Fluvaquents and is divided into seven(7) sub-series by reaction, organic materials, variant etc. They are deep soils and are characterized by a very dark gray, clay or clay loam A horizon overlying a gray or light gray clay C horizon. The lithologic discontinuity reaction is strongly acid.

9) Tak Bai series : Ta

The Tak Bai series is fine loamy, mixed, acid, isohyperthermic, Typic Tropaquepts. They are deep soils and characterized by a light gray silty clay loam or clay loam cambric B horizon. Brownish mottles occur throughout the profile, red mottles may occur in the deeper subsoil at depth approximately below 80 cm from the soil surface. Reaction is medium to very strongly acid.

10) Thon Sai series : Ts

The Thon Sai series is fine loamy, mixed, acid, isohyperthermic, Sulfic tropic Fluvaquents and is divided into three(3) sub-series by variant. They are deep soils and are characterized by a dark brown, dark grayish brown or very dark grayish brown A horizon overlying a strongly acid to very strongly acid over medium to strongly acid.

Table E-2 Description of soil map unit in development zone (1)

Mapping unit	Symbols	Description
1.	Ba-ly/a2	Bang Nara loamy, pH 4.5-4.9
5.	Cb-ly/a1	Chon Buri loamy, pH 5.0-5.5
7.	Cyi-ly/a3	Chain Yai loamy, pH 4.0-4.4
		fibrist, pH 4.0-4.4
9.	Cyi-o. sub-ly/a3	Chain yai organic substratum variant, loamy, pH 4.0-4.4
10.	Cyi-r. sub-ly/a4	Chain yai riverine substratum variant, loamy, pH <4.0
11.	Cyi & Mu-ly/a4	Chain yai and Muno complex, lomay, pH <4.0
13.	Kd-oi/a2	Kab Daeng fibrist, pH 4.5-4.9
14.	Kd-oi/a3	Kab Daeng fibrist, pH 4.0-4.4
15.	Kd-oi/a4	Kab Daeng fibrist, pH <4.0
16.	Kd-str-oe, ly/a2	Kab Daeng stratified, hemist, and Kab Daeng loamy, complex, pH 4.5-4.9
19.	Mu-ly/a4	Muno loamy, pH <4.0
20.	Nw-oi/d1, m, a2	Narathiwat fibrist, OM>100-150cm over marine clay substratum, pH 4.5-4.9
21.	Nw-oi/d2, m, a2	Narathiwat fibrist, OM>150-200cm over marine clay substratum, pH 4.5-4.9
22.	Nw-oi/d1&d2, m, a3	Narathiwat fibrist, OM>100-150cm and OM>150-200cm complex, over marine clay substratum, pH 4.0-4.4
		substratum, pH <4.0
24.	Nw-oi/d3, m, a2	Narathiwat fibrist, OM>200-300cm over marine clay substratum, pH 4.5-4.9
25.	Nw-oi/d3, m, a1&a2	Narathiwat fibrist, OM>200-300cm over marine clay substratum, pH 5.0-5.5 and pH 4.5-4.9 complex

Table E-2 Description of soil map unit in development zone (2)

Mapping unit	Symbols	Description
26.	Nw-mk-oi/bs, a4	Narathiwat moderately thick variant, fibrist, over marine sand substratum, pH <4.0
30.	Pti-ly/a1	Pattani loamy, pH 5.0-5.5
33.	Ra-ly/a2	Rangae loamy, pH 4.5-4.9
34.	Ra-ly/a3	Rangae loamy, pH 4.0-4.4
35.	Ra-m, sub-ly/a2	Rangae marine clay substratum, loamy, pH 4.5-4.9
36.	Ra-o-oi/a3	Rangae organic surface variant, fibrist, pH 4.0-4.4
37.	Ra-o, sub-ly/a2	Rangae organic surface variant, loamy, pH 4.5-4.9
38.	Ra-ly & Kd-oi/a3	Rangae loamy and Kab Daeng fibrist complex, pH 4.0-4.4
40.	Ta-ly/a2	Tak Bai loamy, pH 4.5-4.9
49	Ts-ly/a3	Thon Sai loamy, pH 4.0-4.4
51	Ts-o-oe/a3	Thon Sai organic surface variant, hemist, pH 4.0-4.4

Remarks: By referring the data of DLD semi-detailed soil map of Narathiwat Province 1:25,000(1985)

a1;pH5.5-5.0, a2;pH4.9-4.5, a3;pH4.4-4.0, a4;pH4.0>

d1;peat depth 100-150cm, d2;peat depth 150-200cm, d3;peat depth 200cm<

Oi;peat is fibrist, mk;peat layer is moderately thick,

m;marine clay, bs;beach sand, ly;loamy,

Table E-3-1 Physical property of soil in the study area

Series name	Groundwater table(cm)	Drainage	Permeability	Flooding frequency
Bangnara	150	poor	slow	yearly
Chon Buri	150	poor	moderate	yearly
Chian Yai	75	very poor	slow	yearly
* Kab Daeng	50	very poor	slow	yearly
* Munoh	75	poor	moderate	yearly
* Narathiwat	50	very poor	slow	yearly
Pattani	20	poor	slow	yearly
* Rangae	100	very poor	slow	yearly
Tak Bai	30	poor	slow	yearly
* Thon Sai	100	very poor	slow	yearly

Remarks

Source:Soil Information System by Mr. Taweesak Vieansilp and staff. Soil survey and classification Division DLD(1991).

* mark: This series occupy in F/S area.

Permeability ; high >15cm/hour

moderate 0.5-15cm/hour

slow <0.5cm/hour

Table E-3-2 Bulk density of soil samples in Narathiwat, Thailand.

			Bulk density	Water content by dry soil %
Bacho	2	1 0- 20 cm	0.13	536
		2 0- 20	0.13	556
		3 20- 40	0.13	690
		4 20- 40	0.11	802
		5 40- 60	0.11	833
		6 40- 60	0.10	878
		7 60- 80	0.11	815
		8 60- 80	0.09	989
		9 80-100	0.12	856
		10 80-100	0.13	778
Bacho	10	1 0- 20 cm	0.19	406
		2 0- 20	0.21	399
		3 20- 40	0.12	750
		4 20- 40	0.13	702
		5 40- 60	0.09	998
		6 40- 60	0.10	909
		7 60- 80	0.11	881
		8 60- 80	0.12	803
		9 80-100	0.08	1140
		10 80-100	0.10	973
Munoh Settlement				
Shallow peat		1 0-15 cm	0.40	450
		2 0-15	0.45	532
Munoh Settlement				
Deep peat		1 0-15 cm	0.31	1050
		2 0-15	0.31	1210

Sources : Kyuma et al. 1992. Coastal lowland ecosystems in southern Thailand and Malaysia

Table E-3-3 Soil texture of soil series in development area(1)

Series name	horizon No.	horizon cm	Particle-size Sand	Particle-size Silt	Particle-size Clay	Soil texture
Bangnara	1.	0 ~ 15	33.0	42.0	25.0	Light Clay
	2.	15 ~ 24	40.0	28.0	32.0	Light Clay
	3.	24 ~ 55	33.0	29.0	38.0	Light Clay
	4.	55 ~ 85	34.0	26.0	40.0	Light Clay
	5.	85 ~ 100	44.0	24.0	32.0	Light Clay
Chon Buri	1.	0 ~ 17	65.0	28.0	7.0	Sandy Loam
	2.	17 ~ 32	68.0	26.0	6.0	Sandy Loam
	3.	32 ~ 62	62.0	20.0	18.0	Sandy Clay Loam
	4.	62 ~ 85	53.0	23.0	24.0	Clay Loam
	5.	85 ~ 100	51.0	26.0	23.0	Clay Loam
	6.	100 ~ 150	54.0	22.0	24.0	Clay loam
Chian Yai	1.	0 ~ 11	54.0	39.0	7.0	Loam
	2.	11 ~ 41	2.4	47.0	50.6	Heavy Clay
	3.	41 ~ 60	8.5	46.6	44.9	Silty Clay
	4.	60 ~ 100	27.1	18.5	54.4	Heavy Clay
	5.	100 ~ 140	79.6	18.9	1.5	Sandy Loam
Munoh	1.	0 ~ 18	10.4	75.4	14.2	Silt Loam
	2.	18 ~ 37	28.5	38.7	32.8	Light Clay
	3.	37 ~ 63	24.7	33.2	42.1	Light Clay
	4.	63 ~ 80	21.7	37.2	41.1	Light Clay
	5.	80 ~110	20.8	52.3	26.9	Silty Clay
	6.	110 ~150	31.7	43.0	25.3	Light Clay
Pattani	1.	0 ~ 9	22.2	45.2	32.6	Silty Clay
	2.	9 ~ 16	13.2	59.2	27.6	Silty Clay
	3.	16 ~ 27	75.4	16.3	8.3	Sandy Loam
	4.	27 ~ 47	93.6	5.4	1.0	Loamy Sand
	5.	47 ~ 68	84.0	14.5	1.5	Sandy Loam
	6.	68 ~ 90	12.2	62.3	25.5	Silty Clay
	7.	90 ~110	94.8	4.2	1.0	Sand

Table E-3-3 Soil texture of soil series in development area(2)

Series name	horizon No.	cm	cm	Particle-size Sand	Silt	Clay	Soil texture
Rangae	1.	0	~ 10	26.0	27.5	46.5	Heavy Clay
	2.	10	~ 25	25.5	26.0	48.5	Heavy Clay
	3.	25	~ 62	1.2	11.3	87.5	Heavy Clay
	4.	62	~ +	29.6	9.4	61.0	Heavy Clay
Tak Bai	1.	0	~ 19	13.0	65.0	22.0	Silty Clay Loam
	2.	19	~ 63	11.0	58.0	31.0	Silty Clay
	3.	63	~ 90	23.0	38.5	38.5	Light Clay
Thon Sai	1.	0	~ 13	46.8	32.7	20.5	Clay Loam
	2.	13	~ 32	38.8	33.7	27.5	Light Clay
	3.	32	~100	46.4	32.1	21.5	Clay Loam

Remarks

Source : Writed out from data of soil series in Thailand

Sand : 2-0.05mm, Silt : 0.05-0.02mm, Clay : <0.002mm

Table E-4-1 Physical and chemical properties of the Histosols in Thailand.

Properties	Organic soil material	Underlying material	
		sandy	loamy or clayey
%moisture at saturation	245 – 1,107	nd	nd
Hydr.conduc. (cm/sec)	0.001 – 0.032	nd	nd
Bulk density (gm/cc)	0.10 – 0.32	nd	nd
loss on ignition (%)	85 – 99	nd	nd
pH 1:1 H_2O	3.4 – 4.4	4.6 – 5.8	2.7 – 4.6
1:1 KCl_2	2.3 – 3.4	3.6 – 4.6	2.7 – 4.4
1:1 $CaCl_2$	2.8 – 3.8	3.9 – 4.8	2.6 – 3.6
Organic carbon (%)	24 – 80.0	0.3 – 1.0	0.9 – 8.6
Nitrogen (%)	0.7 – 1.9	0.01 – 0.1	0.1 – 0.3
CEC (me/100g soil)	66 – 192	2.1 – 4.1	13.7 – 23.2
Exchangeable cations			
Ca (me/100g soil)	0.9 – 10.8	0.1 – 1.0	0.4 – 1.0
Mg (" ")	0.6 – 6.7	0.1 – 0.9	0.6 – 2.7
Na (" ")	0.3 – 3.4	0.2 – 0.9	0.3 – 0.9
K (" ")	0.1 – 0.9	< 0.1	0.1 – 0.2
Base saturation (%)			
by CEC	2 – 15	18 – 70	6 – 12
by Sum of cations	2 – 12	10 – 22	3 – 16
Bray II-P (ppm)	18 – 94	7 – 23	9 – 31
Al (N-KCl soluble, me/100 g soil)	0.4 – 9.9	0.2 – 2.1	2.3 – 7.5
Free Fe (%)	0.1 – 0.8	< 0.1	0.1 – 0.4
DTPA (extractable)			
Cu (ppm)	0.1 – 0.3	nd	nd
Zn (ppm)	0.1 – 2.0	nd	nd
Fe (ppm)	260 – 386	nd	nd

Sources : Kyuma et al. 1992. Coastal lowland ecosystems in southern Thailand and Malaysia

Table E-4-2 Chemical analysis of Narathiwat series.

Characteristics	Depth (cm)			
	0-10	10-30	30-50	50-100
pH (1:1 H_2O)	3.4	3.4	3.5	3.8
EC (dSm^{-1})	0.64	0.41	0.24	0.31
OM (%)	70.61	76.44	90.02	92.40
OC (%)	40.96	44.34	52.21	53.60
Total N (%)	1.23	0.86	0.87	0.80
CEC (me/100 g soil)	132.18	138.79	128.63	113.37
Exch.Ca (me/100 g soil)	3.00	2.77	0.26	0.36
Exch.Mg (me/100 g soil)	7.39	5.94	5.25	6.01
Exch.Na (me/100 g soil)	1.15	1.07	1.46	1.12
Exch.K (me/100 g soil)	0.64	0.30	0.21	0.20
Ext.Al^{3+} (me/100 g soil)	1.86	0.86	0.43	0.45
Active Fe (%)	0.18	0.07	0.03	0.03
Soluble Cl (me/L)	1.47	1.96	0.98	0.98
Soluble SO_4^{2-} (me/L)	1.33	1.40	1.01	1.09
Extr.S (ppm)	305	399	260	167

Sources : Kyuma et al. 1992. Coastal lowland ecosystems in southern Thailand and Malaysia

Table E-4-3 Chemical analysis of Munoh series.

Characteristics	Depth (cm)			
	0-10	10-30	30-50	50-100
pH (1:1 H_2O)	3.8	3.6	3.7	2.5
EC (dSm^{-1})	0.82	0.38	0.48	10.10
OM (%)	22.65	7.42	4.69	3.04
OC (%)	13.14	4.30	2.72	1.76
Total N (%)	0.53	0.05	0.11	0.09
CEC (me/100 g soil)	25.93	9.66	14.24	8.39
Exch.Ca (me/100 g soil)	1.68	0.45	0.17	0.26
Exch.Mg (me/100 g soil)	0.15	0.12	0.20	1.38
Exch.Na (me/100 g soil)	0.31	0.17	0.20	0.05
Exch.K (me/100 g soil)	0.16	0.07	0.10	0.03
Ext.Al^{3+} (me/100 g soil)	3.42	5.11	7.21	24.60
Active Fe (%)	0.46	0.11	0.15	0.98
Soluble Cl (me/L)	2.45	0.49	0.98	4.89
Soluble SO_4^{2-} (me/L)	4.02	3.47	4.49	380.31
Extr.S (ppm)	460	118	281	3191

Sources : Kyuma et al. 1992. Coastal lowland ecosystems in southern Thailand and Malaysia

Table E-4-4 The variation of sabsidence in the peat soil(surface:cm)

Location	Year →	1983	1984	1985	1986	1987	1988	1989	1990	1991	sinking per year
Bacho	1	0	0	0	-5	-12	-14	-16	-54	-53	7
	2	-1	0	-13	-4	-11	-13	-11	-13	-16	2
	3	-3	0	-1	-4	-18	-26	-36	-39	-39	5
	4	-3	18	7	3	-31	-31	-33	-38	-39	5
	5	-3	0	0	-2	-11	-9	-12	-19	-18	2
	ave.	-2	4	-1	-2	-17	-19	-22	-33	-33	4
To Daeng	1	2	-3	0	-	6	9	8	9	-5	-1
	2	-3	-3	-11	-	-10	-7	-17	-6	-9	-1
	3	-3	14	-1	-	6	-8	-9	-5	2	0
	4	-3	0	-28	-	-19	-19	(85)	(97)	(85)	-
	5	-3	0	12	-	-	36	6	5	2	0
	ave.	-2	2	-6	-	-4	2	-3	1	-3	0
Kab Daeng	1	-2	0	-4	-13	-33	-32	-33	-32	-34	-4
	2	(-75)	0	-1	-3	-6	-3	-8	-10	-11	-1
	ave.	-2	0	-3	-8	-20	-18	-21	-21	-23	-3

Remarks : Source; Making from the data of Pigoolthong Development Study Centre in Thailand
( )mark is no calculation

Table B-4-5 Pyrite content and acidity of soil in Narathiwat Province

Code	Pyrite (%)	Total S (%)	pH (H_2O)	pH (1n NaCl)	pH (after Oxidation)	Actual Acidity (me/100g)	Potential Acidty (me/100g)
Phikul thong	2.42	2.00	4.90	3.55	1.90	4.36	51.71
Plot 1	3.34	2.28	5.05	4.60	1.80	1.61	90.30
2	2.38	1.75	6.20	5.90	2.20	0	60.68
3	3.36	2.33	4.70	4.15	1.85	2.74	77.81
4	3.93	2.80	4.30	3.95	1.95	2.42	80.26
5	3.61	2.50	5.60	4.40	1.90	2.10	89.10
6	3.43	2.43	4.10	3.70	1.85	5.16	90.65
Kalugo	1.64	1.41	4.20	3.60	1.95	4.52	96.62

Remarks : source is data analyzed by Pikulthong center(1992).

Table E-6 Soil profile in Bacho F/S area (1)

Pit BC-1

Ban:Nikomsahakorn Bacho, Tambon:Khok Khain, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use:Melaleuca Leucadendron, fern, grasses
Soil Series:Narathiwat series, Ground Water Depth:60cm

Horizon	Depth(cm)	Horizon Description
Oi1	0- 30	Black(10YR 2/1) fibric material; massive structure;many charcoal fragment, extremely acid(field pH <4.5)
Oi2	30- 60	Black(10YR 2/1) fibric material; massive structure; extr emly acid (field pH <4.5)
Oi3	60-110	Black(10YR 2/1) fibric material; massive structure;very coarse fibric material; extremely acid(field pH <4.5)
Cg1	110-130	Grayish yellow brown(10YR 5/2)silt loam, massive structu re; slightly sticky, slightiy plastic; extremely acid (field pH <4.5)
Cg2 (Bh)	130+	Dark brown(10YR 3/3)loamy sand; massive structure;non sticky, non plastic; strongly acid(field pH 5.5)

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (2)

Pit BC-2

Ban:Nikomsahakorn Bacho, Tambon:Khok Khain, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Fern, grasses and Melaleuca Leucadendron,
Soil Series:Narathiwat series, Ground Water Depth:150cm

Horizon	Depth(cm)	Horizon Description
Oi1	0- 30	Black(7.5YR 2/1) fibric material; massive structure; many fine and medium of fern roots; very strongly acid(field pH 4.5).
Oi2	30-60	Black(7.5YR 2/1) fibric material; massive structure; some root rot; very strongly acid(field pH 4.5).
Oi3	60-90	Black(10YR 2/1) fibric material; some root rot; very strongly acid(field pH 4.5).
Oi4	90-190	Black(10YR 2/1) fibric material; very coarse fibric material; massive structure; strongly acid(field pH 5.5).
Cg	190+	Grayish yellow brown(10YR 5/2) silt loam; massive structure; slightly sticky; strongly acid(field pH 5.5).

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (3)

Pit BC-3

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Melaleuca Leucadendron,
Soil series:Narathiwat series, Ground Water Depth: 50cm

Horizon	Depth(cm)	Horizon Description
Oil	0- 30	Black(10YR 2/1) fibric material; massive structure; very srtongly acid(field pH 4.5).
Oe	30-55	Black(10YR 2/1) hemic material; massive structure; extremely acid(field pH <4.5).
Cg1	55-85	Olive black(5Y 3/2) loam; massive structure; slightly sticky slightly plastic; extremely acid(field pH <4.5).
Cg2 (Bh1)	85-110	Grayish yellow brown(10YR 4/2) sandy loam; massive structure; non sticky, non plastic; extremely acid (field pH <4.5).
Cg3 (Bh2)	110-150	Dark brown(10YR 3/3) sandy clay loam; massive structure; slightly sticky, slightly plastic; strongly acid(field pH 5.5).

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (4)

Pit BC-4

Ban:Nikomsahakorn Bacho, Tambon:Khok Khain, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Melaleuca Leucadendron, fern, grasses, reed
Soil Series:Narathiwat series, Ground Water Depth: 50cm

Horizon	Depth(cm)	Horizon Description
Oi1	0- 30	Black(10YR 2/1) fibric material; massive structure, common fern and grasses root; extremely acid (field pH<4.5)
Oi2	30- 70	Black(10YR 2/1) fibric material; massive structure; many coarse and medium melaleuca roots; extremely acid (field pH<4.5)
Cg1	70-100	Olive black(5Y 3/2) silt loam; massive structure; strongly acid (field pH5.5)
Cg2 (Bh)	100-130	Grayish yellow brown(10YR 4/2) loamy sand; massive structure, medium acid (field pH6.0)

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (5)

Pit BC-5

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Melaleuca Leucadendron, fern, grasses
Soil Series:Narathiwat series, Ground Water Depth:150cm

Horizon	Depth(cm)	Horizon Description
Oe	0- 25	Black(7.5YR 2/1) hemic material; massive structure; extremely acid (field pH<4.5).
Cg1	25- 45	Yellowish brown(10YR 5/6) and dull yellow orange(10YR 7/2) sand; massive structure; non sticky, non plastic; strongly acid (field pH5.5).
Cg2	45- 70	Brownish black(10YR 3/1) loamy sand; massive structure; non sticky, non plastic; strongly acid (field pH 5.5).
Cg3	70-100	Brownish gray(10YR 5/1) loamy sand; massive structure; non sticky, non plastic; medium acid (pH6.0).
Cg4	100+	Dull yellow orange(10YR 7/2) loamy sand; many medium distinct bright yellowish brown(10YR 6/8) mottles; massive structure; non sticky, non plastic; medium acid (field pH6.0).

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (6)

Pit BC-6 (Pikulthong oil palm experiment field)

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat

Physiography:Swampy, Parent Material:Organic soil material

Natural Vegetation or Land Use: Oil palm, fern, grasses

Soil Series: Narathiwat series, Ground Water Depth: 90cm

Horizon	Depth(cm)	Horizon Description
Oi1	0- 35	Black(10YR 2/1) fibric material; massive structure; many fine and medium of ferns and grasses root; extremely acid (field pH<4.5).
Oe	35- 75	Black(10YR 2/1) hemic material; massive structure; some large root and very large root; extremely acid (field pH <4.5).
Oi2	75+	Black(10YR 2/1) fibric material; massive structure; many large and very large root; very strongly acid(field pH 4.5)

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (7)

Pit BC-7

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Fern, reed, grasses, Melaleuca Leucadendron,
Soil Series: Narathiwat series, Ground Water Depth:130cm

Horizon	Depth(cm)	Horizon Description
Oe	0- 2/10	Black(10YR 2/1) hemic material; massive structure; extremely acid (field pH<4.5).
Cg1	2/10-18/20	Dark brown(10YR 3/3) loamy sand; massive structure; non sticky, non plastic; extremely acid (field pH<4.5).
Cg2	18/20-35/40	Dark brown(10YR 3/3) and dull yellow orange(10YR 7/2) loamy sand; massive structure; non sticky, non plastic; extremely acid (field pH<4.5).
Cg3	35/40-60	Brownish black(10YR 3/2) and brown(10YR 4/6) loamy sand; massive structure; non sticky, non plastic; slightly acid (field pH6.5)
Cg4	60-90	Light gray(10YR 8/1) sand; massive structure; non sticky non plastic; strongly acid (field pH5.5).
Cg5	90-130	Dull yellow orange(10YR 7/2)and bright yellowish brown(10YR 7/6) loamy sand; massive structure, non sticky, non plastic; medium acid (field pH 6.0)
Cg6	130-160	Light gray(10YR 8/1) loamy sand; massive structure, non sticky, non plastic; slightly acid (field pH 6.5)

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (8)

Pit BC-8

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Reed, Grasses and Melaleuca Leucadendron,
Soil Series: Narathiwat series, Ground Water Depth: 80cm

Horizon	Depth(cm)	Horizon Description
Oe	0- 3/5	Black(10YR 2/1) hemic material; massive structure; extremely acid (field pH<4.5).
Cg1	3/5-30	Dull yellow orange(10YR 6/3) and light Dull yellow orange(10YR 7/2) sand; massive structure; non sticky, non plastic; strongly acid (field pH5.5).
Cg2	30-50	Brownish black(10YR 3/2) to grayish yellow brown(10YR 4/2) loamy sand; common fine brown(7.5YR 4/6)mottles, massive structure; non sticky, non plastic; medium acid (field pH6.0).
Cg3	50-140	Grayish yellow brown(10YR 6/2) loamy sand; many medium and coarse bright brown(7.5YR 5/8) mottles; massive structure non sticky, non plastic; strongly acid (field pH 5.5)
Cg4	140+	Light bluish gray(5B 7/1) sand; massive structure; non sticky, non plastic; slightly acid (field pH6.5)

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (9)

Pit BC-9

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Melaleuca Leucadendron,
Soil Series: Narathiwat series, Ground Water Depth: 80cm,

Horizon	Depth(cm)	Horizon Description
Oi1	0- 25	black(10YR 2/1) fibric material; massive structure; one very large root, extremely acid (field pH<4.5).
Oi2	25- 55	Black(10YR 2/1) and dull yellowish brown(10YR 4/3)fibric material; massive structure; extremely acid (field pH< 4.5)
Cg1	55-80	Dark grayish yellow(2.5Y 4/2) silt loam; massive structure; slightly sticky, slightly plastic; strong acid(field pH5.5).
Cg2	80+	Brownish gray(10YR 4/1) sand; massive structure; non sticky, non plastic; strongly acid(field pH5.5).

