JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MALAYSIA
GOVERNMENT OF MALAYSIA

No. 2

THE FINAL REPORT
OF
THE MASTER PLAN STUDY FOR THE FOREST PLANTATION DEVELOPMENT IN NORTHERN SABAH
IN
MALAYSIA
(DATA)

November 1994

Japan Overseas Forestry Consultants' Association

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Contents

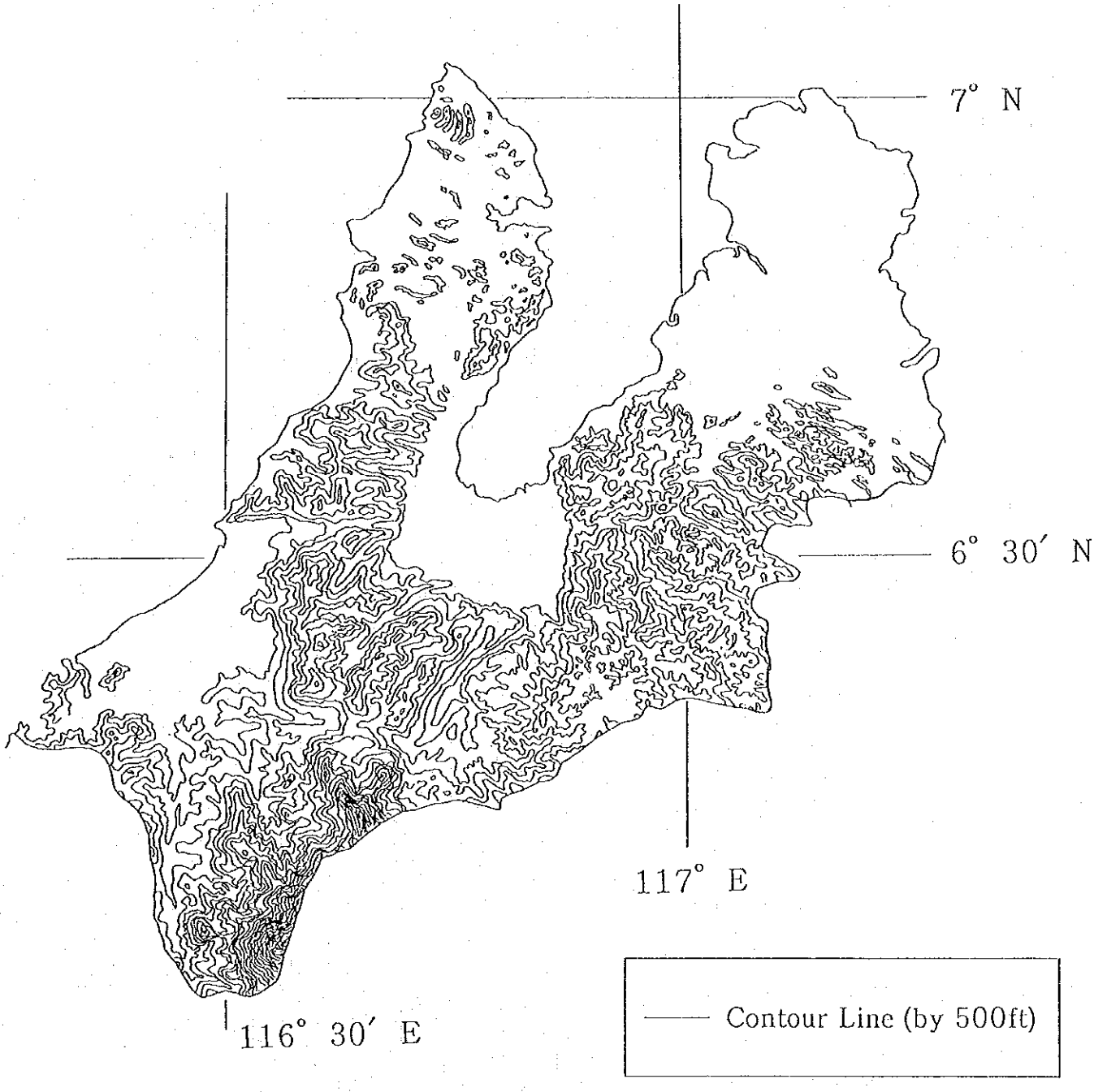


Fig. 1 Topography of the Project Area

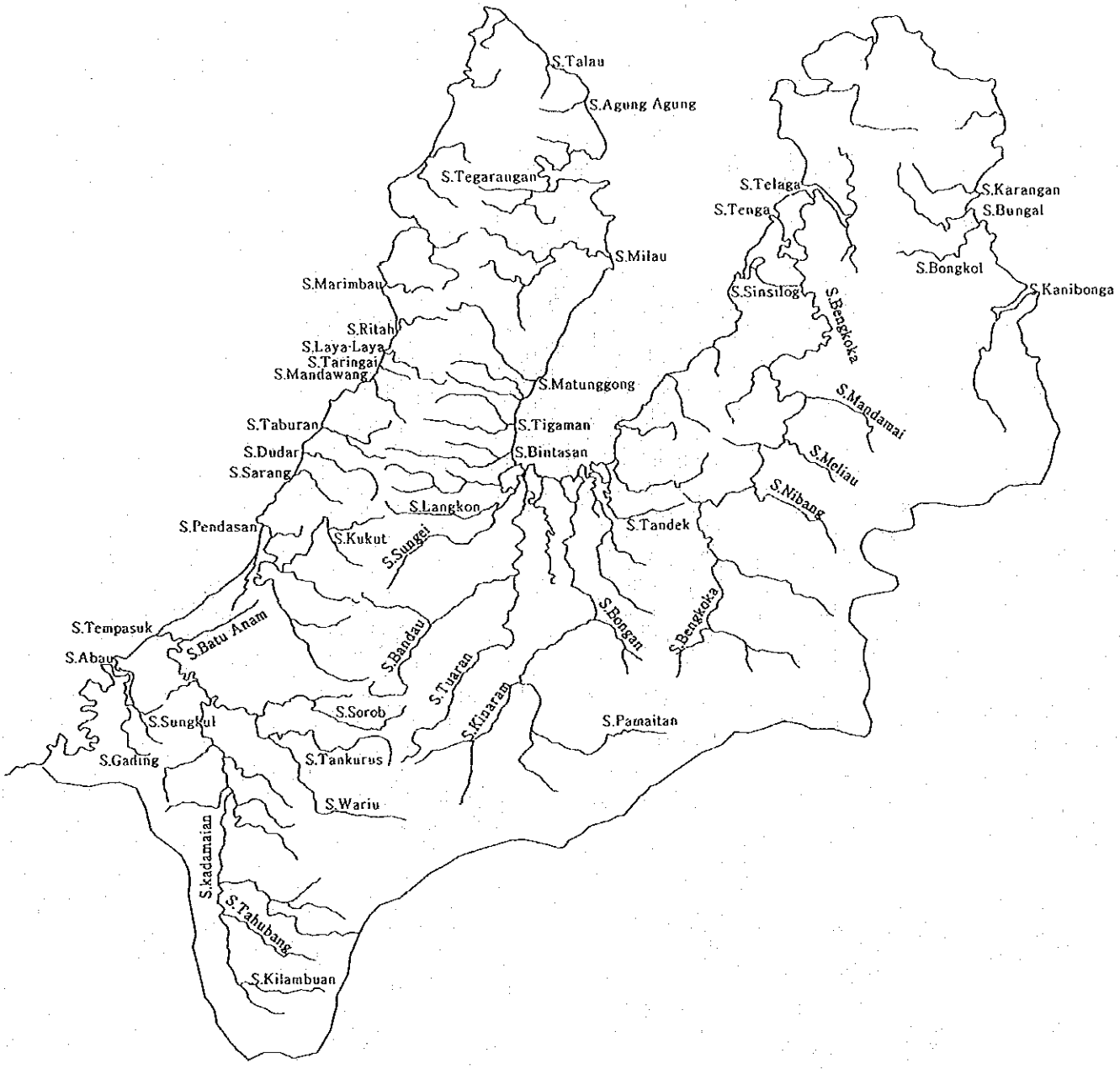
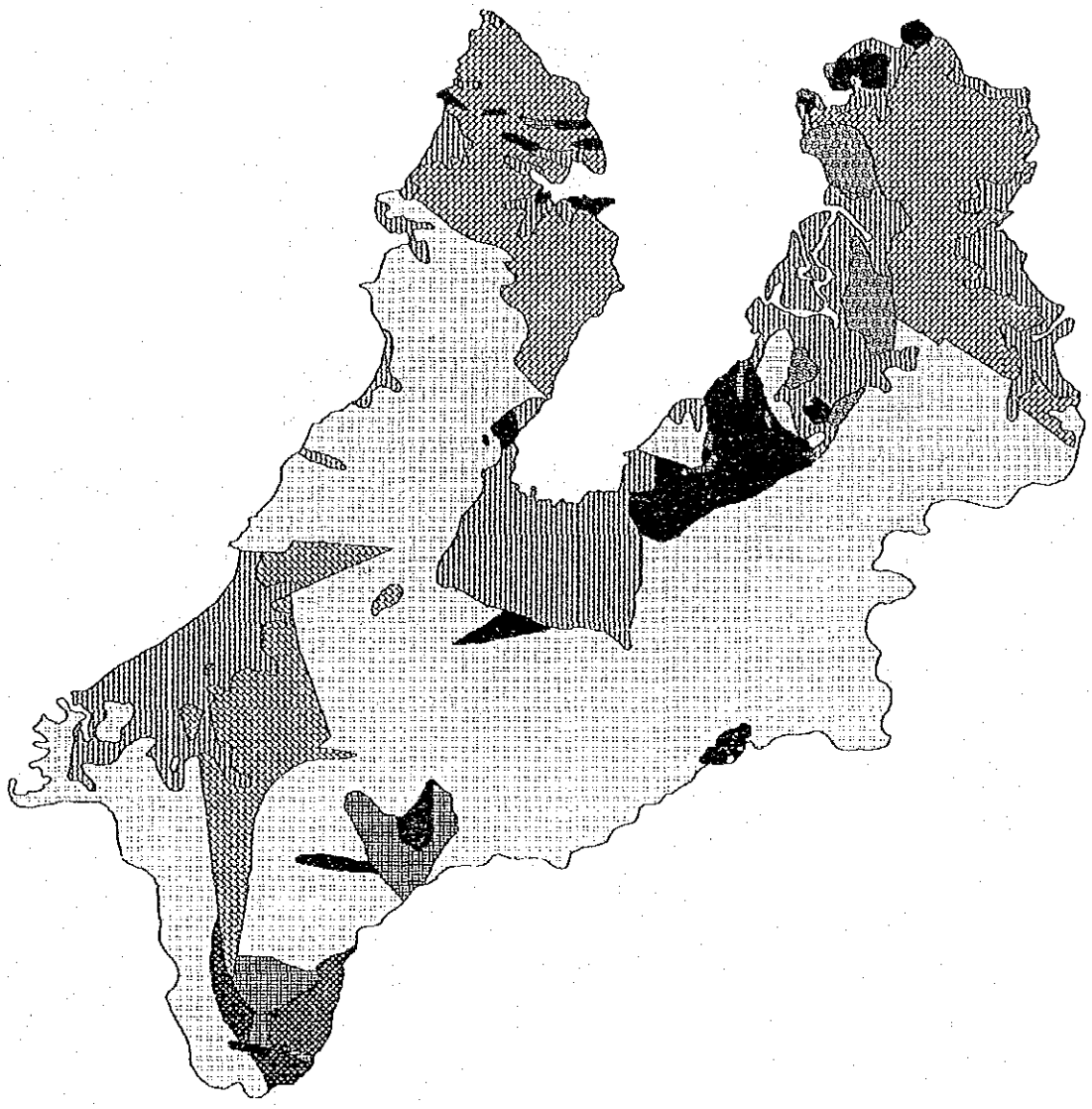


Fig. 2 Water Systems in the Project Area



Coastal and riverine alluvium

Terrace sand, gravel and (a) coral

