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A SEMI-DETAILED SOIL SURVEY,
LAND CAPABILITY/SUITABILITY STUDY FOR OIL PALM CULTIVATION
IN PART OF
SUNGEI SEPUK AND SUNGEI GALASAH AREA FOR
SARAWAK OIL PALM SDN BHD
VOL. 2
SOIL PROFILE DESCRIPTION

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1. INTRODUCTION
2. RED-YELLOW PODZOLIC SOILS

2.1 Merit series
Soil profile no. 37
10'
20'
30'
40'

A SEMI-DETAILED SOIL SURVEY,
LAND CAPABILITY/SUITABILITY STUDY FOR OIL PALM CULTIVATION
IN PART OF
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SARAWAK OIL PALM SDN BHD
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SOIL PROFILE DESCRIPTION

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MALAYSIA SARAWAK
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INTRODUCTION

A total of fifty two soil profiles were examined and described in the surveyed area. In addition, four soil auger examinations were made and described in the poorly drained Gley soils and Organic soils. A total of eighty nine soil samples were collected from twenty four selected soil profiles and auger holes. These were the representatives of the major soils of the surveyed area. Soil samples were analysed for major mechanical and chemical properties in the Ebor Laboratories, Sime Darby Plantations, Kelang, West Malaysia. The location of the soil profiles and auger holes are provided in Appendix 1.

RED-YELLOW PODZOLIC SOILS

Soil profiles were described according to the method laid down in Handbook No.18, U.S. Department of Agriculture, Soil Survey Manual (1951). Soil colours were described according to the Munsell Colour Charts. The terms and modifying adjectives for pores and roots description are provided in Appendix 2.

Soil families and series separation are made in accordance to the revised "Soil Classification in Sarawak" (TIE, 1982)

Soil profile no.	4
Soil name	Merit series
Elevation:	33 to 43 meters
Landform:	Steep
Physiography at site:	Red-slope
Slope at site:	2-4
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	145 cm
Vegetation:	Hill forest
Moisture condition in profile:	Moist throughout

RED-YELLOW PODZOLIC SOILS

Profile Description

A ₀		leaf litter, 2 to 6 cm, thick
A ₁	0-5 cm	Yellowish brown (10YR 5/4), clay loam, moderate, medium and fine subangular blocky and crumbs; friable; some fine pores; abundant fine and coarse roots; clear boundary.
B ₁	5-70 cm	Brownish yellow (10YR 6/6), clay loam, moderately strong, medium and coarse subangular blocky; friable; many very fine pores; frequent fine and medium roots; with brown (10YR 5/3) organic acid coatings on some root surfaces and along few channels; some krotovinas; gradual boundary

Soil profile no.	2
Soil name:	Merit series
Elevation:	30 to 45 meters
Landform:	Steep
Physiography at site:	Mid-slope
Slope at site:	22°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	145 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A _o		leaf litter, 3 to 5 leaves thick
A _h	0-5 cm	Yellowish brown (10YR 5/4); clay loam; moderate, medium and fine subangular blocky and crumbs; friable; many fine pores; abundant fine and coarse roots; clear boundary.
B ₁	5-20 cm	Brownish yellow (10YR 6/6); clay loam, moderately strong, medium and coarse subangular blocky; friable; many very fine pores; frequent fine and medium roots; with brown (10YR 5/3) organic acid coatings on some ped surfaces and along few channels; some krotovinas; gradual boundary

B ₂ 1	20-60 cm	Reddish yellow (7.5YR 6/8) to strong brown (7.5YR 5/8); clay loam; moderately strong, coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky; friable to slightly firm; common fine pores; few, fine and medium roots; moderately developed cutans on most ped surfaces; few krotovinas; gradual boundary
B ₂ 2	60-85 cm	Similar to the horizon above but with very few fine and medium roots; texture is clay; clear boundary
B ₂ 3cn	85-115 cm	Reddish yellow (7.5YR 6/8); clay loam; moderately strong, coarse and very coarse subangular blocky; friable to slightly firm; few fine pores; very few fine and medium roots; with few 5-30 mm gravels of laterites and platy laterised shale; gravels are loosely packed; clear boundary
BC	115-145 cm	Reddish yellow (7.5YR 6/8), strong brown (7.5YR 5/8), brownish yellow (10YR 6/6) and 6/8); clay loam; moderately strong, coarse and medium subangular blocky; friable; few medium pores; very few, very fine roots; some scattered decomposing parent rocks (5 to 20 mm) spaced at 5 to 40 mm apart; interstices are filled with clay loam; tongue boundary
CR	145 cm +	A continuous layer of undecomposed parent material shale

SOIL ANALYTICAL DATA

Soil profile No: 2
Soil name: Merit series

HORIZON	Depth in cm	pH	Elect. cond. µmho/cm	Percentage			Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free Co ₃	CaCO ₃	Organic carbon	Organic matter	H	C/N ratio
				Clay	Silt	Clay												
Ah	0-5	3.75	191	30.8	25.8	20.7	11.0	6.3	1.1	0.6	1.02	N	0.5	1.53	2.63	0.18	8.5	
B1	5-20	3.75	148	30.8	26.2	25.8	7.9	7.3	0.8	0.3	1.28	N	ND	0.57	0.98	0.11	5.18	
B2 1	20-60	4.00	95	38.8	25.3	21.5	6.9	5.9	0.4	0.4	1.34	N	ND	0.22	0.38	0.08	2.75	
B2 2	60-85	4.00	77	42.1	24.0	22.0	5.8	4.1	0.4	0.8	1.43	N	ND	0.20	0.34	0.09	2.22	
B2cm	85-115	4.25	33	37.3	26.3	19.9	5.7	3.8	1.4	2.8	1.52	N	0.3	0.16	0.28	0.06	2.67	
BC	115-145	4.25	36	26.9	27.4	24.2	6.9	6.2	1.6	2.7	1.48	N	ND	0.11	0.19	0.05	2.2	

Horizon	Perchloric Digestible				Perchloric Digestible				me* C/C in NH ₄ OAC	Exchangeable Cation				IES*					
	K	Mg	Ca	Na	P	Cu	Mn	Zn		Total S	Av P	H ₂ O soluble B	K		Ca	Na	AI		
Ah	0.49	0.09	0.02		105	10	25	28	325	12	3.7	9.3	0.15	0.35	0.06	0.11	1.30	0.67	7
B1	0.50	0.10	0.02		95	9	31	34	47	8	1.3	9.2	0.18	0.07	0.01	0.11	1.98	0.37	4
B2 1	0.60	0.13	0.02		95	13	31	45	188	8	0.6	7.1	0.10	0.05	0.02	0.11	2.06	0.28	4
B2 2	0.63	0.14	0.02		90	14	29	49	ND	10	0.6	13.1	0.13	0.04	0.02	0.09	2.17	0.28	2
B2cm	0.77	0.16	0.02		89	12	35	48	ND	8	0.4	12.4	0.13	0.03	0.01	0.09	1.79	0.26	2
BC	0.90	0.16	0.02		70	16	30	44	63	9	0.9	7.7	0.15	0.03	0.01	0.11	1.32	0.30	4

* B.S. = % Base saturation

ND = Not Detected
N = Negligible

Soil profile no.	10
Soil name:	Merit series
Elevation:	30 to 45 meters
Landform:	Undulating (isolated low hill)
Physiography at site:	Very gentle slope
Slope at site:	4°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	60 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 leaves thick
A _h	0-4 cm	Yellowish brown (10YR 5/4); clay loam; moderately strong, fine and medium subangular blocky and crumb structures; friable; many fine pores; abundant very fine to coarse (1-20 mm) roots; clear boundary
B ₁	4-15 cm	Brownish yellow (10YR 6/6 to 6/8); clay; moderate, medium subangular blocky structures; friable; many fine pores; many medium (2-5 mm) roots; weakly developed organic stains; few krotovinas; gradual boundary
B ₂	15-60 cm	Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; many very fine and few medium pores; many medium (2-5 mm) roots; weakly developed cutans; some krotovinas; clear boundary

CR 60-150 cm A continuous layer of decomposing parent material - shale

Soil profile no. 70		Soil name: Neff series									
Depth (cm)	Soil type	Parent material					Soil				
		Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Very coarse sand (%)	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Very coarse sand (%)
0-10	Chc	43.4	21.7	14.5	6.4	1.4	0.04	4	56	2.18	0.16
10-20	Chc	33.4	23.8	16.3	7.1	2.4	1.77	6	38	2.11	0.16
20-30	Chc	32.4	24.0	15.0	6.2	2.3	1.12	8	40	1.98	0.13

Soil profile no. 70		Soil name: Neff series											
Depth (cm)	Soil type	Parent material					Soil						
		Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Very coarse sand (%)	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Very coarse sand (%)		
30-40	Chc	18.6	14	49	19.6	1.7	0.37	30.3	0.21	0.75	0.07	1.05	2.71
40-50	Chc	10.8	11	44	21	1.4	0.3	2.2	0.18	0.55	0.05	1.46	0.95
50-60	Chc	10.7	10	45	24	1.4	0.3	1.9	0.18	0.55	0.05	1.46	0.95

Soil name: Neff series

SOIL ANALYTICAL DATA

Soil profile No: 10

Soil name: Merit series

Horizon	Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio
				Clay	Silt	Very fine sand						
Ah	0-4	3.90	262	33.2	21.7	16.5	0.84	N	2.18	3.75	0.26	8.38
B1	4-15	4.05	130	35.4	23.2	18.3	1.17	N	0.86	1.48	0.14	6.14
B2	15-65	4.00	97	34.4	24.0	18.0	1.16	N	0.48	0.83	0.09	5.33

Horizon	Perchloric Digestible				Total S	Av P	H ₂ O soluble B	meq CEC in NH_4OAC	Exchangeable Cation				B.S.*		
	K	Mg	Ca	Na					K	Mg	Ca	Na			
Ah	0.43	0.10	0.03	195	126	17	3.7	11.3	0.21	0.96	0.97	0.07	1.05	2.21	20
B1	0.48	0.12	0.02	158	31	9	0.9	9.7	0.18	0.58	0.05	0.09	1.44	0.90	9
B2	0.48	0.11	0.02	100	ND	8	ND	10.0	0.13	0.20	0.01	0.06	1.31	0.40	4

* % Base Saturation N = Negligible
 ND = Not Detected

Soil profile no. 51
Soil name: MERIT series
Elevation: 30 to 45 meters
Landform: Steep
Physiography at site: Mid-steep slope
Slope at site: 23°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Presence of surface stones or rock outcrops: Nil
Effective soil depth: 150 cm
Vegetation: Hill forest
Moisture conditions in profile: Moist throughout

Profile Description

A₀ Leaf litters, 3 to 5 leaves thick

A_h 0-3 cm Brown to dark brown (10YR 4/3); clay loam; moderate, fine and medium subangular blocky and few crumb structures; friable; few very fine pores; abundant fine to coarse (1 to 15 mm) roots; clear boundary

B₁ 3-20 cm Yellowish brown (10YR 5/6); clay loam; moderate, coarse subangular blocky breaking into moderately strong, medium and some coarse subangular blocky structures; friable; common fine to medium (1 to 4 mm) pores; many medium (2 to 5 mm) roots; moderately developed light yellowish brown (10YR 6/4) to brownish yellow (10YR 6/6) organic acid coatings on most ped surfaces; many krotovinas; clear boundary

B21 20-55 cm Strong brown (7.5YR 5/8); clay; moderately strong, very coarse and some coarse subangular blocky structures; slightly firm; few fine pores; many medium (2 to 5 mm) and very few coarse (30 mm) roots; many well-developed reddish yellow (7.5YR 6/6) cutans on most ped surfaces; clear boundary

B22 55-120 cm Yellowish red (5YR 5/8) and brownish yellow (10YR 6/6); clay; moderate, very coarse subangular and angular blocky structures; slightly firm; few fine pores; few medium roots; presence of about 5% white (10YR 8/2) blotches; clear boundary

B3cn 120-150 cm Similar to the horizon above but with the presence of about 15% gravels of laterised shale and semi-decomposed shale

SOIL ANALYTICAL DATA

Soil profile No: 51

Soil name: Merit series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CaCO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio
			Clay	Silt	Sand												
Ah	4.05	330	33.0	29.2	20.1	10.6	1.8	0.7	0.5	0.88	N	ND	1.80	3.10	0.29	6.21	
B1	3.80	183	36.0	28.4	21.0	10.8	1.9	0.5	0.4	1.33	N	0.25	1.09	1.87	0.11	9.91	
B21	3.95	113	43.9	25.9	19.1	1.7	8.5	0.4	0.4	1.39	N	ND	0.53	0.91	0.10	5.30	
B22	4.00	83	54.0	24.9	11.8	6.9	1.1	0.5	0.7	1.26	N	0.5	0.24	0.41	0.07	3.43	
B3cn	3.90	112	45.1	26.8	17.4	8.2	1.2	0.3	0.3	1.30	N	0.5	0.26	0.45	0.08	3.25	

Depth in cm	Perchloric Digestible			Perchloric Digestible			me% CEC in NH_4OAC	Exchangeable Cation				TEB	B.S.		
	K	Mg	Ca	P	Cu	Mn		Zn	K	Mg	Ca			Na	Al
Ah	0.69	0.13	0.06	165	11	192	43	7.87	0.26	0.97	2.89	0.10	0.57	4.22	54
B1	0.76	0.14	0.03	125	11	71	49	12.27	0.15	0.21	0.08	0.11	0.93	0.55	5
B21	0.88	0.17	0.02	120	12	59	60	15.87	0.18	0.21	0.05	0.10	1.15	0.54	3
B22	1.15	0.21	0.02	115	13	43	74	9.20	0.18	0.43	0.04	0.09	1.16	0.74	8
B3cn	0.89	0.17	0.02	120	13	61	63	10.00	0.15	0.21	0.05	0.10	1.35	0.51	5

* % Base Saturation
 N = Negligible
 ND = Not Detected

Soil profile no.	57
Soil name:	Merit series
Elevation:	15 to 30 meters
Landform:	Rolling
Physiography at site:	Mid-gentle slope
Slope at site:	90
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	100 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-3 cm	Brown to dark brown (10YR 4/3); clay loam; moderate, fine and some medium subangular blocky and few crumb structures; friable; few fine pores; many fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	3-25 cm	Reddish yellow (7.5 YR 6/8) to strong brown (7.5YR 5/8); clay; moderately strong, coarse and medium subangular blocky structures; friable; few fine pores; few fine to medium (1 to 5 mm) and very few coarse (50 mm) roots; moderately developed yellowish brown (10YR 5/4) organic acid coatings; few krotovinas; gradual boundary
B ₂	25-65 cm	Strong brown (7.5YR 5/8); clay; moderately strong, coarse and some very coarse subangular blocky structures; slightly firm; few fine pores; few fine (1 to 2 mm) roots; many cutans on ped surfaces; few

organic acid coatings; few krotovinas; clear boundary

B3 65-100 cm

Strong brown (7.5YR 5/8) and yellowish red (5YR 5/8); clay; moderately strong, coarse and medium subangular blocky structures; friable; laterised shale (<15 mm); very few fine white (10YR 8/2) blotches; very few krotovinas; abrupt boundary

CR 100-150 cm

A continuous layer of parent bedrock - shale

SOIL ANALYTICAL DATA

Soil profile No: 57

Soil name: Merit series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage		Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CaCO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio
			Clay	Silt												
A _n 0-3	4.45	245	34.1	40.2	16.4	4.9	2.5	1.2	0.5	0.92	N	0.5	3.20	5.50	0.31	10.32
B ₁ 3-25	3.90	180	45.2	29.1	16.7	5.4	2.0	0.6	0.5	1.21	N	ND	1.08	1.66	0.13	8.31
B ₂ 25-65	4.10	115	54.6	26.8	10.7	3.9	1.4	0.7	0.5	1.33	N	0.5	0.56	0.96	0.11	5.09
B ₃ 65-100	4.40	48	49.0	25.6	11.4	5.0	3.0	1.9	1.4	1.33	N	0.5	0.37	0.64	0.10	3.70

Horizon	Perchloric Digestible			Total S	Av P	H ₂ O soluble B	me% CEC in NH_4OAC	Exchangeable Cation			S.S.			
	K	Mg	Ca					K	Mg	Ca		Na	Al	TEB
A _n	0.98	0.23	0.08	188	14	4.6	10.4	0.28	1.37	7.05	0.07	0.32	8.77	84
B ₁	1.06	0.25	0.03	125	8	1.8	9.5	0.21	0.54	1.02	0.10	1.62	1.87	20
B ₂	1.28	0.30	0.02	125	8	1.1	12.7	0.26	0.32	0.03	0.10	2.10	0.71	6
B ₃	1.71	0.34	0.02	263	9	0.4	13.6	0.26	0.31	0.01	0.09	1.45	0.67	5

* % Base Saturation

N = Negligible
 ND = Not Determined
 nd = Not detected

Soil profile no.	58
Soil name:	Merit series
Elevation:	15 to 30 meters
Landform:	Rolling
Physiography at site:	Mid-slope
Slope at site:	90
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	105 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀	Leaf litters; 6 to 8 leaves thick
A _h 0-3 cm	Brown to dark brown (10YR 4/3); clay loam; moderate, medium and fine subangular blocky structures; friable; few fine pores; abundant fine to coarse (1 to 20 mm) roots; clear boundary
B ₁ 3-25 cm	Yellowish brown (10YR 5/6 to 5/8); clay; moderate, coarse and very coarse subangular blocky structures; friable; common fine and micro-pores; many fine to medium (1 to 5 mm) roots; many krotovinas; weakly developed organic acid coatings; gradual boundary
B ₂₁ 25-45 cm	Strong brown (7.5YR 5/8); clay; moderately strong, coarse and some very coarse subangular blocky structures; friable; few fine pores; many fine (1 to 2 mm) roots; patchy cutans; some krotovinas; clear boundary

- B22 45-65 cm Similar to the horizon above but with presence of 5% yellowish red (5YR 5/8) blotches; few fine (1 to 2 mm) roots; patchy cutans; some krotovinas; presence of <5% gravelly shale and platy laterised shale (< 20 mm); gradual boundary
- B3 65-105 cm Strong brown (7.5YR 5/8); clay; moderate, coarse subangular blocky structures; firm; few fine pores; very few fine (1 to 2 mm) roots; presence of 10 to 20% very pale brown (10YR 7/4) and few yellowish red (5YR 5/8) blotches
- CR 105 cm + A continuous layer of semi-decomposed parent rock - shale

Soil profile No. 10
Soil name: Mollisols

Depth (cm)	pH	Clay (%)	Silt (%)	Org. C (%)	Field capacity (%)	Shrinkage (%)	Porosity (%)	Penetration (kg/cm ²)	Moisture (%)
0-5	8.25	22	78.5	45	0.5	2.0	1.0	1.0	1.0
5-22	8.00	18	82	37.7	9.1	1.7	1.4	1.0	1.0
22-45	8.25	70	31.5	20.7	2.5	2.0	2.3	1.0	1.0
45-65	8.00	89	11.7	21.6	4.1	2.1	2.7	1.0	1.0
65-105	7.50	30	70	21.8	5.4	2.2	2.3	1.0	1.0

Soil profile No. 10

SOIL ANALYTICAL DATA

Soil profile No: 58

Soil name: Merit series

Horizon	Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Free CaCO_3	Bulk density	Organic carbon	Organic matter	N	C/N ratio																																																																																																																				
				Clay	Silt	Sand																																																																																																																										
A ₁	0-3	4.35	242	29.9	45.1	9.4	N	0.96	3.80	6.54	0.35	10.86																																																																																																																				
B ₁	3-25	4.15	118	44.0	37.7	9.1	N	1.22	0.60	1.03	0.14	4.29																																																																																																																				
B ₂₁	25-45	4.25	70	51.5	30.7	4.5	N	1.32	0.38	0.65	0.11	3.45																																																																																																																				
B ₂₂	45-65	4.35	60	49.7	31.4	4.7	N	1.45	0.37	0.64	0.10	3.70																																																																																																																				
B ₃	65-105	4.50	35	45.8	31.8	8.4	N	1.32	0.26	0.45	0.08	3.25																																																																																																																				
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Perchloric Digestable</th> <th colspan="2">Perchloric Digestable</th> <th colspan="2">ppm</th> <th colspan="2">meq in NH₄OAC</th> <th colspan="2">Exchangeable Cation</th> <th colspan="2">TEB</th> </tr> <tr> <th>K</th> <th>Mg</th> <th>Ca</th> <th>P</th> <th>Cu</th> <th>Mn</th> <th>Zn</th> <th>Total S</th> <th>Av P</th> <th>H₂O soluble B</th> <th>K</th> <th>Mg</th> <th>Ca</th> <th>Al</th> </tr> </thead> <tbody> <tr> <td>A₁</td> <td>1.13</td> <td>0.21</td> <td>0.12</td> <td>225</td> <td>11</td> <td>53</td> <td>263</td> <td>14</td> <td>5.8</td> <td>10.00</td> <td>0.79</td> <td>1.88</td> <td>5.42</td> <td>0.11</td> <td>0.47</td> <td>8.20</td> <td>82</td> </tr> <tr> <td>B₁</td> <td>1.22</td> <td>0.22</td> <td>0.02</td> <td>160</td> <td>11</td> <td>57</td> <td>263</td> <td>7</td> <td>2.1</td> <td>10.80</td> <td>0.44</td> <td>0.36</td> <td>0.16</td> <td>0.08</td> <td>1.83</td> <td>1.04</td> <td>10</td> </tr> <tr> <td>B₂₁</td> <td>1.74</td> <td>0.29</td> <td>0.02</td> <td>155</td> <td>18</td> <td>70</td> <td>63</td> <td>8</td> <td>0.9</td> <td>14.40</td> <td>0.26</td> <td>0.45</td> <td>0.02</td> <td>0.08</td> <td>2.14</td> <td>0.81</td> <td>6</td> </tr> <tr> <td>B₂₂</td> <td>1.56</td> <td>0.29</td> <td>0.01</td> <td>140</td> <td>21</td> <td>69</td> <td>25</td> <td>9</td> <td>0.4</td> <td>11.20</td> <td>0.39</td> <td>0.38</td> <td>0.02</td> <td>0.10</td> <td>1.89</td> <td>0.88</td> <td>8</td> </tr> <tr> <td>B₃</td> <td>1.58</td> <td>0.29</td> <td>0.01</td> <td>140</td> <td>21</td> <td>68</td> <td>9</td> <td>10</td> <td>0.4</td> <td>11.60</td> <td>0.26</td> <td>0.21</td> <td>0.02</td> <td>0.10</td> <td>1.44</td> <td>0.59</td> <td>5</td> </tr> </tbody> </table>													Perchloric Digestable		Perchloric Digestable		ppm		meq in NH ₄ OAC		Exchangeable Cation		TEB		K	Mg	Ca	P	Cu	Mn	Zn	Total S	Av P	H ₂ O soluble B	K	Mg	Ca	Al	A ₁	1.13	0.21	0.12	225	11	53	263	14	5.8	10.00	0.79	1.88	5.42	0.11	0.47	8.20	82	B ₁	1.22	0.22	0.02	160	11	57	263	7	2.1	10.80	0.44	0.36	0.16	0.08	1.83	1.04	10	B ₂₁	1.74	0.29	0.02	155	18	70	63	8	0.9	14.40	0.26	0.45	0.02	0.08	2.14	0.81	6	B ₂₂	1.56	0.29	0.01	140	21	69	25	9	0.4	11.20	0.39	0.38	0.02	0.10	1.89	0.88	8	B ₃	1.58	0.29	0.01	140	21	68	9	10	0.4	11.60	0.26	0.21	0.02	0.10	1.44	0.59	5
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* % Base Saturation

