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PERMODALAN PLANTATIONS SDN. BHD.

**DETAILED SOIL SURVEY AND
FERTILIZER RECOMMENDATIONS
FOR
4738 HECTARES OF IMMATURE
AND
MATURE COCOA
IN KRETAM AREA, SABAH**

NOVEMBER 1984

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APPENDICES

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The second part of the report is devoted to a detailed analysis of the... (text is very faint and mostly illegible)

The third part of the report is devoted to a summary of the... (text is very faint and mostly illegible)

1. INTRODUCTION

The purpose of this report is to provide a comprehensive overview of the... (text is very faint and mostly illegible)

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The third section deals with the... (text is very faint and mostly illegible)

The fourth section deals with the... (text is very faint and mostly illegible)

1. INTRODUCTION

1.1 For planning and development purposes, soil studies have been undertaken at various stages (Sime Darby Plantations - 1980, Felda Agricultural Services Corporation - 1980). However, mapping at that broad level is inadequate for fertilizer recommendation purposes and it is therefore decided that a detailed soil survey be carried out.

1.2 The discriminatory fertilizer policy will be formulated on the basis of soil properties which include, but not limited to, soil texture, cation exchange capacity, nutrient availability as well as rainfall pattern, cultural practices and monthly yield distribution.

1.3 The scope of work in this study therefore includes:-

- i) Conducting a detailed soil survey of the planted area, total 4,738 ha., at a grid of 200 x 200 m.
- ii) Preparing a soil map using Soil Families and slope and depth phases as the mapping units.
- iii) Preparing a discriminatory fertilizer policy for the mature and immature cocoa.

1.4 The study, conducted by a soil scientist/agronomist and a soil surveyor, was carried out between July and September 1984. A total of 45 samples was collected from 14 of the total 23 soil profiles described. The soils were analysed for pH water, % N, % water soluble P, CEC, exchangeable cation K, Mg and Ca as well as particle size distribution.

2. TOPOGRAPHY

2. TOPOGRAPHY

2.1 The enclosed soil maps incorporate terrain classes as phases and the distribution is presented in the following Table 1.

Table 1 - Distribution of Terrain Classes
Distribution in Hectares (%)

<u>Terrain Classes</u>	<u>Sg. Bendera</u>	<u>Sg. Kretam</u>	<u>Sg. Parkis</u>	<u>Sg. Batu</u>	<u>Total</u>
0 - 2° Flat to low-lying	358 (18.5)	278.6 (20)	104.4 (12)	38.3 (5)	779.3 (15.9)
0 - 2° Flat with incised stream	283 (14.6)	272.9 (20)	108.7 (13)	219.3 (28)	883.9 (18)
2 - 6° Undulating	4 (0.2)	83.4 (6)	-	1 (1)	88.4 (1.8)
6 - 12° Rolling	601.7 (31.1)	204.1 (15)	168 (20)	352.2 (44)	1326.3 (27)
12 - 20° Hilly	550.7 (28.4)	431.5 (32)	254.7 (30)	93.2 (12)	1330.1 (27)
20 - 25° Steep	103.6 (5.4)	60.7 (5)	134.8 (16)	67.5 (9)	366.6 (7.5)
25 - 33° Very steep	32.7 (1.7)	28.4 (2)	53.3 (7)	4.1 (1)	118.5 (2.4)
> 33°	-	-	16.4 (2)	-	16.4 (0.3)
Total:	1934	1359.6	840	776	4909.6

Appendices IA - ID present details of the terrain classes in the different blocks.

2.2 From the data it is evident that Sg. Bendera has predominance of terrain below 12° (1,247 ha. or 64.4%) while Sg. Parkis is generally more dissected with 57% of hilly to very steep land. Some slopes have been observed to exceed 33°.

CLIMATE

The climate data have been sufficiently reported in the 1960 and 1964 reports. It will suffice to mention that the rainfall pattern over the following decade is likely to be similar to that of the 1960s. The rainfall is expected to be around 1000 mm per annum and the temperature around 25°C. The humidity is expected to be around 70% and the wind speed around 10 km per hour. The climate is expected to be similar to that of the 1960s.

3. CLIMATE

3.

CLIMATE

The climatic data have been sufficiently reported in the SDP 1980 and FELDA 1980 reports. It will suffice to mention that the rainfall pattern apart from influencing disease incidence does play a part in determining seasonal yield trend and leaf flushes. These are factors to consider in planning fertilizer rounds and types. Heavy fertilizer dosages should be avoided as far as possible during seasons of high rainfall intensities because of risk of wash, particularly where terrain is steep and where planting is along slopes.

SOILS OF THE AREA

Soils in the area were classified into soil families and soil orders and their names as mapping units are attached to this report.

The distribution of the soil families within the Census Block of each individual estate is presented in an appendix to this report. A summary of the distribution is presented in Table 2.

Table 2. Distribution of Soil Families
Distribution in Percent (%)

Soil Family	No. Estates	% Estates in Family	% Area
Forest	108 (21.2)	17.4 (21)	10.1 (3)
Soil	108 (21.2)	17.4 (21)	10.1 (3)
Barren	108 (21.2)	17.4 (21)	10.1 (3)
Shrubland	108 (21.2)	17.4 (21)	10.1 (3)
Grassland	108 (21.2)	17.4 (21)	10.1 (3)
Woods	108 (21.2)	17.4 (21)	10.1 (3)
Swamp	108 (21.2)	17.4 (21)	10.1 (3)
Water	108 (21.2)	17.4 (21)	10.1 (3)

4. SOILS OF THE AREA

Distribution of Soil Families

The soil family names are those that have been assigned to the soils of the area (Table 1).

Appendix III to this report presents the profile descriptions of the various soil families and the respective analytical data.

Appendix IV to this report presents the profile descriptions of several of the soil families for which soil samples have not been collected.

4 SOILS OF THE AREA

4.1 Detailed soil maps with Soil Families and soil depth and slope phases as mapping units are attached to this report.

4.2 The distribution of the Soil Families within the Cocoa Block of each individual estate is presented in Appendices IIA to IID. A summary of the distribution is presented in Table 2.

Table 2 - Distribution of Soil Families
Distribution in Hectares (%)

<u>Soil Families</u>	<u>Sg. Bendera</u>	<u>Sg. Kretam</u>	<u>Sg. Parkis</u>	<u>Sg. Batu</u>	<u>Total</u>
Inanam	358 (18.5)	278.6 (20)	104.4 (12)	38.3 (5)	779.3 (15.9)
Paliu	282 (14.6)	272.9 (20)	108.7 (13)	219.3 (28)	882.9 (18)
Kumansi	1130 (58.4)	579.4 (43)	482.4 (57)	394.5 (51)	2586.3 (52.7)
Tanjong Lipat	147 (7.6)	84.4 (6)	73.8 (9)	86.8 (11)	392 (8)
Kapilit	10 (0.5)	111.3 (8)	45.7 (5)	77.1 (5)	204 (14.2)
Dagat	6 (0.4)	33 (3)	2.6 (1)	-	41.6 (0.8)
Sipit	-	-	22.7 (3)	-	22.7 (0.4)
Total:	1934	1359.6	840	776	4909.6

4.3 Descriptions of the Soil Families

The Soil Family names are those that have been described in "The Soils of Sabah (1975).

Appendices IIIA to IIIN present the profile descriptions of the various Soil Families and the respective analytical results.

Appendices IVA to IVH present the profile descriptions of several of the Soil Families for which soil samples have not been collected.

4.3.1

Paliu Family

Orthic Acrisols on sub-recent alluvium are very deep and well-drained. The soils are clay loam in texture and are formed on slightly raised flat alluvial fans with deeply incised streams at the foot of the sandstone and mudstone hills. They have been tentatively classified as Paliu Family.

The top soil consists of brown to dark brown friable loam with moderately strong fine and medium subangular blocks and crumbs. Abundant roots are present and they range from 1 to 15 mm. in diameter. Sub-soils are stoneless and are deep to very deep and may extend to below 100 cm. depth. Soil colours are brown to strong brown to dark yellowish brown and occasionally light olive brown. They have moderately well-developed coarse and very coarse subangular blocky structures and friable to slightly firm consistency. Clay cutans on ped surfaces are common features of the sub-soil. Grey mottles may be present but are mainly at the lower depth of the sub-soil.

Top soil is acidic with pH between 5.8 to 6.2 and sub-soil is strongly acidic with pH 4.7 to 4.9. Organic carbon is highest in top soil with values between 3.8 to 4.8% while sub-soil organic carbon is less than 1%. Exchangeable cations are generally medium to high in the surface soil and low to medium in the sub-soil. The cation exchangeable capacity for the whole soil is medium to high.

4.3.2

Inanam Family

The soils of the Inanam Family are classified as Gleyic Acrisols formed on medium to fine textured recent alluvium. The soils are imperfect to poorly drained and occur on flat to low-lying areas.

The top soil consists of dark greyish brown to dark yellowish brown friable loam with moderately developed medium and fine structures. Sub-soil is light grey to light brownish grey silty clay loam to clay. Consistency is friable to slightly firm, becoming more plastic with depth. Structures are moderately developed, medium to very coarse subangular blocky, becoming prismatic and structureless at depth below 55 cm. Dark brown and yellowish brown mottles are the common features and manganese stains are also present.

Soils of the Inanam Family are acidic to strongly acidic with pH ranges from 4.8 to 5.8. Exchangeable cation levels are variable. Magnesium tends to be medium to high, potassium is medium to low while Ca is low to very low. Exchangeable cations for the surface soils are however high.

4.3.3

Kumansi Family

Soils of the Kumansi Family are the most dominant in the surveyed area. They have been classified as Orthic Acrisols developed on mudstone and shale and have more than 40% clay in the sub-soil. The soils are well to moderately well-drained and occur on gently undulating to steep topography. Slopes of 6 to 20° are the most common.

The top soil consists of humus rich A_h horizon, usually less than 5 cm. thick, with brown to dark brown friable sandy loam. Structures are moderately developed with fine and medium subangular blocks and crumbs. The alluvial B_1 horizon lies immediately underneath the A_h horizon. It is about 15 to 20 cm. thick and consists of yellowish brown to light olive brown friable clay loam. Structures are moderate to well-developed with medium and coarse subangular blocks. Coatings of organic acid are common on most of the ped surfaces. Micro-bio activities are found along coarse channels and between ped cleavages. The A_h and B_1 horizons have the highest concentration of roots.

Sub-soil B₂ horizons are moderately deep to deep, extending to below 75 cm. depth. They consist of brownish yellow to yellowish brown to strong brown, and occasionally yellowish red and olive yellow clay with friable to slightly firm consistency. Structures are well-developed coarse subangular blocky. Both the organic acid coatings and micro-bio activities are less prominent and are confined to the upper layer of the B₂ horizon. Clay cutans are common and well-developed on many ped surfaces. Scattered fine gravels of sandstone or mudstone may be present in the lower part of the horizon. Soils of the Kumansi Family may be stony in the lower part of the sub-soil, with fragments of undecomposed or decomposed sandstone or mudstone. The stony horizons are not continuous, with interstices filled with clay of the overlying horizon. This layer is considered not a limitation to cocoa root penetration.

At depth below 100 cm. lies the parent rock - mudstone or shale with varying degrees of weathering and hardness. This impervious parent rock C horizon is not penetrable by roots.

Soils of the Kumansi Family are acidic to strongly acidic with pH ranges from 4.6 to 5.9. Top soil pH is higher with values above 5.0 while the sub-soil values are below 5.0. Organic carbon is highest in the humus rich A_n horizon, ranging from 1.9 to 6.6%, and decreases abruptly in the underlying B horizon where most values are 0.6% or lower. Top soil also has the higher base saturation with high exchangeable K and Mg and medium to high exchangeable Ca and available P. Sub-soil base saturation is very low with medium to low exchangeable K, Mg and available P and very low exchangeable Ca. The cation exchange capacity for the whole soil is medium to high.

4.3.4

Tanjong Lipat Family

Soils of the Tanjong Lipat Family are classified as Orthic Acrisols formed on sandstone and mudstone and have 25 to 40%

clay in the sub-soil. The soils are well to moderately well-drained and are formed on rolling to very steep topography.

The A_h top soil consists of about 4 cm. thick of dark brown to dark yellowish brown fine sandy loam to fine loamy sand. Structures are moderately developed with fine and medium subangular blocks and crumbs. Consistency is friable to very friable. Sub-soil colour varies from brown to strong brown to yellowish brown and brownish yellow and texture is uniformly sandy clay loam. Structures are moderately strong with coarse and medium subangular blocks and friable consistency. Organic acid coatings and micro-bio activities are present in the upper part of the B horizon. Stones are common in the sub-soil although many profiles have deep horizons. In the stony Tanjong Lipat Family the stones consist of fragmented sandstone with minor mudstone and interstices filled with the overlying sandy clay loam. This stony horizon poses no limitation to root penetration. The impervious bedrock of sandstone is usually encountered below 75 cm. depth.

The top soil is acidic with pH of 6.6 while the sub-soil is strongly acidic with pH of 4.8 to 5.0. Organic carbon ranges from 2.4% in the top soil and decreases abruptly to below 0.6% in the sub-soil. The top soil also has higher cation exchange capacities, total nitrogen and exchangeable cations than the sub-soil where the values are lower, particularly exchangeable Ca and total nitrogen.

4.3.5

Kapilit Family

Soils of the Kapilit Family are formed on sandstones occurring on rolling to hilly topography. They are classified as Orthic Acrisols and have similar morphological properties to those of the Tanjong Lipat Family except that the sub-soil has a lower clay content of less than 25%.

4.3.7 The top soil is usually a thin layer of dark brown friable sandy loam with well-developed fine structures. Sub-soil colour ranges from yellowish brown to strong brown and has fine sandy clay loam to loamy fine sand textures. Structures are moderately strong, medium and coarse subangular blocky and consistency is friable but tending towards more compact with depth. Organic acid coatings and micro-bio activities are present mainly in the upper horizon of the sub-soil.

The top soil has a higher pH of 6.1 as compared to those of the sub-soil which average at 4.8. Soils of the Kapilit Family are generally lower in exchangeable potassium, magnesium, calcium and cation exchange capacities than those of the Tanjong Lipat Family.

4.3.6

Dagat Family

The soils of the Dagat Family are classified as Orthic Acrisols on tuffaceous rocks occurring on rolling topography.

Top soil consists of brown to dark brown friable loam with moderately developed fine structures. Sub-soil colour ranges from brown to strong brown with well-developed medium and coarse subangular blocky structures. Consistency is friable and texture is clay loam to clay. Gravels of tuffaceous shale ranging from 5 to 30 mm. may be present and these constitute less than 5% of the sub-soil volume. At depth below 75 cm. is a layer of weakly developed clay intermixed with many semi-decomposing tuffaceous shale. This layer is compact and is not easily penetrable by roots.

Soils of the Dagat Family are acidic to strongly acidic with higher pH in the surface soil. The cation exchange capacities are medium to high. Exchangeable potassium and magnesium are high to very high while level of calcium is low.

4.3.7 Sipit Family

Soils of the Sipit Family are of minor occurrence, found mainly in Sg. Pakis Estate. They are classified as Ferric Acrisols formed on sandstone and mudstone on rolling to steep topography.

The top soil consists of dark brown to dark yellowish brown fine sandy loam to fine loamy sand with friable consistency. Sub-soils are usually deep and stony with strong brown to yellowish brown friable sandy clay loam to sandy clay. Coarse reddish mottles are the common feature in this soil and they occur at depth between 50 to 100 cm. The stony C horizon consisting of fragmented sandstone or mudstone is found below 75 cm. depth.

Soils of the Sipit Family are similar in morphological characteristic to soils of the Tanjong Lipat Family except for the presence of prominent reddish mottles in the Sipit Family.

4.4 Summary of Soil Properties

4.4.1 The important properties of the various Soil Families are presented in Table 3. It is evident that except for the common occurrence of soils on hilly topography and gravelly sub-soils, generally without continuous impediments at < 100 cm., the soils present no serious limitation for cocoa cultivation.

4.4.2 Table 4 presents the principal criteria in grading of soil suitability classes for cocoa. However, it is to be pointed out that the terrain class limit appears too severe and experience has shown that cocoa can easily be planted on slopes of 20°.