Sandstone, mudstone, siltstone, shale, conglomerate and lignite with minor limestone and tuff

Mudstone ,sandstone, siltstone, conglomerate, minor limestone and lignite

Slump breccia and sequences of interbedded mudstone, tuff, tuffaceous sandstone, shale, conglomerate with minor chert and limestone

Sandstone, shale, mudstone, siltstone, conglomerate and limestone
Rhythmic alternations of siltstone and shale with rare limestone

Red calcareous sandstone and shale
Flysch type sandstone, shale, siltstone with rare tuff, limestone, breccia and agglomerate

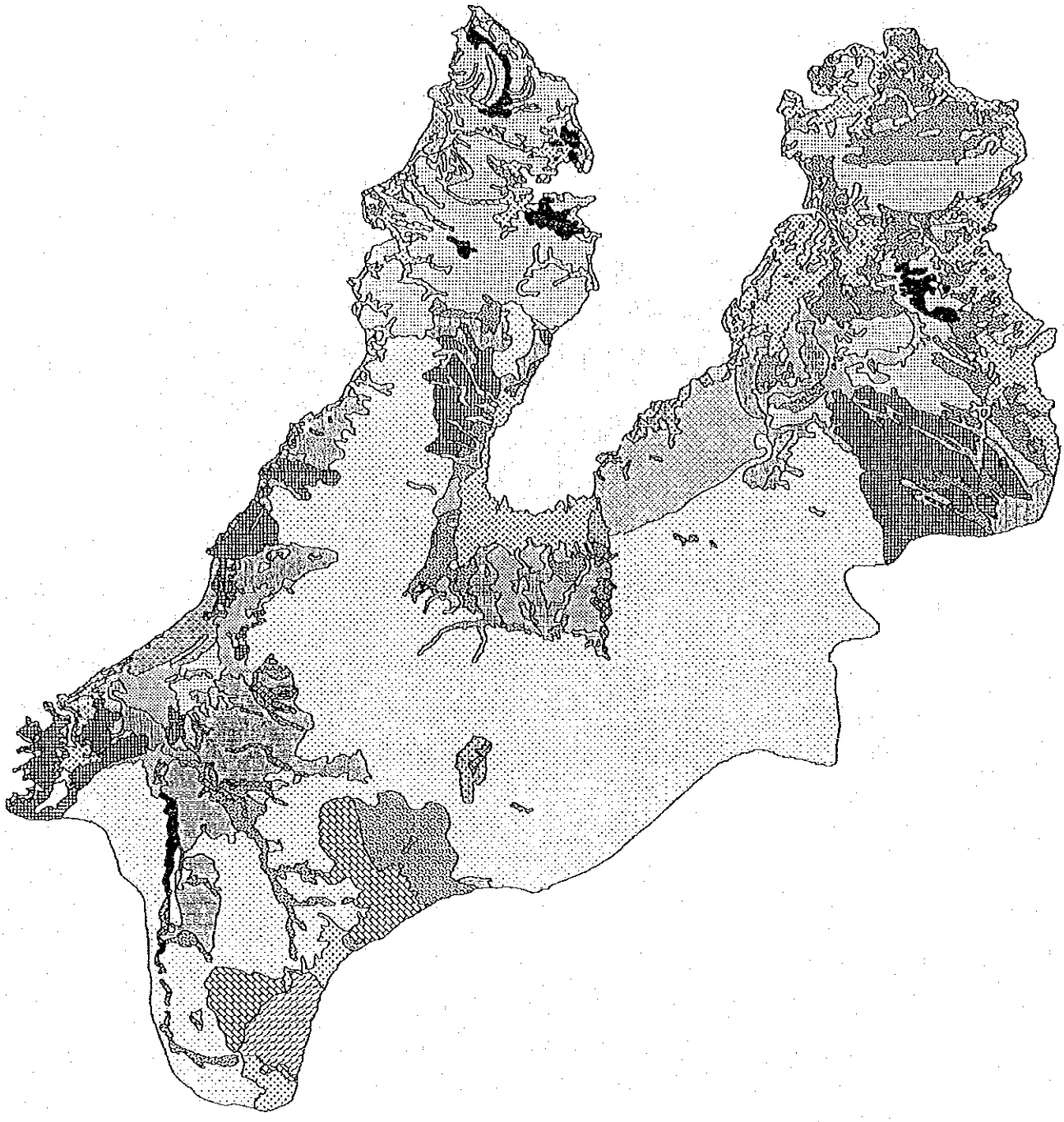
Shale and phyllite with some siltstone and sandstone; weak regional metamorphism