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (10)

Pit BC-10

Ban:Nikomsahakorn Bacho, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Melaleuca Leucadendron,
Soil Series: Narathiwat series, Ground Water Depth: 40cm

Horizon	Depth(cm)	Horizon Description
Oi1	0- 20	Black(10YR 2/1) fibric material; massive structure; very coarse fibric material; extremely acid (field pH<4.5).
Oi2	20- 40	Black(10YR 2/1) fibric material; massive structure; extr emely acid (field pH<4.5).
Cg1	40- 80	Dull yellow orange (10YR 6/3) loamy sand; massive struct ure; non sticky, non plastic; slightly acid (field pH6.5).
Cg2	80-110	Brownish gray(10YR 4/1) loamy sand; massive structure; non sticky, non plastic; slightly acid (field pH6.5)

Remark: soil survey at 1992

Table E-6 Soil profile in Bacho F/S area (11)

Pit BC-11

Ban:Nikomsahakorn Bacho, Tambon:Khok Khain, Amophoe:Muang, Changwat:Narathiwat
Physiography:Swampy, Parent Material:Organic soil material
Natural Vegetation or Land Use: Melaleuca Leucadendron, Test field
Soil Series: Narathiwat series, Ground Water Depth:150cm

Horizon	Depth(cm)	Horizon Description
Oi	0- 25	Black(7.5YR2/2) fibric material; massive structure; very coarse fibric material; extremely acid (field pH<4.5).
Oe	25- 50	Very dark redish brown(5YR 2/3) hemic material ;massive structure; extrmely acid (field pH<4.5).
Oi	50-170	Brownish black (5YR 2/2) fibric material massive structure; strongly acid (field pH 5.5).
Cg	170+	Dark brown (10YR 3/4) silt loam; massive structure; slightly sticky ; strongly acid (field pH5.5)

Remark: soil survey at 1992

Table E-7 Area of land use in F/S area (ha)

Land use	F/S area							
	Bacho		Kab Daeng		MuNo-Koknai		Total	
	area(ha)	index(%)	area(ha)	index(%)	ha	index	ha	index
waste land	-	-	-	-	67	9.3	67	1.7
natural forest	-	-	-	-	35	4.9	35	0.9
melaleuca forest	2,599	98.4	473	91.0	128	17.8	3,200	82.5
pasture	-	-	12	2.3	374	52.0	386	9.9
paddy field	-	-	-	-	15	2.1	15	0.4
oil palm(DID field)	5	0.2	-	-	-	-	5	0.1
coconut	-	-	-	-	14	1.9	14	0.4
cashw nut	-	-	16	3.1	-	-	16	0.4
vegetable	-	-	1	0.2	-	-	1	tr
para-rubber forest	-	-	-	-	21	2.9	21	0.5
road	3	0.1	6	1.1	10	1.4	19	0.5
canal	33	1.3	12	2.3	19	2.6	64	1.7
village	-	-	-	-	36	5.0	36	0.9
other	-	-	-	-	1	0.1	1	tr
Total	2,640	100.0	520	100.0	720	100.0	3,880	99.9

Remark : The data surveyed by JICA team at Oct. 1992

Table E-8 Soil profile in Kab Daeng F/S area (1)

Pit KD-1

Ban:Khoh Kraduk mu, Tambon:Prison, Amophoe:Tak Bai, Changwat:Narathiwat,
Physiography:Swamy, Parent Material:Organic soil material,
Natural Vegetation or Land Use:Melaleuca Leucadendron, grasses,
Soil series:Kab Daeng series Ground Water Depth: 40cm

Horizon	Depth (cm)	Horizon Description
Oe1	0- 10	Brownish black(10YR 3/1) and dull yellowish brown(10YR 4/3)hemic material; massive structure, many fine grasses road; some soil crack; strongly acid(field pH 5.5).
Oe2	10- 30/45	Black(10YR 2/1)hemic material; massive structure;many fine grasses root; some soil crack; very strongly acid(field pH 5.0)
Oe3	30/45-50/55	Brownish black(10YR 3/2)and black (10YR 2/1)hemic material; massive structure; some root rot and soil crack;very strongly acid(field pH 5.0).
Oe4	50/55-75/80	Black(10YR 2/1)hemic material;massive structure; some root rot; very strongly acid(field pH 5.0).
Cg	75/80+	Dark olive gray(5GY 4/1)silty clay loam;massive structur some root rot; slightly acid(field pH 6.5)

Remark: soil survey ;1992

Table E-8 Soil profile in Kab Daeng F/S area (2)

Pit KD-2

Ban:Khoh Kraduk mu, Tambon:Priwan, Amophoe:Tak Bai, Changwat:Narathiwat,
Physiography:Swamy, Parent Material:Organic soil material,
Natural Vegetation or Land Use: grasses,
Soil series:Kab Daeng series Ground Water Depth: 160cm

Horizon	Depth(cm)	Horizon Description
Oe1	0- 15/25	Black(7.5YR 2/1) hemic material; massive structure; very strongly acid(field pH 5.0) (0-4cm many fine grasses roo t)
Oe2	15/25-45/50	Black(10YR 2/1) hemic material; massive structure; some large root; very strongly acid(field pH 5.0)
Oe3	45/50-80/90	Brownish black(10YR 3/1) hemic material; massive structu re; some very large root; very strong acid(field pH 5.0)
Oi1	80/90-160	Brownish black(10YR 3/1) and dark brown(10YR 3/3) fibric material; massive structure; many soft large roots; str ong acid(field pH 5.5).
Oi2	160-240	Black(7.5YR 2/1) fibric material; massive structure; sli ghtly acid (field pH 6.5)
Cg	240+	Marine clay;massive structure; slightly acid (field pH 6.5) (by augor).

Remark: soil survey ;1992

Table E-8 Soil profile in Kab Daeng F/S area (3)

Pit KD-3

Ban:Sapom, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat,
Physiography:Swamy, Parent Material:Organic soil material,
Natural Vegetation or Land Use:grasses, Melaleuca Leucadendron,
Soil series:Narathiwat series, Ground Water Depth: 120cm,

Horizon	Depth(cm)	Horizon Description
Oe1	0- 5/10	Brownish black(10YR 3/2) hemic material; massive structure; very strongly acid (field pH 5.0).
Oe2	5/10-50	Brownish black(2.5Y 3/2) hemic material; massive structure slightly acid (field pH 6.5).
Oi1	50-70/75	Black(10YR 2/1) and brownish black(10YR 3/1)fibric material; massive structure; slightly acid (field pH 6.5).
Oi2	70/75-90/100	Black(10YR 2/1) and brownish black(10YR 3/1)fibric material; massive structure; some spot of marine clay; slightly acid (field pH 6.5).
Oi3	90/100-120/140	Brownish black(10YR 3/1)fibric material; massive structure; some spot of marine clay; slightly acid (field pH 6.5)
Cg	120/140+	Dark greenish gray(5G 4/1) silty clay loam; massive structure; slightly acid (field pH 6.5).

Remark: soil survey ;1992

Table E-8 Soil profile in Kab Daeng F/S area (4)

Pit KD-4

Ban:Sapom, Tambon:Kaluwonue, Amophoe:Muang, Changwat:Narathiwat,
Physiography:Swamy, Parent Material:Organic soil material,
Natural Vegetation or Land Use:Melaleuca Leucadendron, fern, reed, grasses,
Soil series:Narathiwat series, Ground Water Depth: 115cm

Horizon	Depth(cm)	Horizon Description
Oe1	0-12/20	Black(10YR 2/1) to brownish black (10YR 3/1) hemic material; massive structure; many fine and medium roots; some soil cracks; extremely acid(field pH 4.5>).
Oe2	12/20-40/45	Brownish black (10YR 3/1) hemic material; massive structure; some root rot; some soil crack; extremely acid (pH 4.5>).
Oe3	40/45-80/90	Dark brown(10YR 3/3) and brownish black (10YR 3/1) hemic material; massive structure; some root rot; extremely acid (field pH 4.5>).
Oe4	80/90-110/115	Brownish black (10YR 3/1) hemic material; massive structure; some root rot; extremely acid (pH 4.5>)
Cg	110/115+	Dark olive gray(5GY 4/1) silty clay loam mixed with some organic soil; slightly acid (field pH 6.5).

Remark soil survey ;1992

Table E-9 Soil profile in MuNo-Koknai(1)

Pit TD-1

Ban:Khok Nai, Tambon:Pron, Amophoe:Tak Bai, Changwat:Narathiwat
Physiography:marginal swamp, Parent Material:Old marine deposite
Natural Vegetation or Land Use:Melaleuca Leucadendron
Soil series:Munoh series Ground Water Depth:100cm

Horizon	Depth (cm)	Horizon Description
Ap	0-15/25	Graynish yellow brown (10YR 5/2) silt loam, common fine Distinct bright reddish brown(7.5YR 5/6)mottle; moderat e medium and coarse subangular blockystructure; slightly sticky, slightly plastic; many fine root; very strongly acid (field pH 4.5) abrupt, wary boundary
Bg1	15/25-55	Grayish yellow brown(10YR 4-5/2)silty clay loam, common fine prominent reddish brown(5YR 4/6) mottles; strong ve ry coase subangular blocky structure, slightly sticky, p lastic; some roots rot; very strongly acid(field pH 4.5) ; gradual, smooth boundary
Bg2	55-70/80	Grayish yellow brown(10YR 5/2)silty clay; common medium prominent yellow(2.5Y 8/6)mottle[jarosite]; moderate coa rse subang ular blocky stracture; sticy, plastic; many r oots rot; some soil crack; very strongly acid (field pH 4.5) ; abrupt, wany boundary
BCg	70/80-100/11 0	Dark bluish gray(5BG 4/1)silty clay loam [pyrite]; many medium and coarse prominent yellaw(2.5Y 8/6)[jarosite]; massive structure; slightly sticky, slightly plastic; so me mica flake; very strongly acid (field pH 4.5); gradua l, wary boundary
Cg	100/110+	Dark bluish gray(5BG 4/1)silty clay loam [pyrite]; no mo ttle; massive structure; many mica flakes; slightly acid (field pH 6.5) by augor

Remark: soil survey;1992

Table E-9 Soil profile in MuNo-Koknai(2)

Pit TD-2

Ban:Khok Nai, Tambon:Pron, Amophoe:Tak Bai, Changwat:Narathiwat
Physiography:marginal swamp, Parent Material:Old marine deposite
Natural Vegetation or Land Use:Grasses and reedes
Soil series:Munoh series Ground Water Depth:150cm

Horizon	Depth(cm)	Horizon Description
Ag	0- 12/15	Grayish yellow brown(10YR 5/2) silty clay loam; some mot tlees in root pores, strong coase subangular blocky stru cture; sticky, plastic; many soil cracks; very strong ac id(field pH 4.5); gradual, smooth boundary.
Bg1	12/15-45	Grayish yellow brown(10YR 5/2) silty clay loam; many med ium distinct dark brown(7.5YR 3/4) to brown(7.5YR 4/4) m ottles; strong coase subangular blocky structure; sticky plastic; many soil cracks; very strong acid(field pH4.5) ; gradual, smooth boundary.
Bg2	45-60/70	Grayish yellow brown(10YR 5/2) silty clay loam; many med ium distinct dark brown(7.5YR 3/4) to brown(7.5YR 4/4) m ottles; strong coase subangular blocky structure; sticky plastic; many soil cracks; very strong acid(field pH4.5) ; gradual, smooth boundary.
BCg	60/70-110	Grayish yellow brown(10YR 5/2) silty clay loam; common f ine prominant yellow(2.5Y 8/6)mottles; few fine dark red dish brown(2.5YR 3/6) and bright brown(7.5YR 5/6)mottles ;massive structure; slightly sticky, slightly plastic; m any mica flakes; some soil clacks; very strong acid(fie ld pH 4.5); gradual, smooth boundary.
Cg	110+	Dark bluish gray(5B 4/1) silty clay loam; massive struct ure; many mica flakes, slightly acid(field pH 6.5) by au gar (220cm+ some shell fragment).

Remark: soil survey;1992

Table E-9 Soil profile in MuNo-Koknai(3)

Pit TD-3

Ban:Khok Nai, Tambon:Pron, Amophoe:Tak Bai, Changwat:Narathiwat
Physiography:marginal swamp, Parent Material:Old marine deposite
Natural Vegetation or Land Use:Abandan paddy field, Melaleuca Leucadendron
Soil series:Munoh series Ground Water Depth: 60cm

Horizon	Depth(cm)	Horizon Description
Ap	0- 15/20	Brownish black(10YR 3/1) silty clay loam; strong coase subanglar blocky structure; slightly sticky, slightly plastic; slightly acid(field pH 6.5); abrupt, wary boundary
Bg1	15/20-40	Grayish yellow brown(10YR 6/2) silty clay loam, common fine distinct bright brown(7.5YR 5/8)mottles; strong coase subanglar blocky structure; sticky, plastic; very strongly acid (field pH 4.5); gradual, smooth boundary.
Bg2	40-65	Grayish yellow brown(10YR 6/2) silty clay; common fine distinct bright yellowish brown(10YR 6/8)mottles; common medium subangular blocky structure; sticky, plastic; very strongly acid(field pH 4.5); gradual, smooth boundary.
BCg1	65-90	Grayish yellow brown(10YR 6/2) silty clay loam, common fine distinct bright yellowish brown(10YR 6/8)mottles; massive structure; slightly sticky, slightly plastic; very strongly acid(field pH 4.5); gradual, smooth boundary .
BCg2	90-130	Grayish yellow brown(10YR 5/2) silty clay loam, many medium prominant yellow (2.5Y 8/6) mottles; massive structure; very strongly acid(field pH 4.5).
Cg	130-200	Dark olive gray(5GY 4/1) silty clay loam; massive structure;(by augar).

Remark: soil survey;1992

Table E-9 Soil profile in MuNo-Koknai(4)

Pit TD-4

Ban:Khok It, Tambon:Pron, Amophoe:Tak Bai, Changwat:Narathiwat
Physiography:marginal swamp, Parent Material:Old marine deposite
Natural Vegetation or Land Use:Abandon paddy field, Melaleuca Leucadendron
Soil series:Munoh series Ground Water Depth:150cm

Horizon	Depth(cm)	Horizon Description
Ap	0- 10/13	Very brownish black(10YR 3/2) silt loam; strong coarse subangular blocky structure; slightly sticky, slightly plastic; many soil cracks; very strongly acid(field pH 4.5); gradual, smooth boundary.
Bg1	10/13-18/20	Brownish gray(10YR 4/1)and light gray(10YR 7/1) to brownish gray(10RY 6/1) silty clay loam; common fine distinct bright brown(7.5YR 5/6) mottles; strong coarse subangular blocky structure; slightly sticky, slightly plastic; some soil cracks; very strongly acid(field pH 4.5); gradual, smooth boundary.
Bg2	18/20-45	Grayish yellow brown(10YR 5/2) silty clay loam; many medium distinct bright brown(7.5YR 5/6) mottles; strong coarse subangiar blocky structure; slightly sticky, slightly plastic; some soil cracks; extremely acid(field pH<4.5); gradual, smooth boundary.
Bg3	45-80/90	Grayish yellow brown(10YR 5/2) silty clay loam; many medium prominent dull reddish brown(5YR 4/4) mottles; moderate medium subanglar blocky structure; some soil cracks; extremely acid(field pH<4.5); abrupt, some boundary.
BCg	80/90-140	Gray(5Y 6/1) to light gray(5Y 7/1) silty clay loam; common medium distinct yellow orange(7.5YR 8/8) and many medium prominant yellow(2.5Y 8/8) mottles; massive structure; slightly sticky, slightly plastic; very strong acid (field pH 6.5).
Cg	140-200	Greenish gray(5G 5/1) silty clay loam; massive structure; no mottled; some shell fragment; slightly acid (field pH 6.5) by augar.

Table E-9 Soil profile in MuNo-Koknai(5)

Pit TD-5

Ban:Khok Ku Wae Tambon:Pron. Amophoe:Tak Bai, Changwat:Narathiwat

Physiography:marginal swamp, Parent Material:Old marine deposite

Natural Vegetation or Land Use:Abandon paddy field Melaleuca Leucadendron

Soil series:Rangae series Ground Water Depth:150cm<

Horizon	Depth(cm)	Horizon Description
Ap	0- 10	Brownish black(10YR 3/2) silt loam; massive structure; common fine and medium roots; very strongly acid(field pH 5.0); abrupt smooth boundary.
Bg1	10-30	Dull yellow brown(10YR 6/3) silty clay loam; few fine faint bright yellowish brown(10YR 6/8)mottles; some soil cracks; strong coarse subangular blocky structure; slightly sticky slightly plastic some soil cracks; very strong acid(field pH 4.5); gradual smooth boundary.
Bg2	30-60	Grayish yellow brown(10YR 5/2)silty clay; common fine bright brown(7.5YR 5/6) mottles; strong blocky structure; sticky, plastic; some soil cracks; very strong acid(field pH 4.5); gradual, smooth boundary.
Bg3	60-90	Dark grayish brown(2.5Y 5/2) silty clay loam, common fine brown(7.5YR 4/4) mottles; moderate coarse subangular blocky structure; sticky, plastic; some soil cracks; common mica flakes; very strong acid(field pH 4.5); gradual smooth boundary.
Cg	90-140	Dark olive gray(5GY 4/1) silty clay loam; common medium prominant brown(7.5YR 4/4)mottles occured in root pores; massive structure; slightly sticky slightly plastic; many mica flacks; slightly acid(field pH 6.5).

Remark: soil survey;1992

Table E-9 Soil profile in MuNo-Koknai(6)

Pit TD-6

Ban:Khok Nai, Tambon:Pron, Amophoe:Tak Bai, Changwat:Narathiwat
Physiography:marginal swamp, Parent Material:Old marine deposite
Natural Vegetation or Land Use:Melaleuca Leucadendron
Soil series:Munoh series Ground Water Depth: 80cm

Horizon	Depth (cm)	Horizon Description
Ap	0-10	Black(10YR 2/1) loam, common fine moderate medium and coarse subangular blocky structure; slightly sticky, slightly plastic; some fine root; very strongly acid (field pH 3.2).
Bg1	10-50	Grayish yellow brown(10YR 5/2)silty clay, strong very coarse subangular blocky structure, slightly sticky, plastic; some roots rot; very strongly acid(field pH 3.4); gradual, smooth boundary
BCg1	50-80	Grayish yellow brown(10YR 5/2)silty clay; common medium prominent yellow(2.5Y 7/8)mottle[jarosite]; moderate coa rse subangular blocky stracture; sticky, plastic; many roots rot; some soil crack; very strongly acid (field pH 2.7),
BCg2	80+	Gray(7.5Y 4/1)silty clay [pyrite];many medium and coarse prominent yellow(2.5Y 7/8)[jarosite]; massive structure , lightly sticky, slightly plastic; some mica flake; very strongly acid(field pH 2.9);gradual, wary boundary.

Remark: soil survey;1992

Table E-9 Soil profile in MuNo-Koknai(7)

Pit TD-7

Ban:Khok Nai, Tambon:Pron, Amophoe:Tak Bai, Changwat:Narathiwat
Physiography:marginal swamp, Parent Material:Old marine deposite
Natural Vegetation or Land Use:Abandan paddy field,
Soil series:Munoh series, Ground Water Depth: 60cm, Leaching test field

Horizon	Depth(cm)	Horizon Description
Ap	0- 23	Brownish black(10YR 3/2) silty clay ; strong coarse subangular blocky structure;slightly sticky, slightly plastic ; slightly acid(field pH 4.5).
Bg1	23- 55	Grayish yellow brown(10YR 5/2) silty clay , common fine yellowish brown(10YR 5/8)mottles;strong coarse subangular blocky structure; sticky, plastic; very strongly acid (field pH 4.5); gradual, smooth boundary.
Bg2	55- 85	Grayish yellow brown(10YR 5/2) silty clay; common fine distinct yellowish brown(10YR 5/8)mottles; common medium subangular blocky structure; sticky, plastic; very strongly acid(field pH 4.5); gradual, smooth boundary.
BCg	85+	Dark brown(10YR 3/3) silty clay, common fine distinct yellow(2.5Y 7/8)mottle[jarosite]; massive strucyure; very strongly acid(field pH 4.5); gradual, smooth boundary; some soil clack.

Remark: soil survey;1992

Table E-10 Soil dressing materials

No.	Location	Latitude	Longitude	Geographical position	Soil pH (H_2O)	Soil pH (KCl)	EC mS/cm	Presumptive reserves (1,000t)	Quality	Remarks
1.	Ban Ka Yo Ma	N6 32 07	E101 38 48	Mountain foot	5.1	3.7	0.007	650	Good	Dig out site
2.	Ban Ka Rae	N6 27 21	E101 41 05	Hill(Tertiary chert)	4.6	3.8	0.013	3,575	Good	Dig out site
3.	Ban Pu Ta	N6 24 06	E101 46 15	Hill(colluvium)	4.6	3.8	0.015	1,300	Good	Dig out site
4.	Bukepalat	N6 22 53	E101 41 56	Hill(colluvium)	4.3	3.6	0.013	3,250	Fair	Road site
5.	Ban Ya Mu	N6 19 54	E101 43 32	Alluvial plain	4.4	3.6	0.026	15,600	Fair	Dumping ground
6.	Ban Tan Young Mug	N6 18 18	E101 43 47	Hill(colluvium)	4.3	3.8	0.020	610	Fair	Upland field
7.	Ban Cho Mong	N6 13 20	E101 51 09	Hill(colluvium)	5.1	4.0	0.008	7,312	Good	Road site
8.	Ban Kawa	N6 02 16	E101 53 50	Dilluvial upland	4.9	4.0	0.007	65,000	Good	Upland field
9.	Sungaikolok	N6 03 54	E102 01 46	Dilluvial upland	3.9	3.6	0.120	12,350	Poor	Lateritic soil
10.	Ban Se Ta Mat	N6 07 07	E101 55 57	Hill(sand dune)	4.2	4.0	0.023	44,850	Fair	Pond, pasture
11.	Ban Ba Ke Ya Mu	N6 31 53	E101 43 36	Mountain foot	4.9	4.1	0.012	1,924	Good	near Bacho
				Total				156,421		
				Within available				79,761		

Remark : Survey at Oct. 1992

E-10-2 Soil dressing materials

Cheaper soil dressing materials can be obtained from the near-by swamps, but most of the fertile soils in these areas are used for paddy cultivation or para-rubber production, making it difficult to obtain good soil dressing materials. On the other hand , soil materials found in the dig out sites on the hills surrounding the swamps are unsuitable for soil dressing due to the presence of gravels which are rather appropriate for road construction.

Therefore, we surveyed the upland areas and the foot of mountains in search of appropriate soil dressing materials. The results of the survey is shown in table E-10 and figure E-5. The analysis in the table is based on pH values pe nding results of the quality analysis of the soil materials.

As seen from the table, the lateritic soil used for making road has a high acidity(<pH4) and is therefore unsuitable as a dressing material. It is observed that in good soils, about 1m depth from surface is suitable for dressing. Past 1 m depth, there are gravels. The potential reserves which are judged good are about 80,000,000 ton and the peat soil in the F/S area cover about 3,200ha. If the soil dressing is 20cm deep, 800 ton are necessary to cover all the area; therefore, the amount of soil dressing is sufficient.

The cost of transportation of soil materials is 400 Baht per 8(eight) ton(average distance 5(five)km). Therefore, the total cost is 4(four) hundred million. Adding up the cost of lime dust for neutralization is necessary. As described above, the improvement by soil dressing is very expensive.

Ideally, the materials of soil dressing should include liming materials such as the Dolomite. Soil dressing is the best way to correct some synthetically related problems found particularly in fibric peat. However, these technics of soil improvement should be applied to intensive agriculture in parts of the development zone, because they are very expensive. On the other hand, lateritic soil found at nearby mountains sites can provide significant improvement on soil dressing but it is necessary to take into account

transportation costs. Before its use as a material, the lateritic nature of the soil should be analyzed. The most available material is sandy soil from sand dune but it is so poor in nutrients and has a loose structure making the mixing with fibric peat unsuitable.

