

CHARACTERISATION AND CLASSIFICATION OF WETLAND SOILS OF NORTH KUTTANAD

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Abstract: Fifteen profiles representing acid saline soils of North Kuttanad were studied for their characterisation and classification. Soils were light grey to dark brown / black in colour, sticky and plastic, subangular blocky in structure, and sandy to clayey in texture, with random deposits of lime shells and organic matter. Faint to prominent reddish yellow or brown mottles were observed from surface downwards. Soils were highly acidic (pH 4.0-5.0) and mildly saline (EC 0.33-1.39 dS m⁻¹). Both acidity and salinity increased with depth. The soils were high in organic carbon, CEC and ECEC, but base saturation was less than 50 per cent. Taxonomically, 93 per cent of North Kuttanad belongs to the soil order Entisol and seven per cent to Inceptisol. At subgroup level, 78 per cent of the area is occupied by Typic Sulfaquent and seven per cent each by Fluventic Dystropept, Typic Tropofluent, Typic Fluvaquent and Typic Tropopsamment.

Key words : Acid saline soil, Kuttanad, Fluventic Dystropept, Typic Fluvaquent, Typic Sulfaquent, Typic Tropofluent, Typic Tropopsamment.

INTRODUCTION

Out of the 55000 ha of wetland soils of Kuttanad, 10120 ha occurs in North Kuttanad. It represents the deltaic formation of Meenachil river, extending from 9 32' to 9 40'N latitude and 76 19' to 76° 33'E longitude on the west coast of Kerala. Several workers have studied the problems and management of Kuttanad soils (Money, 1961; Koshy, 1970; Money and Sukumaran, 1973, Kabeerathumma and Patnaik, 1978; Mathews and Jose, 1984; Marykutty and Aiyer, 1987; KAU, 1994; Kuruvila and Patnaik, 1994). Flood submergence during monsoons and salinity intrusion during summer are the major problems of the area. A spillway was constructed at Thottapally to drain off excess flood water and a regulator at Thanneermukkom to prevent saline water intrusion into Kuttanad. North Kuttanad was one of the most benefitted areas due to the above activities. Some attempts have been made to classify Kuttanad soils (Chattopadhyay and Sidarthan, 1985). However, systematic studies are lacking on the soils of North Kuttanad which is subjected to the severe attack of both floods and salinity. In this study an attempt has been made to classify the wetland soils of North Kuttanad.

MATERIALS AND METHODS

The study area covers Arpookara, Aymanam, Kumarakom, Chengalam, Thiruvarpu, Onamthuruthu and Kaipuzha villages of Kottayam District. It has a humid tropical climate with mean annual rainfall of 2963 mm, out of which 80 per cent occurs during June to September. Fifteen soil profiles were collected from the study area at an interval of 5 km for detailed study. Morphological characteristics of these profiles were studied in the field (Soil Survey Staff, 1987). Standards methods were followed for determining particle size composition (Black *et al.*, 1965), pH, organic carbon, and CEC (Jackson, 1958), and effective CEC (Coleman *et al.*, 1954). Soils were classified as per Keys to Soil Taxonomy provided by Soil Survey Staff (1987).

RESULTS AND DISCUSSION

The study area represented ill-drained flat lands lying 0.6 to 2.0 m below msl, developed over marine, lacustrine and fluvial deposits. Some of the special features observed were: the presence of layers of fibrous organic matter, lime shell deposits and partially decomposed wooden fragments in subsoil layers.