Table 3 - Summary of Properties of the Soil Families

Family	Parent Material	Terrain	pH Sub-soil	Sub-soil Texture	Base Saturation Surface Horizon	Soil Depth	Effective Drainage	Classification	Remarks on Management
PALIU	Sub-recent alluvium	Flat	4.7 - 4.9	Clay loam	Medium to high	> 100 cm	Moderate to well	Orthic Acrisol	Routine treatment of balance fertilizer with reduced Mg
INANAM	Recent alluvium	Flat	5.2	Loam	Medium to high	> 100 cm	Imperfect	Gleyic Acrisol	Good drainage is required. Fertilizer as Paliu
KUMANSI	Mudstone & shale	Undulating to steep	5.0	Clay	Low to medium	75 - 100 cm	Well	Orthic Acrisol	Routine treatment of balance fertilizer at slightly higher rate
TANJONG LIPAT	Sandstone & mudstone	Rolling to very steep	4.9	Sandy clay loam	Low	≤ 75 cm	Well to moderate	Orthic Acrisol	Routine treatment of balance fertilizer at slightly higher rate
KAPILIT	Sandstone	Rolling to hilly	4.8	Sandy clay loam	Low	≤ 75 cm	Well	Orthic Acrisol	As Tanjong Lipat
DAGAT	Tuffaceous	Rolling	5.0	Clay loam to clay	Medium to high	≤ 75 cm	Well	Orthic Acrisol	Routine treatment of balance fertilizer with reduced Mg
SIPIT	Sandstone & mudstone	Rolling to steep	-	Gravelly sandy clay loam	-	≤ 75 cm	Well	Ferric Acrisol	Fertilizer treatment as Tanjong Lipat

Table 4 - Principal Criteria in Grading of Soil Suitability Classes for Cocoa

<u>Soil Properties</u>	<u>Degree in Severity of Limitation</u>	<u>Desirable Range</u>	<u>Minor Limitation</u>	<u>Serious Limitation</u>	<u>Very Serious Limitation</u>
Texture		Sandy clay loam to clay	Loam, sandy loam, silty clay, very loamy clay	Loamy sand	Sand
Effective soil depth		100 cm.	75 - 100 cm.	60 - 75 cm.	60 cm.
Structure		Strongly developed	Moderately developed	Weak or massive	Weak or massive
Consistence		Friable to moderately firm	Firm	Very firm	Very firm
Laterite		Nil	Nil	25% nodular or fragmented laterite 30 cm. in thickness	25% nodular or fragmented laterite > 30 cm. in thickness. Presence of massive laterite
pH		5.5 - 7.5	4.0 - 5.5	3.5 - 4.0	< 3.5
Peat layer		Nil	0 - 30 cm.	> 30 cm.	> 30 cm.
Permeability		Moderately well drained to well	Imperfect drainage or very well drained	Poorly drained	Very poorly drained or excessively drained
Terrain		0 - 6°	6 - 12°	12 - 16°	16°
Nutrient content		Low applications of fertilisers only required	Moderate to high quantities of fertilisers required. Application normally economic	High to very high fertiliser application required. May not be economic at low cocoa prices	Very high fertiliser applications required. Probably economic rates only at times of high cocoa prices

COCAO FERTILIZER RECOMMENDATIONS

5. COCOA FERTILIZER RECOMMENDATIONS

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- 5.1 The detailed soil survey at an 8 chain x 8 chain grid has enabled individual soil units as small as 6.4 acres (3 ha.) to be delineated on the map. It is therefore obvious that blocks of the cocoa fields as laid out in the plantations may consist of more than one Soil Family. The distribution according to Soil Families within blocks has been detailed in Appendix II.
- 5.2 Seven Soil Families have been encountered within the project area. The properties of these soils have been studied in detail from field observations and laboratory analysis.
- 5.3 In consideration of the approach in the fertilizing of cocoa under the Permodalan condition, the following points will be relevant:-
- i) Cocoa is planted under thinned-out jungle shade.
 - ii) The abundance of organic matter will slowly mineralise and nutrients made available for plant uptake.
 - iii) Generally, trend of nutrient accumulation and removal once cropping begins.
 - iv) October to January are the highest rainfall months.
 - v) For practical field application the use of too many soil variables in formulating the fertilizer schedules is precluded. On examining the soil analysis results it appears that the major soil difference that is of particular significance to cocoa fertilizing is the contents of available soil Magnesium and Calcium, or generally the Base Saturation $\left(\frac{\text{Total cations}}{\text{CEC}} \times 100\% \right)$

at the top two layers. K levels, appear fairly constant and vary within narrow limits.

The Soil Families are divided as follows:-

<u>Low Base Saturation</u>	<u>High/Moderate Base Saturation</u>
Kumansi	Paliu
Tanjong Lipat	Inanam
Kapilit	Dagat
Sipit	

- vi) In blocks where there is occurrence of both high and low Base Saturation, discriminatroy fertilizer schedules should be used as long as the minority soil group occupies more than 20% of the block hectarage.

It is pointed out that the high base saturation soils are predominantly Paliu and Inanam Soil Families and exclusively occur as flat terrain. The occurrence of Dagat however is small.

5.4 On the basis of the above, the fertilizer schedules have been formulated as presented in Tables 5 and 6.

5.5 All immature cocoa of the 83 and 84 plantings will follow the standard schedule. Adjustments, where necessary, will be made based on field observation.

The recommendations for mature cocoa are presented in Table 7.

Table 5 - Fertilizer Schedule for Immature Cocoa

	Fertilizer	Gm/tree
At planting	CIRP	115
1	NPK-Y	28
3	NPK-Y	28
5	NPK-B	60
6	GML	85
7	NPK-Y	85
9	NPK-B	85
12	NPK-Y	85

15	CCM 25	115
18	CCM 25	115
21	CCM 66	115
22	GML	140
24	CCM 66	140

27	CCM 33	140
30	CCM 33	140

Table 6 - Fertilizer Schedule for Mature Cocoa

i) Soils with high base saturation (BS)

Month	Fertilizer	Year of Maturity		
		1st Year 500 kg/ha	2nd Year 500-1000 kg/ha	3rd Year >1000 kg/ha
Feb.	CCM 66	140	155	170
Apr.	CCM 44	140	155	170
July	CCM 66	155	170	185
Oct.	CCM 44	155	170	185

ii) Soils with low base saturation (BS)

Month	Fertilizer	Year of Maturity		
		1st Year 500 kg/ha	2nd Year 500-1000 kg/ha	3rd Year >1000 kg/ha
Feb.	CCM 66	140	170	185
Apr.	CCM 44	140	170	185
July	CCM 66	170	170	185
Oct.	CCM 44	170	170	185
Dec.	GML	170	170	170

Table 7 - Fertilizer Recommendations for Mature Cocoa

<u>Estate</u>	<u>Division</u>	<u>Year</u>	<u>Low BS</u>	<u>High BS</u>
Sg. Bendera	Main	81B	All other blocks	98
	Batu Cave	81C	All other blocks	16A, 17A, 17F, 19D and low-lying areas of 18A (4 ha), 19A (8 ha)
	Tanjong Batu	81D	All other blocks	24C and low-lying areas of 21E (4 ha), 23A (9.5 ha), 24A (5 ha), 24B (4 ha), 24D (6 ha)
	Pertama	NP 80 NP 81A	All blocks All other blocks	4B, 5A, 6B, 6C, 7C and low-lying areas of 4A (10 ha), 4C (6 ha), 5B (6 ha), 5C (6 ha), 6A (6.5 ha), 7A (9 ha), 7B (10 ha), 8B (4 ha)
Sg. Kretam	Batu Gajah	NP 81E	All other blocks	Low-lying areas of 29A (4 ha), 29C (3 ha), 30B (5 ha), 30C (10 ha), 32A (4.5 ha), 33A (6 ha)
		NP 82	All other blocks	28A and low-lying areas of 28B (4 ha), 28C (3 ha)
		NP 81 82	All other blocks	1, 2 1, 2, 7 and low areas of 3 (17 ha), 4 (14 ha), 5 (12 ha) 6 (18 ha), 8 (10 ha)
Sg. Parkis		NP 82	All blocks	

It is tentatively proposed that 170 gm/tree of limestone dust be applied to mature cocoa in the high Base Saturation Soils during December 1986 for all yield categories.

APPENDICES

Appendix IA

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSES IN SG. BENDERA ESTATE - MAIN DIVISION

Block	Total ha	0-2°				6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very Steep
		Flat to low lying	Flat - raised with deeply incised stream	Flat - raised with deeply incised stream	Flat - raised with deeply incised stream				
81B									
9 B	1.7	1.4 (85)	-	0.3 (15)	-	-	-	-	
10 B	12.6	3.1 (25)	-	9.5 (75)	-	-	-	-	
11 B	11.6	3.5 (30)	2.3 (20)	5.8 (50)	-	-	-	-	
12 A	15.2	-	1.5 (10)	-	6.9 (50)	6.8 (50)	1.9 (27)	-	
12 B	7.1	-	3.2 (45)	-	2.0 (28)	-	-	-	
13 A	16.2	-	6.5 (40)	9.7 (60)	-	-	-	-	
13 B	9.8	0.5 (5)	5.3 (55)	2.5 (25)	0.8 (8)	0.7 (7)	4.8 (30)	-	
13 C	16.2	6.5 (40)	-	-	4.9 (30)	4.8 (30)	1.2 (10)	-	
13 D	11.9	-	-	4.8 (40)	5.9 (50)	1.2 (10)	-	-	
13 E	10.1	4.0 (40)	-	3.1 (30)	3.0 (30)	-	-	-	
14 A	15.4	-	3.8 (25)	7.0 (45)	2.3 (15)	2.3 (15)	5.5 (35)	-	
14 B	15.7	-	1.6 (10)	1.6 (11)	7.0 (45)	5.3 (29)	1.2 (10)	-	
14 C	18.2	0.4 (2)	-	3.6 (20)	8.9 (49)	1.2 (10)	-	-	
14 D	12.1	2.4 (20)	-	3.6 (30)	4.9 (40)	-	-	-	
14 E	12.4	3.7 (30)	-	4.4 (35)	4.3 (35)	-	-	-	
15 A	12.9	-	-	4.5 (35)	6.5 (50)	1.9 (15)	0.8 (5)	-	
15 B	16.4	-	3.3 (20)	5.7 (35)	6.6 (40)	-	-	-	
15 C	17.9	-	5.4 (30)	6.3 (35)	6.2 (35)	-	-	-	
15 D	12.1	1.2 (10)	-	5.5 (45)	5.4 (45)	-	-	-	
15 E	11.4	-	-	5.7 (50)	5.7 (50)	-	-	-	
15 F	6.1	-	-	3.1 (50)	3.0 (50)	-	-	-	
15 G	13.6	-	-	6.8 (50)	6.8 (50)	-	-	-	
84B									
9 A	18.2	5.5 (30)	-	12.7 (70)	-	-	-	-	
10 A	14.4	4.3 (30)	-	10.1 (70)	-	-	-	-	
11 A	11.4	-	2.3 (20)	4.5 (40)	2.3 (20)	2.3 (20)	2.3 (20)	-	
TOTAL	320.6	36.5 (11)	35.2 (11)	120.8 (38)	93.4 (29)	34.7 (11)	-	-	

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSES IN SG. BENDERA ESTATE - PERTAMA DIVISION

Block	Total ha	0-2°			6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very Steep
		Flat to low lying	Flat - raised with deeply incised stream	Flat - raised with deeply incised stream				
80								
1 A	12.9	-	0.6 (5)	6.2 (48)	6.1 (47)	-	-	
1 B	3.8	-	-	1.9 (50)	1.9 (50)	-	-	
1 C	45.6	9.1 (20)	-	18.3 (40)	18.2 (40)	-	-	
81A								
2 A	16.2	-	9.7 (60)	3.2 (20)	3.3 (20)	-	-	
2 B	16.2	-	4.1 (25)	6.1 (38)	6.0 (37)	-	-	
2 C	18.7	0.9 (5)	3.8 (20)	7.1 (38)	6.9 (37)	-	-	
3 A	17.9	-	7.2 (40)	5.3 (30)	5.4 (30)	-	-	
3 B	16.2	-	3.2 (20)	6.5 (40)	6.5 (40)	-	-	
3 C	16.2	-	11.3 (70)	1.6 (10)	3.3 (20)	-	-	
4 A	20.0	11.0 (55)	2.0 (10)	3.6 (18)	3.4 (17)	-	-	
4 B	18.2	12.7 (70)	-	2.7 (15)	2.8 (15)	-	-	
4 C	18.9	7.6 (40)	1.9 (10)	4.7 (25)	4.7 (25)	-	-	
5 A	18.5	14.8 (80)	-	1.9 (10)	1.8 (10)	-	-	
5 B	14.4	4.3 (30)	-	5.1 (35)	5.0 (35)	-	-	
5 C	19.7	5.9 (30)	-	6.9 (35)	6.9 (35)	-	-	
6 A	16.4	6.6 (40)	-	4.9 (30)	4.9 (30)	-	-	
6 B	15.7	11.0 (70)	-	2.3 (15)	2.4 (15)	-	-	
6 C	15.2	12.2 (80)	-	1.5 (10)	1.5 (10)	-	-	
7 A	17.7	8.9 (50)	-	4.4 (25)	4.4 (25)	-	-	
7 B	19.2	8.6 (45)	3.0 (15)	5.4 (28)	5.2 (27)	-	-	
7 C	19.7	8.9 (45)	-	6.4 (33)	1.4 (7)	-	-	
8 A	12.9	3.9 (30)	4.4 (30)	4.5 (35)	4.5 (35)	-	-	
8 B	14.7	-	0.5 (5)	5.9 (40)	4.4 (30)	-	-	
8 C	9.1	-	-	8.6 (95)	-	-	-	
TOTAL	414.0	126.4 (30)	51.7 (12)	125 (30)	110.9 (28)	-	-	

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSSED IN SG. BENDERA ESTATE - BATU GAJAH DIVISION

Block	Total ha	0-2°				20-25° Steep	Very Steep
		Flat to low lying	Flat raised with deeply incised stream	6-12° Rolling	12-20° Hilly		
29 A	16.4	3.3 (20)	-	6.6 (40)	6.5 (40)	-	-
29 B	13.6	0.7 (5)	-	6.5 (48)	6.4 (47)	-	-
29 C	13.2	2.6 (20)	-	5.3 (40)	5.3 (40)	-	-
30 A	17.7	-	8.9 (50)	3.5 (20)	5.3 (30)	-	-
30 B	19.5	4.9 (25)	-	7.4 (38)	7.2 (37)	-	-
30 C	19.2	9.6 (50)	-	1.9 (10)	7.7 (40)	-	-
31 A	14.4	-	1.4 (10)	6.5 (45)	6.5 (45)	-	-
31 B	17.7	-	-	6.2 (35)	11.5 (65)	-	-
32 A	18.2	3.6 (20)	-	6.4 (35)	6.4 (35)	1.8 (10)	-
32 C	18.2	-	2.7 (15)	-	10.0 (55)	5.5 (30)	-
33 A	14.9	6.0 (40)	-	6.7 (45)	2.2 (15)	-	-
33 B	15.2	-	4.6 (30)	6.0 (40)	4.6 (30)	-	-
33 C	15.7	-	3.1 (20)	5.5 (35)	2.4 (15)	4.7 (30)	-
34 A	19.7	0.6 (3)	15.7 (80)	2.2 (11)	1.2 (6)	-	-
34 B	17.7	-	13.3 (75)	3.2 (18)	1.2 (7)	-	-
34 C	17.2	-	12.0 (70)	4.3 (25)	0.9 (5)	-	-
35 A	14.2	-	7.1 (50)	5.0 (35)	2.1 (15)	-	-
35 B	12.1	-	7.3 (60)	1.8 (15)	2.2 (18)	0.8 (7)	-
35 C	10.4	-	4.7 (45)	5.7 (55)	-	-	-
28 A	8.1	7.3 (90)	-	0.4 (5)	0.4 (5)	-	-
28 B	16.4	3.3 (20)	-	8.2 (50)	4.9 (30)	-	-
28 C	14.4	1.4 (10)	-	6.5 (45)	6.5 (45)	-	-
31 C	15.2	-	-	-	15.2 (100)	-	-
32 B	20.7	-	-	8.3 (40)	8.3 (40)	4.1 (20)	-
Planted Swamp	7.1	7.1 (100)	-	-	-	-	-
TOTAL	387.1	50.4 (13)	80.8 (21)	114.1 (30)	124.9 (32)	16.9 (4)	-

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSES IN SG. BENDERA ESTATE - BATU CAVE DIVISION

Block	Total ha	0-2°					
		0-2° Flat to low lying	Flat - raised with deeply incised stream	6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very steep
16 A	17.2	10.3 (60)	-	3.5 (20)	3.4 (20)	-	-
16 B	18.1	4.5 (25)	4.5 (25)	4.6 (25)	4.6 (25)	-	-
16 C	15.9	4.0 (25)	-	6.0 (28)	5.9 (37)	-	-
16 D	14.2	5.7 (40)	-	4.3 (30)	4.2 (30)	-	-
16 E	14.9	-	-	7.5 (50)	7.4 (50)	-	-
16 F	17.2	-	-	8.6 (50)	8.6 (50)	-	-
16 G	14.9	4.5 (30)	-	5.2 (35)	5.2 (35)	-	-
17 A	13.6	12.2 (90)	-	0.7 (5)	0.7 (5)	-	-
17 B	9.6	7.7 (80)	-	1.0 (10)	0.9 (10)	-	-
17 C	15.0	1.5 (10)	-	6.8 (45)	6.7 (45)	-	-
17 D	17.4	0.9 (5)	-	8.3 (48)	8.2 (47)	-	-
17 E	14.9	1.5 (10)	-	6.7 (45)	6.7 (45)	-	-
17 F	5.3	3.7 (70)	-	0.8 (15)	0.8 (15)	-	-
18 A	14.2	7.1 (50)	-	3.6 (25)	3.5 (25)	-	-
18 B	3.5	-	-	1.8 (50)	1.7 (50)	-	-
18 C	24.5	6.1 (25)	-	12.3 (50)	6.1 (25)	-	-
18 D	5.8	1.7 (30)	-	2.6 (45)	1.5 (25)	2.6 (15)	2.6 (15)
19 A	17.4	8.7 (50)	-	1.8 (10)	1.7 (10)	3.8 (50)	3.8 (50)
19 B	7.6	-	-	-	-	1.4 (50)	1.4 (50)
19 C	2.8	-	-	-	-	-	-
19 D	13.6	13.6 (100)	-	5.4 (35)	5.3 (35)	1.5 (10)	1.5 (10)
20 A	15.2	1.5 (10)	-	-	-	3.3 (48)	3.2 (47)
20 B	6.8	0.3 (5)	-	-	-	1.7 (30)	1.6 (30)
20 C	5.5	2.2 (40)	-	-	-	-	-
TOTAL:	305.1	97.7 (32)	4.5 (1)	91.5 (30)	83.0 (27)	14.3 (5)	14.1 (5)

