

Assessment of morphological and physico-chemical properties of dominant soil series in Western and North-Western Zones of Tamil Nadu

ABSTRACT

A comprehensive soil analysis was conducted in the Western and North-Western regions, encompassing four districts: Coimbatore, Tiruppur, Erode and Salem in Tamil Nadu, India. Owing to differences in topography and terrain features, seven distinct soil series i.e. Somayanur, Ammapettai, Palathurai, Tulukkanur, Yethapur, Suramangalam and Salem were recognized. Seven representative pedons were examined for their morphological, physical and physico-chemical attributes. The soils range from shallow to profoundly deep, with drainage varying from well-drained to poorly drained. When moist, they exhibit a hue from light brown to dark red to dark brown and when dry light brown to light yellowish brown. Soils have textures spanning from light (sandy loam) to heavy (silty clay). The pH values ranged from 6.2 to 8.92 in water, 5.41 to 7.68 in CaCl_2 and 5.65 to 7.89 in KCl, Electrical conductivity (EC) varied between 0.11 and 0.41 dS_m^{-1} , organic carbon content was between 1.2 $\text{g}\cdot\text{kg}^{-1}$ and 9.6 $\text{g}\cdot\text{kg}^{-1}$, cation exchange capacity varies from 5.60 to 30.80 $\text{cmol}(p+)\cdot\text{kg}^{-1}$, base saturation percentage and exchangeable sodium percentage varies from 81.0 to 98.2 % and 0.37 to 3.88 %. Free calcium carbonate of soil ranges from 0 to 10 % which indicates non-calcareous to calcareous nature of soils. Implementing suitable site-specific technologies is essential for attaining sustainable productivity of the soils of Western and North-Western Zones of Tamil Nadu.

Keywords: Western, North-Western zone, morphological parameters, texture, Physico-Chemical parameter

1. INTRODUCTION

Soil is one of the most important natural resources in nature, and preserving its health is crucial to supplying the growing demand for food, fibre, fuel, and fodder. In order to address some of the specific soil difficulties facing the ecosystem, soil characterisation provides the fundamental knowledge necessary to create useful soil categorization systems and quantify soil fertility. Soil Characterization is a part of study of soil properties in which soils are characterized and classified based on their properties in a specific area. Soil characterization is done by analysing and comparing the properties of soil from one to another area of study. As the soil forming processes changes it leads to changes in soil properties in different area or agro-ecological zones so that it's dynamic in nature.

Knowledge of soil capabilities and limitations is critical for scientific soil management. A thorough analysis of the soils is absolutely necessary before adopting effective management practices and corrective solutions for different soils. A soil test involves analysing a soil sample to ascertain the amount of nutrients and contaminants present as well as other soil properties including salinity, acidity, alkalinity, and level of calcareousness. Since each crop's growth is mostly influenced by the aforementioned characteristics. Typically, tests are carried out to determine the soil's anticipated potentials, especially in terms of crop growth.

This study specifically conducted to assess the potentials and constraints of seven major soil series of four districts of Western and North-Western Tamil Nadu and suggest proper management practices for better crop growth.

2. MATERIAL AND METHODS

2.1 Study area

This study covers soil series comes under Western and North-Western zones of Tamil Nadu and covers Coimbatore, Tiruppur, Erode and Salem districts. Geographical distribution of study areas are given in Table 1.

Table 1: Geographical Distribution of study area

District	Village	Block	Taluk	Latitude	Longitude	Soil series
Coimbatore	Samichettipalayam*	P.N.Palayam	Coimbatore North	11 ⁰ 10'17. 3" N	76 ⁰ 56'09.0 "E	Somayanur
Erode	Ammapettai	Ammapet	Bhavani	11 ⁰ 37'12. 3" N	77 ⁰ 44' 09.4"E	Ammapettai
Salem	Yethapur	Pethanaickenpalayam	Attur	11 ⁰ 39'06. 7"N	78 ⁰ 28'14.2 "E	Yethapur
	Pallipatty	Ayothiya Pattinam	Salem	11 ⁰ 41'46. 8"N	78 ⁰ 14'22.6 "E	Salem
	Old Suramangalam	Salem	Salem	11 ⁰ 40' 02.1" N	78 ⁰ 6' 30.4" E	Suramangalam
Tiruppur	Manakadu	Dharapuram	Dharapuram	10 ⁰ 42'19. 8" N	77 ⁰ 32'56.8 " E	Tulukkanur
	Ragalpari	Udumalaipettai West	Udumalaipettai	10 ⁰ 34'54. 6"N	77 ⁰ 10'56.4 "E	Palathurai