Table E-11 The physical property -(1)

CODE NO.	DEPTH cm.	HORIZON	USDA Grading Sand >0.05	Silt 0.05~0.002	Clay 0.002>	Tex-ture	Core Depth	Bulk Density	Moisture Content	Perme-ability	Corresponding permeability classes
BC-1-4	110~130	Cg1	13.3	29.9	56.8	HC	-	-	-	-	-
BC-1-5	130+	Cg2	90.5	3.5	6.0	LS	-	-	-	-	-
BC-3-3	55~85	Cg1	80.4	12.6	7.0	SL	-	-	-	-	-
BC-3-4	85~110	Cg2	83.5	5.7	10.8	SL	-	-	-	-	-
BC-3-5	110~150	Cg3	80.5	5.8	13.7	SL	-	-	-	-	-
BC-4-3	70~100	Cg1	65.0	12.8	22.2	SCL	-	-	-	-	-
BC-4-4	100~130	Cg2	73.1	10.0	16.9	SCL	-	-	-	-	-
BC-5-2	25~45	Cg1	-	-	-	-	25~29	0.37	10.1	25.8	very.rapid
BC-5-3	45~70	Cg2	95.8	3.2	1.0	S	50~54	0.47	16.7	2.83	moderate
BC-5-4	70~100	Cg3	95.9	1.6	2.5	S	-	-	-	-	-
BC-5-5	100+	Cg4	94.2	4.8	1.0	S	-	-	-	-	-
BC-7-2	2/10~18/20	Cg1	93.7	4.3	2.0	S	-	-	-	-	-
BC-7-3	18/20~35/40	Cg2	94.8	3.7	1.5	S	25~29	1.42	1.9	9.53	very.rapid
BC-7-4	35/40~60	Cg3	93.9	4.1	2.0	S	50~54	1.55	13.9	4.91	moderate
BC-7-5	60~90	Cg4	80.4	8.6	11.0	SL	-	-	-	-	-
BC-7-6	90~130	Cg5	97.0	1.9	1.0	S	-	-	-	-	-
BC-7-7	130~160	Cg6	91.5	2.5	6.0	S	-	-	-	-	-
BC-8-2	3/5~30	Cg1	95.7	0.8	3.5	S	10~14	1.53	12.8	1.13	very.slow
BC-8-3	30~50	Cg2	93.0	4.0	3.0	S	45~49	1.63	18.8	5.35	moderate
BC-8-4	50~140	Cg3	85.0	1.5	13.5	LS	-	-	-	-	-
BC-8-5	140+	Cg4	89.9	4.7	5.5	LS	-	-	-	-	-
BC-9-3	55~80	Cg1	54.2	12.3	33.5	LiC	-	-	-	-	-
BC-9-4	80+	Cg2	90.3	6.7	3.0	S	-	-	-	-	-
BC-10-1	0~20	O1	-	-	-	-	5~9	0.32	185.2	-	moderate
BC-10-2	20~40	O2	-	-	-	-	25~29	0.21	345.2	27.09	very.rapid

Remark : Determined by DLD

Remarks

1. BC shows that all samples are collected from Bacho area.

2. Corresppondings Permeability Class

Class	Hydraulic Conductivity cm/hr
very slow	<0.125
slow	0.125~0.5
moderate slow	0.5~2.0
moderate	2.0~6.25
moderate rapid	6.25~12.5
rapid	12.5~25.0
very rapid	>25.0

* If the soil is peat (i.e.O horizon), texture could not determined.

Table E-11 Physical property -(2)

CODE NO.	DEPTH cm.	HORIZON	USDA Grading Sand >0.05	Silt 0.05~0.002	Clay 0.002>	Tex-ture	Core Depth	Bulk Density	Moisture Content	Perme-ability	Corresponding permeability classes	Remarks
KD-1-1	0~10	Oe1	-	-	-	-	0~4	0.37	46.8	22.65	Rapid	1. KD shows that all samples are collected from
KD-1-2	10~30/45	Oe2	-	-	-	-	15~19	0.76	90.0	14.22	Rapid	Kab Daeng area.
KD-1-3	30/45~50/55	Oe3	-	-	-	-	50~54	0.43	146.4	13.96	Rapid	
KD-1-4	50/55~75/80	Oe4	-	-	-	-	60~64	0.42	129.0	-	many holes(rd)	2. Corresppondings Permeability Class
KD-1-5	75/80+	Cg1	-	-	-	-	-	-	-	-	-	Class Hydraulic Conductivity
KD-2-1	0~15/25	Oe1	-	-	-	-	10~14	0.36	149.3	-	many holes(rd)	cm/hr
KD-2-2	15/25~45/50	Oe2	-	-	-	-	35~39	0.23	289.8	51.74	very.rapid	very slow <0.125
KD-2-3	45/50~80/90	Oe3	-	-	-	-	-	-	-	-	-	slow 0.125~0.5
KD-2-4	80/90~160	Oi1	-	-	-	-	-	-	-	-	-	moderate slow 0.5~2.0
KD-2-5	160~240	Oi2	-	-	-	-	-	-	-	-	-	moderate 2.0~6.25
KD-3-1	0~5/10	Oe1	-	-	-	-	-	-	-	-	-	moderate rapid 6.25~12.5
KD-3-2	5/10~50	Oe2	-	-	-	-	15~19	0.38	149.7	-	many holes(rd)	rapid 12.5~25.0
KD-3-3	50~70/75	Oi1	-	-	-	-	55~59	0.23	311.2	19.85	Rapid	very rapid >25.0
KD-3-4	70/75~90/100	Oi2	-	-	-	-	-	-	-	-	-	* If the soil is peat (i.e.O horizon), texture
KD-3-5	90/100~120/140	Oi3	-	-	-	-	-	-	-	-	-	could not determined.
KD-3-6	35/40~60	Cg	-	-	-	-	-	-	-	-	-	
KD-4-1	0~12/20	Oe1	-	-	-	-	6~10	0.45	119.3	-	many holes(rd)	
KD-4-2	12/20~40/45	Oe2	-	-	-	-	35~39	0.19	328.9	71.56	very.rapid	
KD-4-3	40/45~80/90	Oe3	-	-	-	-	70~74	0.39	156.8	-	many holes(rd)	
KD-4-4	80/90~110/115	Oe4	-	-	-	-	-	-	-	-	-	
KD-4-5	110/115+	Cg	-	-	-	-	-	-	-	-	-	

Remark : Determined by DLD

Table E-11 The Physical prorerty -(3)

CODE NO.	DEPTH cm.	HORIZON	USDA Grading Sand >0.05	Silt 0.05~0.002>	Clay 0.002>	Tex-ture	Core Depth	Bulk Density	Moisture Content	Perme-ability	Corresponding permeability classes	Remarks
TD-1-1	0~15/25	Ag	-	-	-	-	0~4	0.88	43.6	5.98	moderate	1. TD shows that all samples are collected from
TD-1-2	15/25~55	Bg1	2.5	62.6	34.9	SiCL	40~44	1.31	31.2	6.81	mod.rapid	Muno-Koknai area.
TD-1-3	55~70/80	Bg2	2.3	58.2	39.5	SiC	70~74	1.11	45.4	2.61	moderate	2. Corresppondings Permeability Class
TD-1-4	70/80~80/110	BCg	7.6	67.4	25.0	SiL	-	-	-	-	-	Class Hydraulic Conductivity
TD-1-5	80/110+	Cg	9.4	67.1	23.5	SiCL	-	-	-	-	-	
TD-2-1	0~12/15	Ag	3.3	57.0	39.7	SiC	0~4	1.13	29.4	0.54	mod.slow	cm/hr
TD-2-2	12/15~45	Bg1	6.6	58.8	35.2	SiC	36~40	1.27	24.9	35.01	very.rapid	very slow <0.125
TD-2-3	45~60/70	Bg2	5.5	61.0	33.5	SiC	65~69	1.09	45.2	9.90	mod.rapid	slow 0.125~0.5
TD-2-4	60/70~110	BCg	4.2	56.8	39.0	SiC	-	-	-	-	-	moderate slow 0.5~2.0
TD-2-5	110+	Cg	5.1	72.1	22.8	SiCL	-	-	-	-	-	moderate 2.0~6.25
TD-3-1	0~15/20	Ap	2.7	52.9	44.4	SiC	2~7	1.04	44.4	2.40	moderate	moderate rapid 6.25~12.5
TD-3-2	15/20~40	Bg1	0.5	59.5	40.0	SiC	25~29	1.24	39.5	8.14	mod.rapid	rapid 12.5~25.0
TD-3-3	40~65	Bg2	2.2	65.7	32.1	SiC	-	-	-	-	-	very rapid >25.0
TD-3-4	65~90	BCg1	2.0	64.1	33.9	SiC	-	-	-	-	-	
TD-3-5	90~130	BCg2	2.5	60.9	36.6	SiC	-	-	-	-	-	* If the soil is peat (i.e.O horizon), texture
TD-3-6	130~200	Cg	3.5	66.1	30.4	SiC	-	-	-	-	-	could not determined.
TD-4-1	0~10/13	Ap	-	-	-	-	-	-	-	-	-	
TD-4-2	10/13~18/20	Bg1	4.4	78.0	17.6	SiCL	3~7	0.94	139.2	1.01	mod.slow	
TD-4-3	18/20~45	Bg2	6.9	59.1	34.0	SiC	30~34	1.26	34.1	15.86	very.rapid	
TD-4-4	45~80/90	Bg3	5.2	51.0	43.8	SiC	60~64	0.98	51.6	12.53	Rapid	
TD-4-5	80/90~140	BCg	6.8	56.4	36.8	SiC	130~134	0.89	66.2	4.39	moderate	
TD-4-6	140~200	Cg	-	-	-	-	-	-	-	-	-	
TD-5-1	0~10	Ap	3.3	51.5	45.2	HC	-	-	-	-	-	
TD-5-2	10~13	Bg1	3.5	48.0	48.5	HC	25~29	0.64	158.8	-	-	
TD-5-3	30~60	Bg2	6.2	57.6	36.2	SiC	45~49	1.32	33.1	47.00	very.rapid	
TD-5-4	60~90	Bg3	16.8	59.3	23.9	SiCL	70~74	1.12	44.0	20.49	Rapid	
TD-5-5	90~140	Cg	6.1	81.4	12.5	SiL	105~109	1.06	52.5	1.69	mod.slow	

Remark : Determined by DLD

Table E-12 The chemical property -(1)

LABORATORY CODE NO.	DEPTH cm.	HORIZON	MOISTURE AIR TO OVEN DRY %	EC m.mho/cm. 1:5	C %	N %	C/N	BASE EXCHANGE CAPACITY AND CATION (milli equiv/100g) Ca	Mg	K	Na	SUM (Ca+Mg+K+Na) (B)	EXTR ACID (A)	SUM (B+A)	CEC SOIL (C)	CEC 100G CLAY	Ca/Mg	Mg/K	BASE SATURATION % Ca/(C) X100	(B/C) X100	(BX100) /(B+A)	P p.p.m. (BRAY No.2)	K p.p.m. (AMMON ACETATE)
BC-1-1	0-30	Oi1	13.2	0.25	54.8 *	1.46	37.5	4.3	7.8	0.30	0.8	13.2	39.8	53.0	162.2	-	0.55	26.0	3	8	25	14	108
BC-1-2	30-60	Oi2	14.2	0.18	55.6 *	1.69	32.9	3.1	2.9	0.30	0.8	7.1	49.8	56.9	159.2	-	1.07	9.7	2	4	12	9	80
BC-1-3	60-110	Oi3	13.1	0.25	53.3 *	1.21	44.0	1.4	3.1	0.20	0.6	5.3	38.6	43.9	141.1	-	0.45	15.5	1	4	12	2	38
BC-1-4	110-130	Cg1	8.8	0.09	5.5	0.16	34.4	0.8	1.5	0.10	0.3	2.7	19.1	21.8	17.4	30.6	0.53	15.0	5	16	12	9	40
BC-1-5	130+	Cg2	0.5	0.95	0.7	0.02	35.0	0.3	0.2	0.04	0.2	0.7	8.2	8.9	2.0	33.3	1.50	5.0	15	37	8	2	4
BC-2-1	0-30	Oi1	26.2	0.27	56.5 *	1.38	40.9	1.3	15.9	0.40	1.8	19.4	48.0	67.4	207.7	-	0.08	39.8	1	9	29	13	90
BC-2-2	30-60	Oi2	10.9	0.30	57.2 *	1.06	54.0	0.55	5.5	0.20	1.5	7.8	43.4	51.2	188.4	-	0.10	27.5	0	4	15	3	38
BC-2-3	60-90	Oi3	11.2	0.19	57.0 *	1.21	47.1	0.6	8.4	0.10	1.4	10.5	42.0	52.5	143.7	-	0.07	84.0	0	7	20	2	33
BC-2-4	90-190	Oi4	4.2	0.22	55.1 *	1.11	49.6	2.4	18.6	0.10	1.3	22.4	32.5	54.9	136.4	-	0.13	186.0	2	16	41	2	43
BC-3-1	0-30	Oi	12.2	0.15	43.4 *	1.30	33.4	2.8	2.0	0.20	0.6	5.6	45.3	51.1	117.4	-	1.40	10.0	2	5	11	16	62
BC-3-2	30-55	Oe	11.1	0.11	36.8 *	0.98	37.6	1.8	1.3	0.10	0.5	3.7	36.6	40.3	114.6	-	1.38	13.0	2	3	9	4	28
BC-3-3	55-85	Cg1	3.0	0.07	6.0	0.10	60.0	0.2	0.2	0.05	0.2	0.7	17.3	18.0	16.8	240.0	1.00	4.0	1	4	4	6	11
BC-3-4	85-110	Cg2	1.6	0.05	4.4	0.03	146.7	0.2	0.1	0.05	0.2	0.6	9.1	9.7	4.9	45.4	2.00	2.0	4	11	6	6	11
BC-3-5	110-150	Cg3	1.4	0.56	1.4	0.03	46.7	0.5	0.2	0.06	0.2	1.0	11.1	12.1	5.4	39.4	2.50	3.3	9	18	8	20	15
BC-4-1	0-30	Oi1	1.4	0.04	52.4 *	1.25	41.9	3.1	0.4	0.10	0.6	4.2	44.8	49.0	148.7	-	7.75	4.0	2	3	9	16	39
BC-4-2	30-70	Oi2	1.3	0.30	55.4 *	1.20	46.2	2.4	4.2	0.10	0.8	7.5	45.6	53.1	161.7	-	0.57	42.0	1	5	14	3	47
BC-4-3	70-100	Cg1	1.4	0.12	3.8	0.05	76.0	1.0	1.5	0.04	0.4	2.9	9.2	12.1	7.4	33.3	0.67	37.5	14	40	24	2	10
BC-4-4	100-130	Cg2	0.8	0.27	0.6	0.01	60.0	0.7	1.2	0.06	0.4	2.4	4.0	6.4	2.9	17.2	0.58	20.0	24	81	37	2	12

Note ; % Organic carbon with * analysed by loss-on ignition method

; Determined by DLD

;BC :Bacho area, KD : Kab Daeng area, TD ; Muno-Koknai area

Table E-12 The chemical property -(2)

LABORATORY CODE NO.	DEPTH cm.	HORIZON	MOISTURE AIR TO OVEN DRY %	EC m.mho/cm. 1:5	C %	N %	C/N	BASE EXCHANGE CAPACITY AND CATION (milli equiv/100g) Ca	Mg	K	Na	SUM (Ca+Mg+K+Na) (B)	EXTR ACID (A)	SUM (B+A)	CEC SOIL (C)	CEC 100G CLAY	Ca/Mg	Mg/K	BASE SATURATION % Ca/(C) X100	(B/C) X100	(BX100) /(B+A)	P p.p.m. (BRAY No.2)	K p.p.m. (AMMON ACETATE)
BC-5-1	0-25	Oe	11.7	1.77	50.8 *	1.12	45.4	4.1	3.8	0.10	0.4	8.4	49.6	58.0	159.4	-	1.08	38.0	3	5	14	6	47
BC-5-2	25-45	Cg1	0.2	0.02	0.3	0.01	30.0	0.3	0.07	0.03	0.2	0.6	1.9	2.5	1.0	-	4.29	2.3	30	>100	24	2	4
BC-5-3	45-70	Cg2	1.1	0.03	0.9	0.01	90.0	0.2	0.06	0.03	0.3	0.6	7.0	7.6	2.8	280.0	3.33	2.0	7	21	8	13	4
BC-5-4	70-100	Cg3	0.4	0.03	0.2	tr	-	0.1	0.05	0.04	0.2	0.4	2.2	2.6	0.9	36.0	2.00	1.3	11	43	15	12	5
BC-5-5	100+	Cg4	0.5	0.02	0.1	tr	-	0.2	0.06	0.04	0.2	0.5	1.5	2.0	1.0	100.0	3.33	1.5	20	50	25	17	6
BC-6-1	0-35	Oi1	14.5	0.17	55.8 *	1.21	46.1	4.4	11.6	0.40	1.8	18.2	45.7	63.9	233.9	-	0.38	29.0	2	8	28	14	108
BC-6-2	35-75	Oe	11.6	0.07	56.6 *	1.08	52.4	2.6	10.5	0.01	1.3	14.4	40.8	55.2	151.8	-	0.25	1050.0	2	9	26	3	23
BC-6-3	75+	Oi2	14.0	0.34	55.9 *	1.26	44.4	16.5	25.0	0.08	1.4	43.0	41.0	84.0	153.6	-	0.66	312.5	11	28	51	3	31
BC-7-1	0-2/10	Oe	5.9	0.14	29.7 *	0.66	45.0	1.6	1.4	0.01	0.3	3.3	33.6	36.9	56.7	-	1.14	140.0	3	6	9	28	29
BC-7-2	2/10-18/20	Cg1	6.3	0.03	1.9	0.04	47.5	0.2	0.1	0.03	0.3	0.6	9.5	10.1	8.3	415.0	2.00	3.3	2	8	6	2	5
BC-7-3	18/20-35/40	Cg2	0.2	0.02	0.4	0.01	40.0	0.2	0.04	0.04	0.2	0.5	2.8	3.3	1.1	73.3	5.00	1.0	18	44	15	1	7
BC-7-4	35/40-60	Cg3	0.6	0.02	0.95	0.02	47.5	6.8	0.02	0.05	0.2	7.1	7.6	14.7	3.3	165.0	340.00	0.4	>100	>100	48	9	6
BC-7-5	60-90	Cg4	1.3	0.03	0.09	0.01	9.0	0.4	0.3	0.10	0.4	1.2	2.3	3.5	1.9	17.3	1.33	3.0	21	63	34	2	32
BC-7-6	90-130	Cg5	0.1	0.02	0.01	-	-	0.2	0.04	0.05	0.2	0.5	0.1	0.6	0.9	90.0	5.00	0.8	22	54	83	1	5
BC-7-7	130-160	Cg6	0.4	0.02	0.09 *	-	-	0.3	0.2	0.05	0.2	0.8	1.2	2.0	0.6	10.0	1.50	4.0	50	>100	38	2	14
BC-8-1	0-3/5	Oe	2.6	0.40	36.9 *	0.72	51.3	4.2	2.3	0.10	0.5	7.1	31.8	38.9	81.7	-	1.83	23.0	5	9	18	27	35
BC-8-2	3/5-30	Cg1	0.8	0.05	0.4	0.00	100.0	0.2	0.05	0.04	0.2	0.5	2.0	2.5	7.2	205.7	4.00	1.3	3	7	20	1	6
BC-8-3	30-50	Cg2	0.8	0.03	0.5	0.01	50.0	0.4	0.1	0.04	0.2	0.7	5.3	6.0	1.5	50.0	4.00	2.5	27	49	12	8	8
BC-8-4	50-140	Cg3	1.2	0.03	0.1	tr	-	0.3	0.1	0.04	0.3	0.7	2.1	2.8	3.1	23.0	3.00	2.5	10	24	26	2	10
BC-8-5	140+	Cg4	0.6	0.02	0.09	tr	-	0.3	0.1	0.06	0.4	0.9	1.8	2.7	1.4	25.5	3.00	1.7	21	61	32	4	18

Note ; % Organic carbon with * analysed by loss-on ignition method

; Determined by DLD

Table E-12 The chemical property -(3)

LABORATORY CODE NO.	DEPTH cm.	HORIZON	MOISTURE AIR TO OVEN DRY %	EC m.mho/cm. 1:5	C %	N %	C/N	BASE EXCHANGE CAPACITY AND CATION (milli equiv/100g)											BASE SATURATION %			P p.p.m. (BRAY No.2)	K p.p.m. (AMMON ACETATE)
								Ca	Mg	K	Na	SUM (Ca+Mg+K+Na) (B)	EXTR ACID (A)	SUM (B+A)	CEC SOIL (C)	CEC 100G CLAY	Ca/Mg	Mg/K	Ca/(C) X100	(B/C) X100	(BX100) /(B+A)		
BC-9-1	0-25	Oi1	19.5	0.44	54.2 *	1.22	44.4	4.4	5.9	0.30	1.1	11.7	52.2	63.9	187.2	-	0.75	19.7	2	6	18	16	90
BC-9-2	25-55	Oi2	11.6	0.30	55.3 *	1.73	32.0	2.1	2.5	0.20	1.5	6.3	43.0	49.3	144.7	-	0.84	12.5	1	4	13	1	40
BC-9-3	55-80	Cg1	5.2	0.06	0.9	0.09	10.0	1.2	0.5	0.06	0.4	2.16	19.3	21.5	18.3	54.6	2.40	8.3	7	12	10	1	12
BC-9-4	80+	Cg2	0.4	0.02	0.6	0.04	15.0	0.6	0.2	0.02	0.2	1.02	2.6	3.6	0.9	30.0	3.00	10.0	67	>100	28	1	5
BC-10-1	0-20	O1	9.1	0.37	48.8 *	1.55	31.5	5.2	7.3	0.30	0.8	13.6	44.5	58.1	119.4	-	0.71	24.3	4	11	23	18	100
BC-10-2	20-40	O2	8.1	0.17	38.7 *	0.86	45.0	4.7	8.0	0.05	0.5	13.25	38.8	52.1	100.4	-	0.59	160.0	5	13	25	4	16
BC-10-3	40-80	Cg1	0.3	0.01	0.3	0.01	30.0	0.3	0.2	0.04	0.2	0.74	0.7	1.4	1.2	-	1.50	5.0	25	62	51	1	7
BC-10-4	80-110	Cg2	0.9	0.02	1.9	0.03	63.3	1.4	1.7	0.03	0.2	3.33	7.8	11.1	5.4	-	0.82	56.7	26	62	30	3	5

Note ; % Organic carbon with * analysed by loss-on ignition method
; Determined by DLD

Table E-12 The chemical property -(4)

LABORATORY CODE NO.	DEPTH cm.	HORIZON	MOISTURE AIR TO OVEN DRY %	EC m.mho/cm. 1:5	C %	N %	C/N	BASE EXCHANGE CAPACITY AND CATION (milli equiv/100g) Ca	Mg	K	Na	SUM (Ca+Mg+K+Na) (B)	EXTR ACID (A)	SUM (B+A)	CEC SOIL (C)	CEC 100G CLAY	Ca/Mg	Mg/K	BASE SATURATION % Ca/(C) X100	(B/C) X100	(BX100) /(B+A)	P p.p.m. (BRAY No.2)	K p.p.m. (AMMON ACETATE)
KD-1-1	0-10	Oe1	9.9	0.35	31.9 *	1.43	22.3	1.4	0.7	0.3	0.6	3.0	42.2	45.2	83.6	-	2.00	2.3	2	4	7	22	80
KD-1-2	10-30/45	Oe2	8.9	0.38	27.6 *	0.95	29.1	1.0	0.8	0.1	0.6	2.5	39.3	41.8	72.4	-	1.25	8.0	1	3	6	5	28
KD-1-3	30/45-50/55	Oe3	7.4	2.19	13.8 *	0.45	30.7	1.5	1.4	0.1	0.4	3.4	48.9	52.3	72.0	-	1.07	14.0	2	5	7	4	28
KD-1-4	50/55-75/80	Oe4	18.3	8.51	27.1 *	0.64	42.3	1.5	2.1	0.1	0.6	4.3	79.2	83.5	75.7	-	0.71	21.0	2	6	5	2	15
KD-1-5	75/80+	Cg	7.3	9.76	7.2	0.16	45.0	4.8	8.2	0.2	0.5	13.7	68.4	82.1	-	-	0.59	41.0	-	-	17	5	20
KD-2-1	0-15/25	Oe1	15.6	0.19	40.5 *	2.58	15.7	10.5	3.2	0.3	0.9	14.9	49.8	64.7	113.6	-	3.28	10.7	9	13	23	22	104
KD-2-2	15/25-45/50	Oe2	8.4	0.23	29.9 *	0.98	30.5	2.6	1.8	0.1	0.6	5.1	40.6	45.7	143.2	-	1.44	18.0	2	4	11	4	23
KD-2-3	45/50-80/90	Oe3	16.7	0.29	43.3 *	1.01	42.9	1.7	3.1	0.1	0.8	5.7	42.4	48.1	128.9	-	0.55	31.0	1	4	12	2	19
KD-2-4	80/90-160	Oi1	13.8	1.09	39.8 *	1.00	39.8	6.4	20.3	0.1	1.4	28.2	45.3	73.5	175.9	-	0.32	203.0	4	16	38	3	41
KD-2-5	160-240	Oi2	10.1	9.66	23.2 *	0.73	31.8	10.2	20.2	0.1	1.4	31.9	72.2	51.1	91.9	-	0.50	202.0	11	35	62	4	45
KD-2-6	240+		5.3	3.52	3.3	0.10	33.0	3.6	8.6	0.1	0.5	12.8	36.1	48.9	125.3	-	0.42	86.0	3	10	26	15	5
KD-3-1	0-5/10	Oe1	10.8	4.71	39.4 *	1.55	25.4	5.6	2.6	0.2	1.3	9.7	35.6	45.3	66.3	-	2.15	13.0	8	15	21	7	40
KD-3-2	5/10-50	Oe2	4.0	0.43	41.9 *	0.72	58.2	4.0	2.7	0.1	0.7	7.5	29.1	36.6	75.0	-	1.48	27.0	5	10	20	1	14
KD-3-3	50-70/75	Oi1	7.9	0.39	15.3 *	0.45	-	5.7	3.9	0.01	0.65	10.3	60.6	70.9	68.8	-	1.46	390.0	8	15	14	1	10
KD-3-4	70/75-90/100	Oi2	9.8	10.11	19.5 *	0.32	-	7.5	3.9	0.2	1.4	13.0	76.9	89.9	35.5	-	1.92	19.5	21	37	14	3	19
KD-3-5	90/100-200/140	Oi3	5.3	4.07	12.9 *	0.28	46.1	4.6	3.3	0.1	0.4	8.4	50.0	58.4	153.3	-	1.39	33.0	3	5	14	1	13
KD-3-6	120-140+	Cg	4.5	5.69	6.7 *	0.14	47.9	3.0	2.6	0.1	0.3	6.0	60.9	66.9	27.4	-	1.15	26.0	11	22	9	4	12
KD-4-1	0-12/20	Oe1	8.4	0.47	34.3 *	1.38	24.9	5.0	3.1	0.1	1.3	9.5	39.8	49.3	129.0	-	1.61	31.0	4	7	19	8	47
KD-4-2	12/20-40/45	Oe2	7.6	0.41	33.8 *	0.77	43.9	2.7	2.6	0.1	0.7	6.1	40.7	46.8	95.4	-	1.04	26.0	3	6	13	2	22
KD-4-3	40/45-80/90	Oe3	7.4	0.27	21.4 *	0.55	38.9	2.1	2.8	0.1	0.9	5.9	44.4	50.3	85.9	-	0.75	28.0	2	7	12	1	20
KD-4-4	80/90-110/115	Oe4	12.3	3.50	9.00	0.17	52.9	3.2	16.2	0.1	0.4	19.9	78.5	98.4	22.6	-	0.20	270.0	14	88	20	8	28

