STUDIES ON CEYLON SOILS

XII. SOME CHARACTERISTIC BUT LESS EXTENSIVE SOILS OF THE DRY ZONE

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IN this paper the textural, chemical and profile data of some characteristic soil groups of the dry zone are furnished, and the rough distribution and suitability of the soils for crops indicated. The five soils studied were the black heavy loams of Tunukkai, similar to the black cotton soils of India; the white calcareous loams of Delft Island, of marked similarity to the chalk soils of England; the deep red loams of the Hambantota district and the allied reddish brown loams of the Tangalla district; and the light sandy loams of parts of the Eastern Province. The same methods of analysis as previously were adopted for these soils, with a few exceptions. Readily available Phosphoric acid was determined by the Truog (1) method in all but the calcareous soils for which this method is not applicable. Replaceable bases in the case of one of the calcareous soils were estimated by Williams' (2) method. Calcium carbonate was determined, in addition, in the calcareous soils. The analytical data are shown in table I.

Tunukkai Black Heavy Loam

Location	..	Tunukkai
Elevation ..	..	Sea level
Climate ..	..	Rainfall : 40 in. (approx.) ; temperature 82° F.
Geological origin	..	Felsphatic gneiss overlain by sedimentary limestone in places
Mode of formation	..	Residual
Topographic position	..	Flat
Drainage	..	Imperfect to poor
Vegetation ..	..	Xerophytic scrub jungle ; wood apple

Profile

A. 0->3 ft.	Black compact heavy loam with nodules of limestone interspersed in places ; reticulate to small clod ; hard and difficultly friable ; cracks abundant in dry weather ; streaks of rust brown due to decomposing roots ; root growth confined to upper soil layer.

The characteristic black soil found at Tunukkai village, about 16 miles from Mankulam in the Northern Province, covers a reported extent of about 16 square miles or approximately 10,000 acres. Reference to this soil type was first made in 1921 by Stockdale, Marshall and Bruce (3) in an article in *The Tropical Agriculturist* entitled " Cotton Soils in the Mannar District ". From the description, the soils appeared to resemble closely the black cotton soils of India described by Bal (4) and others. The rainfall of the area is probably about 40 inches, practically all of which occurs during the north-east monsoon. The vegetation is typical xerophytic, low scrub jungle. Soil drainage is imperfect, the soil being reported to be somewhat water-logged in the rainy season. The soil, which shows no apparent change in colour, appearance and general characteristics with depth, is from 18 in. to 15 ft. deep. Interspersed within the soil, at varying depths but generally within the first foot, are nodules of limestone of varying sizes. In certain places underlying the soil, slabs of limestone similar to the Jaffna Miocene series occur. The limestone is, apparently, a superficial deposit overlying felsphatic gneiss. In the dry season the soil shows deep cracks of a depth, in places, of 6 feet or more.

The analysis of a typical soil sample shows that it is a heavy loam, poor in organic matter and nitrogen, rich in both available and total lime, and alkaline in reaction. Analysis for total potash and phosphoric acid showed it to contain 0·196 and 0·091 per cent. of these constituents respectively. The soil is, therefore, fairly well supplied with potash, but is somewhat deficient in phosphoric acid. The texture varies to some degree as will be apparent from Bruce's analyses (4). The soil is non-lateritic in nature. The iron content of the clay fraction is low. Bruce found a high percentage of magnesia in the soil and this may account for its stickiness, when wet, and poor drainage.

In respect of its morphological characters, chemical composition and the rainfall conditions under which it has been formed, the soil is similar to the black cotton soils of India. It makes an excellent paddy soil, yields of 60 bushels being reported, and would appear to be quite suitable for cotton, dhal and probably tobacco and chillies. Soil drainage will appear to be necessary. On the deeper soils, provided adequate drainage

is given, fruits like mangoes would probably do well. Successful citrus cultivation is problematic, but if citrus is grown, irrigation would be necessary in the dry season and good soil drainage in the wet season.

Delft Calcareous Loam

Location ..	.. Delft Island
Elevation ..	.. Sea level
Climate	.. Rainfall : 46 in. (approx.) ; temperature : 80° F.
Geological origin	.. Sedimentary limestone (Miocene)
Mode of formation	.. Residual
Topographic position	.. Flat
Drainage ..	.. Good
Vegetation ..	.. Pasture grass, dry grains, palmyrah palms

Profile

A1. 0-9 in.	.. Greyish white calcareous loam ; compact ; cubical to small columnar ; fairly hard but friable ; root growth good ; horizon boundary indistinct.
A2. 9 in - > 3 ft.	.. Similar to A1 but of slightly heavier texture and more compact ; overlying limestone

