https://doi.org/10.29321/MAJ.10.A02550

Madras Agric. J. 71. (12) 777-782 December, 1984.

SOILS OF KALRAYAN HILLS OF TAMIL NADU

S. NATARAJAN and C. RATNAM*

Kalrayan hills extend over parts of Salem and South Arcot districts, Tamil Nadu The hill range has been under shifting cultivation for a very long time. However, soils of this range have not been studied in detail. The present paper brings out a study of the morphological, physical and chemical characteristics of the hills in a transect line from summit to valley bottoms. The results indicated the influence of topography on many of the soil properties such as depth, texture, drainage and water table. $CaCO_3$ content of the soils is low due to continuous leaching. Reaction is acid to neutral and electrical conductivity is normal Continuous cropping has resulted in low organic matter and total P_2O_5 content. Total K_2O is medium to high and CEC is medium in the soils.

The Kalrayan hills cover an area of 854.63 sq km. They lie between 11° 37' and 12° 01' N latitude; and 78° 31' and 78° 53' E longitudes. The area consists of five Jagirs namely the Chinnakalrayan, Periyakalrayan, Jadayagoundan. Kurumbagoundan and Ariyagoundan Jagirs. The first two Jagirs lie in Attur taluk of Salem district while the rest lie in Kallakurichi taluk of South Arcot district. The topography is a rolling one, composing of hillocks and valleys. The presest soil studies confine to the valleys which are accessible and where the permanent cultivation is going on. Valleys consist of convex summits, convex slopes and valley bottoms. Physical and chemical characters of the soil profile were studied for this toposequence consisting of the convex summit, slope and valley bottom.

Geology of the range consists of gneisses and charnockites. Drainage pattern of the streams is dendritic with sub-parallel at higher altitudes.

METHODS AND MATERIALS

Morphological characteristics of three representative profiles examined on convex summit, convex slope and valley bottom are described, following the guidelines laid down in the Soil Survey Manual, (IARI, 1970). Horizon-wise soil samples were collected in the field and were analysed for their physical and chemical properties (Piper, 1950 and Jackson, 1958).

(i) Profile in convex summit :

Location	-	Kovil Kadu
Elevation	-	762 metres
Drainage	-	Well drained
Water table	-	40 metres and more
Slope	-	2-5%
Vesetation	-	*Pongamia glabra, Tectona grandis*
Land use	-	Cultivation with tapioca.

Pedon characteristics

A1 : 0-21 cm red (2.5 YR 4/6) moist and (2.5 YR 4/6) dry; loam, moderate, medium, subangular blocky; soft, firm, sticky; moderately repaid permeability; clear, smooth boundary; pH 5.8

* Soil Survey and Land Use Organisation, Coimbatore.

B1 : 21-52 cm dark red (2.5 YR 3/6) moist; sandy clay loam; moderate, medium, subangular blocky; slightly firm; sticky, palstic; moderately rapid permeability; clear, smooth boundary; pH 6.2

B21 : 52-88 cm dark red (2.5 YR 3/6) moist; clayey; massive to weak, medium. subangular blocky; slightly firm, sticky, plastic; moderately rapid permeability; clear, smooth boundry: pH 6.0.

B 22 : 88-134 cm red (2.5 YR 4/6) moist; clayey; weak, medium, subangular blocky; sticky, slightly plastic, firm; very few, small, round, ferro-manganese concretions; moderately rapid permeability; clear, smooth boundary; pH 6 1.

B 31 : 134-166 cm red (2.5 YR 4/6) moist; gravelly clayey; weak, medium, subangular blocky breaking to granules; slightly firm, sticky, slightly plastic; few, found, ferro-manganese concretions; common, irregular, 2-3 cm size quartz gravels; rapid permeability: pH 6.0

(ii) Profile in convex slope :

Location	..	Keraliyur
Elevation	..	709 metres
Drainage	..	Excessively drained
Water table	..	13-15 metres
Slope	..	5-20%
Vegetation	..	*Cassia auriculate, Calotropis gigantea*
Land use	..	Cultivation with tapioca.