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSES IN SG. BENDERA ESTATE - TANJONG BATU DIVISION

Block	Total ha	0-2°					6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very Steep
		Flat to low lying	Flat - raised with deeply incised stream							
21 A	9.4	0.9 (10)	-	1.5 (15)	1.4 (15)	2.8 (30)	2.8 (30)	2.8 (30)	2.8 (30)	
21 B	6.1	0.3 (5)	-	-	-	2.9 (48)	2.9 (48)	2.9 (48)	2.9 (47)	
21 C	9.6	-	-	2.9 (30)	2.9 (30)	1.9 (20)	1.9 (20)	1.9 (20)	-	
21 D	5.3	-	-	2.7 (50)	2.6 (50)	-	-	-	-	
21 E	8.9	-	4.5 (50)	3.6 (40)	0.8 (10)	-	-	-	-	
21 F	8.1	-	-	6.5 (80)	1.6 (20)	-	-	-	-	
21 G	10.8	-	1.1 (10)	4.9 (45)	4.8 (45)	-	-	-	-	
21 H	6.8	-	0.7 (10)	-	3.1 (45)	3.0 (45)	3.0 (45)	3.0 (45)	-	
21 I	3.3	-	-	1.7 (50)	0.8 (25)	0.8 (25)	0.8 (25)	0.8 (25)	-	
22 A	14.9	3.0 (20)	-	4.5 (30)	4.4 (30)	1.5 (10)	1.5 (10)	1.5 (10)	1.5 (10)	
22 B	16.9	-	-	1.7 (10)	1.6 (10)	6.8 (40)	6.8 (40)	6.8 (40)	6.8 (40)	
22 C	19.5	-	-	8.8 (45)	8.7 (45)	1.0 (5)	1.0 (5)	1.0 (5)	1.0 (5)	
22 D	16.2	-	-	8.1 (50)	8.1 (50)	-	-	-	-	
22 E	18.2	-	7.3 (40)	5.5 (30)	5.4 (30)	-	-	-	-	
22 F	17.2	-	5.2 (30)	6.0 (35)	6.0 (35)	-	-	-	-	
22 G	19.7	-	5.9 (30)	3.0 (15)	6.9 (35)	3.9 (20)	3.9 (20)	3.9 (20)	3.9 (20)	
22 H	16.7	-	1.7 (10)	3.3 (20)	5.9 (35)	5.8 (35)	5.8 (35)	5.8 (35)	5.8 (35)	
22 I	17.9	-	-	9.0 (50)	4.5 (25)	4.4 (25)	4.4 (25)	4.4 (25)	4.4 (25)	
23 A	18.9	7.6 (40)	-	4.7 (25)	4.7 (25)	1.0 (5)	1.0 (5)	1.0 (5)	0.9 (5)	
23 B	15.7	4.7 (30)	-	4.7 (30)	0.8 (5)	0.8 (5)	0.8 (5)	0.8 (5)	0.8 (5)	
23 C	14.9	3.7 (25)	-	6.0 (40)	5.2 (35)	-	-	-	-	
23 D	18.2	3.6 (20)	-	7.3 (40)	7.3 (40)	-	-	-	-	
23 E	21.0	-	8.4 (40)	6.3 (30)	6.3 (30)	-	-	-	-	
23 F	18.2	-	10.9 (60)	3.7 (20)	3.6 (20)	0.4 (2)	0.4 (2)	0.4 (2)	0.4 (2)	
23 G	18.9	-	13.2 (70)	0.6 (3)	4.7 (25)	0.7 (5)	0.7 (5)	0.7 (5)	0.7 (5)	
23 H	15.2	-	6.1 (40)	7.6 (50)	0.8 (5)	-	-	-	-	
23 I	17.7	-	5.3 (30)	12.4 (70)	-	-	-	-	-	

TANJONG BATU DIVISION

Appendix 1B

ESTIMATED VEGETATION (%) OF THE VARIOUS SOIL CLASSES IN SURVEY DISTRICT

Block	Total ha	0-2° Flat to low lying	0-2° Flat - raised with deeply incised stream	2-6° Undulating	6-12° Rolling	21-20° Hilly	20-25° Steep	25-33° Very Steep
24 A	9.1	3.6 (40)	-	-	4.1 (45)	1.4 (15)	-	-
24 B	13.4	5.4 (40)	-	3.4 (25)	3.2 (27)	0.4 (3)	-	-
24 C	12.1	7.9 (65)	-	0.6 (5)	3.1 (25)	3.1 (25)	-	-
24 D	12.4	6.2 (50)	-	-	1.6 (10)	1.5 (10)	-	-
24 E	15.4	-	12.3 (80)	-	-	5.0 (35)	-	-
24 F	14.4	-	9.4 (65)	-	-	12.0 (65)	-	-
24 G	18.5	-	6.5 (35)	-	1.3 (10)	6.3 (50)	-	-
24 H	12.6	-	5.0 (40)	-	7.4 (50)	-	-	-
24 I	14.9	-	7.5 (50)	-	-	-	-	-
TOTAL	:507.0	46.9 (9)	111.0 (22)	4.0 (1)	150.3 (30)	138.5 (27)	37.7 (7)	18.6 (4)

Appendix IB

ESTIMATED HECTARE (%) OF THE VARIOUS TERRAIN CLASSES IN SUNGEI KRETAM ESTATE

Block	Total (ha)	0 - 2° Flat to low-lying	0 - 2° Flat (raised) with deeply incised stream	2 - 6° Undulating	6 - 12° Rolling	12 - 20° Hilly	20 - 25° Steep	25 - 33° Very steep
81								
1	22.1	18.8 (85)	-	-	3.3 (15)	-	-	-
2	22.1	15.5 (70)	-	-	4.4 (20)	2.2 (10)	-	-
3	25.0	3.7 (15)	-	-	7.5 (30)	13.8 (55)	-	-
4	17.4	0.9 (5)	0.5 (3)	-	2.1 (12)	13.9 (80)	-	-
5	22.3	2.2 (10)	2.2 (10)	-	2.2 (10)	15.7 (70)	-	-
6	22.9	1.8 (8)	2.2 (10)	-	2.3 (10)	14.9 (65)	0.5 (2)	-
7	19.1	1.5 (8)	3.4 (15)	-	2.3 (12)	12.4 (65)	2.9 (15)	-
8	20.2	2.0 (10)	-	-	2.0 (10)	12.1 (60)	4.1 (20)	-
9	20.2	0.4 (2)	-	-	2.0 (10)	19.4 (96)	0.4 (2)	-
82								
1	29.7	25.2 (85)	-	1.5 (5)	3.0 (10)	-	-	-
2	18.9	10.4 (55)	-	1.9 (10)	6.6 (35)	-	-	-
3	30.2	15.1 (50)	-	13.6 (45)	-	-	-	-
4	30.3	13.6 (45)	1.5 (5)	2.3 (8)	2.1 (7)	1.5 (5)	1.6 (5)	-
5	29.1	11.6 (40)	13.6 (45)	-	6.0 (20)	3.8 (13)	3.5 (12)	-
6	30.1	16.6 (55)	5.8 (20)	1.5 (5)	1.5 (5)	-	-	-
7	29.5	22.1 (75)	7.5 (25)	4.4 (15)	9.4 (32)	2.3 (8)	-	-
8	29.4	11.2 (38)	4.4 (15)	6.2 (20)	17.1 (55)	4.7 (15)	-	-
9	31.1	-	7.3 (25)	4.4 (15)	15.6 (53)	2.1 (7)	-	-
10	29.4	-	11.7 (40)	-	16.1 (55)	1.5 (5)	-	-
11	29.3	-	14.8 (50)	-	8.9 (30)	5.9 (20)	-	-
12	29.6	-	25.0 (85)	1.9 (5)	3.8 (10)	3.1 (8)	0.8 (2)	-
13	38.5	3.9 (10)	10.8 (25)	1.3 (3)	16.0 (37)	5.6 (13)	3.1 (7)	-
14	43.3	6.5 (15)	24.8 (60)	7.0 (17)	7.0 (17)	1.0 (3)	1.3 (3)	-
15	41.3	-	9.9 (25)	3.2 (8)	5.1 (13)	10.6 (27)	0.8 (2)	-
16	39.4	9.8 (25)	1.9 (5)	6.9 (18)	15.6 (41)	6.9 (18)	-	-
17	38.2	3.7 (12)	0.9 (3)	6.2 (20)	7.2 (23)	13.1 (42)	-	-
18	31.1	-	-	-	-	-	-	-

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSES IN SG. PAKIS ESTATE

Block	Total ha	0-2°					20-25° Steep	25-33° Very steep
		Flat to low lying	Flat raised with deeply incised stream	Undulating	6-12° Rolling	12-20° Hilly		
82	11.4	-	0.2 (2)	-	-	11.2 (98)	-	-
	7.6	-	0.4 (5)	-	-	7.2 (95)	-	-
	14.7	-	1.5 (10)	-	-	13.2 (90)	-	-
	16.7	-	2.5 (15)	-	-	6.3 (38)	6.2 (37)	-
	30.6	-	7.6 (25)	-	1.7 (10)	0.9 (3)	12.9 (42)	-
	21.7	-	2.2 (10)	-	9.2 (30)	9.1 (42)	2.6 (12)	2.6 (12)
	26.6	-	2.6 (10)	-	5.2 (24)	8.3 (31)	6.9 (26)	2.7 (10)
	10.8	-	1.6 (15)	-	6.1 (23)	1.4 (13)	2.7 (25)	2.7 (25)
	19.9	1.6 (8)	0.4 (2)	-	2.4 (22)	1.2 (6)	7.6 (38)	6.3 (32)
	24.3	-	1.2 (5)	-	2.8 (14)	7.3 (30)	6.0 (25)	4.9 (20)
	9.0	-	1.4 (15)	-	4.9 (20)	7.6 (85)	-	-
	10.8	-	1.6 (15)	-	1.1 (10)	4.9 (45)	3.2 (30)	-
83	20.8	-	1.0 (5)	-	-	14.1 (68)	4.2 (20)	1.5 (7)
	25.0	-	1.3 (5)	-	0.8 (3)	10.5 (42)	8.2 (33)	4.2 (17)
	12.7	-	1.3 (10)	-	9.2 (72)	1.1 (9)	1.1 (9)	-
	8.1	-	-	-	4.9 (60)	1.6 (20)	1.6 (20)	-
	6.9	-	0.7 (10)	-	6.2 (90)	-	-	-
	1.5	-	-	-	1.5 (100)	-	-	-
	8.0	-	-	-	4.4 (55)	1.8 (23)	1.8 (22)	-
	9.1	-	0.9 (10)	-	8.2 (90)	-	-	-
	4.4	-	0.4 (10)	-	4.0 (90)	-	-	-
	9.3	-	2.3 (25)	-	4.1 (44)	2.9 (31)	-	-
	12.3	-	2.5 (20)	-	6.1 (50)	3.7 (30)	-	-
	14.2	-	3.6 (25)	-	8.2 (58)	2.4 (17)	-	-
	11.5	-	1.2 (10)	-	4.0 (35)	6.3 (55)	-	-
	7.0	-	2.5 (35)	-	2.4 (35)	2.1 (30)	-	-
	8.7	-	4.8 (55)	-	3.0 (35)	0.9 (10)	-	-

ED INCREASE (C) OF THE HILLS'S TERRAIN CLASSES IN SG. DATU ESTATE

TERRAIN CLASSES IN SG. PAKIS ESTATE

Block	Total ha	0-2° Flat to low lying	0-2° Flat raised with deeply incised stream	2-6° Undulating	6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very steep	>33°
5 A	10.4	4.2 (40)	-	-	2.7 (26)	2.8 (27)	0.7 (7)	-	-
5 B	11.7	-	0.2 (2)	-	4.4 (37)	4.2 (36)	2.9 (25)	-	-
5 C	11.7	-	0.6 (5)	-	-	1.2 (10)	9.9 (85)	-	-
6 A	7.8	-	0.5 (7)	-	3.7 (47)	3.6 (46)	-	-	-
6 B	7.5	-	3.8 (50)	-	1.9 (25)	1.8 (25)	-	-	-
6 C	9.4	-	1.2 (13)	-	0.1 (1)	0.1 (1)	8.0 (85)	-	-
7 A	13.5	-	6.8 (50)	-	6.3 (47)	0.4 (3)	-	-	-
7 B	14.7	-	7.4 (50)	-	7.3 (50)	-	-	-	-
7 C	16.7	-	10.9 (65)	-	0.3 (2)	-	5.5 (33)	-	-
TOTAL: 840.3 (100)	104.4 (12)	108.7 (13)	-	168.0 (20)	254.7 (30)	134.8 (16)	53.3 (7)	16.4 (2)	-

4	11.5	-	0.6 (6)	-	10.9 (95)	0.4 (3)	0.3 (2)	-	-
5	15.9	-	2.6 (20)	-	11.5 (96)	0.4 (3)	0.3 (2)	-	-
6	12.0	-	2.0 (20)	-	1.8 (15)	0.4 (3)	0.2 (2)	-	-
7	10.2	-	2.0 (20)	-	1.5 (15)	2.8 (31)	3.3 (32)	-	-
8	12.8	-	-	-	5.1 (40)	3.8 (30)	3.9 (30)	-	-
9	40.0	-	1.0 (20)	-	16.6 (40)	5.2 (12)	8.0 (20)	2.8 (7)	-
54A	41.3	-	4.1 (10)	-	2.1 (5)	18.6 (45)	15.7 (39)	0.8 (2)	-
7	28.2	4.3 (15)	4.3 (15)	-	20.2 (70)	-	-	-	-
3	32.4	6.5 (20)	17.8 (50)	-	8.1 (25)	-	-	-	-
4	33.7	0.7 (3)	15.2 (45)	-	17.8 (53)	-	-	-	-
5	40.1	-	20.1 (50)	-	16.0 (40)	2.0 (5)	2.0 (5)	-	-
6	6.6	-	-	-	5.6 (100)	-	-	-	-
7	20.2	-	3.0 (15)	-	11.1 (55)	6.1 (30)	-	-	-
8	25.8	-	9.0 (36)	-	5.1 (20)	11.5 (45)	-	-	-
9	33.9	-	17.4 (50)	-	4.1 (12)	8.4 (25)	-	-	-
					1.0 (3)				
					20.3 (52)				

ESTIMATED HECTARAGE (%) OF THE VARIOUS TERRAIN CLASSES IN SG. BATU ESTATE

Block	Total ha	0-2° Flat to low lying	0-2° Flat raised with deeply incised stream	2-6° Undulating	6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very steep
83A	4.8	-	0.8 (17)	-	3.8 (77)	0.1 (3)	0.1 (3)	-
	10.9	-	3.8 (35)	-	5.5 (50)	1.6 (15)	-	-
	15.0	-	5.3 (35)	-	9.0 (60)	0.7 (5)	-	-
	21.2	-	-	-	5.3 (25)	8.1 (38)	7.8 (37)	-
	16.6	-	1.7 (10)	-	7.5 (45)	3.8 (23)	3.6 (22)	-
	19.7	-	4.9 (25)	-	14.8 (75)	-	-	-
	25.3	-	12.7 (50)	-	12.1 (48)	0.3 (1)	0.2 (1)	0.5 (2)
	27.3	-	8.2 (30)	-	17.7 (65)	-	0.8 (3)	-
83B	14.4	-	7.2 (50)	-	4.3 (30)	-	2.9 (20)	-
	8.7	-	7.8 (90)	-	0.9 (10)	-	-	-
	11.9	-	5.4 (45)	-	6.5 (55)	-	-	-
	17.0	-	1.7 (10)	-	11.1 (65)	2.2 (13)	2.0 (12)	-
	11.5	-	-	-	10.9 (95)	0.3 (3)	0.3 (2)	-
	12.9	-	0.6 (5)	-	11.6 (90)	0.4 (3)	0.3 (2)	-
	12.0	-	9.6 (80)	-	1.8 (15)	0.4 (3)	0.2 (2)	-
	10.2	-	2.0 (20)	-	1.5 (15)	3.4 (33)	3.3 (32)	-
	12.8	-	-	-	5.1 (40)	3.8 (30)	3.9 (30)	-
84A	40.0	-	8.0 (20)	-	16.0 (40)	5.2 (13)	8.0 (20)	2.8 (7)
	41.3	-	4.1 (10)	-	2.1 (5)	18.6 (45)	15.7 (38)	0.8 (2)
	28.8	4.3 (15)	4.3 (15)	-	20.2 (70)	-	-	-
	32.4	6.5 (20)	17.8 (55)	-	8.1 (25)	-	-	-
	33.7	0.7 (2)	15.2 (45)	-	17.8 (53)	2.0 (5)	2.0 (5)	-
	40.1	-	20.1 (50)	-	16.0 (40)	-	-	-
84B	6.6	-	-	-	6.6 (100)	-	-	-
	20.2	-	3.0 (15)	-	11.1 (55)	6.1 (30)	-	-
	25.6	-	9.0 (35)	-	5.1 (20)	11.5 (45)	-	-
	33.9	-	20.4 (60)	1.0 (3)	4.1 (12)	8.4 (25)	-	-
	32.7	-	12.4 (38)	-	20.3 (62)	-	-	-

TERRAIN CLASSES IN SG. BATU ESTATE

- 2 -

Block	Total ha	0-2° Flat to low lying	0-2° Flat raised with deeply incised stream	2-6° Undulating	6-12° Rolling	12-20° Hilly	20-25° Steep	25-33° Very steep
6	32.6	-	3.3 (10)	-	29.3 (90)	1.1 (3)	1.1 (3)	-
7	37.0	7.4 (20)	-	-	27.4 (74)	0.3 (1)	0.3 (1)	-
8	29.8	15.8 (53)	5.4 (18)	-	8.0 (27)	-	-	-
9	35.6	3.6 (10)	23.1 (65)	-	8.9 (25)	-	-	-
84C	31.0	-	1.5 (5)	-	10.9 (35)	9.3 (30)	9.3 (30)	-
2	10.3	-	-	-	5.1 (50)	2.6 (25)	2.6 (25)	-
3	12.2	-	-	-	6.1 (50)	3.0 (25)	3.1 (25)	-
TOTAL:776 (100)		38.3 (5)	219.3 (28)	1.0 (1)	352.5 (44)	93.2 (12)	67.5 (9)	4.1 (1)