Note ; % Organic carbon with * analysed by loss-on ignition method

; Determined by DLD

Table E-12 The chemical property -(5)

LABORATORY CODE NO.	DEPTH cm.	HORIZON	MOISTURE AIR TO OVEN DRY %	EC m.mho/cm. 1: 5	C %	N %	C/N	BASE EXCHANGE CAPACITY AND CATION (milli equiv/100g) Ca	Mg	K	Na	SUM (Ca+Mg+K+Na) (B)	EXTR ACID (A)	SUM (B+A)	CEC SOIL (C)	CEC 100G CLAY	Ca/Mg	Mg/K	BASE SATURATION % Ca/(C) X100	(B/C) X100	(BX100) /(B+A)	P p.p.m. (BRAY No.2)	K p.p.m. (AMMON ACETATE)
TD-1-1	0-15/25	Ag	4.8	0.62	9.1	0.54	16.9	5.4	0.9	0.1	0.4	6.8	31.8	38.6	28.5	-	6.00	9.0	19	24	18	80	30
TD-1-2	15/25-55	Bg1	2.3	0.38	1.3	0.07	18.6	0.6	0.9	0.1	0.3	1.9	15.2	17.1	9.8	28.1	0.67	9.0	6	19	11	3	29
TD-1-3	55-70/80	Bg2	4.9	0.51	1.7	0.09	18.9	0.8	1.1	0.1	0.4	2.4	19.3	21.7	5.1	12.9	0.73	11.0	16	47	11	3	25
TD-1-4	70/80-100/110	BCg	4.9	3.31	2.8	0.10	28.0	1.3	1.7	0.04	0.3	3.3	62.0	65.3	14.5	58.0	0.76	42.5	9	23	5	7	8
TD-1-5	100/110+	Cg	4.0	2.67	5.2	0.99	5.3	5.3	7.0	0.05	0.3	12.7	36.9	49.6	13.7	58.3	0.76	140.0	39	92	26	27	5
TD-2-1	0-12/15	Ag	3.8	0.63	6.1	0.23	26.5	0.5	1.2	0.1	0.4	2.2	27.3	29.5	22.2	55.9	0.42	12.0	2	10	7	14	20
TD-2-2	12/15-45	Bg1	2.4	0.56	1.1	0.06	18.3	1.1	1.4	0.1	0.3	2.9	16.6	19.5	9.7	27.6	0.79	14.0	11	30	15	1	26
TD-2-3	45-60/70	Bg2	2.4	0.45	1.0	0.06	16.7	0.8	2.8	0.1	0.2	3.9	16.6	20.5	10.4	31.0	0.29	28.0	8	38	19	1	32
TD-2-4	60/70-110	BCg	3.8	0.62	1.4	0.07	20.0	1.4	2.2	0.1	0.3	4.0	18.8	22.8	12.5	32.1	0.64	22.0	11	32	18	2	36
TD-2-5	110+	Cg	3.5	2.21	3.2	0.08	40.0	8.2	22.0	0.1	0.4	30.7	20.3	51.1	18.1	79.4	0.37	220.0	45	>100	60	21	76
TD-3-1	0-15/20	Ap	3.0	0.81	5.2	0.19	27.4	1.3	1.7	0.1	0.4	3.5	28.0	31.5	18.5	41.7	0.76	17.0	7	19	11	10	17
TD-3-2	15/20-40	Bg1	2.4	0.64	0.8	0.06	13.3	1.4	1.8	0.1	0.3	3.6	17.5	21.1	9.4	23.5	0.78	18.0	15	38	17	0	21
TD-3-3	40-65	Bg2	2.7	0.59	0.8	0.05	16.0	1.4	1.7	0.1	0.3	3.5	16.7	20.2	8.5	26.5	0.82	17.0	16	41	17	1	20
TD-3-4	65-90	BCg1	2.5	0.72	0.8	0.06	-	1.5	1.9	0.1	0.4	3.9	17.2	21.1	9.4	27.7	0.79	19.0	16	41	18	1	20
TD-3-5	90-130	BCg2	3.8	1.31	1.7	0.08	-	2.4	3.0	0.1	0.6	6.1	25.0	31.1	12.7	34.7	0.80	30.0	19	48	20	7	15
TD-3-6	130-200	Cg	4.0	2.30	2.5	0.08	31.3	9.0	17.0	0.1	0.8	26.9	22.8	49.7	15.8	52.0	0.53	170.0	57	>100	54	18	59
TD-4-1	0-10/13	Ap	3.7	0.89	9.1	0.52	17.5	2.6	2.1	0.2	0.5	5.4	27.5	32.9	22.0	-	1.24	10.5	12	25	16	13	52
TD-4-2	10/13-18/20	Bg1	2.6	0.40	4.1	0.14	29.3	1.7	1.2	0.1	0.3	3.3	16.1	19.4	11.0	62.5	1.42	12.0	15	30	17	3	15
TD-4-3	18/20-45	Bg2	2.3	0.30	0.6	0.05	12.0	2.2	1.7	0.1	0.3	4.3	12.3	16.6	9.8	28.8	1.29	17.0	22	44	26	1	29
TD-4-4	45-80/90	Bg3	4.3	0.49	0.8	0.06	13.3	3.5	3.1	0.2	0.4	7.2	17.9	25.1	14.1	32.2	1.13	15.5	25	51	29	1	54
TD-4-5	80/90-140	BCg	5.2	2.03	1.6	0.08	20.0	4.0	4.1	0.1	0.3	8.5	32.5	41.0	17.3	47.0	0.98	41.0	23	49	21	9	18
TD-4-6	140-200	Cg	4.0	1.34	2.50	0.08	31.3	9.8	14.7	0.3	0.7	25.5	12.4	37.9	16.6	-	0.67	49.0	59	>100	67	20	110

Note ; % Organic carbon with * analysed by loss-on ignition method
; Determined by DLD

Table E-12 The chemical property -(6)

LABORATORY CODE NO.	DEPTH cm.	HORIZON	MOISTURE AIR TO OVEN DRY %	EC m.mho/cm. 1:5	C %	N %	C/N	BASE EXCHANGE CAPACITY AND CATION (milli equiv/100g) Ca	Mg	K	Na	SUM (Ca+Mg+K+Na) (B)	EXTR ACID (A)	SUM (B+A)	CEC SOIL (C)	CEC 100G CLAY	Ca/Mg	Mg/K	BASE SATURATION % Ca/(C) X100	(B/C) X100	(BX100) /(B+A)	P p.p.m. (BRAY No.2)	K p.p.m. (AMMON ACETATE)
TD-5-1	0 - 10	Ap	9.1	0.39	24.2 *	1.13	21.4	1.0	0.7	0.3	0.5	2.5	45.2	47.7	49.9	110.4	1.43	2.3	2	5	5	20	102
TD-5-2	10 - 30	Bg1	3.0	0.07	2.4	0.12	20.0	0.7	0.6	0.1	0.3	1.7	13.4	15.1	10.5	21.6	1.17	6.0	7	16	11	9	16
TD-5-3	30 - 60	Bg2	2.6	0.06	2.3	0.08	28.8	1.2	1.0	0.1	0.3	2.6	11.1	13.7	8.7	24.0	1.20	10.0	14	30	19	3	18
TD-5-4	60 - 90	Bg3	2.8	0.51	1.8	0.07	25.7	1.7	1.4	0.1	0.4	3.6	16.1	19.7	10.3	43.1	1.21	14.0	17	35	18	8	35
TD-5-5	90 - 140	Cg	4.3	2.61	2.40	0.08	30.0	3.3	5.0	0.03	0.3	8.6	39.7	48.3	23.5	188.0	0.66	166.7	14	37	18	9	4

Note ; % Organic carbon with * analysed by loss-on ignition method
; Determined by DLD

Table E-13 The chemical property -(1)

CODE NO.	DEPTH cm.	HORIZON	EC m.mho/ cm.	SATURN %	SOLUBLE OCATION AND ANIONS IN SOIL EXTRACT (me/litre)								KCl extr. Al me/100g. soil	DTPA. extr. p.p.m.			
					Na+	K+	Ca++	Mg++	Cl-	SO4=	CO3=	HCO3-		Fe	Mn	Cu	Zn
BC-1-4	110~130	Cg1	0.36	48.9	1.08	0.11	0.76	1.10	0.80	1.3	0	0	8.65	11.14	0.22	0.41	0.10
BC-1-5	130~160	Cg2	7.83	18.2	0.48	0.01	3.91	8.55	3.60	121.3	0	0	4.24	365.40	2.35	0.46	0.51
BC-3-3	55~85	Cg1	0.19	31.2	0.52	0.04	0.36	0.44	0.60	0.96	0	0	3.96	56.84	0.81	0.18	0.39
BC-3-4	85~110	Cg2	0.26	23.8	0.59	0.07	0.38	0.63	0.80	1.03	0	0	1.88	38.40	0.65	0.11	0.09
BC-3-5	110~150	Cg3	3.08	26.9	0.83	0.19	2.20	4.17	8.32	32.87	0	0	4.70	264.90	0.92	0.10	0.15
BC-4-3	70~100	Cg1	0.98	31.6	2.26	0.05	1.68	8.63	1.17	3.34	0	0	1.61	284.60	0.68	0.21	0.19
BC-4-5	100~130	Cg2	1.96	29.8	3.48	0.10	4.01	8.24	1.42	8.97	0	0.17	0.92	251.20	0.19	0.13	0.08
BC-5-2	25~45	Cg1	0.17	22.7	0.35	0.03	0.31	0.36	0.79	0.77	0	0.08	0.42	4.98	0.02	0.07	0.18
BC-5-3	45~70	Cg2	0.16	25.1	0.17	0.04	0.39	0.29	0.45	0.49	0	0	0.42	3.62	0.01	0.09	0.06
BC-5-4	70~100	Cg3	0.17	22.5	0.17	0.04	0.55	0.53	0.65	0.67	0	0.08	0.10	7.06	0.002	0.09	0.01
BC-5-5	100+	Cg4	0.08	26.0	0.33	0.02	0.02	0.04	0.58	0.21	0	0	0.08	9.61	0.02	0.04	0.09
BC-7-2	2/10~18/20	Cg1	0.17	26.9	0.25	0.05	0.20	0.50	0.65	1.00	0	0	1.59	18.55	0.03	0.10	0.10
BC-7-3	18/20~35/40	Cg2	0.17	22.8	0.35	0.05	0.11	0.22	0.71	0.61	0	0.08	0.57	3.55	0.02	0.13	0.20
BC-7-4	35/49~60	Cg3	0.19	23.6	0.34	0.10	0.25	0.26	0.58	0.63	0	0	1.01	4.02	0.03	0.10	0.11
BC-7-5	60~90	Cg4	0.14	29.8	0.56	0.09	0.14	0.21	0.41	0.38	0	0.08	0.51	26.58	0.33	0.01	0.06
BC-7-6	90~130	Cg5	0.17	23.8	0.24	0.07	0.47	0.30	0.36	0.95	0	0	0.10	2.89	0.01	0.05	0.06
BC-7-7	130~160	Cg6	0.13	25.7	0.38	0.09	0.16	0.19	0.35	0.32	0	0	0.20	16.86	0.25	0.05	0.12

Remark : Determined by DLD

BC : Bacho area, KD : Kab Daeng area, TD : Muno-Koknai area

Table E-13 The chemical property -(2)

CODE NO.	DEPTH cm.	HORIZON	EC m.mho/ cm.	SATURN %	SOLUBLE OCATION AND ANIONS IN SOIL EXTRACT (me/litre)								KCl extr. Al me/100g. soil	DTPA. extr. p.p.m.			
					Na+	K+	Ca++	Mg++	Cl-	SO4=	CO3=	HCO3-		Fe	Mn	Cu	Zn
BC-8-2	3/5~18/20	cg1	0.54	22.0	0.38	0.09	1.70	0.93	0.53	1.70	0	0	0.35	28.24	0.06	0.07	0.05
BC-8-3	30~50	cg2	0.17	24.9	0.28	0.03	0.60	0.41	0.44	0.39	0	0.08	0.32	55.10	0.16	0.17	0.23
BC-8-4	50~140	cg3	0.13	27.2	0.59	0.02	0.29	0.14	0.39	0.13	0	0.17	0.55	23.20	0.15	0.02	0.02
BC-8-5	140~160	cg4	0.20	25.5	1.03	0.06	0.20	0.08	0.52	0.45	0	0.08	0.34	30.20	0.07	0.05	0.06
BC-9-3	55~80	cg1	0.41	35.5	1.58	0.03	0.69	1.13	0.95	1.68	0	0.17	4.07	433.30	0.10	0.11	0.09
BC-9-4	80+	cg2	0.22	26.6	0.87	0.03	0.34	0.38	0.17	0.68	0	0.08	0.48	146.80	0.12	0.08	0.04
BC-10-3	40~80	cg1	0.15	24.7	0.23	0.04	0.35	0.89	0.65	1.35	0	0.08	0.07	13.50	0.19	0.08	0.08
BC-10-4	80~110	cg2	0.21	28.0	0.24	0.03	0.45	1.85	0.58	1.52	0	0.25	tr	17.58	0.68	0.08	0.09

Remark : Determined by DLD

Table E-13 The chemical property -(3)

CODE NO.	DEPTH cm.	HORIZON	EC m.mho/ cm.	SATURN %	SOLUBLE OCATION AND ANIONS IN SOIL EXTRACT (me/litre)								KCi extr. Al me/100g. soil	DTPA. extr. p.p.m.			
					Na+	K+	Ca++	Mg++	Cl-	SO4=	CO3=	HCO3-		Fe	Mn	Cu	Zn
KD-1-5	75/80+	cg	37.07	41.9	3.26	0.08	7.28	88.01	148.6	1800.45	0	0	54.46	15477.10	188.92	0.45	61.30

Remark : Determined by DLD

Table E-13 The chemical property -(4)

CODE NO.	DEPTH cm.	HORIZON	EC m.mho/ cm.	SATURN %	SOLUBLE OCATION AND ANIONS IN SOIL EXTRACT (me/litre)								KCl extr. Al me/100g. soil	DTPA. extr. p.p.m.			
					Na+	K+	Ca++	Mg++	Cl-	SO4=	CO3=	HCO3-		Fe	Mn	Cu	Zn
TD-1-1	0~15/25	Ag	2.80	49.2	1.39	0.17	2.99	0.26	21.30	20.58	0	0	11.71	202.38	3.02	0.74	0.92
TD-1-2	15/25~55	Bg	1.40	49.8	0.91	0.16	1.87	6.17	0.45	6.77	0	0	5.94	151.01	3.35	0.38	0.41
TD-1-3	55~70/80	Bg2	1.68	50.5	1.04	0.15	2.41	8.24	0.58	11.28	0	0	7.44	77.06	4.31	0.71	0.57
TD-1-4	70/80~100/110	Bcg	19.59	41.4	0.56	0.05	10.63	33.65	36.92	742.70	0	0	39.43	1773.36	25.64	11.68	6.87
TD-1-5	100/110+	Cg	15.81	41.5	0.43	0.05	25.50	133.08	31.28	405.31	0	0	16.74	1049.79	318.50	1.52	56.63
TD-2-1	0~12/15	Ag	2.87	47.4	1.24	0.11	3.63	13.95	10.49	18.27	0	0	9.42	117.60	6.03	0.70	0.86
TD-2-2	12/15~45	Bg1	2.80	49.8	1.00	0.17	2.65	11.30	0.78	11.22	0	0	6.65	104.40	4.59	0.20	0.27
TD-2-3	45~60/70	Bg2	2.01	47.4	0.80	0.20	2.39	9.16	0.39	9.00	0	0	7.19	86.53	4.67	0.39	0.26
TD-2-4	60/70~100	Bcg	2.59	46.9	1.35	0.24	3.87	16.48	1.04	14.71	0	0	8.79	54.08	9.15	0.54	0.41
TD-2-5	110~130+	Cg	13.29	41.7	1.43	0.04	25.60	65.64	13.28	235.90	0	0	4.50	364.30	204.72	0.07	4.70
TD-3-1	0~15/20	Ap	3.08	48.4	2.04	0.07	5.81	13.83	1.93	28.14	0	0	10.50	158.30	5.95	0.97	0.99
TD-3-2	15/20~40	Bg1	2.56	49.5	1.87	0.13	4.49	13.61	4.73	15.66	0	0	6.40	60.74	5.68	0.21	0.36
TD-3-3	40~65	Bg2	2.52	48.4	1.87	0.14	5.06	16.98	1.75	18.43	0	0	5.96	63.02	5.00	0.18	0.33
TD-3-4	65~90	Bcg1	3.01	47.7	2.30	0.15	5.45	10.01	15.34	34.73	0	0	7.17	83.10	6.95	0.38	0.58
TD-3-5	130~160	Bcg2	6.30	45.3	3.04	0.06	10.12	24.67	5.68	110.16	0	0	14.56	263.02	17.62	1.24	2.45

Remark : Determined by DLD

Table E-13 The chemical property -(5)

CODE NO.	DEPTH cm.	HORIZON	EC m.mho/ cm.	SATURN %	SOLUBLE OCATION AND ANIONS IN SOIL EXTRACT (me/litre)								KCl extr. Al me/100g. soil	DTPA. extr. p.p.m.			
					Na+	K+	Ca++	Mg++	Cl-	SO4=	CO3=	HCO3-		Fe	Mn	Cu	Zn
TD-4-1	0~10/13	Ap	3.29	48.1	2.56	0.09	11.81	23.48	0.95	33.49	0	0	5.42	212.58	2.80	0.04	2.76
TD-4-2	10/13~18/20	Bg1	1.96	42.4	1.19	0.09	7.76	12.73	0.45	13.91	0	0	4.43	80.91	3.34	1.86	1.63
TD-4-3	18/20~45	Bg2	1.26	46.6	1.09	0.14	3.94	5.41	0.58	5.64	0	0	5.04	41.60	1.14	0.47	0.49
TD-4-4	45~80/90	Bg3	2.41	44.3	2.13	0.31	8.82	3.78	0.71	15.22	0	0.07	5.87	52.16	4.45	0.53	0.45
TD-4-5	80/90~140	Bcg	10.21	42.0	0.48	0.03	22.28	41.21	6.01	225.43	0	0	19.75	358.85	17.15	0.57	5.50
TD-4-6	140~200	Cg	8.11	43.4	5.43	0.49	26.67	80.35	1.68	126.32	0	0.85	0.59	318.55	60.16	1.40	2.17
TD-5-1	0~10	Ap	1.12	58.7	7.62	0.74	1.29	3.95	1.29	3.92	0	0	8.66	221.21	2.91	0.33	0.97
TD-5-2	10~30	Bg1	2.17	49.9	0.36	0.03	0.03	0.69	0.84	17.82	0	0.15	4.82	44.46	4.86	1.29	0.33
TD-5-3	30~60	Bg2	2.52	44.5	0.39	0.05	0.39	0.90	0.52	293.26	0	0.17	4.02	171.50	2.94	4.41	0.83
TD-5-4	60~90	Bg3	2.31	42.3	0.81	0.28	2.89	9.11	1.51	12.97	0	0	5.76	314.40	4.83	2.10	1.44
TD-5-5	90~140	Cg	15.39	42.4	0.29	0.04	23.17	59.11	18.75	359.49	0	0	19.34	659.33	302.07	1.64	23.80

Remark : Determined by DLD

E-13-2 The result of soil analysis

(1) Bacho area

The mineral soil under the peat layer in the Bacho F/S area is generally sandy with few portions of low clay and loamy sand content. It is therefore generally characterized by a good percolation with few expections as in the case of the Cord No. BC-8-2. This cord located in a runway showed a very slow percolation due probably to soil compaction in the area.

Fibric peat layers show a very good percolation, but hemic peat layers which the decomposition is almost complete tend to show lower percolation. With respect to chemical properties, the top soil is strongly acid with pH values amounting to less than 4.5. The total carbon content ranges generally between 30～60% with most values recorded between 50～60%. The total nitrogen content ranges between 0.9～1.8%, with most values recorded between 1 ～1.5%; the mineral soil under the peat shows values less than 0.1%.

The C/N Ratio tends to be high due to humus leaching throughout the layers.

The Cation exchange capacity(CEC) of peat soil shows about more than 100, but the exchangeable calcium and potassium are low and the base saturation percentage is less than 50%, but the exchangeable magnesium is higher than other bases and is found extremely high in the cord No. BC-6 location. This area coincides with the palm oil growing area where the application of chemical fertilizer is high. The exchangeable aluminium of deeper layers is relatively low except in some areas. The available phosphorus of the layers is generally low and amounts to less than 3mg/100g soil. Sulfate ions are mainly found below 1m in the cords No. BC-1 and BC-3 which are located nearby the conservation zone. It is cbserved that places of high concentrations of sulfate ions correspond also to places of high concentrations of released iron(Fe).

(2) Kab Daeng area

The percolation in the Kab Daeng F/S area is also very good similarly to that in the Bacho F/S area.

With respect to chemical properties, the field pH is 5.5 and is higher than the Bacho F/S area except in some parts(the north part has pH values less than 4.5). The total carbon content is less than 50%, and the total nitrogen content is less than about 1% except in the top soil. The C/N ratio is low particularly in the Hemic peat which is nearly completely decomposed. The CEC ranges between 60 and 180 meq/100 g soil, but in the cord No. KD-2 it is higher than 100 meq/100g soil. The exchangeable calcium and potassium is low, but the Mg/K ratio exceeds 2 in all cases showing unexpectedly a higher magnesium than potassium concentration. The base saturation percentage is fairly low and amounts to less than 50%. The available phosphorus is extremely low amounting to less than 10 mg/100 g soil similarly to the Bacho F/S area. The sulfate ion concentration is very high in the substratum under 80 cm depth and may probably affect the upper layers. However, no definite inference can be made concerning this point pending the results of the analysis. It is worthy noting that in the Bacho area similar high sulfate ion concentrations in the substratum did not affect much the upper layers.

When the soil is dry, the sulfate ions in the substratum rise toward the top soil; therefore, a careful management to keep the soil wet is necessary throughout the year. The ion concentration in the mineral soil under the peat is higher than the Bacho area, this reason is considered due to the clayey soil in the Kab Daeng area.

On the other hand, trace elements such as ferrous iron, manganese and zinc are

highly available while copper is present in small concentrations.

The samples of potential acid sulfate soil are not yet analysed but the results are expected to be similar to those of the essentially actual acid sulfate or acid sulfate soils.

(3) Mu No-Kounai area

The clay content is approximately more than 25%. But the percolation is somewhat good and particularly that of the second layer is rapid due to the presence of cracks. Jarosites are made from oxydized pyrite by this way.

With respect to chemical properties, the field pH is less than 4.5, but the pH of the Cg layers existing beyond 1m depth is pH 6.5, which is high. This high pH soil become highly acidic when dry, therefore the existence of potential acid sulfate soil including pyrite can be expected in these layers. The total carbon content is approximately less than 10% and the top soil is higher than the subsoil. The total nitrogen content is less than 0.1% except in the top soil. The CEC of the top soil and layers underneath is approximately less than 20me/100g soil. The top soil is rich in organic matter. The exchangeable calcium and potassium is low and exchangeable magnesium relatively high. The substratum(Cg horizon) is high in calcium and magnesium and shows a high pH. The exchangeable aluminium is generally high . The available phosphorus is generally low and amounts to less than 10mg/100g soil but it is high in the top soil and relatively in the Cg layer . The water soluble sulfate ions are somewhat high particularly in the substratum. The trace elements such as iron and manganese are relatively high and copper and zinc relatively low.

Table E-14-1 Limestone composition for Agriculture from Ratapcom District, Songkhla province

Source of Limestone	%					ppm			%	%				Kinds
	Al	Fe	Mg	K	Ca	S	P	Mn	C.C.E	Calcite	Boron oxide	Pyrite	Other	
Rug-geat Mt.	1.5	0.4	5.8	0.3	27.9	180	2570	370	80.8	92.7-100 98.0	0-1.5 0.4	-	-	Reef Limestone Calcarenite
Kuha Mt.	0.3-1.3	0.1-0.3	tr	tr-0.1	36.1-39.1	10-280	290-3720	50-530	76.3-87.0	90-91.9	-	4.2-9.8	1.9	Calcilutite
	1.7-2.4	0.5	tr-0.3	0.1	36.3-36.6	10-235	3400-6450	510-805	75.9-83.5	57.0-81.6	-		1.9(Clay) 0.6(Quartz)	Breciated Limestone
Pra Mt.	1.0-2.3	0.3-0.6	tr-0.5	0.1-1.2	32.7-37.9	240-1580	125-4945	50-235	70.2-84.4	90.8-94.4	0-0.4	2.4-3.0	0.2-0.4 (Quartz) 0-1.0(Clay) 0.1-0.3(Carbon)	Calcilutite
Wang Mt.	1.3-1.8	0.2-0.4	0.6-2.6	0.8-1.2	32.6-35.6	225 1130	95-2870	50-100	76.7-89.6	85.2-94.0 92.0	2.6-3.8 3.4	- -	2.4-2.6(Quartz) 0-2.0(Apatite) 4.6(Quartz)	Calcilutite Calcarenite
Nuo Mt.	1.4	0.3	1.0	0.4	35.7	435	370	40	83.7	78.0	4.6		3.4(Quartz) 12.2(Tremolite) 1.8(Diopside)	Marble

Remarks: C.C.E = Total neutralizing power. Source ; A study on physical chemical and mineralogical properties of limestone for agriculture in the southern part of Thailand, 1982 by Pojanee Moncharoen etal.

