STUDIES ON CEYLON SOILS

VIII. THE FERNLAND (KEKILLA) AND SOME DRY AND SEMI-DRY ZONE SOILS

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IN continuation of the studies on the major soil groups of the Island reported in previous issues of this journal (1), attention was directed to a group of soils popularly known as the *kekilla* (fernland) soils, occupying fairly considerable areas in the moist low and mid-country, and to some types or series of dry and semi-dry zone soils. The profile and analytical characteristics of eight of these soils are described and discussed in this article. They comprise two highland *kekilla* soils, one lowland *kekilla* soil, a parkland (*damana*) soil and a reddish brown loam of the semi-dry zone and one each of the grey-brown, chocolate-brown and chocolate-red loams of the dry zone. The analytical determinations were made as before.

THE FERNLAND (KEKILLA) SOILS

The fernlands (*kekillas*) are a characteristic feature of certain low and mid-country areas having an annual rainfall of 100 inches and over. They furnish their best examples in Sabaragamuwa and in certain parts of the Western Province. *Kekilla* lands are generally situated on hill slopes, but low-lying fernlands of small extent do also occur. Their soil depths vary considerably. The surface soil layer of the average type of fernland is a dark humic loam of a depth varying from 2 to 4 inches. Underlying this is a lateritic or laterite loam of reddish yellow to yellowish red colour, containing varying proportions of quartz gravel and undecomposed or partially-decomposed ferruginous concretions. The typical vegetation

consists of the fern *Gleichenia linearis* (S. *Kekilla*), *Hedyotis fruticosa*, *Doona zeylanica* and the grass *Themeda tremula*. On the better class of fernland where the humic layer is of greater thickness (extending to about 12 inches in rare cases) and the underlying soil of appreciably greater depth and in a more advanced stage of decomposition, the large-leaf fern *Nephrolepsis* is the dominant species. Generally speaking, the *kekilla* lands are not suitable for cultivation with annual or chena crops, probably owing to the very acid nature of the soils. There would, however, appear to be no reason why they should not be rendered suitable for this purpose by adequate liming and proper cultivation. Tea and rubber can be grown very successfully on them. They could also probably be utilised for the cultivation of certain timber species and fruit crops.

The fernlands are not infrequently contiguous with high jungle (*mukalana*) on the same hill slope and the lines of demarcation are often clear and regular. This appears to indicate that the fern is a secondary growth having succeeded *mukalana* jungle when the latter was cut down or burnt. The periodic firing of these fernlands would account, partly at any rate, for the stability of their vegetation. On the other hand, the view is held that these fernlands have existed as such within living memory. This does not, however, preclude the possibility that the forest was cut down two or three centuries previously and that it has been superseded by fernland for nearly as long a period.

Notwithstanding the high air temperatures, rainfall conditions obtaining in these fernland areas—steady, almost continuous showers throughout the year—are favourable for the accumulation of humus even on hill slopes, provided the cover of vegetation is good. The variable depth of the surface humic layer, while doubtless related to the nature of the underlying soil, is also connected with the frequency of the firing of the fernlands. With each burn the humus layer is partly destroyed, and in the interval between the burn and the regrowth of the fern, erosion takes its toll. The more frequent the burn therefore, the less the depth of humic soil. The humus accumulation will be the greater, the longer the vegetation is left undisturbed.

Two hillside profiles, one representative of the better class and the other the average fernland, and one lowland *kekilla* profile are described below. Their analytical data are presented in table I.

GOOD HIGHLAND (KEKILLA) SOIL

Location	Liniyawa
Elevation	300-400 ft.
Climate	Rainfall 164 in. ; temperature 80°F.
Geological origin ..	Igneous
Mode of formation ..	Residual
Drainage	Fairly good
Topographic position ..	Hilly (sample midway down slope)
Vegetation	*Gleichenia, Nephrolepsis*, etc.