N = Negligible
 ND = Not Determined
 nd = Not detected

Soil profile no.	4
Soil name:	Bedup series
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Lower slope
Slope at site:	70°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A _o		Leaf liter, 6 to 8 leaves thick
A _h	0-4 cm	Brown (10YR 5/3); clay loam; moderately strong, medium and fine subangular blocky and crumbs; friable; many fine and medium pores; abundant fine and coarse roots; clear boundary
B ₁	4-15 cm	Brownish yellow (10YR 6/6 to 6/8); clay loam; moderately strong, medium subangular blocky; friable; many fine pores; many fine and medium roots; many weakly developed pale brown (10YR 6/4) organic acid coatings on some ped surfaces; gradual boundary

B ₂	15-45 cm	Brownish yellow (10YR 6/8) to reddish yellow (7.5YR 6/8); clay; moderately strong, coarse and some medium subangular blocky; friable; many fine pores; very few 5-15 mm laterites and medium platy laterised shale; many fine and few coarse roots; few patchy weakly developed light yellow brown (10YR 6/4) organic acid coatings on ped surfaces; some cutans; gradual boundary
BC _{R1}	45-80 cm	Reddish yellow (7.5YR 6/8); clay; moderate coarse and some very coarse subangular blocky; friable; few fine pores; very few 5-10 mm laterites; few scattered undecomposed parent rocks (3 to 20 cm diameter) spaced at 5 to 40 cm apart, interstices are filled with clay; gradual boundary
BC _{R2}	80-150 cm	Brownish yellow (10YR 6/8); clay; moderately weak, coarse and very coarse subangular blocky; friable; fine pores; very few fine roots; about 20-30% gravelly and stony undecomposed parent rocks (3-20 cm diameter) spaced at 5-30 cm apart; interstices are filled with clay.

Note: Both BC_{R1} and BC_{R2} layer pose no limitation to root penetration

SOIL ANALYTICAL DATA

Soil profile No: A
Soil name: Bedup Series

Depth in cm	pH (1:2.5)	Elect. cond. µmho/cm	Percentage			Bulk density	Free Co ₃	CaCo ₃	Organic carbon	Organic matter	N	C/N ratio					
			Clay	Silt	Very fine sand												
A1	3.85	232	34.0	30.0	11.7	8.7	8.7	9.1	1.0	1.0	0.98	N	ND	2.15	3.70	0.26	8.27
B1	4.00	119	39.4	23.3	16.3	9.5	9.4	1.0	0.8	1.0	1.18	N	0.1	0.90	1.55	0.10	9
B2	4.20	75	47.9	23.0	11.4	6.9	6.1	1.8	2.3	1.8	1.35	N	0.1	0.85	1.46	0.09	9.44
BCR145-80	4.25	72	48.8	28.6	6.5	3.4	5.1	3.1	3.8	3.1	1.32	N	0.3	0.32	0.55	0.14	2.29

Depth	Perchloric Digestible				Perchloric Digestible				ppm Total S	me* CEC in NH ₄ OAC	Exchangeable Cation			B.S.*						
	Mg	Ca	Cu	P	Mn	Zn	K	Ca			Na	Al								
A1	0.73	0.14	0.03	0.03	185	11	90	47	125	12	4.4	H ₂ O soluble B	7.1	0.21	0.61	0.25	0.08	0.99	1.15	16
B1	0.84	0.15	0.02	0.02	150	14	41	50	ND	8	2.5	8.0	8.0	0.15	0.42	0.03	0.11	1.28	0.71	9
B2	1.10	0.19	0.02	0.02	140	17	50	62	16	8	0.2	10.4	10.4	0.15	0.33	0.03	0.09	1.27	0.60	6
BCR1	1.58	0.26	0.02	0.02	160	21	72	74	63	10	1.3	13.1	13.1	0.26	0.34	0.01	0.08	1.80	0.69	5

* B.S. = % Base saturation

N = Negligible
ND = Not Detected

Soil profile no.	14
Soil name:	Bedup series
Elevation:	45 to 60 meters
Landform:	Hilly
Physiography at site:	Mid-steep slope
Slope at site:	20°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	90 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0-4 cm	Yellowish brown (10YR 5/4); clay loam; moderate, medium and some fine subangular blocky and few crumb structures; friable; common fine pores; many fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	4-20 cm	Brownish yellow (10YR 6/6); clay loam; moderately strong, medium and some coarse subangular blocky structures; friable; many fine and medium pores; many fine and medium (1 to 5 mm) roots; patchy organic acid coatings on ped surfaces; many krotovinas; gradual boundary
B ₂₁	20-50 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse subangular blocky structures; friable; common fine pores; few fine to coarse (1 to 10 mm) roots; many well-developed cutans; many krotovinas; gradual boundary

B₂₂

50-90 cm

Brownish yellow (10YR 6/8); sandy clay loam; moderately strong, coarse subangular blocky structures breaking into moderately strong, coarse and some medium subangular blocky structures; friable; very few very fine pores; few fine and medium (1 to 5 mm) roots; with about 5% gravels of laterites and platy laterised shale (5 to 20 mm); presence of 10 to 15% light grey (10YR 7/2) blotches; clear boundary

C_u

90-150 cm

A layer of somewhat continuous decomposing parent material - carbonaceous shale, intermix with about 20% brownish yellow (10YR 6/8) clay

SOIL ANALYTICAL DATA

Soil profile No: 14

Soil name: Bedup series

HORIZON	Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage				Bulk density	Free CO_3	Ca CO_3	Organic carbon	Organic matter	N	C/N ratio				
				Clay	Silt	Very fine sand	Fine sand								Medium sand	Coarse sand	Very coarse sand	
A ₀	0-4	4.20	220	26.8	39.2	9.7	11.1	9.9	1.4	0.3	0.3	0.71	N	0.5	3.10	5.33	0.34	9.12
B ₁	4-20	4.15	150	36.2	31.4	15.1	9.6	6.3	0.8	0.6	1.06	N	ND	1.48	2.55	0.19	7.79	
B ₂₁	20-50	4.05	150	42.7	30.2	11.4	12.5	2.1	0.1	0.6	1.24	N	ND	0.44	0.76	0.11	4.00	
B ₂₂	50-90	4.50	41	28.2	23.1	10.6	15.0	22.1	0.6	0.3	1.30	N	0.3	0.29	0.50	0.09	3.22	

HORIZON	Perchloric Digestible		Perchloric Digestible				Total S	AV P	H ₂ O soluble B	CEC in NH_4OAC	Exchangeable Cation				IEB	B.S.*	
	K	Mg Ca	P	Cu	Mn	Zn					K	Ca	Na	Al			
A ₀	0.91	0.15 0.02	200	17	423	75	263	11	5.5	9.3	0.31	0.82	0.17	0.10	0.96	1.40	15
B ₁	1.00	0.17 0.02	155	15	345	83	263	9	2.6	2.5	0.26	0.40	0.03	0.08	1.21	0.77	31
B ₂₁	1.18	0.20 0.02	115	16	102	56	63	9	1.6	6.9	0.28	0.47	0.02	0.13	2.05	0.90	13
B ₂₂	1.53	0.24 0.02	105	21	99	70	125	10	0.5	11.5	0.28	0.21	0.02	0.09	2.92	0.60	5

* B.S. = % Base saturation

N = Negligible
ND = Not Detected

Soil profile no.	25
Soil name:	Bedup series
Elevation:	15 to 30 meters
Landform:	Undulating
Physiography at site:	Mid-slope
Slope at site:	4°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	115 cm
Vegetation:	Recent secondary growth
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-5 cm	Brown (10YR 5/3); clay loam; moderate, medium and fine subangular blocky and crumbs; friable; few fine pores; many fine to medium roots (1 to 5 mm); clear boundary
B ₁	5-35 cm	Yellowish brown (10YR 5/6 to 5/8); clay; moderately strong, medium and coarse subangular blocky structures; friable; common fine pores; few fine to coarse roots (1 to 30 mm); moderately developed organic acid coatings; many krotovinas; gradual boundary
B ₂₁	35-65 cm	Strong brown (7.5YR 5/8); clay; moderately strong, very coarse and coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; common fine pores; few fine to medium roots (1 to 5 mm); patchy cutans on ped surfaces; gradual boundary

- B22 65-115 cm Strong brown (7.5YR 5/8); clayey; moderately strong, very coarse and coarse subangular blocky structures; friable; few very fine pores; very few fine (1 to 2 mm) roots; patchy cutans on ped surfaces; clear boundary
- BC 115-150 cm Variegated light grey (10YR 7/2); strong brown (7.5YR 5/6) and yellowish red (5YR 5/6); clay; moderately weak, coarse and medium subangular blocky structures; friable; very few fine (1 to 2 mm) roots; presence of about 20% platy laterised shale and gravels of carbonaceous shale (5 to 30 mm)

SOIL ANALYTICAL DATA

Soil profile No: 25

Soil name: Bedup series

Horizon	Depth in cm	pH (1:2.5)	Elect. conc. $\mu\text{mho/cm}$	Percentage		Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio
				Clay	Silt												
A _h	0-5	4.65	245	32.5	47.2	2.2	3.2	4.4	2.7	2.1	1.02	N	0.3	3.75	6.45	0.37	10.14
B ₁	5-35	4.00	185	51.6	39.9	2.0	1.5	2.0	0.7	0.2	1.11	N	ND	1.32	2.27	0.19	6.95
B ₂₁	35-65	4.80	14	54.9	36.7	2.2	1.5	1.5	0.5	0.2	1.32	N	ND	0.69	1.19	0.13	5.31
B ₂₂	65-115	4.00	105	64.2	28.1	2.2	1.5	1.3	0.4	0.1	1.29	N	ND	0.47	0.81	0.11	4.27
BC	115-150	4.95	9	53.7	28.4	1.9	2.4	4.1	2.4	2.7	1.50	N	ND	0.20	0.34	0.09	2.22

Horizon	Perchloric Digestable			Total S	Av P	H ₂ O soluble B	me% CEC in NH ₄ OAC	Exchangeable Cation					p. r.	
	K	Mg	Ca					K	Mg	Ca	Na	Al		EB
A _h	1.20	0.22	0.10	400	14	4.1	10.8	0.64	1.37	8.50	0.11	0.21	10.62	98
B ₁	1.33	0.23	0.03	63	9	2.7	14.7	0.36	0.36	0.95	0.09	1.78	1.76	12
B ₂₁	1.41	0.24	0.02	16	10	0.6	10.1	0.18	0.23	0.18	0.12	1.26	0.71	7
B ₂₂	1.48	0.25	0.02	31	9	0.6	7.6	0.18	0.18	0.06	0.12	2.11	0.54	7
BC	2.00	0.29	0.02	172	13	ND	11.9	0.26	0.11	0.07	0.10	3.11	0.54	5

* % Base Saturation

N = Negligible
 ND = Not Determined
 nd = Not detected

Soil profile no.	3
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Mid-gentle slope
Slope at site:	10°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	140 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A0		Leaf litters; 4 to 6 leaves thick
Ah	0-3 cm	Brown (10YR 5/3); sandy clay loam; moderate, medium and fine subangular blocky and crumbs; friable; few fine pores; abundant fine and medium (1 to 5 mm) roots; clear boundary
B1	3-10 cm	Brownish yellow (10YR 6/6); clay; moderate, coarse subangular blocky; friable; many fine pores; many fine roots; about 5% yellowish red (5YR 5/6) fine streaks; moderately developed brown (10YR 5/3) organic acid coatings on some ped surfaces; few krotovinas; gradual boundary
B2	10-60 cm	Brownish yellow (10YR 6/6 to 6/8); clay; moderately strong, coarse and very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky; friable; many fine pores; many fine and medium (1 to 5 mm) roots; many moderately developed cutans on some ped surfaces; abrupt boundary

Elevation:

30 to 45 meters

B2 cn 60-100 cm

Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky; friable; very few fine pores; very few fine (1 to 2 mm) roots; about 2 to 5% fine yellowish red (5YR 5/8) mottles; few 5 to 30 mm laterited shale (mainly platy) and are loosely packed; clear boundary

Physiography at site:

Slope at site:

Soil drainage:

Soil erosion:

BC 100-140 cm

Reddish yellow (7.5YR 6/8); strong brown (7.5YR 5/8); brownish yellow (10YR 6/6 and 6/8); clay; moderately strong, coarse and medium subangular blocky; friable; very few fine pores; very few fine (1 to 2 mm) roots; about 20 to 30% 10 to 20 cm undecomposed stony shale; stones are spaced at about 20 cm apart; tongue boundary

Effective soil depth:

Vegetation:

Moisture conditions:

Profile Description

CR 140 cm +

A continuous layer of undecomposed parent bedrock - shale

A0

Ah 0-3 cm

Yellowish brown (10YR 5/4); clay-loam; moderate, fine and medium subangular blocky and crumbs; friable; common fine and medium pores; abundant fine and few coarse (1 to 20 mm) roots; clear boundary

B1 3-10 cm

Brownish yellow (10YR 6/6); clay loam; moderate, coarse and very coarse subangular blocky; friable; many fine pores; many fine to coarse (1 to 10 mm) roots; many weakly developed pale brown (10YR 6/3) organic acid coatings on ped surfaces; few krotovinas; gradual boundary

B2 10-55 cm

Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse and few medium subangular blocky; friable; many fine pores; many fine to coarse (1 to 10 mm) roots; discontinuous cutans; organic acid coatings along some root channels; few krotovinas; clear boundary

Soil profile no.	5
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Mid to lower slope
Slope at site:	8°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	100 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0-3 cm	Yellowish brown (10YR 5/4); clay loam; moderate, fine and medium subangular blocky and crumbs; friable; common fine and medium pores; abundant fine and few coarse (1 to 20 mm) roots; clear boundary
B ₁	3-10 cm	Brownish yellow (10YR 6/6); clay loam; moderate, coarse and very coarse subangular blocky; friable; many fine pores; many fine to coarse (1 to 10 mm) roots; many weakly developed pale brown (10YR 6/3) organic acid coatings on ped surfaces; few krotovinas; gradual boundary
B ₂	10-55 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse and few medium subangular blocky; friable; many fine pores; many fine to coarse (1 to 10 mm) roots; discontinuous cutans; organic acid coatings along some root channels; few krotovinas; clear boundary

Soil profile no. 7

Soil name: KIRIT family

Elevation: 30 to 45 meters

B2 cn 55-100 cm Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular blocky breaking into moderately strong, coarse subangular blocky; friable; many very fine pores; few 5 to 20 mm gravelly laterites and medium platy laterised shale; few fine (1 to 2 mm) roots; abrupt boundary

Soil position: covers sheet erosion

CR 100-150 cm A almost continuous layer of undecomposed parent rocks with less than 15% interstics of which is filled with brownish yellow (10YR 6/8) clay

Effective soil depth:

Vegetation: 1) forest

Moisture conditions in profile: moist throughout

Profile Description

A₀ Leaf litter; 3 to 5 leaves thick

A₁ 0-2 cm Brown to dark brown (10YR 4/3); clay loam, moderate, medium and fine subangular blocky structures and few crumbs; friable; few fine pores; many fine to coarse (1 to 5 mm) roots; clear boundary

A₂ 2-15 cm Brownish yellow (10YR 6/8); clay; moderately strong medium subangular blocky structures; friable; common fine pores; many medium and coarse (2 to 15 mm) roots; some yellowish brown (10YR 5/4) organic stains on few ped surfaces; few krotovinas; gradual boundary

B₂ 15-50 cm Reddish yellow (7.5YR 6/8); clay; moderately weak, very coarse subangular and angular blocky structures; slightly firm; few fine pores; many fine roots; about 2 to 5% yellow (10YR 7/6) < 5 mm slitches; well developed cutans; clear boundary

Soil profile no.	7
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Hilly
Physiography at site:	Lower slope
Slope at site:	18°
Soil drainage:	Moderately well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	70 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 3 to 5 leaves thick
A _h	0-2 cm	Brown to dark brown (10YR 4/3); clay loam, moderate, medium and fine subangular blocky structures and few crumbs; friable; few fine pores; many fine to coarse (1 to 5 mm) roots; clear boundary
B ₁	2-15 cm	Brownish yellow (10YR 6/8); clay; moderately strong medium subangular blocky structures; friable; common fine pores; many medium and coarse (2 to 15 mm) roots; some yellowish brown (10YR 5/4) organic stains on few ped surfaces; few krotovinas; gradual boundary
B ₂	15-50 cm	Reddish yellow (7.5YR 6/8); clay; moderately weak, very coarse subangular and angular blocky structures; slightly firm; few fine pores; many fine roots; about 2 to 5% yellow (10YR 7/6) < 5 mm blotches; well-developed cutans; clear boundary

- B_{3cn} 50-70 cm Reddish yellow (7.5YR 6/8); clay; few fine pores; very few fine roots; about 10-20% yellow (10YR 7/6) < 5 mm blotches; with about 40% (5 to 10 cm) undecomposed stony sandstone interstices of which is filled with clay; clear boundary
- B₃ 70-110 cm Reddish yellow (7.5YR 6/8) and (5YR 6/8); light grey (10YR 7/2); clay; weak, very coarse subangular and angular blocky structures; slightly firm; 10 to 15% gravels of laterised shale and laterites (2 to 20 mm); no biological activities; clear boundary
- CR 110-150 cm A continuous layer of consolidated undecomposed parent rock - shale

Profile Description

Leaf litters, 4 to 6 leaves thick

- A_u 0-4 cm Brown to dark brown (10YR 4/3); clay loam; moderate, medium subangular blocky structures; slightly sticky, slightly plastic; few fine pores; many medium (2-5 mm) roots; clear boundary
- B₁ 4-15 cm whitish brown (10YR 5/5 to 5/8); clay; moderately strong, medium and coarse subangular blocky structures; friable; many fine pores; many fine (1-2 mm) and few coarse (> 5 mm) roots; patchy organic stains on ped surfaces; some lenticles; gradual boundary
- B₂ 15-60 cm Yellow (10YR to 2.5Y 7/8); strong brown (7.5YR 5/8); clay; moderately strong, coarse and medium subangular blocky structures; friable; many fine pores; many fine to coarse (1-10 mm) roots; well-developed cutans; many lenticles; clear boundary

Soil profile no.	8
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Mid gentle slope
Slope at site:	7°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in A _h horizon, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-4 cm	Brown to dark brown (10YR 4/3); clay loam; moderate, medium subangular blocky structures; slightly sticky, slightly plastic; few fine pores; many medium (2-5 mm) roots; clear boundary
B ₁	4-15 cm	Yellowish brown (10YR 5/6 to 5/8); clay; moderately strong, medium and coarse subangular blocky structures; friable; many fine pores; many fine (1-2 mm) and few coarse (> 5 mm) roots; patchy organic stains on ped surfaces; some krotovinas; gradual boundary
B ₂	15-60 cm	Yellow (10YR to 2.5Y 7/6), strong brown (7.5YR 5/8); clay; moderately strong, coarse and medium subangular blocky structures; friable; many fine pores; many fine to coarse (1-10 mm) roots; well-developed cutans; many krotovinas; clear boundary

Soil profile no.