Table E-14-2 Sources of lime and their neutralizing values in $CaCO_3$ equivalent

Material	Primary ingredients	Neutralizing value
Burned Lime	CaO	179
Hydrated Lime	$Ca(OH)_2$	136
Dolomite	$CaMg(CO_3)_2$	109
Calcic	$CaCO_3$	100
Basic slag	$CaSiO_3$	86

Source : Kamarudin, 1988

Table E-14-3 The calibrations for lime requirement

Woodruff buffer solution pH	Lime requirement		Woodruff buffer solution pH	Lime requirement	
	kg / rai	kg / ha		kg / rai	kg / ha
6.9	156	975	5.4	2,496	15,600
6.8	312	1,950	5.3	2,652	16,575
6.7	468	2,925	5.2	2,808	17,550
6.6	624	3,900	5.1	2,964	18,525
6.5	780	4,875	5.0	3,120	19,500
6.4	936	5,850	4.9	3,276	20,475
6.3	1,092	6,825	4.8	3,432	21,450
6.2	1,248	7,800	4.7	3,588	22,425
6.1	1,404	8,775	4.6	3,744	23,400
6.0	1,560	9,750	4.5	3,900	24,375
5.9	1,716	10,725	4.4	4,056	25,350
5.8	1,872	11,700	4.3	4,212	26,325
5.7	2,028	12,675	4.2	4,368	27,300
5.6	2,184	13,650	4.1	4,524	28,275
5.5	2,340	14,625	4.0	4,680	29,250
			3.9	4,836	30,225

Remark : Lime mean $CaCO_3$

Table E- 14-4 Requirement of lime stone for concerning the series in the pilot area

series	mapping unit	pH 5			pH 6.5		
		Area(ha)	ton/ha	Req. (ton)	Area(ha)	ton/ha	Req. (ton)
Narathiwat	22	822	25	20,550	822	30	24,660
	25	24	28	672	24	38	912
	26	2,165	30	64,950	2,165	44	95,260
Munoh	19	256	20	5,120	256	30	7,680
Rangae	33	64	12	768	64	15	960
	34	288	16	4,608	288	20	5,760
	35	80	12	960	80	15	1,200
Kab daeng	14	36	20	720	36	35	1,260
Thon Sai	49	145	12	1,740	145	14	2,030
		3,880	-	100,088	3,880	-	139,722

Remak:1)Source is the data by DLD

2)Total neutralizing power in limestone ; about 80%.

3)Lime requirement used Woodruff method.

pH 2:never determined for L.R.

E-14-5 Determination of total potential and actual acidity.

Methods

Total acidity of the soil was determined by titration up to pH 5.5 with NaOH of a sample suspended in a NaCl solution(1 mol/l), in a soil/solution ratio of 1/5 by volume or 1/2.5 by mass. pH measurements were done with an Orion Digital Ionalyzer, model 801A. Total acidity at pH 5.5 was read from the titration curves. Potential acidity of the samples was determined after they were oxidized, actual acidity was determined of the fresh or freeze-dried samples.

Titration methods

Four titration methods were tested:

1. 'Slow titration' of the soil suspension. Different amounts of NaOH solution were added to 20 ml subsamples of the soil suspension. After various time steps(immediately after titration, after 1 h, 24 h, 48 h and 1 week), the pH of all subsamples was measured and titration curves were drawn;

2. 'Fast titration' of the soil suspension. Subsamples(100 ml) of the soil suspension were rapidly titrated by small additions of NaOH solution. After each addition the suspension was homogenized and the pH measured. Additions were continued until pH between 6 and 7 was reached;

3. 'Back titration' of the suspension. After fast titration of the soil suspension to pH 6-7 and a 24 h waiting period(during which the pH dropped to 5.5-6), the suspension was back titrated with a HCl solution to pH 5.0-5.5. After another wait of 24 h the pH was measured again;

4. 'Fast titration' of the soil extract. Subsamples(50 or 100 ml) of the soil suspension were extracted twice with a NaCl solution(1 mol/l). The extract was titrated fast.

Oxidation method

After suspending the soil sample in a NaCl solution(1 mol/l), in a soil/solution ratio of 1/5 by volume or 1/2.5 by mass, the suspension was oxidized with 30 % H_2O_2 at room temperature or on a moderately warm waterbath. Hydrogen peroxide was added until the mineral soil material became clear gray to clear brown coloured and no foam existed or was formed upon adding further H_2O_2. A possible surplus of H_2O_2 was evaporated by heating briefly on a boiling waterbath. The suspension was then brought to the original volume by evaporation or by addition of water.

Further chemical analyses

Pyrite was measured as Fe after extraction by HNO_3. Non-pyrite iron was excluded by a pretreatment with a HF/H_2SO_4 mixture. Water-soluble plus exchangeable sulphate and jarosite were determined turbidimetrically as sulphate, after successive extractions by EDTA.3Na(0.1 mol/l) and by HCl (4 mol/l)(Begheijin et al. 1978).

Elemental sulphur was determined turbidimetrically as colloidal sulphur after

extraction with acetone and exchange of acetone by water.

Source:

Selected Paper of Dakar Symposium on Acid Sulfate soils. ILRI publication 44Dakar, Senegal, January 1986.

Edited by H.Dost Publication 44 International Institute for land Reclamationand Improvement/ILRI P.O.Box 45, 6700 AA Wageningen, the Natherland, 1988.

E-14-6 Lime Requirement (Woodruff method)

1. Reagents

Preparation of Woodruff's buffer solution

1. Weigh 40.0 g of calcium acetate($Ca(OAc)_2$) into a beaker, and dissolve in approximately 300 ml. of distilled water.

2. Weigh 8.0 g Para-nitrophenol into a beaker, and dissolve in approximately 300 ml. of hot distilled water.

3. Mixed solution from (1) and (2), shaking as they are combined, and add 350 ml. of distilled water, again shaking as the addition is made and leave it over night.

4. Adjust to pH 7.00 with 1.2 g sodium hydroxidc(NaOH) using the standardized pH meter.

2. Procedure

Weigh 10 g of air-dry soil into 50 ml. beakers, add 10 ml. of distilled water, mix or stir, let stand and read soil pH in water. Add 10 ml. of the woodruff's buffer solution to the soil suspensions after pH values in water are read. Mix or stir, and let the suspensions stand 30 min. before determining the pH measured Value.

Select and record the amount of lime required to bring the soil to the pH you choose to lime the soil base on the calibrations which have been already calibrated(see table).

E-16-2 Method of the leaching test in laboratory

(1) Purpose; To get the supplemental data of field test.

(2) Method

1) Experimental soil Samples

No. 1 Surface soil of Muno series

No. 2 Soil including Jarosite of Muno series

No. 3 Peat soil of Narathiwat series

2) Soil:water ratio = 1:2, collect 10 leaching sample replications

3) Determination

Measurement of pH, EC, Alkaline consumption(designate the titration of 0.1M NaOH in 400ml leachate).

4) Preparation and process of experiment

Soil is passed through 2mm diameter (sieve of 2mm) and 2 replications of test.

(a) Tube test

Place 200g of soil in a tube of top cross section about 40 cm^2 with wool filter in bottom and drop tube(5 times)from 5cm height, to allow a uniform packing of soil. Then place paper of filtration on top of soil (to prevent disturbing soil when pouring).

↓

Pour slowly distiled water into tube equipped with a stopper(screw pinch cook).

↓

Beging the leaching(speed less than 400ml/1hour controled by the screw pinch cook stopper).

↓

Receive in 500 ml beaker with 400ml marking.

↓

When the leaching solution reaches 400ml, stop leaching (at that time, keep saturated condition into tube to prevent oxidation of pyrite).

↓

Determination of leachate(take 10 ～100ml as concentration to titration in Alkaline consumption).

(b) Beaker test

Place 100g soil and water 200ml(by measuring cylinder)in 500ml beaker.

↓

Mix soil well by glass stick(about 3 min).

↓

Let alone until making the upper clear solution(about 30 min at room temperature).

↓

Decant upper clear solution to another beaker.

↓

Determination of leachate (the same as the tube test).

Remark; After going home the experimentalist should keep saturated conditions into the tube to prevent oxidation of pyrite.

At the end of the leaching, the soil sample can be air dried at room temperature about one week (oxidative condition). After that, leaching experimentscan be carried out similarly as the above.

Table E-15 Result of leaching test in laboratory(tube) (2)

Times of leaching		pH			EC(mS)			1/10 M NaOH titration		
		2	2'	Ave.	2	2'	Ave.	2	2'	Ave.
Wet	1	3.2	3.1	3.2	1.27	0.87	1.07	34.4	17.6	26.0
	2	3.5	3.6	3.6	0.28	0.18	0.19	3.5	2.0	2.8
	3	3.5	3.6	3.6	0.22	0.17	0.20	3.2	2.1	2.7
	4	3.5	3.7	3.6	0.16	0.11	0.13	2.3	1.3	2.3
	5	3.6	3.6	3.6	0.14	0.10	0.12	2.0	1.2	1.6
	6	3.7	3.6	3.7	0.12	0.09	0.10	1.8	1.3	1.6
	7	3.7	3.8	3.8	0.12	0.07	0.10	1.6	1.2	1.4
	8	3.6	3.8	3.8	0.10	0.06	0.08	1.5	1.0	1.3
	9	3.6	-	-	0.09	-	-	1.4	-	-
	10	3.6	-	-	0.09	-	-	1.4	-	-
	Total	-	-	-	-	-	-	-	-	-
After dry	1	-	-	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-	-	-
	3	-	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-

Table E-15 Result of leaching test in laboratory(tube) (3)

Times of leaching		pH			EC(mS)			1/10 M NaOH titration		
		3	3'	Ave.	3	3'	Ave.	3	3'	Ave.
Wet	1	3.6	3.9	3.8	0.33	0.10	0.22	7.8	3.5	5.7
	2	3.9	3.8	3.9	0.23	0.11	0.17	8.6	2.2	10.8
	3	4.0	3.9	4.0	0.11	0.12	0.12	8.0	4.6	6.3
	4	4.0	4.0	4.0	0.13	0.06	0.10	7.2	3.0	2.1
	5	4.0	3.8	3.9	0.08	0.07	0.08	4.9	2.9	3.9
	6	3.7	3.8	3.8	0.05	0.03	0.04	3.9	2.2	3.1
	7	3.8	4.1	4.0	0.08	0.07	0.08	6.6	2.6	4.6
	8	3.9	4.0	4.0	0.05	0.03	0.05	4.6	1.7	3.2
	9	4.2	4.0	4.1	0.05	0.04	0.05	3.4	3.3	3.4
	10	4.0	4.0	4.0	0.07	0.03	0.05	8.3	1.5	4.9
	Total	-	-	-	-	-	-	63.3	27.5	48.0
After dry	1	3.7	4.0	3.9	0.08	0.05	0.07	6.4	2.0	4.2
	2	3.7	4.1	3.9	0.05	0.03	0.04	3.4	1.5	2.5
	3	3.8	3.9	3.9	0.05	0.05	0.05	4.7	2.0	3.4
	4	4.0	4.0	4.0	0.04	0.05	0.05	3.3	1.2	2.3
	5	4.0	4.0	4.0	0.05	0.04	0.05	3.2	1.0	2.1
	Total	-	-	-	-	-	-	21.0	7.7	14.5

Table E-16 Result of leaching test in laboratory(beaker)(1)

Times of leaching		pH			EC(mS)			1/10 M NaOH titration		
		1	1'	Ave.	1	1'	Ave.	1	1'	Ave.
Wet	1	3.3	3.3	3.3	1.40	1.43	1.42	60 0	60.0	60.0
	2	3.3	3.3	3.3	1.20	1.20	1.20	50.4	48.8	49.6
	3	3.4	3.4	3.4	0.82	0.80	0.81	29.6	32.8	31.2
	4	3.4	3.5	3.5	0.72	0.64	0.68	20.0	24.0	22.0
	5	3.5	3.5	3.5	0.53	0.60	0.57	15.0	16.1	15.6
	6	3.5	3.5	3.5	0.46	0.48	0.47	12.9	12.0	12.5
	7	3.6	3.6	3.6	0.37	0.40	0.39	10.3	9.4	9.9
	8	3.6	3.6	3.6	0.29	0.36	0.32	7.4	8.2	7.8
	9	3.6	3.6	3.6	0.28	0.30	0.29	6.3	6.6	6.5
	10	3.7	3.7	3.7	0.23	0.20	0.22	5.6	6.0	5.8
	Total	-	-	-	-	-	-	217.5	223.9	220.9
After dry	1	3.7	3.7	3.7	0.20	0.21	0.21	5.3	5.6	5.5
	2	3.7	3.7	3.7	0.18	0.18	0.18	5.0	5.4	5.2
	3	3.6	3.7	3.7	0.19	0.21	0.20	4.8	5.0	4.9
	4	3.7	3.7	3.7	0.17	0.19	0.18	4.6	4.7	4.7
	5	3.7	3.7	3.7	0.15	0.17	0.16	4.7	4.8	4.8
	Total	-	-	-	-	-	-	24.4	25.5	25.1

Remarks No.1 : Surface soil of Muno series Testing:Oct.-Nov.1992
No.2 : Soil including Jarosite of Muno series
No.3 : Peat soil of Narathiwat series

Table E-16 Result of leaching test in laboratory(beaker)(2)

Times of leaching		pH			EC(mS)			1/10 M NaOH titration		
		2	2'	Ave.	2	2'	Ave.	2	2'	Ave.
Wet	1	3.2	3.2	3.2	1.00	1.00	1.00	26.4	27.2	26.8
	2	3.2	3.3	3.3	0.85	0.76	0.86	16.8	20.8	18.8
	3	3.3	3.3	3.3	0.56	0.63	0.60	10.4	13.6	12.0
	4	3.4	3.4	3.4	0.45	0.40	0.43	5.6	5.6	5.6
	5	3.4	3.4	3.4	0.44	0.38	0.41	7.3	5.8	6.6
	6	3.4	3.5	3.5	0.39	0.37	0.38	5.8	5.0	5.4
	7	3.5	3.5	3.5	0.24	0.26	0.25	3.2	3.5	3.4
	8	3.6	3.6	3.6	0.20	0.22	0.21	2.4	3.0	2.7
	9	3.5	3.5	3.5	0.23	0.23	0.23	2.8	3.1	3.0
	10	3.6	3.6	3.6	0.18	0.20	0.19	2.2	2.6	2.4
	Total	-	-	-	-	-	-	82.9	90.2	86.7
After dry	1	3.7	3.6	3.7	0.16	0.18	0.17	2.2	2.4	2.3
	2	3.7	3.6	3.7	0.14	0.17	0.16	1.8	2.2	2.0
	3	3.7	3.6	3.7	0.15	0.18	0.17	1.6	1.9	1.8
	4	3.6	3.6	3.6	0.13	0.15	0.14	1.4	1.5	1.5
	5	3.7	3.6	3.7	0.12	0.13	0.13	1.5	1.8	1.7
	Total	-	-	-	-	-	-	8.5	9.8	9.3

Table E-16 Result of leaching test in laboratory(beaker)(3)

Times of leaching		pH			EC(mS)			1/10 M NaOH titration		
		3	3'	Ave.	3	3'	Ave.	3	3'	Ave.
Wet	1	3.4	3.5	3.5	0.25	0.25	0.25	6.4	7.2	6.8
	2	3.7	3.7	3.7	0.16	0.16	0.16	4.9	4.4	4.7
	3	3.7	3.7	3.7	0.12	0.13	0.13	3.9	4.2	4.1
	4	3.8	3.8	3.8	0.11	0.11	0.11	3.6	3.3	3.5
	5	3.7	3.7	3.7	0.10	0.11	0.11	4.3	4.3	4.3
	6	3.8	3.8	3.8	0.09	0.09	0.09	4.5	4.0	4.3
	7	3.9	3.9	3.9	0.08	0.08	0.08	3.2	3.0	3.1
	8	4.0	4.0	4.0	0.07	0.07	0.07	3.4	3.4	3.4
	9	4.0	4.0	4.0	0.06	0.06	0.06	3.2	3.3	3.3
	10	4.1	4.1	4.1	0.05	0.05	0.05	2.4	2.2	2.3
	Total	-	-	-	-	-	-	39.8	39.3	39.6
After dry	1	4.0	4.1	4.1	0.04	0.05	0.05	2.3	2.2	2.3
	2	4.0	4.1	4.1	0.04	0.04	0.04	2.0	1.9	2.0
	3	4.0	4.0	4.0	0.04	0.05	0.05	1.8	1.8	1.8
	4	4.0	4.0	4.0	0.03	0.04	0.04	1.5	1.6	1.6
	5	4.0	4.0	4.0	0.02	0.03	0.03	1.7	1.8	1.8
	Total	-	-	-	-	-	-	9.3	9.3	9.3

Table E-17 Land Suitability Classification for Economic Crops of Thailand

Kind of limitation	Symbol	Range of limitation		Land suitability ratings					
				5 classes			3 classes		
				I very well suit. II well suited III mod. well suit. IV poorly suited V unsuited			I suited II poorly suited III unsuited		
				P	N	F	R	C	L
Soil reaction (average soil depth 0-30 cm.)	a	0 - 4.0		IV	IV	*	*	*	*
		4.0 - 4.5		-	III	*	*	*	*
		4.5 - 8.0		-	-	*	*	*	*
		8.0 - 8.5		-	II	*	*	*	*
Consolidated layer (soil depth cm.)	c	< 15		V	V	V	III	III	III
		15 - 25		IV	IV	V	III	III	II
		25 - 50		III	III	IV	II	II	-
		50 - 100		-	-	III	-	-	-
Soil drainage	d	very poorly drain.		-	V	V	III	III	*
		poorly drained		-	IV	V	III	III	*
		somewhat poorly		-	III	III	-	-	*
		moderlately well		IV	-	-	-	-	*
		well drained		IV	-	-	-	-	*
		somewhat excess.		IV	IV	IV	-	-	*
		excessively well		IV	V	IV	II	-	*
Gravels (% by volumn)	g	average soil depth 0-30 cm.	> 80	V	V	X	X	X	III
			40 - 80	IV	IV	X	X	X	II
			15 - 40	III	III	X	X	X	-
			5 - 15	II	-	X	X	X	-
		average soil depth 0-75 cm.	> 80	X	X	V	II	III	X
			40 - 80	X	X	IV	II	III	X
			15 - 40	X	X	III	-	-	X
			< 15	X	X	-	-	-	X
Jarosite	j	0 - 40 cm.		IV	*	V	III	II	*
		40 - 100 cm.		III	*	IV	II	-	*

Land Suitability Classification for Economic Crops of Thailand

Kind of limit.	Symbol	Range of limition		(P)	(N)	(F)	(R)	(C)	(L)
Nutrients status	n	average soil depth 0-30 cm.	toxicity	*	*	X	X	X	II
			L.&Mg<25%	*	*	X	X	X	*
			very low	*	*	X	X	X	II
			low	II	II	X	X	X	*
		average soil depth 0-100 cm.	toxicity	X	X	*	*	*	*
			L.&Mg<25%	X	X	*	II	*	X
			very low	X	X	*	II	II	X
			low	X	X	II	*	*	X
Organic layer (depth cm.)	o	> 40		V	V	V	III	III	*
		20 - 40		IV	IV	IV	II	II	*
Permeability	p	rapid		IV	*	*	*	*	*
		medium		III	*	*	*	*	*
Texture	s	ave. soil depth 0-30 cm.	sand loamy sand	IV	IV	X	X	X	*
			silt	IV	-	X	X	X	*
			sandy loam	III	III	X	X	X	*
			sil, l,scl	II	-	X	X	X	*
			poor structure clay	*	III	X	X	X	*
		particle size class	sandy	X	X	IV	II	-	*
			coarse loamy	X	X	III	-	-	*
			sandy + cemented Bh 50-100 cm.	X	X	*	*	II	*
			50 cm.	X	X	V	III	III	II
			massive clay	X	X	*	II	*	*

Land Suitability Classification for Economic Crops of Thailand

Kind of limit.	Symbol	Range of limition		(P)	(N)	(F)	(R)	(C)	(L)
Salinity	x	ave.	> 16,000	V	V	X	X	X	X
(μ S)		soil	10,000-16,000	V	V	X	X	X	X
		depth	7,000-10,000	IV	V	X	X	X	X
		0-30	5,000-7,000	IV	V	X	X	X	X
		cm.	4,000-5,000	III	V	X	X	X	X
			2,500-4,000	III	IV	X	X	X	X
			2,000-2,500	II	III	X	X	X	X
			> 16,000	X	X	V	III	III	III
		ave.	10,000-16,000	X	X	V	III	II	III
		soil	7,000-10,000	X	X	V	III	II	III
		depth	5,000-7,000	X	X	V	III	II	II
		0-100	4,000-5,000	X	X	V	III	II	II
		cm.	2,500-4,000	X	X	IV	II	-	-
			2,000-2,500	X	X	III	II	-	-
Erosion	e	very severely		*	V	V	III	III	III
		severely eroded		*	IV	IV	II	II	II
		moderately eroded		*	III	III	-	-	-
Flood hazard	f	flood > 6 m.		X	X	X	X	X	III
		flood 3-6 m.		X	X	X	X	X	II
		flood every year		V	V	X	X	X	X
		flood 7-9/ 10 year		IV	X	X	X	X	X
		flood 4-6/ 10 year		III	X	X	X	X	X
		flood 1-3/ 10 year		II	X	X	X	X	X
		flood 1/ 2 year		X	IV	X	X	X	X
		flood 2/ 5 year		X	III	X	X	X	X
		flood 1/ 5 year		X	II	X	X	X	X
		flood > 1/ 5 year		X	X	V	III	III	X
		flood > 1/ 10 year		X	X	IV	II	II	X
		flood > 1/ 15 year		X	X	III	-	-	X
		flood > 1/ 25 year		X	X	II	-	-	X
Risk of damage by drought	m	serverely		*	IV	IV	*	II	*
		medium		*	III	III	*	-	*
		slightly		*	II	II	*	-	*

Land Suitability Classification for Economic Crops of Thailand

Kind of limit.	Symbol	Range of limition	(P)	(N)	(F)	(R)	(C)	(L)
Rockiness or Stoniness (percent)	r	> 90	V	V	V	III	III	III
		50-90	V	V	V	II	III	II
		40-50	V	V	V	II	III	-
		25-40	IV	V	IV	-	II	-
		10-25	III	IV	III	-	-	-
		2-10	II	III	II	-	-	-
Topography or % slope		rolling-very steep high topography position	V	*	*	*	*	*
		low water storage 40-50 % flat	V	*	*	*	*	*
		nearly flat < 3 % 50-80 % flat and	IV	*	*	*	*	*
		slope < 3 %	III	*	*	*	*	*
		> 75	V	V	V	III	III	III
		50-75	V	V	V	II	III	III
		35-50	V	V	IV	II	III	III
		25-35	V	V	III	II	II	II
		20-25	V	V	III	-	-	-
		16-20	V	IV	III	-	-	-
		8-16	V	III	-	-	-	-
		4-8	V	II	-	-	-	-
		3-4	V	II	-	-	-	-
Risk of water shortage	w	very severely	V	*	*	*	*	*
		serevely	IV	*	*	*	*	*
		moderately	III	*	*	*	*	*
		slightly	II	*	*	*	*	*

Remark
P : Paddy
N : Nonflooded annual crop
F : Fruit trees
R : Para-rubber
* : no data
C : Coconut
L : Permanent pasture
- : no limiting factor
X : other parameter

Soil Survey and Classification Division, Land Development Department, Ministry of Agriculture and Cooperative, Bangkok, Thailand.

Table E-18 Three phases distribution

Horizon	Mu No- Koknai leaching test field					Bacho test field				
	Depth (cm)	Bulk density	Phase(%) Solid	Liquid	Gaseous	Depth (cm)	Bulk density	Phase(%) Solid	Liquid	Gaseous
I	0～23	0.84	38.9	45.0	16.1	0 ～25	0.33	29.6	57.9	12.5
II	23～55	1.25	48.9	48.3	1.9	25 ～50	0.37	33.7	62.2	4.1
III	55～85	1.21	46.3	48.5	5.2	59 ～170	0.22	20.3	74.1	5.6
IV	85～	1.15	44.5	53.8	1.7	170 ～	1.64	63.1	36.9	0

Remark: Soil sampling date ; Oct. 5, 1992 and Oct. 20(Bacho).

