. The cation exchange capacity (cmol (p+) kg⁻¹) varied from 8.30 to 46.33 and it had increased with depth in Tadvai, Nallabelli, Wardhannapet, Pakala and Malyal profiles. Soil calcium carbonate content varied from 1.42 to 13.67 per cent and it increased with depth in most of the profiles. The soils of Nallabelli, Duggondi, Regonda and Warangal Research station were calcareous. As per Taxonomy, Eleti Ramayapalli, Wardhannapet, Pakala and Duggondi profiles were classified into Inceptisols: Tadvai, Nallabelli, Bachannapet, Eturunagaram and Raghunathapalli profiles into Alfisols and Regonda, Ghanpur, Khanapur and Warangal research station profiles into Vertisols based on soil properties.

Key words: Soils, CEC, Base saturation, Taxonomy

India has very diversified climate, topography, types of rocks with different level of weathering, forming very young to matured soils. The soil properties are determined by nature of parent materials, climatic factor and nature of weathering process. Soil diversity of our country known for existence of nine soil orders and capacity to serve as medium for plants and microorganism differ with physical, chemical and biological properties. The soils have limitation to crop production by nature or improper land use management caused the excess or deficiency of nutrients and other soil physical constraints. The spatial and temporal variation in soil properties is very high, need to characterize and classify properly such way that it remembered and interpreted easily for selection of crop and management practice of crop production. This knowledge will also help to monitor the trend of management practice on soil property, way and method to replenish nutrients to the soil, sustainable harvesting of nutrients without affecting the resources for future generation and identification of abiotic stresses prevails in soils of Warangal district and provide those need of good management practice for crop production. Lack of soil characterization becomes obstacle to utilize the soil production potentials and adaptation of better management practice to increase the productivity of

the soil (ISSS, 2000). Soil classification by following the standard system makes users and researchers enable to remember logically the salient features and agro technology transfer to other area, where do found similar soil series. The soils of Warangal district classified as red earths, black soils (shallow to deep) and forest soils extend over an area of 12834 Km². The characterization and classification is not on systematic analysis, hence the present study was taken up in 2009 to characterize and classify the soils of Warangal district of Central Telangana Zone, a newly created agro-climatic zone in Andhra Pradesh.

Materials and Methods

Warangal district lies between 17° 19' & 18° 36' N latitude and 78° 49' & 80° 43' E longitude and the topography of the district consists of isolated hills, rainfed tanks, lakes and shrubby forests. The geological formation of the district mainly developed from the granite and genesis of arachean period and dharwars of Precambrian period. Prevailing climatic condition of Warangal district was very hot in Summers even mercury sometimes touching 50°C and in winter's temperature, it dips to 13°C in during the months of December and January. This district receives annual rainfall of 994 mm. Hence, the study area qualifies for hyperthermic soil temperature and ustic soil moisture regimes. The soils were

*Corresponding author email: rjpsac@gmail.com

classified upto family level as per USDA taxonomy (Soil Survey Staff, 1998). Horizon-wise soils samples were collected from each pedon of fourteen locations. The soil morphological, physical, physicochemical and chemical properties analyzed with standard procedures. The particle sizes were determined by hydrometer method and the soil bulk density was by core sampler method (Blake and Hartge, 1986). The soil water retention capacity was determined by using pressure plate apparatus. The soil reaction, EC and free calcium carbonate were determined by adopting standard methods and the organic carbon (OC) of soil was determined by chromic acid digestion (Walkley and Black, 1934) and the cation exchange capacity was determined through centrifuge methods. The cation exchange capacity of the soil was determined as per procedure given by Bower *et al.*, (1952).