PROFILE

A1. 0-6 in. Blackish brown gravelly loam with abundance of humic material and ferruginous gravel and small boulders ; loose and friable ; amorphous ; root growth good ; horizon boundary distinct.

A2. 6-14 in. Light brown sandy loam with small proportion of humic material ; ferruginous gravel and small boulders in fair proportion ; loose ; irregular prismatic ; roots fair ; horizon boundary fairly distinct.

C. 14 in.-> 3 ft. Yellowish gravelly loam with abundance of ferruginous and quartz gravel and boulders ; compact ; fairly friable ; irregular prismatic to clod ; root growth fair.

AVERAGE HIGHLAND (KEKILLA) SOIL

Location	Bulathsinghala, Pasdun Korale
Elevation	100-200 ft.
Climate	Rainfall > 100 in.; temperature 80°F.
Geological origin ..	Gneiss
Mode of formation ..	Residual
Drainage	Good
Topographic position ..	(Hilly sample from bottom of slope)
Vegetation	*Gleichenia*, etc.

PROFILE

A.	0-9 in.	Dark brown gravelly loam ; 3 in. of partly decomposed humic material ; concretions in abundance ; loose and friable ; granular ; root growth good ; horizon boundary fairly distinct.
C1.	9 in.-2 ft.	Yellowish grey gravelly loam with fair proportion of undecomposed and partly decomposed reddish ferruginous concretions, giving mottled appearance ; conglomerate; root growth poor.
C2.	> 2 ft.	Hard lateritic material.

LOW-LYING FERNLAND (KEKILLA) SOIL

Location	Homagama
Elevation	20-30 ft. above sea level
Climate	Rainfall 120 in. (approx.) ; temperature 80°F.
Geological origin ..	Recent deposits over Charnockite
Mode of formation ..	Transported (alluvial)
Drainage	Impeded
Topographic position ..	Flat
Vegetation	Ferns, *Hedyotis*, etc.

PROFILE

A.	0-13 in.	Blackish grey sandy loam ; ferruginous gravel in small proportion ; friable ; fairly compact ; granular to small clod ; root growth good.
C.	13 in.-3 ft.	Yellowish grey compact sandy loam with reddish brown decomposing ferruginous concretions and quartz gravel in fair quantity ; small clod to granular ; drainage poor ; water below 3 ft.

TABLE I

	Good Highland Fernland (Kekilla) Soil			Average Highland Fernland (Kekilla) Soil		Lowlying Fernland (Kekilla) Soil	
	A1	A2	C	A	C	A	C
Mechanical Analysis							
Stones and gravel	25·3	5·8	16·8	49·7	50·8	2·4	9·9
Coarse sand	54·2	55·2	56·2	50·1	53·5	60·3	62·0
Fine sand	21·8	21·1	19·5	28·0	25·3	18·6	15·9
Silt	5·1	3·4	3·5	3·1	2·7	3·8	3·8
Clay	15·4	16·6	17·5	13·9	13·9	14·4	13·8
Loss by solution	0·9	0·5	0·6	2·3	1·7	1·1	1·5
Moisture	2·6	3·2	2·7	2·6	2·9	1·8	3·0
Texture index number	14·5	15·5	16·7	13·1	13·0	13·5	12·9
Soil type	Gravelly loam	Sandy loam	Gravelly loam	Gravelly loam	Gravelly loam	Sandy loam	Sandy loam
Chemical Analysis							
Loss on ignition	7·53	6·14	6·24	6·79	6·67	4·71	3·53
Organic matter	3·68	2·36	1·51	5·19	1·38	2·45	·79
Combined water	3·85	3·78	4·73	1·60	5·29	2·26	2·74
Carbon	2·13	1·37	0·87	2·91	0·78	1·40	0·45
Nitrogen	0·113	0·079	0·065	0·091	0·041	0·077	0·035
Carbon/nitrogen ratio	18·8	17·3	13·5	32·2	9·4	18·1	12·7
Reaction	5·1	5·0	4·8	5·0	5·0	4·6	5·1
Total lime	0·099	0·085	0·085	0·028	0·035	0·049	0·028
Total phosphoric acid	0·045	0·048	0·033	0·049	0·050	0·048	0·039
Total potash	0·086	0·094	0·201	0·145	0·151	0·187	0·156
Total exchangeable bases (m.e. per 100 gm. soil)	2·54	2·05	1·02	1·03	0·71	1·08	0·88
Exchangeable calcium	1·09	0·70	0·80	0·78	0·69	0·88	0·69
Exchangeable sodium	—	—	—	—	—	—	—
Clay Analysis							
Loss on ignition	29·87			21·61		25·93	
Silica (SiO_2)	21·74			34·12		33·17	
Sesquioxides (R_2O_3)	45·63			42·39		37·28	
Alumina (Al_2O_3)	30·29			38·35		32·04	
Iron oxides (Fe_2O_3)	15·34			4·04		5·24	
SiO_2/Al_2O_3 (molecular)	1·22			1·51		1·74	
SiO_2/R_2O_3 (molecular)	0·89			1·43		1·58	
Soil type	Laterite			Lateritic		Lateritic	