Appendix IIA

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SUNGAI BENDERA ESTATE - PERTAMA DIVISION

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SUNGAI BENDERA ESTATE - MAIN DIVISION

	<u>Block</u>	<u>Total (ha)</u>	<u>Inanam Family</u>	<u>Paliu Family</u>	<u>Kumansi Family</u>
81B	9 B	1.7	1.4 (85)	- (5)	0.3 (15)
	10 B	12.6	3.1 (25)	-	9.5 (75)
	11 B	11.6	3.5 (30)	2.3 (20)	5.8 (50)
	12 A	15.2	-	1.5 (10)	13.7 (90)
	12 B	7.1	-	3.2 (45)	3.9 (55)
	13 A	16.2	-	6.5 (40)	9.7 (60)
	13 B	9.8	0.5 (5)	5.3 (55)	4.0 (40)
	13 C	16.2	6.5 (40)	- (40)	9.7 (60)
	13 D	11.9	-	- (20)	11.9 (100)
	13 E	10.1	4.0 (40)	- (70)	6.1 (60)
	14 A	15.4	- (55)	3.8 (25)	11.6 (75)
	14 B	15.7	- (70)	1.6 (10)	14.1 (90)
	14 C	18.2	0.4 (2)	- (10)	17.8 (98)
	14 D	12.1	2.4 (20)	-	9.7 (80)
	14 E	12.4	3.7 (30)	-	8.7 (70)
	15 A	12.9	- (30)	-	12.9 (100)
	15 B	16.4	- (40)	3.3 (20)	13.1 (80)
	15 C	17.9	- (70)	5.4 (30)	12.5 (70)
	15 D	12.1	1.2 (10)	-	10.9 (90)
	15 E	11.4	- (50)	-	11.4 (100)
	15 F	6.1	- (45)	-	6.1 (100)
	15 G	13.6	- (45)	- (15)	13.6 (100)
84B	9 A	18.2	5.5 (30)	-	12.7 (70)
	10 A	14.4	4.3 (30)	-	10.1 (70)
	11 A	11.4	-	2.3 (20)	9.1 (80)
TOTAL:		320.6 (100)	36.5 (11)	35.2 (11)	248.9 (78)

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SG. BENDERA ESTATE - PERTAMA DIVISION

	<u>Block</u>	<u>Total ha</u>	<u>Inanam family</u>	<u>Paliu family</u>	<u>Kumansi family</u>
80	1 A	12.9	-	0.6 (5)	12.3 (95)
	1 B	3.8	-	-	3.8 (100)
	1 C	45.6	9.1 (20)	-	36.5 (80)
81A	2 A	16.2	-	9.7 (60)	6.5 (40)
	2 B	16.2	-	4.1 (25)	12.1 (75)
	2 C	18.7	0.9 (5)	3.8 (20)	14.0 (75)
	3 A	17.9	-	7.2 (40)	10.7 (60)
	3 B	16.2	-	3.2 (20)	13.0 (80)
	3 C	16.2	-	11.3 (70)	4.9 (30)
	4 A	20.0	11.0 (55)	2.0 (10)	7.0 (35)
	4 B	18.2	12.7 (70)	-	5.5 (30)
	4 C	18.9	7.6 (40)	1.9 (10)	9.4 (50)
	5 A	18.5	14.8 (80)	-	3.7 (20)
	5 B	14.4	4.3 (30)	-	10.1 (70)
	5 C	19.7	5.9 (30)	-	13.8 (70)
	6 A	16.4	6.6 (40)	-	9.8 (60)
	6 B	15.7	11.0 (70)	-	4.7 (30)
	6 C	15.2	12.2 (80)	-	3.0 (20)
	7 A	17.7	8.9 (50)	-	8.8 (50)
	7 B	19.2	8.6 (45)	-	10.6 (55)
	7 C	19.7	8.9 (45)	3.0 (15)	7.8 (46)
8 A	12.9	3.9 (30)	-	9.0 (70)	
8 B	14.7	-	4.4 (30)	10.3 (70)	
8 C	9.1	-	0.5 (5)	8.6 (95)	
TOTAL:		414.0 (100)	126.4 (30)	51.7 (13)	235.9 (57)

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SUNGAI BENDERA ESTATE - TANJONG SATU DIVISION

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SUNGAI BENDERA ESTATE - BATU CAVE DIVISION

Block	ha.	Inanam family	Paliu family	Kumansi family
81C 16 A	17.2	10.3 (60)	-	6.9 (40)
16 B	18.1	4.5 (25)	4.5 (25)	9.1 (50)
16 C	15.9	4.0 (25)	-	11.9 (75)
16 D	14.2	5.7 (40)	-	8.5 (60)
16 E	14.9	-	-	14.9 (100)
16 F	17.2	-	-	17.2 (100)
16 G	14.9	4.5 (30)	-	10.4 (70)
17 A	13.6	12.2 (90)	-	1.4 (10)
17 B	9.6	7.7 (80)	-	1.9 (20)
17 C	15.0	1.5 (10)	-	13.5 (90)
17 D	17.4	0.9 (5)	-	16.5 (95)
17 E	14.9	1.5 (10)	-	13.4 (90)
17 F	5.3	3.7 (70)	-	1.6 (30)
18 A	14.2	7.1 (50)	-	7.1 (50)
18 B	3.5	-	-	3.5 (100)
18 C	24.5	6.1 (25)	-	18.4 (75)
18 D	5.8	1.7 (30)	-	4.1 (70)
19 A	17.4	8.7 (50)	-	8.7 (50)
19 B	7.6	-	-	7.6 (100)
19 C	2.8	-	-	2.8 (100)
19 D	13.6	13.6 (100)	-	-
20 A	15.2	1.5 (10)	-	13.7 (90)
20 B	6.8	0.3 (5)	-	6.5 (95)
20 C	5.5	2.2 (40)	-	3.3 (60)
TOTAL :	305.1	97.7 (32)	4.5 (1)	203.9 (67)

**ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SG. BENDERA ESTATE - TANJONG BATU DIVISION**

IN SG. BENDERA ESTATE - BATU GAJAH DIVISION

	<u>Block</u>	<u>Total ha</u>	<u>Inanam family</u>	<u>Paliu family</u>	<u>Kumansi family</u>	<u>Tanjong Lipat family</u>
81D	21 A	9.4	0.9 (10)	-	8.5 (90)	-
	21 B	6.1	0.3 (5)	-	5.8 (95)	-
	21 C	9.6	-	-	9.6 (100)	-
	21 D	5.3	-	-	5.3 (100)	-
	21 E	8.9	-	4.5 (50)	4.4 (50)	-
	21 F	8.1	-	-	4.9 (60)	3.2 (40)
	21 G	10.8	-	1.1 (10)	-	9.7 (90)
	21 H	6.8	-	0.7 (10)	-	6.1 (90)
	21 I	3.3	-	-	1.7 (50)	1.6 (50)
	22 A	14.9	3.0 (20)	-	11.9 (80)	-
	22 B	16.9	-	-	-	16.9 (100)
	22 C	19.5	-	-	-	19.5 (100)
	22 D	16.2	-	-	-	16.2 (100)
	22 E	18.2	-	7.3 (40)	10.9 (60)	-
	22 F	17.2	-	5.2 (30)	1.7 (10)	10.3 (60)
	22 G	19.7	-	5.9 (30)	-	13.8 (70)
	22 H	16.7	-	1.7 (10)	3.3 (20)	11.7 (70)
	22 I	17.9	-	-	9.0 (50)	8.9 (50)
	23 A	18.9	7.6 (40)	-	11.3 (60)	-
	23 B	15.7	4.7 (30)	-	11.0 (70)	-
	23 C	14.9	3.7 (25)	-	11.2 (75)	-
	23 D	18.2	3.6 (20)	-	14.6 (80)	-
	23 E	21.0	-	8.4 (40)	12.6 (60)	-
	23 F	18.2	-	10.9 (60)	3.6 (20)	3.7 (20)
	23 G	18.9	-	13.2 (70)	3.8 (20)	1.9 (10)
	23 H	15.2	-	6.1 (40)	7.6 (50)	1.5 (10)
	23 I	17.7	-	5.3 (30)	12.4 (70)	-
	24 A	9.1	3.6 (40)	-	5.5 (60)	-
	24 B	13.4	5.4 (40)	-	8.0 (60)	-
	24 C	12.1	7.9 (65)	-	4.2 (35)	-
	24 D	12.4	6.2 (50)	-	6.2 (50)	-
	24 E	15.4	-	12.3 (80)	3.1 (20)	-
	24 F	14.4	-	9.4 (65)	5.0 (35)	-
	24 G	18.5	-	6.5 (35)	12.0 (65)	-
	24 H	12.6	-	5.0 (40)	7.6 (60)	-
	24 I	14.9	-	7.5 (50)	7.4 (50)	-
	TOTAL	507.0	46.9 (9)	110.0 (22)	224.1 (44)	125.0 (25)

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SG. BENDERA ESTATE - BATU GAJAH DIVISION

	Block	Total ha	Inanam family	Paliu family	Kumansi family	Dagat family	Tanjong Lipat family	Kapilit family
1E	29 A	16.4	3.3 (20)	-	13.1 (80)	-	-	-
	29 B	13.6	0.7 (5)	-	12.9 (95)	-	-	-
	29 C	13.2	2.6 (20)	-	10.6 (80)	-	-	-
	30 A	17.7	-	8.9 (50)	8.8 (50)	-	-	-
	30 B	19.5	4.9 (25)	-	14.6 (75)	-	-	-
	30 C	19.2	9.6 (50)	-	9.6 (50)	-	-	-
	31 A	14.4	-	1.4 (10)	13.0 (90)	-	-	-
	31 B	17.7	-	-	17.7 (100)	-	-	-
	32 A	18.2	3.6 (20)	-	12.8 (70)	1.8 (10)	-	-
	32 C	18.2	-	2.7 (15)	10.0 (55)	-	-	5.5 (30)
	33 A	14.9	6.0 (40)	-	8.9 (60)	-	-	-
	33 B	15.2	-	4.6 (30)	9.1 (60)	-	1.5 (10)	-
	33 C	15.7	-	3.1 (20)	2.4 (15)	-	5.5 (35)	4.7 (30)
	34 A	19.7	0.6 (3)	15.7 (80)	1.4 (7)	-	2.0 (10)	-
	34 B	17.7	-	13.3 (75)	1.8 (10)	-	2.6 (15)	-
	34 C	17.2	-	12.0 (70)	2.6 (15)	-	2.6 (15)	-
	35 A	14.2	-	7.1 (50)	2.8 (20)	-	4.3 (30)	-
	35 B	12.1	-	7.3 (60)	0.6 (5)	-	4.2 (35)	-
35 C	10.4	-	4.7 (45)	5.7 (55)	-	-	-	
82	28 A	8.1	7.3 (90)	-	0.8 (10)	-	-	-
	28 B	16.4	3.3 (20)	-	13.1 (80)	-	-	-
	28 C	14.4	1.4 (10)	-	13.0 (90)	-	-	-
	31 C	15.2	-	-	15.2 (100)	-	-	-
	32 B	20.7	-	-	16.6 (80)	4.1 (20)	-	-
	Planted swamp	7.1	7.1 (100)	-	-	-	-	-
TOTAL		387.1	50.4 (13)	80.8 (21)	217.1 (56)	5.9 (1)	22.7 (6)	10.2 (3)

Appendix IIB

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES IN SUNGAI KRETAM ESTATE

Block	Total (ha)	Inanam Family	Paliu Family	Kumansi Family	Dagat Family	Tanjong Lipat Family	Kapilit Family	
81	1	22.1	18.8 (85)	-	2.2 (10)	1.1 (5)	-	
	2	22.1	15.5 (70)	-	1.1 (5)	5.5 (25)	-	
	3	25.0	3.7 (15)	-	3.8 (15)	17.5 (70)	-	
	4	17.4	0.9 (5)	0.5 (3)	0.3 (2)	13.1 (75)	2.6 (15)	
	5	22.3	2.2 (10)	2.2 (10)	1.6 (7)	12.9 (58)	3.4 (15)	
	6	22.9	1.8 (8)	3.4 (15)	13.7 (60)	2.3 (10)	1.7 (7)	
	7	19.1	1.5 (8)	-	11.8 (62)	-	5.8 (30)	
	8	20.2	2.0 (10)	-	10.1 (50)	-	8.1 (40)	
	9	20.2	0.4 (2)	-	19.0 (94)	-	0.8 (4)	
82	1	29.7	25.2 (85)	-	4.5 (15)	-	-	
	2	18.9	10.4 (55)	-	8.5 (45)	-	-	
	3	30.2	15.1 (50)	1.5 (5)	13.6 (45)	-	-	
	4	30.3	13.6 (45)	13.6 (45)	-	-	3.1 (10)	
	5	29.1	11.6 (40)	5.8 (20)	4.4 (15)	-	7.3 (25)	
	6	30.1	16.6 (55)	7.5 (25)	6.0 (20)	-	-	
	7	29.5	22.1 (75)	4.4 (15)	3.0 (10)	-	2.3 (8)	
	8	29.4	11.2 (38)	2.1 (7)	13.8 (47)	-	4.7 (15)	
	9	31.1	-	3.1 (10)	23.3 (75)	-	1.5 (5)	
	10	29.4	-	7.3 (25)	20.6 (70)	-	-	
	11	29.3	-	11.7 (40)	17.6 (60)	-	-	
	12	29.6	-	14.8 (50)	14.8 (50)	-	-	
	13	38.5	3.9 (10)	25.0 (65)	7.7 (20)	1.9 (5)	-	
	14	43.3	6.5 (15)	10.8 (25)	21.7 (50)	4.3 (10)	-	
	15	41.3	-	24.8 (60)	16.5 (40)	-	-	
	16	39.4	9.8 (25)	9.9 (25)	11.8 (30)	7.9 (20)	-	
	17	38.2	6.9 (18)	1.9 (5)	22.5 (59)	1.9 (5)	1.6 (4)	
	18	31.1	3.7 (12)	0.9 (3)	17.4 (56)	2.6 (8)	6.5 (21)	
83	1, 1A	33.1	6.0 (18)	8.2 (25)	6.0 (18)	4.0 (12)	6.6 (20)	
	2, 2A	34.0	6.8 (20)	6.8 (20)	8.8 (26)	1.4 (4)	3.4 (10)	
	3, 3A	30.3	2.4 (8)	2.1 (7)	15.2 (50)	3.0 (10)	4.5 (15)	
	4, 4A	28.3	6.5 (23)	6.2 (22)	15.6 (55)	-	-	
	5	25.5	6.4 (25)	6.4 (25)	12.7 (50)	-	-	
	6	29.0	9.6 (33)	7.8 (27)	11.6 (40)	-	-	
	7	32.2	3.2 (10)	9.7 (30)	19.3 (60)	-	-	
	8	30.0	1.2 (4)	-	21.0 (70)	-	7.8 (26)	
	9	33.8	1.0 (3)	0.7 (2)	18.6 (55)	-	13.5 (40)	
	10	29.1	-	1.4 (5)	14.6 (50)	-	13.1 (45)	
84	1	31.9	-	16.0 (50)	15.9 (50)	-	-	
	2	35.0	1.7 (5)	24.5 (70)	8.8 (25)	-	-	
	3	29.8	-	-	26.8 (90)	-	3.0 (10)	
	4	32.1	-	-	25.7 (80)	-	6.4 (20)	
	5	29.7	-	0.6 (2)	23.2 (78)	-	5.9 (20)	
	6	40.9	4.1 (10)	26.6 (65)	8.2 (20)	2.0 (5)	-	
	7	46.7	11.7 (25)	4.7 (10)	25.7 (55)	4.6 (10)	-	
	8	38.5	14.6 (38)	-	10.4 (27)	13.5 (35)	-	
TOTAL:		1359.6	278.6 (20)	272.9 (20)	579.4 (43)	33.0 (3)	84.4 (6)	111.3 (8)

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SG. BENDERA ESTATE - TANJONG BATU DIVISION