2.2 Climate

Southwest monsoon brings 400mm of rain to the North Western zone, which is located between 200 and 600 metres above sea level. The average maximum temperature is between 30°C and 37°C, and the average minimum temperature is between 19°C and 25.5°C. In this zone, the growing season lasts 180 days. In this region, a variety of crops

including finger millet, sorghum, peanuts, horse gram, sugarcane, cotton, tapioca, and vegetables are produced extensively (Soil and Land Use Survey of India,2022)

Mean annual precipitation is 715 mm within 45 rainy days falls on the Western zone, which has a similar height range, with 49 percent of that total falling during the northeast monsoon season. In January and April, respectively, the mean minimum and maximum temperature is 30°C and 35°C. While sorghum, groundnut, tiny millets, pulses, cotton, sorghum, bengal gram, and sunflower are grown as rainfed crops, rice, sugarcane, and banana are grown in wetland conditions (Soil and Land Use Survey of India , 2022)

Table 2 :Climatic and vegetation Data of Western and North-Western Zones

Agro-Climatic Zone	Climatic attributes				Crops Grown	Natural Vegetation
	Max Temperature	Min Temperature	Altitude	Rainfall		
North Western Zone	30°C to 37°C	19°C to 25.5°C	200 to 600 metres above sea level	400mm (mean annual) With 27 rainy days	finger millet, sorghum, peanuts, horse gram, sugarcane, cotton, tapioca, and vegetables etc	Coconut, Mango, Teak, Banana, Tamarind, Neem, Moringa, Sapota
Western Zone	35°C	30°C	200 to 600 metres above sea level	715 mm (mean annual) with 45 rainy days	sorghum, groundnut, tiny millets, pulses, cotton, sorghum, bengal gram, sunflower etc	Neem, Palm, Teak, Prosopios, Tamarind, Errukku

Kavitha and Ravichandran(2020) , Soil and Land Use Survey of India (2022)

2.3 Methodology

According to the soil survey handbook, seven pedons were excavated with dimensions of 2 meters in length and 1 meter in width, with a depth ranging between 1.5 to 2 meters. The specific depth was determined by the presence of the parent rock in the underlying layers. Horizon wise samples were collected, air-dried, sieved through a 2 mm sieve, and weighted separately for the amount of gravel present. The samples were analyzed for physical parameters like soil texture, Bulk Density, Particle Density, Colour, porosity, Physico-chemical properties like pH, EC , CEC, Exchangeable Cations, free CaCO₃ were determined.(Table 3)

Table 3 : Parameter analysed, techniques adopted and reference for soil sample analysis

Parameters	Methods adopted	References	
Physical parameters			
Bulk Density	Cylinder Method	Tan (1998)	
Particle Density			
Porosity			
Colour	Munsell Colour Chart	Soil Survey Staff (1970)	
Texture	Robinson Pipette Method	Piper (1966)	
Gravel content	After wetting the horizon sample as such, wet seiving through a 2 mm sieve	Govindarajan and Koppa (1975)	
Chemical Parameters			
pH	Water(1:2.5)	pH Meter	Jackson(1973)
	0.15M		
	CaCl ₂ (1:2.5)		
	1 M KCl(1:2.5)		
Electrical Conductivity	Electrical Conductivity Meter	Jackson(1973)	
Organic Carbon	Chromic acid digestion	Walkley and Black(1934)	
Free CaCO ₃	Rapid Titration Method	Piper (1966)	
Cation Exchange Capacity	Neutral Normal Ammonium acetate method(soil pH <8.2)	Schollenberger and Dreibelbis, 1930	
	Sodium Acetate method(Soil pH>8.2)	Schollenberger and Dreibelbis(1930)	
Exchangeable Ca and Mg	Versenate titration	Jackson(1973)	
Exchangeable K and Na	Flame photometry,Sanford and English(1949)	Sanford and English(1949)	
Base Saturation %	Calculated from CEC and exch. cations		
Effective Sodium %	Calculated from CEC and exch. Sodium		
interpretive categories and soil taxonomy			

Detail soil survey	Soil Survey Staff (2014)
Pedon description and sample collection	Soil Survey Staff (2014)
Interpretative groupings	Soil Survey Staff (2014)
Soil Taxonomy	Soil Survey Staff (2014)

3. RESULTS AND DISCUSSION

Seven dominant soil series present in Western and North western zone of Tamil Nadu viz., Somayanur series (82228 ha), the Ammapettai series (59508 ha), the Palathurai series (116878 ha), the Tulukkanur series (422121 ha), the Yethapur series (41300 ha), the Suramangalam series (67849 ha), and the Salem series (66255 ha) were identified for assessing the morphological (Table 4), physico-chemical properties (Table 5).