Results and Discussion

Morphological investigation and physical properties of soil

Morphological properties of 14 pedons studied are given in Table 1. The soils were moderately shallow with depth varying from 55 cm in Eleti Ramayapalli to 120 cm in Eturunagaram. The horizon boundaries were clear smooth to clear wavy and diffused wavy. The soil colour was yellowish red (Hue 10 YR to 2.5 YR) with value between 3 and 5 and chroma ranged from 1 to 8 and decreased with depth. The differences in colour in different horizons and in different profiles could be attributed to various pedological processes, organic matter, iron contents and the degree of oxidation as reported by Rajeswar and Arif Khan (2008). The sub angular blocky structure in the surface horizon of all profiles and the sub angular blocky to angular blocky structure in sub - surface horizons of Duggondi, Regonda, Ghanpur, Khanapur and Warangal RS (Research Station) profiles was observed. This variation in soil structure is a reflection of physiographic position of the profile (Singh and Agarwal, 2003). Soil texture of profiles varied from sandy loam to sandy clay loam to clay loam in surface horizons and sandy clay loam to clay loam to clay in subsurface horizons. The polished shining surface were observed in Regonda, Khanapur and Warangal research station profiles in the sub-surface horizons. The pores observed in the profiles varied from few (less than 1 %) to many (5% per unit area) with fine to medium in size. Roots were observed in upper horizons of the profiles and number varied from few to many and sizes were from very fine (less than 0.5 mm) to medium (2.5 mm).

Gravel content in the soils varied from 2.82 per cent in surface horizon to 48.52 per cent. The sand content of the soils varied from 40.90 per cent in bottom layer of Ghanpur profile to 77.56 per cent in surface layer of Eturunagaram profile and sand content decreased with depth. The silt and clay content varied from 7.91 to 19.87 and 12.48 to 39.46 per cent, respectively (Table 2). Clay content was

found to increase with depth in all the profiles might be due to translocation of finer particles from surface to sub-surface horizons (Gangopadhyay *et al.*, 2001) except in Malyal profile where there was decrease in bottom layer. The bulk density (BD) of soils varied from 1.32 to 1.71 Mg m⁻³ and it was found to increase with depth. This might be due to more compaction of finer particles in deeper layers caused by overhead weight of surface soils and plough pan (Jewitt *et al.*, 1979) and low BD in surface layers could also be attributed to higher organic matter content (Walia and Rao, 1996). The particle density of soils varied from 2.42 Mg m⁻³ in third layer of Eleti Ramaya Palli profile to 2.61 Mg m⁻³ in bottom layer of Pakala profile.

Chemical properties of soils

Organic carbon content of the soils in surface horizons ranged from 0.58 per cent in Raghunathapalli profile to 0.81 per cent in Malyal profile and the decrease in organic carbon content with depth could be due to organic matter accumulation in the surface soil (Vara Prasad Rao *et al.*, 2008). Soil reaction varied from 6.31 in second layer of Pakala profile to 8.7 in third layer of Khanapur profile. In Wardhannapet, Raghunathapalli, Malyal and Khanapur profiles, pH increased with depth whereas in Nallabelli, Bachannapet and Pakala it decreased with depth but in other profiles, no definite trend was observed with depth. Electrical conductivity of soils varied from 0.03 dS m⁻¹ in bottom layer of Tadvai profile to 1.05 dS m⁻¹ in bottom layer of Warangal research station profile. Cation exchange capacity (cmol (p⁺) kg⁻¹) ranged from 8.30 in surface layer of Bachannapet profile to 46.33 in third layer of Regonda profile and lower most horizons was higher than the surface horizons could be due to the increase in clay content with depth in the soil as reported by Surekha *et al.* (1997).

The Ca, Mg, K and Na content of soil varied from 4.35 to 24.3, 1.2 to 14.2, 0.1 to 3.7 and 0.2 to 8.1 (cmol (p⁺) kg⁻¹) respectively. Base saturation percentage ranged from 72 per cent in surface layer of Eletti Ramayapalli profile to 94 per cent in surface and bottom layer of Duggondi profile as similar trend reported by Sathyawathy and Suryanarayan (2005). Free soil CaCO₃ ranged from 1.42 per cent in surface horizon of Bachannapet profile to 13.67 per cent in bottom layer of Duggondi profile and increased with depth.