Sandstone, chert, conglomerate, volcanic breccia, agglomerate, basalt, spilite

Adamellite and granodiorite at Gunung Kinabalu, Poring and Paranchangan

Gabbro, dolerite in the Upper Segama, Labuk Valley, Pulau Banggi and at Gunung Tambuyukon; serpentinite, peridotite, dunite, pyroxenite of Upper Sagama, Darvel Bay, Labuk Valley, Kinabalu, Gunung Tambuyukon, Pulau Banggi and Pulau Malawali

Fig. 3 Geology of the Project Area



Thionic Fluvisol; Dystric Histosol; Thionic Gleysol

Dystric and Eutric Regosols; Humic, Dystric and Eutrit Gleysols; Gleyic Podzol

Eutric Fluvisol; Gleyic, Dystric and Eutric Cambisols; Humic,Dystrric and Eutric Gleysols

Gleyic Acrisol; Gleyic Luvisol; Humic, Dystric and Eutric Gleysols

Humic, Dystric and Eutric Gleysols; Dystric Histosol

Orthic Ferralsol; Gleyic, Ferric and Orthic Luvisols; Ferric and Orthic Acrisols

Gleyic, Chromic and Orthic Luvisols; Gleyic and Eutric Cambisols; Eutric Fluvisol

Gleyic and Dystric Cambisols; Dystric and Eutric Fluvisols; Gleyic and Orthic Acrisols

Orthic, Ferric and Gleyic Acrisols

Ferric, Orthic nd Gleyic Acrisols

Orthic Acrisol; Dystric Cambisol

Orthic, Ferric and Gleyic Acrisols; Gleyic Podzol

Gleyic Podzol; Gleyic Acrisol

Gleyic, Ferric and Orthic Acrisols; Gleyic, Ferric, Chromic and Orthic Luvisols

Ferric and Orthic Acrisols; Ferric, Chromic and Orthic Luvisols

Rhodic and Orthic Ferralsols; Eutric Cambisol; Chromic and Orthic Luvisols; Lithosol

As oir Associations 41, 42and 47 with Chromic Cambisolss and Lithosols on chert

Orthic Acrisol; Orthic Luvisol; Dystric and Eutric Cambisols; Lithosol

Orthic Acrisol; Chromic and Dystric Cambisols; Lithosol

Orthic Acrisol; Dystric Cambisol; Gleyic Podrol; Humic Gleysol; Lithosol

Gleyic and Orthic Acrisols; Gleyi Podzol; Humic Gleysol; Dystric Histosol; Lithosol