3.1 Differentiation of Horizons:

Pedon 1 belongs to Somayanur series has 6 distinct horizons, Pedon 2, Ammapettai series with 4 horizons, Pedon 3, Palathurai series has 4 horizons, Pedon 4 comes under Tulukkanur series having 4 horizons, Pedon 5 is coming under Yethapur series with 7 horizons, Pedon 6 and 7 belong to suramangalam and salem series having 5 and 4 horizons respectively .

3.2 Morphological Properties:

Table 4 lists the physical along with the morphological properties of soils. The depth of the soil varies with pedon, which is moderately deep (50-100 cm) (pedon-2,3,4,6,7), to deep (>100 cm) (Pedon-1,5).

The moist soil colour of the Somayanur series varies from 10 YR 3/3 in surface to 7.5 YR 3/4 in subsurface soil, whereas dry colour varies from 10 YR 4/3 in surface to 7.5 YR 5/4 in subsurface soil. In Ammapettai soil series, colour varies from 10 YR 3/1 to 10 YR 6/3 when moist and 10 YR 3/2 to 10 YR 7/2 when dry. Soils of Palathurai series found have the soil colour varies from 5 YR 3/4 to 7.5 YR 4/3 (Moist) and from 5 YR 4/4 to 7.5 YR 5/3 in dry. Tulukkanur soil series are found with the colour of 5 YR 4/6 to 5 YR 4/4 (Moist) and 5 YR 4/4 to 7.5 YR 5/4 when dry . The Yethapur soils are having moist soil colour of 2.5 YR 3/4 to 5 YR 4/6 and dry soil colour of 2.5 YR 3/6 to 5 YR 5/8. The soils of Suramangalam series found to have the soil colour of 10 YR 3/1 to 10 YR 4/3 (Moist) and 10 YR 4/2 to 10 YR 5/3 when dry. The colour of the Salem soil series found between 7.5 YR 3/4 to 5 YR 3/4 when moist and 7.5 YR 4/4 to 5 YR 4/3 when dry. According to earlier research by Mohekar and Chella (2000), the nature and kind of soil formation processes are responsible for the variance in soil hues.

Somayanur soil series found to have the texture of sandy clay loam in surface to sandy loam in subsurface, moderate to well drained, angular blocky to sub-angular blocky in structure with slight to violent effervescence (surface horizon gives moderate effervescence compared to next two horizon with slight effervescence). These soils are having very gentle slope of 1-3%. Soils of Ammapettai series are calcareous, clay loam (surface) to sandy loam (subsurface) in texture with moderate to violent effervescence that increases with depth, poor to moderately drained, subangular blocky in structure, Soils of Palathurai series are calcareous, well-drained, sandy loam(surface) to sandy (subsurface) in texture with low to moderate effervescence. Soils are having very gentle slope of 0-1%. The structure is mostly sub-angular blocky. The calcareous, red insitu soils of the Tulukkanur series are

found on top of bedding composed of calcareous material combined with weathered Quartz-felspathic gneiss. The texture of the soil is Sandy Loam (surface) to Sandy (subsurface) and poor to moderately drained, shows slight to moderate effervescence, which increases with depth. The structure of these soils varies from weak single grained to subangular blocky. Yethapur soil series are non calcareous, well drained, red soil with sandy clay loam (surface) to loamy Sand (subsurface) in texture with no to slight effervescence with depth. The structure is subangular blocky with gravels of different sizes. Slope varies from 2-5 % which results in moderate erosion. The soils of Suramangalam series are calcareous, poorly drained soils with level (0-1%) slope and slight erosion. The texture of the soils varies from sandy clay to loamy sand texture with silt rich silty clay in middle horizons.. With increasing depth this soil gives slight to strong effervescence with 1:1 HCl. Soil structure is subangular blocky in the upper layers to massive in the lower layer. Salem series consists of weathered gneissic parent material-derived soil which is moderately drained , non-calcareous and having Fe mottles in lower layers. The texture varies from sandy clay loam(surface) to sandy(subsurface). The structure is subangular blocky in the upper layers and hard massive in the lower layers.