Classification

The field morphological investigation and laboratory analysis helped to group the soils of Warangal district. These were classified (Table 3) into Alfisols, Inceptisols and Vertisols at order level and eventually at family level of (Soil Survey Staff, 1999) USDA classification system.

The Eleti Ramayapalli, Wardhannapet, Pakala and Duggondi profiles classified into Inceptisols; it comes under ustic moisture regime hence it is classified to

Table 1. Morphological properties of soils in Warangal district

Location	Depth (cm)	Color		Effervescence	Texture	Structure	Consistency			Pores	Roots		Boundaries
		Dry	Moist				D	M	W				
1. Tadvai	0-15	2.5YR 4/3	5YR 3/3	—	Sl	f1 sbk	l	fr	so & po	m m	fw	Fn	cs
	15-37	2.5YR 4/4	2.5YR 3/6	—	Scl	f1 sbk	sh	Fr	ss & po	c m	fw	Fn	cs
	37-55	2.5YR 4/6	2.5YR 3/6	—	Scl	f2 sbk	sh	Fr	ss & ps	m f	vfw	Fn	dw
2. Nallabelli	55-70+	2.5YR 4/8	2.5YR 3/6	—	Scl	f2 sbk	sh	Fr	ss & ps	m vf	-	-	dw
	0-15	10YR 5/4	10YR 4/4	se	Scl	m2 sbk	sh	Fr	ss & po	m m	fw	Fn	cs
	15-30	10YR 4/4	10YR 3/4	se	Scl	m2 sbk	sh	Fi	ss & ps	c f	vfw	Vfn	cs
3. Bachannapet	30-70+	10YR 4/6	10YR 3/6	se	Scl	m2 sbk	vh	Fi	ss & p	f f	-	-	dw
	0-80	2.5YR 4/6	2.5YR 3/6	se	Sl	f1 sbk	l	Fi	ss & ps	c m	fw	Fn	cs
	8-50	2.5YR 4/8	2.5YR 3/6	se	Scl	f2 sbk	sh	Fi	ss & ps	m m	fw	Vfn	cs
4. Eturunagaram	50-65+	5YR 4/6	2.5YR 3/4	se	Scl	f1 sbk	sh	Fi	s & p	m m	-	-	cs
	0-15	5YR 4/6	2.5YR 3/3	—	Sl	f1 sbk	l	Fr	so & po	m m	fw	Fn	cs
	15-47	2.5YR 4/6	2.5YR 3/4	—	Scl	f1 sbk	sh	Fr	ss & po	m m	fw	Vfn	cs
5. Eleti Ramayapalli	47-80	2.5YR 4/8	2.5YR 3/6	—	Scl	m2sbk	sh	Fr	s & p	c f	-	-	dw
	80-120	2.5YR 4/6	2.5YR 3/6	—	Scl	m2sbk	h	Fi	s & p	f f	-	-	dw
	0-11	7.5YR 4/4	7.5YR 3/4	—	Scl	f1 sbk	l	Fr	ss & po	c m	fw	Fn	cs
6. Wardhannapet	11-30	7.5YR 4/6	7.5YR 3/4	—	Scl	m2 sbk	sh	Fi	ss & Ps	m m	vfw	Fn	cs
	30-55	7.5YR 4/6	7.5YR 3/4	—	Scl	m2 sbk	sh	Fi	s & Ps	f f	vfw	Fn	dw
	55+	7.5YR 4/6	7.5YR 3/4	—	Scl	m2 sbk	sh	Fi	s & Ps	f f	-	-	dw
7. Raghunathapalli	0-80	10YR 5/4	10YR 4/4	se	Sl	m1 sbk	l	Fr	so & po	m m	fw	Fn	cs
	8-33	5YR 5/6	2.5YR 4/6	se	Scl	m2 sbk	sh	Fi	ss & ps	c f	fw	Vfn	cs
	33-80+	10YR 5/4	7.5YR 4/6	se	Scl	m2 sbk	sh	Fi	s & p	f vf	-	-	dw