Table 1. Morphological features of soils

Horizon	Depth cm	Colour (moist)		Texture	Structure	Consistence	Remarks
		Matrix	Mottles				
I. Typic Sulfaquent (Akathekaripadam, Arpookkara)							
Ap	0-15	10YR 3/2	-	scl	c 2 sbk	mfi, ws, wp	Abundance of roots
C1	15-25	10YR 7/1	-	s	sg	mvfr, wso, wpo	-
C2	25-37	10YR 5/1	-	ls	m 2 sbk	mfr, wss, wps	Org. matter accumulation
C3	37-77	10YR 2.5/1	-	c	vc 1 sbk	mfi, wss, wps	„ „
C4	77-110+	10YR 3/1	-	c	m 3 sbk	mefi, wvs, wvp	-
II. Typic Tropo-samment, (Maleekayal, Aymanom)							
Ap	0-15	10YR 3/2	-	ls	m 3 sbk	mfi, ws, wp	Abundance of roots, root canals
C1	15-35	10YR 3/2	7.5YR 5/4, f 2 d	ls	m 2 sbk	mfi, ws, wp	-
C2	35-90	10YR 3/2	-	ls	c 2 sbk	mfi, ws, wp	-
III. Typic Tropofluent (Thekkepallipadam, Kumarakom)							
Ap	0-15	10YR 4/2	7.5YR 5/4, m 1 d	scl	m 2 sbk	mfi, ws, wp	Abundance of roots, root canals
C1	15-36	10YR 4/2	-	s	m 2 sbk	mfr, wss, wps	-
C2	36-90	10YR 3/1	7.5YR 6/4, f 1 d	s)	m 2 sbk	mfr, wss, wps	-
IV. Typic fluvaquent (Keezhimuttathusseri, Kumarakom)							
Ap	0-15	10YR 4/2	7.5YR 6/8, c 2 p	sl	c 3 sbk	mfr, wso, wpo	Abundance of roots, root canals
C1	15-35	10YR 3/1	7.5 YR 6/6, f 2 d	sl	c 2sbk	mfi, wss, wps	Presence of fine root canals
C2	35-78	10YR 4/1	-	sl	c 3 sbk	mfi, ws, wp	-
V. Fluventic Dystropept (Kadayakolmidavali, Chengalam)							
Ap	0-20	10YR 4/4	7.5 YR 5/6, m 2 d	scl	vc 3 sbk	mfi, ws, wp	Abundance of roots, root canals
Bw1	20-64	10YR 5/3	-	scl	c 2 sbk	mfi, wss, wps	-
Bw2	64-95	10YR 5/2	10YR 8/3, c 2 f	scl	vc 3 sbk	mfi, ws, wp	-

Mottles: f - few, c = common, m = many; 1 = fine, 2 = medium; f = faint, d = distinct, p - prominent

Texture : s - sandy, l - loam, c - clay

Structure : c - coarse, vc - very coarse, m = medium, 1 - weak, 2 = moderate, 3 - strong, sbk - subangular blocky, Consistence : = m - moist, vfr = very friable, fi = firm, efi = extremely firm; w - wet, so - non-sticky, ss - slightly sticky, s - sticky, vs = very sticky, po = non-plastic, ps = slightly plastic, p = plastic, vp - very plastic

Morphological characteristics

Morphologically the soils show a great deal of heterogeneity due to their sedimentary nature of genesis. The soil colour varied from light grey to dark brown / black with a hue of 10 YR. Light textured horizons with varying colour intensity were noticed in a few profiles. The colour variation was due to the difference

in pigmentation and cementing substances like organic matter and clay. Except the profile from Kadayakolmidavali padasekharam of Chengalam Village, all other soil profiles have only AC horizons reflecting their immaturity. The Kuttanad soils are young soils with immature profiles (Chattopadhyay and Sidharthan, 1985). In most of the soil profiles, faint to prominent reddish yellow or brown mottles

Table 2. Physicochemical properties of soils of North Kuttanad

Profile No.	Horizon	Per cent			Sand / Silt ratio	Clay / Silt ratio	pH	EC	Org. C	CEC	ECEC	PBS
		Sand	Silt	Clay				dS m ⁻¹	%	cmol(+) kg ⁻¹	%	
I	Ap	64.7	9.0	24.8	7.2	2.8	4.5	1.39	3.00	19.0	6.6	22.9
	C1	93.1	5.1	1.0	18.6	0.4	3.3	3.76	1.30	15.9	5.5	23.6
	C2	79.3	5.6	13.3	13.1	3.8	2.0	8.93	2.82	33.0	28.6	34.6
	C3	20.5	17.3	60.6	1.2	3.4	2.6	6.18	16.2	62.4	23.1	32.2
	C4	22.9	17.2	59.9	1.4	3.5	3.3	5.78	8.58	29.5	19.9	35.6
II	Ap	81.6	10.1	6.3	7.5	0.63	4.6	1.14	0.64	9.6	7.7	54.6
	C1	84.1	11.6	4.1	7.0	0.33	6.1	2.34	0.28	8.7	4.0	40.2
	C2	84.9	3.0	10.2	21.2	2.75	5.5	1.52	1.03	11.0	7.1	48.1
III	Ap	74.8	2.4	21.1	2.5	7.30	5.0	0.62	0.36	19.1	9.5	26.8
	C1	90.8	3.7	5.2	22.8	1.50	3.4	1.21	0.79	17.0	3.7	10.2
	C2	73.5	15.4	9.7	4.6	0.63	4.8	1.00	1.31	19.0	7.5	24.5
IV	Ap	54.2	37.2	8.0	1.5	0.24	4.0	0.55	1.32	21.0	10.3	40.7
	C1	57.7	21.0	19.8	2.8	1.00	4.2	0.47	0.77	22.1	8.1	26.0
	C2	58.7	19.0	20.0	3.1	1.10	4.3	0.40	1.49	20.2	7.8	28.9
V	Ap	52.0	14.9	31.1	3.53	2.13	4.8	0.33	0.12	15.1	5.8	33.7
	Bw1	47.1	26.4	24.0	1.85	1.00	5.5	0.39	0.07	15.1	9.7	61.0
	Bw2	13.7	54.2	30.5	0.4	0.40	3.3	3.06	2.75	32.6	13.6	38.0

