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Soils of Tripura. I- Characterisation and classification

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Abstract

A proper grouping and delineation of the soils of Tripura have been attempted using the latest remote sensing techniques as well as field and laboratory studies to suit applications in several developmental projects of the state. The soils which occupy the tillas and hills are loamy textured and well drained. Waterlogged soils, however, occur in the basins and are intensively cultivated. The soils, in general, are acidic in reaction and medium in organic carbon content. The soil texture is variable in nature, ranging from sand in the uplands to clay in the low lands including marshy and waterlogged area. The soils have been classified into 5 orders, 7 suborders, 9 great groups and 19 subgroups. The 5 orders viz. Inceptisols, Entisols, Ultisols, Alfisols and Histosols occupy 80.6, 8.1, 6.6, 4.5 and 0.2 per cent area respectively.

Additional key words: Taxonomic grouping, hills, basins.

Introduction

Due to fairly high rainfall, the soils and bed rocks in Tripura are subject to severe chemical weathering and rapid erosion. The humid tropical monsoon climate of Tripura has given rise to different kinds of soils. The occurrence of such wide varieties of soils largely depends on the topography, parent rock, climatic regime and the type of vegetal cover. Each group of soils exhibit characteristic soil properties, the knowledge of which is essential for successful farming. Several authors attempted to group the soils of Tripura into three or four broad categories keeping in view of the physiographic position, soil colour and other properties (Datta 1952; Raychaudhury *et al.* 1963; Majumdar 1976; Lasker *et al.* 1983).

Tripura state, the smallest in the North Eastern Region of India, has limited cultivable area with a tremendous potential for the expansion of general agricultural, horticultural and other plantation crops. For a state with such a vast scope of expansion, only three

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or four broad soil groupings without proper data base were considered inadequate by the planners for implementing different developmental programmes. Therefore, to get adequate soil information the state of Tripura was surveyed and mapped on 1:250,000 scale at the level of family association. An attempt has been made to describe the soils with special reference to their taxonomic groupings in the present paper (Soil Survey Staff 1994).

Materials and methods

Study area

Tripura state, covering an area of 1.05 Mha, is bounded by Bangladesh in the south, north, west and south-east, Mizoram in the east and Assam in the north-east. The terrain consists of the Western fringe of typical "ridge and valley" (structural) province of the late Tertiary fold mountain belt, commonly known as the Indo-Burman Ranges (Purbanchal Range). The valleys are terraced, a greater part being made up of deeply dissected highland characterised by steep erosional scarp of 15-20 m in height along the river basins. The elevation of hills gradually increases in the east. The drainage network of Tripura follows the north-south direction as it is controlled by N-S aligned hill ranges. The geology is represented by sedimentary rocks which range in age from Miocene (25 million years old) to loosely consolidated sediments of Recent age. The climate is humid subtropical characterised by high annual rainfall ranging from 2000-3000 mm. The state represents udic soil moisture regime and hyperthermic soil temperature regime.

Field studies

The field survey was preceded by interpretation of images for the preparation of base maps. For image interpretation IRS-1B LISS II FCL (545-151/PO15/RSI, 546-151/PO15-RSI, 546-152/PO16-RSI and 546-151/PO16-RSI) data (1:125,000 scale) were used. The imageries were interpreted for generating a map of landforms of the state. The information thus generated was transferred on the topobase prepared from the Survey of India topographical sheets for undertaking field surveys. The survey included studies of (1) soil profiles (Soil Survey Staff 1951) at different physiographic locations,(2) auger bore at 5 km intervals and (3) random checking of soils at required sites to generate soil mapping units (soil family association) showing soil-physiographic and climatic relationships(Sehgal *et al.* 1987).

Laboratory investigations

The soils were analysed for various physical and chemical properties using standard methods (Jackson 1973; Sarma *et al.* 1987).

Results and discussion

The soils of Tripura state were grouped and mapped into 43 soil units of soil family association (Bhattacharyya *et al*, 1996). The major characteristics of the representative soils on different physiographic units and their taxonomic groupings are given in Tables 1 and 2. and are briefly described here. The soil-physiographic relationship of a representative transect is shown in figure 1.