3.3 Physical Properties:

Table 4 list the complete soil's physical characteristics. According to information on particle size distribution, the clay concentration ranged from 6.12 to 41.48 percent among all 7 pedons. In the subsoils of Pedon 6, and Pedon 7, more clay was found. Except for pedons 3 and 7, all of the pedons' silt content displayed an uneven tendency with varying depth. This may be caused by variations in the way soil forms and the effects of different weathering processes. Soils of Pedon 6 had the highest silt concentration in second and third horizon, which may be related to greater water changes from various sources at various times (Srinivasan *et al.*,2015). Pedon 2 and Pedon 6 soils had the highest sand variation, with sand contributions ranging from 16.82 to 88.79 percent. Sand contribution is highest in classes of textures, which might be attributed to the Granite-gneiss's parent rock being siliceous. Sandy soils have poor nutrient retention and water-holding capacity, which restricts the amount of moisture available to the crop. In order to increase agricultural output, these soils must be carefully maintained. The soils' bulk densities ranged from 1.05 to 1.33 Mg m⁻³. In pedons 6 and 7, the gradual rise in bulk density along with depth was seen. It might be caused by an increase in coarse soil fragments. The soils ranged in particle density from 1.81 to 3.33 Mg m⁻³ and in porosity from 34.8 to 78%, however, the bulk of samples have porosity of around 50%, which has an erratic distribution pattern with depth.

Table 4 : Morphological and physical characteristics of 7 soil series in the study area

Depth (Cm)	Horizon	Colour		Mechanical Analysis(%)			Texture	BD (g.c m ⁻³)	PD (g.cm ⁻³)	Effervescence
		Moist	Dry	Sand	Silt	Clay				
Pedon 1 : Somayanur Series										
0-18	Ap	10 YR 3/3	10 YR 4/3	56.45	14.28	29.23	Sandy Clay Loam	1.05	2.64	medium
18-40	Bt	5 YR 3/4	2.5 YR 3/4	60.28	4.47	35.24	Sandy Clay	1.05	2.68	slight
40-62	B1	2.5 YR 2.5/3	2.5 YR 2.5/4	56.62	10.23	33.12	Sandy Clay Loam	1.11	2.59	slight
62-81	B2	5 YR 3/4	2.5 YR 3/4	67.88	12.18	19.90	Sandy Loam	1.11	2.28	medium
81-110	B3	5 YR 3/3	5 YR 3/4	70.00	11.74	18.21	Sandy Loam	1.17	3.33	violent
110-130	Ck	7.5 YR 3/4	7.5 YR 5/4	69.51	11.56	18.88	Sandy Loam	1.11	2.50	violent
Pedon 2 : Ammapettai Series										
0-14	Ap	10 YR 3/1	10 YR 3/2	44.23	19.24	36.48	Clay Loam	1.33	2.65	medium
14-36	A1	10 YR 3/2	10 YR 4/2	50.98	12.60	36.42	Sandy Clay	1.17	2.50	medium
36-74	Bk	10 YR 4/3	10 YR 5/3	62.21	8.54	29.23	Sandy Clay Loam	1.18	2.86	violent
74-110	Ck	10 YR 6/3	10 YR 7/2	70.02	10.76	19.17	Sandy Loam	1.25	2.50	violent
Pedon 3 : Palathurai Series										
0-18	Ap	5 YR 3/4	5 YR 4/4	61.23	21.57	17.18	Sandy Loam	1.05	2.22	slight
18-40	B1	5 YR 3/3	5 YR 4/4	64.41	15.79	19.78	Sandy Loam	1.17	2.85	slight
40-82	B2	5 YR 3/4	5 YR 4/3	70.13	12.74	17.12	Sandy Loam	1.25	3.33	medium
82-88	Ck	7.5 YR	7.5 YR	88.7	5.00	6.21	Sand	1.17	3.33	medium