8. Pakala	0-25	5YR 4/4	7.5YR 3/4	—	Sl	f1 sbk	sh	Fr	so & po	m m	fw	Fn	cs
	25-55	5YR 4/6	5YR 3/3	—	Scl	m2 sbk	sh	Fi	ss & ps	c f	fw	Vfn	cs
	55-75+	5YR 4/4	5YR 3/4	—	Scl	m2 sbk	h	Fi	s & p	f vf	-	-	dw
9. Malyal	0-10	5YR 4/4	5YR 3/3	se	Scl	f1 sbk	l	Fr	so & po	m m	fw	Fn	dw
	10-35	5YR 4/4	5YR 3/3	se	Scl	f2 sbk	h	Fr	ss & ps	c f	vfw	Fn	cs
	35-55+	5YR 4/4	5YR 3/3	se	Scl	m2 sbk	sh	Fr	ss & ps	f f	-	-	dw
10. Duggondi	0-20	10YR 4/2	10YR 4/3	Se	Scl	m2 sbk	l	Fr	so & ps	m m	vfw	Fn	cs
	20-40	10YR 4/3	10YR 4/4	Se	Cl	m2 sbk	sh	Fi	ss & ps	c f	fw	Fn	cs
	40-65	10YR 4/4	10YR 4/2	Ve	Cl	m3 abk	h	Fi	ss & ps	f f	fw	Fn	dw
11. Regonda	65-95+	10YR 4/5	10YR 4/2	Ve	Scl	f3 abk	h	Fi	ss & ps	f f	-	-	Dw
	0-15	10YR 5/2	2.5Y 4/3	Ve	Cl	m2 sbk	sh	Fi	ss & ps	c m	fw	Fn	Cs
	15-37	10YR 5/3	10YR 3/3	Ve	Cl	m2 sbk	h	Fi	ss & ps	m m	fw	Vfn	Dw
12. Ghanpur	37-65+	10YR 5/4	10YR 3/4	Ve	Cl	f1 abk	h	Fi	s & p	f f	-	-	Ds
	0-11	7.5YR 3/1	7.5YR2.5/1	Se	Cl	m2 sbk	h	Fi	ss & sp	m m	fw	Fn	Cs
	11-35	7.5YR 3/1	7.5YR2.5/1	Se	Cl	m2 abk	h	Fi	ss & sp	c f	fw	Fn	Dw
13. Khanapur	35-55	7.5YR 3/1	7.5YR2.5/1	Se	Cl	f2 abk	sh	Fi	s & p	c f	-	-	Ds
	55-75	7.5YR 3/1	7.5YR .5/1	Se	Cl	f3 abk	sh	Fi	s & p	c f	-	-	Ds
	75+	7.5YR 3/1	7.5YR2.5/1	Se	Cl	f3 abk	sh	Fi	s & p	f vf	-	-	Ds
14. Warangal RS	0-17	7.5YR 5/2	7.5YR 3/3	Se	Cl	m1 sbk	h	Fi	ss & po	m m	fw	Fn	Cs
	17-45	7.5YR 5/2	7.5YR 3/3	Se	Cl	m1 abk	h	Fi	ss & ps	c vf	vfw	Fn	Cs
	45-60	7.5YR 5/2	7.5 YR 3/3	Se	Cl	m2 abk	sh	Fi	s & p	f vf	fw	Fn	Dw
15. Khanapur	60-65+	7.5YR 5/2	7.5YR 3/3	Se	Cl	m1 abk	sh	Fi	s & p	f -	-	-	Dw
	0-12	10YR 5/4	10YR 4/6	Se	Cl	m1 sbk	h	Fi	ss & p	m m	fw	Fn	Cs
	30-12	10YR 5/6	10YR 4/6	Se	Cl	m1 sbk	h	Fi	ss & p	c m	fw	Fn	Cs
16. Warangal RS	30-45	10YR 4/4	10YR 3/4	Ve	Cl	m1 abk	sh	vfi	s & p	f vf	-	-	Dw
	45-65+	10YR 4/6	10YR 3/6	Ve	Cl	m2 abk	sh	vfi	s & p	f vf	-	-	Dw
	0-15	10YR 3/2	10YR 3/1	Se	Cl	m1 sbk	h	Fi	ss & ps	c m	fw	Fn	Cs
17. Warangal RS	15-55	10YR 3/2	10YR 3/1	Se	Cl	m2 abk	h	Fi	s & p	c m	vfw	Vfn	Cs
	55-72	10YR 3/2	10YR 3/1	Ve	Cl	m2 abk	sh	vfi	vs & vp	f vf	-	-	Dw
	72+	10YR 3/2	10YR 3/1	Ve	C	m3 abk	sh	vfi	vs & vp	f vf	-	-	Dw
18. Warangal RS	45-65+	10YR 4/6	10YR 3/6	Ve	Cl	m2 abk	sh	vfi	s & p	f vf	-	-	Cs

