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Pedogenesis and Soil Resources Investigation of Major Soil Series of Ramanathapuram District, Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Detailed soil survey (DSS) was carried out in drought prone district of Ramanathapuram during April 2023 to find out the weathering pattern of the soil. Totally 4 soil profiles was excavated from Mandabam, Pudukudi, Paramakudi and Muthukulathur areas and studied for soil morphological characteristics. Soil samples was collected in each horizon and analysed for soil physical characteristics, chemical constituents and weathering indices by using the standard procedures.

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The results showed that soil colour were ranged from dark yellowish brown to dark grey with single grain to angular to sub-angular blocky structure. Soil consistency ranged from loose, hard to very hard, firm to very firm, sticky to very sticky, plastic to very plastic in dry and moist condition. The bulk density, hydraulic conductivity, infiltration rate ranged from 1.19 to 1.31 Mg m^{-3}, 0.01 to 8 cm hr^{-1} and 0.02 to 8 cm/hr. The variations in molar ratios and weathering intensity were seen in all the profiles. The weathering pattern of the soils from different areas of the coastal district was identified.

Keywords: Pedological investigation; detailed soil survey; chemical analysis; weathering.

1. INTRODUCTION

Soil resource inventory determines the land utilization pattern in an area by characterizing it in different ways. Utilizing scientific principles in the management of soil resources is imperative to preserve current soil productivity levels and mitigate soil degradation [1]. Detailed Soil survey results in gathering the complete information about a particular area/region/location [2].

Coastal ecosystem degradation is brought about by natural calamities like tropical cyclones, climate fluctuations, soil erosion, tidal surges, sea level rise, sea water intrusions ,flooding and more [3]. All these disasters impact on agriculture, biodiversity, freshwater sources, and their associated resources, significantly deteriorating the soil health and quality particularly in semi-arid regions of the coastal areas [4]. Soil physical and chemical degradation create salinity ,alkalinity and acidity in the coastal areas which in turn affect the productivity of soil and crop production.

Salinity is a major threat in the coastal areas due to the sea water intrusion, irrigating poor quality irrigation water, management practices [5], geographical landscape, nature of parent material, high evapotranspiration rate, climatic conditions of the environment, natural events and at sometimes salinity may also leads to crop desertification [6].

Salt affects the crop growth by creating osmotic stress and interrupts the crop physiology particularly in the root zone, which can influence on germination rates, growth stages, and ultimately affect the crop yield. Soil properties decide the soil health and quality and indirectly affect crop productivity. In coastal saline soil, the fertility and agricultural production will be deteriorated to an extreme extent [7]. Soil morphology will clearly describes the overall idea about the soil development in the coatal areas.[8].

Ramanathapuram is the drought prone district lies between Latitude 9º40' N and Longitude 78º 70' E surrounded by Sivagangai, Gulf of Munnar, Palk strait, Virudhunagar and Thoothukudi with longest coast line for about 236.8 km. The physiographic units of the district was bounded mostly with alluvial plains, coastal plain and buried pediments within a small area. The average rainfall of the district is 823 mm including North East, South West monsoon, summer and winter, contributing 60, 17, 14 and 9 % respectively [9]. The district was consecutively affected by drought during 2015 to 2018 due to very low rainfall during South West and North East monsoon period. The district has sandy soil, black soil, and red loamy and lateritic soils.

Ramanathapuram district is the semi-arid region with major constraints such as low rainfall pattern, salinity, sodicity, alkalinity and low availability of soil nutrients for agricultural crop production [9]. The district is affected by inland salinity due to the marine sediments accumulation and sea water intrusion [10]. During 2006, tsunami hit the Ramanathapuram district and frequent cyclones passes through the area, made the soil as an unproductive one.

In this context an attempt was made to study the properties and weathering pattern of major soil series of Ramanathapuram district during 2023. Soil samples were collected from major soil profiles and analyzed for its properties, classified up to family level. Finally interpretative groupings were worked out and suitable management practices are arrived to revamp the land in to a productive one.

2. MATERIALS AND METHODS

2.1 Detailed Soil Survey

Detailed soil survey was carried out using cadastral/village map with scale of 1:5000. Field traverse was done in the study areas of *Mandabam, Pudukudi, Paramakudi and Muthukulathur* blocks and fixed for soil profile excavation using geo-coordinates.