12

Soil name:

MERT family

Elevation:

30 to 45 meters

B_{2cn} 60-80 cm

Colour as above. Clay; moderate, coarse subangular blocky structures; friable; few very fine pores; few fine to coarse (1 to 10 mm) roots; with about 15 to 20% gravels of decomposing sandstone and laterised shale (10 to 50 mm); clear boundary

B₃ 80-150 cm

Yellow (2.5Y 7/6), reddish yellow (5YR 6/8), yellowish red (5YR 5/8), strong brown (7.5YR 5/8); clay; moderate, coarse subangular blocky structures; friable; few fine pores; few fine (1 to 2 mm) roots (more roots concentration than the above horizon); with about 10% gravels of laterised shale, mainly platy

Profile Description

A₀

Leaf litter; 4 to 6 leaves thick

A₁ 0-4 cm

Brown to dark brown (10YR 6/3 to 5/3); clay loam; moderate, medium and fine subangular blocky and medium crumb structures; friable; common fine pores; many fine and coarse (1 to 10 mm) roots; clear boundary

B₁ 4-20 cm

Brownish yellow (10YR 6/8); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; many fine pores; many fine and medium (1 to 5 mm) roots; patchy organic acid coatings on ped surfaces; many krotovinas; gradual boundary

B₂ 20-30 cm

Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; slightly fine; common fine pores; few fine (1 to 2 mm) roots; many well-developed cutans; many krotovinas; clear boundary

Soil profile no.	12
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Mid-slope
Slope at site:	9°
Soil drainage:	Well-drained to 2 m; rapid
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0-4 cm	Brown to dark brown (10YR 5/3 to 4/3); clay loam; moderate, medium and fine subangular blocky and medium crumb structures; friable; common fine pores; many fine and coarse (1 to 10 mm) roots; clear boundary
B ₁	4-20 cm	Brownish yellow (10YR 6/8); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; many fine pores; many fine and medium (1 to 5 mm) roots; patchy organic acid coatings on ped surfaces; many krotovinas; gradual boundary
B ₂	20-70 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; slightly firm; common fine pores; few fine (1 to 2 mm) roots; many well-developed cutans; many krotovinas; clear boundary

Soil profile no: 17
 Soil name: WART family
 Elevation: 15 to 30 meters
 Location: Isolated small grassy hill
 Physiography at site: Foot slope
 B3 70-150 cm Reddish yellow (5YR 6/8); clay; moderately weak, very coarse subangular blocky structures; slightly firm; few fine pores; very few fine (1 to 2 mm) roots; no micro-bio activities
 Stage at site:
 Soil drainage:
 Soil erosion:
 Presence of surface stones or rock outcrops:
 Effective soil depth: 150 cm
 Vegetation: Hill forest
 Moisture conditions in profile: Moist throughout

Profile Description

- A₁ Leaf litter; 6 to 8 leaves thick
- A₂ 0-4 cm Brown to dark brown (10YR 5/3 to 4/3); clay loam; moderate fine and medium subangular blocky structures; friable; common fine pores; abundant fine to medium roots (1 to 30 mm); clear boundary
- B₁ 4-30 cm Brownish yellow (10YR 6/6) to yellowish brown (10YR 5/6); clay loam; moderately strong, medium and coarse subangular blocky structures; friable; many fine and medium pores; many fine to coarse roots (1 to 20 mm); many yellowish brown (10YR 5/6) to 5/8 organic acid coatings on ped surfaces and along channels; many krotovinas; clear boundary
- B₂ 30-60 cm Reddish yellow (7.5YR 6/6); clay; moderate, coarse subangular blocky structures; slightly compact in place, firm when removed; common fine pores; very few fine roots; (a distinct decrease in wet density); presence of

Soil profile no.	17
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Isolated small gentle hill
Physiography at site:	Foot slope
Slope at site:	10°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-4 cm	Brown to dark brown (10YR 5/3 to 4/3); clay loam; moderate fine and medium subangular blocky and crumbs; friable; common fine pores; abundant fine to coarse roots (1 to 10 mm); clear boundary
B ₁	4-30 cm	Brownish yellow (10YR 6/6) to yellowish brown (10YR 5/6); clay loam; moderately strong, medium and coarse subangular blocky structures; friable; many fine and medium pores; many fine to coarse roots (1 to 20 mm); many yellowish brown (10YR 5/6) to 5/8) organic acid coatings on ped surfaces and along channels; many krotovinas; clear boundary
B ₂	30-60 cm	Reddish yellow (7.5YR 6/6); clay; moderate, coarse subangular blocky structures; slightly compact in place, firm when removed; common fine pores; very few fine roots; (a distinct decrease in root density); presence of

Soil profile no. _____
 Soil name: _____ MERT family
 Elevation: _____
 Landform: _____
 Physiography at site: _____
 Slope at site: _____
 BC 60-150 cm Brownish yellow (10YR 6/6 to 6/8); clay; weak, coarse and very coarse subangular blocky structures; slightly compact in place, slightly firm when removed; few very fine pores; very few fine roots; presence of 10 to 15% laterites, platy laterised shale and parent materials (10 to 50 mm); many reddish yellow (5YR 6/8) blotches
 Vegetation: _____
 Moisture conditions in profile: _____ Slightly wet in top soil, otherwise moist throughout

Profile description

A₀ Leaf litter, 4 to 8 leaves thick
 A₁ 0-4 cm Brown to dark brown (10YR 4/3); sandy clay loam; moderately strong, fine and medium subangular blocky and crumb; slightly sticky; slightly plastic; few pores; abundant fine to coarse roots (1 to 15 mm); clear boundary
 A₂ 4-20 cm Brownish yellow (10YR 6/6); sandy clay loam; moderately strong, medium and coarse subangular blocky structures; friable; common fine pores; many fine to coarse (1 to 10 mm) and few 5 to 10 cm roots; weakly developed yellowish brown (10YR 5/8) organic acid coatings; many krotovinas; gradual boundary
 B₂ 20-40 cm Brownish yellow (10YR 6/8); clay loam; moderate, coarse subangular blocky structures; friable; common fine pores; few fine roots; few scattered (<25) gravel or sandstone (< 25 mm); weakly developed organic acid coatings; gradual boundary

Soil profile no.	23
Soil name:	MERIT family
Elevation:	45 to 60 meters
Landform:	Steep
Physiography at site:	Mid-steep slope
Slope at site:	25°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-4 cm	Brown to dark brown (10YR 4/3); sandy clay loam; moderately strong, fine and medium subangular blocky and crumbs; slightly sticky; slightly plastic; few pores; abundant fine to coarse roots (1 to 15 mm); clear boundary
B ₁	4-20 cm	Brownish yellow (10YR 6/8); sandy clay loam; moderately strong, medium and coarse subangular blocky structures; friable; common fine pores; many fine to coarse (1 to 10 mm) and few 5 to 10 cm roots; weakly developed yellowish brown (10YR 5/4) organic acid coatings; many krotovinas; gradual boundary
B ₂	20-60 cm	Brownish yellow (10YR 6/8); clay loam; moderate, coarse subangular blocky structures; friable; common fine pores; few fine roots; few scattered (< 2%) gravels of sandstone (< 25 mm); very weakly developed organic acid coatings; gradual boundary

Soil profile no. 24
Soil name: MERT family
Elevation: 15 to 30 meters
Landform: Rolling
B₃ 60-150 cm Brownish yellow (10YR 6/8); clay; moderately weak, coarse subangular blocky structures; friable; few very fine pores; few fine to coarse roots (1 to 15 mm);
Slope at site:
Soil drainage: presence of about 5% stony carbonaceous shale (5 to 10 cm); stones are spaced at 20 to 40 cm apart
Soil erosion:
Presence of surface stones or rock outcrops: N/A
Effective soil depth: 100 cm
Vegetation: edges
Moisture conditions in profile: Moist throughout.

Profile Description

A₀ Semi-decomposed sedge (2 cm thick).
A₁ 0-5 cm Brown to dark brown (10YR 4/3); sandy clay loam; moderately strong, fine subangular blocky and crumb structures; friable; common fine pores; many fine to coarse roots (1 to 10 mm); clear boundary
B₁ 5-25 cm Brownish yellow (10YR 6/5); clay loam; moderately strong, medium and some coarse subangular blocky structures; friable; common fine pores; many fine to medium roots (1 to 5 mm); weakly developed brown to dark brown (10YR 4/3) organic acid coatings; many krotovinas; gradual boundary
B₂ 25-60 cm yellowish brown (10YR 5/5) to strong brown (7.5YR 5/3); clay; moderately strong, coarse subangular blocky structures; friable; common fine pores; few fine to medium roots (1 to 5 mm); many krotovinas; many cutans on ped surfaces; clear boundary

Soil profile no.	24
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Rolling
Physiography at site:	Lower slope
Slope at site:	8°
Soil drainage:	Well-drained
Soil erosion:	Moderate sheet erosion
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	100 cm
Vegetation:	Sedges
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Semi-decomposed sedges (2 cm thick)
A _h	0-5 cm	Brown to dark brown (10YR 4/3); sandy clay loam; moderately strong, fine subangular blocky and crumb structures; friable; common fine pores; many fine to coarse roots (1 to 10 mm); clear boundary
B ₁	5-25 cm	Brownish yellow (10YR 6/6); clay loam; moderately strong, medium and some coarse subangular blocky structures; friable; common fine pores; many fine to medium roots (1 to 5 mm); weakly developed brown to dark brown (10YR 4/3) organic acid coatings; many krotovinas; gradual boundary
B ₂	25-60 cm	Yellowish brown (10YR 5/8) to strong brown (7.5YR 5/8); clay; moderately strong, coarse subangular blocky structures; friable; common fine pores; few fine to medium roots (1 to 5 mm); many krotovinas; many cutans on ped surfaces; clear boundary

Soil profile no.	20
Soil name:	NKTR 1011y
Elevation:	15 to 30 meters
Landform:	Undulating
Topography at site:	Top gentle slope
Slope at site:	
Soil drainage:	
Soil erosion:	Severe sheet erosion
B2cn 60-85 cm	As above horizon but with presence of <5% fine light grey (10YR 7/2) and yellowish red (5YR 5/8) mottles; also presence of about 5 to 10% platy laterised shale and laterites (< 15 mm); gradual boundary
BC 85-100 cm	Brownish yellow (10YR 6/6) and light grey (10YR 7/2); clay; moderately weak, coarse subangular blocky structures; friable; presence of <5% gravels of carbonaceous shale (< 20 mm); clear boundary
CR 100-150 cm	A continuous layer of decomposing carbonaceous shale.

Profile Description

Ao	Leaf litters, 4 to 5 leaves thick
As 0-7 cm	Brown to dark brown (10YR 4/3); clay loam; moderate, medium and fine subangular blocky structures; friable; few fine pores; some fine to coarse roots (1 to 20 mm); clear boundary
B1 7-40 cm	Yellowish brown (10YR 5/6); clay; moderately strong, coarse and some medium subangular blocky structures; friable; common very fine pores; few fine roots (1 to 2 cm); moderately developed organic acid coatings; few krotovinas; clear boundary
B2 40-90 cm	Strong brown (7.5YR 5/8) to yellowish red (5YR 5/8); clay; moderate, medium and coarse subangular blocky structures; friable; few very fine pores; very few fine roots (1 to 2 cm); presence of 3% platy laterised shale (5 to 30 mm); also presence of about 10% very pale brown (10YR 7/4) blotches; clear boundary

Soil profile no.	26
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Undulating
Physiography at site:	Top gentle slope
Slope at site:	3°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-7 cm	Brown to dark brown (10YR 4/3); clay loam; moderate, medium and fine subangular blocky structures; friable; few fine pores; many fine to coarse roots (1 to 20 mm); clear boundary
B ₁	7-40 cm	Yellowish brown (10YR 5/6); clay; moderately strong, coarse and some medium subangular blocky structures; friable; common very fine pores; few fine roots (1 to 2 mm); moderately developed organic acid coatings; few krotovinas; clear boundary
B ₂	40-90 cm	Strong brown (7.5YR 5/8) to yellowish red (5YR 5/8); clay; moderate, medium and coarse subangular blocky structures; friable; few very fine pores; very few fine roots (1 to 2 mm); presence of 5% platy laterised shale (5 to 30 mm); also presence of about 10% very pale brown (10YR 7/4) blotches; clear boundary

Soil profile no. 20
Soil name: HULL family
Elevation: 15 to 30 meters
Landform: Hilly
Physiography at site: Mid-slope facing valley floor
Slope at site: 15°
BCR 90-150 cm Light grey (10YR 7/2); silty clay; moderately weak, coarse and medium subangular blocky structures; friable; presence of about 20 to 30% gravels of carbonaceous shale; few strong brown (7.5YR 5/8) blotches
Soil erosion:
Presence of surface:
Effective soil depth: 130 cm
Vegetation: *Adiantum* sp.
Moisture conditions in profile: Slightly wet at BC, otherwise moist throughout

Profile Description

- A₀ 1-6 cm Decaying debris of sedges
- A₁ 0-7 cm Yellowish brown (10YR 5/4); clay loam, moderate, medium subangular blocky and fine crumb; friable; few very fine pores; many fine roots (1 to 2 mm); clean boundary
- B₁ 7-20 cm Brownish yellow (10YR 6/5); clay loam, moderate, coarse subangular blocky structures; friable; few fine pores; few fine roots (1 to 2 mm); many kermas; moderately developed organic acid coatings on ped surfaces; gradual boundary
- B₂ 20-70 cm Strong brown (7.5YR 5/8); clay, moderately strong, very coarse subangular blocky structures; slightly firm; few fine pores; very few fine roots (<1 mm); many well-developed sutans; gradual boundary

Soil profile no.	28
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Hilly
Physiography at site:	Mid-slope facing valley floor
Slope at site:	15°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	130 cm
Vegetation:	Recent secondary growth
Moisture conditions in profile:	Slightly wet at BC, otherwise moist throughout

Profile Description

A ₀	1-0 cm	Decaying debris of sedges
A _h	0-7 cm	Yellowish brown (10YR 5/4); clay loam; moderate, medium subangular blocky and fine crimbs; friable; few very fine pores; many fine roots (1 to 2 mm); clear boundary
B ₁	7-20 cm	Brownish yellow (10YR 6/6); clay loam; moderate, coarse subangular blocky structures; friable; few fine pores; few fine roots (1 to 2 mm); many krovinas; moderately developed organic acid coatings on ped surfaces; gradual boundary
B ₂	20-70 cm	Strong brown (7.5YR 5/8); clay; moderately strong, very coarse subangular blocky structures; slightly firm; few fine pores; very few fine roots (<1 mm); many well-developed cutans; gradual boundary

B ₃	70-130 cm	Reddish yellow (2.5Y 7/4); clay; moderately weak, very coarse subangular blocky breaking into moderately strong, medium and some coarse subangular blocky structures; friable; presence of < 2% red (2.5YR 4/8) soft iron-concretions (< 5 mm); very few fine roots; presence of < 2% yellowish red (5YR 5/6) mottles; clear boundary
BC	130-150 cm	Variegated pale yellow (2.5Y 7/4); light grey (10YR 7/2) and brownish yellow (10YR 6/8); clay; weak very coarse subangular blocky structures; slightly sticky, slightly plastic; common micro-pores; no roots

Profile Description

A ₀		leaf litter, 4 to 6 leaves thick
A ₁	0-5 cm	Brown (10YR 5/3) to yellowish brown (10YR 5/4); loose; moderate, fine and medium subangular blocky and few crumb, friable; few medium cores; many fine to coarse roots (3 to 20 mm); clear boundary
B ₂	5-35 cm	Brownish yellow (10YR 6/6); clay; moderately strong, coarse and some medium subangular blocky structures; friable; many fine pores; many fine to coarse roots (3 to 30 mm); moderately developed brown (10YR 5/3) organic acid coatings on ped surfaces; gradual boundary
B ₃	35-65 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; very fine and medium pores; few fine to coarse roots (3 to 10 mm); well-developed light yellowish brown (10YR 6/4) mottles; presence of about 5% gravels of laterized shale and soft manganese concretions; clear boundary

Soil profile no.	30
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Undulating
Physiography at site:	Lower slope
Slope at site:	30°
Soil drainage:	Well-drained
Soil erosion:	Moderate sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	65 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist up to parent bed rocks

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-5 cm	Brown (10YR 5/3) to yellowish brown (10YR 5/4); loam; moderate, fine and medium subangular blocky and few crumbs; friable; few medium pores; many fine to coarse roots (1 to 20 mm); clear boundary
B ₂	5-35 cm	Brownish yellow (10YR 6/6); clay; moderately strong, coarse and some medium subangular blocky structures; friable; many fine pores; many fine to coarse roots (1 to 10 mm); moderately developed brown (10YR 5/3) organic acid coatings on ped surfaces; gradual boundary
B ₃	35-65 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; many fine and medium pores; few fine to coarse roots (1 to 10 mm); well-developed light yellowish brown (10YR 6/4) cutans; presence of about 5% gravels of laterised shale and soft manganese concretions; clear boundary

Soil profile no.		01
Soil order		MOLLISOL
Elevation		15 to 45 meters
Landform		Hilling
Physiography at site		Mid-gentle slope
Cu	65-70 cm	A continuous layer of unconsolidated, fragmented carbonaceous shale
Soil drainage		Well-drained
CR	70-100 cm	A continuous layer of impervious consolidated parent rocks - carbonaceous shale
Presence of surface		
Effective soil depth		110 cm
Vegetation		Hill forest
Moisture conditions in profile		Slightly wet in the soil, otherwise moist throughout

Profile Description

O		Leaf litter, 4 to 5 leaves thick
A _h	0-2 cm	Brown (7.5YR 5/4); clay loam; moderate, medium subangular blocky and crumbs; friable to slightly sticky and slightly plastic; few fine pores; many fine to coarse roots (1 to 15 cm); clear boundary
B ₁	2-15 cm	Yellowish brown (10YR 5/6) to strong brown (7.5YR 5/8); clay; moderate, very coarse and coarse subangular blocky structures; slightly firm; many fine pores; few fine to coarse (1 to 10 cm) roots; strongly developed organic acid coatings on pod surfaces and along channels; many bioturbation; clear boundary
B ₂	15-30 cm	Strong brown (7.5YR 5/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; few very fine and micro-pores; few fine to medium roots (1 to 5 cm); present of fine (< 5 mm) faint yellowish red (5YR 5/8) mottles; clear boundary

Soil profile no.	31
Soil name:	MERIT family
Elevation:	15 to 45 meters
Landform:	Rolling
Physiography at site:	Mid-gentle slope
Slope at site:	90
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	110 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-2 cm	Brown (7.5YR 5/4); clay loam; moderate, medium subangular blocky and crumbs; friable to slightly sticky and slightly plastic; few fine pores; many fine to coarse roots (1 to 15 mm); clear boundary
B ₁	2-15 cm	Yellowish brown (10YR 5/8) to strong brown (7.5YR 5/8); clay; moderate, very coarse and coarse subangular blocky structures; slightly firm; common fine pores; few fine to coarse (1 to 10 mm) roots; strongly developed organic acid coatings on ped surfaces and along channels; many krotovinas; clear boundary
B ₂	15-30 cm	Strong brown (7.5YR 5/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; few very fine and micro-pores; few fine to medium roots (1 to 5 mm); present of fine (<5 mm) faint yellowish red (5YR 5/8) mottles; clear boundary

Soil profile no.	32	
Soil name		REGO (partly)
Coordinates		30 to 45 meters
Elevation		hilly
Physiography at site		hill in lower slope
B ₃	30-70 cm	Brownish yellow (10YR 6/6) to olive yellow (2.5Y 6/6); clay; moderate very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; common fine and micro-pores; very few fine and medium roots (1 to 5 mm); presence of few (< 5%) fine (< 5 mm) strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/8) mottles; clear boundary
B _{3cn}	70-100	Brownish yellow (10YR 6/6) to olive yellow (2.5Y 6/6); clay; moderately weak, very coarse subangular and angular blocky breaking into moderately strong, coarse subangular blocky structures; friable; common fine and micro-pores; few fine to coarse roots (1 to 10 mm); presence of 15% platy (5 to 20 mm) laterised shale and few laterites; few fine (< 5 mm) strong brown (7.5YR 5/6) and reddish yellow (7.5YR 6/8) mottles; gradual boundary
C	100-150 cm	Light grey (2.5Y 7/2); clay; weak to structureless; somewhat massive; very few fine roots; presence of 5 to 10% platy (10 to 30 mm) laterised shale
B ₂	30-45 cm	Brownish yellow (10YR 6/8); clay moderate, very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; few fine roots; few fine to medium roots (1 to 5 mm) and very few medium to coarse roots (5 to 10 mm); moderately developed organic acid coatings; many root-tubes; gradual boundary

Soil profile no.	32
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Hilly
Physiography at site:	Mid to lower slope
Slope at site:	16°
Soil drainage:	Well-drained
Soil erosion:	Severely sheet erosion
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	65 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 8 to 10 leaves thick
A _h	0-7 cm	Yellowish brown (10YR 5/4); clay loam; moderate, fine and medium subangular blocky and few crumbs; slightly sticky; many very fine pores; many fine to coarse roots (1 to 20 mm); clear boundary
B ₁	7-30 cm	Brownish yellow (10YR 6/6); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; common fine pores; few fine to medium roots (1 to 5 mm) and very few medium to coarse roots (5 to 30 mm); moderately developed organic acid coatings; many krotovinas; gradual boundary
B ₂	30-65 cm	Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; few fine pores; few fine to medium (1 to 5 mm) roots; patchy organic acid coatings; discontinuous cutans; abrupt boundary

Soil profile no.	43
Elevation:	30 to 45 meters
Landform:	Hilly
Physiography at site:	Mid-slope slope
Cu 65-150 cm	A layer of fragmented parent rock - carbonaceous shale intermixed with some 15% clay from the overlying horizon
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	120 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 5 leaves thick
A ₁	0-3 cm	Dark greyish brown (10YR 4/2); clay loam; moderate, medium and fine subangular blocky structures; friable; few fine pores; many fine to coarse roots (1 to 20 cm); clear boundary
B ₁	3-15 cm	Brownish yellow (10YR 5/6 to 6/8); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; few fine pores; few fine to medium (2 to 5 mm) roots; weakly developed arenitic soil coatings; gradual boundary
B ₂ ca	15-65 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; few fine pores; very few fine (1 to 2 mm) roots; with about 15% laterised shale; clear boundary
B ₂ c	65-120 cm	A layer of about 60 to 70% fragmented shale into which is filled with brownish yellow (10YR 4/2) clay

Soil profile no.	43
Soil name:	MERIT family
Elevation:	30 to 45 meters (1 to 2 m)
Landform:	Hilly
Physiography at site:	Mid-steep slope
Slope at site:	16°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	120 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-3 cm	Dark greyish brown (10YR 4/2); clay loam; moderate, medium and fine subangular blocky structures; friable; few fine pores; many fine to coarse roots (1 to 20 mm); clear boundary
B ₁	3-15 cm	Brownish yellow (10YR 6/6 to 6/8); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; few fine pores; few fine to medium (2 to 5 mm) roots; weakly developed organic acid coatings; gradual boundary
B _{2cn}	15-65 cm	Brownish yellow (10YR 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; few fine pores; very few fine (1 to 2 mm) roots; with about 15% laterised shale; clear boundary
BC _R	65-120 cm	A layer of about 60 to 70% fragmented shale interstices of which is filled with brownish yellow (10YR 6/8) clay

Soil profile to:

Soil name:

Elevation: from the overlying horizon; very few fine (1 to 2 mm) roots; clear boundary

Landform: Steep

Physiography of site:

CR 120-150 cm A continuous layer of parent bedrock - shale

Slope at site: 20%

Soil drainage: Well-drained

Soil erosion: Severe sheet erosion

Presence of surface stones or rock outcrops: (H)

Effective soil depth: 135 cm

Vegetation: Hill forest

Moisture conditions in profile: Moist throughout

Profile Description

A₀

Leaf litter; 5 to 8 leaves thick

A₁

0-3 cm

Brown to dark brown (10YR 4/3); clay loam, moderate, medium and fine subangular blocky and crumb; friable; few fine pores; many fine to coarse (1 to 20 mm) roots; clear boundary

B₁

3-10 cm

Strong brown (7.5YR 5/6); clay loam; moderate; coarse and very coarse subangular blocky structures; friable; few fine to medium pores; few fine to medium (1 to 5 mm) roots; many strongly developed yellowish brown (10YR 5/4) organic acid coatings; some cutans on acid surfaces; gradual boundary

B₂

10-50 cm

Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular blocky breaking into moderate, coarse and very coarse subangular blocky structures; friable; few fine and medium pores; few fine (1 to 2 mm) roots; many moderately developed cutans; some krotovines on few channels; clear boundary

Soil profile no.	44
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Steep
Physiography at site:	Foot slope
Slope at site:	23°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	135 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-3 cm	Brown to dark brown (10YR 4/3); clay loam, moderate, medium and fine subangular blocky and crumbs; friable; few fine pores; many fine to coarse (1 to 20 mm) roots; clear boundary
B ₁	3-10 cm	Strong brown (7.5YR 5/8); clay loam; moderate; coarse and very coarse subangular blocky structures; friable; few fine to medium pores; few fine to medium (1 to 5 mm) roots; many strongly developed yellowish brown (10YR 5/4) organic acid coatings; some cutans on ped surfaces; gradual boundary
B ₂	10-50 cm	Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular blocky breaking into moderate, coarse and very coarse subangular blocky structures; friable; few fine and medium pores; few fine (1 to 2 mm) roots; many moderately developed cutans; some krotovinas on few channels; clear boundary

Elevation: 15 to 30 meters

Topography: Steep

B2cn 50-135 cm Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular and some angular blocky structures; slightly firm; few fine pores; very few fine (1 to 2 mm) roots; presence of about 10% scattered gravels of shale; with 10% faint reddish yellow (7.5YR 6/6) mottles; abrupt boundary

CR 135-150 cm A continuous layer of parent bedrock - shale

Vegetation: Regenerated forest

Moisture conditions in profile: Moist throughout

Profile Description

A₀ Leaf litter, 4 to 5 leaves thick.