Humic Cambisol; Dystric Histosol; Lithosol

Fig. 4 Soils in the Project Area

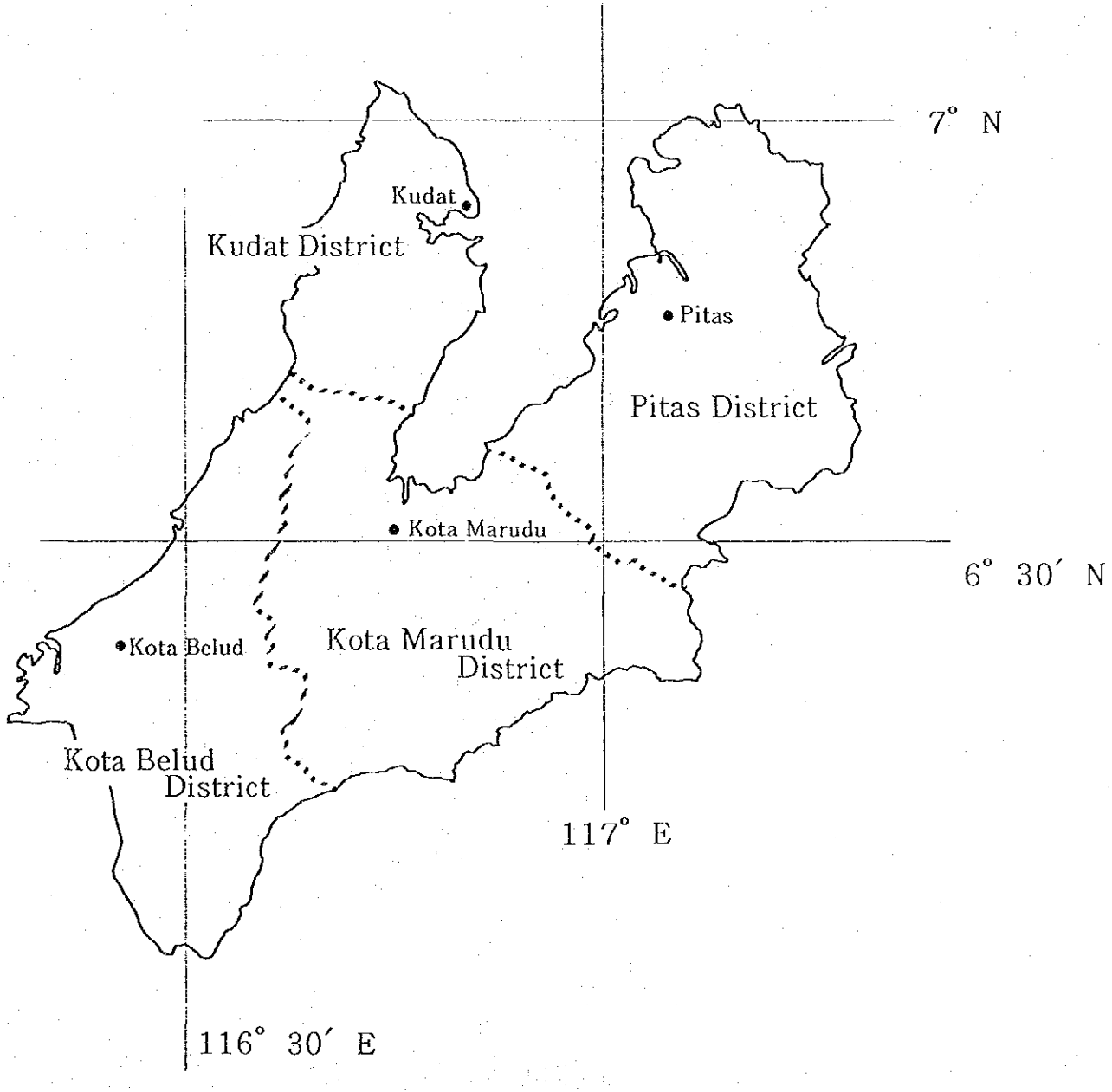


Fig. 5 Administrative Division of the Project Area

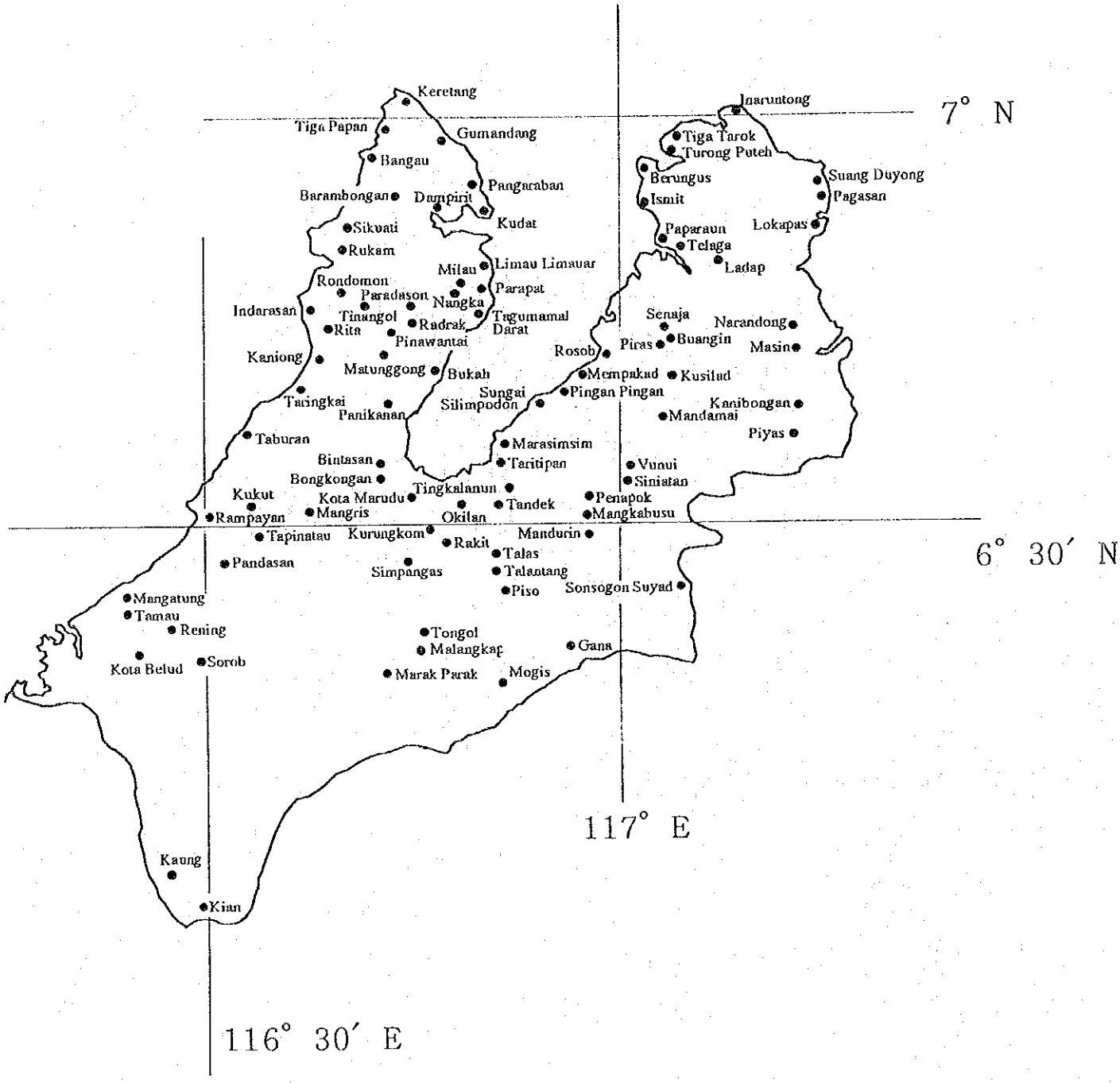


Fig. 6 Main Communities in the Project Area

Results of the Forest Inventory and Soil Survey
in Phase I-1

A survey of forest inventory and soil was carried out in six plots which represent the pattern of vegetation typical of the proposed planting site. The location of these plots and results of the survey will be described in the following.

1. Kudat. Jagil Tanangoi
2. Kota Marudu. Teak Plantation
3. Pitas. Bongkol A. mangium Plantation (10 years)
4. Pitas. Bongkol (Tobi-2) A. mangium Plantation (5 years)
5. Kota Belud. Kg. Sarang
6. Kota Belud. Kg. Sarang Tokora

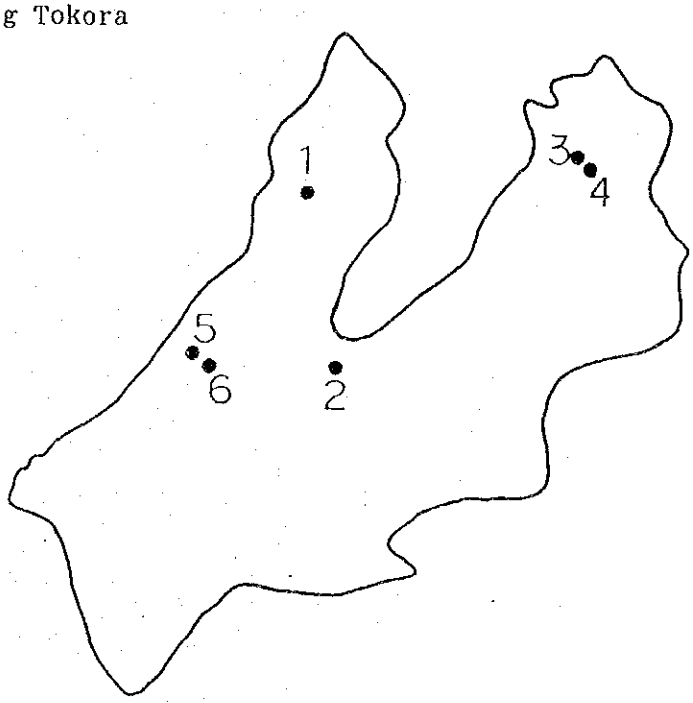


Fig. 7 Plot of Forest and Soil Inventory

Plot No. 1

Location:	Secondary forest in Kg. Jagil Tinangol in Kudat 6°46'35" N Latitude 116°40'15" E Longitude
Date of Survey:	Mar. 15, 1993
Altitude:	250 m
Area:	20 m x 20 m
Bearing:	130° SE
Inclination:	24°
Av. tree height:	6.5 m
Av. DBH:	8.0 cm

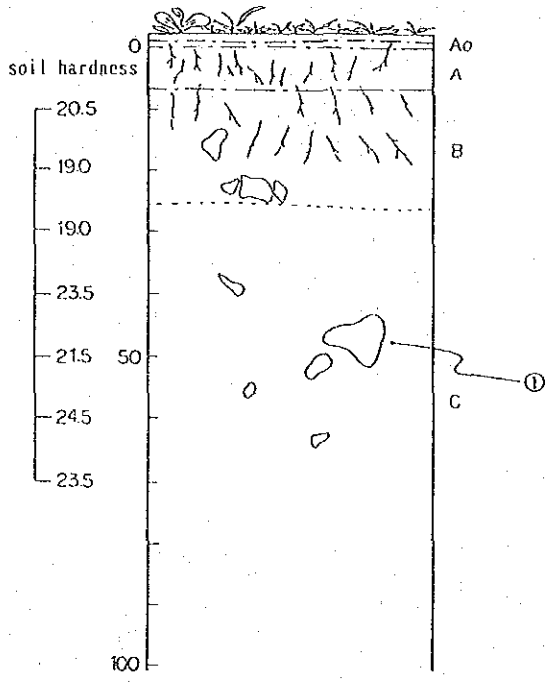


Fig. 8 Plot No. 1 soil profile

①mud stone

Record of soil profile

Horizon:	A_o	A	B	C
Thickness (cm):	2	7	22	
Condition of change:		Clear	Clear	
Colour:		7.5YR3/4	7.5YR4/4	7.5YR4/6
		Brown	Brown	Brown
Humus:	Rich	Rich	Poor	Nothing
Gravel:		Nothing	Poor	Rich
Structure:		Crumb	Massive	Massive
Moisture:		A little wet	Wet	Wet
Illuviation:		Nothing	Nothing	Fe, C?
Root:		Rich	Rich	Poor
Acidity (pH):		5.7	5.4	

Others: This is a site abandoned in 1988 after shifting cultivation. The crown density is low. The pit was dug in the lower part of the changing point of inclination. Soil originates from colluviel soil. Mudstone gravel (10 to 40 cm in diameter) is scattered on the topsoil. Floor vegetation comprises mostly lianas and a plant bamboo like grass locally called Pirizok.
The correlation between DBH and height is shown in Figure 14.