A comparison of the profile characteristics and analytical data of the average and better quality highland fernland soils will indicate that the humic A horizon is greater in the latter than in the former, being 9 and 14 inches respectively; the percentages of quartz and ferruginous gravel are much higher in the average *kekilla* soil, while the depth of soil is greater in the better type of fernland. The carbon contents vary from 2·1 to 2·9 per cent. in the A horizons to 0·78 to 0·87 per cent. in the C horizons. The nitrogen contents of all horizons of the better class fernland are higher than those of the corresponding horizons of average fernland. The nitrogen contents of the A1 horizon of the former is fair (·113 per cent.). The C horizons have low percentages of this constituent—·065 and ·041 respectively. The carbon/nitrogen ratios vary from 32·2 to 9·4 in average fernland and from 18·8 to 13·5 in good fernland. The soils are all markedly acid in reaction with pH values varying from 4·8 to 5·1. They are all poor in exchangeable bases, lime, phosphoric acid and to a lesser degree in potash. The better fernlands have however comparatively much higher exchangeable base and lime contents than average fernlands, the figures being respectively 2·5 mgm. equivalent and ·099 per cent. against 1·1 mgm. equivalent and ·028 per cent. in the A horizons. On the basis of the clay analysis of the A horizons, the good fernland has a laterite top soil with a silica/alumina molecular ratio of 1·22 and the average fernland a lateritic top soil with a ratio of 1·51. The former has however a much higher iron oxide content than the latter. It is likely that the C horizons of both types of fernland would have soils of a lateritic nature.

The low-lying fernland differs from the highland fernlands discussed above in having low proportions of stones and gravel in its different horizons. These soils are sandy loams, the texture remaining constant with depth. Like in the highland profiles, the various soil horizons are poor in fertilising constituents, but have even lower carbon and nitrogen contents. In reaction they are again markedly acid. The silica/alumina ratio of the clay complex of the A layer is 1·74, indicating that the soil is lateritic in type.

THE DAMANA SOIL OF THE SEMI-DRY ZONE

The *damanas*, also known as *talawas* in certain districts, are parklands occurring in the dry and semi-dry zones, characterised mainly by the presence of grasses, among others *Chrysopogon aciculatus* (Love grass), *Dactyloctenium aegyptiacum* and *Chloris barbata*, and a few xerophytic low trees and shrubs. The soil proper varies in depth from 3 or 4 in. to 15 or 18 in., but is generally shallow. The underlying strata is semi-decomposed or partly decomposed rock. The profile described below is typical of an area under the Minneriya Scheme which has been considered, if not unsuitable for paddy, at any rate far from ideal for the crop. The grasses die down during the drought, owing to the shallow depth of soil and its low water-retaining capacity. The *damanas* are therefore not suitable as natural pasture lands. They could however be utilised for the growth of fodder grasses under irrigation. Table II furnishes the analytical data of this soil profile.