Pedon characteristics

A1 : 0-22 cm reddish brown (5 YR 3/3) moist and (5 YR 5/4) dry; clayey; moderate, medium to coarse, subangular blocky; firm; sticky, plastic; very few, round, ferro-manganese concretions; moderate to moderately slow permeability; clear, smooth boundary pH 5 8.

A22 : 22-75 cm reddish brown (5 YR 3/3) moist; gravelly clayey; weak, medium, subangular blocky; slightly firm; sticky, slightly plastic; few, iron concretions with very few, 6 cm size ferro-manganese gravels; moderate to moderately slow permeability; gradual, wavy boundary; pH 6 4.

C1 : 75-93 cm reddish broan (5 YR 4/4) moist; clayey; slightly firm, sticky, slightly plastic; massive; few, ferro-manganese concretions; frequent, irregular guartz of 1-2 cm size; moderate to moderately slow permeability; pH 6.4.

C 93 cm + Parent material

iii) Profiie in Valley Bottom

Location	:	Kilakadu
Elevation	:	686 metres
Drainage	:	Moderately well drained
Water table	:	3-6 metres
Slope	:	0-1%
Vegetation	:	*Leucas aspera, Tridax procumbens.*
Land use	:	Cultivation with cereals

Pedon characteristics

A1 : 0-24 cm dark reddish brown (2.5 YR 3/4) moist; clayey loam; moderate, medium, subangular blocky; friable. sticky, plastic; moderately rapid permeability; clear, smooth boundary; pH 5.7.

B21 : 24-46 cm dark reddish brown (2:5 YR 3/4) moist ; clayey ; moderate, coarse, subangular blocky ; slightly firm sticky; plastic, very few, round, ferro-manganese concretions and few. 1 cm size quartz; moderately rapid premeability; clear, wavy boundary; pH 5.8.

B22t : 46-72 cm red (2.5 YR 4/6) moist; clayey; moderate, coarse, subangular blocky; slightly firm, sticky and plastic; very thin. clay films; very few, round, ferro-manganese concretions and very few, 1 cm quartz fragments; moderate permeability; clear, smooth bounday; pH 6.0

B23t : 72-101 cm red (2.5 YR 4/6) moist; clayey; moderate, coarse, subangular blocky; friable, sticky and slightly plastic; thin, clay films; common, fine, distinct, strong brown (7.5 YR 5/6) mottlings; moderate permeability: abrupt, smooth boundary; pH 5.6.

B24t : 101-136 cm red (2.5 YR 4/8) moist; clayey; strong, coarse, subangular biocky; firm; sticky, plastic, very few, round, ferro-manganese concretions; many dominant, coarse, light gray (7.5 YR 7/1) kaolin and strong brown (7.5 YR 5/6) iron mottlings; moderately slow permeability; abrupt, smooth boundary; pH 6 0.

B3 : 136-154+strong brown (7.5 YR 5/6) and light gray (7.5 YR 7/0) moist; clay loam; strong, coarse, subangular blocky; firm, sticky, plastic, kaolin present; few feldspathic fragments; moderately slow permeability; pH 7.0.

RESULTS AND DISCUSSION

Soil depth in convex summit is more than 1 metre, it is 15 cm to 1 metre in convex slope and more than 2 metre in valley bottom. The wide variation of soil depth in the above toposequence can be attributed to either the slow 'gelogic' eroosion of soil material from the soil surface or the lack of percolating water or both occurring on the slope. Similar results have been reported by Kandaswamy, *et al.* (1965) and Buol *et al.* (1973). The soil in convex summit is well drained with water table of more than 40 metres. The profile in convex slope is excessively drainedwith water table of 13-15 metres and the soil in valley bottom is moderately well drained with water table of 3-6 m. Thus the drainage of soil in any toposequence is related to water table (Soil Survey Staff, 1951). The mottlings and concretions in the profile of valley bottom suggest the alternate conditions of reduction and oxidation by fluctuating water table.