Effervescence: se-slightly effervescence, ve-violent effervescence

Structure: Type; abk- angular blocky, sbk-sub angular blocky; Class f-fine, m-medium; Grade; 1- weak, 2-moderate, 3- strong Consistency: D-dry; l-loose, sh- slightly hard, h- hard, vh- very hard; M-moist; ss- slightly sticky, s-sticky, vs- very sticky; W-wet; po-non plastic, sp-slightly plastic- plastic, vp-very plastic, Pores: f-few- common, m-many, m-medium, f-fine, Roots: f-few, vfw-very few undaries: c-clear, d-diffuse, s-smooth, w-wavy

Ustepts sub order, Haplustepts in Great group and Typic Haplustepts in sub group. Tadvai, Nallabelli, Bachannapet, Eturunagaram and Raghunathapalli profiles into Alfisols and based on moisture regime keyed out to Ustalf in sub order. The exchangeable sodium percentage is more than fifteen percent in Nallabelli profile therefore it is classified to Natrustalf great group and Typic Natrustalf in sub group whereas the Eturunagaram had grouped to Rhodusatlf for the property of argillic horizons in sub soils within

100 cm and value of 2.5 YR in moist condition and Typic Rhodustalf in subgroup. Regonda, Ghanpur, Khanapur and Warangal Research station profiles into Vertisols based on soil properties. The profiles classified as Ustepts sub order, Haplustepts great group and Typic Haplustepts sub group except Regonda where it had grouped to Sodic Haplustepts sub group due to the exchangeable sodium percentage is more than 15 percent.