PARKLAND (DAMANA) SOIL

Location	Minneriya
Elevation	300 ft.
Climate	Rainfall 73 in. (approx.); temperature 81·5°F.
Geological origin ..	Recent deposits over metamorphic rock
Mode of formation ..	Transported (alluvial)
Drainage	Impeded
Topographic position ..	Flat
Vegetation	Grass and xerophytic shrubs

PROFILE

A.	0-8 in.	Greyish brown, friable loam; compact; small clod; root growth good.
C1.	9-27 in.	Light brown sandy loam; hard and compact but friable; nodular ferruginous concretions; root growth poor.
C2.	> 27 in.	Decomposing rock.

TABLE II

	Damana Soil		*Reddish Brown Loam*	
	A	C	A	C
Mechanical Analysis				
Stones gravel	11·3	12·8	17·4	25·8
Coarse sand	41·1	37·0	43·8	32·5
Fine sand	38·8	37·6	25·0	27·9
Silt	1·5	3·5	6·7	14·8
Clay	16·2	19·2	20·8	19·7
Loss by solution	0·6	0·5	1·2	1·7
Moisture	1·8	2·2	2·5	3·4
Texture index number	15·1	18·0	19·6	19·3
Soil type	Sandy loam	Sandy loam	Gravelly loam	Gravelly loam
Chemical Analysis				
Loss on ignition	2·91	2·46	4·21	4·33
Organic matter	1·41	0·70	2·41	1·76
Combined water	1·50	1·76	1·80	2·57
Carbon	0·80	0·40	1·39	1·02
Nitrogen	0·078	0·049	0·109	0·080
Carbon/nitrogen ratio	10·3	8·1	12·8	12·8
Reaction	5·9	6·2	6·6	6·4
Total lime	0·273	0·259	—	—
Total phosphoric acid	0·018	0·015	0·060	0·041
Total potash	0·504	0·708	0·320	0·310
Total exchangeable bases (m.e. per 100 gm. soil)	6·13	8·62	10·36	9·83
Exchangeable calcium	4·76	4·82	7·47	7·03
Calcium carbonate	—	—	0·54	0·84
Clay Analysis				
Loss on ignition	20·93		22·10	
Silica (SiO_2)	36·81		45·00	
Sesquioxides (R_2O_3)	40·45		46·04	
Alumina (Al_2O_3)	29·21		29·46	
Iron oxides (Fe_2O_3)	11·24		16·58	
SiO_2/Al_2O_3 (molecular)	2·15		2·59	
SiO_2/R_2O_3 (molecular)	1·71		1·90	
Soil type	Non-lateritic		Non-lateritic	

A glance at this table will indicate that the soil is a sandy loam, its texture becoming slightly heavier with depth. Both A and C horizons are poor in organic matter and nitrogen, acid in reaction, rich in potash and to a lesser degree in lime, but very poor in phosphoric acid. They are fairly rich in exchangeable bases, containing 6·1 and 8·6 mgm. equivalents in the A and C horizons respectively. On analysis of the clay fraction of the A horizon, a silica/alumina molecular ratio of 2·14 is obtained, indicating that the soil is of a non-lateritic nature.

THE SEMI-DRY ZONE REDDISH BROWN LOAM

In the same area as the soil just described, occur large extents of a dark reddish brown free-working loam, of 3 foot depth and greater, carrying low to medium jungle. These soils can be utilised with advantage either for paddy or for fruit cultivation. A typical profile is described below and its analytical characteristics shown for comparison with the previous soil in table II.

THE REDDISH BROWN LOAM

Location	Minneriya
Elevation	300 ft.
Climate	Rainfall 73 in. ; temperature 81·5°F.
Geological origin ..	Recent on metamorphic rocks possibly dolomitic limestone
Mode of formation ..	Transported and residual
Drainage	Satisfactory
Topographic position ..	Flat
Vegetation	Low to medium jungle

PROFILE

A. 0-9 in. Dark reddish brown loam overlain by one inch of humic material ; fair proportion of ferruginous gravel ; fairly hard but friable ; irregular small clod ; slightly acid ; root growth good ; horizon boundary indistinct.