A₁ 0-3 cm Brown to dark brown (10YR 5/3 to 4/3); clay loam; moderate, medium subangular blocky and fine crumb structures; friable; few fine pores; many fine to medium (1 to 5 mm) roots; clear boundary

B₁ 3-20 cm Brownish yellow (10YR 6/5); clay loam; moderate, coarse and some very coarse subangular blocky structures; friable; few medium pores; many fine to coarse (1 to 10 mm) roots; very weakly developed light yellowish brown (10YR 5/4) organic acid coatings on ped surfaces and along channels; clear boundary

B₂ 20-65 cm Strong brown (7.5YR 5/8) to yellowish red (5YR 5/8); clay; moderately strong, coarse and very coarse subangular blocky breaking into moderately strong, coarse and medium subangular blocky structures; friable; few medium pores; few fine to medium (1 to 5 mm) roots; very strong brown (7.5YR 5/6) stains on

Soil profile no.	46
Soil name:	MERIT family
Elevation:	15 to 30 meters
Landform:	Steep
Physiography at site:	Foot slope
Slope at site:	24°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	130 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-3 cm	Brown to dark brown (10YR 5/3 to 4/3); clay loam; moderate, medium subangular blocky and fine crumb structures; friable; few fine pores; many fine to medium (1 to 5 mm) roots; clear boundary
B ₁	3-20 cm	Brownish yellow (10YR 6/6); clay loam; moderate, coarse and some very coarse subangular blocky structures; friable; few medium pores; many fine to coarse (1 to 10 mm) roots; many weakly developed light yellowish brown (10YR 6/4) organic acid coatings on ped surfaces and along channels; clear boundary
B ₂	20-65 cm	Strong brown (7.5YR 5/8) to yellowish red (5YR 5/8); clay; moderately strong, coarse and very coarse subangular blocky breaking into moderately strong, coarse and medium subangular blocky structures; friable; few medium pores; few fine to medium (1 to 5 mm) roots; many strong brown (7.5YR 5/6) cutans on

Elevation:	30 to 45 meters	
Landform:	Rolling	
Physiography at site:	Mid-slope	
B3	65-130 cm	Strong brown (7.5YR 5/8), yellow (10YR 7/6) and red (2.5YR 4/8); clay; moderately strong, coarse and some medium subangular blocky structures; friable; few fine pores; few fine to medium (1 to 5 mm) roots; many strong brown (7.5YR 5/8) cutans on ped surfaces; few krotovinas; clear boundary
B3cn	130-150 cm	Light olive brown (2.5Y 5/4) to light yellowish brown (2.5Y 6/4); clay; moderate, coarse subangular blocky structures; presence of 20 to 30% gravels of shale (10 to 30 mm); no roots; abrupt boundary
<u>Profile Description</u>		
CR	150 cm +	A continuous layer of parent bedrock - shale
Ac		Leaf litter, 5 to 8 leaves thick
A ₁	0-1 cm	Dark greyish brown (10YR 4/2) to brown (10YR 5/3); clay loam; moderate, medium and fine subangular blocky and crumb structures; friable and slightly sticky; common fine pores; abundant fine to medium roots; clear boundary
B ₁	1-25 cm	Brownish yellow (10YR 5/8); clay loam; moderately strong, medium and coarse subangular blocky structures; friable; common fine pores; many fine to medium roots (1 to 5 mm); moderately developed yellowish brown (10YR 5/4) organic acid coatings on ped surfaces and along root channels; many krotovinas; gradual boundary

Soil profile no.	47
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Mid-slope
Slope at site:	10°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	> 150 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Slightly wet in A _h horizon, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 6 to 8 leaves thick
A _h	0-1 cm	Dark greyish brown (10YR 4/2) to brown (10YR 5/3); clay loam; moderate, medium and fine subangular blocky and crumb structures; friable and slightly sticky; common fine pores; abundant fine to medium roots; clear boundary
B ₁	1-25 cm	Brownish yellow (10YR 6/8); clay loam; moderately strong, medium and coarse subangular blocky structures; friable; common fine pores; many fine to medium roots (1 to 5 mm); moderately developed yellowish brown (10YR 5/4) organic acid coatings on ped surfaces and along root channels; many krotovinas; gradual boundary

Soil profile no.

Elevation:

30 to 45 meters

B₂ 25-60 cm

Brownish yellow (10YR 6/8); clay; moderate, very coarse subangular blocky structures; slightly firm; few very fine pores; few fine to medium roots; well-developed brownish yellow (10YR 6/6) cutans on most ped surfaces; few krotovinas; clear boundary

B₃₁ 60-80 cm

Brownish yellow (10YR 6/6 to 6/8); clay; moderate, coarse subangular blocky structures; friable; few fine pores; very few fine roots; presence of about 5% white (10YR 8/2) and about 15% yellowish red (5YR 5/8) blotches (5 to 10 mm); gradual boundary

B₃₂ 80-150 cm

Brownish yellow (10YR 6/6); clay; moderate, very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; few micro-pores; very few very fine roots; presence of about 5% white (10YR 8/2) and very few strong brown (7.5YR 5/8) blotches.

A_b 0-5 cm

Dark grayish brown (10YR 4/2) to brown (10YR 4/3), clay loam; moderately weak, medium and fine subangular blocky structures; friable; few fine pores; many coarse roots (5 to 30 mm); clear boundary

B₁ 5-15 cm

Brownish yellow (10YR 6/8); clay; moderate, medium and coarse subangular blocky structures; friable; common fine to medium pores; few fine to coarse (1 to 15 mm) roots; moderately developed brownish yellow (10YR 6/6) organic acid coatings; gradual boundary

B_{2cd} 15-70 cm

Brownish yellow (10YR 6/8); clay; moderate, coarse subangular blocky structures; friable; common fine pores; few fine (1 to 2 mm) and very few coarse (30 mm) roots; moderately developed yellow (10YR 7/5) cutans on most ped surfaces; clear boundary

Soil profile no.	48
Soil name:	MERIT family
Elevation:	30 to 45 meters
Landform:	Steep
Physiography at site:	Upper slope
Slope at site:	23°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	70 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-5 cm	Dark greyish brown (10YR 4/2) to brown (10YR 4/3); clay loam; moderately weak, medium and fine subangular blocky structures; friable; few fine pores; many coarse roots (5 to 30 mm); clear boundary
B ₁	5-15 cm	Brownish yellow (10YR 6/8); clay; moderate, medium and coarse subangular blocky structures; friable; common fine to medium pores; few fine to coarse (1 to 15 mm) roots; moderately developed brownish yellow (10YR 6/6) organic acid coatings; gradual boundary
B _{2cn}	15-70 cm	Brownish yellow (10YR 6/8); clay; moderate, coarse subangular blocky structures; friable; common fine pores; few fine (1 to 2 mm) and very few coarse (30 mm) roots; moderately developed yellow (10YR 7/6) cutans on most ped surfaces; clear boundary

Elevation: 45 to 50 meters
 Landform: Rolling
 Physiography of site: Foot slope
 Slope at site: 30°
 CR 70-150 cm A layer of almost continuous layer of parent bedrock - shale with less than 15% interstices filled with the overlying brownish yellow clay
 Presence of surface stones or rock outcrops: Nil
 Effective soil depth: 170 cm
 Vegetation: Recent secondary growth
 Moisture conditions in profile: Moist throughout

Profile Description

- A₀** 1 cm of decomposed and semi-decomposed talang
- A₁** 3-5 cm Yellowish brown (10YR 5/4); clay loam; moderate, medium subangular blocky and crumb structures; friable; few fine pores; many fine and medium (1-5 mm) roots; clear boundary
- B₁** 6-20 cm Yellowish brown (10YR 5/6); clay; moderate, medium and coarse subangular blocky structures; friable; common fine pores; many fine (1 to 2 mm) roots; many microvoids; moderately developed light yellowish brown (10YR 6/4) organic acid coatings; gradual boundary
- B₂** 20-50 cm Yellowish brown (10YR 5/8) to strong brown (7.5YR 5/6); clay; moderate, coarse subangular blocky structures; slightly firm; few fine pores; very few fine (1 to 2 mm) roots; many microvoids; few patchy yellowish brown (10YR 5/8) cutans; clear boundary

Soil profile no.	49
Soil name:	MERIT family
Elevation:	45 to 60 meters
Landform:	Rolling
Physiography at site:	Foot slope
Slope at site:	30°
Soil drainage:	Well-drained
Soil erosion:	Moderate sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	120 cm
Vegetation:	Recent secondary growth
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		3 cm of decomposed and semi-decomposed lallang
A _h	0-6 cm	Yellowish brown (10YR 5/4); clay loam; moderate, medium subangular blocky and crumb structures; friable; few fine pores; many fine and medium (1-5 mm) roots; clear boundary
B ₁	6-20 cm	Yellowish brown (10YR 5/8); clay; moderate, medium and coarse subangular blocky structures; friable; common fine pores; many fine (1 to 2 mm) roots; many krotovinas; moderately developed light yellowish brown (10YR 6/4) organic acid coatings; gradual boundary
B ₂	20-50 cm	Yellowish brown (10YR 5/8) to strong brown (7.5YR 5/8); clay; moderate, coarse subangular blocky structures; slightly firm; few fine pores; very few fine (1 to 2 mm) roots; many krotovinas; few patchy yellowish brown (10YR 5/6) cutans; clear boundary

Soil profile no. 50

Elevation: 30 to 45 meters

Landform: Gentle isolated hill-top

B3 50-120 cm Yellow (10YR 7/6) and reddish yellow (7.5YR 6/8); clay; moderate, coarse subangular blocky structures; friable; very few very fine (<1 mm) roots; presence of 10 to 20% gravels of shale; about 15% strong brown (7.5YR 5/8) mottles (< 5 mm); many krotovinas; distinct boundary

CR 120 cm + A continuous layer of parent bedrock - shale

Vegetation: Recent secondary forest

Moisture conditions in profile: Moist throughout

Profile Description

A0 2 cm of decomposed and semi-decomposed falling

Aa 0-4 cm Yellowish brown (10YR 5/4); fine sandy clay loam; moderate, medium and fine subangular and blocky structures; very friable; common small pores; abundant fine to coarse (1-10 cm) roots; clear boundary

Ab 4-20 cm Brownish yellow (10YR 6/6); clay loam; moderate, coarse and some medium subangular blocky structures; friable; few fine to medium pores; many fine to coarse (1-10 cm) roots; weakly developed light yellowish brown (10YR 6/4) organic acid mottles; many krotovinas; gradual boundary

B21 20-50 cm Brownish yellow (10YR 6/6); clay; moderately strong, very coarse subangular blocky blocky structures; strong, coarse and some medium subangular blocky structures; friable; few fine pores; few fine to medium (1 to 4 cm) roots; many well-developed

Soil profile no. 50
Soil name: MERIT family
Elevation: 30 to 45 meters
Landform: Gentle isolated hill-lock
Physiography at site: Gentle mid-slope
Slope at site: 3°
Soil drainage: Well-drained
Soil erosion: Moderately eroded
Presence of surface stones or rock outcrops: Nil
Effective soil depth: 125 cm
Vegetation: Recent secondary growth
Moisture conditions in profile: Moist throughout

Profile Description

A₀ 2 cm of decomposed and semi-decomposed lallang

A_h 0-4 cm Yellowish brown (10YR 5/4); fine sandy clay loam; moderate, medium and fine subangular blocky and crumb structures; very friable; common micro-pores; abundant fine to coarse (1-10 mm) roots; clear boundary

B₁ 4-20 cm Brownish yellow (10YR 6/6); clay loam; moderate, coarse and some medium subangular blocky structures; friable; few fine to medium pores; many fine to coarse (1-15 mm) roots; weakly developed light yellowish brown (10YR 6/4) organic acid coatings; many krotovinas; gradual boundary

B₂₁ 20-50 cm Brownish yellow (10YR 6/8); clay; moderately strong, very coarse subangular blocky breaking into moderately strong, coarse and some medium subangular blocky structures; friable; few fine pores; few fine to medium (1 to 4 mm) roots; many well-developed

Soil profile no.	18
Soil name	Bekenu series
Elevation:	30 to 45 meters
Location:	1871
Physiography at site:	brownish yellow (10YR 6/6) cutans on most ped surfaces; many krotovinas; clear boundary
Slope at site:	12°
B22 50-90 cm	Strong brown (7.5YR 5/8); clay; moderately strong, coarse and some medium subangular blocky structures; friable; few very fine pores; very few fine (1 to 2 mm) roots; presence of < 2% yellowish red (5YR 5/8) mottles (< 5 mm); few krotovinas; clear boundary.
B3 90-125 cm	Strong brown (7.5YR 5/8), brownish yellow (10YR 6/6 and 6/8) and yellowish red (5YR 5/8); clay; moderate, very coarse subangular blocky breaking into moderate, coarse and medium subangular blocky structures; friable; few fine pores; roots are rare; very few fine white (10YR 8/2) blotches; few krotovinas; about 10% gravels of shale (20 to 50 mm); abrupt boundary
A ₀	
Ah 0-4 cm	Brown to dark brown (10YR 4/3-5/3); sandy clay
CR 125-150 cm	A layer of somewhat fragmented parent rock-shale, with about 20% interstices filled with clay as above. pores; abundant; fine and coarse roots; clear boundary
B1 4-25 cm	Brownish yellow (10YR 6/6-6/8); fine sandy clay; loam moderate, coarse and very coarse subangular blocky breaking into moderately strong, coarse and medium subangular blocky structures; friable; many very fine and few medium pores; many very fine and coarse roots; many organic stains on ped surfaces; many fine krotovinas (< 5 mm); gradual boundary

Soil profile no.	18
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Hilly
Physiography at site:	Mid-steep slope
Slope at site:	15°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litter, 4 to 6 leaves thick
A _h	0 - 4 cm	Brown to dark brown (10YR 4/3-5/3); sandy clay loam; moderate, medium and fine subangular blocky and some crumbs; friable; many fine pores; abundant; fine and coarse roots; clear boundary
B ₁	4 - 25 cm	Brownish yellow (10YR 6/6-6/8); fine sandy clay; loam moderate, coarse and very coarse subangular blocky breaking into moderately strong, coarse and medium subangular blocky structure; friable; many very fine and few medium pores; many very fine and coarse roots; many organic stains on ped surfaces; many fine krotovinas (< 15 mm); gradual boundary

B 2 25 - 90 cm Brownish yellow (10YR 6/8) to strong brown (7.5YR 5/8); clay loam; moderate; very coarse and coarse subangular blocky structures; friable to slightly firm; few very fine pores; few very fine and coarse roots; few root channels; many krotovinas (< 15 mm); many moderately developed cutans; clear boundary.

B₂ cn 90 - 150 cm Brownish yellow (10YR 6/8) to strong brown (7.5YR 5/8); clay; moderate, coarse and very coarse subangular blocky structures; friable; few fine pores; few very fine roots; about 20-30% gravels (5-30 mm) of soft iron-coated shale and laterites; gravels are loosely-packed; with <5% light yellowish brown (10YR 6/4) and light grey (10YR 7/2) blotches

SOIL ANALYTICAL DATA

Soil profile No: 18

Soil name: Bekenu series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio
			Clay	Silt	Sand												
Ah	4.05	235	23.7	21.8	9.8	11.0	27.1	5.4	0.8	1.05	N	ND	2.40	4.13	0.24	10.00	
B1	4.00	135	27.9	24.3	12.4	5.2	25.3	3.8	0.3	1.36	N	ND	0.68	1.17	0.10	6.80	
B2	3.95	115	35.1	25.2	11.0	5.6	20.1	0.6	1.9	1.52	N	ND	0.26	0.45	0.07	3.71	
B2c	4.30	57	33.5	23.7	9.4	4.8	19.6	3.3	5.3	1.51	N	ND	0.17	0.29	0.06	2.83	

Depth in cm	Ferchloric Digestible				ppm Total S	Av P	H_2O soluble B	meq CEC in NH_4OAC	Exchangeable Cation			TEB						
	Mg	Ca	P	Cu					Mn	Zn	K		Ca	Na	Al			
Ah	0.44	0.09	0.04	140	9	58	26	250	18	2.5	13.3	0.18	1.66	1.75	0.12	0.48	3.71	28
B1	0.52	0.10	0.02	100	8	20	27	250	7	2.6	9.3	0.13	0.24	0.01	0.11	1.10	0.49	5
B2	0.65	0.13	0.02	145	9	24	35	525	7	ND	10.4	0.13	0.12	0.01	0.12	1.54	0.38	4
B2c	0.83	0.14	0.02	145	15	36	44	250	15	ND	7.7	0.13	0.46	0.04	0.13	0.51	0.76	10

* B.S. = % Base saturation

ND = Not Determined
N = Negligible

Soil profile no.	45
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Undulating
Physiography at site:	Nearly level to very gentle slope
Slope at site:	2°
Soil drainage:	Well-drained
Soil erosion:	Moderately eroded
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	130 cm
Vegetation:	Secondary growth
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-3 cm	Brown (10YR 5/3); sandy loam; moderate, medium and fine subangular blocky and crumb structures; friable; few very fine pores; abundant fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	3-15 cm	Yellowish brown (10YR 5/6) to dark yellowish brown (10YR 4/6); fine sandy clay loam; moderate, medium and coarse subangular blocky breaking into moderate, medium and some fine subangular blocky structures; very friable; common fine pores; many fine to coarse (1 to 10 mm) roots; weakly developed faint yellowish brown (10YR 5/4) organic acid coatings; gradual boundary
B ₂	15-45 cm	Brownish yellow (10YR 6/6); sandy loam; moderate, very coarse subangular blocky breaking into moderately strong, coarse subangular blocky structures; friable;

common fine pores; few fine to medium (1 to 5 mm) roots; very weakly developed organic acid coatings; many krotovinas along channels; clear boundary

- B3 45-130 cm Brownish yellow (10YR 6/6) and light yellowish brown (2.5Y 6/4); sandy clay loam; moderate, coarse and very coarse subangular blocky structures; friable; few fine to medium pores; very few fine roots; very patchy organic acid coatings; few krotovinas along channels; presence of 20 to 30% gravelly and stony (5 to 10 cm) arenaceous shale; abrupt boundary
- CR 130 cm + A continuous layer of carbonaceous shale

Depth (cm)	Moisture (%)	Dry weight (%)	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)	Gravel (%)	Stones (%)	Organic matter (%)	pH	Other
0-5	1.15	20	18.1	21.0	27.7	2.6	0.4					
5-10	2.28	17	19.2	19.8	29.1	2.6	0.1					
10-15	1.19	34	18.1	25.1	25.8	2.6	0.1					
15-20	1.80	25	18.2	23.8	15.1	22.3	3.2	1.3				

SOIL ANALYTICAL DATA

Soil profile No: 45

Soil name: Bekenu series

Horizon	Depth in cm	pH (1:2.5)	Elect. conc. $\mu\text{mho/cm}$	Percentage		Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free Co_3	CaCo_3	Organic carbon	Organic matter	N	C/N ratio
				Clay	Silt												
Ah	0-3	5.15	160	14.3	23.0	22.8	27.7	7.6	0.8	1.0	1.04	N	ND	2.25	3.87	0.24	9.38
B1	3-15	4.30	84	29.8	3.9	29.4	25.2	4.9	0.4	0.3	1.10	N	ND	1.00	1.72	0.13	7.69
B2	15-45	4.15	88	19.3	15.1	33.4	26.0	3.9	0.2	0.2	1.43	N	ND	0.40	0.69	0.07	5.71
B3	45-130	4.80	26	22.0	23.5	18.1	22.1	5.2	1.5	1.4	1.25	N	ND	0.38	0.65	0.07	5.43