The greyish-white calcareous loam of Delft Island which is entirely comprised of Miocene limestone occurs only to a limited extent on the Island. It is very closely allied to the *rendzinas* or the chalk soils of Britain. Its texture increases slightly with depth. The soil is poor in organic matter and nitrogen. Phosphoric acid is present in good supply, to judge from the analysis of a sample of pasture grass from the area which showed a phosphoric acid content of 0·83 per cent. against an average of 0·36 per cent. for Ceylon pasture grasses. The soil contains no lesss than 56 per cent. of calcium carbonate and is markedly alkaline in reaction. It is non-lateritic in nature with a silica/alumina ratio of 2·78. Dry grains, leguminous crops and pasture grasses are grown successfully on it. Dhal would appear to be a very suitable crop for the area, and also soybeans and cotton. The pasture, as would be expected, is very rich in lime, a sample being found to contain no less than 3·8 per cent. of this constituent.

Hambantota Brick Red Loam

Location ..	.. 3 miles from Hambantota
Elevation ..	.. About 50 ft.
Climate ..	.. Rainfall : 42 in. (approx.) ; temperature : 81° F.
Geological origin	.. Pleistocene plateau deposits over felsphatic gneiss
Mode of formation	.. Probably transported (aeolian) deposits over residual material
Topographic position	.. Flat
Drainage	.. Very good.
Vegetation ..	.. Low scrub jungle

Profile

A.	0- >10 ft.	.. Uniform brick red loam; loose and friable; columnar to irregular prismatic structure breaking down to single grain
C.	10-13 ft.	.. Reddish brown gravelly loam with high proportions of ironstone nodules in various stages of decomposition; pan-like layer formed from decomposing gneiss.

The Hambantota brick-red loam varies in depth from 10 to 30 ft. or more. The soil of the A horizon is uniform in colour and texture and probably derived, in part, from wind-borne deposits. It is probably also a residual product of hornblende gneiss. The soil of the B horizon is a reddish-brown heavy loam, and is obviously derived from the gneiss. It contains a high proportion of decomposing ironstone nodules and hydrated alumina. The soil is poor in organic matter and nitrogen but has a fair content of bases. The replaceable lime content is only about 50 per cent. of the total bases, suggesting that either the rock is rich in magnesian minerals or that dolomitic limestone has had some influence on the constitution of the soil. In reaction it is alkaline. It is poor in available phosphoric acid and is slightly lateritic in nature. The soil of another profile in the Hambantota district (5) was observed, however, to be of the non-lateritic type. Variations in local conditions are doubtless responsible for this observed difference.

The soil of the A horizon, though a loam, has low cohesive power. Soil erosion of the gully type is very severe at the place the profile was investigated. The extent of these soils is not great and, owing to a deficient rainfall, successful crop cultivation is difficult. They are, however, from the standpoints of texture and depth, very suitable for fruit cultivation.

/Middeniya Red-Brown Loam

Location ..	.. Middeniya
Elevation ..	.. About 250 ft.
Climate	.. Rainfall: 67 in. (approx.); temperature: 81° F.
Geological origin	.. Pleistocene plateau deposits overlying felsphatic gneiss
Mode of formation	.. Transported (aeolian) overlying residual material
Topographic position	.. Undulating to slightly hilly; sample from bottom of gentle slope
Drainage	.. Very good
Vegetation ..	.. Citrus and other fruits, rotation crops

Profile

A.	0 - >3 ft.	.. Uniform reddish-brown loam of depth greater than 6 feet in places, overlying loam containing ironstone nodules; fairly hard and compact but friable; irregular columnar; root growth good

This soil appears to be a modification of the Hambantota type, and is similar in many respects to the red lateritic earth of Mullaittivu described in a previous paper (6). It is a deep uniform loam of poor organic matter and nitrogen content and has a carbon/nitrogen ratio of 10·8. In reaction it is alkaline. Its replaceable base content is low, calcium constituting only about 50 per cent of the total. It is also low in available phosphoric acid. The soil is somewhat lateritic in type, with a silica/alumina ratio of 1·8. In origin it is probably a wind-borne deposit overlying residual gneissic material. The soil occurs in fairly appreciable extents in the Tangalla district and vicinity. Physically, it is ideal for fruit crops, particularly citrus, but is equally suited for cotton, dry grain and other rotation crops. Manuring with bulky organics and, where citrus is grown, the periodical application of lime would be necessary.