C. 9 in.-> 3 ft. Reddish brown loam; fair proportion of decomposed ferruginous nodules and quartz gravel; irregular clod: slightly acid; root development good.

An examination of the analytical data would indicate that the soils are medium loams, containing a fair proportion of stones and gravel, which increases slightly with depth Unlike the *damana* soils, these are fairly well supplied with organic matter and nitrogen. Their carbon/nitrogen ratios are about 12·8 They are acid in reaction, though not markedly so, rich in exchangeable bases (containing 10·4 and 9·8 mgm. equivalents respectively in the A and C horizons), potash and evidently in lime. Small percentages of free calcium carbonate are noted. Like the *damana* soils, they are poor in phosphoric

acid. The silica/alumina ratio of the clay complex is 2·59 indicating that the soil is non-lateritic in nature. The general similarity in mineral composition of the *damana* and this type of soil would point to the rock from which they are derived being rich in potash and lime and poor in phosphoric acid. There is some indication that the soil composition is influenced to some degree by the dolomitic limestone occurring in close vicinity.

THE DRY ZONE SOILS

THE CHOCOLATE BROWN LOAM

This type of soil occurs in certain parts of the dry zones where the topography permits of the accumulation of alluvial deposits, both mineral and organic. The A horizon is consequently of a distinctly darker colour than the lower horizons. Gravel deposits occur mainly in the C1 horizon. These soils are suitable for the cultivation of dry zone annuals or perennial crops, like citrus, but irrigation is often necessary for the latter. A typical profile taken in the Anuradhapura district is described below and the analytical data shown in table III.

CHOCOLATE BROWN LOAM

Location ..	.. Anuradhapura Experiment Station
Elevation ..	.. 150 ft.
Climate ..	.. Rainfall 55 in. ; temperature 81°F.
Geological origin	.. Recent and possibly dolomitic limestone
Mode of formation	.. Transported (alluvial and possibly residual)
Drainage ..	.. Impeded
Topographic position	.. Flat
Vegetation ..	.. Dry zone crops ; fruits

PROFILE

A.	0-6 in.	Dark chocolate brown sandy loam ; small clod; compact ; hard but friable ; root growth good.
C1.	6-28 in.	Reddish brown loam ; compact but fairly friable ; quartz gravel in fair proportions ; irregular clod approximating columnar structure ; mottlings of grey ferrous oxide.
C2.	28 in.-> 3ft.	Same as C1 but more compact.