2.2 Soil Morphological Property

Soil morphological properties were studied in the profile by adopting the standard procedure and guidelines [11]. Soil horizon were demarcated , soil colour was noted based on Munsell colour chart, soil texture by feel method, structure, consistency, roots, pores were observed in the profile itself . The presence of calcium carbonate was tested with 0.1 N HCl . Apart from morphological property, site characteristics were also observed. Soil sample were collected from each soil horizon and processed for further laboratory analysis.

2.3 Soil Physical property

Soil texture was determined by using International pipette method [12]. Soil Bulk density, hydraulic conductivity infiltration rate was determined by using cylindrical method, core sampler method and double ring infiltrometer [13].

2.4 Soil Chemical Constituents

Soil chemical constituents viz., acid insoluble, silica, sesquioxides, aluminum and iron oxides were determined by HCl acid extract [12]. The oxides of sodium and potassium was determined by using flame photometer [14]. The oxides of calcium and magnesium was analysed from sesquioxide free acid extract using Versanate titration method [15]. The molar ratios were calculated based on the analyzed chemical constituents.

2.5. Weathering Index

Weathering Index Parker (WIP), Product Index of Alteration (PIA) and Chemical Index of Alteration (CIA) were worked out based on chemical constituents to find out the weathering pattern.

$$\text{WIP} = \frac{2\text{Na}_2O}{0.35} + \frac{MgO}{0.9} + \frac{2\text{K}_2O}{0.25} + \frac{CaO}{0.7} \text{ X } 100$$

$$\text{CIA} = \frac{\text{Al}_2O_3}{(\text{Al}_2O_3 + CaO + \text{Na}_2O + \text{K}_2O)} \text{ X } 100$$

$$\text{PIA} = \frac{\text{Al}_2O_3 - \text{K}_2O}{(\text{Al}_2O_3 + CaO + \text{Na}_2O - \text{K}_2O)} \text{ X } 100$$

3. RESULTS AND DISCUSSION

The results on morphological properties, physical properties, chemical constituents and weathering Indices of major four soil series of Ramanathapuram District are presented below.

3.1 Soil Morphological Characteristics

The results on soil morphological properties are presented in Table 1 and Fig. 1.

3.1.1 Soil colour

The colour for Mandabam soil series was dark yellowish brown (10YR4/4) in the surface and had yellowish brown (10 YR 6/3) to pale brown (10YR 6/3) in subsurface horizons. The occurrence of brown to dark yellowish brown colour soil might be due to presence of high silica, iron and aluminium oxides and granitic gneiss parent material. The same was also observed by Anjali and Hebbara [16] in coastal sandy soil of Semi arid region of Karnataka.

The Pudukudi soil series was dark yellowish brown (10 YR 3/6) in the surface and strong brown (7.5 YR 4/4) to brown (10 YR 4/3) colour in the subsurface horizons.The Paramakudi soil series was brown (10 YR 4/3) colour in surface and brown to yellowish brown in sub-surface horizons. Anandur series was noted with dark greyish brown (10 YR 4/2) in surface and subsurface horizons.The dark coloured nature of soil was due to its minerological composition and gneiss parent material . Similar results was also reported by Onweremadu and Oti [17] in the coastal areas of southern Nigeria and Dhanasekaran Pandian and Vijaya Kumar [9] in the semi-arid regions of Ramanathapuram district.

3.1.2 Soil texture

The Mandabam soil series had loamy sand in all the horizons. The coarse texturedness of soil might be due to the coastal deposition of sand by water [18]. The same pattern of texture distribution was also noted by Dhanasekara pandian and Vijay Kumar [9] in Velipattinam , Ramanathapuram district .