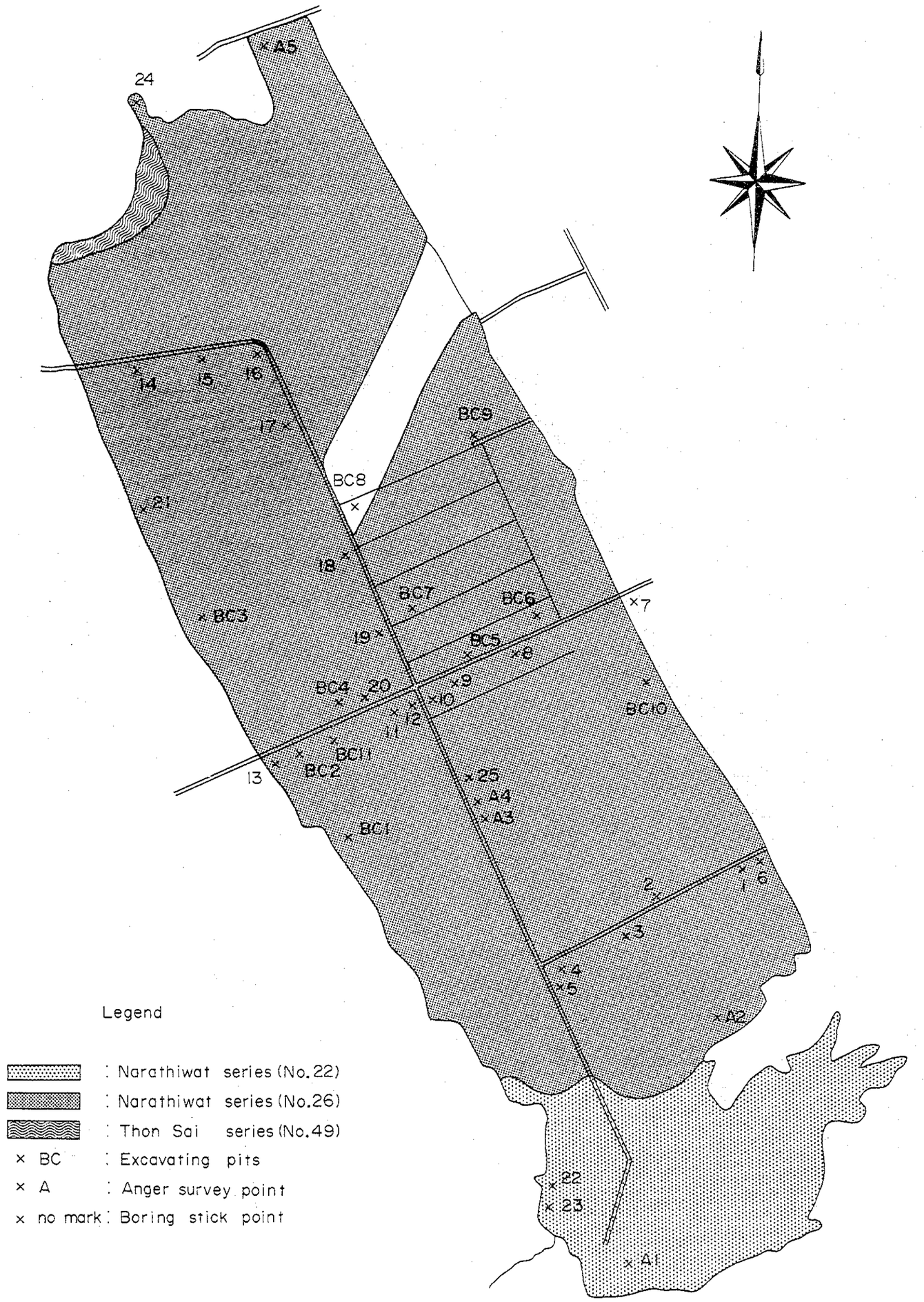


Figure E-1 Soil series and soil survey points in Bacho F/S area

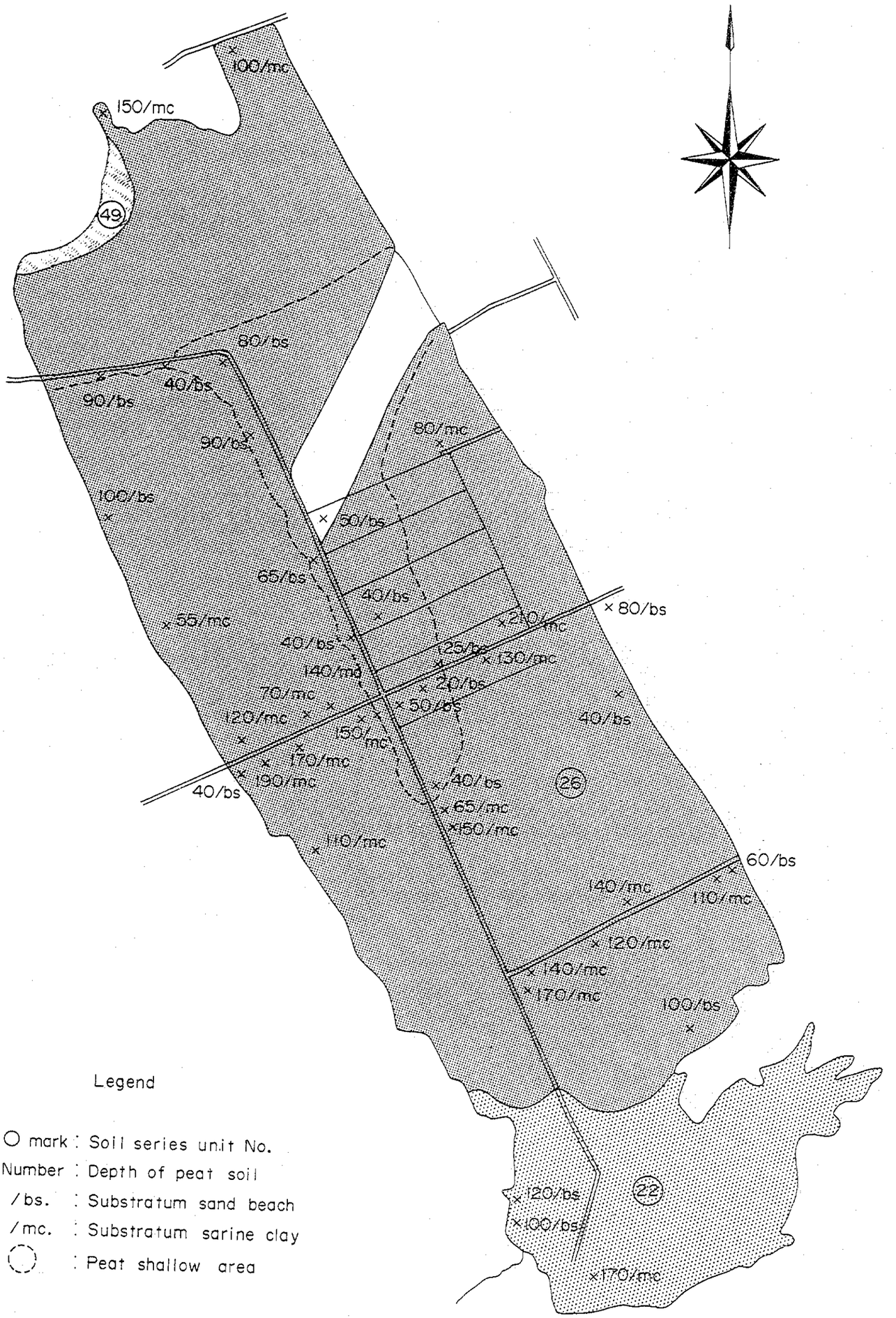


Figure E-2 Depth of peat soil in Bacho F/S area

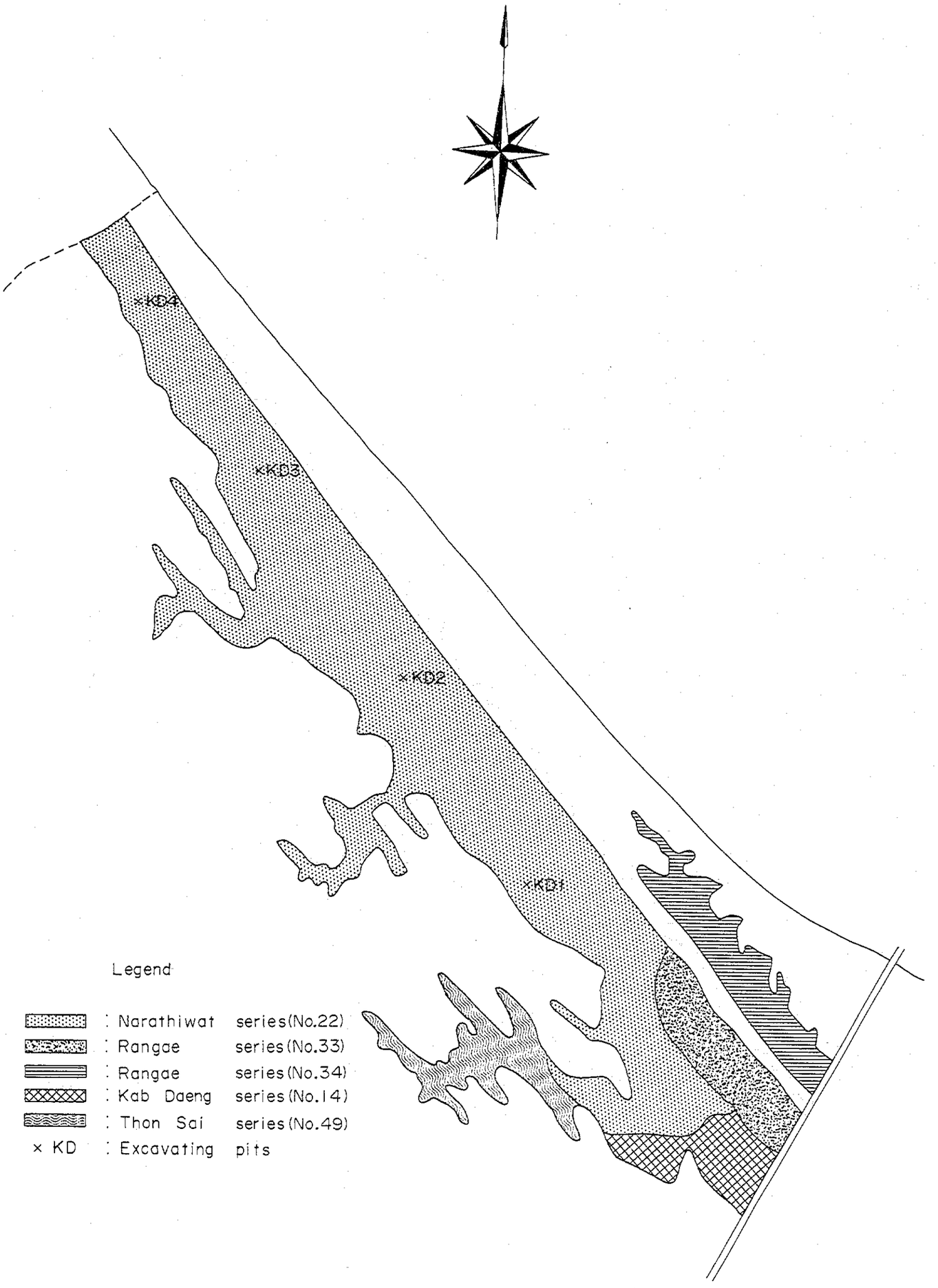


Figure E-3 Soil series and soil survey points in Kab Daeng F/S area

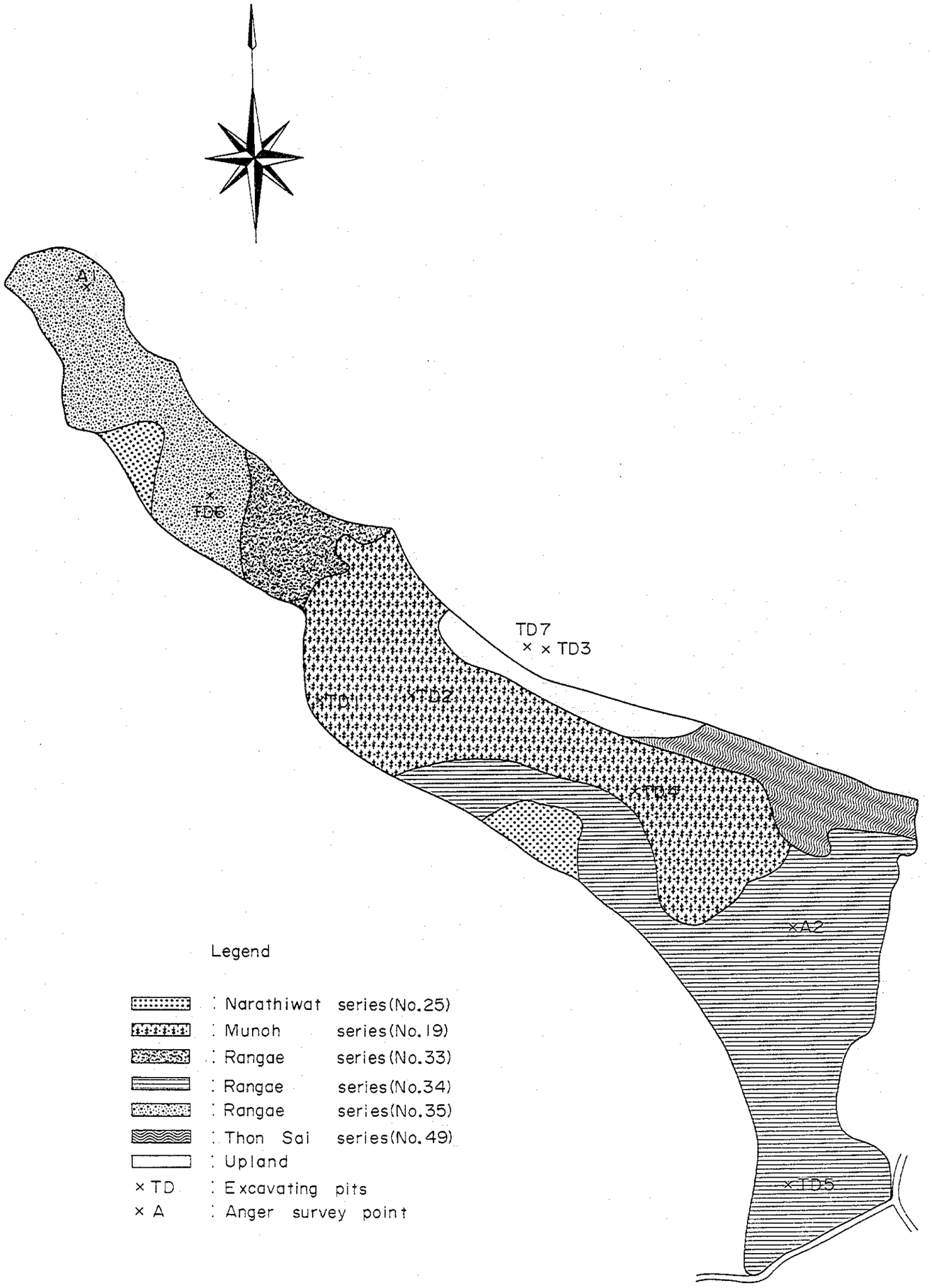


Figure E-4 Soil series and soil survey points in Mu No-Koknai F/S area

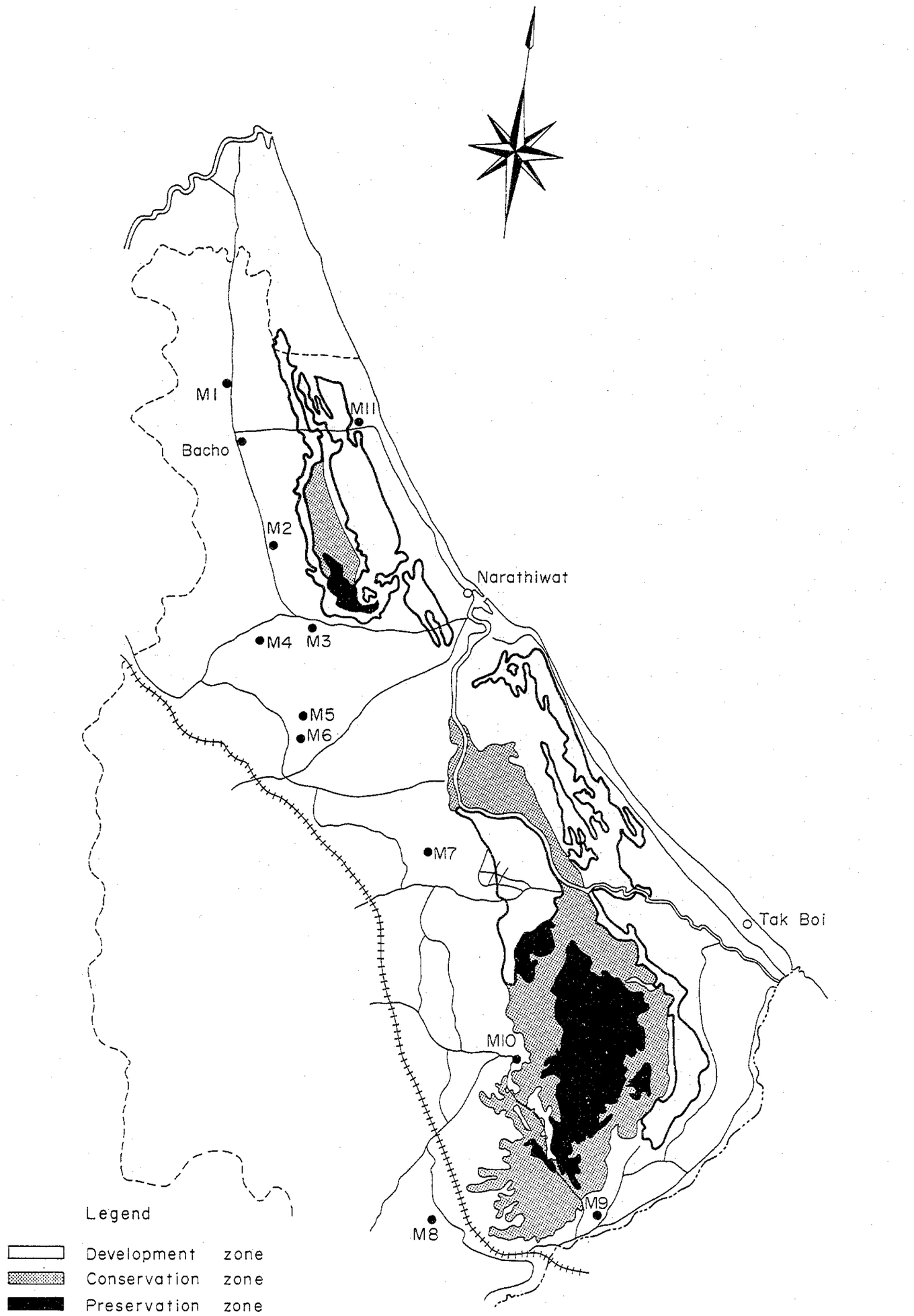


Figure E-5 Survey points of soil dressing materials $\frac{1}{250,000}$

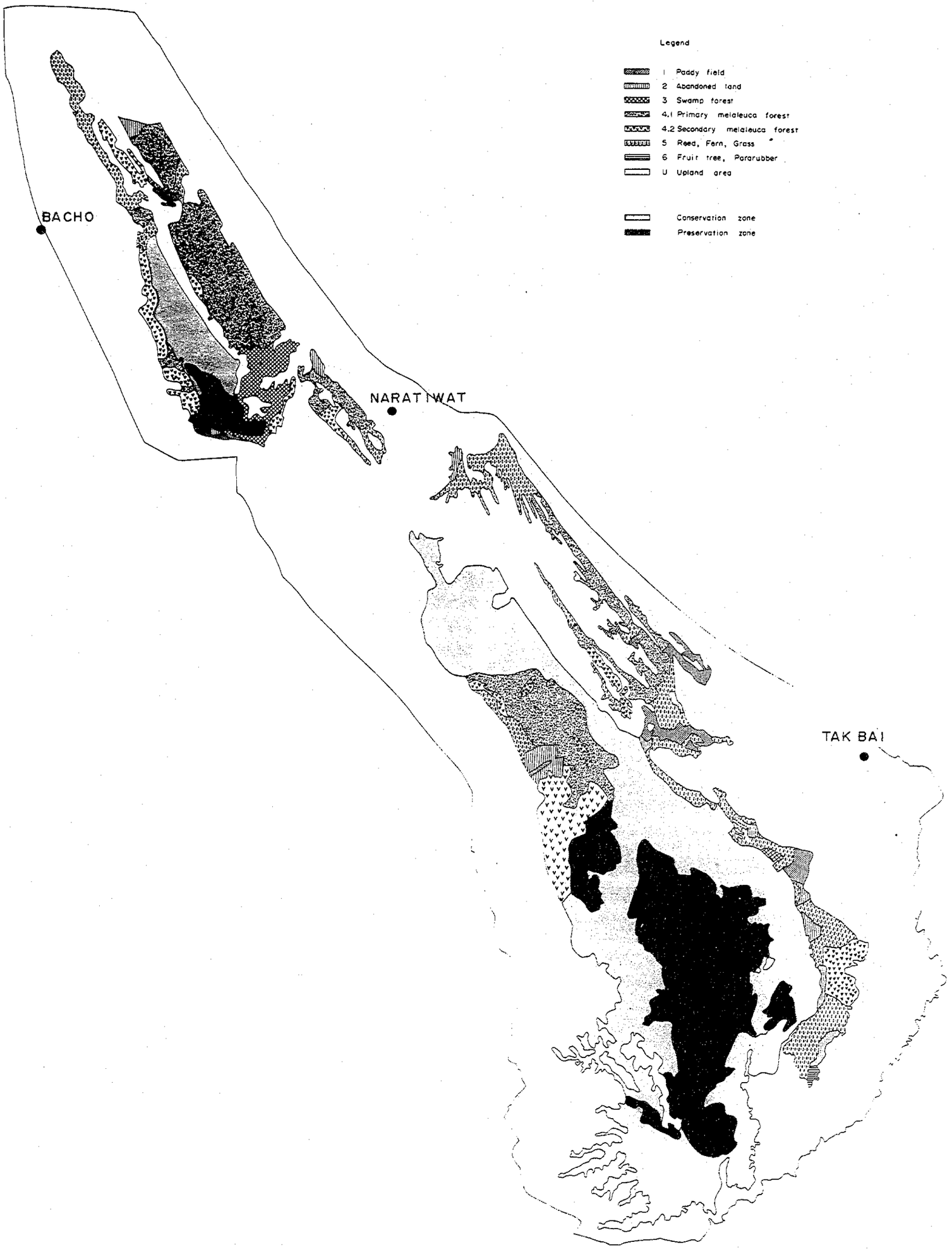


Figure E-6 Land use in Development zone Source : By DLD (1992)