Plot No. 2

Location:	Teak plantation in Kota Marudu District.
Date of Survey:	Mar. 18, 1993
Altitude:	25 m
Area:	
Bearing:	
Inclination:	0°
Av. tree height:	29.4 m
Av. DBH:	59.6 cm
Samples:	11
Age of tree:	67 years

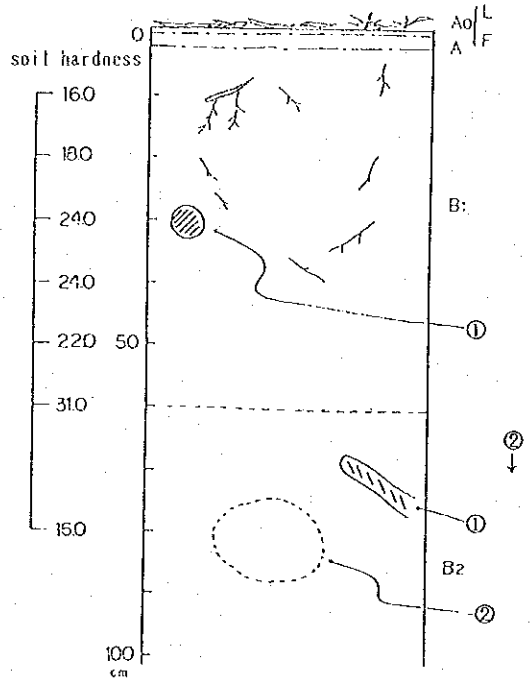


Fig. 9 Plot No. 2 soil profile

①root of teak
②gleyzation

Record of soil profile

Horizon:	A_o	A	B_1	B_2
Thickness (cm):	1	2	60	
Condition of change:		Clear	Gradually	
Colour:		7.5YR3/2	7.5YR4/4	10YR6/3
		Brownish black	Brown	Dull yellow orange
Humus:	Rich	Rich	Poor	Poor
Gravel:	Nothing	Nothing	Nothing	Nothing
Structure:		Crumb	Massive	Massive
Moisture:		Wet	Wet	High wet
Illuviation:		Nothing	Nothing	Gleyzation
Root/Rhizome:		Rich	Rich	Poor
Acidity (pH):		6.0	5.6	5.4

Others: They were initially planted spaced at 3x4 m in 1926. The species comes from Myanmar. This is the oldest of remaining teak plantations in Sabah. It is now managed by the Forestry Department, which conducts measurements twice a year. Without other types of tending, the plantation is in good condition and not subject to diseases or pests. Although natural seedlings regenerated, they have not developed into a succeeding forest. The crown density is medium. The plantation is covered with alluvial soil in humid condition. The nutrient condition of soil seems to be good.

There is a little floor vegetation except regeneration of teaks and some kinds of lianas locally called Lingkong.

The correlation between DBH and height is shown in Figure 16.

Plot No. 3

Location:	SAFODA's plantation of *A. mangium* in Bongkol in Pitas District.
Date of Survey:	Mar. 17, 1993
Altitude:	30 m
Area:	30 m x 40 m
Bearing:	130° SW
Inclination:	10°
Av. tree height:	20.3 m
Av. DBH:	16.3 cm
Samples:	100
Age of tree:	10 years

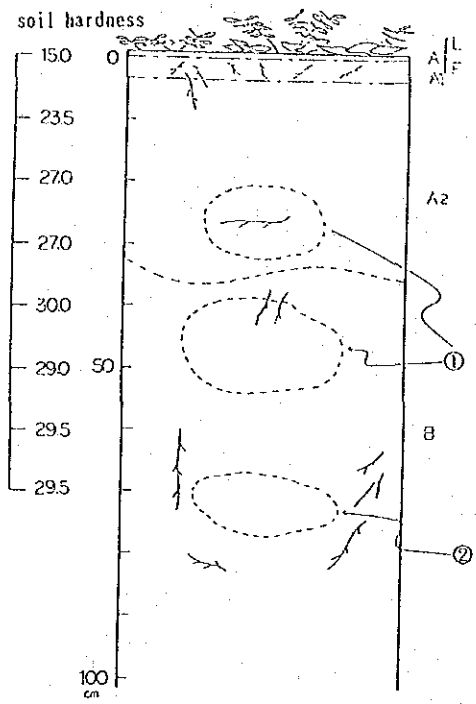


Fig. 10 Plot No. 3 soil profile

Record of soil profile

①reddish brown speckled (ferrous integration)
②brownish black speckled(carbide?)

Horizon:	A_o	A_1	A_2	B
Thickness (cm):	1	2.5	30	
Condition of change:		Clear	Gradually	
Colour:		7.5YR5/4 Dull brown	7.5YR6/3 Dull brown	10YR5/2 Grayish yellow brown
Humus:	Rich	Poor	Poor	Nothing
Gravel:	Nothing	Nothing	Nothing	Nothing
Structure:		Crumb	Crumb	Platy
Moisture:		A little dry	A little dry	Wet
Illuviation:		Nothing	Fe	Fe, C
Root/Rhizome:		Rich	Poor	Poor
Acidity (pH):		5.6 - 5.4	5.4 - 5.2	5.2

Others: These trees were planted spaced at 3 x 3 m from November to December 1983. The crown density is medium. These trees once underwent pruning. As a result, there are only a few dead branches compared with other *A. mangium* plantations.
The floor vegetation entirely consists of bamboo like grass (*Oplismenus* sp.). Weeds akin to joe-pye weeds (*Eupatorium* sp.) and *Lantana camara* are found. According to an official from SAFODA, the vegetation was formerly a Lalang plain.
The correlation between DBH and height is shown in Figure 15.

Plot No. 4

Location:	SAFODA's plantation of A. mangium in Bongkol (Tobi-2) in Pitas District.
Date of Survey:	Mar. 17, 1993
Altitude:	38 m
Area:	31.5 m x 31.5 m (0.1 ha)
Bearing:	SW
Inclination:	23°
Av. tree height:	13.1 m
Av. DBH:	14.1 cm
Samples:	78
Age of tree:	5 years

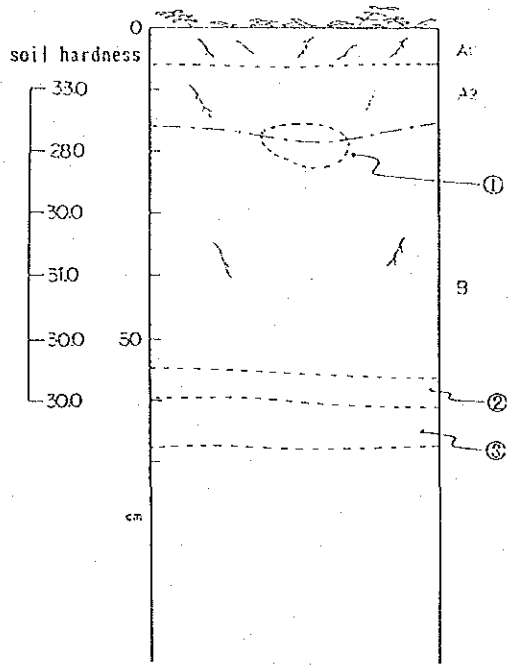


Fig. 11 Plot No. 4 soil profile

① reddish brown speckled (ferrous integration)
② reddish brown zone (ferrous integration)
③ light gray zone (gleyzation)

Record of soil profile

Horizon:	A_0	A_1	A_2	B
Thickness (cm):		6	10	
Condition of change:		Gradually	Clear	
Colour:		2.5Y6/3	2.5Y7/6	10YR5/8
		Dull yellow	Bright yellow brown	Yellowish brown
Humus:	Middle	Middle	Poor	Nothing
Gravel:	Nothing	Nothing	Nothing	Nothing
Structure:		Nutty	Massive	Massive
Moisture:		Dry	Dry	A little wet
Illuviation:		Nothing	Fe	Greyzation, Fe
Root/Rhizome:		Rich	Rich	Middle
Acidity (pH):		5.6	5.2	5.2

Others: These trees were planted spaced at intervals of 2 x 5 m in 1988. The crown density is thin. They are not specially treated.
The floor vegetation comprises about 1 to 1.5 m high locally called Blid Tambang and trees about 0.5 to 1 m high locally called Blingangasan. Lianas locally called Lingkong and weeds locally called Lahunai, akin to joe-pye weeds under Compositae, are also found.
The correlation between DBH and height is shown in Figure 15.