Table 1. Morphological characteristics of four major soil series of Ramanathapuram District

Depth (cm)	Horizon	Texture	Colour (dry)	Structure	Consistency				Bnd	Roots	Cutans
					D	M	sti	Pls			
Pedon 1 – Mandabam series											
0-13	C_1	Ls	10 YR 4/4	0 c sg	l	l	so	po	c w	m m i	-
14-31	C_2	Ls	10 YR 6/4	0 c sg	l	l	so	po	c s	c ct	-
32-48	C_3	Ls	10 YR 5/6	0 c sg	l	l	so	po	c s	f c t	-
48-92	C_4	Ls	10 YR 4/6	0 c sg	l	l	so	po	c s	-	-
93+	C_5	Coastal alluvium									
Pedon 2 – Pudukudi											
0-35	Ap1	Sic	10 YR 4/4	3 m abk	h	fi	Vs	vs	g w	f f i	-
36-53	Ap2	Sic	10 YR 4/6	3 m abk	h	fi	Vs	vs	g w	-	-
53-77	Bw1	Sil	7.5 YR4/6	1 m sbk	h	fr	Ss	sp	g w	-	-
78-97	Bw2	Sl	7.5 YR4/6	1 f sg	l	l	Ns	np	g w	-	-
98-125	Bw3	Ls	7.5 YR4/6	0 c sg	l	l	Ns	np	c w	-	-
125+	C	River alluvium									
Pedon 3 – Paramakudi											
0-13	Ap	Sc	10 YR 4/3	3 c abk	vh	vfi	Vs	vp	g w	f vf i	-
14-28	AB	Gsc	10 YR 4/3	3 vc abk	vh	vfi	Vs	vp	g w	-	-
29-47	Bt1	Sic	10 YR 4/3	3 f abk	vh	vfi	Vs	vp	g w	-	-
47-68	Bt2	Sc	10 YR 4/4	3 vc abk	vh	vfi	Vs	vp	g w	-	-
69-90	Bt3	Sc	10 YR 4/4	3 vc abk	vh	vfi	Vs	vp	g w	-	-
92+	C	Calcareous gneiss									
Pedon 4 – Anandur											
0-45	Ap	Scl	10 YR 4/2	2 m abk	h	fi	Vs	vp	g w	m vf i	-
46-104	Bw1	Cl	10 YR 4/2	3 m abk	h	fi	Vs	vp	g w	m c i	-
105-122	BC	Cl	7.5 YR 4/2	3 m abk	h	fi	Vs	vp	a s	-	-
92+	C	Weathered calcareous gneiss									

*Abbrevations: i). Texture: S- sand, LS- loamy sand, SL-sandy loam, L-loam, SiL-siltyloam,Si-silt, ScL- sandy clay loam ,CL- clay: loam, SiCL- silty clay loam, SC- sandy clay, SiC- silty clay loam, .C- clay. ii).Grade: 0-structureless, 1-weak, 2-moderate, 3-strong; Size; vf- very fine, f-fine, m-medium, c-coarse, vc-very coarse,iii). Type; gr-granular, cr-crumb, clr-columnar, pr-prismatic, pl-platy, abk- angular blocky, sbk- subangular blocky, sg- single grain, m-massive, c-cloddy, iv). Dry; l-loose, s-soft, sh-slightly hard, h-hard, vh-very hard, eh-extremely hard,. Moist: l-loose, vfr-very friable, fr-friable, fi- firm, vfi –very firm, efi – extremely firm,. Stickiness: so – non sticky, ss- slightly sticky, ms- moderately sticky, vs- very sticky. Plasticity: po- non plastic, sp- slightly plastic, mp-moderately plastic, vp- very plastic; v). (Kd): Disseminated materials, Masses, Nodules, Concretions, vi). Roots: Quantity: f- few (<1 per area), c- common (1-5), m- many (>5); Size: vf- very fine, f- fine, m-medium, c- coarse; vc- very coarse; Location (Loc): between peds (p), cracks ©, throughout (t); Shape(Shp): tubular/ irregular/ vesicular/ interstitial. Abbrevations: i). Texture: S- sand, LS- loamy sand, SL-sandy loam, L-loam, SiL-siltyloam,Si-silt, ScL- sandy clay loam ,CL- clay loam, SiCL- silty clay loam, SC- sandy clay, SiC- silty clay loam, .C- clay. ii).Grade: 0-structureless, 1-weak, 2-moderate, 3-strong; Size; vf- very fine, f-fine, m-medium, c-coarse, vc-very coarse,iii). Type; gr-granular, cr-crumb, clr-columnar, pr-prismatic, pl-platy, abk- angular blocky, sbk- subangular blocky, sg- single grain, m-massive, c-cloddy, iv). Dry; l-loose, s-soft, sh-slightly hard, h-hard, vh-very hard, eh-extremely hard,. Moist: l-loose, vfr-very friable, fr-friable, fi- firm, vfi –very firm, efi – extremely firm,. Stickiness: so – non sticky, ss- slightly sticky, ms- moderately sticky, vs- very sticky. Plasticity: po- non plastic, sp- slightly plastic, mp-moderately plastic, vp- very plastic; v). (Kd): Disseminated materials, Masses, Nodules, Concretions, vi). Roots: Quantity: f- few (<1 per area), c- common (1-5), m- many (>5); Size: vf- very fine, f- fine, m-medium, c- coarse; vc- very coarse; Location (Loc): between peds (p), cracks ©, throughout (t); Shape(Shp): tubular/ irregular/ vesicular/ interstitial. * i). Texture: S- sand, LS- loamy sand, SL-sandy loam, L-loam, SiL-siltyloam,Si-silt, ScL- sandy clay loam ,CL- clay loam, SiCL- silty clay loam, SC- sandy clay, SiC- silty clay loam, .C- clay. ii).Grade: 0-structureless, 1-weak, 2-moderate, 3-strong; Size; vf- very fine, f-fine, m-medium, c-coarse, vc-very coarse,iii). Type; gr-granular, cr-crumb, clr-columnar, pr-prismatic, pl-platy, abk- angular blocky, sbk- subangular blocky, sg- single grain, m-massive, c-cloddy, iv). Dry; l-loose, s-soft, sh-slightly hard, h-hard, vh-very hard, eh-extremely hard,. Moist: l-loose, vfr-very friable, fr-friable, fi- firm, vfi –very firm, efi – extremely firm,. Stickiness: so – non sticky, ss- slightly sticky, ms- moderately sticky, vs- very sticky. Plasticity: po- non plastic, sp- slightly plastic, mp-moderately plastic, vp- very plastic; v). (Kd): Disseminated materials, Masses, Nodules, Concretions, vi). Roots: Quantity: f- few (<1 per area), c- common (1-5), m- many (>5); Size: vf- very fine, f- fine, m-medium, c- coarse; vc- very coarse; Location (Loc): between peds (p), cracks(c), throughout (t); Shape(Shp): tubular/ irregular/ vesicular/ interstitial*