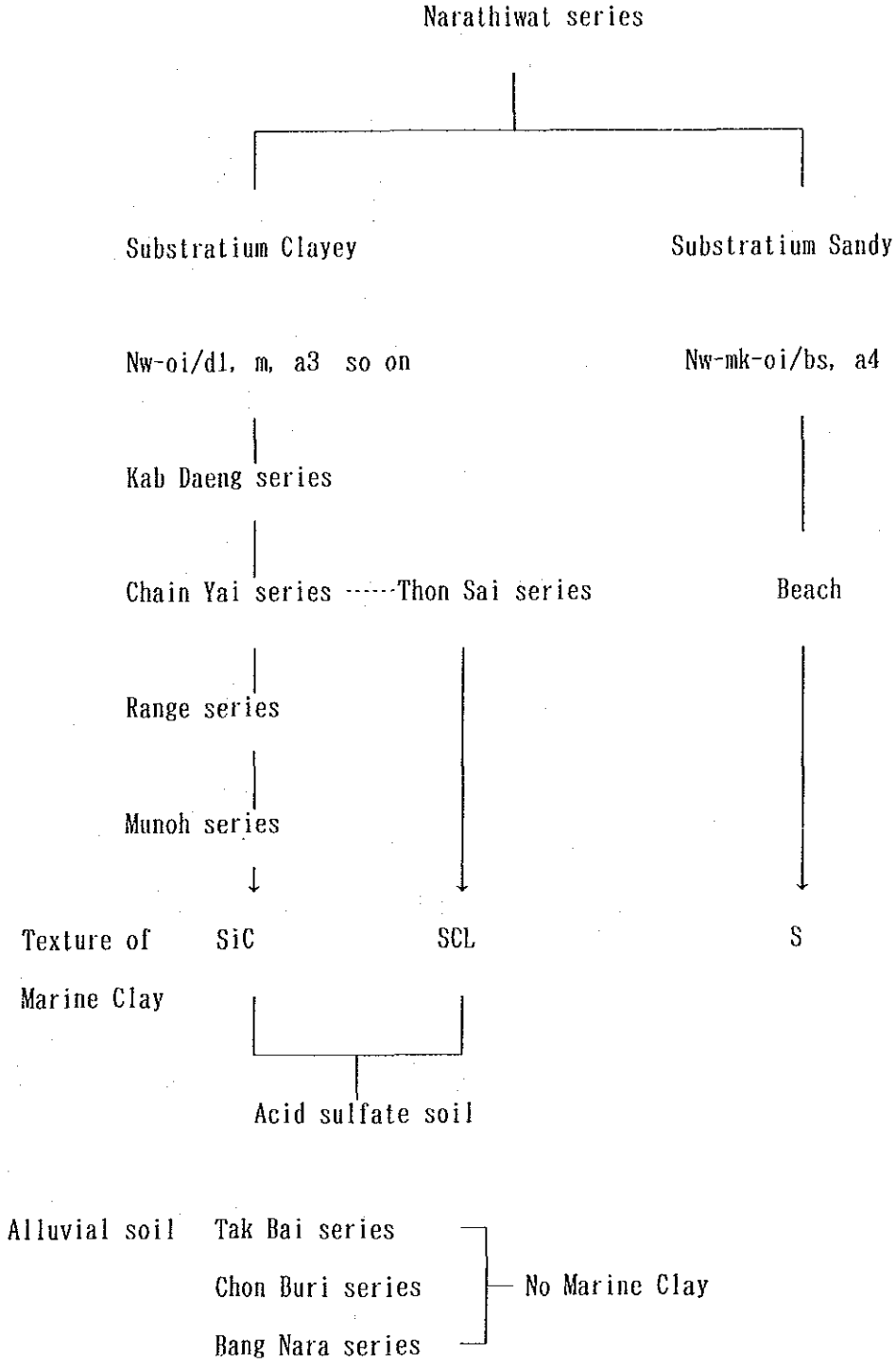
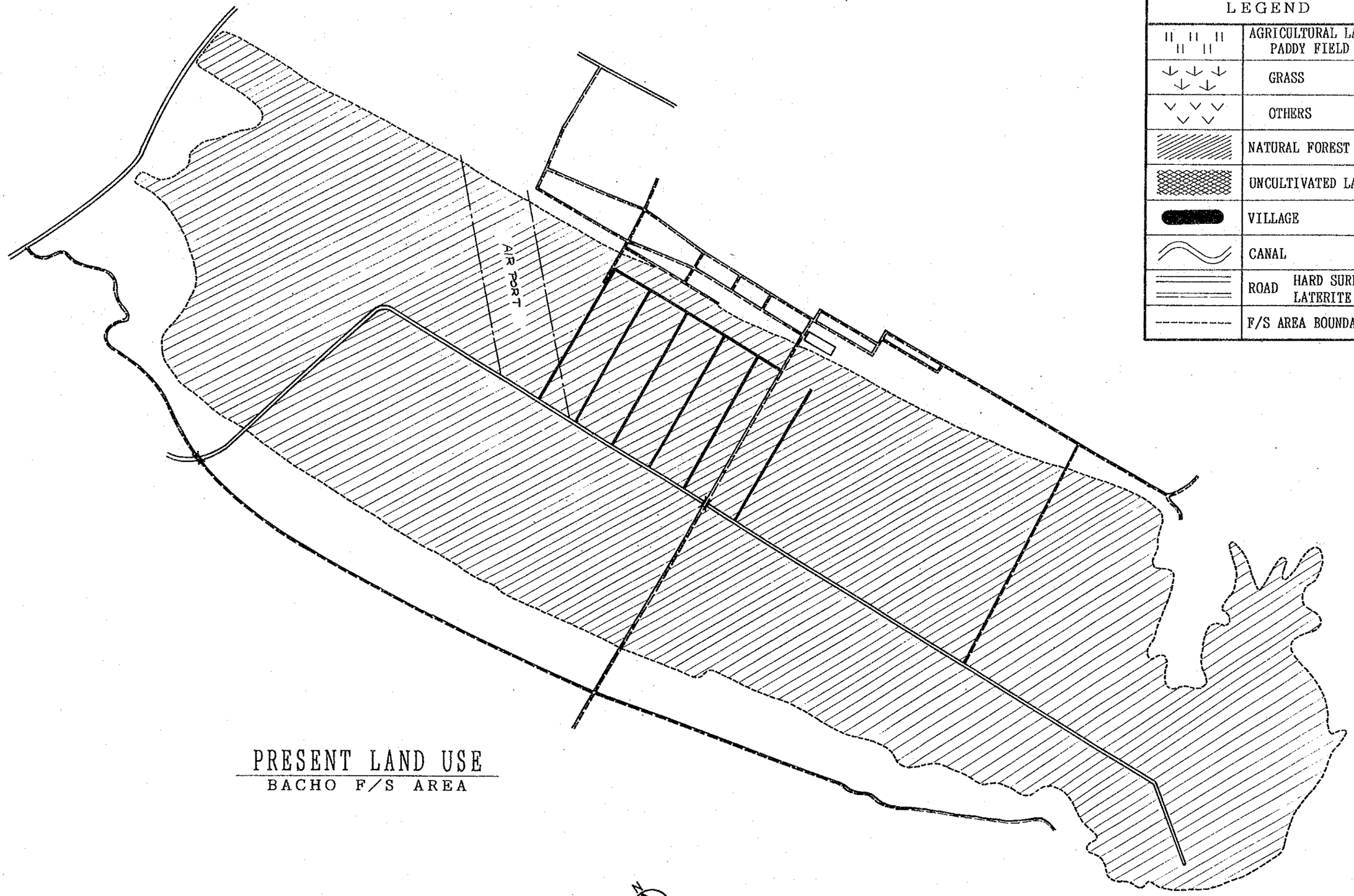


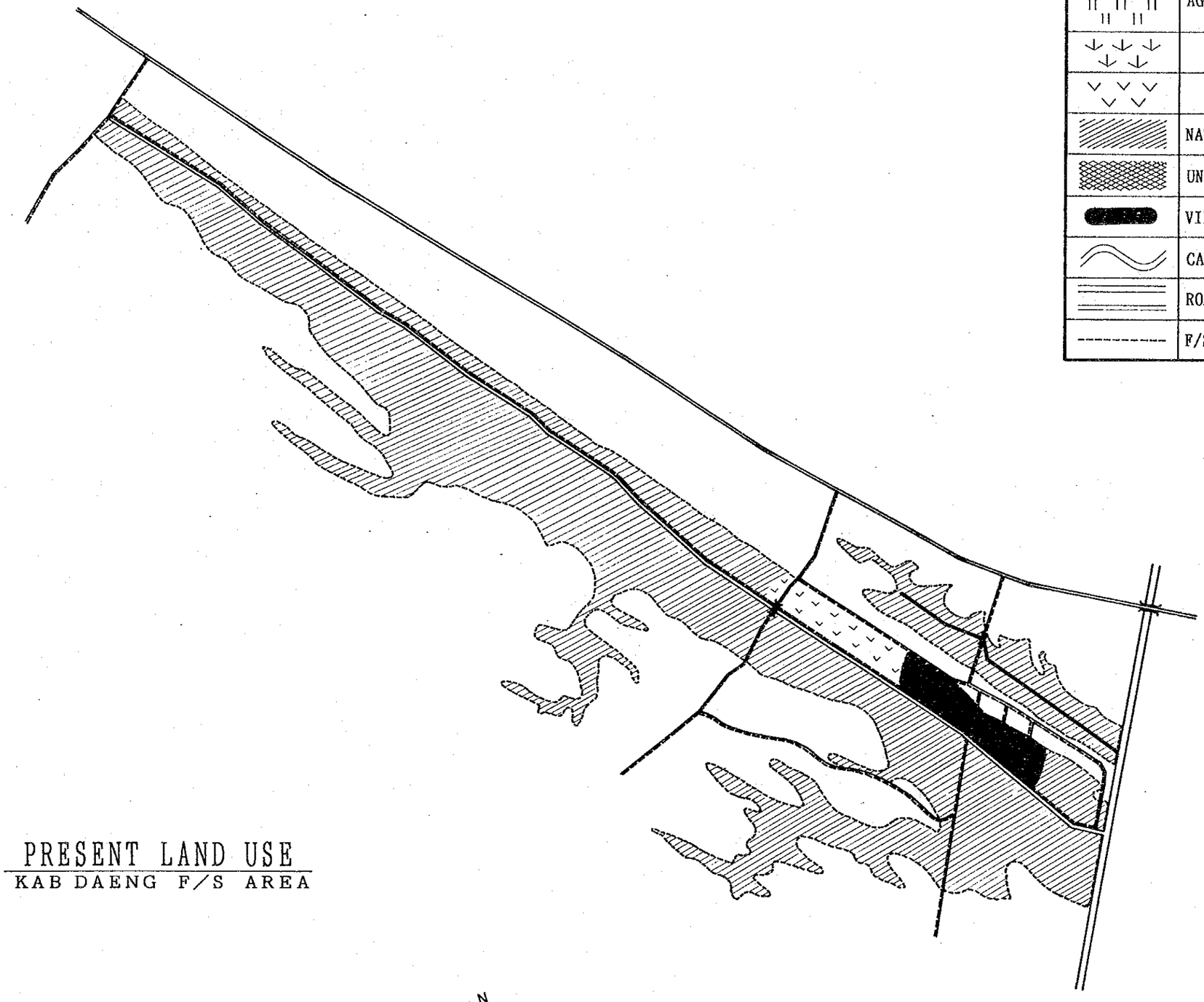
Figure E-7 Succession of soil series in swamp area

Remark:By referring the data of DLD semi-detaild soil map of Narathiwat Province



PRESENT LAND USE

BACHO F/S AREA



LEGEND

	AGRICULTURAL LAND PADDY FIELD
	GRASS
	OTHERS
	NATURAL FOREST
	UNCULTIVATED LAND
	VILLAGE
	CANAL
	ROAD HARD SURFACE LATERITE
	F/S AREA BOUNDARY

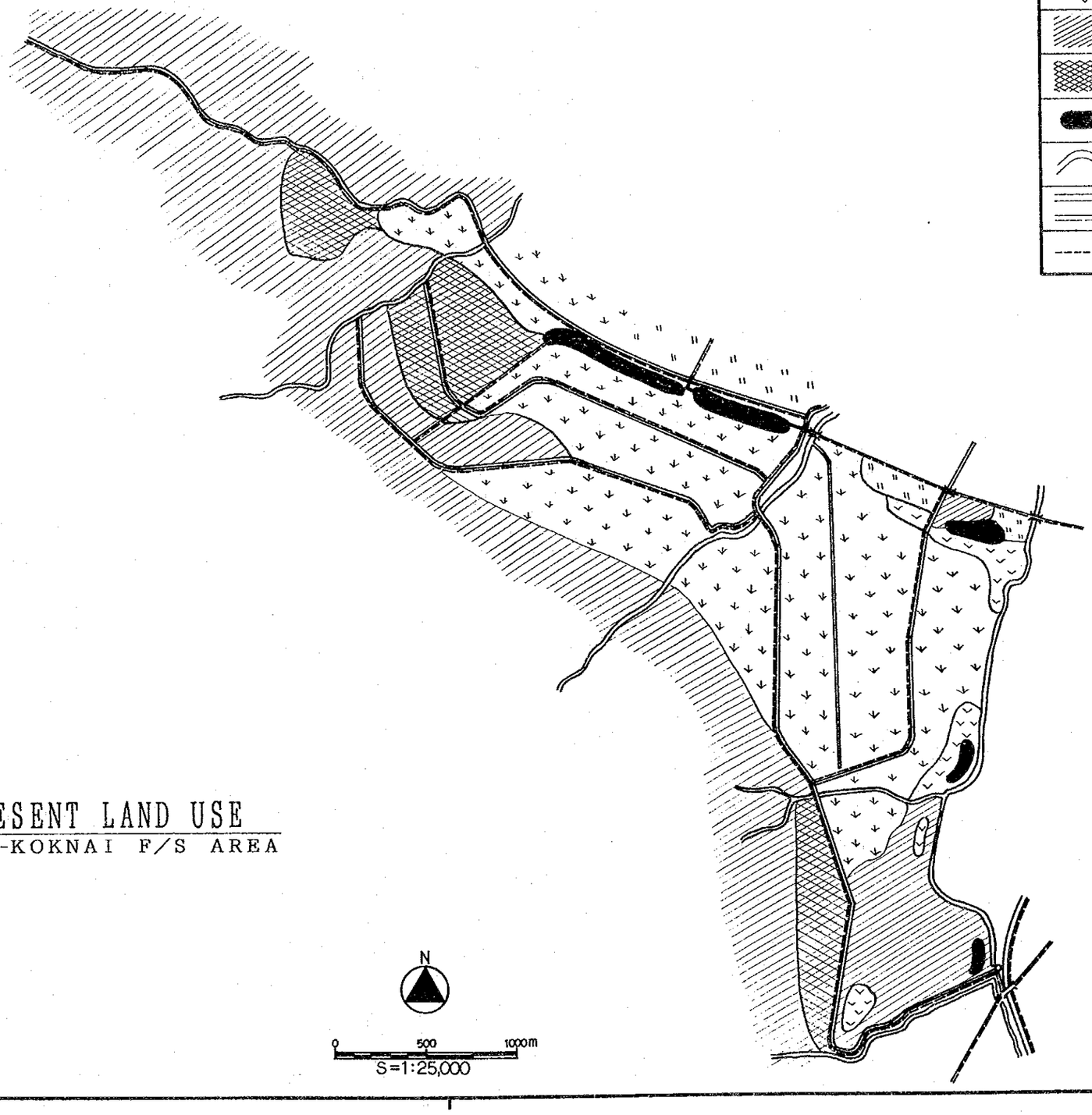
PRESENT LAND USE

KAB DAENG F/S AREA

N

0 500 1000m

S=1:25,000



PRESENT LAND USE

MUNO-KOKNAI F/S AREA

APPENDIX F. AGRICULTURE

APPENDIX F. AGRICULTURE

LIST OF TABLES

TABLE F-1-1 PRODUCTION OF PADDY RICE, THAILAND

Year	Second+Major				Second				Major			
	Aria				Aria				Aria			
	Planted	Harested	Production	Yield	Planted	Harested	Production	Yield	Planted	Harested	Production	Yield
	,000rais	,000rais	,000tons	kg/rai	,000rais	,000rais	,000tons	kg/rai	,000rais	,000rais	,000tons	kg/rai
1.1981/82	59,970	56,906	17,774	312	3,578	3,553	2,017	568	56,312	53,353	15,758	295
2.1982/83	60,134	55,875	18,879	302	3,963	3,901	2,104	539	56,171	51,975	14,774	284
3.1983/84	62.596	60,038	19,549	326	4,481	4,410	2,606	591	58,115	55,628	16,942	305
4.1984/85	62,328	60,183	19,905	331	4,415	4,412	2,630	596	57,915	55,774	17,272	310
5.1985/86	63,422	61,457	20,264	330	3,985	3,981	2,334	588	59,437	57,476	17,930	312
6.1986/87	61,571	57,463	18,868	328	3,628	3,627	2,042	563	57,943	53,836	16,826	313
7.1987/88	58,888	57,169	18,428	322	4,564	4,505	2,771	615	54,324	52,664	15,658	297
8.1988/89	64,677	61,912	21,263	343	5,306	5,264	3,381	642	59,372	56,648	17,882	316
9.1989/90	64,439	61,744	20,801	334	5,244	4,587	2,124	465	59,195	57,177	18,477	323
10.1990/91	61,910	54,949	17,193	313	3,705	3,648	2,291	628	58,205	51,303	14,902	290
Average	61,894	58,770	19,072	325	4,287	4,187	2,430	580	57,699	54,583	16,642	305
		(9,403ha)		(2,028kg/ha)		(670ha)		(3,627kg/ha)		(8,733ha)		(1,906kg/ha)

SOURCE:Agricultural Statistics of Thailand Crop Year 1983/84,1987/88,1990/91.

TABLE F-1-2 PRODUCTION OF PADDY RICE, NARATHIWAT

Year	Second+Major				Second				Major			
	Aria				Aria				Aria			
	Planted	Harested	Production	Yield	Planted	Harested	Production	Yield	Planted	Harested	Production	Yield
	rais	rais	tons	kg/rai	rais	rais	tons	kg/rai	rais	rais	tons	kg/rai
1.1981/82	217,343	198,440	47,710	240	4,663	4,663	2,119	454	212,680	193,777	45,591	235
2.1982/83	185,943	185,886	62,119	334	2,151	2,151	1,030	479	183,792	183,735	61,089	332
3.1983/84	232,308	167,715	50,623	302	4,242	4,242	1,981	467	228,066	165,473	48,642	294
4.1984/85	231,412	206,751	68,123	329	13,186	13,186	5,274	400	218,226	193,565	62,849	325
5.1985/86	173,797	156,268	53,600	343	2,983	2,983	1,160	389	170,814	153,285	52,440	342
6.1986/87	155,630	122,666	35,487	289	5,804	5,804	1,776	306	149,826	116,862	33,711	288
7.1987/88	197,394	172,522	60,585	351	5,635	5,106	2,482	486	191,759	167,416	58,103	347
8.1988/89	218,249	201,971	68,816	341	19,188	15,139	7,963	526	192,572	186,832	60,853	326
9.1989/90	207,720	203,364	52,683	259	8,659	8,605	3,316	385	199,061	194,759	49,367	253
10.1990/91	104,228	103,734	33,897	327	1,520	1,520	620	408	102,708	102,214	33,277	326
Average	192,402	171,932	53,364	310	6,803	6,340	2,772	437	186,950	165,792	50,592	305
		(27,507ha)	(1,940kg/ha)			(1,014ha)	(2,734kg/ha)			(26,527ha)	(1,907kg/h)	

SOURCE:Agricultural Stateties Thailand Crop Year 1983/84,1987/88,1990/91.

TABLE F-2 PRODUCTION OF GROUND NUT

Year	THAILAND Aria Planted	Harested	Production	Yield	NARATHIWAT Aria Planted	Harested	Production	Yield
	,000rais	,000rais	,000tons	kg/rai	rais	rais	tons	kg/rai
1.1981/82	764	733	147	200	194	182	23	128
2.1982/83	781	734	145	178	718	686	105	153
3.1983/84	783	753	147	174	351	351	49	140
4.1984/85	820	781	172	220	3,151	3,119	772	248
5.1985/86	779	756	171	227	1,862	1,564	383	245
6.1986/87	790	781	169	217	–	–	–	–
7.1987/88	763	736	162	219	643	618	148	239
8.1988/89	771	737	164	222	1,256	1,091	266	244
9.1989/90	763	752	161	215	152	152	33	217
10.1990/91	760	734	161	200	–	–	–	–
Average	775	750	160	213	1,041	970	222	228
		(120ha)		(1,333kg/ha)		(155ha)		(1,432kg/ha)

SOURCE:Agricultural Statistics of Thailand Crop Year 1983/84,1987/88,1990/91.

TABLE F-3 PRODUCTION OF MUNGBEAN

Year	THAILAND Aria Planted	Harested	Production	Yield	NARATHIWAT Aria Planted	Harested	Production	Yield
	,000rais	,000rais	,000tons	kg/rai	rais	rais	tons	kg/rai
1.1981/82	3,040	2,881	284	99	245	67	20	299
2.1982/83	3,034	2,775	281	101	518	163	34	209
3.1983/84	3,022	2,803	288	103	–	–	–	–
4.1984/85	3,280	3,017	352	117	–	–	–	–
5.1985/86	3,426	3,307	323	98	–	–	–	–
6.1986/87	3,170	3,081	301	98	–	–	–	–
7.1987/88	2,900	2,735	267	98	160	160	13	81
8.1988/89	2,964	2,888	333	115	–	–	–	–
9.1989/90	3,205	3,102	356	115	204	204	17	83
10.1990/91	2,808	2,674	303	113	–	–	–	–
Average	3,850	2,924	309	108	281	149	21	141
		(468ha)		(660kg/ha)		(24ha)		(875kg/ha)

SOURCE:Agricultural Statistics of Thailand Crop Year 1983/84,1987/88,1990/91.

TABLE F-4-1 PRODUCTION OF PARA RUBBER

No.	Year	National Level				Naratiwat Province			
		Area		Production	Yield	Area		Production	Yield
		Planted (1000 rai)	Harvested (1000 rai)	(1000 ton)	(kg/rai)	Planted (1000 rai)	Harvested (1000 rai)	(1000 ton)	(kg/rai)
1	1981/82	9,867	7,933	508	64.0				
2	1982/83	10,001	8,862	576	65.0				
3	1983/84	10,143	8,864	594	67.0				
4	1984/85	10,254	8,572	617	72.0				
5	1985/86	10,288	8,821	773	87.6				
6	1986/87	10,346	9,001	811	90.1				
7	1987/88	10,399	9,253	891	96.3				
8	1988/89	10,577	9,247	862	93.2				
9	1989/90	10,822	10,063	1,048	104.1				
10	1990/91	10,996	10,273	1,097	106.8				
	Mean	10,369	9,089	778	85.6				

Source: Agricultural Stastics of Thailand, Crop Year 1990/91, MAC

TABLE F-4-2 PRODUCTION, AREA AND YIELD OF PARA RUBBER (1991/1992)

District	Local Vareity			Hyblid Vareity				
		Planted			Planted Area		Harvested Area	
	Production (ton)	Area (rai)	Yeild (ton/rai)	Production (ton)	Area (rai)	Yeild (ton/rai)	Area (rai)	Yeild (ton/rai)
Narathiwat	682, 720	5, 020	136	4, 662, 110	32, 072	145	24, 409	191
Takbai	87, 055	757	115	597, 978	3, 147	190	2, 151	278
Bajah	277, 200	2, 640	105	1, 628, 000	16, 163	101	6, 512	250
Yingo	131, 355	973	135	8, 858, 925	52, 833	168	39, 373	225
Rangae	3, 447, 702	33, 801	102	20, 475, 074	105, 687	194	81, 574	251
Ruso	58, 880	512	115	23, 198, 400	155, 039	150	128, 880	180
Waeng	6, 116, 280	50, 969	120	6, 975, 670	53, 381	131	30, 329	230
Sungai Kolok	1, 379, 620	12, 542	110	2, 445, 120	13, 055	187	9, 056	270
Sungai Padi	550, 050	5, 790	95	14, 880, 672	70, 677	211	68, 892	216
Srisakorn	809, 990	7, 570	107	27, 128, 663	125, 627	216	95, 861	283
Sukirin	979, 800	9, 798	100	4, 226, 400	52, 416	81	23, 480	180
Cha-Nai	6, 351, 070	57, 737	110	9, 692, 750	72, 536	134	38, 771	250
Total	20, 871, 722	188, 109	111	124, 769, 762	752, 633	166	549, 288	227

Source : Agricultural Office

TABLE F-5-1 PRODUCTION OF COCONUT

No.	Year	National Level				Naratiwat Province			
		Area		Production	Yield	Area		Production	Yield
		Planted (1000 rai)	Harvested (1000 rai)	(1000 ton)	(kg/rai)	Planted (1000 rai)	Harvested (1000 rai)	(1000 ton)	(kg/rai)
1	1981/82	2,373	1,720	887	515.7				
2	1982/83	2,443	1,738	1,076	619.1				
3	1983/84	2,451	1,754	1,102	628.3				
4	1984/85	2,511	1,853	1,128	608.7				
5	1985/86	2,593	1,915	1,226	640.2				
6	1986/87	2,586	2,045	1,280	625.9				
7	1987/88	2,545	2,072	1,311	632.7				
8	1988/89	2,490	2,106	1,378	654.3				
9	1989/90	2,481	2,190	1,437	656.2				
10	1990/91	2,455	2,163	1,426	659.3				
	Mean	2,493	1,956	1,225	626.3				

Source: Agricultural Stastics of Thailand, Crop Year 1990/91, MAC

TABLE F-5-2 PRODUCTION, AREA AND YIELD OF COCONUT (1991/1992)

District	Production (kg)	Planted Area (rai)	Yeild (kg/rai)	Harvested Area (rai)	Yeild (kg/rai)
Narathiwat	8,008,472	16,011	500	14,614	548
Takbai	16,975,200	23,715	716	21,219	800
Bajah	4,854,600	12,468	389	10,788	450
Yingo	1,860,000	4,150	448	3,700	503
Rangae	7,641,600	4,776	1,600	4,776	1,600
Ruso	1,879,200	2,439	770	2,349	800
Waeng	239,200	547	437	520	460
Sungai Kolok	126,000	317	397	210	600
Sungai Padi	2,168,320	1,744	1,243	1,694	1,280
Srisakorn	976,640	1,055	926	896	1,090
Sukirin	0	0	0	0	0
Cha-Nai	258,400	316	818	304	850
Total	44,987,632	67,538	666	61,070	737

Source : Agricultural Office

TABLE F-6 PLANTED, DAMAGED AND HARVESTED AREAS, PRODUCTION AND YIELD OF VEGETABLES

Crop Name	Planted Area (rai)		Damaged Area (rai)		Havested Area (rai)		Production (ton)		Yield (kg/rai)	
	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89
Short Cucumber	1,117	1,515	198	54	919	1,461	993	1,826	1,081	1,250
Yard Long Bean	926	1,376	187	109	739	1,267	438	820	593	847
Angled Loofah	287	538	1	61	286	477	114	321	399	673
Water Spinach	48	504	0	31	48	473	24	267	490	565
Hot Papper	180	296	3	59	177	239	164	301	924	1,260
Chilli	175	113	6	7	169	106	114	78	672	738
Bottle Gourd	49	68	0	0	49	68	25	45	504	694
Chinese Pakchai	65	47	0	0	65	47	137	35	2,059	747
Water Convelvulus	0	42	0	31	0	11	0	7	0	600
Chinese Kale	44	34	2	1	42	33	32	39	752	1,185
Pampkin	19	30	0	10	19	20	42	50	2,211	2,485
Mutiplt Onion	17	10	1	0	16	10	45	7	2,836	650
Ginger	11	0	0	0	11	0	16	0	1,481	0
Shallot	10	0	0	0	10	0	10	0	1	0
White Gourd	8	7	0	0	8	7	3	5	328	717
Tomato	0	4	0	0	0	4	0	3	0	750
Long Cucumber	74	7	3	0	71	7	81	7	1,145	1,000
Chinese Cabbage	1	3	0	0	1	3	1	3	1,000	1,000
Cabbage	2	0	0	0	2	0	2	0	3,200	0
Baby Corn	0	1	0	0	0	1	0	0	0	150
Califlower	1	0	0	0	1	0	1	0	1,200	0
Lettuce	51	0	0	0	51	0	22	0	437	0

Source : Agricultural Statistical Analysis Sub-Division
Planning Division
Depertment of Agricultural Extension

TABLE F-7 PLANTED AREA, PRODUCTION, YIELD AND PRICES OF FRUITS (1988/89)

Name of fruits		Planted Area (rai)			Average Yield	Total Prodct'n	Farm gate price (bath/kg)			
		Breeding	not Breeding	Total	kg/rai	(ton)	Early Season	Mid Season	Late Season	Average
Durian	Total	25,821	5,631	31,452	2,200	56,811	0	0	0	0
	Chani	808	337	1,145	1,189	961	18.6	17	18.66	18.09
	Kanyao	614	687	1,301	1,922	1,180	15.66	13.33	15	14.66
	Mon Thang	1,395	1,221	2,616	1,263	1,762	22.12	19.8	23	21.64
	Kradum	2	1	3	2,000	4	12	10	11	11
	Miscell.	23,002	3,385	26,387	2,300	52,905	6	5	6	5.67
Rambutan	Total	26,973	4,417	31,390	1,819	49,077	0	0	0	0
	Rongrian	4,252	3,224	7,476	2,250	9,588	7.6	5.8	6.6	6.67
	Miscell.	22,721	1,193	23,914	1,651	39,489				
Longkong		18,329	13,071	31,400	1,556	28,520	42.41	33	39.83	38.41
Lang Sat		9,614	94	9,708	1,190	11,441	11.41	9.16	11.25	10.61
Mangosteen		2,238	965	3,203	1,568	3,509	8.37	6	7.37	7.25
Kluai Khai		907	36	943	792	718	5.8	5.8	5.8	5.8
Pummels	Total	571	45	617	769	439	0	0	0	0
	Thonadi	6	4	10	400	2	7	7	7	7
	Miscell.	565	42	607	773	437	5.5	4.16	4.33	4.66
Santol	Total	32	5	37	930	30	0	0	0	0
	Native	24	5	29	950	23	2	2	2	2
	Miscell.	8	0	8	870	7				
Snake Fruit		20	0	20	130	3	18	15	15	16
Cardamon		0	5	5	0	0	0	0	0	0

Note: The unit of production of Kluai Khai is in hand.