		4/3	5/3	9						
Pedon 4 : Tulukkanur Series										
0-15	A	5 YR 4/6	5 YR 4/4	63 .0 2	16. 95	19. 98	Sandy Loam	1.33	2.85	slight
15-30	B1	5 YR 3/3	5 YR 4/4	82 .8 1	4.7 7	12. 41	Loamy sand	1.18	3.33	medium
30-60	B2	5 YR 3/4	5 YR 4/4	83 .0 7	4.5 7	12. 34	Loamy sand	1.25	2.86	medium
60-90	Ck	5 YR 4/4	7.5 YR 5/4	88 .3 8	5.3 4	6.2 5	sand	1.25	3.33	violent
Pedon 5 : Yethapur Series										
0-20	Ap	2.5 YR 3/4	2.5 YR 3/6	59 .1 9	9.8 2	30. 89	Sandy Clay Loam	1.18	2.61	nil
20-40	Bt1	2.4 R 3/4	2.5 YR 3/4	60 .0 5	4.4 0	35. 45	Sandy Clay	1.05	2.22	nil
40-62	Bt2	2.5 YR 2.5/3	2.5 YR 3/4	57 .2 8	4.5 6	38. 64	Sandy Clay	1.11	2.85	Very slight
62-89	B3	2.5 YR 3/4	2.5 YR 3/6	65 .3 6	5.7 4	28. 87	Sandy Clay Loam	1.18	2.85	Very slight
89-121	B4	2.5 YR 3/6	2.5 YR 4/4	69 .9 6	8.7 4	21. 28	Sandy Clay Loam	1.18	2.85	slight
121-150	BC1	2.5 YR 3/6	2.5 YR 4/8	83 .7 8	5.7 6	10. 46	Loamy Sand	1.25	3.33	slight
150-180	BC2	5 YR 4/6	5 YR 5/8	84 .2 2	6.5 4	9.2 4	Loamy Sand	1.25	3.33	slight
Pedon 6 : Suramangalam Series										
0-10	Ap	10 YR 3/1	10YR 4/2	60 .0 0	4.7 9	35. 16	Sandy Clay	1.05	2.22	slight
10 to 20	Bt1	10 YR 3/1	10YR 3/2	17 .4 6	40. 56	41. 48	Silty Clay	1.11	2.22	slight
20-68	B2	10 YR 3/4	10 YR 4/3	16 .8 2	42. 10	40. 98	Silty Clay	1.18	2.85	medium
68-100	Bk3	10YR 4/3	10 YR 5/3	86 .9 6	2.0 5	10. 96	Loamy Sand	1.18	2.85	violent

Pedon 7 : Salem Series										
0-13	Ap	7.5 YR 3/4	7.5YR 4/4	59 .3 4	18. 30	22. 34	Sandy Clay Loam	1.05	2	Nil
13-40	Bt	5 YR 3/3	5 YR 4/4	61 .2 1	15. 72	26. 67	Sandy Clay Loam	1.18	3.33	Nil
40-65	Bc	5 YR 3/4	5 YR 4/4	64 .6 9	10. 63	23. 87	Sandy Clay Loam	1.18	2.85	Nil
65-80	C	5 YR 3/4	5 YR 4/3	88 .2 5	5.6 3	6.1 2	Sand	1.18	2.22	Very slight

3.4 Chemical and Physico-Chemical Properties:

Soil pH found to be slightly acidic (pedon 5,7) to moderately alkaline (pedon 1,2,3,4,5,6), with pH varying from 6.2 to 8.92 in water, 5.41 to 7.68 in CaCl₂ and 5.65 to 7.89 in KCl. The less pH value in CaCl₂ and KCl due to the exchange of H⁺ ion by Ca²⁺ and K⁺ ion of solution results more H⁺ ion concentration in solution which lowers pH value of solution compared to water. This extensive variation in pH among all soil series was attributed to the properties of the parent material, capacity of leaching, free CaCO₃ as well as exchangeable cations. The highest pH has been shown in Suramangalam series (pedon 6) and the lowest in Salem Series (pedon 7). The electrical conductivity (EC) measurements varied between 0.11 (pedon 5) and 0.41 (pedon 6) dS m⁻¹, indicating that the soils were not saline. Such observations align with the studies conducted by Nayak *et al.* (2000) and Vijayakumar *et al.* (1994). The organic carbon content was found to be minimal in pedon 2 at 1.2 g.kg⁻¹ while pedon 1 exhibited a higher content of 9.6 g.kg⁻¹. Organic carbon content demonstrated a reduction as depth increased across all the pedons where as irregular pattern was recorded in sugarcane growing soils (Sellamuthu *et al.*, 2001) The organic carbon content in surface soils was observed to be greater than in sub-surface soils. This can be attributed to the accumulation of litter, crop residues, as well as the application of manure and fertilizers to the topsoil layers. Pedons 1,2,3,4,6 are calcareous in nature and free Calcium Carbonate content varies from 0.00 to 10.00% and pedon 5 and 7 are slightly calcareous to non calcareous in nature having free Calcium Carbonate ranging from 0 to 1.87%. The cation exchange capacity (CEC) of pedon 7 was found to be 5.60 cmol (p+) kg⁻¹, whereas pedon 6 exhibited a higher value of 30.80 cmol (p+) kg⁻¹. Such differences can be ascribed to the nature and amount of clay and organic material present. The cation exchange capacity (CEC) of pedons 1,2, 3,5,6 and 7 exhibited an initial increase followed by a decrease as the depth progressed except pedon 4. In all the pedons, the sequence of abundance for exchangeable cations was as follows: Ca²⁺> Mg²⁺>K⁺>Na⁺. The high base saturation in these soils ranging from 81.0 to 98.2 % can be attributed to the exchangeable Ca²⁺ and Mg²⁺. Notably, the exchangeable sodium percentage (ESP) in all the pedons was found to be significantly below the crucial threshold of 15%.