Pudukudi series had textural variations in surface and subsurface horizons.The clay content decreased with depth and soil texture starts from fine textured to coarse textured towards the depth . The textural variations from fine to coarse texturedness was due to the alluvial deposition and soil is under weathering stage. The same trend of results was also reported by Gour [19] in Sunderbans.

Soil texture of Paramakudi series had sandy clay in surface and silty clay to sandy clay in sub-surface horizons. Presence of calcareous gneiss parent material produces heavy clay soil which leads to the formation of argillic horizon and clay skins. The same trend of result was also observed by Dasog [20] in the *vertisol* soils of Karnataka.

Sandy clay loam to clay loam texture was observed in Anandur series from surface to subsurface horizons.The presence of medium to fine textured soil was due to the illuviation process and reflected in the clay content distribution pattern along with depth. The same trend of result was also reported by Siddaram Patil and Anil Kumar [21] in the coastal region of Karnataka District.

3.1.3 Soil structure

Single grained structure was noted both in surface and subsurface layers of Mandabam series might be due to marine deposits by water, physiographic landscape and presence pf coarse grained parent material. The same trend of result was also reported in the west coastal region of Karnataka by SiddaramPatil and Anil Kumar [21].

Pudukudi series had angular blocky structure in surface and sub-angular blocky to single grained structure in subsurface soil. The variation in soil structure was due to the decreased clay content from topsoil to subsoil Siddaram Patil and Anil Kumar [21].

Paramakudi series had angular to sub-angular blocky structure in surface and sub-surface layers due to the illuvial nature of clay.

Anandur series had angular blocky soil structure, due to high clay fraction in the soils and same trend was also observed in alluvial soils of Uttar Pradesh by Ghosh [22]. These variation of soil structure depends upon the geographic landscape, nature of parent material and weathering condition of the soil [23].