Texture of the surface layers in the convex summit is coarser when compared to the subsoil horizons; comparative studies on texture of the profile No. (i) and (ii) show evidence that the surface layers in profile (ii) have been eroded. The surface soil of the profile (ii , although clayey in texture, is a conglomerate with gravels and boulders both on the surface and in the solum, as observed in the field investigation. There is a general increase in clay content in the case of profile in the valley bottom revealing pedogenic processes involved. These results go to show the influence of the topography, slope and run-off on the soil texture (Buol *et al.* 1973)

Table No. 1a—Profile details.

S. No.	Village	Taluk	Profile location	Horizon	Depth in cm
	1	2	3	4	5
1	Kovilkadu	Attur	Convex summit	A1	0-21
2	"	"	"	B1	21-52
3	"	"	"	B21	52-88
4	"	"	"	B22	83-134
5	"	"	"	B31	134-166
6	Keraliyur	Kallakurichi	Convex slope	A1	0-22
7	"	"	"	A22	22-75
8	"	"	"	C1	75-93
9	Kilakadu	Attur	Valley bottom	A1	0-24
10	"	"	"	B21	24-46
11	"	"	"	B22t	46-72
12	"	"	"	B23t	72-101
13	"	"	"	B24t	101-136
14	"	"	"	B3	136-154

Table 1 b. — Physical properties of soils.

S. No.	Mechanical constituents: Coarse sand %	Fine sand %	Clay %	Silt %	Textural class	pH 1:2	EC m.mohos/cm	$CaCO_3$ %	Org. carbon %	Airdry moisture %
1	30.58	23.49	23.10	21.79	l	5.8	0.04	0 10	0.84	2.0
2	30.67	24.54	28.74	5.34	Scl	6.2	0.04	0.12	0.62	2.8
3	32.37	17.61	47.02	3.27	c	6.0	0.04	0.31	0.51	3.2
4	30.67	13.58	49.04	2.08	c	6.1	0.04	0.21	0 26	3.4
5	36.38	13.09	48.00	1.82	c	6.0	0.05	0 26	0.17	3.4
6	25.70	18.93	49.51	2.89	c	5.8	0.05	0.47	0.99	5.5
7	34.06	13.21	49.51	2.62	c	6.4	0.05	0.47	0.51	5.4
8	34.05	14.22	47.67	3.41	c	6.4	0.06	0.21	0.28	5.4
9	24.27	34.39	26 94	13.82	cl	5.9	00.6	0 41	1.14	3.0
10	22.97	22.81	49.56	2.34	c	5.8	0.05	0.21	0.85	4 4
11	23.97	18.15	51.64	1.51	c	6.0	0.01	0.36	0.48	4.0
12	22.40	21.65	50.08	2.60	c	5.6	0.05	0.31	0.21	4.0
13	22.86	16.20	53.46	2.82	c	6.0	0.09	0.43	0.21	4.4
14	19.94	33.75	23.52	20.00	cl	7.0	0.09	0 47	0.08	4.4

Table 1 c — Chemical composition of soils.

S. No.	Chemical constituents						CEC me/ 100 g. soil	Exchangeable cations me/100 g of soil			
	R_2O_3 %	FO_2O_3 %	Al_2O_3 %	Total CaO %	Total P_2O_5 %	Total K_2 %		Ca^{++}	Mg^{++}	Na^{+}	K^{+}
1	11.22	4.98	6.24	0 42	0.02	0.42	8.6	3 5	0.5	3.8	0.2
2	20.60	6.59	14.01	0.32	0 05	0.72	12.2	4.0	2.5	4.2	0 2
3	19.57	7.42	12 15	0.32	0.03	0.67	10 5	3.5	1.5	4.2	0.2
4	18.54	6.84	11 70	0.42	0.02	0.77	11.6	5.0	1.5	4.0	0.2
5	19.57	7.75	11.82	0.42	0.05	0.79	10.0	3.0	2.0	4.0	0.2
6	24.38	8.14	16.24	0.42	0.06	0.28	10.5	3.0	2.0	3.6	0.2
7	23.10	6.47	16.63	0.42	0.01	0.28	13.8	5.5	2.5	3.6	0.2
8	21.00	5.04	15.96	0.42	0.02	0.20	13.8	7.0	1.0	3.6	0.2
9	16.48	5.44	11.04	0.42	0:05	0.45	16.4	5.5	2.0	3.4	0.2
10	23.92	6.91	17.01	0.42	0.06	0.48	16.6	5.5	2.0	3.2	0.2
11	19.76	8.15	11.61	0.42	0.03	0.38	17.5	5.5	4.0	4.2	0.2
12	19.76	7.24	12.52	0.42	0.02	0.38	17.4	5.0	3.5	4.6	0.2
13	20.80	8.24	12.56	0.42	0.02	0.38	13.3	3.5	2.5	4.2	0.2
14	21.00	7.98	13.02	0.53	0.02	0.28	18.9	6.5	4.5	4.2	0.2