Kiliveddi Sandy Loam

Location ..	.. Kiliveddi
Elevation ..	.. About sea level
Climate	.. Rainfall : 68 in. (approx.) ; temperature : 82° F.
Geological origin	.. Recent
Mode of formation	.. Transported ; alluvial
Topographic position	.. Flat to gently sloping
Drainage ..	.. Good
Vegetation ..	.. Scrub jungle

Profile

A.	0-14 in.	.. Dark brown sandy soil ; fairly hard when dry but very friable ; single grain ; root growth good ; horizon boundary fairly distinct
C.	14 in.-3 ft.	.. Dark grey sandy loam ; fairly loose and friable ; root growth good

This soil type is typical, in respect of texture, of the forest soils of the Eastern Province. It is a dark-brown, light, sandy loam which increases in heaviness with depth. The lower horizon of this profile contains a high proportion of gravel composed mainly of potsherds, indicating probably that it was the site of human habitation in the past. One other characteristic of this soil is its very high content of readily-available phosphoric acid. It is probable that this is purely local and due to some abnormal factor *e.g.*, the decay of animal remains. The soil is low in organic matter, but strangely enough has a higher carbon content in the lower than in the upper horizon. In reaction the upper horizon is alkaline and the lower slightly acidic. The soil is fairly well supplied with replaceable bases and is of the non-lateritic type. It is at present

being experimentally cultivated with sugar cane under irrigation, and would be very suitable for cultivation with fruits and cashew nuts.

SUMMARY

In this paper the profile and analytical data of five less extensively occurring, but characteristic soil types of the dry zone—the black heavy loams of Tunukkai, similar to the black cotton soils of India, the light grey calcareous loams of Delft Island, similar to the chalk soils of Britain, the brick-red and brown deep loams of the dry, south-eastern parts of the Island, and the light sandy soils of the Eastern Province—are furnished and the suitability of the soils for crops discussed and their rough distribution indicated.

TABLE I.

	Tunukkai	Delft		Hambantota		Middeniya	Kiliveddi	
	A %	A %	C %	A %	C %	A %	A %	C %
Mechanical Analysis								
Stones and gravel	10·1	nil	nil	nil	12·7	nil	3·4	23·5
Coarse sand	24·9	—	—	45·3	34·1	38·5	44·1	48·2
Fine sand	22·4	14·7	7·3	22·8	19·7	28·1	37·5	30·6
Silt	8·9	2·9	2·8	3·3	5·0	4·1	5·4	6·4
Clay	31·7	17·2	21·9	25·1	34·1	27·2	10·3	11·7
Loss by solution	6·1	61·1	62·6	1·1	2·6	0·5	0·9	1·0
Moisture	6·0	4·1	5·4	2·4	4·5	1·6	1·8	2·1
Texture index number	29·5	15·7	20·2	23·0	31·3	25·0	9·8	11·3
Soil type	Heavy loam	Light loam	Loam	Loam	Heavy loam	Loam	Sand	Sandy loam
Chemical Analysis								
Loss on ignition	5·12	16·90	12·06	3·73	4·06	4·02	2·67	3·64
Combined water	4·24	15·52	11·29	2·94	3·48	3·21	1·04	1·14
Organic matter	0·86	1·38	0·77	0·79	0·58	0·81	1·63	2·58
Carbon	0·505	0·803	0·449	0·458	0·336	0·469	0·943	1·50
Nitrogen	0·069	0·094	0·050	0·044	0·034	0·043	0·069	0·073
Carbon/nitrogen ratio	7·40	8·56	9·00	10·58	9·88	10·85	13·67	20·55
Reaction (pH)	8·6	8·4	8·4	8·1	8·1	7·9	7·7	6·4
Total exchangeable bases (m.e. per 100 gm. soil)	76·5	—	—	6·01	6·49	4·11	8·89	7·72
Exchangeable calcium	43·3	—	—	2·99	3·15	2·09	7·49	5·61
Readily available phosphoric acid (mgm. per 100 gm. soil)	—	—	—	0·59	0·46	0·43	35·5	27·6
Calcium Carbonate	3.64	56·73	58·14	—	—	—	—	—
Clay Analysis								
Loss on ignition	23·36	19·79	—	20·38	19·54	18·76	18·41	—
Silica (SiO_2)	53·12	51·02	—	41·58	43·04	43·08	52·76	—
Sesquioxides (R_2O_3)	37·10	39·35	—	55·85	51·60	51·55	34·95	—
Alumina (Al_2O_3)	31·98	31·12	—	40·68	38·46	40·26	18·29	—
Iron oxides (Fe_2O_3)	5·12	8·23	—	15·17	13·14	11·29	16·66	—
SiO_2/Al_2O_3 (molecular)	2·81	2·78	—	1·74	1·89	1·81	4·90	—
SiO_2/R_2O_3	2·56	2·38	—	1·40	1·55	1·54	3·09	—
Soil type	Non-lateritic	Non-lateritic		Lateritic		Lateritic	Non-lateritic	

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