3.1.4 Soil consistency

The consistency of the soil were loose non-sticky and non-plastic in dry and moist condition in Mandabam series (Mbm). This might be due to its coarse textured with very low clay content. This same trend was observed in the coastal soils of Guntur, Andhra Pradesh [24]. Pudukudi series (Pdk) had hard, firm, very sticky and very plastic consistency in surface layers. The soil consistency varied from hard to loose, friable to loose, slightly sticky to non–sticky and slight plastic to non-plastic in Bw2 and Bw3 horizon.The soil consistency of Parmakudi (Pmk) were very hard, very firm, very sticky and very plastic in nature whereas , Anandur series (And) had hard, firm, very sticky and very plastic consistency due to fine textured soils. The variation in soil consistency was due to coarse soil fractions, fine to medium textured soil, different clay minerals from surface to sub-surface layer.The same trend was also pointed out in the soils of Mahanadi mandal, Andhra Pradesh by [25].

3.2 Soil Physical Properties

3.2.1 Bulk density

The soil bulk density of Mandabam (Mdm) soil series ranged from 1.27 to 1.31 Mg m^{-3}. The highest bulk density was due to its coarse textured nature with high silicon di oxide with very rapid permeability [26]. The compaction was observed in the subsurface layers of C_2 and C_3 horizons and might be due to the usage of heavy machineries and predicted in the Figure Fig 2.a. The Bulk density of Pudukudi (Pdk), Parmakudi (Pmk) and Anandur series (And) ranged from 1.19 to 1.25, 1.19 to 1.20 and 1.19 to 1.21 Mg m^{-3} respectively. The variation might be due to the clogging of pores by fine textured soil throught the soil profile [27]. The same trend of result on bulk density was observed in the west coast of soils of Karnataka by Siddaram Patil and Anil Kumar [21].