Plot No. 5

Location:	Kg. Sarang in Kota Belud District. 6°33'07" N 116°31'73" E
Date of Survey:	Mar. 19, 1993
Altitude:	210 m
Area:	25 m x 25 m
Bearing:	E
Inclination:	26°
Av. tree height:	9.2 m
Av. DBH:	26.5 cm
Samples:	6

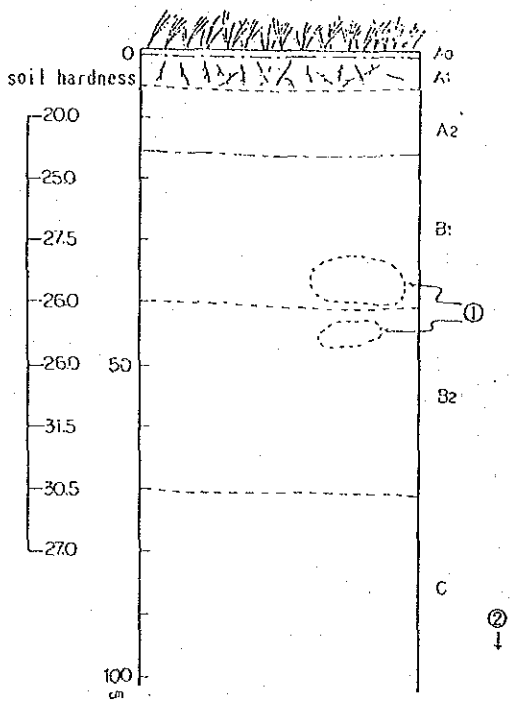


Fig. 12 Plot No, 5 soil profile

①reddish brown speckled (ferrous integration)
②gleyzation

Record of soil profile

Horizon:	A_0	A_1	A_2
Thickness (cm):	1	5	10
Condition of change:		Gradually	Clear
Colour:		10YR3/3	10YR4/3
		Dark Brown	Dull yellowish brown
Humus:	Poor	Poor	Poor
Gravel:	Nothing	Nothing	Nothing
Structure:		Crumb	Massive
Moisture:		Wet	Wet
Illuviation:		Nothing	Nothing
Root/Rhizome:		Rich	Rich
Acidity (pH):		5.6	5.4

Horizon:	B_1	B_2	C
Thickness (cm):	25	30	
Condition of change:	Gradually	Gradually	
Colour:	10YR5/6	10YR5/8	10YR6/4
	Yellowish brown	Yellowish brown	Dull yellowish orange
Humus:	Nothing	Nothing	Nothing
Gravel:	Nothing	Nothing	Nothing
Structure:	Massive	Massive	Massive
Moisture:	Wet	A little wet	A little wet
Illuviation:	Fe	Fe	Gleyzation
Root/Rhizome:	Middle	Poor	Nothing
Acidity (pH):	5.2	5.2	

Others: This plot has suffered frequent damage by forest fires over a long time. The last fire occurred in April 1992. Topographically, the plot is the upper part of the slope leading to a gentle slope at the summit. There are six samples of Tundurupis species. The crown density is extremely thin.
This plot is mostly covered with Lalang. Shrubs locally called Kulimpapa also appear in the lower story of Tundurupis.

Plot No. 6

Location:	Secondary forest in Kg. Sarang Tokora in Kota Belud District. 6°32'88" N 116°32'81" E
Date of Survey:	Mar. 19, 1993
Altitude:	100 m
Area:	50 m x 20 m
Bearing:	SE
Inclination:	30° - 40°
Av. tree height:	14.3 m
Av. DBH:	18.1 cm
Samples:	36

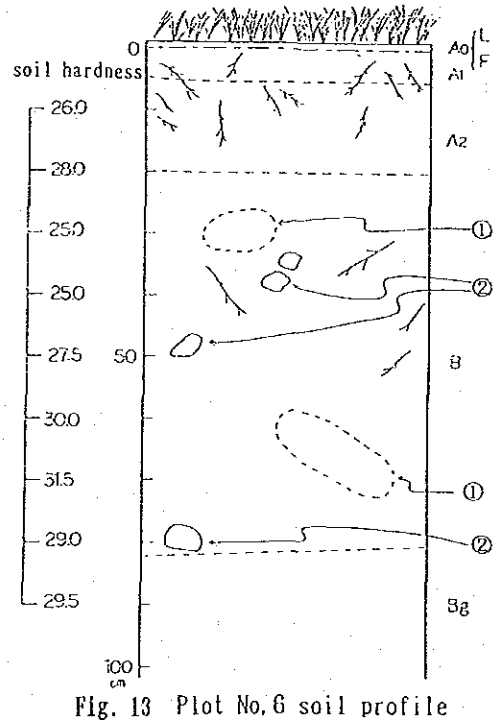


Fig. 13 Plot No. 6 soil profile

①reddish brown speckled (ferrous integration)
②weathering mudstone

Record of soil profile

Horizon:	A_0	A_1	A_2	B
Thickness (cm):	1	5	15	
Condition of change:		Gradually	Quite gradually	
Colour:		10YR4/3	10Y4/6	10YR5/6
		Dull yellowish brown	Brown	Yellowish brown
Humus:	Middle	Rich	Poor	Nothing
Gravel:	Nothing	Nothing	Nothing	Poor
Structure:		Nutty	Massive	Massive
Moisture:		A little dry	Wet	Wet
Illuviation:		Nothing	Nothing	Greyzation, Fe
Root/Rhizome:		Rich	Rich	Middle
Acidity (pH):		5.8	5.8	5.0

Others: It is presumable that the upper part of the slope was used for long-term shifting cultivation. Useful succeeding species of Dipterocarpaceae is not found. The lower part of the slope is steep, including a landslide accounting for about 40% of this plot. The crown density is thin.

The correlation between DBH and height is shown in Figure 17.