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Table 5 : Physico-Chemical and Exchangable properties of soil Series in the study area

Depth	Horizon	pH (1:2.5)			EC (dS. m ⁻¹)	OC (g. Kg ⁻¹)	Free Ca CO ₃ (%)	Exch. Bases (C mol Kg ⁻¹)					CEC (C mol Kg ⁻¹)	BS P (%)	ESP (%)
		Water	Ca Cl ₂	K Cl				Ca	Mg	K	Na	Total			
Pedon 1 : Somayanur Series															
0-18	Ap	7.25	6.68	7.01	0.24	9.6	2.50	16.01	5.00	0.42	0.01	21.53	22.40	96.1	0.45
18-40	Bt	7.31	6.71	6.95	0.22	5.7	1.25	18.89	7.31	0.82	0.01	27.23	30.20	90.2	0.69
40-62	B1	7.28	6.77	6.99	0.19	7.4	1.25	17.98	6.09	0.82	0.02	24.97	27.00	92.5	0.81
62-81	B2	7.77	7.13	7.24	0.20	3.9	3.75	11.60	5.01	0.56	0.02	17.49	18.80	93.0	1.69
81-110	B3	7.98	7.41	7.72	0.19	2.7	5.75	13.05	2.33	0.41	0.03	15.91	17.60	90.4	1.29
110-130	Ck	8.02	7.53	7.88	0.26	1.5	7.25	11.02	4.10	0.22	0.02	15.62	17.00	91.9	1.29
Pedon 2 : Ammapettai Series															
0-14	Ap	7.55	6.84	6.91	0.37	8.7	3.75	15.54	8.50	0.41	0.08	24.63	27.80	88.6	0.63
14-36	A1c	7.81	6.93	7.00	0.29	4.5	5.00	16.12	7.91	0.42	0.07	24.62	28.40	86.7	0.60
36-74	B2c	7.83	7.01	6.98	0.38	3.6	6.25	14.16	7.05	0.44	0.07	21.82	24.90	87.6	0.70
74-110	C	8.02	7.12	7.22	0.24	1.2	10.00	12.23	4.71	0.43	0.04	17.50	21.60	81.0	0.65
Pedon 3 : Palathurai series															
0-18	Ap	7.23	6.51	6.68	0.16	7.2	2.50	10.91	4.00	0.44	0.00	15.48	18.20	85.0	0.4