	<u>Block</u>	<u>Total ha</u>	<u>Inanam family</u>	<u>Paliu family</u>	<u>Kumansi family</u>	<u>Tanjong Lipat family</u>
81D	21 A	9.4	0.9 (10)	-	8.5 (90)	-
	21 B	6.1	0.3 (5)	-	5.8 (95)	-
	21 C	9.6	-	-	9.6 (100)	-
	21 D	5.3	-	-	5.3 (100)	-
	21 E	8.9	-	4.5 (50)	4.4 (50)	-
	21 F	8.1	-	-	4.9 (60)	3.2 (40)
	21 G	10.8	-	1.1 (10)	-	9.7 (90)
	21 H	6.8	-	0.7 (10)	-	6.1 (90)
	21 I	3.3	-	-	1.7 (50)	1.6 (50)
	22 A	14.9	3.0 (20)	-	11.9 (80)	-
	22 B	16.9	-	-	-	16.9 (100)
	22 C	19.5	-	-	-	19.5 (100)
	22 D	16.2	-	-	-	16.2 (100)
	22 E	18.2	-	7.3 (40)	10.9 (60)	-
	22 F	17.2	-	5.2 (30)	1.7 (10)	10.3 (60)
	22 G	19.7	-	5.9 (30)	-	13.8 (70)
	22 H	16.7	-	1.7 (10)	3.3 (20)	11.7 (70)
	22 I	17.9	-	-	9.0 (50)	8.9 (50)
	23 A	18.9	7.6 (40)	-	11.3 (60)	-
	23 B	15.7	4.7 (30)	-	11.0 (70)	-
	23 C	14.9	3.7 (25)	-	11.2 (75)	-
	23 D	18.2	3.6 (20)	-	14.6 (80)	-
	23 E	21.0	-	8.4 (40)	12.6 (60)	-
	23 F	18.2	-	10.9 (60)	3.6 (20)	3.7 (20)
	23 G	18.9	-	13.2 (70)	3.8 (20)	1.9 (10)
	23 H	15.2	-	6.1 (40)	7.6 (50)	1.5 (10)
	23 I	17.7	-	5.3 (30)	12.4 (70)	-
	24 A	9.1	3.6 (40)	-	5.5 (60)	-
	24 B	13.4	5.4 (40)	-	8.0 (60)	-
24 C	12.1	7.9 (65)	-	4.2 (35)	-	
24 D	12.4	6.2 (50)	-	6.2 (50)	-	
24 E	15.4	-	12.3 (80)	3.1 (20)	-	
24 F	14.4	-	9.4 (65)	5.0 (35)	-	
24 G	18.5	-	6.5 (35)	12.0 (65)	-	
24 H	12.6	-	5.0 (40)	7.6 (60)	-	
24 I	14.9	-	7.5 (50)	7.4 (50)	-	
	TOTAL	507.0 (100)	46.9 (9)	110.0 (22)	224.1 (44)	125.0 (25)

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SG. PAKIS ESTATE

Block	Total ha	Inanam family	Paliu family	Kumansi family	Dagat family	Tanjong Lipat family	Kapilit family	Sipit family
82	1	-	0.2 (2)	11.2 (98)	-	-	-	-
	2	-	0.4 (5)	7.2 (95)	-	-	-	-
	3	-	1.5 (10)	13.2 (90)	-	-	-	-
	4	-	2.5 (15)	9.2 (55)	-	5.0 (30)	-	-
	5	-	7.6 (25)	9.2 (30)	-	13.8 (45)	-	-
	6	-	2.2 (10)	19.5 (90)	-	4.0 (15)	-	-
	7	-	2.6 (10)	20.0 (75)	-	-	-	-
	8	-	1.6 (15)	9.2 (85)	-	-	-	-
	9	-	0.4 (2)	16.9 (85)	-	1.0 (5)	-	-
	10	1.6 (8)	1.2 (5)	21.9 (90)	-	1.2 (5)	-	-
	11	-	1.4 (15)	7.6 (85)	-	-	-	-
	12	-	1.6 (15)	9.2 (85)	-	-	-	-
83	A	20.8	1.0 (5)	15.6 (75)	-	4.2 (20)	-	-
	B	25.0	1.3 (5)	20.0 (80)	-	3.9 (15)	-	-
	C	12.7	1.3 (10)	7.6 (60)	-	3.8 (30)	-	-
	D1	8.1	-	4.9 (60)	-	3.2 (40)	-	-
	D2	6.9	0.7 (10)	6.2 (90)	-	-	-	-
	D3	1.5	-	1.5 (100)	-	-	-	-
	E1	8.0	-	4.4 (55)	-	3.6 (45)	-	-
	E2	9.1	0.9 (10)	8.2 (90)	-	-	-	-
	E3	4.4	0.4 (10)	4.0 (90)	-	-	-	-
	F1	9.3	2.3 (25)	7.0 (75)	-	-	-	-
	F2	12.3	2.5 (20)	9.8 (80)	-	-	-	-
	F3	14.2	3.6 (25)	10.6 (75)	-	-	-	-
G1	11.5	1.2 (10)	10.3 (90)	-	-	-	-	
G2	7.0	2.5 (35)	4.5 (65)	-	-	-	-	
G3	8.7	4.8 (55)	3.9 (45)	-	-	-	-	
84A	8 A	9.8	1.5 (15)	8.3 (85)	-	-	-	-
	8 B	9.6	6.2 (65)	3.4 (35)	-	-	-	-
	8 C	10.6	9.0 (85)	1.6 (15)	-	-	-	-
	9 A	12.3	4.9 (40)	2.5 (20)	-	-	-	4.9 (40)

SOIL FAMILIES - SG. PAKIS ESTATE

Block	Total ha	Inanam family	Paliu family	Kumansi family	Dagat family	Tanjong Lipat family	Kapilit family	Sipit family
9 B	20.0	-	-	6.0 (30)	-	-	-	14.0 (70)
10 A	10.5	7.4 (70)	-	1.0 (10)	-	-	-	2.1 (20)
10 B	16.8	0.8 (5)	-	12.6 (75)	-	1.7 (10)	-	1.7 (10)
11 A	10.6	5.8 (55)	-	4.8 (45)	-	-	-	-
11 B	24.4	1.2 (5)	-	15.9 (65)	-	7.3 (30)	-	-
12 A	12.4	3.1 (25)	-	8.7 (70)	0.6 (5)	-	-	-
12 B	12.8	-	-	12.2 (95)	0.6 (5)	-	-	-
13 A	10.9	-	-	10.4 (95)	0.5 (5)	-	-	-
13 B	17.2	-	-	12.0 (70)	0.9 (5)	4.3 (25)	-	-
14 A	14.3	0.3 (2)	3.3 (23)	10.7 (75)	-	-	-	-
14 B	20.0	-	-	12.0 (60)	-	8.0 (40)	-	-
15 A	12.9	-	6.5 (50)	6.4 (50)	-	-	-	-
15 B	25.7	-	5.1 (20)	11.6 (45)	-	9.0 (35)	-	-
84B								
1 A	10.2	8.7 (85)	-	1.5 (15)	-	-	-	-
1 B	10.7	9.6 (90)	-	1.1 (10)	-	-	-	-
1 C	8.6	6.9 (80)	-	1.7 (20)	-	-	-	-
2 A	8.5	7.2 (85)	-	1.3 (15)	-	-	0.5 (5)	-
2 B	10.0	7.0 (70)	-	2.5 (25)	-	-	0.2 (2)	-
2 C	12.4	9.1 (73)	-	3.1 (25)	-	-	-	-
3 A	9.3	3.7 (40)	-	5.6 (60)	-	-	-	-
3 B	10.6	6.9 (65)	-	1.1 (10)	-	-	2.6 (25)	-
3 C	10.5	7.4 (70)	-	1.0 (10)	-	-	2.1 (20)	-
4 A	9.9	7.9 (80)	-	2.0 (20)	-	-	-	-
4 B	10.7	0.7 (7)	-	4.3 (40)	-	-	5.7 (53)	-
4 C	11.1	-	-	2.8 (25)	-	-	8.3 (75)	-
5 A	10.4	4.2 (40)	-	6.2 (60)	-	-	-	-
5 B	11.7	-	0.2 (2)	8.6 (73)	-	-	2.9 (25)	-
5 C	11.7	-	0.6 (5)	1.2 (10)	-	-	9.9 (85)	-
6 A	7.8	-	0.5 (7)	7.3 (93)	-	-	-	-
6 B	7.5	-	3.8 (50)	3.7 (50)	-	-	-	-
6 C	9.4	-	1.2 (13)	0.2 (2)	-	-	8.0 (85)	-

ESTIMATED RECTARAGE (S) OF THE VARIOUS SOIL FAMILIES IN SG. DATU ESTATE

SOIL FAMILIES - SG. PAKIS ESTATE

Block	Total ha	Inanam family	Paliu family	Kumansi family	Dagat family	Tanjong Lipat family	Kapilit family	Sipit family
7 A	13.5	-	6.8 (50)	6.7 (50)	-	-	-	-
7 B	14.7	-	7.4 (50)	7.3 (50)	-	-	-	-
7 C	16.7	-	10.9 (65)	0.3 (2)	-	-	5.5 (33)	-
TOTAL:	840.3 (100)	104.4 (12)	108.7 (13)	482.4 (57)	2.6 (1)	73.8 (9)	45.7 (5)	22.7 (3)

	Paliu family	Kumansi family	Tanjong Lipat family	Kapilit family
	0.8 (17)	3.8 (80)	-	0.2 (3)
	1.6 (35)	7.1 (65)	-	-
	5.3 (38)	9.7 (65)	-	-
	-	21.2 (100)	-	-
	1.7 (10)	14.9 (90)	-	-
	4.9 (25)	16.3 (75)	-	-
	12.7 (50)	12.1 (48)	0.5 (2)	-
	8.2 (30)	17.7 (65)	-	1.4 (5)
	7.2 (50)	3.8 (25)	1.8 (25)	-
	7.8 (80)	0.3 (10)	-	-
	9.4 (45)	6.5 (55)	-	-
	1.7 (10)	11.3 (85)	-	4.2 (25)
	-	11.5 (100)	-	-
	0.6 (6)	12.3 (95)	-	-
	6.6 (80)	1.8 (15)	0.6 (5)	-
	2.0 (20)	1.6 (15)	6.8 (65)	-
	-	2.6 (20)	7.7 (50)	2.5 (26)
	8.0 (28)	25.0 (65)	-	6.0 (18)
	4.3 (16)	35.1 (85)	-	2.1 (5)
	4.8 (15)	20.2 (70)	-	-
	17.8 (53)	8.5 (20)	-	1.6 (6)
	15.2 (45)	17.8 (53)	-	-
	20.1 (50)	16.8 (40)	-	4.0 (10)
	-	8.6 (100)	-	-
	3.0 (19)	12.1 (60)	5.1 (25)	-
	9.9 (35)	3.8 (15)	12.8 (50)	-
	20.4 (60)	1.0 (3)	12.5 (37)	-
	12.4 (38)	3.3 (18)	16.4 (50)	0.6 (2)
	1.1 (10)	9.6 (28)	13.0 (40)	6.5 (20)
	7.4 (20)	14.8 (40)	7.4 (20)	7.4 (20)
	13.8 (53)	7.4 (25)	0.6 (2)	0.6 (2)
	3.8 (10)	23.1 (65)	8.7 (25)	-

Appendix IID

ESTIMATED HECTARAGE (%) OF THE VARIOUS SOIL FAMILIES
IN SG. BATU ESTATE

	<u>Block</u>	<u>Total ha</u>	<u>Inanam family</u>	<u>Paliu family</u>	<u>Kumansi family</u>	<u>Tanjong Lipat family</u>	<u>Kapilit family</u>
83A	1	4.8	-	0.8 (17)	3.8 (80)	-	0.2 (3)
	2	10.9	-	3.8 (35)	7.1 (65)	-	-
	3	15.0	-	5.3 (35)	9.7 (65)	-	-
	4	21.2	-	-	21.2 (100)	-	-
	5	16.6	-	1.7 (10)	14.9 (90)	-	-
	6	19.7	-	4.9 (25)	14.8 (75)	-	-
	7	25.3	-	12.7 (50)	12.1 (48)	0.5 (2)	-
	8	27.3	-	8.2 (30)	17.7 (65)	-	1.4 (5)
83B	1	14.4	-	7.2 (50)	3.6 (25)	3.6 (25)	-
	2	8.7	-	7.8 (90)	0.9 (10)	-	-
	3	11.9	-	5.4 (45)	6.5 (55)	-	-
	4	17.0	-	1.7 (10)	11.1 (65)	-	4.2 (25)
	5	11.5	-	-	11.5 (100)	-	-
	6	12.9	-	0.6 (5)	12.3 (95)	-	-
	7	12.0	-	9.6 (80)	1.8 (15)	0.6 (5)	-
	8	10.2	-	2.0 (20)	1.6 (15)	6.6 (65)	-
	9	12.8	-	-	2.6 (20)	7.7 (60)	2.5 (20)
84A	1	40.0	-	8.0 (20)	26.0 (65)	-	6.0 (15)
	2	41.3	-	4.1 (10)	35.1 (85)	-	2.1 (5)
	3	28.8	4.3 (15)	4.3 (15)	20.2 (70)	-	-
	4	32.4	6.5 (20)	17.8 (55)	6.5 (20)	-	1.6 (5)
	5	33.7	0.7 (2)	15.2 (45)	17.8 (53)	-	-
	6	40.1	-	20.1 (50)	16.0 (40)	-	4.0 (10)
84B	1	6.6	-	-	6.6 (100)	-	-
	2	20.2	-	3.0 (15)	12.1 (60)	5.1 (25)	-
	3	25.6	-	9.0 (35)	3.8 (15)	12.8 (50)	-
	4	33.9	-	20.4 (60)	1.0 (3)	12.5 (37)	-
	5	32.7	-	12.4 (38)	3.3 (10)	16.4 (50)	0.6 (2)
	6	32.6	-	3.3 (10)	9.8 (30)	13.0 (40)	6.5 (20)
	7	37.0	7.4 (20)	-	14.8 (40)	7.4 (20)	7.4 (20)
	8	29.8	15.8 (53)	5.4 (18)	7.4 (25)	0.6 (2)	0.6 (2)
	9	35.6	3.6 (10)	23.1 (65)	8.9 (25)	-	-

SOIL FAMILIES IN SG. BATU ESTATE

1 - Sungai Batu Estate - NP843/DK4

Soil names: PALIU family

Landform: Alluvial plain

Block	Total ha	Inanam family	Paliu family	Kumansi family	Tanjong Lipat family	Kapilit family
84C 1	31.0	-	1.5 (5)	29.5 (95)	-	-
2	10.3	-	-	10.3 (100)	-	-
3	12.2	-	-	12.2 (100)	-	-
TOTAL: 776.0 (100)		38.3 (5)	219.3 (28)	394.5 (5)	86.8 (11)	37.1 (5)

Parent material: Sub-recent alluvium

Profile Description

A ₀	0-2 cm	Dark brown 10YR 3/3; loam; strong, fine and medium subangular blocky and few crumb structures; friable consistency; many fine and coarse roots (1-15 mm diameter); common fine and coarse pores; clear wavy boundary
B ₁₋₂	2-95 cm	Dark yellowish brown 10YR 4/4; loam; moderately strong; very coarse subangular blocky breaking into medium and coarse subangular blocky structures; friable; many fine and medium (1-5 mm) and few large roots; many fine and coarse pores; micro-bio activities on ped surfaces; clear straight boundary
B ₂₁	40-75 cm	Dark yellowish brown 10YR 4/4; clay loam; moderately strong, very coarse and coarse subangular blocky structures; slightly compact in place, slight firm consistency; common medium (1-5 mm) roots; few fine and coarse pores; with micro-bio activities on ped surfaces and along channels; gradual straight boundary

Appendix IIIA

Soil Profile No: 1 - Sungei Batu Estate - NP84B/Bk4
Soil name: PALIU family
Landform: Alluvial plain
Physiography at site: Nearly flat with deeply incised streams
Slope at site: < 1°
Soil drainage: Well-drained
Soil erosion: Slightly eroded
Effective soil depth: > 120 cm
Parent material: Sub-recent alluvium

Profile Description

A _h	0-2 cm	Dark brown 10YR 3/3; loam; strong, fine and medium subangular blocky and few crumb structures; friable consistency; many fine and coarse roots (1-15 mm diameter); common fine and coarse pores; clear wavy boundary
B ₁ -B ₂	2-40 cm	Dark yellowish brown 10YR 4/4; loam; moderately strong, very coarse subangular blocky breaking into medium and coarse subangular blocky structures; friable; many fine and medium (1-5 mm) and few large roots; many fine and coarse pores; micro-bio activities on ped surfaces; clear straight boundary
B ₂₁	40-75 cm	Dark yellowish brown 10YR 4/4; clay loam; moderately strong, very coarse and coarse subangular blocky structures; slightly compact in place, slight firm consistency; common medium (1-5 mm) roots; few fine and coarse pores; with micro-bio activities on ped surfaces and along channels; gradual straight boundary

Soil Profile: Pallo I
 Site No: I
 Field No: NP 842/20.4
 Corridor: 8g. bktu
 Division:

- B22** 75-120 cm Dark yellowish brown 10YR 4/4-4/6; clay loam; moderately strong, very coarse and coarse angular and subangular blocky structures; slightly compact in place, firm consistency; very few fine roots; very few fine pores; clear straight boundary
- B3** 120 cm + Brown to dark brown 7.5YR 4/4 (75%) and pinkish grey 7.5YR 7/2 (25%); clay loam; moderate, very coarse angular and subangular blocky structures; slightly firm to slightly plastic consistency; rare roots; very few fine pores; with less than 2% dark reddish brown 5YR 3/2 manganese stains.