Horizon	Perchloric Digestible		Perchloric Digestible				ppm Total S	Av P	H ₂ O soluble B	me% CEC in NH_4OAC	Exchangeable Cation			B.S.			
	K	Ca	Cu	Mn	Zn	K					Mg	Ca	Na		Al	TEB	
Ah	0.30	0.13	0.19	130	5	79	31	17	0.2	7.47	0.28	0.97	9.13	0.09	0.14	10.47	140
B1	0.31	0.12	0.03	90	6	54	34	8	ND	5.47	0.18	0.27	1.55	0.09	0.58	2.09	38
B2	0.33	0.13	0.02	65	6	94	35	8	0.5	5.20	0.18	0.11	0.61	0.10	0.90	1.00	19
B3	0.65	0.25	0.06	75	8	179	56	9	ND	8.13	0.13	0.44	3.78	0.11	0.47	4.46	55

* % Base Saturation

N = Negligible
 ND = Not Determined
 nd = Not detected

Soil profile no.	53
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Undulating
Physiography at site:	Mid-gentle slope
Slope at site:	4°
Soil drainage:	Well-drained
Soil erosion:	Moderate sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	90 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0-4 cm	Brown (10YR 4/3) to dark yellow brown (10YR 4/4); sandy clay loam; moderate, fine and medium subangular blocky and crumb structures; few very fine pores; abundant fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	4-25 cm	Brownish yellow (10YR 6/6); sandy clay loam; moderately strong, medium and some coarse subangular blocky structures; friable; common fine to medium pores; many fine to medium (1 to 4 mm) roots; weakly developed organic acid coatings; many krotovinas; few yellowish red (5YR 5/8) streaks; gradual boundary
B ₂	25-70 cm	Yellowish brown (10YR 5/8) to strong brown (7.5YR 5/8); sandy clay loam; moderately strong, very coarse subangular blocky structures; friable;

few fine pores; few fine to medium (1 to 5 mm) roots; patchy well-developed cutans; few krotovinas; clear boundary

BCr 70-90 cm Strong brown (7.5YR 5/8); presence of about 50% gravelly and stony (5 to 15 cm) shale with interstices filled with sandy loam clay; somewhat diffuse and tongue boundary

CR 90-150 cm A layer of somewhat continuous parent rock with about 30% interstices filled with strong brown (7.5YR 5/8); sandy clay loam

Depth (cm)	Soil Color (Munsell)	Texture	Structure	Roots	Other Features
0-5	10YR 8/6	loam	blocky	fine	clear
5-10	10YR 7/6	loam	blocky	fine	clear
10-15	10YR 6/6	loam	blocky	fine	clear
15-20	10YR 5/6	loam	blocky	fine	clear
20-25	10YR 4/6	loam	blocky	fine	clear
25-30	10YR 3/6	loam	blocky	fine	clear
30-35	10YR 2/6	loam	blocky	fine	clear
35-40	10YR 1/6	loam	blocky	fine	clear
40-45	10YR 0/6	loam	blocky	fine	clear
45-50	10YR 0/6	loam	blocky	fine	clear
50-55	10YR 0/6	loam	blocky	fine	clear
55-60	10YR 0/6	loam	blocky	fine	clear
60-65	10YR 0/6	loam	blocky	fine	clear
65-70	10YR 0/6	loam	blocky	fine	clear
70-75	10YR 0/6	loam	blocky	fine	clear
75-80	10YR 0/6	loam	blocky	fine	clear
80-85	10YR 0/6	loam	blocky	fine	clear
85-90	10YR 0/6	loam	blocky	fine	clear
90-95	10YR 0/6	loam	blocky	fine	clear
95-100	10YR 0/6	loam	blocky	fine	clear
100-105	10YR 0/6	loam	blocky	fine	clear
105-110	10YR 0/6	loam	blocky	fine	clear
110-115	10YR 0/6	loam	blocky	fine	clear
115-120	10YR 0/6	loam	blocky	fine	clear
120-125	10YR 0/6	loam	blocky	fine	clear
125-130	10YR 0/6	loam	blocky	fine	clear
130-135	10YR 0/6	loam	blocky	fine	clear
135-140	10YR 0/6	loam	blocky	fine	clear
140-145	10YR 0/6	loam	blocky	fine	clear
145-150	10YR 0/6	loam	blocky	fine	clear

SOIL ANALYTICAL DATA

Soil profile No: 53

Soil name: Bekenu series

Horizon	Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio					
				Clay	Silt	Sand											
Ah	0-4	4.05	143	20.1	28.6	25.2	15.2	5.6	1.5	0.5	0.89	N	0.5	2.51	4.32	0.24	10.46
B1	4-25	3.85	146	26.1	25.5	18.5	27.0	2.0	0.2	0.3	1.19	N	0.3	0.83	1.43	0.10	8.30
B2	25-70	4.10	67	33.2	21.6	29.8	1.7	1.7	0.2	0.2	1.59	N	0.5	0.55	0.95	0.07	7.86

Horizon	Perchloric Digestible			ppm Total S	Av P	H ₂ O soluble B	ppm NH ₄ OH	Exchangeable Cation				IEB					
	K	Mg	Ca					K	Ca	Na	Al		B.S.				
Ah	0.31	0.09	0.05	115	7	39	28	12	4.5	9.2	0.21	0.59	3.41	0.10	0.80	4.31	47
B1	0.35	0.11	0.02	85	6	17	30	6	2.0	7.5	0.10	0.07	0.02	0.07	1.28	0.26	4
B2	0.45	0.13	0.02	75	8	22	40	7	1.1	12.9	0.10	0.04	0.01	0.07	1.69	0.22	2

* % Base Saturation

N = Negligible
 ND = Not Determined
 nd = Not detected

Soil profile no.	54
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Rolling
Physiography at site:	Mid-slope
Slope at site:	10°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	130 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0 to 3 cm	Yellowish brown (10YR 5/4 to 5/6); sandy clay loam; moderate, fine subangular blocky and crumb structures; friable; few fine pores; abundant fine (1 to 2 mm) roots of nephrolepis; clear boundary
B ₂₁	3 to 15 cm	Brownish yellow (10YR 6/6 to 6/8); sandy clay loam; moderate strong, medium and some coarse subangular blocky structures; friable; common fine pores; many fine to coarse (1 to 10 mm) roots; weakly developed organic acid coatings; some krotovinas; gradual boundary
B ₂₂	15 to 80 cm	Brownish yellow (10YR 6/8); clay loam, moderately strong, coarse and some coarse subangular blocky structures; friable; few fine pores; few fine to medium (1 to 5 mm) roots; patchy cutans; few krotovinas; clear boundary

SOIL ANALYTICAL DATA

Soil profile No.: 54

Soil name: Bekenu series

Horizon	Depth in cm	pH	Elect. cond. $\mu\text{mho/cm}$	Percentage				Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio				
				Clay	Silt	Very fine sand	Fine sand							Medium sand	Coarse sand	Very coarse sand	
Ah	0-5	3.75	187	22.7	22.9	30.7	14.0	4.4	0.8	0.6	1.02	N	0.3	1.75	3.01	0.15	11.67
B21	5-15	3.95	105	26.0	20.8	36.0	13.0	2.8	0.4	0.3	1.47	N	0.5	0.35	0.60	0.06	5.83
B22	15-80	4.05	214	35.0	19.9	30.0	11.7	1.9	0.2	0.3	1.38	N	0.3	0.20	0.34	0.05	4.00

Horizon	Perchloric Digestible				Perchloric Digestible				ppm Total S	Av P	H ₂ O soluble B	me% CEC in NH_4OAC	Exchangeable Cation				TEB	B.S.	
	K	Mg	Ca	Na	P	Cu	Mn	Zn					K	Mg	Ca	Na			Al
Ah	0.25	0.08	0.02	0.02	105	6	20	27	125	9	4.8	8.7	0.18	0.23	0.14	0.08	1.92	0.63	7
B21	0.30	0.09	0.02	0.02	80	6	21	34	63	5	0.9	5.1	0.10	0.05	0.02	0.08	1.44	0.25	5
B22	0.35	0.12	0.02	0.02	85	7	26	49	125	8	ND	7.1	0.10	0.03	0.01	0.09	1.13	0.23	3

* % Base Saturation

N = Negligible
 ND = Not determined
 nd = Not detected

Soil profile no. 1.
Soil name: Bekenu series
Elevation: 30 to 45 meters
Landform: Hilly
Physiography at site: Mid slope
Slope at site: 16°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Presence of surface stones or rock outcrops: Nil
Effective soil depth: 150 cm
Vegetation: Hill forest
Moisture conditions in profile: Slightly wet in 0-5 cm, otherwise moist throughout

Profile Description

A₀ Leaf litters, 2 to 4 leaves thick

A_h 0- 2 cm Yellowish brown (10YR 5/4); fine sandy clay laom; weak medium subangular blocky structures; slightly sticky; slightly plastic; many fine pores; abundant fine & medium (1 to 5 mm) roots; clear boundary

B₂ 2-30 cm Reddish yellow (7.5YR 6/8); fine sandy clay; weak to somewhat structureless; firm; few micro pores; few, fine and medium (1-5 mm) roots; with less than 5% scattered pockets of very pale brown (10YR 7/4) blotches; gradual boundary

B₂ 30-75 cm Reddish yellow (7.5YR 6/8); fine sandy clay; moderately weak, very coarse and coarse subangular blocky; firm; many very fine pores; few coarse (5 to 15 mm) roots, some decayed; few, medium distinct very pale brown (10YR 7/4) and brownish yellow (10YR 6/6) mottles; some cutans on ped surfaces; clear boundary

Soil profile no.

Soil name:

Soil series

Elevation:

30 to 45 meters

B3cn 75-170 cm

Reddish yellow (5YR 6/8); fine sandy clay; moderate coarse subangular blocky; slightly plastic; few very fine pores; few medium roots, some decayed; <25% gravels of laterised shale; non-compact with common distinct light grey (10YR 7/2) and yellow (10YR 7/6) mottles.

Physiography at site

Slope at site:

Soil drainage:

Soil erosion:

Presence of surface stones or rock outcrops:

Effective soil depth:

Vegetation:

Moisture conditions in profile:

Severe sheet erosion

Nil

55 cm

Hill forest

Wet throughout

Note: This profile is somewhat compacted by past logging activities

Profile Description

A₀ Leaf litter, 4 to 6 leaves thick

A₁ 0-5 cm Yellowish brown (10YR 6/4); fine sandy clay loam; moderate, medium subangular blocky and crumb structures; very friable; common fine and medium pores; abundant medium to coarse (2 to 10 mm) roots; clear boundary

A₂ 5-15 cm Brownish yellow (10YR 6/6); fine sandy clay; moderately strong, medium subangular blocky structures; very friable; many fine pores; many medium (1 to 2 mm) roots; many yellowish brown (10YR 5/3) organic stains; gradual boundary

A₃ 15-40 cm Brownish yellow (10YR 6/8); fine sandy clay loam; moderately strong, coarse and medium subangular blocky structures; friable; many medium pores; abundant fine and medium (1 to 5 mm) roots; some weakly developed cottons; few protozoans; gradual boundary

Soil profile no.	11
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Undulating
Physiography at site:	Foot slope adjacent to small ravine
Slope at site:	5°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	55 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-5 cm	Yellowish brown (10YR 5/4); fine sandy clay loam; moderate, medium subangular blocky and crumb structures; very friable; common fine and medium pores; abundant medium to coarse (2 to 10 mm) roots; clear boundary
B ₁	5-15 cm	Brownish yellow (10YR 6/6); fine sandy clay; moderately strong, medium subangular blocky structures; very friable; many fine pores; many medium (1 to 2 mm) roots; many yellowish brown (10YR 5/4) organic stains; gradual boundary
B ₂	15-40 cm	Brownish yellow (10YR 6/8); fine sandy clay loam; moderately strong, coarse and medium subangular blocky structures; friable; many medium pores; abundant fine and medium (1 to 5 mm) roots; some weakly developed cutans; few krotovinas; gradual boundary

Soil profile no.		
Soil name:		Rehau series
Elevation:		30 to 45 meters
B ₃	40-55 cm	Brownish yellow (10YR 6/6); fine sandy clay; moderate, coarse subangular blocky structures; friable; few medium pores; few medium (2 to 5 mm) roots; with about 15% reddish yellow (7.5YR 6/8) and strong brown (7.5YR 5/8) blotches; broken boundary
CR	55-150 cm	A continuous layer of decomposing parent material - shale
Presence of surface		rock outcrops: Nil
Effective soil depth:		100 cm
Vegetation:		hill forest
Moisture conditions in profile:		Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 5 leaves thick
A ₁	0-3 cm	Yellowish brown (10YR 5/6); fine sandy clay loam; moderate, medium subangular blocky and crumb; very friable; common fine pores; very fine and medium (1 to 5 mm) roots; clear boundary
B ₁	3-10 cm	Brownish yellow (10YR 6/6 to 5/8); sandy clay loam; moderate, medium and some coarse subangular blocky structures; very friable; many fine and few medium pores; few fine and medium (1 to 5 mm) roots; with patchy very pale brown (10YR 7/4) and strong brown (7.5YR 5/8) blotches; many organic acid coatings on ped surfaces; many protozoans; gradual boundary
B ₂	10-35 cm	Brownish yellow (10YR 6/6); sandy clay loam; moderately strong, coarse and very coarse subangular blocky structures; friable; many fine pores; few medium and coarse (2 to 10 mm) roots; many well developed cilia; many protozoans; gradual boundary

Soil profile no.	15
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Steep
Physiography at site:	Mid-steep slope
Slope at site:	25°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	100 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A0		Leaf litters; 4 to 6 leaves thick
Ah	0-3 cm	Yellowish brown (10YR 5/6); fine sandy clay loam; moderate, medium subangular blocky and crumbs; very friable; common fine pores; many fine and medium (1 to 5 mm) roots; clear boundary
B1	3-10 cm	Brownish yellow (10YR 6/6 to 6/8); sandy clay loam; moderate, medium and some coarse subangular blocky structures; very friable; many fine and few medium pores; few fine and medium (1 to 5 mm) roots; with patchy very pale brown (10YR 7/4) and strong brown (7.5YR 5/8) blotches; many organic acid coatings on ped surfaces; many krotovinas; gradual boundary
B2	10-35 cm	Brownish yellow (10YR 6/8); sandy clay loam; moderately strong, coarse and very coarse subangular blocky structures; friable; many fine pores; few medium and coarse (2 to 10 mm) roots; many well-developed cutans; many krotovinas; gradual boundary

BC	35-100 cm	Brownish yellow (10YR 6/8); clay loam; moderate, coarse and very coarse subangular blocky structures; friable; many fine pores; very few fine (1 to 2 mm) roots; presence of about 10% plat (2 to 10 mm) laterised shale and gravels of undecomposed shale. Shale gravels increase with depth but is penetrable by roots; somewhat tongue boundary
CR	100-150 cm	A continuous layer of consolidated parent rock - carbonaceous shale

Profile description

Ag		Leaf litter, 4 to 5 leaves thick
A ₁	0-5 cm	Brown to dark brown (10YR 4/3); fine sandy clay loam; moderate, fine and medium subangular blocky and few crumb structures; slightly sticky, slightly plastic; many fine and medium pores; abundant very fine to coarse roots (<1 to 20 mm); clear boundary
B ₁	5-15 cm	Brownish yellow (10YR 6/6); sandy clay loam; moderate, coarse subangular blocky breaking into moderately strong, medium and some coarse subangular blocky structures; friable; many fine pores; many fine to coarse roots (1 to 10 mm); with many yellowish brown (10YR 5/4) organic acid coatings on ped surfaces; many krotovinas; gradual boundary
B ₂	15-30 cm	Brownish yellow (10YR 6/8); sandy clay loam; moderately strong, coarse and some medium subangular blocky structures; friable; many fine pores; many fine to coarse roots; many organic acid coatings on ped surfaces; many krotovinas; clear boundary

Soil profile no.	19
Soil name:	Bekenu series
Elevation:	30 to 45 meters
Landform:	Hilly
Physiography at site:	Lower slope
Slope at site:	12° to 15°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	150 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-5 cm	Brown to dark brown (10YR 4/3); fine sandy clay loam; moderate, fine and medium subangular blocky and few crumb structures; slightly sticky, slightly plastic; many fine and medium pores; abundant very fine to coarse roots (<1 to 20 mm); clear boundary
B ₁	5-15 cm	Brownish yellow (10YR 6/6); sandy clay loam; moderate, coarse subangular blocky breaking into moderately strong, medium and some coarse subangular blocky structures; friable; many fine pores; many fine to coarse roots (1 to 10 mm); with many yellowish brown (10YR 5/4) organic acid coatings on ped surfaces; many krotovinas; gradual boundary
B ₂	15-40 cm	Brownish yellow (10YR 6/8); sandy clay loam; moderately strong, coarse and some medium subangular blocky structures; friable; many fine pores; many fine to coarse roots; many organic acid coatings on ped surfaces; many krotovinas; clear boundary

Soil profile description:
Soil name:
Elevation: 15 to 30 meters
Lithology: Irregular
B₂cn 40-80 cm Brownish yellow (10YR 6/8); sandy clay loam; moderate, coarse subangular blocky structures; friable; common fine pores; few fine roots; presence of 30 to 40% laterites and platy laterised shale (5 to 20 mm); gravels are not compact and are penetrable by roots; some krotovinas; somewhat tongue boundary
Physiography at site:
Slope at site:
Soil drainage:
Soil erosion:
Presence of surface stones or rock outcroppings:
BCR 80-150 cm Brownish yellow (10YR 6/8); sandy clay loam; weak, coarse subangular and angular blocky structures; friable; presence of 20 to 30% laterised shale (5 to 20 mm) and parent rock (15 cm); parent rocks are spaced at about 15 cm apart; some light yellowish brown (10YR 6/4) blotches; no micro-bio activities
Vegetation:
Moisture conditions:

Profile Description

A₀ Leaf litter, 6 to 8 leaves thick
A₁ 0-3 cm Dark to dark brown (10YR 4/3); sandy clay loam; moderate, medium and fine subangular blocky and crumb; friable; few fine pores; few fine to coarse (5 to 20 mm) roots; clear boundary
B₁ 3-20 cm Brownish yellow (10YR 6/6); sandy clay loam; moderate, very coarse subangular blocky structures; slightly fine; few medium pores; very few fine roots; about 10% yellow (2.5Y 7/6) blotches and 2% distinct yellowish red (5YR 5/8) noddles; some krotovinas along channels; few organic acid coatings on some ped surfaces; clear boundary
B₂ 20-80 cm Brownish yellow (10YR 6/6); clay loam; moderate, very coarse subangular blocky breaking into moderately strong, coarse and very coarse subangular blocky structures; friable; few fine pores; very few fine

Soil profile no.	41
Soil name:	Bekenu series
Elevation:	15 to 30 meters
Landform:	Undulating
Physiography at site:	Mid-gentle slope
Slope at site:	3°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	150 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 6 to 8 leaves thick
A _h	0-3 cm	Brown to dark brown (10YR 4/3); sandy clay loam; moderate, medium and fine subangular blocky and crumbs; friable; few fine pores; few fine to coarse (1 to 20 mm) roots; clear boundary
B ₁	3-20 cm	Brownish yellow (10YR 6/6); sandy clay loam; moderate, very coarse subangular blocky structures; slightly firm; few medium pores; very few fine roots; about 10% yellow (2.5Y 7/6) blotches and 2% distinct yellowish red (5YR 5/8) mottles; some krotovinas along channels; few organic acid coatings on some ped surfaces; clear boundary
B ₂	20-80 cm	Brownish yellow (10YR 6/6); clay loam; moderate, very coarse subangular blocky breaking into moderately strong, coarse and very coarse subangular blocky structures; friable; few fine pores; very few fine

Soil name: ...
Elevation: 30 to 45 meters
Slope: Steep
Physiography at site: roots; many well-developed yellow (10YR 7/6) cutans on ped surfaces; few organic acid coatings; diffuse boundary
Soil drainage: well-drained
B₂cn 80-150 cm Brownish yellow (10YR 6/6); clay loam; similar to B₂ horizon except with about 5 to 10% fragmented shale (slightly laterised); fragmented shale are spaced at 15 to 30 cm apart
Effective soil depth: 100 cm
Vegetation: Hill forest
Moisture conditions in profile: Moist throughout

Profile description

A₀ Leaf litter, 5 to 8 leaves thick
A₁ 0-10 cm Brown to dark yellowish brown (10YR 4/3 to 4/4); sandy loam; moderate, medium and fine subangular blocky and crumb structures; friable; common fine pores; many fine to coarse (1 to 15 mm) roots; clear boundary
B₁ 10-35 cm Olive yellow (2.5Y 6/6); sandy clay; moderately well sorted, coarse subangular blocky structures; friable; few fine to medium pores; many fine to medium (1 to 5 mm) roots; many brown to dark brown (7.5Y 4/4) streaks along roots; many moderately developed organic acid coatings; many tricharaxes; gradual boundary

Soil profile no: 52
Soil name: Bekenu series
Elevation: 30 to 45 meters
Landform: Steep
Physiography at site: Foot slope
Slope at site: 3° at site, surrounding 18-25°
Soil drainage: Well-drained
Soil erosion: Very slightly eroded; somewhat accreting
Presence of surface stones or rock outcrops: Nil
Effective soil depth: 100 cm
Vegetation: Hill forest
Moisture conditions in profile: Moist throughout

Profile Description

A₀ Leaf litters, 6 to 8 leaves thick

A_h 0-10 cm Brown to dark yellowish brown (10YR 4/3 to 4/4); sandy loam; moderate, medium and fine subangular blocky and crumb structures; friable; common fine pores; many fine to coarse (1 to 15 mm) roots; clear boundary