Soils of high relief structural hills

Soils on this physiographic unit are deep to very deep, well to somewhat excessively drained, loamy skeletal with severe erosion hazard and developed on sandstones (Table 1). These soils are classified as loamy skeletal Typic Dystrochrepts , fine loamy Umbric Dystrochrepts and fragmental Lithic Udorthents. The soils are acidic with low exchange

capacity.The exchange complex is dominated by Ca,Mg and Al.Due to thick vegetation on the hills, surface soils contain higher amount of organic carbon (Table 2).

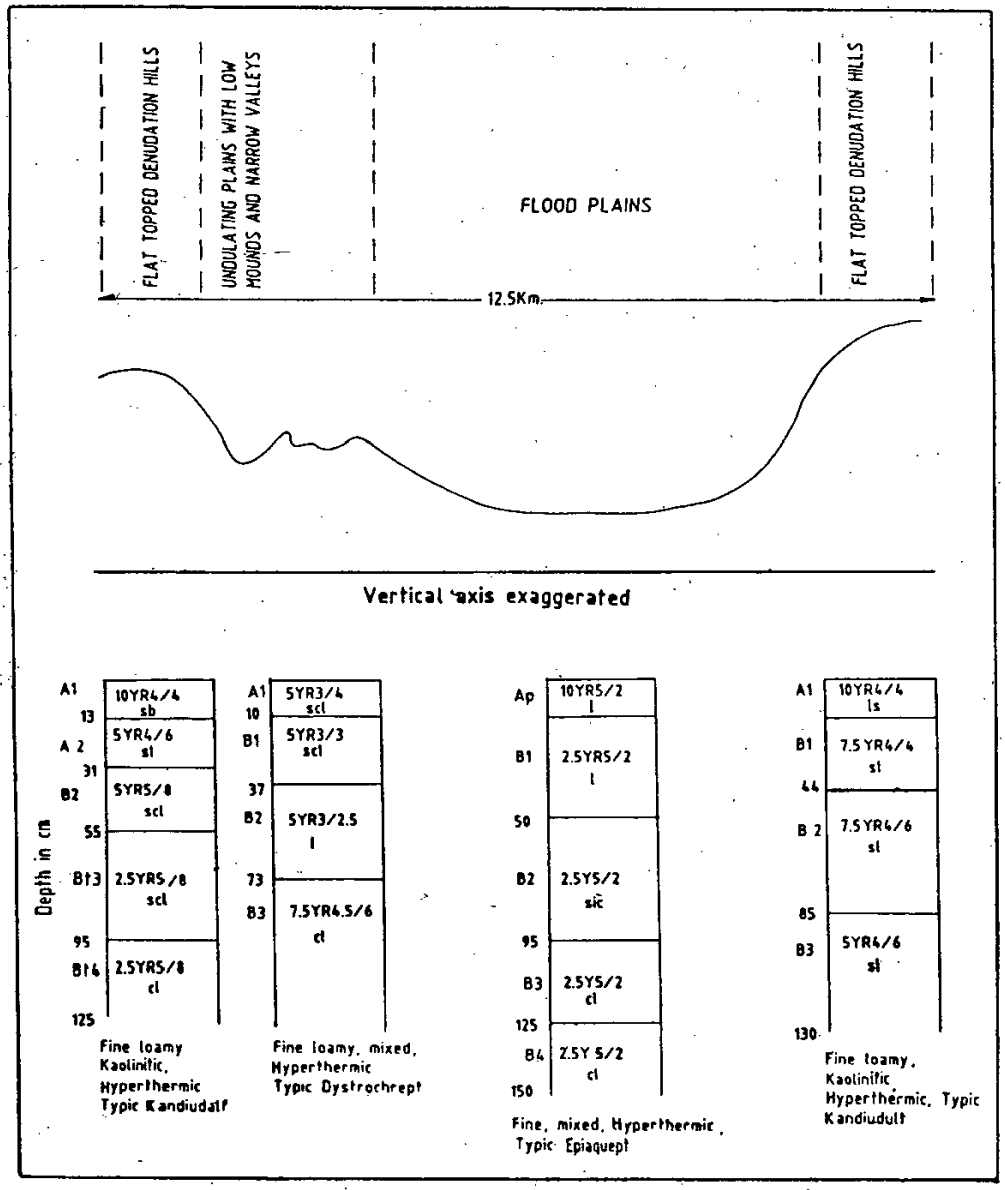

Fig. 1 Representative cross-section of landforms and soils in South Tripura district, Tripura.