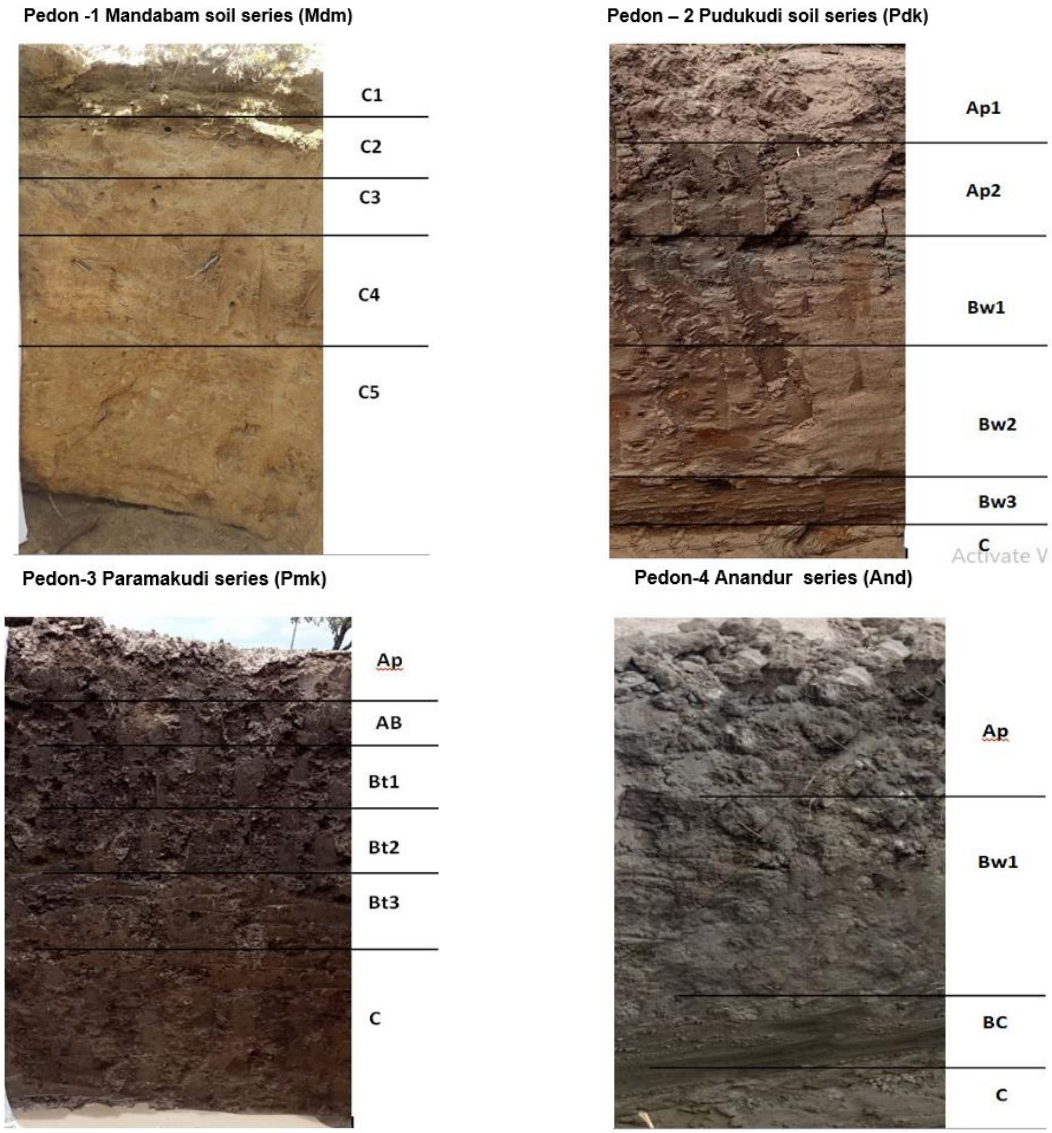

Fig. 1. Soil profile view of four soil profile

3.2.2 Hydraulic conductivity

The soil hydraulic conductivity for Mandabam soil series ranged from 5.95 to 8.04 cm hr^{-1}. The highest hydraulic conductivity was due to its coarse textured nature with less soil aggregated materials. The hydraulic conductivity of Pudukudi, Paramakudi and Anandur series varied from 0.03 to 4.30 cm hr^{-1}, 0.01 to 0.05 cm hr^{-1}, 0.10 to 0.15 cm hr^{-1} respectively and predicted in the Fig. 2.b. The lowest hydraulic conductivity was observed due to its medium to fine textured nature of soil, smectite type of clay minerals and irregular occurrence of soil fractions down to the depth .The same trend of result was observed in south Saurashtra, Gujarat by Chouthu Ram Hakla and Meena [28].

3.2.3 Hydraulic conductivity

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3.2.4 Infiltration rate

Soil infiltration rate for Mandabam series was 8 cm/hr. The Pudukudi, Paramakudi and Anandur series had infiltration rate of 0.02, 0.04 and 0.10 cm/hr respectively and the variation was due to the presence of soil fraction variations and compaction (Fig. 2.c).

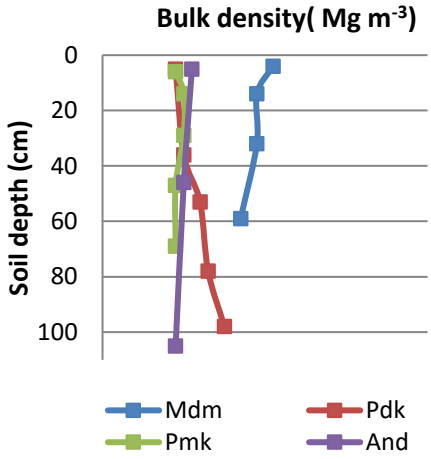

Fig. 2.a. Bulk density of soil

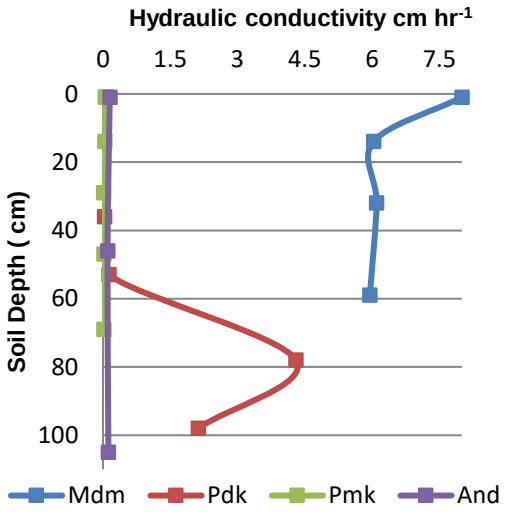

Fig. 2.b. Hydraulic conductivity of soil

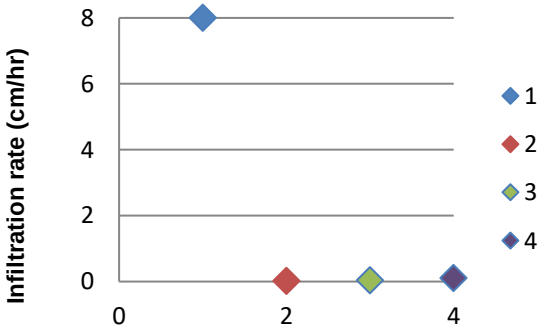

Fig. 2.c. Infiltration rate of soil

Table 2. Characteristics of the four major soil series of Ramanathapuram District