B₁ 10-35 cm Olive yellow (2.5Y 6/6); sandy clay; moderately weak, coarse subangular blocky structures; friable; few fine to medium pores; many fine to medium (1 to 5 mm) roots; many brown to dark brown (7.5YR 4/4) streaks along roots; many moderately developed organic acid coatings; many krotovinas; gradual boundary

B2	35-60 cm	Strong brown (7.5YR 5/8); sandy clay; moderately weak, coarse subangular blocky structures; friable; presence of about 20% gravels of platy laterised shale (5 to 20 mm); few medium to coarse (2 to 10 mm) roots; presence of about 10% yellow (10YR 7/6) blotches; few streaks as in above horizon; clear boundary
IIBC _R	60-100 cm	Brownish yellow (10YR 6/6 to 6/8); clay; a layer of about 50% fragmented parent rock-shale (30-50 mm) with interstices filled with clay; clear boundary
IIC _R	100-150 cm	A continuous layer of parent bedrock - shale

Profile Description

Note: Top 60 cm probably colluvial materials

A ₀	0-3 cm	Yellowish brown (10YR 5/4); sandy loam; moderate, medium and fine subangular blocky and crumb and few coarse subangular blocky structures; slightly sticky; slightly plastic; few very fine pores; many fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	3-20 cm	Brownish yellow (10YR 6/5 to 6/6); clay loam; moderately strong, very coarse subangular blocky breaking into strong, coarse and some medium subangular or blocky structures; friable; few fine and a few pores; few fine to medium roots (1 to 2 mm); presence of about 10 to 20% strong brown (7.5YR 5/8) and pale yellow (2.5Y 7/6) mottles (± 5 mm size); moderately developed yellowish brown (10YR 5/3) mottles and coatings on ped surfaces; many roots; clear boundary

Soil profile no.	27
Soil name:	Kabuloh series
Elevation:	15 to 30 meters
Landform:	Old river bed
Physiography at site:	Flat, raised
Slope at site:	< 2°
Soil drainage:	Moderately well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops:	Boulders on soil surface spaced at about 5 meters apart
Effective soil depth:	130 cm
Vegetation:	Riverine forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-8 cm	Yellowish brown (10YR 5/4); sandy loam; moderate, medium and fine subangular blocky and crumbs and few coarse subangular blocky structure; slightly sticky; slightly plastic; few very fine pores; many fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	8-20 cm	Brownish yellow (10YR 6/6 to 6/8); clay loam; moderately strong, very coarse subangular blocky breaking into strong, coarse and some medium subangular blocky structures; friable; few fine and medium pores; few fine to medium roots (1 to 5 mm); presence of about 10 to 20% strong brown (7.5YR 5/8) and pale yellow (2.5Y 7/4) mottles (< 5 mm); many moderately developed yellowish brown (10YR 5/4) organic acid coatings on ped surfaces; many krotovinas; clear boundary

- B₂ 20-50 cm Reddish yellow (7.5YR 6/6) with about 25% pale yellow (2.5Y 7/4); clay loam; strong, coarse and very coarse and some medium subangular blocky structures; friable; common fine pore; very few medium roots (2 to 5 mm); well-developed cutans on most ped surfaces; presence of about 5% strong brown (7.5YR 5/8) blotches; gradual boundary
- B₃ 50-130 cm Pale yellow (2.5Y 7/4) and strong brown (7.5YR 5/8); sandy clay loam; moderately weak, very coarse subangular and angular blocky breaking into moderate, coarse subangular blocky structures; slightly firm; common fine pores; very few very fine roots; presence of about 2% reddish brown (5YR 4/4) soft manganese concretions (2 mm)

SOIL ANALYTICAL DATA

Soil profile No: 27

Soil name: Kabulooh series

Depth in cm	pH (1-2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio
			Clay	Silt	Very fine sand						
A _h	5.50	120.0	17.3	22.4	22.7	1.20	N	2.03	3.49	0.21	9.67
B ₁	4.90	42.5	32.9	24.5	22.3	1.35	N	1.13	1.94	0.07	16.14
B ₂	5.20	35.5	34.4	27.4	14.4	1.31	N	0.25	0.43	0.07	3.57
B ₃	4.70	29.0	28.3	25.3	23.9	1.38	N	0.10	0.17	0.04	2.50

Depth	Perchloric Digestible				Total S	Av P	H ₂ O soluble B	Exchangeable Cation				TEB	B.S.*		
	K	Mg	Ca	ppm				Mg	Ca	Na	Al				
A _h	0.53	0.18	0.28	150	250	13	1.1	8.13	0.26	1.09	12.34	0.10	0.10	13.79	sat**
B ₁	0.04	0.01	0.18	90	250	9	ND	11.87	0.20	1.14	8.66	0.10	0.18	10.10	85
B ₂	0.69	0.25	0.31	75	250	11	ND	10.93	0.28	1.43	14.03	0.12	0.13	15.86	sat**
B ₃	0.43	0.10	0.06	95	63	7	0.2	8.80	0.18	0.51	3.34	0.13	0.60	4.16	47

* B.S. = %Base saturation
 ** sat = Saturated

N = Negligible
 ND = Not Detected

Soil profile no.	36
Soil name:	Kabuloh series
Elevation:	Below 15 meters
Landform:	Old river bed
Physiography at site:	Extensive flat, raised
Slope at site:	< 1°
Soil drainage:	Well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops:	Nil at site
Effective soil depth:	85 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Slightly wet at 85 cm and below, otherwise moist throughout

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-8 cm	Brown to dark brown (7.5YR 4/2); slity loam; moderate, medium and fine subangular blocky and very few crumbs; friable; few fine pores; abundant fine to coarse (1 to 10 mm) roots; clear boundary
B ₁	8-25 cm	Light yellowish brown (2.5Y 6/4); loam; moderately strong, coarse and some medium subangular blocky structures; friable; few very fine pores; many fine to medium (1 to 5 mm) roots; many moderately developed organic acid coatings on ped surfaces and along pores; gradual boundary
B ₃	25-85 cm	Light yellowish brown (2.5Y 6/4) and yellowish brown (10YR 5/6); clay; moderately weak, very coarse angular and subangular blocky structures; slightly massive; few fine pores; very few fine to medium roots; few boulders (rounded) at lower depth of the horizon; clear boundary

BCg

85-130 cm

Light yellowish brown (2.5Y 6/4) and yellowish brown (10YR 5/6); clay loam; weak to structureless; massive; very few very fine pores; no micro-bio activities.

Soil profile No. 36
Soil name: Subsoil Series

Depth (cm)	Moist. (1:1)	Elect. Cond. (µmhos/cm)	Distillate (1:1)	Very fine sand (%)	Fine sand (%)	Coarse sand (%)	Clay (%)	Free Ca (mg/kg)	Free Mg (mg/kg)	pH	EC (µmhos/cm)	CEC (cmol(+) / kg)
85-90	6.20	270	15.0	60.0	2.0	3.0	3.0	0.0	0.0	7.0	1.0	0.07
90-95	6.05	220	20.0	48.7	3.0	0.0	3.0	0.0	0.0	7.0	1.0	0.10
95-100	6.30	350	45.0	30.0	3.0	1.0	0.0	0.0	0.0	6.5	1.0	0.08
100-105	6.40	320	40.0	30.0	3.0	2.0	0.0	0.0	0.0	6.5	1.0	0.10
105-110	6.45	300	35.0	30.0	3.0	2.0	0.0	0.0	0.0	6.5	1.0	0.10
110-115	6.40	280	30.0	30.0	3.0	2.0	0.0	0.0	0.0	6.5	1.0	0.10
115-120	6.40	280	30.0	30.0	3.0	2.0	0.0	0.0	0.0	6.5	1.0	0.10
120-125	6.40	280	30.0	30.0	3.0	2.0	0.0	0.0	0.0	6.5	1.0	0.10
125-130	6.40	280	30.0	30.0	3.0	2.0	0.0	0.0	0.0	6.5	1.0	0.10

Soil from Subsoil Series

SOIL ANALYTICAL DATA

Soil profile No: 36
Soil name: Kabuloh series

Horizon	Depth in cm	pH	Elect. cond. $\mu\text{mho/cm}$	Percentage				Bulk density	Free CO_3	CaCO ₃	Organic carbon	Organic matter	N	C/N ratio			
				Clay	Silt	Very fine sand	Fine sand								Medium sand	Coarse sand	Very coarse sand
Ah	0-8	6.30	295	19.8	53.8	7.9	3.8	4.3	2.0	0.8	0.91	N	1.25	4.20	7.22	0.07	60.00
B1	8-25	6.35	128	22.5	46.7	13.5	6.8	4.9	0.8	0.2	1.25	N	1.25	1.24	2.13	0.13	9.54
B3	25-85	6.45	55	46.0	39.2	8.0	3.6	1.8	0.4	0.1	1.40	N	0.50	0.38	0.65	0.09	4.22
BCg	85-130	6.55	53	36.9	39.9	8.9	4.9	2.2	0.1	0.1	1.44	N	0.25	0.26	0.45	0.07	3.71

Horizon	Perchloric Digestable		Perchloric Digestable				Total S	Av P	H ₂ O soluble B	me% CEC in NH ₄ OAC	Exchangeable Cation			TEB			
	K	Mg	ppm P	ppm Cu	ppm Mn	ppm Zn					K	Ca	Mg		Al	B.S.	
Ah	0.68	0.25	0.57	290	14	387	62	18	1.1	12.53	0.18	1.43	26.83	0.12	0.11	28.56	228
B1	0.68	0.25	0.37	185	12	462	59	18	ND	6.27	0.13	0.86	18.82	0.13	0.09	19.94	318
B3	0.79	0.30	0.34	113	13	351	61	12	0.5	11.87	0.15	0.75	17.36	0.15	0.07	18.41	155
BCg	0.84	0.32	0.41	98	14	312	64	14	ND	12.67	0.44	0.75	20.90	0.14	0.03	22.23	175

* % Base Saturation

N = Negligible
ND = Not Determined
nd = Not detected

Soil profile no.	40
Soil name:	Kabuloh series
Elevation:	15 to 30 meters
Landform:	Old river bed
Physiography at site:	Extensive flat
Slope at site:	< 10°
Soil drainage:	Well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	120 cm
Vegetation:	Re-generated ofrest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 6 to 8 leaves thick
A _h	0-5 cm	Yellowish brown (10YR 5/4); loam; moderate, medium and fine subangular blocky and some crumbs; friable; common fine pores; many fine and coarse roots; clear boundary
B ₁	5-30 cm	Light yellowish brown (2.5Y 6/4) to olive brown (2.5Y 6/6); loam; moderately strong, coarse subangular blocky breaking into moderately strong, medium and coarse subangular block structures; friable; common fine pores; many fine and coarse roots; many moderately developed organic acid coatings on ped surfaces; many krotovinas; clear boundary

B21

30-80 cm

Pale yellow (2.5Y 7/4), olive yellow (2.5Y 6/6), and strong brown (7.5YR 5/8); clay loam; moderate, coarse and very coarse subangular and angular blocky breaking into moderately strong, coarse subangular and angular blocky structures; slightly firm; many very fine pores; few fine roots; many well-developed pale yellow (2.5Y 7/4) cutans on ped surfaces; few krotovinas; gradual boundary

B22

80-120 cm

Pale yellow (2.5Y 7/4) and strong brown (7.5YR 5/6); clay; structures are as above horizon; few very fine pores; very few fine roots; many well-developed pale yellow (2.5Y 7/4) cutans on ped surfaces; presence of 2 to 5% dark reddish brown (5YR 3/4) manganese concretions (< 5 mm diameter)

Soil profile no: 60
Soil name: Krasnodar series

Horizon	Depth (cm)	Color (Munsell)	Texture	Structure	Moisture	Temperature	Notes
B21	30-80	2.5Y 7/4, 2.5Y 6/6, 7.5YR 5/8	clay loam	blocky			
B22	80-120	2.5Y 7/4, 7.5YR 5/6	clay	blocky			

ED = Not detected
Mg = Mg/g/5h

SOIL ANALYTICAL DATA

Soil profile No: 40
Soil name: Kabuloh series

HORIZON	Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Free CO_3	Bulk density	Organic carbon	Organic matter	N	C/N ratio					
				Clay	Silt	Sand											
A _n	0-5	5.30	190	19.7	45.0	9.0	8.6	8.9	1.2	0.3	1.20	N	0.75	2.22	3.82	0.08	27.75
B ₁	5-30	5.20	125	26.6	38.6	13.5	8.6	5.4	0.6	0.1	1.25	N	ND	0.90	1.55	0.15	6.00
B ₂₁	30-80	4.85	95	35.9	37.5	10.0	6.8	1.9	0.4	0.1	1.42	N	ND	0.34	0.58	0.10	3.40
B ₂₂	80-120	5.10	55	42.7	35.6	8.3	6.5	2.9	0.4	ND	1.33	N	ND	0.25	0.43	0.08	3.13
HORIZON	Perchloric Digestable		Ferriehloric Digestable				Total S	Av P	H ₂ O soluble B	meq CEC in NH ₄ OAC	Exchangeable Cation			TEB			
	K	Ca	P	Cu	Mn	Zn					K	Ca	Na		A1	B.S.*	
A _n	1.50	0.24	0.36	120	20	60	76	18	1.1	10.80	0.33	0.97	15.97	0.13	0.04	17.40	sat**
B ₁	0.75	0.24	0.28	190	14	586	62	13	1.1	11.60	0.26	0.26	13.58	0.13	0.07	14.23	sat**
B ₂₁	0.81	0.27	0.31	160	11	328	65	11	ND	4.93	0.26	0.31	14.38	0.16	0.05	15.11	sat**
B ₂₂	0.64	0.29	0.34	145	11	363	67	11	ND	10.93	0.28	0.31	16.42	0.15	0.02	17.16	sat**

* B.S. = % Base saturation

**sat. = Saturated

ND = Not Detected

N = Negligible

Soil profile no. 35
Soil name: Kabuloh series
Elevation: Below 15 meters
Landform: Old river bed
Physiography at site: Extensive flat; raised
Slope at site: 1-2°
Soil drainage: Well-drained
Soil erosion: Slightly eroded
Presence of surface stones or rock outcrops: Scattered pitted and grooved boulders
Vegetation: Riverine forest
Effective soil depth: 120 cm
Moisture conditions in profile: Moist throughout

Profile Description

A₀ Leaf litters, 6 to 8 leaves thick

A_h 0-8 cm Brown to dark brown (10YR 4/3); sandy clay loam; moderate, medium and fine subangular blocky and crumb structures; friable; few fine pores; many fine to medium (1 to 5 mm) roots; clear boundary

B₁ 8-45 cm Brownish yellow (10YR 6/6); clay loam; moderately strong, coarse and very coarse subangular blocky breaking into moderately strong, medium and coarse subangular blocky structures; friable; common fine to very fine pores; many fine to coarse roots; many krotovinas; presence of few (<2%) light yellowish brown (10YR 6/4) blotches; moderately developed yellowish brown (10YR 5/4) organic acid coatings; gradual boundary

B₂₁ 45-80 cm Brownish yellow (10YR 6/6) and strong brown (7.5YR 5/8); clay loam; moderately strong, coarse and some medium subangular blocky structures; friable; common fine to

Elevation: 15 to 20 meters

Landform: Old river bed

Physiography at site: medium (1 to 5 mm) pores; few fine roots; many

slowly; krotovinas; very patchy organic acid-brown

Soil drainage: (10YR 5/4) coatings; gradual boundary

B22 80-120 cm Brownish yellow (10YR 6/8) and olive yellow (2.5Y 6/6); clay loam; moderate, coarse subangular blocky structures; friable; common fine (1 to 2 mm) and few medium (2 to 4 mm) pores; few fine roots; some krotovinas; abrupt boundary

IICR 120 cm + Rock boulder (rounded)

Profile description

- A0 Leaf litter; 5 to 8 leaves thick
- A1 0-7 cm Brown to dark brown (7.5YR 4/2); silty loam; moderate, medium and fine subangular and crumb structures; friable; fine fine pores; abundant fine to coarse (1 to 20 mm) roots; clear boundary
- B1 7-20 cm light yellowish brown (2.5Y 6/4); loam; moderately strong, coarse subangular blocky structures; friable; few fine and medium pores; many fine to medium (1 to 5 mm) roots; moderately developed organic acid coatings; few cutans; gradual boundary
- B2 25-80 cm light yellowish brown (2.5Y 6/4); clay; moderately weak, very coarse subangular and few angular blocky structures; slightly nodular; few fine pores; very few fine to medium roots; clear boundary; presence of faint yellowish brown (10YR 5/6) to greenish yellow (10YR 5/6) blotches

Soil profile no.	38
Soil name:	Kabuloh series
Elevation:	15 to 30 meters
Landform:	Old river bed
Physiography at site:	Extensive flat, raised
Slope at site:	<1°
Soil drainage:	Moderately well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops:	Nil at site
Effective soil depth:	90 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Moist from 0 to 90 cm; slightly wet below 90 cm

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-7 cm	Brown to dark brown (7.5YR 4/2); silty loam; moderate, medium and fine subangular and crumb structures; friable; fine fine pores; abundant fine to coarse (1 to 20 mm) roots; clear boundary
B ₁	7-28 cm	Light yellowish brown (2.5Y 6/4); loam; moderately strong, coarse subangular blocky structures; friable; few fine and medium pores; many fine to medium (1 to 5 mm) roots; moderately developed organic acid coatings; few cutans; gradual boundary
B ₃	28-90 cm	Light yellowish brown (2.5Y 6/4); clay; moderately weak, very coarse subangular and few angular blocky structure slightly massive; few fine pores; very few fine to medium roots; clear boundary; presence of faint yellowish brown (10YR 5/6) to brownish yellow (10YR 6/6) blotches

Soil profile No. 101
Soil name: 101
Elevation: Below 15 meters
BCg 90-150 cm Light yellowish brown (2.5Y 6/4) and yellow brown (10YR 5/6); clay; moderately weak to structureless; slightly massive; no roots
Physiography at site: Flat
Slope at site: < 1°
Soil drainage: Moderately well-drained
Soil erosion: Slightly eroded
Presence of surface stones or rock outcrops: Nil
Effective soil depth: 70 cm
Vegetation: Re-generated forest
Moisture conditions in profile: Moist from 0 to 70 cm; somewhat wet below 70 cm

Profile Description

A₀ Leaf litter; 6 to 8 leaves thick
A₁ 0-8 cm Yellowish brown (10YR 5/4) and brown (7.5YR 4/2); clay loam; moderate, fine and medium subangular blocky and few crumb; friable; few fine pores; many fine to coarse (1 to 20 mm) roots; clear boundary
B₂₁ 8-30 cm Brownish yellow (10YR 6/5); clay loam; moderately strong, coarse and very coarse and some medium subangular blocky structures; friable; common very fine pores; few fine roots; moderately developed light yellowish brown (10YR 6/4) cortex on ped surfaces; few krotovinas; gradual boundary
B₂₂ 30-70 cm Pale yellow (2.5Y 7/4) and yellowish brown (10YR 5/8); clay; moderate, coarse and very coarse subangular blocky structures; slightly firm; few very fine pores;

Soil profile no. 39
Soil name: Kabuloh series
Elevation: Below 15 meters
Landform: Raised terrace
Physiography at site: Flat
Slope at site: < 1°
Soil drainage: Moderately well-drained
Soil erosion: Slightly eroded
Presence of surface stones or rock outcrops: Nil
Effective soil depth: 70 cm
Vegetation: Re-generated forest
Moisture conditions in profile: Moist from 0 to 70 cm;
somewhat wet below 70 cm

Profile Description

A₀ Leaf litters; 6 to 8 leaves thick

A_h 0-8 cm Yellowish brown (10YR 5/4) and brown (7.5YR 4/2); clay loam; moderate, fine and medium subangular blocky and few crumbs; friable; few fine pores; many fine to coarse (1 to 20 mm) roots; clear boundary

B₂₁ 8-30 cm Brownish yellow (10YR 6/6); clay loam; moderately strong, coarse and very coarse and some medium subangular blocky structures; friable; common very fine pores; few fine roots; moderately developed light yellowish brown (10YR 6/4) cutans on ped surfaces; few krotovinas; gradual boundary

B₂₂ 30-70 cm Pale yellow (2.5Y 7/4) and yellowish brown (10YR 5/8); clay; moderate, coarse and very coarse subangular blocky structures; slightly firm; few very fine pores;

Soil profile no. _____
Soil use _____
Elevation _____
Landform: _____
Physiographic site _____
IICg 70-150 cm Grey (5G 6/1); silty clay; structureless; massive; sticky and plastic; many fine decayed roots; 10 to 20% yellowish brown (10YR 5/8) streaks and reddish yellow (7.5YR 6/8) mottles
Slope at site _____
Soil drainage: _____
Soil position: _____
Presence of surface stones or rock outcrops: _____
Effective soil depth: _____
Vegetation: _____
Moisture conditions in profile: _____

Note: i) Gley soils of the Mundai series is located 3 meters from this profile

ii) Few buried tree trunk at the boundary of B22 and IICg

Bp 0-3 cm Brown to dark brown (10YR 4/3); clay loam; moderate, medium subangular blocky structures; friable; few fine pores; many fine to medium (1 to 5 mm) roots; clear boundary

B1 3-12 cm Light olive brown (2.5Y 5/4) to olive brown (5YR 4/4); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; few pores; few fine to medium (1 to 5 mm) roots; about 5 to 15% yellowish brown (10YR 5/5) streaks; moderately developed organic acid nodules on soil surface; some sandstone; clear boundary

B2 15-40 cm Light yellowish brown (2.5Y 6/4); clay loam; moderately weak, very coarse subangular and angular blocky structures; somewhat massive; few very fine pores; few fine to medium (1 to 5 mm) roots; presence of

Soil profile no.	42
Soil name:	Kabuloh sereis
Elevation:	Below 15 meters
Landform:	Old river bed
Physiography at site:	Flat; between 2 small raised
Slope at site:	< 1°
Soil drainage:	Well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops:	Nil at site
Effective soil depth:	75 cm
Vegetation:	Riverine forest
Moisture conditions in profile:	Moist at 0-40 cm; slightly wet below 40 cm