PBS = Percentage base saturation

of hue 7.5 YR to 10 YR (Table 1) were noticed, due to mobilisation and immobilisation of Fe as a result of alternating oxidising and reducing conditions. Soils were sticky and plastic with a subangular blocky structure. Large number of rice roots and root canals were observed in the Ap horizon.

Physical properties

A definite pattern of distribution of sand, silt or clay was not observed within the profiles. The estuarine and fluvial deposition during each year results in the development of strata with varying quantities of sand, silt and clay. Soil texture varied from sandy to clayey. The sand content of soil profiles varied from 13.7 to 93.1 per cent. The range observed for silt was 2.4 to 54.2 per cent and for clay it was 1.0 to 60.6 per cent (Table 2). Generally sand predominated in the Ap horizon. None of the soil profiles showed uniform sand / silt ratio indicating a lesser intensity of weathering. The peculiar physiographic position of Kuttanad retarded the profile development in this tract.

Chemical characteristics

The soils of the study area were invariably acidic with a pH range of 4.0 to 5.0 (Table 2) in surface soil and 2.0 to 6.1 in subsoil layers. Ap horizon recorded lesser acidity compared to lower layers. Liming and washing and surface drainage have washed down a part of

acidity from the Ap horizon. The results of the experiments carried out at AICRP on Agricultural Drainage, Karumadi (KAU, 1988) revealed that soil acidity increases with depth. The electrical conductivity ranged from 0.33 to 1.39 dS m⁻¹ in surface soil. The subsoil layers showed still higher values for EC (0.39-8.93 dS m⁻¹) due to the downward movement and accumulation of salts.

A non-uniform distribution of organic carbon along the depth of profiles confirmed the heterogeneity of parent materials due to their sedimentary nature. The surface soils recorded 0.12 to 3.0 per cent of organic carbon and subsoil layers 0.28 to 16.22 per cent.

The CEC ranged from 9.6 to 21.0 cmol(+) kg⁻¹ in surface soil. Most of the subsurface layers recorded still higher values. The CEC of these acid soils are mainly decided by the organic carbon (0.567**) and clay content (0.413*), but the influence of organic carbon is more predominant, as evidenced by its high correlation coefficient. The ECEC ranged from 5.8 to 10.3 cmol(+) kg⁻¹ in surface soils. ECEC also showed positive and significant correlation with clay and organic carbon (0.559*, 0.599**).

The base saturation showed a very wide range which extended from 10.2 to 61.0 per cent. This was evidently due to the strong textural variation of the soil from sandy to clayey and

difference in organic matter content.

Taxonomic classification

Taxonomic classification of the profiles have been attempted up to subgroup level based on the available data, as per Keys to Soil Taxonomy provided by Soil Survey Staff (1987). Except one profile, all other profiles key out under soil order Entisol. Hence 93 per cent of the study area belongs to Entisol and the remaining 7 per cent to Inceptisol order.

Kadyakolmidavali padasekharam of Chengalam village gets keyed out under order Inceptisol, suborder Trocept because of an isothermic temperature regime, great group Dystrocept because it has less than 50 per cent base saturation in some sub-horizons and Fluventic subgroup because of irregular organic carbon content.

Eleven profiles have sulphidic materials with 0.75 per cent S in some subhorizon within 50 cm and have aquic properties, leading to keying out under suborder Aquents, greatgroup Sulfaquents and subgroup Typic Sulfaquents. These soils occupied a major area of almost all the villages of the study area i.e., 78 per cent of total area, leading to the conclusion that the soils of North Kuttanad are mainly acid sulphate in nature. Maleekayal which adjoins with the Vembanad lake belongs to suborder Psamment because of loamy sand texture and presumed Udic moisture, keys out under great group Tropopsamment and subgroup Typic Tropopsamment. Profile from Thekkepallipadam, Kumarakom gets keyed out under suborder Fluvent, greatgroup Tropofluent because of isohyperthermic temperature regime and under subgroup Typic Tropofluent. Soils of Keezhimuttathusseri padasekharam of Kumarakom Village keys out under suborder Aquent, greatgroup Fluvaquent and subgroup Typic Fluvaquent. Except Typic Sulfaquent, all the subgroups occupy seven per cent of the study area.

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