Table 2. Physical and Physio-Chemical properties of soils in Warangal district

Location	Depth (cm)	Gravel (%)	Particle Size distribution			BD (Mg m ⁻³)	PD (Mg m ⁻³)	pH (1:2.5)	OC (%)	CaCO ₃ (%)	EC (dS m ⁻¹)	Exchangeable Bases				CEC cmol(p ⁺) kg ⁻¹	ESP (%)	Base saturation (%)
			(%)									(cmol(p ⁺)kg ⁻¹)						
			Sand	Silt	Clay							Ca	Mg	Na	K			
1. Tadvai	0-15	5.40	75.69	7.97	16.34	1.57	2.51	6.88	0.72	-	0.13	4.3	2.8	1.4	0.2	12.50	11.20	87
	15-37	9.40	66.18	8.61	25.21	1.61	2.48	6.82	0.60	-	0.63	5.6	3.2	1.2	0.1	15.20	7.80	79
	37-55	7.90	64.25	9.00	27.65	1.65	2.51	6.83	0.58	-	0.06	8.1	4.3	0.3	0.1	18.80	1.59	81
	55-70+	35.21	62.49	9.61	27.90	1.65	2.48	6.83	0.58	-	0.03	7.3	3.6	0.2	0.1	18.20	1.09	75
2. Nallabelli	0-15	15.60	65.92	11.61	22.47	1.60	2.53	8.64	0.60	5.20	0.28	7.4	4.7	4.6	2.1	21.50	21.39	87
	15-30	32.52	61.63	9.87	28.50	1.65	2.48	8.42	0.62	6.20	0.26	8.6	5.8	3.8	2.6	26.30	14.44	79
	30-70+	36.28	60.16	10.21	29.63	1.71	2.56	8.39	0.50	6.80	0.28	12.8	8.4	2.3	0.8	28.50	8.07	85
3. Bachannapet	0-8	30.25	76.87	10.65	12.48	1.58	2.48	6.88	0.65	1.42	0.19	5.0	1.2	0.3	0.2	8.30	3.61	80
	8-50	42.52	65.41	11.84	22.75	1.62	2.51	6.44	0.52	1.82	0.14	4.3	1.5	0.2	0.3	7.40	2.70	85
	50-65+	48.52	59.93	12.21	27.86	1.69	2.49	6.74	0.43	2.26	0.13	3.6	2.6	0.4	0.2	10.30	3.88	66
4. Eturunagaram	0-15	2.82	77.56	7.91	14.53	1.52	2.56	6.75	0.67	-	0.19	13.5	8.4	2.3	0.8	29.30	7.84	85
	15-47	8.36	68.07	8.32	23.61	1.59	2.52	6.51	0.62	-	0.10	10.6	6.4	2.0	1.1	26.60	7.51	75
	47-80	5.40	63.02	8.65	28.33	1.60	2.48	6.46	0.35	-	0.05	11.0	5.7	2.2	0.6	24.32	9.04	80
	80-120	31.22	61.48	9.87	28.65	1.60	2.52	6.74	0.25	-	0.29	8.7	7.6	2.8	1.6	28.27	9.90	73
5. Eleti Ramayapalli	0-11	25.65	68.78	9.04	22.18	1.53	2.46	7.47	0.62	-	0.20	8.8	2.3	1.3	0.9	18.56	7.08	72
	11-30	35.68	65.90	10.56	23.54	1.59	2.44	7.62	0.51	-	0.30	14.4	5.3	1.3	0.6	24.93	5.21	87
	30-55	35.45	60.55	11.20	28.25	1.61	2.42	7.60	0.51	-	0.26	12.2	4.1	1.3	0.6	24.52	5.30	74
	55+	36.12	58.69	12.15	29.16	1.63	2.48	7.46	0.36	-	0.24	14.2	3.9	1.42	0.5	21.12	6.72	76
6. Wardhannapet	0-8	33.13	74.25	10.21	15.54	1.58	2.56	6.45	0.72	1.60	0.10	9.2	6.6	1.8	0.7	21.32	8.44	85
	8-33	38.16	61.79	11.56	27.65	1.67	2.58	6.69	0.65	2.52	0.07	11.2	7.1	2.1	0.8	24.87	8.44	85
	33-80+	40.62	59.67	12.01	28.32	1.67	2.49	6.62	0.63	3.10	0.13	10.8	8.2	3.4	0.6	26.31	12.90	87
7.Raghunathapalli	0-25	23.43	74.95	9.73	15.32	1.52	2.51	7.08	0.58	-	0.90	8.4	3.3	2.1	0.8	18.32	11.46	80
	25-55	32.57	61.87	8.57	24.56	1.58	2.48	7.62	0.51	-	0.25	10.3	4.6	1.8	3.7	21.42	8.40	95
	55-75+	35.66	63.63	10.25	26.12	1.62	2.52	7.75	0.44	-	0.28	8.2	3.3	2.4	0.7	19.21	12.40	76