The unit of production of Mangosteen is in fruit(s) or in piece(s).

Source: Agricultural Statistic Analysis Sub-Division

Planning Division

Department of Agricultural Extension

TABLE F-8 NUMBER OF LIVESTOCKS

(Narathiwat level)

(unit:heads)

year	Buffaloes	Trend	Cattle	Trend	Swine	Trend	Chicken	Trend	Duck	Trend
1981	14,820	1.00	85,099	1.00	10,866	1.00	-	-	-	-
1982	15,406	1.04	90,485	1.06	13,186	1.21	-	-	-	-
1983	15,905	1.07	96,190	1.13	9,579	0.88	-	-	-	-
1984	12,261	0.83	72,043	0.85	17,460	1.61	-	-	-	-
1985	13,533	0.91	74,530	0.88	12,773	1.18	770,838	1.00	-	-
1986	13,679	0.92	74,614	0.88	11,916	1.10	718,917	0.93	-	-
1987	13,827	0.93	73,305	0.86	11,126	1.02	655,962	0.85	40,985	1.00
1988	14,062	0.95	72,966	0.86	4,615	0.42	226,572	0.29	41,599	1.01
1989	14,200	0.96	77,044	0.91	3,836	0.35	284,592	0.37	41,312	1.01
1990	12,389	0.84	78,518	0.92	3,340	0.31	319,923	0.42	53,950	1.32
Mean	14,008	1.00	79,479	1.00	9,870	1.00	496,134	1.00	44,462	1.00

Source : Agricultural Statistics of Thailand Crop Year 1990/91

(National Level)

(unit:heads)

year	Buffaloes	Trend	Cattle	Trend	Swine	Trend
1981	85,620	1.00	327,180	1.00	3,224,090	1.00
1982	86,560	1.01	356,683	1.09	3,252,504	1.01
1983	103,150	1.20	381,582	1.17	3,145,210	0.98
1984	129,744	1.52	418,689	1.28	3,180,622	0.99
1985	133,934	1.56	411,787	1.26	3,479,709	1.08
1986	144,678	1.69	396,722	1.21	3,332,773	1.03
1987	153,334	1.79	401,503	1.23	3,259,885	1.01
1988	164,116	1.92	391,187	1.20	3,403,928	1.06
1989	178,031	2.08	395,259	1.21	3,554,682	1.10
1990	173,143	2.02	404,312	1.24	3,815,626	1.18
Mean	135,231		388,490	1.00	3,364,903	1.00

Source : Agricultural Statistics of Thailand Crop Year 1990/91

TABLE F-9 NATIONAL RESERVED FOREST IN NARATHIWAT

No.	Name	Location (Amphur)	Area (ha)
1	Loo Buo La Soa	Rangae	2, 100. 00
2	Bangnara #2	Sungai Padi, Tak Bai, Sungai Kolok	28, 616. 00
3	Ko Si Ko	Tak Bai	1, 026. 40
4	Do Ngo	Tak Bai	2, 634. 96
5	Bangnara #1	Rangae	9, 400. 00
6	Buket Ta Ware	Rangae, Sungai Padi	3, 056. 00
7	Teuk Kao Rue Sao	Rangae	3, 138. 88
8	Teuk Kao Rue Sao	Rue Sao, Yingao, Bajo, Range	13, 649. 92
9	Buket Ta Mong	Rangae, Sungai Padi	1, 388. 96
10	Ka Lu Bi	Rangae	388. 92
11	I Sa Tea	Rangae	100. 00
12	Bu Ngao	Yingao	96. 48
13	Kao Tanyong	Muang	429. 92
14	Kao Somnak	Waeng, Sukirin	200. 00
15	Kao Mala	Waeng	16, 900. 00
16	Krue Sua	Sungai Padi	1, 400. 00
17	Bu Kae Ta Ware #1	Rue So	5, 060. 96
18	Tae Kae	Rue So	430. 00
19	Left Rimyo #1	Sukirin, Janae	20, 000. 00
20	Right Sei Buri	nd	1, 300. 00
Total			111, 317. 40

Note: The all data of the forest on being prepared for preservation : 72, 234 ha

Source: Marketing data of Narathiwat, 1990

TABLE F-10-1 IN LAND FRESH WATER ANIMALS IN THE NARATIWAT PROVINCE

Fresh Water Animals	Value of the Fresh Water Animals from 1988 - 1991								Remarks
	1988		1989		1990		1991		
	Product (kg)	Value (Baht)	Product (kg)	Value (Baht)	Product (kg)	Value (Baht)	Product (kg)	Value (Baht)	
1. Smakehead fish	64,500	2,902,500	35,678	1,605,510	36,886	1,659,870	31,870	1,434,150	
2. Cat fish	98,750	4,937,500	94,241	4,523,568	106,874	4,809,330	250,560	8,769,600	
3. Tiger mandid	13,540	541,600	12,121	484,840	8,536	341,440	10,615	3,181,450	
4. Common silver barb	7,100	213,000	11,022	330,660	13,391	401,730	23,898	716,940	
5. Nile Tilapia	16,350	399,870	16,965	508,950	20,986	629,580	36,324	1,089,720	
6. Cinnib caro	5,000	150,000	6,387	223,545	6,168	215,880	10,475	366,625	
7. Sepat Siam	5,540	166,200	6,905	193,340	5,890	176,700	6,640	185,920	
8. Swamp eel	17,455	698,200	6,560	164,000	7,814	195,350	12,165	425,775	
9. Cat fish-Black ear	4,565	114,125	21,327	746,445	25,235	883,225	18,770	469,250	
10. Miscelleneous fish	50,500	1,515,000	43,308	1,082,700	38,986	779,720	45,230	1,130,750	
11. Gaint freshwater prawn	6,630	994,000	4,916	884,880	4,490	673,500	7,085	1,275,300	
12. Small shrimp	5,200	104,000	4,710	70,650	5,090	101,800	1,720	25,800	
13. Other aquatic animals	50,150	1,522,500	58,940	1,473,500	49,139	1,228,475	31,565	789,125	
Total	345,280	14,258,995	323,080	12,292,588	329,485	12,096,600	486,917	16,997,405	

Source : Naratiwat Provincial Office

TABLE F-10-2 REGISTERED AQUA-BREEDERS

No.	Amphoe	No. of Breeders			
		Tambon	Farms	Ponds	Area m^2
	Total	73	2,604	3,315	948,673 m^2

Source : Naratiwat Provincial Office

TABLE F-11-1 PRODUCTION, AREA AND YIELD OF PARA RUBBER (1991/1992)

District	Local Variety			Hyblid Variety				
	Production (kg)	Planted Area (rai)	Yield (kg/rai)	Production (kg)	Planted Area		Harvested Area	
					Area (rai)	Yield (kg/rai)	Area (rai)	Yield (kg/rai)
Narathiwat	682,720	5,020	136	4,662,110	32,072	145	24,409	191
Takbai	87,055	757	115	597,978	3,147	190	2,151	278
Bajah	277,200	2,640	105	1,628,000	16,163	101	6,512	250
Yingo	131,355	973	135	8,858,925	52,833	168	39,373	225
Rangae	3,447,702	33,801	102	20,475,074	105,687	194	81,574	251
Ruso	58,880	512	115	23,198,400	155,039	150	128,880	180
Waeng	6,116,280	50,969	120	6,975,670	53,381	131	30,329	230
Sungai Kolok	1,379,620	12,542	110	2,445,120	13,055	187	9,056	270
Sungai Padi	550,050	5,790	95	14,880,672	70,677	211	68,892	216
Srisakorn	809,990	7,570	107	27,128,663	125,627	216	95,861	283
Sukirin	979,800	9,768	100	4,226,400	52,416	81	23,480	180
Cha-Nai	6,351,070	57,737	110	9,692,750	72,536	134	38,771	250
Total	20,871,722	188,109	111	124,769,762	752,633	166	549,288	227

Source : Agricultural Office

TABLE F-11-2 PRODUCTION, AREA AND YIELD OF RAMBUTAN, LANGSON AND CASHEWNUT (1991/1992)

RAMBUTAN						
District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	461,490		524	2.7	1,139	
Takbai	10,800		41	0.2	1,543	
Bajah	584,500		899	4.7	779	
Yingo	1,823,150		2,292	11.9	820	
Rangae	7,500,792		6,750	35.2	1,357	
Ruso	2,132,790		779	4.1	1,385	
Waeng	889,600		818	4.3	1,600	
Sungai Kolok	197,255		408	2.1	861	
Sungai Padi	901,000		593	3.1	1,700	
Srisakorn	1,945,050		1,324	6.9	2,197	
Sukirin	2,011,200		4,288	22.3	800	
Cha-Nai	894,900		513	2.7	1,627	
Total/Average	19,282,527		19,229	100.0	1,306	

LANGSON						
District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	0		0	0.0		
Takbai	11,259		27	1.3	1,251	
Bajah	57,950		61	2.9	950	
Yingo	40,000		59	2.9	1,000	
Rangae	333,928		424	20.4	938	
Ruso	198,720		184	8.9	1,080	
Waeng	328,100		418	20.2	850	
Sungai Kolok	81,104		192	9.3	548	
Sungai Padi	588,350		287	13.9	2,050	
Srisakorn	210,000		210	10.1	1,000	
Sukirin	34,800		76	3.7	600	
Cha-Nai	146,400		132	6.4	1,200	
Total/Average	2,030,611		2,070	100.0	1,091	

CASHEWNUT						
District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	501,250		2,260	41.1	250	
Takbai	573,500		1,497	27.3	500	
Bajah	372,400		1,633	29.7	245	
Yingo	-		0	0.0	-	
Rangae	12,000		60	1.1	200	
Ruso	-		0	0.0	-	
Waeng	1,630		9	0.2	170	
Sungai Kolok	2,300		10	0.2	230	
Sungai Padi	2,100		21	0.4	100	
Srisakorn	-		0	0.0	-	
Sukirin	-		0	0.0	-	
Cha-Nai	-		0	0.0	-	
Total/Average	1,465,080		5,490	100.0	307	

Source : Agricultural Office

TABLE F-11-3 PRODUCTION, AREA AND YIELD OF PADDY (1991/1992)

District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	7,085,754		22,074	9.6	321	
Takbai	18,398,731		38,251	16.7	481	
Bajah	8,749,328		22,904	10.0	382	
Yingo	9,903,222		26,838	11.7	369	
Rangae	23,034,914		71,537	31.4	322	
Ruso	4,360,608		12,978	5.7	336	
Waeng	1,919,846		4,694	2.1	409	
Sungai Kolok	727,650		1,890	0.8	385	
Sungai Padi	7,360,320		19,680	8.6	374	
Srisakorn	1,156,540		3,004	1.3	385	
Sukirin	27,072		64	0.0	423	
Cha-Nai	1,940,800		4,852	2.1	400	
Total/Average	84,664,785	100.0	228,766	100.0	370	100.0

TABLE F-11-4 PRODUCTION, AREA YIELD OF COCONUT (1991/1992)

District	Production (kg)	Planted Area (rai)	Yeild (rai)	Harvested Area (rai)	Yeild (ton/rai)
Narathiwat	8,008,472	16,011	500	14,614	548
Takbai	16,975,200	23,715	716	21,219	800
Bajah	4,854,600	12,468	389	10,788	450
Yingo	1,860,000	4,150	448	3,700	503
Rangae	7,641,600	4,776	1,600	4,776	1,600
Ruso	1,879,200	2,439	770	2,349	800
Waeng	239,200	547	437	520	460
Sungai Kolok	126,000	317	397	210	600
Sungai Padi	2,168,320	1,744	1,243	1,694	1,280
Srisakorn	976,640	1,055	926	896	1,090
Sukirin	0	0	0	0	0
Cha-Nai	258,400	316	818	304	850
Total/Average	44,987,632	67,538	666	61,070	737

Source : Agricultural Office

TABLE F-11-5 PRODUCTION, AREA AND YIELD OF STRINGBEAN, SWEET CORN AND WATER MELON (1991/1992)

STRINGBEAN						
District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	85,579		19	0.6	6,583	
Takbai	-		10	0.3	-	
Bajah	81,000		14	0.5	6,750	
Yingo	41,250		85	2.7	5,500	
Rangae	5,538,750		715	23.0	5,550	
Ruso	1,098,042		160	5.1	8,646	
Waeng	702,450		378	12.2	3,150	
Sungai Kolok	-		0	0.0	-	
Sungai Padi	355,500		395	12.7	1,000	
Srisakorn	-		0	0.0	-	
Sukirin	1,288,800		787	25.4	2,400	
Cha-Nai	3,742,500		544	17.5	7,500	
Total/Average	12,933,371		3,107	100.0	5,466	

SWEET CORN 100						
District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	174,564		39	.3	4.476	
Takbai	265,452		132	11.3	2,011	
Bajah	98,970		30	2.5	3,299	
Yingo	373,381		61	5.2	6,121	
Rangae	916,484		389	33.1	2,356	
Ruso	96,164		116	9.8	829	
Waeng	426,384		56	4.7	7,614	
Sungai Kolok	30,702		17	1.4	1,806	
Sungai Padi	147,913		59	5.0	2,507	
Srisakorn	216,200		115	9.7	1,880	
Sukirin	486,530		110	9.3	4,423	
Cha-Nai	364,000		56	4.7	6,500	
Total/Average	3,596,744		1,180	100.0	3,048	

WATER MELON 100						
District	Production (kg)	Ratio (%)	Planted Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	294,120		129	11.6	2,280	
Takbai	802,752		339	30.5	2,368	
Bajah	229,658		73	6.5	3,146	
Yingo	428,280		172	15.4	2,490	
Rangae	276,000		115	10.3	2,400	
Ruso	34,800		29	2.6	1,200	
Waeng	334,400		160	14.3	2,090	
Sungai Kolok	130,176		32	2.9	4,068	
Sungai Padi	117,382		38	3.4	3,089	
Srisakorn	-		0	0.0	-	
Sukirin	10,155		5	0.4	2,031	
Cha-Nai	64,400		23	2.1	2,800	
Total/Average	2,722,123		1,115	100.0	2,441	

Source : Agricultural Office

TABLE F-11-6 PRODUCTION, AREA AND YIELD OF DURIAN, LONGKONG AND MANGOSTEIN (1991/1992)

DURIAN						
District	Production (kg)	Ratio (%)	Harvested Area (rai)	Ratio (%)	Yeild (kg/rai)	Ratio (%)
Narathiwat	64,925		173	0.0	1,855	
Takbai	9,000		24	0.0	1,800	
Bajah	92,400		730	0.0	700	
Yingo	50,400		163	0.0	600	
Rangae	1,407,834		1,573	0.0	1,566	
Ruso	432,674		670	0.0	1,562	
Waeng	1,824,000		826	0.0	3,200	
Sungai Kolok	37,116		70	0.0	1,031	
Sungai Padi	1,252,800		582	0.0	2,880	
Srisakorn	837,000		1,360	0.0	1,350	
Sukirin	16,800		509	0.0	480	
Cha-Nai	2,068,500		1,181	0.0	2,100	
Total/Average	8,093,449	100.0	0	100.0	1,968	100.0

LONGKONG						
District	Production (ton)	Ratio (%)	Harvested Area (rai)	Ratio (%)	Yeild (ton/rai)	Ratio (%)
Narathiwat	1,028,300	3.5	565	2.9	1,820.0	137.3
Takbai	96,427	0.3	58	0.3	1,662.5	125.4
Bajah	1,141,950	3.9	993	5.1	1,150.0	86.8
Yingo	682,000	2.3	1,240	6.4	550.0	41.5
Rangae	6,753,600	23.2	5,628	28.9	1,200.0	90.5
Ruso	851,724	2.9	708	3.6	1,203.0	90.8
Waeng	634,380	2.2	654	3.4	970.0	73.2
Sungai Kolok	212,504	0.7	263	1.3	808.0	61.0
Sungai Padi	4,270,500	14.6	2,190	11.2	1,950.0	147.1
Srisakorn	1,388,660	4.8	1,274	6.5	1,090.0	82.2
Sukirin	1,808,000	6.2	1,808	9.3	1,000.0	75.5
Cha-Nai	10,310,000	35.4	4,124	21.1	2,500.0	188.6
Total/Average	29,178,045	100.0	19,505	100.0	1,325.3	100.0

MANGOSTEIN						
District	Production (ton)	Ratio (%)	Harvested Area (rai)	Ratio (%)	Yeild (ton/rai)	Ratio (%)
Narathiwat	49,842	2.2	39	2.1	1,278.0	110.1
Takbai	54,681	2.5	33	1.7	1,657.0	142.8
Bajah	247,040	11.1	193	10.2	1,280.0	110.3
Yingo	63,600	2.9	53	2.8	1,200.0	103.4
Rangae	341,341	15.3	341	18.0	1,001.0	86.2
Ruso	120,950	5.4	112	5.9	1,079.0	93.0
Waeng	158,000	7.1	158	8.3	1,000.0	86.2
Sungai Kolok	157,035	7.0	145	7.7	1,083.0	93.3
Sungai Padi	646,200	28.9	359	18.9	1,800.0	155.1
Srisakorn	103,500	4.6	115	6.1	900.0	77.5
Sukirin	115,500	5.2	165	8.7	700.0	60.3
Cha-Nai	172,900	7.8	182	9.6	950.0	81.8
Total/Average	2,230,589	100.0	1,895	100.0	1,160.7	100.0

Source : Agricultural Office

TABLE F-12-1 RELATION BETWEEN CROP AND pH

Location	Crop Name	pH H_2O	pH KCl	E. C. (mS/cm) 1 : 2
1.Munu(S)	Foage Crops	3.6	3.5	0.94
2.Munu(N)	Foage Crops	3.7	3.6	0.41
3.Kab Daeng	Pineppe	4.7	3,4	0.12
4.Kab Daeng	Paddy rice	3.9	3.4	0.36
5.Ban khok kathom	Long Bean			
	Egg plant etc.	3.9	3.5	0.74
6.Bacho mu4	Chilli			
	Egg plant etc.	4.2	3.5	0.17
7.Bacho mu4 No Lime		3.3	2.6	0.18
8.Bacho.Burrapek	Nanking shallot			
	Chilli etc.	5.7	5.3	0.31
9.Bacho.Burrapek No Lime		3.1	3.1	0.62
10.Bacho.Banton (Soil dressing)				
	Durian,Banana	5.5	4.1	0.02
Sab soil	Peat Soil	4.3	3.9	1.37
11.Bacho.Banton	Coconut	4.4	3.7	0.06

Source:JICA team investigation 10,1992.

TABLE F-12-2 RELATION BETWEEN pH OF SOIL AND WATER

Treatment	Crop Name	pH H_2O	pH KCl	E. C. (mS/cm) 1 : 2
		Soil(Water)	Soil(Water)	Soil (Water)
L_1 C_1 F_1	Long Bean	5.27	5.15	1.492
L_1 C_0 F_0		4.15	3.91	1.194
L_0 C_1 F_0		3.98	3.74	0.651
L_0 C_0 F_1		3.60	3.40	0.709
L_0 C_0 F_0		3.72	3.52	0.455
Non Lime	Paddy rice			
No drainage		5.26(3.80)	4.25	0.135(0.52)
2 Week		5.45(3.85)	4.30	0.063(0.42)
4 Week		5.35(4.61)	4.30	0.111(0.18)
6 week		5.33(4.38)	4.18	0.063(0.14)
1/2 Lime (1.1t/rai)	Paddy rice			
No drainage		5.98(4.16)	4.65	0.058(0.18)
2 Week		5.79(-)	4.65	0.075(0.12)
4 Week		6.01(5.67)	4.80	0.048(0.15)
6 week		6.10(4.70)	4.66	0.058(0.25)
Lime weight	Paddy rice			
1/2Lime		5.54(4.10)	4.56	0.276(0.75)
1/4Lime		5.02(3.82)	4,35	0.237(0.65)
1/8Lime		4.69(3.71)	4.31	0.198(0.60)
Non Lime		4.45(3.53)	3/92	0.194(0.62)

Source:JICA team investigation 10,1992.

TABLE F-13-1 CROPPING GUIDE (Food Crop)

Crops Name: Paddy Rice
(Variety)

1. Sowing Time 1st Sep. ~30th Oct. Seeding 25~30 days

2. Transplanting time 30th Sep. ~30th Oct.

3. Planting pattern (Row width × Spacing) 25 cm × 25 cm = 25,600 plant/rai

4. Seed Rate 5 kg/rai 4-5 Baht/kg

5. Fertilizers Input (1) Before Sowing

		Offical	Farmers
Lime stone	1.92 - 4.8 kg/rai		
Clayey Soil	16 - 20 - 0	25~30 kg/rai	10 kg/rai
Sandy Soil	16 - 16 - 8	25~30 kg/rai	10 kg/rai

(2) Flower-bud-appearing stage

Urea 10 kg/rai

6. Irrigation Interval 2 Time before transplanting → drain water out
before harvesting 10 days

7. Pest Control (Agricultural Chemicals name)

Furadan (stern worm) Sowing 3-5 kg/rai

8. Harvesting Mar.~Apr.

9. Average Production 420 kg/rai

10. Cropping Season
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.
1st Sep. ~ 30th Apr.

Source : Agricultural Station

TABLE F-13-2 CROPPING GUIDE (Vegetables)

Crops Name: Sweet Corn
(Variety)

1. Sowing Time — all year round
2. Transplanting time — all year round
3. Planting pattern — row width × spacing: 75 cm × 50 cm = 4,266 plant/rai
4. Seed Rate — 4 kg/rai — 500 Baht/kg
5. Fertilizers Input
   (1) Before Sowing
   - Lime stone — kg/rai
   - N15 :P15 : K15 — 25 - 30 kg/rai

   (2) Flower-bud-appearing stage
   - Urea — 25 kg/rai
6. Irrigation Interval — cultivate - harvest
7. Pest Control (Agricultural Chemicals name)
   - Disease injury - Metalaxyl + Maucozeb (Metalaxyl MZ 72)
   - Insect injury - Carbofuran (Furandan 3% G)
8. Harvesting — 70 days
9. Average Production — 4,000 - 8,000 kg/rai
10. Cropping Season

    Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

    ← all year → 3 ~4 times (70 days/times)

Source : Agricultural Station

TABLE F-13-3 CROPPING GUIDE (Vegetables)

Crops Name: Bady Corn
(Variety)

1. Sowing Time — Feb. - Oct.
2. Transplanting time — 1st Feb. ~ 15th Sep.
3. Planting pattern — row width × spacing: 50 cm × 50 cm = 6,400 - 12,800 plant/rai
4. Seed Rate — 3 - 4 kg/rai — 100 Baht/kg
5. Fertilizers Input
   (1) Before Sowing
   Lime stone — kg/rai
   N15 : P15 : K15 — 25 - 30 kg/rai
   (2) Flower-bud-appearing stage
   Urea — 25 kg/rai
6. Irrigation Interval — start cultivating - harvest
7. Pest Control (Agricultural Chemicals name)
   Disease injury - Metalaxyl MZ 72
   Insect injury - Carbonfuran (Furandan 3% G)
8. Harvesting — Jun. ~ Oct.
9. Average Production — 1,013 kg/rai
10. Cropping Season
    Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.
    sowing time

Source : Agricultural Station