Depth (cm)	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-2	A1	11.52	25.30	43.35	3.44
2-48	B1-B2	20.20	40.70	25.35	1.69
40-75	B21	27.68	37.48	31.30	1.54
75-120	B22	38.32	37.66	18.24	0.39

Loss on ignition	100
% base	50
	27
	4

Depth (cm)	pH (alc-dry)	Organic Carbon (%)	N (%)	C/N ratio	K (%)	
					H ₂ O	Ycl
0-2	6.2	1.75	0.36	10	1.67	0.10
2-40	4.9	1.05	0.17	6	0.33	2.47
40-75	4.9	0.51	0.12	1	0.31	2.40
75-120	4.9	0.21	0.08	3	0.33	0.31

SOIL ANALYTICAL RESULTS

Estate: Sg. Batu

Site No: 1

Soil family: Paliu

Division: _____

Field No: NP 84B/Bk. 4

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-2	Ah	13.52	35.30	43.75	3.44
2-40	B1-B2	20.20	40.70	35.35	1.49
40-75	B21	27.68	37.48	31.50	1.51
75-120	B22	38.22	37.66	18.24	0.39

Depth in cm	Cation Exchange Capacity %	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			Exch. Mn	ppm		Loss on ignition		% Base saturation	Conductivity
		H ₂ O	KCl				K	Mg	Ca		Av. P	Boron	Total S	Sol. SO ₄		
0-2	24	6.2		3.75	0.36	10	1.67	6.40	18.71		17			108		
2-40	18	4.9		1.05	0.17	6	0.33	2.47	6.07		9			50		
40-75	19	4.9		0.51	0.12	4	0.31	2.40	1.56		9			23		
75-120	22	4.9		0.21	0.08	3	0.33	0.51	0.07		9			4		

Appendix IIIB

Soil profile No. 6 - Sg. Kretam Estate - 83NP/Bk.4
Soil name: PALIU family (tentative)
Landform: Alluvial plain
Physiography at site: Flat (raised) with deeply incised streams
Slope at site: < 1°
Soil drainage: Moderately well-drained
Soil erosion: Slightly eroded
Effective soil depth: 90 cm
Parent material: Sub-recent alluvium

Profile Description

90-125 cm Light
Ah 0-3 cm Dark brown 10YR 3/3; loam; moderately strong, fine and medium subangular blocky and crumb structures; structures are attached to roots; slightly hard; abundant fine to coarse (1-15 mm) roots; many fine and medium pores; clear straight boundary
B₁ 3-25 cm Light olive brown 2.5Y 5/6; loam; moderate, very coarse and coarse subangular and angular blocky structures; slightly firm; many fine to coarse (1-10 mm) roots; many fine and coarse pores; many micro-bio activities; patchy weakly developed yellowish brown 10YR 5/4 organic acid coatings on some ped surfaces; clear straight boundary.

Soil family: Palau
 Site no: 6
 Field no: 83 SP/2004

- B₂** 25-75 cm Light olive brown 2.5Y 5/6; clay loam; moderately strong, coarse and some medium subangular blocky structures; friable to slightly firm; few fine and medium (1-5 mm) roots; many fine pores; few micro-bio activities; discontinuous cutans on ped surfaces; clear straight boundary.
- B₃** 75-90 cm Light grey 5Y 7/2 (45%), yellowish brown 10YR 5/6 (45%) and strong brown 7.5YR 5/8 (10%); clay loam; moderately weak, very coarse and coarse angular blocky structures; slightly plastic; very few roots; very few fine pores; clear straight boundary.
- Cg** 90-125 cm Light grey 5Y 7/1 (70%), yellowish brown 10YR 5/8 and yellowish red 5YR 5/8 (30%); silty clay loam; massive and structureless; plastic.

Division: 88. Kretan

Depth (cm)	Moisture (%)	Clay (%)	SS (%)	Silt (%)	Field Moisture (%)	Chemical Soil (g)
0-2	4p	14.74	38.34	38.94	3.68	
3-25	B1	19.24	41.88	37.70	0.68	
25-75	B2	29.00	32.42	31.00	2.60	

Depth (cm)	CaCO ₃ (%)	Ca (%)	Mg (%)	K (%)	N (%)	P (%)	C/N ratio
0-2	21	5.8	6.43	9	0.56		
3-25	12	4.7	6.16	5	0.38		
25-75	17	4.9	6.08	7	0.36		

SOIL ANALYTICAL RESULTS

Estate: **Sg. Kretam**

Site No: **6**

Soil family: **Palju**

Field No: **83 NP/Bk.4**

Division: _____

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)	pH (air-dry)		Cation Exchange Capacity %	Exch. cation (m.e.q. %)			C/N ratio	plant			Loss on ignition	% Base saturation	Conduc-tivity
						H ₂ O	KCl		K	Mg	Ca		Exch. Mn	AV. P	Boron			
0-3	Ah	14.74	38.54	38.94	3.68		5.8		0.56	3.31	9.01	9	15			60		
3-25	B1	19.24	41.88	37.70	0.68		4.7		0.38	0.60	0.96	5	8			16		
25-75	B2	29.00	32.42	31.00	2.65		4.9		0.56	0.86	0.08	7	10			9		

Appendix IIIC

Soil profile No. 24 - Sg. Bendera Estate
Batu Gajah Division - 81 E/34A

Soil name: PALIU family

Landform: Alluvial plain

Physiography at site: Flat (raised); with deeply incised
streams.

Slope at site: $< 1^{\circ}$

Soil drainage: Well-drained

Soil erosion: Slight

Effective soil depth: 120 cm

Parent material: Sub-recent alluvium

Profile Description

A_h 0-6 cm Brown to dark brown 10YR 4/3-3/3;
loam; moderately strong, fine subangular
blocky and crumb structures; friable;
many fine and coarse (1-10 mm) roots;
many medium and coarse pores; clear
boundary.

B₂ 6-70 cm Dark yellowish brown 10YR 4/4; clay
loam; moderate, coarse subangular
blocky breaking into moderately strong,
medium and some coarse subangular
blocky structures; friable; many coarse
and very coarse (2-50 mm) roots; many
fine and medium pores; many organic
acid and micro-bio activities; many
cutans; gradual boundary.

B₃ 70-120 cm Strong brown 7.5YR 5/6; clay; moderate,
coarse subangular blocky structures;
friable; few fine roots; few medium
pores; with strong brown 7.5YR 4/6
cutans; gradual boundary.

Soil family: Yellow

Site No: 24

Station: 56. Bendera

Field No: 82 E/74A

Location: Batu Gajah

BC

120 cm +

Variegated strong brown 7.5YR 5/6;
 dark yellowish brown 10YR 4/4 and light
 grey 10YR 7/2; clay; moderately weak,
 coarse subangular blocky structures;
 friable; slightly compact in place;
 no roots; very few fine pores; few
 manganese fine concretion.

Depth in cm	Horizon	Clay (%)	silt (%)	Org Matter (%)	Coarse sand (%)
0-6	B ₀	10.28	37.82	25.67	11.42
6-70	B ₂	16.22	38.90	21.30	1.50

Depth in cm	pH	Organic carbon (%)		C/N ratio	Exch. cations (meq/100g)			Total P
		H ₂ O sol	NaOH sol		K	Ca	Mg	
0-6	4.9	4.60	0.50	10	0.45	0.17	22.68	25
6-70	4.9	0.40	0.16	4	0.26	2.17	0.07	9

Appendix IIID

Soil profile No. 3 - Sg. Batu Estate - NP84A/Bk.4
Soil name: INANAM family
Landform: Alluvial plain
Physiography at site: Flat
Slope at site: < 1°
Soil drainage: Imperfectly drained
Soil erosion: Slightly eroded
Effective soil depth: 80 cm
Parent material: Recent alluvium

Profile Description

A_h 0-4 cm Dark greyish brown 10YR 4/2; loam; moderately strong, fine and medium subangular blocky structures; friable consistency; abundant fine and medium (1-5 mm) and few very coarse roots; few medium pores (1-2 mm); clear straight boundary.

B₁ 4-15 cm Yellowish brown to light yellowish brown 10YR 5/4-6/4; loam; moderate, coarse subangular blocky structures; friable consistency; abundant fine and coarse (1-30 mm) roots; many fine and coarse pores; very patchy pockets of organic acid coatings along root channels; gradual boundary.

- B₂ 15-40 cm Light grey 5Y 7/2 (70%), yellowish brown 10YR 5/6-5/8 (30%); clay loam; moderate, coarse and some medium subangular blocky structures; friable consistency; many medium (5-10 mm) roots; many fine (<1 mm) pores; very few micro-bio activities; gradual straight boundary
- BC 40-65 cm Light grey 5Y 7/1; clay loam; moderate, coarse and medium subangular blocky structures; friable consistency; few fine to coarse (1-10 mm) roots; many fine pores; very few micro-bio activities; with 15% prominent dark brown 7.5YR 5/4 mottles; clear straight boundary.
- BC_g 65-80 cm Light grey 5Y 7/1; clay loam; moderately weak, very coarse and coarse angular blocky structures; slightly plastic consistency; rare roots; rare pores; with 20% prominent strong brown 7.5YR 5/8 mottles; gradual straight boundary
- C_g 80-130 cm Light grey 5Y 7/1 (50%), dark yellowish brown 10YR 4/6 (50%); clay loam; weak to structureless; slightly plastic; rare roots; rare pores.

Estate: Sg. Batu

Site No: 3

Soil family: Inanam

Division: -

Field No: NP 84A/Bk. 4

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-4	Ah	11.52	38.00	39.64	4.34
4-15	B1	21.08	37.70	39.18	1.66
15-40	B2	28.58	30.56	39.41	1.29
40-65	BC	30.04	22.90	39.31	3.13

Depth in cm	Cation exchange capacity (%)	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			Exch. Mn	Av. P	Boron	Total S (%)		Loss on ignition	% Base saturation	Conductivity
		H ₂ O	KCl				K	Mg	Ca				S	Sol. SO ₄			
0-4	22	5.1		3.15	0.41	8	0.64	4.91	4.99	12					48		
4-15	15	4.8		1.06	0.19	6	0.38	1.23	0.13	11					12		
15-40	13	5.2		0.27	0.09	3	0.26	1.17	0.01	9					11		
40-65	14	5.4		0.19	0.07	3	0.26	1.60	0.02	11					13		

Appendix III E

Soil profile No.	7 - Sg. Kretam Estate - 82NP/Bk.5
Soil name:	INANAM family
Landform:	Alluvial plain
Physiography at site:	Flat
Slope at site:	< 1°
Soil drainage:	Imperfectly drained
Soil erosion:	Slightly eroded
Effective soil depth:	55 cm
Parent material:	Recent alluvium

Profile Description

A _h	0-7 cm	Dark yellowish brown 10YR 3/4; loam; moderate, medium and fine subangular blocky structures; friable; abundant fine and medium (1-5 mm) roots; clear straight boundary.
B ₁	7-25 cm	Yellowish brown 10YR 5/4; silty clay loam; moderately strong, very coarse and coarse subangular blocky structures; slightly firm; many fine and coarse (1-10 mm) roots; many fine and medium pores; many micro-bio activities; patchy brown 10YR 4/3 organic acid coatings on ped surfaces; clear smooth boundary
B ₂ -B ₃	25-55 cm	Light brownish grey 2.5Y 6/2; clay; moderate, very coarse prismatic structures; firm to slightly plastic; very few roots; very few fine pores; organic acid coating along root channels only; gradual smooth boundary

Field No. 55.87/26.3

Cg 55-125 cm Light grey 5Y 7/1 (60%), yellowish red 5YR 5/8 (40%); silty clay; massive and structureless; very few roots.

Depth in cm	Horizon	Clay (%)	Silt (%)	Field moisture (%)	Field moisture (g)
0-7	A ₁	20.44	49.30	28.25	12.18
7-25	B ₁	28.24	49.86	16.93	0.62
25-55	B ₂ -B ₃	42.72	30.42	3.20	3.55

Depth in cm	Horizon	pH		Capillary suction (atm)	Cation exchange (meq/100g)	Exch. cations (meq/100g)			Beam		Total C
		in water	in CaCl ₂			K	Na	Ca	Exch. Mn	P	
0-7	B ₁	5.6	5.6	4.13	0.30	1.02	4.00	21.09	24		37
7-25	B ₂	5.0	5.0	1.10	0.23	0.31	3.08	4.87	16		33
25-55	B ₃	5.0	5.0	0.29	0.12	0.30	3.53	1.58	18		31

SOIL ANALYTICAL RESULTS

Estate: Sg. Kretam
 Division: _____

Site No: 7
 Field No: 82 NP/Bk.5

Soil family: Inanam

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			ppm			Loss on Ignition	% Base Saturation	Conductivity
						H ₂ O	KCl				K	Mg	Ca	Exch. Mn	Av. P	Boron			
0-7	Ah	20.44	40.30	22.25	12.14		5.8	4.13	0.50	8	1.02	4.00	11.09	29			57		
7-25	B1	28.94	49.84	16.93	0.62		5.0	1.10	0.23	5	0.51	3.08	4.87	16			35		
25-55	B2-B3	49.72	38.42	5.20	3.65		5.0	0.29	0.12	2	0.38	3.43	1.58	18			21		

Appendix IIIF

Soil profile No. 2 - Sg. Batu Estate - NP83B/Bk.5
Soil name: Brown KUMANSI family
Landform: Rolling
Physiography at site: Upper slope
Slope at site: 7°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 140 cm
Parent material: Argillaceous shale

Profile Description

Cu 140 cm Somewhat continuous layer of brownish shale.
Ah 0-1 cm Dark brown 10YR 3/3; fine sandy loam; moderate, fine and medium subangular and few crumb structures; friable consistency; many fine (1-2 mm) roots; many fine and medium pores; clear straight boundary.
B21 1-30 cm Brownish yellow 10YR 6/6; clay loam; moderately strong, very coarse and coarse subangular blocky structures; slightly firm consistency; many fine and medium (1-5 mm) roots; many fine and medium pores; few micro-bio activities on ped surfaces and along channels; weakly developed yellowish brown 10YR 5/4 organic acid coating on ped surfaces; gradual straight boundary.

Station: 55, Date: _____
 Location: _____
 Site No.: 2
 Field No.: NP 628/MK.5
 Soil Family: Kurost
 Order: _____
 Suborder: _____
 Superorder: _____
 Class: _____
 Subclass: _____
 Order: _____
 Suborder: _____
 Superorder: _____
 Class: _____
 Subclass: _____

B22	30-85 cm	Brownish yellow 10YR 6/8; clay; strong, coarse subangular blocky structures; friable to slightly firm consistency; few fine and medium (1-5 mm) roots; very few fine pores; very few micro-bio activities; many moderately developed cutans on ped surfaces; with about 15% faint strong brown 7.5YR 5/8 mottles (< 5 mm); clear straight boundary.
B3cn	85-140 cm	Strong brown 7.5YR 5/8; clay; moderate, coarse subangular blocky structures; friable consistency; rare roots; very few fine pores; about 5% gravels of laterised shale (5-40 mm); tongue boundary.
Cu	140 cm	Somewhat continuous layer of bedrock-shale.

Depth (cm)	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)	OM (%)	N (%)	C/N	OM/Clay	OM/Silt	OM/Sand
0-1	Ah	14.26	29.22	39.55	10.42	0.8	0.12	13	0.02	0.03	0.04
1-20	B21	25.70	22.68	24.69	1.17	0.8	0.10	5	0.02	0.03	0.04
30-85	B22	43.78	22.96	27.17	1.17	0.8	0.09	3	0.02	0.03	0.04

Appendix III G

Soil profile No. 5 - Sg. Kretam Estate - 84NP/Bk.5
Soil name: KUMANSI family
Landform: Steep
Physiography at site: Mid-slope
Slope at site: 16°
Soil drainage: Moderately well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 120 cm
Parent material: Mudstone

Profile Description

C 120-150 cm A variegated layer of decomposing mudstone with about 10% undecomposed mudstones.

A_h 0-2 cm Brown to dark brown 10YR 4/3-3/3; fine sandy loam; strong, fine and medium subangular blocky and crumb structures; many structures attached to roots; slightly hard consistency; many fine and medium roots and organic debris; many fine and medium pores; clear straight boundary.

B₁ 2-30 cm Yellowish brown 10YR 5/6 to light olive brown 2.5Y 5/6; clay loam; moderately strong, very coarse and coarse and some medium subangular blocky structures; slightly compact in place, firm consistency; many fine to coarse (1-20 mm) roots; many fine pores; common micro-bio activities; weakly developed yellowish brown 10YR 5/4 organic acid coatings on ped surfaces; about 20% gravels and stones; clear straight boundary.

- Site No: 5
Field No: B1/B2/B3-5
- Location: Eg. Kretan
- Division:
- B₂ 30-90 cm Yellowish brown 10YR 5/6; clay; strong, very coarse subangular blocky breaking into strong, coarse subangular blocky structures; compact in place, firm consistency; common fine and medium (1-5 mm) roots; many fine pores; very few micro-bio activities; less than 2% gravels; gradual straight boundary
- B₃ 90-120 cm Light olive brown 2.5Y 5/6; clay; moderate, very coarse and coarse subangular and angular blocky structures; compact in place, firm consistency; few fine roots; few fine pores; clear straight boundary.
- C 120-160 cm A variegated layer of decomposing mudstone with about 10% undecomposed mudstones.

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-2	Ah	18.82	27.00	41.74	7.89
2-30	B ₁	34.02	30.09	31.36	3.48
30-90	B ₂	40.04	31.04	19.77	6.00

Depth in cm	Horizon	pH	Organic substance (%)	N (%)	C/N ratio
0-2	22	3.5	4.65	0.88	13
2-30	16	4.9	0.43	0.12	4
30-90	17	5.0	0.23	0.10	3

SOIL ANALYTICAL RESULTS

Estate: Sg. Kretam Site No: 5 Soil family: Kumansi
 Division: _____ Field No: 84 NP/Bk.5

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-2	Ah	18.82	27.00	41.78	7.89
2-30	B1	34.02	30.00	31.36	3.48
30-90	B2	40.04	31.04	19.77	6.00

Depth in cm	Cation Exchange Capacity %	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			ppm			Loss on ignition	% Base Saturation	Conduc
		H ₂ O	KCl				K	Mg	Ca	Exch. Mn	Av. P	Boron			
0-2	22	5.5		4.65	0.42	11	0.77	3.66	5.36	17			45		
2-30	16	4.9		0.43	0.12	4	0.51	1.44	0.03	7			12		
30-90	17	5.0		0.29	0.10	3	0.28	2.17	0.02	10			15		

Appendix IIIH

Soil profile No. 12 - Sg. Pakis Estate - 84 NP/Bk.14
Soil name: KUMANSI family
Landform: Rolling
Physiography at site: Mid-gentle slope
Slope at site: 7°
Soil drainage: Well-drained
Soil erosion: Moderate sheet erosion
Effective soil depth: 55 cm
Parent material: Mudstone

Profile Description

A _h	0-5 cm	Brown 10YR 4/3 to dark yellowish brown 10YR 4/4; sandy loam; moderate, medium and fine subangular blocky structures; friable; many fine and medium (1-5 mm) roots; few coarse pores; clear boundary.
B ₂₁	5-20 cm	Strong brown 7.5YR 5/6; clay loam; moderately strong, coarse and some medium subangular blocky structures; friable; many fine and medium (1-5 mm) roots; many fine and coarse (1-3 mm) pores; patchy organic acid coatings; some micro-bio activities; clear boundary.
B _{2cn}	20-55 cm	Strong brown 7.5YR 5/6; clay; moderately strong, coarse subangular blocky structures; friable; few coarse (5 mm) roots; very patchy cutans; about 10% stony mudstones; distinct boundary.
CR	55-130 cm	A continuous layer of somewhat fragmented mudstones.