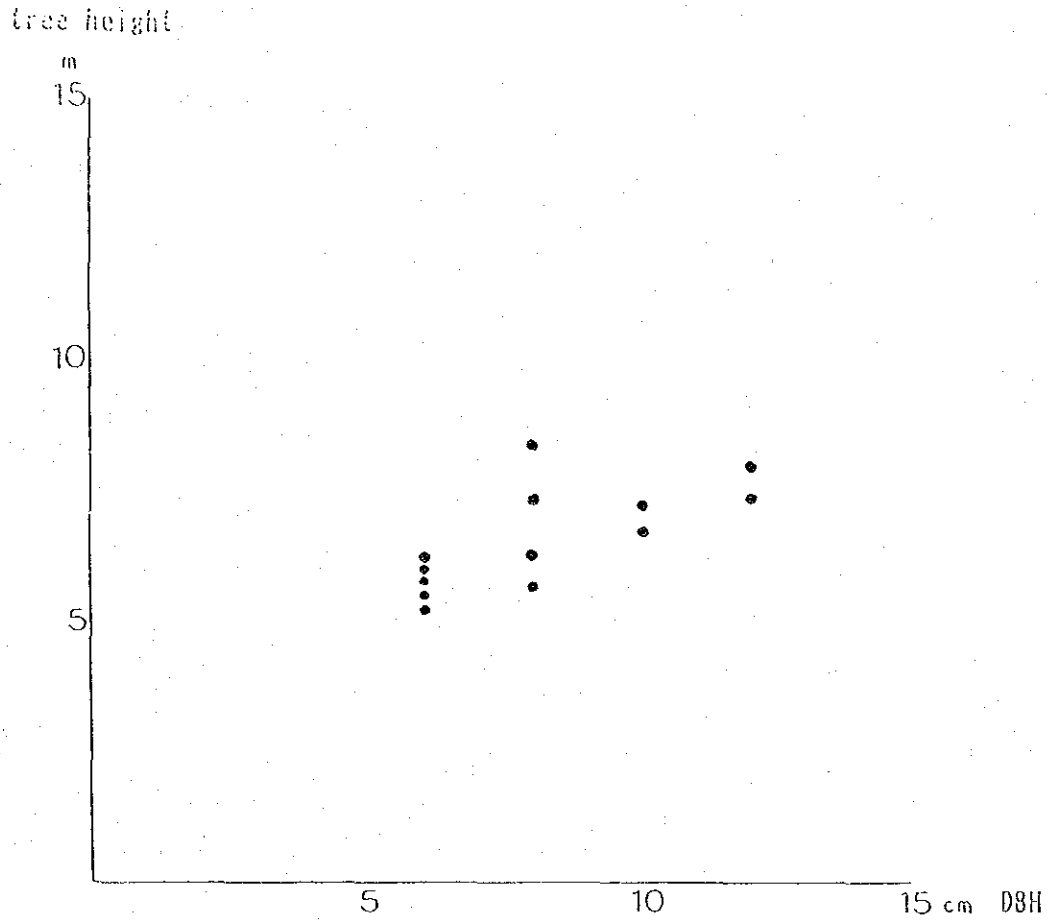


Fig. 14 Kg. Jagil Tinangol, Correlation of between DBH and Tree Height

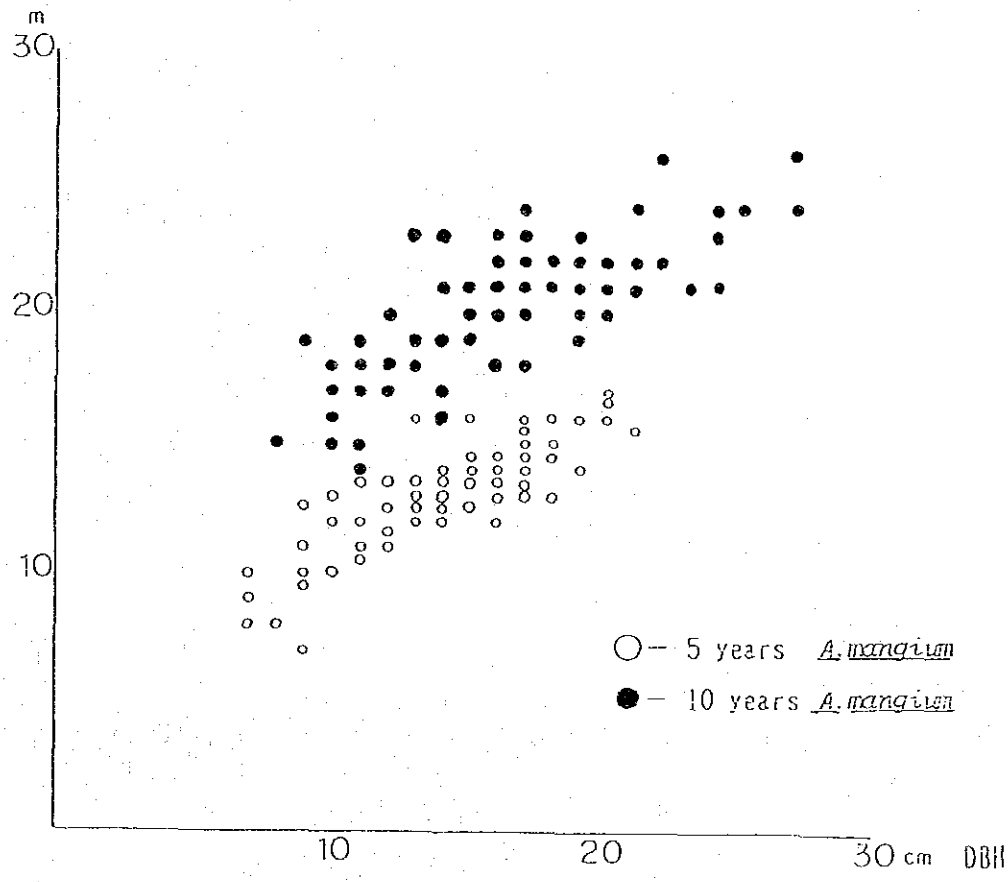


Fig. 15 Bongkol *Acacia mangium* Plantation, Correlation of between DBH and Tree Height