Soils of medium relief structural hills

These soils are also deep and well drained. They are clay loam to sandy clay loam in texture and are grouped into Umbric Dystrochrepts and Typic Dystrochrepts (Table 1). These soils are very deep, clay loam to clay in texture and contain high organic carbon. Unlike soils in the high relief hills these soils have higher exchange capacities with higher exchangeable H^+ ions (Table 2).Besides,Ultisols (Typic Hapludults)were also identified on some of the ridges.

Table 1. Morphometric properties of some representative soils on different physiographic units

Horizon	Depth (cm)	Matrix colour (Moist)	Texture	Structure	Others (Clay cutan, mottles)
1	2	3	4	5	6
a) Very steeply sloping high relief structural hills of sandstone					
(Pedon: Loamy skeletal,mixed hyperthermic Typic Dystrochrept)					
A1	0-10	10YR 4/3	l	sbk	-
B1	10-36	10YR 4/4	gcl	sbk	-
B2	36-49	10YR 5/6	gcl	sbk	-
B3	49-75	10YR 5/6	gcl	sbk	-
B4	75-109	10YR 5/8	gcl	sbk	-
b) Steeply sloping medium relief structural hills					
(Pedon: Fine loamy, mixed, hyperthermic Typic Hapludult)					
Ap	0-16	10YR 3/3	l	sbk	-
B1	16-28	10YR 4/3	cl	sbk	-
B2	28-35	10YR 4/4	cl	sbk	-
Bt1	35-70	10YR 4/6	c	sbk	Clay cutan
Bt2	70-88	10YR 5/6	c	sbk	-do-
B3	88-110	10YR 6/6	c	sbk	-do-
BC1	110-135	10YR 5/8	cl	-	-
BC2	135-160	10YR 5/6	cl	-	-
c) Moderately steeply sloping low relief structural hills of shale					
(Pedon: Fine, mixed, hyperthermic Typic Dystrochrept)					
A1	0-12	7.5YR 3/4	cl	sbk	-
B1	12-45	5YR 4/4	c	sbk	-
B2	45-90	5YR 4/6	cl	sbk	-
BC	90-120	5YR 4/6	cl	sbk	-
d) Moderately sloping flat topped denudation hills of sandstone					
(Pedon: Fine-loamy, mixed, hyperthermic Typic Kandiudult)					
A1	0-20	10YR 4/3	scl	sbk	-
A2	20-39	10YR 4/3	scl	sbk	-
B1	39-55	7.5YR 5/6	scl	sbk	-
B2	55-79	7.5YR 6/8	sicl	sbk	-
B3	79-95	7.5YR 5/8	cl	sbk	-
Bt	95-150	7.5YR 5/8	cl	sbk	-
e) Gently sloping low lying residual hills of sandstone and shale					
(Pedon: Coarse-loamy, mixed, hyperthermic Typic Dystrochrept)					
A1	0-11	10YR 4/4	sl	sbk	-
B1	11-38	10YR 4/6	scl	sbk	-
B2	38-57	10YR 5/8	cl	sbk	-
B3	57-74	10YR 5/8	c	sbk	-
B4	74-100	10YR 6/6	c	sbk	-
B5	100-125	7.5YR 5/6	c	-	-
B6	125-135	7.5YR 5/6	c	-	-