Estate: **Sg. Pakis**

Site No: **12**

Soil family: **Kumanel**

Division: _____

Field No: _____

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			ppm			Loss on ignition	% Base saturation	Conduc-
						H ₂ O	KCl				K	Mg	Ca	Exch. Mn	Av. P	Boron			
0-5	Ah	17.02	25.52	43.18	9.64		5.1	1.90	0.24	8	0.59	1.83	7.07	12			44		
5-20	B2	32.40	25.36	34.40	3.93		4.7	0.64	0.12	5	0.38	0.88	1.31	8			12		
20-55	B2cn	45.20	22.58	19.69	3.53		4.9	0.36	0.10	4	0.38	0.99	0.06	10			6		

Appendix III I

Soil profile No. 21 - Sungei Bendera Estate -
Tanjong Batu Div. - 81 D/23C

Soil name: KUMANSI family

Landform: Rolling

Physiography at site: Mid-slope

Slope at site 10°

Soil drainage: Well-drained

Soil erosion: Severe sheet erosion

Effective soil depth: 130 cm

Parent material: Red shale

Profile Description

A _h	0-4 cm	Dark brown 10YR 3/3; loam; moderate, fine and medium subangular blocky and crumb structures; friable; many fine and medium roots; many fine pores; clear boundary
B ₁	4-15 cm	Yellowish brown 10YR 5/8; clay loam; moderately strong, coarse and medium subangular blocky structures; friable; many medium (1-2 mm) roots; many organic acid coatings; many micro-bio activities; with light yellowish brown 10YR 6/4 blotches; gradual boundary.
B ₂	15-55 cm	Yellowish red 5YR 5/6; clay; moderately strong, coarse and some medium subangular blocky structures; friable; with olive yellow 2.5Y 6/6 blotches; many medium roots; many fine and medium pores; well-developed cutans; gradual boundary

9033 family: Kowandei

Slide No: 21

Field No: 23 C

Estimate: 5g. Bendoro

Division: Tanjong Raya

- B₃ 55-110 cm Yellowish red 5YR 6/6; clay; moderate, coarse and very coarse subangular blocky structure; friable; few fine and medium roots (1-3 mm); few fine pores; few micro-bio activities along channels; patchy cutans; clear boundary
- B_{3cn} 110-130 cm Yellowish red 5YR 5/8; clay; moderate, very coarse and coarse subangular blocky structures; friable; few fine roots; few pores; about 10% gravelly iron-coated shale; clear boundary
- C_R 130 cm + A variegated layer of decomposing and undecomposed shale.

Depth in cm	Horizon	Clay (w)	Silt (g)	Fine Sand (w)	Oxide Sand (g)
0-4	Ah	17.96	33.60	33.86	10.19
4-15	B1	24.96	29.56	24.82	6.44
15-55	B2	43.56	27.94	18.36	4.90

Depth in cm	pH (air-dry)	Organic Carbon (%)		C/N ratio	Each (m.e.g.)		
		N (%)	Ca (%)		K	Mg	
0-4	5.4	4.50	0.25	13	1.15	5.25	8
4-15	4.7	0.51	0.16	3	0.21	0.56	0.6
15-55	4.7	0.46	0.11	4	0.26	0.47	0.6

SOIL ANALYTICAL RESULTS

Estate: Sg. Bendera

Site No: 21

Soil family: Kumansi

Division: Tanjong Batu

Field No: 23 C

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-4	Ah	17.96	33.60	33.86	10.19
4-15	B1	34.96	29.56	24.82	6.44
15-55	B2	43.56	27.94	18.36	4.90

Depth in cm	Cation Exchange Capacity %	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.g. %)			ppm			Loss on ignition	% Base saturation	Conductivity
		H ₂ O	KCl				K	Mg	Ca	Exch. Mn	Av. P	Boron			
0-4	25	5.4	'	4.50	0.35	13	1.15	5.25	8.52	11			59		
4-15	20	4.7		0.51	0.16	3	0.31	0.56	0.11	6			5		
15-55	20	4.7		0.46	0.11	4	0.26	0.47	0.01	6			4		

Appendix IIIJ

Soil profile No. 22 - Sungei Bendera Estate -
Tanjong Batu Division - 81 D/22I

Soil name: KUMANSI family

Landform: Rolling

Physiography at site: Mid-gentle slope

Slope at site: 10°

Soil drainage: Well-drained

Soil erosion: Severe sheet erosion

Effective soil depth: 150 cm

Parent material: Red shale

B2cn2 110-150 cm Reddish brown 5YR 4/4 to yellowish
red 5YR 4/6; clay; moderate, very
coarse subangular blocky
Profile Description
strong, medium and coarse subangular

Ah 0-3 cm Brown to dark brown 10YR 3/3-4/3; few
loam; moderate, fine and medium pores;
subangular blocky and crumbs; friable;
abundant fine and medium roots; many
fine pores; clear boundary.

B1 3-10 cm Strong brown 7.5YR 5/6; clay loam;
moderate, medium subangular blocky
structures; friable; many fine and
medium roots; many medium pores; many
organic acid coatings and micro-bio
activities; clear boundary.

B2 10-25 cm Yellowish red 5YR 5/6; clay; moderate,
coarse and very coarse subangular
blocky structures; slightly firm; few
fine roots; few fine pores; few
micro-bio activities; clear boundary.

- B2cn1 25-110 cm** Yellowish red 5YR 5/6-4/6; clay; strong, coarse subangular blocky breaking into strong, medium subangular blocky structures; friable; very few fine roots; few medium pores; about 5% scattered stony iron-coated shale and sandstones; patchy cutans; gradual boundary.
- B2cn2 110-150 cm** Reddish brown 5YR 4/4 to yellowish red 5YR 4/6; clay; moderate, very coarse subangular blocky breaking into strong, medium and coarse subangular blocky structures; friable; very few fine roots; few medium and fine pores; with less than 2% decomposing red shale.

Depth (cm)	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-3	Ah	18.84	31.14	38.81	8.13
3-10	B1	27.02	31.28	33.63	2.90
10-25	B2	43.84	25.70	18.49	6.67
25-110	B2cn	41.76	28.22	17.24	7.78

Depth (cm)	pH (air-dry)	Cation exchange capacity		C/N ratio
		H ₂ O	KCl	
0-3	3.5	0.33	10	1.15
3-10	4.7	0.16	6	0.54
10-25	4.8	0.09	5	0.51
25-110	4.6	0.07	4	0.31

Appendix IIIK

Soil profile No.	23 - Sungei Bendera Estate - Batu Cave Division - 81 C/17E
Soil name:	KUMANSI family
Landform:	Rolling
Physiography at site:	Top flat
Slope at site:	3°
Soil drainage:	Well-drained
Soil erosion:	Moderate sheet erosion
Effective soil depth:	115 cm
Parent material:	Red shale

Profile Description

Ah	0-4 cm	Dark brown 7.5YR 3/4; sandy clay loam; strong, fine and medium subangular blocky and medium granules; friable; many fine and medium (1-3 mm) roots; many coarse pores; clear boundary
B21	4-25 cm	Yellowish red 5YR 4/6; clay loam; moderately weak, very coarse subangular blocky structures; firm; slightly compact in place; many very fine (<1 mm) roots; very few fine pores; clear boundary.
B22	25-75 cm	Red 2.5YR 4/6; clay; moderately strong, coarse subangular blocky breaking into strong, medium and coarse subangular blocky structures; friable; very few fine roots; many fine and medium pores; many reddish brown 5YR 5/4 cutans; very few micro-bio activities; gradual boundary.
B3	75-115 cm	As above but with 5% scattered decomposing shale; tongue boundary.
Cu	115 cm +	A layer of decomposing mudstone and shale

SOIL ANALYTICAL RESULTS

Estate: Sg. Bendera
 Division: Batu Caves

Site No: 23
 Field No: 81C/17E

Soil family: Kumansi

Soil profile No: 13 - Sg. Pak
 Soil name: TANJONG LIP
 Landform: Very steep
 Physiography at site: Mid-very steep
 Slope at site: 30°
 Soil drainage: Well-drained
 Soil erosion: Very severe sheet
 Effective soil depth: 65 cm
 Parent material: Sandstone

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)	Exch. cation (m.e.q. %)			C/N ratio	N (%)	Organic carbon (%)	pH (air-dry)		Cation Exchange Capacity %	Loss on ignition	% Base saturation	Conductivity
						K	Mg	Ca				H ₂ O	KCl				
0-4	Ah	20.52	25.62	37.18	9.11	0.95	3.77	14.55	12	0.32	3.90	5.9		24		80	
4-25	B21	37.56	31.22	22.55	6.12	0.36	1.37	2.50	5	0.13	0.63	5.0		22		19	
25-75	B22	51.78	28.74	12.98	2.40	0.36	1.17	0.26	3	0.09	0.30	4.9		22		8	

Depth in cm	Exch. Mn	Av. P ppm	Boron	Total S (%)		Sol. SO ₄
				S	S	
0-4		26				
4-25		7				
25-75		8				

Appendix IIII

Soil profile No. 13 - Sg. Pakis Estate - 84 NP/Bk.13
 Soil name: TANJONG LIPAT family
 Landform: Very steep
 Physiography at site: Mid-very steep slope
 Slope at site: 38°
 Soil drainage: Well-drained
 Soil erosion: Very severe sheet erosion
 Effective soil depth: 65 cm
 Parent material: Sandstone

Profile Description

A _h	0-4 cm	Dark yellowish brown 10YR 4/4 and dark brown 10YR 3/3; fine sandy loam; moderate, medium and few fine subangular blocky structures; friable; many coarse and few fine roots; many coarse pores; clear boundary
B ₂₁	4-25 cm	Strong brown 7.5YR 5/8; fine sandy clay loam; moderate, coarse and few very coarse subangular blocky structures; friable; many fine and medium pores; many fine and very fine (<1-2 mm) roots; patchy organic acid coatings; many micro-bio activities; gradual boundary.
B ₂₂	25-65 cm	Strong brown 7.5YR 5/8; fine sandy clay loam; moderately strong, coarse and some medium subangular structures; friable; many fine and medium pores; many fine roots; very few micro-bio activities; distinct boundary
C _R	65-170 cm	A continuous layer of impervious bedrock-sandstone.

SOIL ANALYTICAL RESULTS

Estate: Sg. Pakis

Site No: 13

Soil family: Tanjong Lipat

Division: _____

Field No: 84 NP/Bk.13

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			Exch. Mn	Av. P	Boron	Total S (%)		Loss on ignition	% Base saturation	Conductivity	
						H ₂ O	KCl				K	Mg	Ca				S	Sol. SO ₄				
0-4	Ah	15.30	20.52	53.26	4.73		6.6	2.40	0.23	10	1.10	2.63	21.14		14							
4-25	B21	24.68	15.86	47.58	7.03		5.0	0.58	0.10	6	0.90	1.51	4.27		10							
25-65	B22	26.06	15.26	45.92	7.46		4.8	0.28	0.07	4	0.33	1.30	0.07		12							

Appendix IIIM

Soil profile No. 4 - Sg. Kretam Estate - 83NP/Bk.9
Soil name: KAPILIT family
Landform: Steep hilly
Physiography at site: Mid-steep slope
Slope at site: 20°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: > 150 cm
Parent material: Sandstone

Profile Description

A _h	0-2 cm	Dark brown 10YR 3/3; sandy loam; moderately strong, fine and medium subangular blocky and some crumb structures; structures attached to roots; slightly hard; abundant fine and medium roots and organic debris; many fine and medium pores; clear straight boundary.
B ₁	2-10 cm	Yellowish brown 10YR 5/6; sandy clay loam; moderately strong, medium and some coarse subangular blocky structures; friable consistency; many medium and fine (1-5 mm) roots; many medium and coarse pores; common yellowish brown 10YR 5/4 and dark brown 10YR 3/3 organic acid coatings on ped surfaces and along root channels; many micro-bio activities; clear straight boundary.

Soil Family: Kapiile

B2cn1 10-40 cm Yellowish brown 10YR 5/8; sandy clay loam; moderately strong, medium subangular blocky structures; friable consistency; many fine and medium (1-5 mm) roots; many medium pores; with 30-40% gravelly and stony (2-10 cm) sandstones; few micro-bio activities; gradual slightly wavy boundary.

B2cn2 40-60 cm Strong brown 7.5YR 5/8; sandy clay loam; moderately strong, medium and coarse subangular blocky structures; friable to slightly firm consistency; many fine and medium (1-5 mm) roots; many coarse pores; with 30-40% gravelly and stony (2-10 cm) sandstones; clear wavy boundary.

BCr 60-150 cm A layer of about 40% fragmented parent rock-sandstones with interstices filled with strong brown 7.5YR 5/8 sandy clay loam matrix; very few fine roots.

Site No: 4
Field No:

Soil No: Kapiile

Horizons

Depth In cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-2	Ah	13.56	13.96	55.85	8.55
2-10	B1	19.34	14.78	51.44	8.68
10-40	B2cn1	23.18	14.44	47.29	8.68
40-60	B2cn2	28.22	16.42	45.29	8.68

Depth in cm	Moisture (%)	Organic Carbon (%)	N (%)	P (%)	C/N Ratio
0-2	6.1	2.10	0.23	9	9
2-10	4.8	0.85	0.15	6	6
10-40	4.8	0.30	0.08	4	4
40-60	4.9	0.23	0.07	3	3

SOIL ANALYTICAL RESULTS

Estate: Sg. Kretam
 Division: _____

Site No: 4
 Field No: _____

Soil family: Kapilit

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-2	Ah	15.56	13.96	55.85	8.55
2-10	B1	19.34	14.78	51.44	9.68
10-40	B2cn1	23.18	14.44	47.29	10.25
40-60	B2cn2	28.22	16.42	45.39	7.12

Depth in cm	Cation Exchange Capacity %	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			Exch. Mn	ppm		Loss on ignition	% Base saturation	Conductivity
		H ₂ O	KCl				K	Mg	Ca		Av. P	Boron			
0-2	20	6.1		2.10	0.23	9	0.69	1.83	8.73	15			57		
2-10	11	4.8		0.85	0.15	6	0.28	0.52	0.98	11			16		
10-40	14	4.8		0.30	0.08	4	0.28	0.73	0.04	9			8		
40-60	15	4.9		0.23	0.07	3	0.23	0.47	0.01	10			5		

Appendix IIIN

Soil profile No. Reddish 10 - Sg. Kretam Estate - 84NP/Bk.8
Soil name: DAGAT family
Landform: Hilly
Physiography at site: Mid-slope
Slope at site: 14°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 80 cm
Parent material: Tuffaceous shale

Profile Description

Ah 0-7 cm Brown to dark brown 10YR 4/3; loam; moderate, medium and fine subangular blocky and few crumb structures; friable; many medium and few very coarse (5-60 mm) roots; few coarse pores; clear boundary.

B1 7-15 cm Brown 7.5YR 5/4; clay loam; moderately strong, medium subangular blocky structures; friable; many fine and medium (1-2 mm) pores; many medium (2-5 mm) roots; patchy organic acid coatings; clear boundary.

B2 15-55 cm Brown to dark brown 7.5YR 4/4 to strong brown 7.5YR 4/6; clay; strong, medium and some fine subangular blocky structures; friable; many medium to coarse (2-50 mm) roots; few fine pores; <5% gravels of tuffaceous shale (5-30 mm); gradual boundary.

B₃

55-80 cm

Reddish brown 5YR 5/3; clay; moderate, coarse and medium subangular blocky structures; friable; many medium and coarse roots (2-30 mm); few medium pores; some decomposing tuffaceous shale; <5% gravels of undecomposed tuffaceous shale; gradual boundary.