				9					8	1	7					0
18-40	B1	7.38	6.71	6.85	0.14	6.9	2.50	11.26	5.81	0.44	0.08	17.59	20.20	87.1	0.37	
40-82	B2	7.45	6.79	6.99	0.17	3.3	3.75	11.02	6.07	0.43	0.11	17.63	18.00	97.9	0.60	
82-88	Ck	7.95	7.01	7.27	0.14	3.0	6.25	6.67	3.04	0.36	0.10	10.16	10.40	97.7	0.94	
Pedon 4 : Tulukkanur Series																
0-15	A	7.55	6.98	7.13	0.16	6.0	1.25	11.01	5.20	0.36	0.08	16.95	18.80	90.2	2.01	
15-30	B1	7.78	7.01	7.24	0.16	5.4	2.50	6.12	2.93	0.35	0.04	9.81	11.20	87.6	3.72	
30-60	B2	7.82	7.11	7.14	0.25	5.1	5.00	6.45	3.00	0.34	0.04	10.22	11.80	86.6	3.73	
60-90	Ck	7.84	7.09	7.21	0.23	2.4	8.25	5.67	2.13	0.34	0.06	8.49	9.20	92.3	3.88	
Pedon 5 : Yethapur Series																
0-20	Ap	7.63	6.59	7.18	0.15	9.1	0.25	12.65	5.32	1.11	0.11	19.40	19.80	98.0	0.58	
20-40	Bt1	7.81	6.43	7.29	0.10	7.8	0.25	12.75	6.90	1.26	0.13	21.04	23.20	90.7	0.57	
40-62	Bt2	7.03	6.17	6.89	0.18	7.2	0.45	14.04	7.91	1.19	0.11	23.27	25.30	92.0	0.49	
62-89	B3	6.73	6.01	6.41	0.19	5.4	0.62	11.05	5.15	0.86	0.11	17.17	18.40	93.3	0.60	
89-121	B4	6.87	6.21	6.48	0.21	3.3	1.25	9.55	5.35	0.54	0.11	15.54	16.40	94.8	0.65	
121-150	BC1	6.57	5.99	6.23	0.20	3.0	1.25	6.90	3.00	0.39	0.02	10.91	11.60	94.0	1.05	
150-180	BC2	6.2	5.92	5.98	0.20	1.8	1.87	6.80	3.04	0.38	0.03	10.35	11.00	94.1	1.17	
Pedon 6 : Suramangalam, Series																

0-10	Ap	7.4 9	6.9 6	7. 1 7	0.20	7.5	1.2 5	13. 80	6. 2 5	0. 7 5	0. 0 9	20. 88	23. 60	88. 5	0. 3 8
10 - 20	Bt1	8.0 2	7.2 1	7. 3 6	0.20	7.8	1.2 5	16. 50	8. 4 5	0. 4 1	0. 1 1	25. 56	30. 80	83. 0	0. 3 7
20- 68	B2	8.3 3	7.4 7	7. 5 8	0.41	6.6	3.5 0	17. 05	8. 8 0	0. 3 3	0. 2 5	26. 42	28. 80	91. 7	0. 8 5
68- 100	Bk 3	8.9 2	7.6 8	7. 8 1	0.28	1.8	7.0 0	8.6 0	3. 8 0	0. 2 2	0. 1 9	12. 81	13. 20	97. 1	1. 4 5
Pedon 7 : Salem Series															
0-13	Ap	6.5 3	5.4 1	5. 6 5	0.28	9.9	0.0 0	10. 90	5. 5 0	0. 5 7	0. 0 9	17. 06	17. 40	98. 1	0. 5 1
13- 40	Bt	6.6 7	5.5 8	5. 8 1	0.22	8.4	0.2 5	13. 80	6. 2 5	0. 2 0	0. 0 8	20. 33	22. 19	91. 6	0. 3 7
40- 65	Bc	6.6 1	5.6 6	5. 8 9	0.16	4.5	0.6 2	11. 01	5. 2 0	0. 2 8	0. 1 0	16. 59	18. 20	91. 1	0. 5 3
65- 80	C	6.6 9	5.7 8	5. 9 9	0.24	2.7	0.6 2	3.9 5	1. 2 0	0. 2 2	0. 1 4	5.5 0	5.6 0	98. 2	2. 4 2

Comment [H1]: You will need to arrange this table so that the numbers can fit in the boxes. Either you put the table in landscape mode

4. CONCLUSION

Soils of Western and North-Western zones of Tamil Nadu specifically 4 districts under study having slightly acidic to moderately alkaline pH, high to medium organic carbon, low to medium CEC, high base saturation percentage. Most of the soils are having level land to gentle slope and having no to slight erosion. All the pedons found to have the sequence of abundance for exchangeable cations in the order of $Ca^{2+} > Mg^{2+} > K^+ > Na^+$ with high base saturation. Notably, the exchangeable sodium percentage (ESP) in all the pedons was found to be significantly below the crucial threshold of 15%. Calcareousness, nutrient deficiency and drainage is the common constraints of those soils. Implementing suitable site-specific technologies is essential for attaining sustainable productivity.

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