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-3 cm	Brown to dark brown (10YR 4/3); clay loam; moderate, medium subangular blocky structures; friable; few fine pores; many fine to medium (1 to 5 mm) roots; clear boundary
B ₁	3-15 cm	Light olive brown (2.5Y 5/4) to olive brown (2.5Y 4/4); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; few pores; few fine to medium (1 to 5 mm) roots; about 5 to 10% yellowish brown (10YR 5/6) streaks; moderately developed organic acid coatings on ped surfaces; some krotovinas; clear boundary
B ₃₁	15-40 cm	Light yellowish brown (2.5Y 6/4); clay loam; moderately weak, very coarse subangular and angular blocky structures; somewhat massive; few very fine pores; few fine to medium (1 to 5 mm) roots; presence of

30 to 40% strong brown (7.5YR 5/8) streaks and mottles; some pale yellow (2.5Y 7/4) cutans on ped surfaces; few krotovinas; few organic acid coatings; gradual boundary

Soil drainage: Well-drained

B32 40-75 cm Yellowish brown (10YR 5/6); clay; moderately weak, very coarse angular blocky structures; somewhat massive; slightly sticky; very few micro-pores; very few fine (1 to 2 mm) roots; many light yellowish brown (2.5Y 6/4) cutans on most ped surfaces; abrupt boundary

CR 75 cm + Rock boulder (rounded)

Profile description

A₀ Leaf litter, 6 to 8 leaves, 10cm

A₁ 0-8 cm Brown (10YR 5/3); loose; moderately strong, medium and fine subangular blocky and crumb structures; friable; many very fine pores; abundant fine and coarse roots (1 to 10 mm); clear boundary

B₁ 8-30 cm Brownish yellow (10YR 6/5); clay; moderately strong, coarse subangular blocky breaking into moderately strong, coarse and medium subangular blocky structures; friable; many fine pores; many fine and coarse roots (2 to 15 mm); weakly developed brown (10YR 5/3) organic acid coatings on ped surfaces and along roots; many krotovinas; gradual boundary

Soil profile no.	20
Soil name:	Tukau series
Elevation:	30 to 45 meters
Landform:	Raised terrace
Physiography at site:	Nearly flat
Slope at site:	< 1°
Soil drainage:	Well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	125 cm
Vegetation:	Riverine forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 6 to 8 leaves thick
A _h	0-8 cm	Brown (10YR 5/3); loam; moderately strong, medium and fine subangular blocky and crumb structures; friable; many very fine pores; abundant fine and coarse roots (1 to 10 mm); clear boundary
B ₁	8-30 cm	Brownish yellow (10YR 6/6); clay; moderately strong, coarse subangular blocky breaking into moderately strong, coarse and medium subangular blocky structures; friable; many fine pores; many fine and coarse roots (1 to 15 mm); weakly developed brown (10YR 5/3) organic acid coatings on ped surfaces and along pores; many krotovinas; gradual boundary

B₂ 30-80 cm Brownish yellow (10YR 6/8); sandy clay loam; moderate; very coarse subangular blocky breaking into moderate, medium and coarse subangular blocky structures; friable; common fine pores; few fine roots; weakly developed cutans on ped surfaces; very few krötovinas; gradual boundary

B₂-B₃ 80-125 cm Strong brown (7.5YR 5/8); sandy clay loam; moderate, coarse and very coarse subangular blocky and some angular blocky structures; friable; few very fine pores; few fine roots; presence of about 20% fine faint yellow (10YR 7/6) and yellowish red (5YR 5/8) mottles; mottles becoming more prominent and increase in amount with depth, few cutans.

SOIL ANALYTICAL DATA

Soil profile No: 20
Soil name: Tukau series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio
			Clay	Silt	Sand												
Ah	4.50	260	22.6	32.0	7.4	13.2	18.8	2.5	1.7	0.99	N	ND	1.92	3.30	0.23	8.35	
B1	4.00	140	44.1	27.9	9.2	6.6	7.1	1.6	2.2	1.44	N	ND	0.53	0.91	0.09	5.89	
B2	4.15	65	25.5	22.7	11.9	13.9	21.8	1.1	0.1	1.53	N	0.3	0.18	0.31	0.05	3.60	
B2 to B3	4.95	9	25.4	24.0	8.7	14.0	24.2	0.9	0.1	1.63	N	0.3	0.11	0.19	0.04	2.75	
Horizon	Perchloric Digestible		Perchloric Digestible				ppm		ppm		ME [*] in NH_4OAC		Exchangeable Cation			TEB	
	% K	Mg Ca	P	Cu	Mn	Zn	Total S	Av P	H ₂ O soluble B	K	Mg	Ca	Na	Al	* B.S.		
Ah	0.70	0.16 0.10	180	12	667	44	250	8	3.0	7.9	0.38	1.83	3.55	0.12	0.31	5.88	74
B1	0.60	0.13 0.02	115	8	67	40	250	7	2.4	5.1	0.10	0.61	0.17	0.12	0.41	1.00	20
B2	0.54	0.11 0.02	88	10	42	43	250	8	0.2	6.0	0.10	0.34	0.05	0.13	0.74	0.62	10
B2 to B3	0.44	0.10 0.02	70	8	26	43	ND	8	ND	9.7	0.08	0.10	0.01	0.09	1.38	0.28	3

* B.S. = % Base saturation

ND = Not Detected
N = Negligible

Soil profile no.	21
Soil name:	Tukau series
Elevation:	15 to 30 meters
Landform:	Raised terrace
Physiography at site:	Flat (adjacent to small low hill)
Slope at site:	< 2°
Soil drainage:	Well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	85 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil, otherwise moist throughout

Profile Description

A ₀		Leaf litter, 6 to 8 leaves thick
A _h	0-5 cm	Brown to dark brown (10YR 4/3); loam; moderate, medium and fine subangular blocky and crumb structures; slightly sticky, slightly plastic; common very fine to coarse roots (1 to 15 mm); clear boundary
B ₁	5-35 cm	Yellowish brown (10YR 5/8); clay loam; moderately strong, coarse and medium subangular blocky structures; friable; common fine and medium pores; many fine and medium roots (1 to 5 mm); presence of 20 to 30% light yellowish brown (2.5Y 6/4) and yellowish red (5YR 5/6) blotches; clear boundary
B _{2cn}	35-85 cm	Strong brown (7.5YR 5/8); clay; moderately weak, coarse subangular blocky structures; slightly compact in place, slightly firm when removed; few fine pores; few fine and medium roots (1 to 5 mm); presence of about 20% platy laterised shale (5 to 30 mm); gravels are not compact; also presence of about 20% very pale brown (10YR 8/4)

Elevation: blotches (10 to 20 mm); clear boundary

Latitude: raised terrace

BCr 85-150 cm Variegated light grey (10YR 7/2), reddish yellow (7.5YR 6/6) and (5YR 6/8); silty clay to clay; weak to structureless; slightly compact in place, slightly firm when removed; presence of about 10% platy laterised shale (5 to 30 mm) and about 20% stony carbonaceous shale (5 to 20 cm). Stones are spaced at 10 to 30 cm apart

Stone at site:

Soil exchange:

Soil erosion:

Presence of surface:

Effective soil depth: 50 cm

Vegetation: re-generated forest

Moisture conditions in profile: Slightly wet below 50 cm, otherwise moist throughout

Profile Description

A₀ Leaf litter, 6 to 8 leaves thick

A₁ 1-6 cm Dark reddish brown (5YR 3/3); loam, moderate, median subangular blocky structures; friable; few fine pores; abundant fine to coarse roots (1 to 15 mm); clear boundary

B₀ 6-50 cm White (10YR 8/1) and brownish yellow (10YR 6/5); loam, moderately weak, very coarse subangular and angular blocky structures; friable to slightly firm; coarse fine pores; very few fine roots; very few yellowish brown (10YR 5/4) organic acid on ped surfaces and on few channels; clear boundary

Soil profile no.	33
Soil name:	Sabangan series
Elevation:	Below 15 meters
Landform:	Raised terrace
Physiography at site:	Nearly flat
Slope at site:	< 1°
Soil drainage:	Imperfectly drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	50 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Slightly wet below 50 cm, otherwise moist throughout

Profile Description

A ₀		Leaf litters, 6 to 8 leaves thick
A _h	0-6 cm	Dark reddish brown (5YR 3/3); loam; moderate, medium subangular blocky structures; friable; few fine pores; abundant fine to coarse roots (1 to 15 mm); clear boundary
BC	6-50 cm	White (10YR 8/1)* and brownish yellow (10YR 6/6); loam; moderately weak, very coarse subangular and angular blocky structures; friable to slightly firm; common fine pores; very few fine roots; very few yellowish brown (10YR 5/4) organic acid on ped surfaces and on few channels; clear boundary

II BC 50-130 cm Variegated white (10YR 8/1)*, brownish yellow (10YR 6/6), reddish yellow (7.5YR 6/8) and red (2.5YR 4/8); clay; weak, very coarse angular blocky structures; slightly massive; few fine pores; very few fine to coarse roots (1-5 mm)

* White colour of the soil matrix is mainly due to the uncoated sand particles

SOIL ANALYTICAL DATA

Soil profile no: 33

Soil name: Sabangan series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio					
			Clay	Silt	Sand											
Ah	4.00	145	15.1	39.4	8.8	30.8	3.2	1.0	0.6	0.85	N	0.25	3.30	5.68	0.24	13.75
BC	4.25	28	15.9	38.8	24.4	16.4	0.7	0.1	ND	1.54	N	ND	0.31	0.53	0.03	10.33
IIIC	4.90	42.5	39.7	26.6	9.4	14.5	2.5	0.1	0.1	1.61	N	ND	0.27	0.46	0.27	1.00

Horizon	Perchloric Digestible			Perchloric Digestible			meq CEC in NH_4OAC	Exchangeable Cation			IEB				
	% K	Mg	Ca	ppm P	Cu	Mn		Zn	K	Ca		Na			
Ah	0.19	0.04	0.04	145	7	11	19	2.8	0.20	0.63	1.91	0.11	0.32	2.85	25
BC	0.19	0.04	0.02	90	4	9	17	ND	0.10	0.06	0.01	0.11	1.57	0.28	7
IIIC	0.79	0.26	0.19	90	12	134	58	ND	0.18	1.37	8.61	0.13	0.26	10.29	84

*B.S. = % Base Saturation

ND = Not Detected
N = Negligible

Soil profile:	Soil profile
Vegetation:	< 15 meters
Landform:	Level
Topography at site:	Flat; slightly raised
Slope at site:	0-10
Soil drainage:	Moderately well-drained
Soil erosion:	Nil; somewhat accreting
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	75 cm
Vegetation:	Riverine forest
Moisture conditions in profile:	Slightly wet below 75 cm; otherwise moist throughout

ALLUVIAL SOILS

		<u>Profile Description</u>
A ₀		(leaf litters, 3 to 5 leaves thick with many organic debris)
A ₁	0-5 cm	Yellowish brown (10YR 5/4 to 5/6); silty clay; friable; (moist)
B ₁	5-20 cm	Yellowish brown (10YR 5/6); silty clay loam; friable; (moist)
B ₂	18-30 cm	Yellowish brown (10YR 5/6); silty clay loam; friable; presence of very pale brown (10YR 7/4) blotches; (moist)
B ₃	30-75 cm	Brownish yellow (10YR 6/6 to 6/8); clay loam; friable; presence of very pale brown (10YR 7/4) blotches and streaks; (moist)
BC	75-100 cm	Light grey (10YR 7/7) and reddish yellow (7.5YR 6/8); clay loam; massive; (wet)

Soil profile no. (by soil auger examination)	16
Soil name:	Seduau series
Elevation:	< 15 meters
Landform:	Levee
Physiography at site:	Flat; slightly raised
Slope at site:	< 1°
Soil drainage:	Moderately well-drained
Soil erosion:	Nil; somewhat accreting
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	75 cm
Vegetation:	Riverine forest
Moisture conditions in profile:	Slightly wet below 75 cm; otherwise moist throughout

Profile Description

A ₀		Leaf litters, 3 to 5 leaves thick with many organic debris
A _h	0-5 cm	Yellowish brown (10YR 5/4 to 5/6); silty clay; friable; (moist)
B ₁	5-18 cm	Yellowish brown (10YR 5/6); silty clay loam; friable; (moist)
B ₂	18-30 cm	Yellowish brown (10YR 5/6); silty clay loam; friable; presence of very pale brown (10YR 7/4) blotches; (moist)
B ₃	30-75 cm	Brownish yellow (10YR 6/6 to 6/8); clay loam; friable; presence of very pale brown (10YR 7/4) blotches and strong brown (7.5YR 5/6 to 5/8) streaks; (moist)
BC	75-100 cm	Light grey (10YR 7/2) and reddish yellow (7.5YR 6/8); clay loam; massive; (wet)

SOIL ANALYTICAL DATA

Soil profile No: 16

Soil name: Sedvau series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C:N ratio					
			Clay	Silt	Sand											
Ah	4.25	365	39.6	41.8	4.0	3.9	4.9	1.4	3.7	nd	N	0.5	4.80	8.25	0.46	10.43
B1	4.15	290	30.1	50.1	2.3	1.8	12.8	2.1	1.7	nd	N	ND	2.70	4.64	0.31	8.71
B2	4.05	175	35.4	44.8	0.6	16.1	2.1	0.4	0.2	nd	N	ND	0.50	0.86	0.14	3.57
B3	4.15	142	38.9	40.0	8.6	4.4	7.2	0.5	0.4	nd	N	ND	0.38	0.65	0.10	3.80
BC	4.35	107	36.3	35.8	9.4	7.3	10.5	0.5	0.2	nd	N	0.3	0.30	0.52	0.07	4.29

Horizon	Perchloric Digestible			ppm			meq DEC in NH_4OAC	Exchangeable Cation			B.S.*							
	%	Mg	Ca	Total S	Av P	H ₂ O soluble B		K	Mg	Ca		Na	Al					
Ah	1.10	0.19	0.13	390	14	750	56	525	23	4.5	13.6	0.51	3.88	5.68	0.15	0.40	10.22	75
B1	1.11	0.19	0.07	320	12	574	52	375	16	5.5	10.4	0.64	2.00	2.19	0.12	0.44	4.95	48
B2	1.11	0.18	0.02	215	11	290	56	125	12	1.8	7.6	0.18	0.96	0.22	0.15	0.40	1.51	20
B3	1.13	0.18	0.02	180	10	203	49	525	10	0.5	13.7	0.20	1.14	0.21	0.14	0.63	1.69	12
BC	1.03	0.17	0.02	150	9	122	49	125	10	1.6	7.9	0.16	2.11	0.68	0.20	0.18	3.17	40

ND = Not Detected
 nd = Not determined
 N = Negligible
 *B.S. = % Base saturation

Soil profile no. (by soil survey examination):
Soil name: *Amundsen Series*
Elevation: Below 15 meters
Landform: low lying valley floor
Physiography at site: Flat
Slope at site: < 3°
Soil drainage: Poorly drained
Soil erosion: Nil; accreting
Presence of surface stones or rock outcrops: Nil
Inactive soil depth: < 25 cm
Vegetation: Sedges with scattered *Haparrage* species
Moisture conditions in profile: Wet below 5 cm

GLEYSOILS

Profile description

A₀ Organic debris - mainly decomposing sedges
A₁ 0-5 cm Dark reddish grey (10YR 4); clay loam; moderately strong; fine subangular and few granular structures; friable; (moist to slightly wet)
E_g 5-100 cm Light grey (10YR 7/2); silty clay; somewhat massive becoming more massive with depth; presence of yellowish brown (10YR 5/6) mottles; mottles becoming less prominent with depth
Water-table met at 8 cm from soil surface

Soil profile no. (by soil auger examination)	37
Soil name:	Mundai series
Elevation:	Below 15 meters
Landform:	Low lying valley floor
Physiography at site:	Flat
Slope at site:	< 10°
Soil drainage:	Poorly drained
Soil erosion:	Nil; accreting
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	< 25 cm
Vegetation:	Sedges with scattered Macarange species
Moisture conditions in profile:	Wet below 5 cm

Profile Description

A ₀		Organic debris - mainly decomposing sedges
A _h	0-5 cm	Dark reddish grey (5YR 4); clay loam; moderately strong, fine subangular and few granular structures; friable; (moist to slightly wet)
C _g	5-100 cm	Light grey (10YR 7/2); silty clay; somewhat massive becoming more massive with depth; presence of yellowish brown (10YR 5/6) mottles; mottles becoming less prominent with depth

Water-table met at 8 cm from soil surface

SOIL ANALYTICAL DATA

Soil profile No: 37

Soil name: Mundai series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage		Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio	
			Clay	Silt													
Ah	6.60	300	32.2	18.4	1.9	0.2	9.3	10.7	8.2	nd	N	1.50	12.60	21.67	0.74	17.03	
Cg	6.25	120	43.7	41.4	4.2	4.6	0.7	0.1	0.3	nd	N	1.50	1.70	2.92	0.17	10.00	
Perchloric Digestible																	
	% N	Mg		Ca													
Perchloric Digestible																	
	ppm P	Cu		Mn		Zn											
Ah	0.49	0.24	1.12	500	18	182	50	1,125	42	0.7	17.47	0.44	2.11	55.20	0.18	0.04	57.93 sat.**
	Cg	0.65	0.33	0.55	170	14	105	68	263	15	0.7	19.60	0.28	1.14	26.42	0.18	0.03
<p>*B.S. = % Base saturation ** sat. = Saturated N = Negligible nd = Not determined</p>																	

*B.S. = % Base saturation

** sat. = Saturated

N = Negligible

nd = Not determined

Soil profile no. (by soil auger examination)	56
Soil name:	Mundai series
Elevation:	Below 15 meters
Landform:	Low lying valley floor
Physiography at site:	Flat
Slope at site:	< 1°
Soil drainage:	Very poorly drained
Soil erosion:	Nil
Presence of surface stones or rock outcrops:	Nil
Effective soil depth	< 25 cm
Vegetation:	Sedges
Moisture conditions in profile:	Wet

Profile Description

A ₀	< 2 cm of semi-decomposed sedges and organic debris
Ag	0 to 10 cm Dark grey (5Y 4/1); clay loam; structureless; massive
Cg	10 to 100 cm Pale olive (5Y 6/3); clay loam; structureless; massive

SOIL ANALYTICAL DATA

Soil profile No: 56

Soil name: Munda1 series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio					
			Clay	Silt	Very fine sand											
Ag 0-10	4.85	62	33.2	28.8	15.9	7.2	3.8	2.1	1.6	ND	N	0.75	2.85	4.90	0.24	11.88
Cg 10-100	4.95	25	31.4	31.6	16.7	10.9	2.1	0.4	0.2	ND	N	0.75	0.12	0.21	0.10	1.20

Depth in cm	Perchloric Digestable				Total S	Av P	H ₂ O soluble B	meq in NH_4OAC	Exchangeable Cation				TEB				
	K	Mg	Ca	Na					K	Ca	Na	Al					
Ag 0.98	0.21	0.09	185	14	221	57	400	11	1.6	6.67	0.64	0.84	3.79	0.17	0.24	5.44	82
Cg 1.81	0.30	0.05	135	19	54	66	63	7	1.1	9.60	0.13	0.38	2.29	0.10	0.20	2.90	30

*B.S. = % Base saturation

ND = Not Detected
N = Negligible

Soil profile no.	25
Soil name	Binangon series
Elevation	15 to 30 meters
Landform	Raised terrace
Physiography at site:	Nearly flat
Slope at site:	4%
Soil drainage	Well-drained
Soil erosion	Slightly eroded
Presence of surface stones or rock outcrops:	Nil
Effective soil depth	30 cm
Vegetation	Re-generated forest
Moisture conditions in profile:	Moist throughout

SKELETAL SOILS

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A ₁	0-4 cm	Brown (10YR 5/3) to yellowish brown (10YR 5/4); loam; moderate, fine and medium subangular blocky and crumb structures; friable; common very fine pores; many fine to coarse roots (1 to 15 mm); clear boundary
B ₁	4-20 cm	Brownish yellow (10YR 6/6); clay; moderate, very coarse subangular blocky structures breaking into moderately strong, coarse and medium subangular blocky structures; friable; common very fine pores; many fine to coarse roots (1 to 10 mm); few weakly developed yellowish brown (10YR 5/4) organic acid coatings; gradual boundary

Soil profile no.	29
Soil name:	Binatang series
Elevation:	15 to 30 meters
Landform:	Raised terrace
Physiography at site:	Nearly flat
Slope at site:	< 2°
Soil drainage:	Well-drained
Soil erosion:	Slightly eroded
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	30 cm
Vegetation:	Re-generated forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-4 cm	Brown (10YR 5/3) to yellowish brown (10YR 5/4); loam; moderate, fine and medium subangular blocky and crumbs structures; friable; common very fine pores; many fine to coarse roots (1 to 15 mm); clear boundary
B ₁	4-20 cm	Brownish yellow (10YR 6/6); clay; moderate, very coarse subangular blocky structures breaking into moderately strong, coarse and medium subangular blocky structures; friable; common very fine pores; many fine to coarse roots (1 to 10 mm); few weakly developed yellowish brown (10YR 5/4) organic acid coatings; gradual boundary

B ₂	20-30 cm	Brownish yellow (10YR 6/6 to 6/8); clay; moderately strong, coarse and very coarse subangular blocky structures; friable; common micro-pores; few fine to coarse roots (1-5 mm); many well-developed light yellowish brown (10YR 6/4) cutans on ped surfaces; abrupt boundary
C _u	30-50 cm	A continuous layer of fragmented carbonaceous shale
C _R	50-90 cm	A continuous layer of consolidated carbonaceous shale
IIC _u	90-150 cm	A layer of fragmented carbonaceous shale in a 20% olive yellow (2.5Y 6/6 to 6/8) clay matrix