Location	Depth (cm)	Gravel (%)	Particle size distribution (%)			BD (Mg m ⁻³)	PD (Mg m ⁻³)	pH (1:2.5)	OC (%)	CaCO ₃ (%)	EC (dS m ⁻¹)	Exchangeable Bases (cmol(p ⁺)kg ⁻¹)				CEC cmol(p ⁺) kg ⁻¹	ESP (%)	Base saturation (%)
			Sand	Silt	Clay							(cmol(p ⁺)kg ⁻¹)						
												Ca	Mg	Na	K			
8. Pakala	0-10	15.20	65.67	8.12	26.21	1.59	2.58	6.94	0.71	1.68	0.10	6.8	2.4	1.6	0.8	15.32	10.44	75
	10-35	29.76	61.36	9.79	28.85	1.60	2.52	6.31	0.68	2.52	0.07	9.2	6.3	1.9	0.9	20.23	9.39	90
	35-55+	40.26	60.43	9.92	29.65	1.63	2.61	6.33	0.63	2.72	0.11	11.2	4.5	2.5	0.5	21.61	11.56	86
9. Malyal	0-20	12.40	56.20	14.22	29.58	1.52	2.52	7.61	0.81	1.60	0.26	10.3	2.1	0.4	0.2	14.00	2.85	92
	20-40	16.24	52.25	17.10	30.65	1.46	2.50	7.92	0.66	2.50	0.22	10.4	4.9	0.6	0.3	16.50	3.63	98
	40-65	19.42	56.35	12.38	31.27	1.46	2.54	7.97	0.56	3.10	0.15	11.1	4.4	0.3	0.2	18.20	1.64	87
	65-95+	18.65	60.23	13.52	26.25	1.48	2.53	8.01	0.31	3.80	0.13	12.1	5.1	0.3	0.1	21.00	1.42	83
10. Duggondi	0-15	18.08	55.98	10.34	33.68	1.36	2.59	8.00	0.71	11.48	0.33	8.7	4.7	2.1	0.8	17.32	12.12	94
	15-37	21.40	48.94	15.85	35.21	1.44	2.54	7.91	0.51	12.15	0.44	11.2	5.8	3.1	0.9	23.21	13.35	90
	37-65+	22.42	48.30	14.27	37.43	1.44	2.56	8.01	0.44	13.67	0.27	10.3	4.2	1.8	1	18.46	9.75	94
11. Regonda	0-11	15.16	52.74	16.63	30.63	1.32	2.49	8.60	0.72	5.40	0.20	15.6	10.1	8.1	1.2	39.59	20.45	88
	11-35	26.22	50.57	17.21	32.22	1.35	2.47	8.55	0.51	6.80	0.13	13.2	9.2	5.6	1.3	37.98	14.94	77
	35-55	15.04	51.06	15.21	33.73	1.38	2.52	8.43	0.31	7.30	0.17	22.1	8.3	7.2	1.4	46.63	15.44	84
	55-75	13.86	48.86	17.01	34.13	1.40	2.59	8.61	0.25	8.50	0.18	20.2	7.2	6.5	2.0	41.94	15.49	86
	75+	12.39	47.12	13.42	39.46	1.41	2.52	8.58	0.19	6.70	0.17	23.6	8.5	6.4	2.2	43.74	14.63	93
12. Ghanpur	0-17	18.62	57.79	11.65	27.56	1.32	2.47	7.60	0.71	2.76	0.27	16.3	4.2	2.1	0.2	25.42	8.26	89
	17-45	10.17	54.23	13.52	32.25	1.34	2.58	7.49	0.54	2.94	0.10	15.0	2.3	1.0	0.2	23.42	4.26	79
	45-60	18.62	48.18	18.01	33.81	1.34	2.56	7.65	0.39	3.25	0.05	16.2	3.4	1.2	0.2	26.10	4.59	80
13. Khanapur	60-65+	29.38	40.90	19.87	39.23	1.38	2.52	7.17	0.28	3.60	0.13	24.3	3.6	1.2	0.2	32.38	3.70	90
	0-12	13.12	47.85	18.89	33.26	1.37	2.46	7.77	0.68	2.26	0.27	14.7	8.3	3.4	0.8	34.68	9.80	78
	12-30	11.36	51.54	12.92	35.54	1.42	2.57	8.44	0.52	2.84	0.27	23.1	8.1	4.2	0.8	39.32	10.68	92
	30-45	15.88	44.65	19.15	36.20	1.46	2.55	8.70	0.45	3.12	0.36	13.2	5.9	3.2	0.7	32.21	9.90	71
	45-65+	19.27	43.21	18.23	38.56	1.48	2.48	8.66	0.36	3.96	0.05	13.2	8.3	4.4	1.2	32.21	13.16	84
14. Warangal RS	0-15	16.53	54.63	15.03	30.34	1.41	2.53	7.95	0.79	5.30	0.25	19.6	14.2	2.6	0.4	39.60	6.56	93
	15-55	19.22	48.76	15.28	35.96	1.41	2.49	7.83	0.58	5.60	0.46	20.8	10.3	3.1	0.2	37.80	8.20	91
	55-72	18.88	49.63	14.16	36.21	1.45	2.51	7.88	0.46	7.30	0.24	17.7	8.8	3.8	0.4	32.70	11.62	93
	72+	19.27	48.20	12.59	39.21	1.48	2.53	7.36	0.44	7.68	1.05	23.8	6.6	2.6	0.1	39.80	6.53	83