$CaCO_3$ content is comparatively low on the convex summit as the drainage may take the CO3s to the valley bottom. Mahalingam and Durairaj (1968) also observed in Nilgiri soils the decrease of time with the increase in elevation. Organic carbon is generally low in all the profiles, the amount decreasing with increasing depth, indicating the low fertility status of the soils. This might be due to continuous cultivation of soil without adding organic manures.

Iron and aluminium axides are generally high. Among these sesquioxides, aluminium oxides contribute higher proportion than iron oxides as reported by Ghabru and Ghosh (1980). The percentage of sesquioxides is high in the convex slope than in the summit or in the valley bottom. This variation may be due to the movement of sesquioxides in free form. Total calcium is fair in all the three profiles. Total P_2O_5 is low in the all the profiles indicating that it dimini-

shed due to continuous cropping. In profile No. (iii) the total P was found decrease in the profile along the traverse in relation to degree of weathering. Godfrey and Reicher (1954) also made similar observations and brought the relationship between the distribution of P and the stage of soil development. Total K_2O is medium to high due to the presence of higher amounts of K bearing minerals in the soil.

Cation exchange capacity is medium. There is a general increase in CEC and exchangeable bases in convex slope and valley bottom than in convex summit. This difference is due to the variation in the proportion of clay as accounted by Chakraborthy *et al.*, (1984).

A study of the morphological, physical and chemical characteristics of the Kalrayan hill soils occurring in different toposequence was taken up. The results show the many of soil properties such as depth, texture, drainage and water table were influenced by the topography. The soils are medium acid to neutral in reaction low in electrical conductivity and hence they can support variety of crops. Low organic matter and P_2O_5 content indicate their deplishment due to continuous cropping. Medium to high K_2O content is due to the presence of K bearing minerals in the soils. The cation exchange capacity is medium and is contributed by the amount of clay and type of clay mineral.

REFERENCES

BOUL, S. W., F. D. HOLE and R. J. Mc CRACKEN. 1973. Soil genesis and classification. Iowa State Univ. Press, Amer. U. S. A.

CHAKRABORTHY, S. K., H. SINHA and B. S. MATHUR. Morphological and physico-chemical properties of some alluvial soils of Assam. J. Indian. Soc. Soil. Scie. 32. 128-136.

GHABRU, S. K. and S. K. GHOSH. 1980. Morphology, genesis and classification of two soil profiles from the Dhauladhar Range of middle Siwaliks. 1980. J. Indian. Soc. Soil Sci. 28 154-161.

GODFREY, C. L. and F. P. REICHEN. 1954. Distribution of P in some genetically related loess derived soils. Soil Sci. Soc. Amer. Proc. 18 : 80-84.

JACKSON, M.L. 1958. Soil Chemical Analysis, Constable & Co., London

IARI. 1970. Soil Survey Manual, New Delhi.

KANDASWAMY, P., G.V. KOTHANDARAMAN and A. DHANAPALAN MOSI. 1965. Studies on a catena in Coimbatore District. II. Physical Properties. Madras agric. J.52 (9) : 377-385.

MAHALINGAM, P. K. and D. J. DURAIRAJ. 1968. A study of the Physical and Chemical Properties of high level soils of the Nilgiris. Madras agric. J. 55 : (7) : 314-319.

PIPER, C.S. 1950. Soil and Plant Analysis, New York. Inter-science Publishers.

Soil Survey Staff, 1951. Soil Surey Manual. U.S.D.A. Agrl. Hand Book No. 60.