TABLE III

	Chocolate Brown Loam			*Chocolate Red Loam*			*Grey Brown Loam*	
	A	C1	C2	A	C1	C2	A	C
Mechanical Analysis								
Stones and gravel	7·0	14·3	7·9	13·6	27·9	17·1	1·4	0·9
Coarse sand	46·3	38·1	30·3	42·2	36·9	43·1	27·8	30·0
Fine sand	31·1	35·8	28·4	23·0	35·3	30·6	36·5	34·4
Silt	4·9	2·3	3·0	5·3	5·3	9·5	14·4	9·2
Clay	14·6	20·8	33·4	22·6	18·7	13·2	16·7	21·6
Loss by solution	1·4	0·8	0·8	2·5	0·6	0·8	1·9	2·2
Moisture	1·7	2·2	4·1	4·4	3·2	2·8	2·7	2·6
Texture index number ..	13·9	19·3	30·6	21·1	17·7	13·0	16·7	20·6
Soil type	Sandy loam	Loam	Heavy loam	Loam	Gravelly loam	Gravelly loam	Sandy loam	Loam
Chemical Analysis								
Loss on ignition	4·47	3·02	4·50	5·10	4·67	4·03	3·62	2·39
Organic matter	3·49	1·09	0·58	2·82	1·25	0·48	1·87	0·67
Combined water	0·98	1·93	3·92	2·28	3·42	3·55	1·75	1·72
Carbon	2·03	0·63	0·34	1·56	0·70	0·27	1·08	0·39
Nitrogen	0·130	0·073	0·066	0·112	0·057	0·028	0·095	0·034
Carbon/nitrogen ratio ..	15·6	8·6	5·1	13·9	12·3	9·9	11·4	11·4
Reaction	7·7	7·7	7·8	8·2	7·5	7·7	6·5	7·2
Total lime	0·473	0·346	0·289	0·317	0·184	0·473	—	—
Total phosphoric acid	0·144	0·108	0·043	0·074	0·048	0·032	0·066	0·056
Total potash	0·515	0·297	0·287	0·164	0·069	0·069	0·470	0·430
Total exchangeable bases (m.e. per 100 gm. soil)	17·05	11·14	14·17	12·98	8·57	16·28	10·24	11·05
Exchangeable calcium	11·57	7·96	8·79	10·38	7·83	15·31	7·37	7·69
Exchangeable sodium	0·68	0·46	0·38	—	—	—	—	—
Calcium carbonate	—	—	—	—	—	—	0·81	0·86
Clay Analysis								
Loss on ignition	24·15	..	..	23·33	..	..	17·88	..
Silica (SiO_2)	34·64	..	..	34·10	..	..	48·10	..
Sesquioxides (R_2O_3)	36·00	..	..	38·03	..	..	43·06	..
Alumina (Al_2O_3)	26·48	..	..	26·80	..	..	30·02	..
Iron oxides (Fe_2O_3) ..	9·52	..	..	11·23	..	..	13·04	..
SiO_2/Al_2O_3 (molecular) ..	2·22	..	..	2·11	..	..	2·72	..
SiO_2/R_2O_3 (molecular)	1·89	..	..	1:79	..	..	2·12	..
Soil type	Non-lateritic	..	..	Non-lateritic	..	..	Non-lateritic	..

The analyses indicate that the surface soil is a sandy loam and that the texture becomes considerably heavier with depth. Thus the clay content increases from 14·6 to 33·4 per cent. from the A to the C horizons. The A horizon is comparatively rich in carbon and nitrogen, but the C horizon is poor in these constituents, particularly the former. The carbon/nitrogen ration decreases from 15·6 to 5·1 with increasing depth. The soils are distinctly alkaline in reaction, and this can be attributed to their very high exchangeable base contents. In this and other respects this soil is very similar to soils derived from limestone and, though the parent rock was not discernable, an examination of the geological map appears to indicate that the soil is, partly at any rate, of limestone origin. The facts that exchangeable calcium constitutes less than 70 per cent. of the total bases and that the exchangeable sodium contents are low, point to the probability of the limestone being of a dolomitic nature. All horizons are rich in total lime and potash and the A and C horizons in phosphoric acid as well. These merely tend to confirm the derivation of the soil from limestone material. The clay analysis reveals that the soil is non-lateritic in nature with a silica/alumina ratio of 2·22. On the whole, the analytical evidence is strongly suggestive that this type of soil belongs to the Nalanda crystalline limestone series.

THE CHOCOLATE RED LOAM

Chocolate red loams occur either in the dry or wet zone, where the underlying rock material is limestone, whether crystalline or Miocene. At Vavuniya where this profile was studied the soils are generally deep, well-drained loams with fairly high proportions of ferruginous and calcareous gravel, and are suitable alike for the cultivation of annual crops or perennial crops like fruits, more particularly citrus species. Some form of irrigation is essential for the successful growth of the latter. A typical profile is described below and the analytical data presented in table III.

CHOCOLATE RED LOAM

Location	.. ..	Vavuniya
Elevation	.. ..	50 ft.
Climate	.. ..	Rainfall 58 in. ; temperature 81°F.