Table 3. Soil classification of Warangal district

Location	Order	Sub-order	Great group	Subgroup	Family
1.Tadvai	Alfisols	Ustalfs	Haplustalfs	Typic haplustalfs	Fine loamy superactive isohyperthermic typic haplustalfs
2.Nallabelli	Alfisols	Ustalfs	Natrustalfs	Typic natrustalfs	Fine loamy semiactive calcareous isohyperthermic typic natrustalfs
3.Bachannapet	Alfisols	Ustalfs	Haplustalfs	Typic haplustalfs	Fine loamy superactive isohyperthermic typic haplustalfs
4.Eturunagaram	Alfisols	Ustalfs	Rhodustalfs	Typic rhodustalfs	Fine loamy super active isohyperthermic typic rhodustalfs
5.Eleti Ramayapalli	Inceptisols	Ustepts	Haplustepts	Typic haplustepts	Fine loamy superactive isohyperthermic typic haplustepts
6.Wardhannapet	Inceptisols	Ustepts	Haplustepts	Typic haplustepts	Fine loamy superactive, isohyperthermic typic haplustepts
7.Raghunathapalli	Alfisols	Ustalfs	Haplustalfs	Typic haplustalfs	Fine Loamy superactive isohyperthermic typic haplustalfs
8.Pakala	Inceptisols	Ustepts	Haplustepts	Typic haplustepts	Fine loamy superactive isohyperthermic typic haplustepts
9.Malyal	Alfisols	Ustalfs	Haplustalfs	Typic haplustalfs	Fine loamy superactive isohyperthermic typic haplustalfs
10.Duggondi	Inceptisols	Ustepts	Haplustepts	Typic haplustepts	Fine loamy semiactive calcareous isohyperthermic typic haplustepts
11.Regonda	Vertisols	Usterts	Haplusterts	Sodic haplusterts	Fine loamy superactive calcareous isohyperthermic sodic haplusterts
12.Ghanpur	Vertisols	Usterts	Haplusterts	Typic haplusterts	Fine loamy superactive isohyperthermic typic haplusterts
13.Khanapur	Vertisols	Usterts	Haplusterts	Typic haplusterts	Fine loamy active isohyperthermic typic haplusterts
14.Warangal	Vertisols	Usterts	Haplusterts	Typic haplusterts	Fine loamy superactivecalcareous Isohyperthermic typic haplusterts

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