Horizon	Molar ratio					Weathering indices		
	SiO_2/R_2O_3	SiO_2/Al_2O_3	SiO_2/Fe_2O_3	Fe_2O_3/Al_2O_3	CaO / MgO	WIP	PIA	CIA
Pedon 1 : Mandabam soil series (Mdm)								
C_1	8.71	43.90	10.87	4.04	9.00	3.61	79.30	93.6
C_2	9.73	48.63	12.16	4.00	3.00	5.12	65.95	78.9
C_3	17.62	84.33	22.28	3.79	0.90	17.37	24.88	-2.9
C_4	14.12	39.28	22.05	1.78	5.00	7.37	56.42	58.5
C_5	Coastal alluvium							
Pedon 2 : Pudukudi soil series (Pdk)								
Ap_1	2.00	2.18	23.12	0.09	1.99	35.44	78.05	83.1
Ap_2	2.10	2.55	11.77	0.22	1.90	29.29	77.73	81.8
Bw_1	3.39	4.26	6.45	0.66	1.63	14.24	82.74	84.4
Bw_2	5.71	30.97	6.48	4.78	1.80	10.86	56.34	62.2
Bw_3	8.11	42.7	10.14	4.21	1.40	41.07	20.77	-38
C	River alluvium							
Pedon 3 : Paramakudi soil series (Pmk)								
Ap	3.32	3.92	22.91	0.17	2.03	32.38	65.51	68.2
AB	2.00	2.87	6.66	0.43	5.54	15.80	73.35	74
Bt_1	1.81	2.37	7.73	0.31	3.05	27.26	68.46	69.6
Bt_2	1.60	2.21	5.82	0.38	2.70	29.36	69.26	70.5
Bt_3	1.46	1.90	6.25	0.30	4.50	28.79	71.09	72.3
C	Calcareous gneiss							
Pedon 4 : Anandur soil series (And)								
A	3.49	5.01	11.51	0.44	1.39	38.84	65.61	73.2
Bw	2.74	3.30	16.37	0.20	3.03	13.90	82.58	83.1
BC	2.39	2.68	22.33	0.12	3.26	13.65	85.91	88.3
C	Weathered calcareous gneiss							

3.3 Total Soil Chemical Constituents, Molar Ratios and Weathering Indices of the Major Soil Series of Ramanathapural District

3.3.1 Silicon dioxide (SiO_2)

The SiO_2 content (89.0-91.52%) was higher in Mandabam soil series due to its coarse textured in surface and sub-surface layers.The slight fluctuations of silica content in the horizon was due to variations in sand fraction, geographic landscape of the area and quarzitic parent material. The same trend of results was also observed by Ratnam et al. [29]. The SiO_2 content of 60.12-81%, 67-70% and 51 to 67 % was observed in Pudukudi, Anandur and Paramakudi series respectively and low silica content was due to its fine textured nature of surface and sub-surface horizons.

3.3.2 Sesquioxides

The Mandabam soil series had 4.05 to 8.2% of Fe_2O_3 and 1.07 to 2.33% of Al_2O_3 . The Pdk, Pmk, And had sesquioxide content ranged from 14.20 to 30.12%, 20.23 to 35.20% and 20.12 to 28% respectively. The fine textured soils had high sesquioxide content than coarse textured soil. The variations in sesquioxide content in the surface and sub-surface layers was due to the clay fractions and mobilized elements within the soil profile [30]. The low sesquioxides and non-ferro magnesium minerals in Mdm series confirmed that the soils were not fully developed and all other series showed developed horizons with medium to high sesquioxide percentage.