Geological origin	..	Crystalline or Miocene limestone
Mode of formation	..	Residual
Drainage ..	..	Good
Topographic position	..	Very gently undulating
Vegetation ..	..	Rotation crops, citrus species

PROFILE

A.	0-8 in.	Chocolate red loam ; fair proportion of ferruginous gravel ; compact ; hard but friable ; irregular clod to columnar structure ; root growth good.
C1.	8 in.-2 ft.	Reddish gravelly loam with abundance of nodular ferruginous quartz and limestone gravel ; compact ; root growth fair.
C2.	> 2 ft.	Reddish brown rock brash ; with fair proportion of nodular ferruginous quartz and limestone gravel.

An examination of the table shows that the surface soil is a loam, while the B and C horizons are gravelly loams. This should make for good drainage. The A horizon is fairly well supplied with organic matter and nitrogen, but the lower strata are poor in these constituents. In reaction the soils are distinctly alkaline. This is due to the nature of the parent rock material and to the high exchangeable base contents of the soils. These vary from 8·6 to 16·3 mgm. equivalents in the different horizons and is highest in the C2 and lowest in the C1 horizon. Exchangeable calcium comprises over 80 per cent. of the total bases. The total lime contents are high but the potash contents are only fair and the phosphoric acid contents, except in the A horizon, poor. These facts would appear to point to crystalline limestone of the calcite type being the probable parent material from which the soil is derived. On the basis of the silica/alumina molecular ratio of the clay complex, *viz.*, 2·11, the soil is non-lateritic.

GREY BROWN PADDY (GLEY) LOAM

Grey brown light loams under paddy occur fairly extensively in the coastal rice-growing belt of the Eastern Province. Provided they have a plentiful supply of irrigation water, and this is often the case, they grow good crops of paddy, from 30 to 40 bushels

per acre being not uncommon. The sub-soil is a typical *gley* horizon with mottlings and streaks of rust brown in a bluish grey loamy matrix. The morphological characteristics of a typical profile are furnished below and its analytical characteristics shown in table III.

GREY BROWN PADDY (GLEY) LOAM

Location	Sengapaddi in Eastern Province
Elevation	Sea level
Climate	Rainfall 60 in. ; temperature 83°F.
Geological origin ..	Recent
Mode of formation ..	Transported (alluvial)
Drainage	Impeded
Topographic position ..	Level
Vegetation	Paddy

PROFILE

A.	0-6 in.	Greyish brown loam ; cloddy ; compact ; fairly hard ; no concretions ; roots abundant ; slightly acid ; horizon boundary distinct.
C.	6 in.-3 ft.	Bluish grey loam with mottlings and streaks of rust brown (*gley*) ; very compact ; hard ; no concretions ; roots absent ; faintly alkaline.

From the table it will be noted that the surface soil is a light loam while the sub-soil is of heavier texture, the clay percentages being 16·7 and 21·6 respectively. The carbon and nitrogen contents of the A horizons are fair, but the C horizons are poor in these constituents. The surface soil is acid in reaction, but the sub-soil is faintly alkaline. The soils are very rich in potash and evidently in lime, but poor in phosphoric acid. The total exchangeable base content is high for Ceylon paddy soils. Exchangeable calcium constitutes about 70 per cent. of the total bases. A small reserve of free calcium carbonate, in the form of marine shell material, exists in both horizons. The analysis of the clay fraction indicates that the soil is distinctly non-lateritic in nature, the silica/alumina ratio being 2·72.

SUMMARY

In the preceding pages an account is given of the morphological and analytical characteristics of typical profiles of highland and lowland fernland (*kekilla*) soils, of parkland (*damana*) soils and the reddish brown loams of the semi-dry zone and of the chocolate red, chocolate brown and grey brown loams of the dry zone.

REFERENCE

Joachim, A.W.R., Kandiah, S. and Panditteseekera, D.G.—Studies on Ceylon Soils. *The Tropical Agriculturist*, Vols. LXXXIV, LXXXV, 1935 & Vol. LXXXVIII, 1937.