1	2	3	4	5	6
f)Moderately sloping undulating plains with low mounds and narrow valleys of sandstone					
(Pedon: Fineloamy, mixed, hyperthermic Typic Dystrochrept)					
Ap	0-10	10YR 4/4	sl	sbk	-
A1	10-47	10YR 3/4	sl	sbk	-
B2	47-90	10YR 3/4	scl	sbk	-
B3	90-115	10YR 3/6	scl	sbk	-
B4	115-140	10YR 3/6	scl	sbk	-
g) Moderately sloping interhill valley in alluvium					
(Pedon: Coarse-loamy, mixed, hyperthermic Aeric Fluvaquent)					
Ap1	0-16	10YR 4/3	scl	sbk	-
A2	16-27	2.5Y 4/2	scl	sbk	2.5YR 4/4
A3	27-43	2.5Y 5/2	sl	gr	10YR 4/4
2Cg1	43-70	5Y 4/1	sil	sbk	10YR 4/6
3Cg2	70-95	5Y 5/2	sil	-	7.5YR 4/4
4Cg3	95-160	5Y 5/3	sicl	-	7.5YR 4/4
h) Very gently sloping floodplains in alluvium					
(Pedon: Fine-loamy, mixed, hyperthermic Typic Epiaquept)					
A1	0-5	10YR 4/2	sl	gr	5YR 3/4
A2	5-19	10YR 5/4	ls	gr	5YR 4/6
Bg1	19-32	10YR 5/2	sl	sbk	5YR 3/4
Bg2	32-57	10YR 5/2	l	sbk	2.5YR 3/4
2Bg3	57-76	10YR 6/2	c	sbk	7.5YR 4/6
2Bg4	76-101	10YR 6/2	cl	-	7.5YR 4/6
2Bg5	101-126	10YR 6/2	c	-	7.5YR 4/6
i) Moderately sloping rolling lands of sandstone					
(Pedon: Fine-loamy, mixed, hyperthermic Typic Haplumbrept)					
A1	0-12	5YR 3/3	c	sbk	-
B1	12-26	5YR 3/3.5	c	sbk	-
B2	26-46	2.5YR 3.5/6	c	sbk	-
B3	46-85	2.5YR 3/6	c	sbk	-
B4	85-122	2.5YR 3.3/6	c	sbk	-

Soils of low relief structural hills and ridges

These are moderately deep to deep, well to somewhat excessively drained, clay loam to sandy clay loam soils on the side slopes of hills developed on shales with moderate to severe erosion hazards (Table 1). The soils are grouped as Typic Dystrochrepts, Typic Udorthents, Umbric Dystrochrepts and Typic Haplumbrepts. They are strongly acidic with low cation exchange capacity and base saturation indicating an intensive leaching of bases. The surface horizons contain relatively higher amount of organic carbon (Table 2).

Soils of flat topped denudation hills

These are very deep, well drained, clay loam soils with moderate to severe erosion hazard and developed on sandstones (Table 1). Taxonomically these are grouped under Typic Kandiudalfs, Typic Kandiudults and Typic Dystrochrepts. These soils are moderately acidic with very low CEC and bases (Table 2). Relatively higher content of organic carbon in the surface is a major characteristic of these soils.

Table 2. Physical and chemical properties of the selected horizons of some representative soils on different physiographic units