SOIL ANALYTICAL DATA

Soil profile No: 29

Soil name: Binatang series

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free Co_3	CaCo_3	Organic carbon	Organic matter	N	C/N ratio
			Clay	Silt	Sand												
Ah	5.30	68	18.9	40.3	7.8	0.9	22.9	3.6	2.2	1.14	N	0.25	2.70	4.64	0.30	9.00	
B1	4.75	21	41.8	33.8	14.1	4.5	3.1	1.1	0.7	1.34	N	0.50	0.94	1.62	0.15	6.27	
B2	4.80	21	39.3	38.9	11.2	3.8	2.9	1.1	0.9	1.43	N	0.75	0.75	1.29	0.14	5.36	

Horizon	Perchloric Digestible			Perchloric Digestible			ppm S	Total P	Av H ₂ O soluble B	meq LEC in NH_4OAC	Exchangeable Cation			TEB			
	% K	Mg	Ca	ppm P	Cu	Mn					Zn	K	Ca		Mg	Na	Al
Ah	0.85	0.24	0.24	180	13	502	57	11	ND	12.53	0.40	1.77	10.92	0.11	0.10	13.20	sat.**
B1	1.14	0.31	0.08	135	16	262	68	8	ND	11.87	0.20	0.69	3.22	0.13	2.75	4.24	36
B2	1.28	0.34	0.09	130	17	292	75	9	ND	14.00	0.20	0.82	4.01	0.13	2.98	5.16	37

*B.S. = % Base saturation

** sat. = Saturated

ND = Not Detected

N = Negligible

Soil profile no.	34
Soil name:	Kapit series
Elevation:	15 to 30 meters
Landform:	Nearly level
Physiography at site:	Nearly level
Slope at site:	2°
Soil drainage:	Well-drained
Soil erosion:	Moderate erosion
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	45 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly wet in top soil; otherwise moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0-4 cm	Yellowish brown (10YR 5/4); sandy loam; moderate, medium subangular blocky structures; very slightly sticky; few fine pores; many fine roots; clear boundary
BC _r	4-55 cm	Brownish yellow (10YR 6/6) to olive yellow (2.5Y 6/6); clay loam; presence of about 70% fragmented laterised shale and undecomposed carbonaceous shale (5 to 10 cm) in a 30% clay matrix from the overlying horizon. Concretion are somewhat compact; clear boundary
CR _u	55-80 cm	A layer of somewhat unconsolidated, continuous shale
CR	80 cm +	A continuous layer of consolidated bedrock

SOIL ANALYTICAL DATA

Soil profile No: 34

Soil name: Kapit series

Horizon	Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CO_3	Ca CO_3	Organic carbon	Organic matter	N	C/N ratio
				Clay	Silt	Sand												
F_n	0-4	4.95	160	20.2	29.4	20.0	12.0	7.9	3.0	2.5	nd	nd	N	1.3	2.03	3.49	0.06	33.83
BCR	4-55	4.45	30	30.7	26.6	22.0	8.0	2.9	1.9	2.8	nd	nd	N	0.3	1.13	1.94	0.39	2.90

Horizon	Perchloric Digestible				Perchloric Digestible				meq CEC in NH_4OAC	Exchangeable Cation				TEB				
	K	Mg	Ca	ppm P	P	Cu	Mn	Zn		Total S	ppm Av P	H_2O soluble B	K		Ca	Na	Al	
A_h	0.54	0.14	0.07	170	7	133	41	263	17	1.9	10.9	0.33	0.98	6.93	0.09	0.10	8.33	76
BCR	1.10	0.20	0.02	85	7	40	56	63	9	ND	10.7	0.15	0.10	0.01	0.10	0.67	0.36	3

* % Base Saturation

N = Negligible
 ND = Not Determined
 nd = Not detected

Soil profile no.	55
Soil name:	Kapit series
Elevation:	30 to 45 meters
Landform:	Extremely steep
Physiography at site:	Lower slope
Slope at site:	33°
Soil drainage:	Well-drained
Soil erosion:	Severe sheet erosion
Presence of surface stones or rock outcrops;	Nil
Effective soil depth:	70 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Moist throughout

Profile Description

A ₀		Leaf litters; 4 to 6 leaves thick
A _h	0-5 cm	Yellowish brown (10YR 5/4); sandy clay loam; moderate, medium and fine subangular blocky structures; friable; few fine pores; many fine to coarse (1 to 10 mm) roots; clear boundary
B _{2cn}	5-30 cm	Brownish yellow (10YR 6/6) to yellowish brown (10YR 5/6); sandy clay loam; moderately strong, medium and some coarse subangular blocky structures; friable; few fine pores; few fine to coarse (1 to 10 mm) roots; many yellowish brown to light yellowish brown (10YR 5/4 to 6/4) organic acid coatings; few krotovinas; gradual boundary
CR ₁	30-70 cm	A layer of fragmented shale with about 20% interstices filled with brownish yellow (10YR 6/6) sandy clay loam; few fine (1 to 2 mm) roots; diffuse and tongued boundary

CR2 70-150 cm A continuous layer of consolidated parent
bedrock - shale

ORGANIC SOILS

Soil profile no. (by soil auger examination)	13
Soil name:	Mukah series
Elevation:	< 15 meters
Landform:	Backswamp
Physiography at site:	Depressional
Slope at site:	< 1°
Soil drainage:	Very poorly drained
Soil erosion:	Nil
Presence of surface stones or rock outcrops:	Nil
Effective soil depth:	< 25 cm
Vegetation:	Fresh water swamp forest
Moisture conditions in profile:	Wet

Profile Description

A01		Leaf litters; 6 to 8 leaves thick, and many organic debris
A02	0-60 cm	Fibrous peat; mainly undecomposed woody materials
IICg	60-100 cm	Grey (5Y 6/1); massive; structureless gleyed horizon

SOIL ANALYTICAL DATA

Soil profile No: 13

Soil name: Mukah series

Depth in (cm)	pH	Elect. cond. $\mu\text{mho/cm}$	Percentage		Very fine sand	Fine sand	Medium sand	Coarse sand	Very coarse sand	Bulk density	Free CO_3	CaCO_3	Organic carbon	Organic matter	N	C/N ratio																																											
			Clay	Silt																																																							
60-100	4.50	270	23.1	35.9	9.9	5.3	5.7	5.6	6.5	nd	N	1.0	7.05	12.13	0.46	15.33																																											
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Perchloric Digestible</th> <th colspan="4">Perchloric Digestible</th> <th colspan="2">ppm</th> <th colspan="2">meq</th> </tr> <tr> <th>K</th> <th>Mg</th> <th>Ca</th> <th>Cu</th> <th>Mn</th> <th>Zn</th> <th>Total S</th> <th>Av P</th> <th>H_2O soluble B</th> <th>CIC in NH_4OAC</th> <th>Exchangeable Cation</th> <th>Ca</th> <th>Na</th> <th>Al</th> <th>IEB</th> </tr> </thead> <tbody> <tr> <td>0.64</td> <td>0.13</td> <td>0.10</td> <td>205</td> <td>13</td> <td>367</td> <td>46</td> <td>250</td> <td>19</td> <td>6</td> <td>20.0</td> <td>0.69</td> <td>4.11</td> <td>4.08</td> <td>0.14</td> <td>0.40</td> <td>9.02</td> <td>45</td> </tr> </tbody> </table>																	Perchloric Digestible		Perchloric Digestible				ppm		meq		K	Mg	Ca	Cu	Mn	Zn	Total S	Av P	H_2O soluble B	CIC in NH_4OAC	Exchangeable Cation	Ca	Na	Al	IEB	0.64	0.13	0.10	205	13	367	46	250	19	6	20.0	0.69	4.11	4.08	0.14	0.40	9.02	45
Perchloric Digestible		Perchloric Digestible				ppm		meq																																																			
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* B.S. = % Base saturation

N = Negligible
nd = Not determined

Soil horizon:	
Soil name:	Unclassified (this profile is adjacent to soils of the Tatum series)
Elevation:	20 to 45 meters
Landform:	Hilly
Physiography at site:	Top flat adjacent to steep slope
Slope at site:	4
Soil drainage:	Somewhat excessively drained
Soil erosion:	Moderately eroded
Presence of surface stones or rock outcrops:	None
Length of soil profile:	125 cm
Vegetation:	UNCLASSIFIED forest
Moisture conditions in profile:	Slightly moist throughout

Profile Description

0-5	Leaf litter, 4 to 5 leaves thick
5-25	Dark reddish brown (5YR 3/3); loamy sand, moderate, medium and fine subangular blocky and crumb structures; friable; common very fine pores; abundant fine to coarse roots (1 to 10 mm); distinct boundary
25-50	Pale yellow (2.5Y 8/4) with some yellowish brown (10YR 5/6) and strong brown (7.5YR 5/3); loamy sand, medium and coarse subangular and some angular blocky structures; friable to slightly loose; common fine and very fine subangular blocky structures; many fine to medium roots (1 to 5 mm); few dark yellowish brown (10YR 4/4) organic acid coatings; distinct boundary

Soil profile no:	22
Soil name:	Unclassified (this profile is adjacent to soils of the Tutoh series)
Elevation:	30 to 45 meters
Landform:	Hilly
Physiography at site:	Top flat adjacent to steep slope
Slope at site:	2°
Soil drainage:	Somewhat excessively drained
Soil erosion:	Moderately eroded
Presence of surface stones or rock outcrops:	Nil
Effective soil depth	135 cm
Vegetation:	Hill forest
Moisture conditions in profile:	Slightly moist throughout

Profile Description

A ₀		Leaf litters, 4 to 6 leaves thick
A _h	0-5 cm	Dark reddish brown (5YR 3/3); loamy sand; moderate, medium and fine subangular blocky and crumb structures; friable; common very fine pores; abundant fine to coarse roots (1 to 10 mm); distinct boundary
A _e	5-30 cm	Pale yellow (2.5Y 8/4) with some yellowish brown (10YR 5/6) and strong brown (7.5YR 5/8); loamy sand weak, medium and coarse subangular and some angular blocky structures; friable to slightly loose; common fine and very fine subangular blocky structures; many fine to medium roots (1 to 5 mm); few dark yellowish brown (10YR 4/4) organic acid coatings; distinct boundary

B ₁	30-65 cm	Dark yellowish brown (10YR 4/6); loamy sand; weak, very coarse subangular and angular blocky structures; slightly brittle; common very fine pores; few fine (1 to 2 mm) and few coarse (20 to 30 mm) roots; clear boundary
B ₂	65-95 cm	Yellow (10YR 8/6 to 8/8); loamy sand; weak, very coarse subangular and angular blocky structures; friable; few very fine pores; few fine to medium roots (1 to 5 mm); weakly developed yellowish brown (10YR 5/6) organic acid coatings; distinct boundary
B ₃	95-135 cm	Yellow (2.5Y 7/6); loamy sand; weak, very coarse subangular and angular blocky structures; friable; few very fine pores; few fine to medium (1 to 5 mm); presence of about 5% very pale brown (10YR 7/4) blotches; abrupt boundary
CR	135 cm +	A continuous layer of undecomposed sandstone

Note: Effective soil depth is less than 50 cm in the surrounding area

SOIL ANALYTICAL DATA

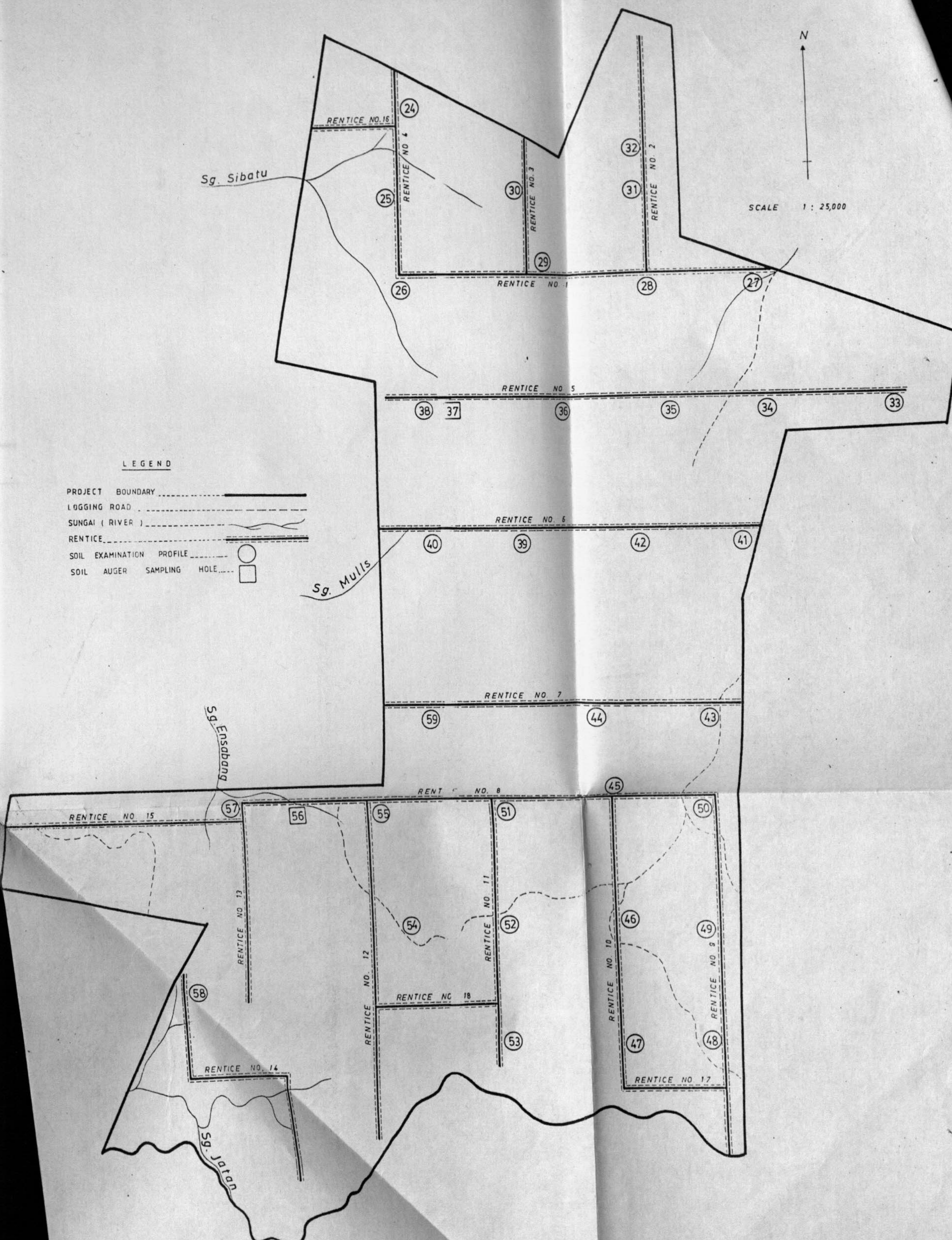
Soil profile no: 22

Soil name: (adjacent to soils of Tutuh series)

Depth in cm	pH (1:2.5)	Elect. cond. $\mu\text{mho/cm}$	Percentage			Bulk density	Free CaCO_3	Organic carbon	Organic matter	N	C/N ratio					
			Clay	Silt	Very fine sand											
Ah	4.00	130	8.6	10.9	ND	4.9	68.8	3.0	0.1	1.04	N	0.3	2.00	3.44	0.14	14.29
Ae	4.75	58	7.2	11.0	2.6	2.9	72.4	1.0	0.2	1.18	N	0.3	1.20	2.06	0.07	17.14
Bi	4.75	37	6.9	5.7	ND	3.4	80.2	3.3	ND	1.01	N	0.3	0.56	0.96	0.06	9.33
B2	4.70	26	9.7	7.7	3.1	7.3	71.5	0.7	ND	1.23	N	0.5	0.42	0.72	0.02	21.00
B3	4.80	18	11.8	7.0	ND	3.7	76.1	0.6	ND	1.44	N	ND	0.19	0.33	0.03	6.33

Horizon	Perchloric Digestible			Perchloric Digestible			ppm Total S	ppm Av P	H ₂ O soluble B	me% CEC in NH_4OAC	Exchangeable Cation			B.S.*				
	Mg	Ca	ppm P	P	Cu	Mn					Zn	K	Ca		Na	Al		
Ah	0.08	0.01	0.02	80	3	7	13	250	28	1.9	6.4	0.15	0.19	0.40	0.08	0.38	0.82	13
Ae	0.08	0.01	0.02	70	3	12	15	125	12	0.2	3.3	0.05	0.07	0.01	0.08	1.55	0.21	6
Bi	0.07	0.01	0.02	45	4	8	14	250	8	ND	2.0	0.05	0.03	0.03	0.07	0.51	0.18	9
B2	0.09	0.02	0.02	45	5	12	24	125	10	0.9	6.4	0.05	0.01	0.01	0.05	0.42	0.12	2
B3	0.15	0.02	0.02	30	3	16	21	125	7	0.2	1.2	0.08	0.01	0.01	0.07	0.46	0.17	14

* % Base Saturation N = Negligible ND = Not Detected



LEGEND

- PROJECT BOUNDARY
- LOGGING ROAD
- SUNGAI (RIVER)
- RENTICE
- SOIL EXAMINATION PROFILE
- SOIL AUGER SAMPLING HOLE

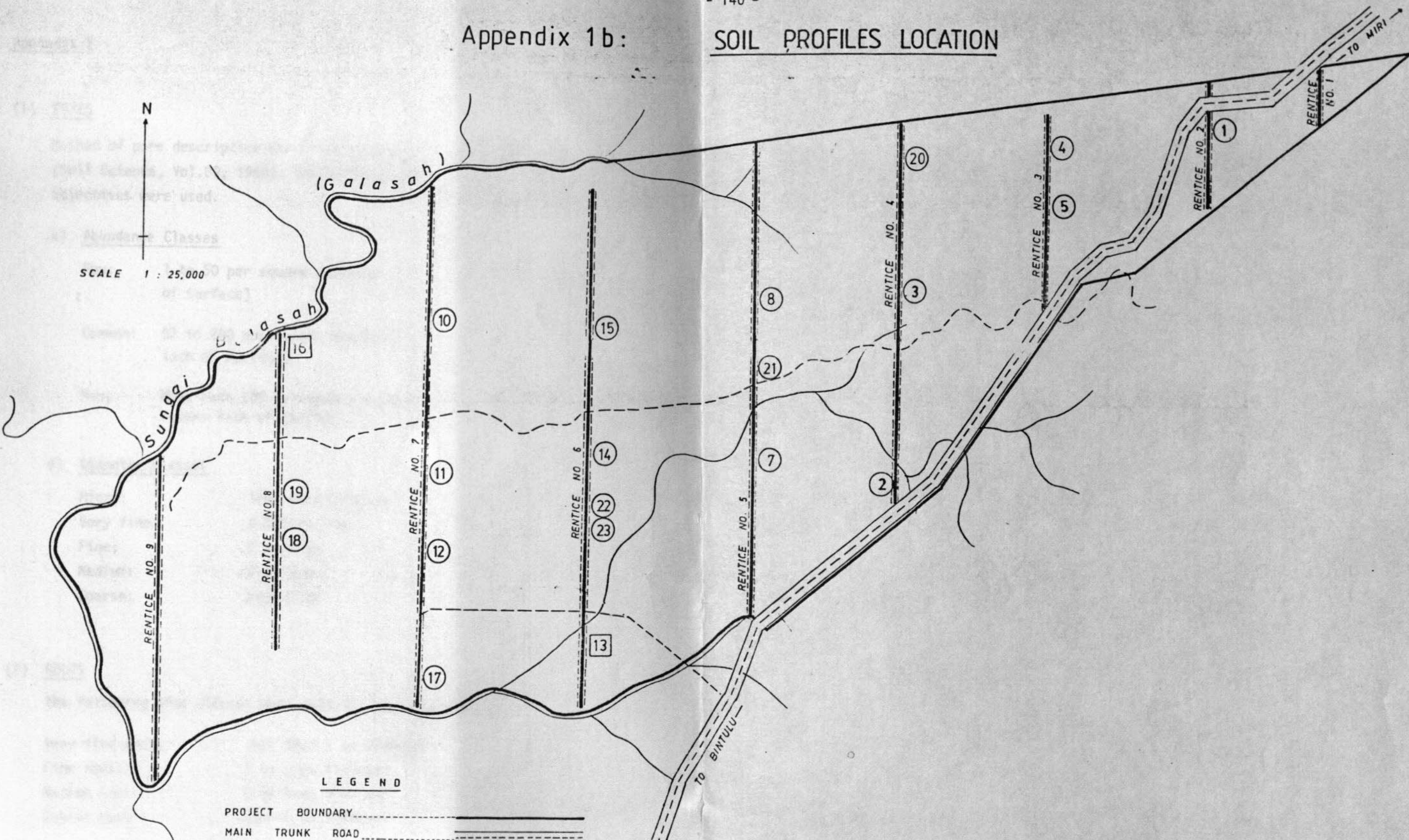


SCALE 1 : 25,000

Appendix 1b:

SOIL PROFILES LOCATION

N
SCALE 1 : 25,000



LEGEND

- PROJECT BOUNDARY.....
- MAIN TRUNK ROAD.....
- LOGGING ROAD.....
- SUNGAI (RIVER).....
- RENTICE.....
- SOIL EXAMINATION PROFILE.....
- SOIL AUGER SAMPLING HOLE.....

Appendix 2

(1) PORES

Method of pore description were in accordance to Johnson et al (Soil Science, Vol.89, 1960). The following terms and modifying adjectives were used.

a) Abundance Classes

Few: 1 to 50 per square decimeter (1 to 3 per square inch of surface)

Common: 51 to 200 per square decimeter (4 to 14 per square inch of surface)

Many: More than 200 per square decimeter (more than 14 per square inch of surface)

b) Diameter Classes

Micro: less than 0.075 mm

Very fine: 0.075 to 1 mm

Fine: 1 to 2 mm

Medium: 2 to 5 mm

Coarse: over 5 mm

(2) ROOTS

The following size classes were used for root description

Very fine roots: less than 1 mm diameter

Fine roots: 1 to 2 mm diameter

Medium roots: 2 to 5 mm diameter

Coarse roots: over 5 mm diameter

Four quantitative terms were used to express relative root abundance between separate horizons in a single soil profile.

i) Very few

iii) Many

ii) Few

iv) Abundance