C

80-145 cm

Reddish brown 5YR 5/3 and 4/4; clay; moderately weak, very coarse sub angular and angular blocky structures; compact in place; slightly massive; many semi-decomposing and undecomposed tuffaceous shale; few roots

Depth in cm	Horizon	Clay (%)	Silt (%)	Plant Sand (%)	Coarse sand (%)
0-7	A _h	16.90	35.90	35.28	8.63
7-15	B ₁	27.96	30.02	50.71	4.58
15-55	B ₂	53.00	29.68	11.51	6.78

Depth in cm	pH (air-dry)	Organic carbon (%)	N (%)	C/N ratio	Anion-cation (m.e.g. %)	
					K	Mg
0-7	6.3	3.75	0.42	9	2.30	4.91
7-15	4.9	1.08	0.17	6	0.90	3.20
15-55	5.0	0.35	0.09	4	0.43	4.00

SOIL ANALYTICAL RESULTS

Estate: **Sg. Kretam**

Site No: **10**

Soil family: **Dagat**

Division: _____

Field No: _____

Depth in cm	Horizon	Clay (%)	Silt (%)	Fine Sand (%)	Coarse Sand (%)
0-7	Ah	14.90	35.90	35.28	8.63
7-15	B1	27.96	30.02	30.31	4.58
15-55	B2	43.00	29.68	11.51	6.72

Depth in cm	Cation Exchange Capacity %	pH (air-dry)		Organic carbon (%)	N (%)	C/N ratio	Exch. cation (m.e.q. %)			ppm			Loss on ignition	% Base saturation	Conductivity
		H ₂ O	KCl				K	Mg	Ca	Exch. Mn	Av. P	Boron			
0-7	29	6.3		3.75	0.42	9	2.30	4.91	14.90	12			76		
7-15	23	4.9		1.08	0.17	6	0.90	3.20	3.27	9			32		
15-55	24	5.0		0.35	0.09	4	0.43	4.00	0.07	9			19		

Appendix IVA

Soil profile No. 17 - Sg. Pakis - 83 NP/G3
Soil name: PALIU family
Landform: Alluvial plain
Physiography at site: Nearly flat (raised with deep incised stream)
Slope at site: $< 1^\circ$
Soil drainage: Well-drained
Soil erosion: Slightly eroded
Effective soil depth: > 150 cm
Parent material: Sub-recent alluvium

Profile Description

A _h	0-3 cm	Brown to dark brown 10YR 4/3; loam; moderately strong, fine and medium subangular blocky structures; friable; many fine and coarse roots; many fine and coarse pores; clear boundary.
B ₁	3-20 cm	Brown to dark brown 7.5YR 4/4; loam; moderately strong, very coarse subangular blocky breaking into medium and coarse subangular blocky structures; friable; many fine and medium roots; many fine and coarse pores; some micro-bio activities; clear boundary.
B ₂	20-100 cm	Strong brown 7.5YR 4/6; clay loam; moderately strong, very coarse and coarse subangular blocky structures; slightly firm; many medium roots; few fine and coarse pores; some micro-bio activities; gradual boundary.

Appendix 14B

Soil profile No. 5 - Sg. Benders Estate
B₃ 100-150 cm Strong brown 7.5YR 4/6; clay loam;
Soil name: moderately weak, coarse subangular
Landform: blocky structures; slightly compact
Physiography at site: in place; friable; with many brown
Slope at site: 7.5YR 5/4 and light brown 7.5YR 6/4
cutans.
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 130 cm
Parent material: Argillaceous shale

Profile Description

A_h 0-4 cm Dark brown 10YR 3/3; sandy loam; moderate,
medium and fine subangular blocky structures;
friable; many fine and medium roots; many
coarse pores; clear boundary.
B₁ 4-25 cm Yellowish brown 10YR 5/6-5/8; clay loam;
moderate, coarse and some medium subangular
blocky structures; friable; many medium and
coarse pores; many medium roots; moderately
developed organic acid coatings; many
micro-bio activities; gradual boundary
B₂ 25-85 cm Strong brown 7.5YR 5/8; clay; moderately
strong, coarse and some medium subangular
blocky structures; friable; many medium and
coarse (2-10 mm) roots; many medium and
coarse pores; many cutans on ped surfaces;
few micro-bio activities; clear boundary.

Appendix IVB

Soil profile No. 8 - Sg. Bendera Estate
Soil name: KUMANSI family
Landform: Hilly
Physiography at site: Mid-slope
Slope at site: 15°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 130 cm
Parent material: Argillaceous shale

Profile Description

A_h 0-4 cm Dark brown 10YR 3/3; sandy loam; moderate, medium and fine subangular blocky structures; friable; many fine and medium roots; many coarse pores; clear boundary

B₁ 4-25 cm Yellowish brown 10YR 5/6-5/8; clay loam; moderate, coarse and some medium subangular blocky structures; friable; many medium and coarse pores; many medium roots; moderately developed organic acid coatings; many micro-bio activities; gradual boundary

B₂ 25-85 cm Strong brown 7.5YR 5/8; clay; moderately strong, coarse and some medium subangular blocky structures; friable; many medium and coarse (2-10 mm) roots; many medium and coarse pores; many cutans on ped surfaces; few micro-bio activities; clear boundary.

Appendix IVC

Soil profile No.	11 - Sg. Kratan Estate - 84 NP/Bk.7
B3cn 85-130 cm	Strong brown 7.5YR 5/8 to yellowish red 5YR 5/8; clay; moderately weak, coarse subangular and angular blocky structures; friable; many decomposing shale and undecomposed stony sandstones; few roots; few pores; gradual boundary
Landform	
Physiography at site	
Slope at site	
Soil drainage	
Soil erosion	
Effective soil depth	115 cm
BC 130 cm +	Variegated yellowish red 5YR 5/8, strong brown 7.5YR 5/8 and light grey 10YR 7/2; clay; weak, coarse subangular and angular blocky structures; friable; about 40% fragmented undecomposed sandstones.
A ₀ 0-3 cm	Dark brown 10YR 3/3; sandy loam; moderate medium and fine subangular blocky and many crumb structures; friable; many fine and medium (1-3 mm) roots; few coarse pores; clear boundary
B ₁ 3-20 cm	Yellowish brown 10YR 5/6 to light olive brown 2.5Y 3/6; clay loam; moderately strong, medium and coarse subangular blocky structures; friable; many fine and medium (1-3 mm) roots; many fine pores; weakly developed organic acid coatings; many micro-bio activities; clear boundary.
B ₂ 20-55 cm	Olive yellow 2.5Y 6/6; clay; moderately strong, coarse and medium subangular blocky structures; friable; many light yellowish brown 2.5Y 6/4 blotches; about 5% gravels of mudstones; few medium roots; few pores; gradual boundary.

Appendix IVC

Soil profile No. 11 - Sg. Kretam Estate - 84 NP/Bk.7
Soil name: KUMANSI family
Landform 65-115 cm Undulating 5Y 7/2 and light yellowish
Physiography at site: Gentle slope clay; moderate, coarse
Slope at site: 4° subangular and angular blocky
Soil drainage: Moderately well-drained tly compact
Soil erosion: Moderate sheet erosion 7.5YR 5/8
Effective soil depth: 115 cm about 10% gravels of mudstones;
Parent material: Mudstone

Profile Description

A_h 0-3 cm Dark brown 10YR 3/3; sandy loam; moderate medium and fine subangular blocky and many crumb structures; friable; many fine and medium (1-3 mm) roots; few coarse pores; clear boundary

B₁ 3-20 cm Yellowish brown 10YR 5/6 to light olive brown 2.5Y 5/6; clay loam; moderately strong, medium and coarse subangular blocky structures; friable; many fine and medium (1-3 mm) roots; many fine pores; weakly developed organic acid coatings; many micro-bio activities; clear boundary.

B₂ 20-65 cm Olive yellow 2.5Y 6/6; clay; moderately strong, coarse and medium subangular blocky structures; friable; many light yellowish brown 2.5Y 6/4 blotches; about 5% gravels of mudstones; few medium roots; few pores; gradual boundary.

Appendix IV

Soil profile No. 14 - Sp. Pakis Bayata - 84 NP/Bk.9
 Soil name: KUMANSI family
 Landform: Steep
 BC-C 65-115 cm Light grey 2.5Y 7/2 and light yellowish
 Physiography at site: High plateau
 Slope at site: 25°
 Soil drainage: Well-drained
 Soil erosion: Severe sheet erosion
 Effective soil depth: 100 cm
 Parent material: Argillaceous shale
 few roots.

Profile Description

Au 0-5 cm Brown 10YR 4/3; sandy loam; moderate, medium and fine subangular blocky structures; friable; many fine and medium (1-5 mm) roots; few coarse pores; clear boundary

B21 5-30 cm Brownish yellow 10YR 6/8; clay loam; moderately strong, coarse and some medium subangular blocky structures; friable; many fine and medium (1-3 mm) roots; many fine pores; patchy organic acid coatings; few micro-bio activities; clear boundary.

B2cn1 30-80 cm Brownish yellow 10YR 6/8; clay; moderately strong, coarse subangular blocky structures; friable; few coarse and fine roots; patchy rutans; about 3% stony mudstones; clear boundary.

B2cn2 80-140 cm As above but stony mudstones increase to about 40% (penetrable by roots).

Appendix IVD

Soil profile No. 14 - Sg. Pakis Estate - 84 NP/Bk.9

Soil profile No. 14 - Sg. Pakis Estate - 84 NP/Bk.9

Soil name: KUMANSI family

Landform: Steep

Physiography at site: Mid-steep slope

Slope at site: 22°

Soil drainage: Well-drained

Soil erosion: Severe sheet erosion

Effective soil depth: 140 cm

Parent material: Argillaceous shale

Profile Description

Ah	0-5 cm	Brown 10YR 4/3; sandy loam; moderate, medium and fine subangular blocky structures; friable; many fine and medium (1-5 mm) roots; few coarse pores; clear boundary
B21	5-30 cm	Brownish yellow 10YR 6/8; clay loam; moderately strong, coarse and some medium subangular blocky structures; friable; many fine and medium (1-5 mm) roots; many fine pores; patchy organic acid coatings; few micro-bio activities; clear boundary.
B2cn1	30-80 cm	Brownish yellow 10YR 6/8; clay; moderately strong, coarse subangular blocky structures; friable; few coarse and fine roots; patchy cutans; about 5% stony mudstones; clear boundary.
B2cn2	80-140 cm	As above but stony mudstones increase to about 40% (penetrable by roots).
B2cn2	70-100 cm	As above, stony mudstones increase to about 30%.

Appendix IVE

Soil profile No. 16 - Sg. Pakis Estate - 82 NP/Bk.10
Soil name: KAMUNSI family
Landform: Rolling
Physiography at site: Mid-gentle slope
Slope at site: 10°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: >100 cm
Parent materials: Argillaceous shale

Profile Description

Profile Description

A _h	0-6 cm	Brown to dark brown 10YR 4/3; sandy loam; moderate, medium and fine subangular blocky structures; friable; many fine and medium roots; few coarse pores; clear smooth boundary.
B ₂₁	6-25 cm	Brownish yellow 10YR 6/8; clay loam; moderately strong, coarse and medium subangular blocky structures; friable; many fine and medium (1-5 mm) roots; many fine and coarse (1-3 mm) pores; patchy organic acid coatings; few micro-bio activities; clear smooth boundary.
B _{2cn1}	25-70 cm	Brownish yellow 10YR 6/8; clay; moderately strong, coarse and very coarse subangular blocky structures; friable; few coarse and fine roots; some cutans on ped surfaces; about 10% stony and gravelly mudstones; clear boundary.
B _{2cn2}	70-100 cm	As above; stony and gravelly mudstones increase to about 30%.

Appendix IVF

Soil profile No. 19 - Sg. Batu Estate 84 B/Bk.2
Soil name: KUMANSI family
Landform: Rolling
Physiography at site: Mid-slope
Slope at site: 8°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 150 cm
Parent material: Mudstone

Profile Description

A _h	0-2 cm	Dark yellowish brown 10YR 3/4; clay loam; moderate, medium and fine subangular blocky structures; friable; many very fine to medium (< 1 to 2 mm) roots; few coarse pores; clear boundary.
B ₁	2-20 cm	Yellowish brown 10YR 5/6-5/8; clay loam; moderately strong, medium and coarse subangular blocky structures; friable; many fine (1-2 mm) roots; many coarse pores; many organic acid coatings; many micro-bio activities; clear boundary.
B _{2cn}	20-90 cm	Yellowish brown 10YR 5/6-5/8; clay; moderate, coarse and medium subangular blocky structures; friable; few coarse (2-5 mm) roots; many fine and few medium pores; about 20-30% gravelly and stony (5-80 mm) mudstones; very few micro-bio activities; clear boundary.
B _{3cn}	90-150 cm	Yellowish brown 10YR 5/6-5/8; clay; moderate, medium and coarse subangular blocky structures; friable; rare roots; very few fine pores; about 30-40% stony (2-20 cm) mudstones.

Appendix IVG

Soil profile No. 18 - Sg. Pakis Estate - 83 NP/Bk.F1
Soil name: KUMANSI family
Landform: Undulating
Physiography at site: Mid-gentle slope
Slope at site: 4°
Soil drainage: Well-drained
Soil erosion: Moderate sheet erosion
Effective soil depth: 110 cm
Parent material: Mudstone

Profile Description

A_h 0-4 cm Bark brown 10YR 3/3; loam; moderate, fine and medium subangular blocky structures; friable; many fine roots; few medium pores; clear boundary.

B₁ 4-25 cm Yellowish brown 10YR 5/6; clay loam; moderate, medium subangular blocky structures; friable; many fine and medium (1-3 mm) roots; many fine to coarse pores; patchy organic acid coatings; few micro-bio activities; gradual boundary.

B₂ 25-80 cm Yellowish brown 10YR 5/6; clay; moderately strong, medium and coarse subangular blocky structures; friable; few medium roots; many fine and medium pores; few micro-bio activities; clear boundary.

Appendix IV

Soil profile No. 9 - Sg. Kretan Estate - SING/HA.7
Soil name: TANJONG LIPAT family

B ₃ cn	80-110 cm	Strong brown 7.5YR 5/8; clay; moderate, coarse and some very coarse subangular blocky structures; friable; rare roots; few medium pores; about 10% gravelly and stony mudstones; with less than 2% yellowish red 5YR 5/8 mottles; abrupt boundary.
CR	110 cm +	A somewhat continuous layer of bedrock-sandstone.

Profile Description

A _h	0-8 cm	Brown to dark brown 10YR 4/3; fine sandy moderate, fine subangular blocky and crumb structures; very friable to somewhat loose; many fine and medium (1-2 mm) roots; many medium pores; clear boundary.
B ₁	4-10 cm	Brown to dark brown 7.5YR 4/4; fine sandy loam; moderate, medium and some fine subangular blocky structures; very friable; many fine to coarse (1-15 mm) roots; many medium and coarse pores; patchy organic matter coatings; clear boundary.
B ₂ k	10-30 cm	Brown to dark brown 7.5YR 4/4 to strong brown 7.5YR 4/6; fine sandy clay loam; moderately strong, medium and coarse subangular blocky structures; very friable; many fine and medium pores; few coarse (2-5 mm) roots; about 30% stony sandstones; tongue boundary.

Appendix IVH

Soil profile No. 9 - Sg. Kretam Estate - 81NP/Bk.7
Soil name: TANJONG LIPAT family
Landform: Hilly
Physiography at site: Mid-steep slope
Slope at site: 16°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 130 cm
Parent material: Sandstone

Profile Description

A _h	0-4 cm	Brown to dark brown 10YR 4/3; fine sand; moderate, fine subangular blocky and crumb structures; very friable to somewhat loose; many fine and medium (1-2 mm) roots; many medium pores; clear boundary
B ₁	4-10 cm	Brown to dark brown 7.5YR 4/4; fine sandy loam; moderate, medium and some fine subangular blocky structures; very friable; many fine to coarse (1-10 mm) roots; many medium and coarse pores; patchy organic acid coatings; clear boundary
BC _R	10-50 cm	Brown to dark brown 7.5YR 4/4 to strong brown 7.5YR 4/6; fine sandy clay loam; moderately strong, medium and coarse subangular blocky structures; very friable; many fine and medium pores; few coarse (2-5 mm) roots; about 30% stony sandstones; tongue boundary

Appendix IV I

BC_{R2} 50-130 cm A layer of about 70% stony and boundary sandstones interstics is filled with fine sandy clay loam with colour as above matrix.

Soil name:
 Landform:
 Physiography at site: Mid to lower slope
 Slope at site: 20°
 Soil drainage: Well-drained
 Soil erosion: Severe sheet erosion
 Effective soil depth: 140 cm
 Parent material: Sandstone

Profile Description

Ab 0-4 cm Brown to dark yellowish brown 10YR 5/3-4/4; fine loamy sand; moderate, fine and medium subangular blocky and crumb structures; very friable; many very fine and coarse (<1 to >3 cm) roots; many fine and medium pores; clear boundary

BCh1 4-80 cm Yellowish brown 10YR 5/5-5/8; fine sandy loam; moderately strong, medium and coarse subangular blocky structures; friable; few coarse (2-20 cm) roots; many medium pores; about 30% stony (5-20 cm) sandstones; few micro-bio activities; gradual boundary

BCh2 80-140 cm Yellowish brown 10YR 5/5 to brownish yellow 10YR 6/4; fine sandy clay loam; moderately strong, coarse subangular blocky structures; friable; few coarse roots; about 30% stony sandstones as above.

Appendix IV I

Soil profile No. 20 - Sg. Batu Estate - 83 B/Bk.9
Soil name: TANJONG LIPAT family
Landform: Steep
Physiography at site: Mid to lower slope
Slope at site: 20°
Soil drainage: Well-drained
Soil erosion: Severe sheet erosion
Effective soil depth: 140 cm
Parent material: Sandstone

Profile Description

Ah	0-4 cm	Brown to dark yellowish brown 10YR 4/3-4/4; fine loamy sand; moderate, fine and medium subangular blocky and crumb structures; very friable; many very fine and coarse (<1 to >5 mm) roots; many fine and medium pores; clear boundary
BCR1	4-80 cm	Yellowish brown 10YR 5/6-5/8; fine sandy loam; moderately strong, medium and coarse subangular blocky structures; friable; few coarse (5-20 mm) roots; many medium pores; about 30% stony (5-20 cm) sandstones; few micro-bio activities; gradual boundary.
BCR2	80-140 cm	Yellowish brown 10YR 5/6 to brownish yellow 10YR 6/6; fine sandy clay loam; moderately strong, coarse subangular blocky structures; friable; few coarse roots; about 30% stony sandstones as above.

SOIL MAPS