Horizon	Depth (cm)	Sand (50μ-2000μ)	Silt (2-50μ)	Clay (<2μ)	O.C.	pH H_2O (1:2.5)	pH KCl	Extractable H	Extractable Al	CEC	BS (%)
		<——(%)——>						cmol(p+) kg^{-1}			
1	2	3	4	5	6	7	8	9	10	11	12
a) High relief structural hills											
A1	0-10	36.6	41.5	21.9	1.8	5.2	4.3	0.2	0.3	9.7	57
B2	36-49	31.8	34.3	33.9	0.6	4.8	3.9	1.5	2.6	7.9	54
B4	75-109	29.2	33.9	36.9	0.5	5.0	4.0	1.5	3.4	8.2	49
b) Medium relief structural hills											
Ap	0-16	33.8	39.4	26.8	1.8	5.0	4.2	0.1	0.1	10.5	62
Bt4	70-88	26.0	29.2	44.8	0.7	4.6	3.9	2.3	2.4	10.4	28
BC2	135-160	39.6	31.8	38.6	0.4	4.9	4.0	2.9	2.1	7.7	33
c) Low relief structural hills											
A1	0-12	43.7	22.8	33.5	1.2	4.5	3.9	0.7	1.0	8.1	65
B2	45-90	38.3	22.2	39.5	0.5	4.4	3.9	0.4	2.2	7.8	18
BC	90-120	38.8	23.7	37.5	-	4.7	3.9	0.7	1.8	8.4	18
d) Flat topped denudation hills											
A1	0-20	55.2	21.2	23.6	0.9	4.8	4.2	0.6	1.7	5.3	28
A2	20-39	58.0	21.4	20.6	0.8	4.9	4.2	0.9	1.2	5.0	26
Bt3	95-150	35.6	28.8	35.6	0.3	5.2	4.3	1.1	1.6	6.0	34
e) Low lying residual hills											
A1	0-11	61.6	18.3	20.1	1.0	5.2	4.4	0.6	0.7	3.9	44
B2	57-74	38.0	20.9	41.1	0.5	4.9	4.0	1.2	1.7	5.6	14
B3	125-135	36.8	26.1	37.1	0.4	5.2	4.3	0.4	0.9	4.3	30
f) Undulating plains with low mounds											
Ap1	0-10	67.2	18.3	14.5	0.7	4.9	3.2	n.d.	n.d.	4.7	45
A2	10-47	59.8	22.7	17.5	0.5	4.3	3.2	n.d.	n.d.	5.1	45
B3	115-140	41.1	35.4	23.5	0.3	5.3	4.3	n.d.	n.d.	6.2	45
g) Interhill valley											
Ap1	0-16	58.0	16.1	25.9	1.0	4.1	3.5	1.8	1.1	6.0	40
A2	16-27	66.8	11.3	21.9	0.2	4.7	3.9	0.4	0.3	5.4	49
2Cg1	43-70	18.0	55.1	26.9	0.2	5.3	4.5	0.9	0.7	8.2	45
4Cg3	95-160	6.4	60.7	32.9	0.3	5.0	4.2	0.5	0.5	12.1	37
h) Floodplains											
A1	0-5	75.0	11.1	13.9	1.2	5.2	4.4	0.1	0.5	3.0	47
A2	5-19	86.4	3.7	9.9	0.3	5.2	4.3	0.0	0.3	1.6	50
Bg1	32-57	50.0	21.1	18.9	0.3	5.0	4.2	0.4	0.7	3.8	37
2Bg4	101-126	28.6	24.5	46.9	0.2	5.0	3.9	0.7	2.0	6.4	41
i) Rolling uplands											
A1	0-12	37.0	22.1	40.9	0.8	4.1	3.7	0.6	3.5	6.6	18
B2	26-46	30.4	24.7	44.9	0.3	4.4	3.7	0.5	3.6	5.9	22
B4	85-122	27.6	24.4	47.9	0.2	4.4	3.8	0.8	3.9	7.0	20

n.d. = not determined

Soils of low lying residual hills with valley

These are very deep, well drained, clay loam to clayey soils with moderate erosion hazard on the hills (Table 1) and are grouped under Typic Dystrochrepts and Typic Hapludalfs. These soils have low cation exchange capacity and their base saturation varies from 14-44 percent. The soils are characterised by high extractable H and Al (Table 2). The soils in the valley are very deep, imperfectly drained and coarse loamy and are susceptible to severe seasonal floods. These are grouped under Aquic Udorthents and Aquic Dystrochrepts.

Soils of undulating plains with low mounds and narrow valleys

These soils on undulating plains are deep to very deep, well drained and clay loam in texture with moderate erosion hazard (Table 1). Taxonomically these soils are grouped under Typic Epiaquepts, Aquic Udorthents and Aquic Dystrochrepts. They are strongly acidic with low bases. The cation exchange capacity and base saturation vary from 4.7-6.2 cmol(+)kg^{-1} and 33-45 percent respectively (Table 2).

Soils of interhill valley

These are deep to very deep, imperfect to moderately well drained, fine loamy to coarse loamy soils on gently to moderately sloping undulating plains with moderate to slight erosion hazard. The dominant soils are Typic Epiaquepts, Aquic Dystrochrepts, Aquic Udorthents and Aeric Fluvaquents. These soils are developed in alluvium and are in most of the cases influenced by local tributaries or other drainage channels.The distribution of particle size separates and organic carbon also indicate the lithological discontinuity (Tables 1 & 2).

Soils of floodplains

The flood plain soils are acidic in nature (pH 4.8-5.1) and the colour varies from grey to light brown to olive brown and are very deep, very poorly drained, clay texured with moderate to severe flooding hazard (Tables 1 & 2). These soils are grouped into Aeric Epiaquepts, Typic Epiaquepts, Aquic Dystrochrepts, Fluaquentic Dystrochrepts and Hydric Medifibrists.

Soils of rolling lands

These are very deep, well drained, clayey and acidic soils developed on moderately to gently sloping hillocks with moderate to severe erosion hazard and classified as Typic Haplumbrepts and Typic Dystrochrepts.

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