3.3.3 Iron oxide and Aluminum oxide

The Mdm series had low Fe_2O_3 and Al_2O_3 varied from 4.05 to 8.2% and 1.07 to 2.33% respectively . This might be due to the absence of fine textured soils in surface and subsurface layers. The Pdk, Pmk and And had iron and aluminium oxides varied from 2.60 to 12.52% ; 2.62 to 27.52%; 2.93 to 9.10% ; 17.13 to 27% ; 3 to 6.10% and 14.02 to 25% respectively.The iron oxides were lower in Pudukudi, Parmakudi and Anandur series when compared with aluminium

oxides. The fluctuations of iron and aluminium oxides in the soil horizon might be due to the less occurence of ferromagnesium minerals in the surface and sub-surface layers. This same trend of results was also observed in Guntur soils of Andhra Pradesh [24].

3.3.4 Calcium and magnesium oxide

The CaO and MgO contents of Pdk, Pmk and And series varied from 0.9 to 4.02% & 0.5 to 2.10%, 6.30 to 9.15% & 1.27 to 3.23%, 3 to 3.20% & 0.92 to 2.30% respectively. The highest CaO and MgO contents were noticed in Pmk series followed by Aandur series and $CaCO_3$ content increased with depth. The CaO and MgO content of Mdm series varied from 0.09 to 1.20 % and 0.01 o 1.33% respectively decreased with depth. The same trend was also observed in Guntur soils of Andhra Pradesh by Vidhyashree et al*.* [24].

3.4 Molar Ratios

Molar ratios of SiO_2/R_2O_3, SiO_2/Al_2O_3, SiO_2/Fe_2O_3 and Al_2O_3 / Fe_2O_3 for Mbm series varied from 8.71 to 17.62 , 39.28 to 84.33, 10.87 to 22.28 and 1.78 to 4.04 respectively. The SiO_2/R_2O_3, SiO_2/Al_2O_3, SiO_2/Fe_2O_3 and Al_2O_3 / Fe_2O_3 for Pdk series varied from 2.0 to 8.11, 2.18 to 30.97, 6.48 to 23.12 and 0.09 to 4.78 respectively. The molar ratios of SiO_2/R_2O_3, SiO_2/Al_2O_3, SiO_2/Fe_2O_3 and Al_2O_3 / Fe_2O_3 for Pmk series varied from 1.60 to 3.32 , 1.90 to 3.92, 5.82 to 22.91 and 0.17 to 0.43 respectively. The SiO_2/R_2O_3, SiO_2/Al_2O_3, SiO_2/Fe_2O_3 and Al_2O_3 / Fe_2O_3 for Pmk series varied from 2.39 to 3.49, 2.68 to 5.01 , 11.51 to 22.33 and 0.12 to 0.44 respectively. The ratio of SiO_2/R_2O_3, SiO_2/Al_2O_3, SiO_2/Fe_2O_3 of Mdm series increased with depth due to the less weathered natured of soil and coarse textured soil . The irregular distribution of molar ratios in Pdk series indicated the slow weathered nature of soil. The Pmk and And series had showed a decreasing trend with depth of molar ratios (SiO_2/R_2O_3, SiO_2/Al_2O_3) and stated that it might be due to the weathering process and expanding type of clay minerals. The same trend of results was observed by Vidhyashree et al*.* [24] in Guntur soils of Andhra Pradesh.

3.5 Weathering Indices

The Pdk and And series had Chemical Index of Alteration values of more than 60 and it indicated the soils are in weathered nature. The SiO_2 content of Mdm series was higher with low sesquioxides and it was due to the presence of kaolinitic silica minerals in least weathered soil profile. The Pmk series was observed to have wide molar ratios with highly weathered nature. The similar trend was observed by Vidhyashree et al*.* [24] in Guntur soils of Andhra Pradesh.

4. CONCLUSION

Soil pedological investigation was carried out in four major soil series of Ramanthapuram studies envisaged that Mandabam series had unweathered nature due to the recent deposition of coastal alluvium parent material with poor physical properties need some management practices. The Pudukudi and Anandur series were intermediate stage of weathered soil had favourable nature of physical and chemical properties. The Paramakudi soil series had well developed soil profiles with argillic horizons. From these studies,it is concluded that the coastal areas mostly has unweathered nature and weathering process expedite due to its natural weathering phenomena. Each coastal soil series needs some management’s practices to make it as a productive one.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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