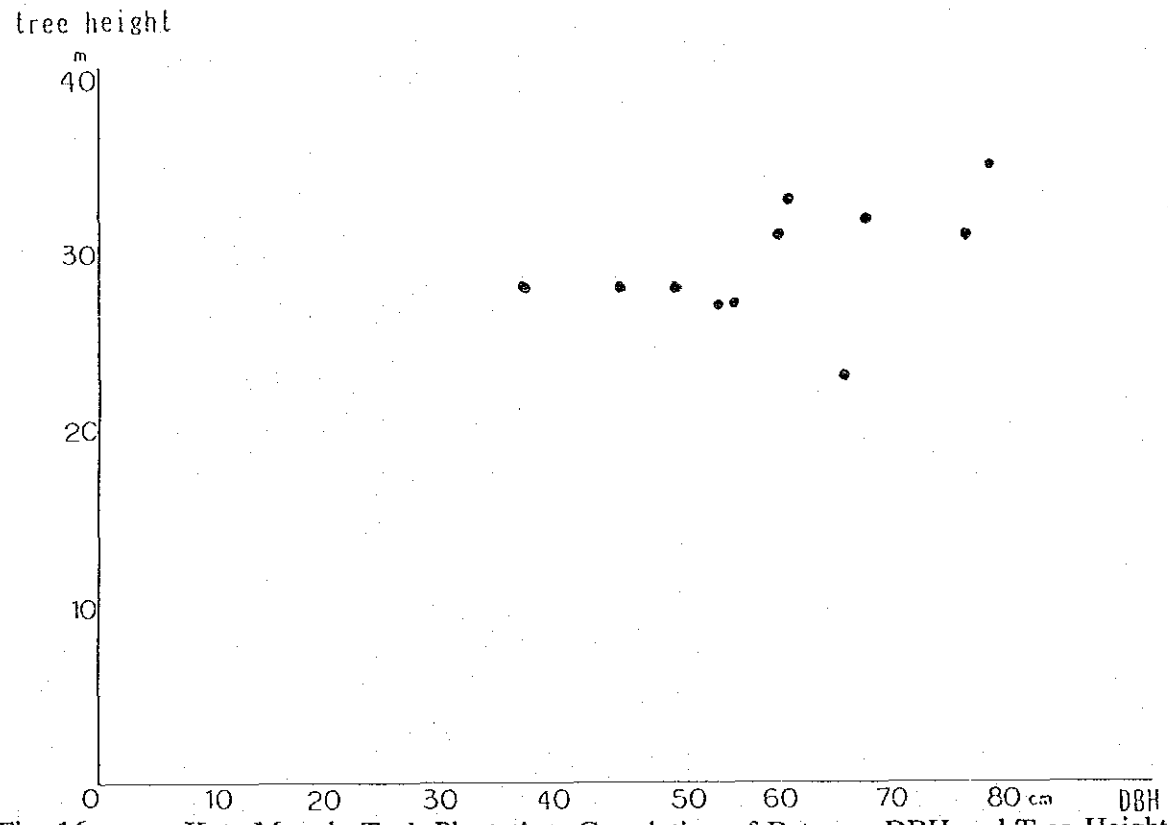


Fig. 16 Kota Marudu Teak Plantation, Correlation of Between DBH and Tree Height

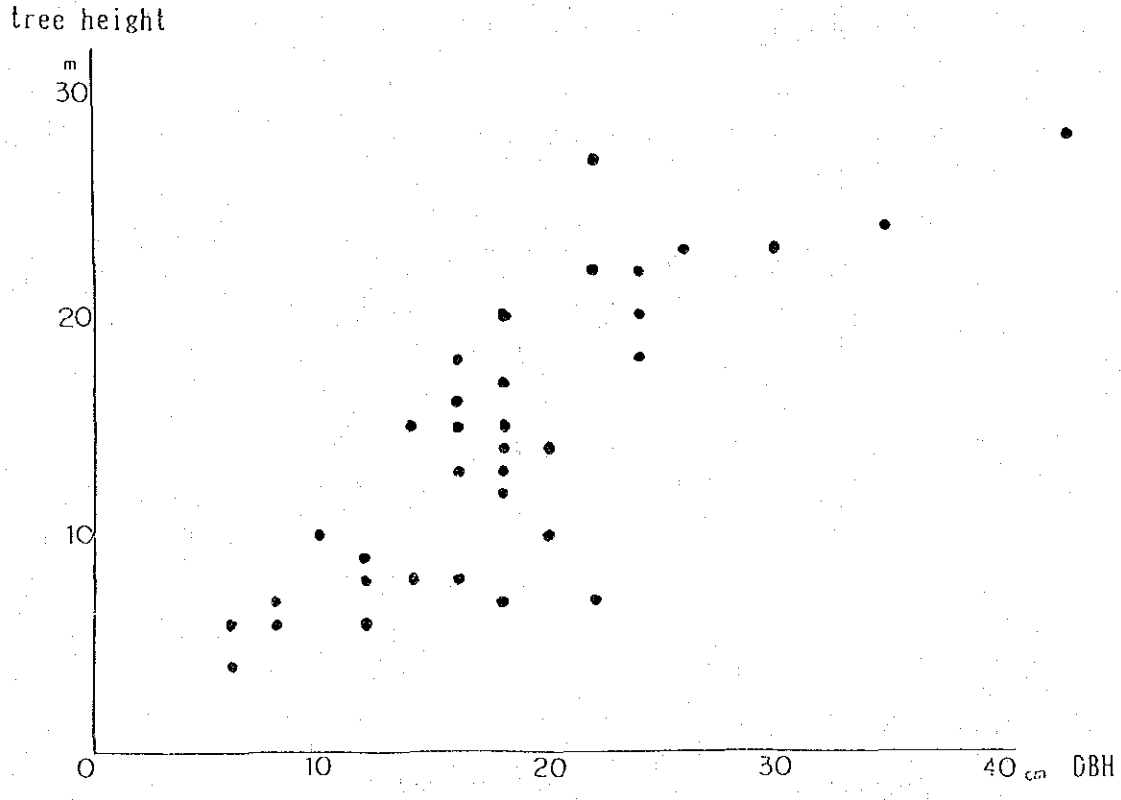


Fig. 17 Kg. Sarang Tokora, Correlation of Between DBH and Tree Height

Major Tree Species in Sabah

As stated in Chapter III, Section 1, Sabah State is situated in the tropical rainforest climate zone, having the zone's typical flora and diverse natural forests. The total number of species constituting these forests is not accurately determined, but estimated at more than 3,000. According to "Timber of Sabah", commercial or known useful species total about 1,160 species, 168 genera and 45 families. Major species representing these genera and families are listed in the table below:

This table is based on the following literature.

. P.F. Burgess, Timber of Sabah, Forest Department, Sabah, 1966.
. P.F. Cockburn, Trees of Sabah Vol. 1, Vol. 2, Forest Department, Sabah, 1976.
. J.E.D. Fox, Preferred Check-List of Sabah Trees, Forest Department, Sabah.
. G.H.S. Wood, Depterocarps, Forest Department, Sabah, 1964.
. Dai Nippon Sanrin Kai, Handbook of Tropical Plants and Trees, Tokyo.

Table 1 Major Tree Species in Sabah

Family, Genus, Species	General (Local Name)	Quality of timber (heavy, medium, light)	Shape of Tree (large, medium, small)
Alangiaceae Alangium spp. A. javanicum	Kondolon	medium	medium
Anacardiaceae Bouea spp. B. oppositifolia	Kundang	light - medium	medium
Buchanania spp. B. arborescens	Kapala tundang	light	medium
Campnosperma spp. C. auriculata	Terentang	light	medium
Dracontomelum spp. D. mangiferum	Sengkuang	light	medium
Gluta spp. G. renghas	Rengas	medium	medium
Melanorrhoea spp. M. aptera	Rengas	light - heavy	
Koordersiodendron spp. K. pinnatum	Rangu	medium	medium
Mangifera spp. M. caesia	Asam	light - medium	medium - large
Santiria spp. S. laevigata	Kerantai	light	medium - large
Scutinanthe spp. S. brunnea	Kedongdong	medium - heavy	large
Triomma spp. T. malaccensis	Kedongdong asam	heavy	large
Casuarinaceae Casuarina spp. C. equisetifolia	Aru	medium - heavy	large
Celastraceae Bhesa spp. B. paniculata	Biku biku	medium - heavy	medium
Kokoona spp. K. ochracea	Perupok kuning	medium - heavy	medium - large

Melanochyla spp. M. auriculata		light	small - medium
Parishia spp. P. sericia	Layang layang	light - medium	medium - large
Pentaspadon spp. P. motleyi	Pelajau	medium	large
Swintonia spp. S. spicifera	Merpauh	medium	medium
Annonaceae spp. Alphonsea A. javanica	Pisang pisang	medium - heavy	large
Canagium spp. C. odoratum	Kenanga	light	medium
Meiogyne spp. M. virgata	Karai		medium
Mezzetia spp. M. leptopoda	Pisang Pisang	medium - heavy	
Mitrephora spp. M. korthalsiana			medium
Monocarpia spp. M. marginalis			
Neouvaria spp. N. accuminatissima	Buan		medium
Orophia spp. O. palawanensis			medium
Polyalthia spp. P. sumatrana	Karai puteh		small
Xylopia spp. X. ferruginia	Karai jangkang	light	medium
Apocynaceae Alstonia spp. A.l angustifolia	Pulai bukit	light	medium
Dyera spp. D. costulata	Jelutong bukit	light	large
Araucariaceae Agathis spp. A. borneensis	Mengilan	light	large

Bombacaceae Bombax spp. B. ceiba	Tambaluang	light	medium - large
Durio spp, D. acutifolius	Durian daun runching	light	medium
Coelostegia spp. C. griffithii	Punggai mont	light	medium
Neesia spp. N. malayan	Durian monyit	light	medium - large
Borajinaceae Cordia spp. C. dichotoma	Guma	light	medium
Burseraceae Canarium spp. C. denticulatum	Kedongdong	light	medium
Dacryodes spp. D. macrocarpa	Kedongdong	light - medium	medium
Garuga spp. G. floribunda	Kedongdong	light	medium
Lophopetalum spp. L. Javanicum	Perupok dual	light	medium
Combretaceae Lumnitzera spp. L. littorea	Geriting merah	heavy	small - medium
Terminalia spp. T. citrina	Talisai jambu	medium	medium
Datiscaceae Octomeles spp. O. sumatrana	Binuang	light	large
Dilleniaceae Dillenia spp. D. borneensis	Simpoh gajah	medium	large
Dipterocarpaceae Anisoptera spp. A. costata	Pengiran kesat	light	large
Dipterocarpus spp. D. verrucosus	Keruing merah	medium - heavy	large
Dryobalanops spp. D. lanceolata	Kapur paji	medium - heavy	large

Hopea spp. H. sangal	Gagil	light - medium	Medium - large
Parashorea spp. P. malaanonan	Urat mata daun lichin	light	large
Shorea S. leprosula	Seraya tembaga	light	large
Vatica spp. V. mangachapoi	Resak bajau	heavy	medium
Cotylelobium spp. C. melanoxylon	Resak tempurong	heavy	medium
Upuna spp. U. borneensis	Upun	heavy	large
Ebenaceae Diospyros spp. D. discocalyx	Kayu malam gajah	medium	large
Elaeocarpaceae Elaeocarpus E. pedunculatus	Parius parius	light	medium
Erythroxylaceae Ixonanthes spp. I. reticulata	Pagar anak	medium	small
Erythroxylon spp. E. cuneatum	Perepat burong	medium	medium
Euphorbiaceae Acalypha spp. A. caturus	Tetepong	light	small
Agrostistachys spp. A. leptostachya	Kayu garang		small
Aleurites spp. A. moluccana	Kamiri	light	medium
Antidesma spp A. ghaesembilla	Tandoropis	light - medium	small
Aporusa spp. A. nitida	Bagil		small
Baccaurea spp. B. lanceolata	Limpaung	medium	small
Bishofia spp. B. javanica	Tuai	medium - heavy	medium - large

Blumeodendron spp. B. tokbrai	Gaham badak	medium	small
Borneodendron spp. B. aenigmaticum	Bangkau bangkau	medium - heavy	medium
Bridelia spp. B. stipularis	Balatotan	light - medium	small
Cephalomappa spp. C. malloticarpa	Kayu mapa	medium	small - medium
Chaetocarpus spp. C. castanocarpus	Dusun dusun	medium - heavy	medium
Cheilosa spp. C. malayana		light - medium	small - medium
Cleistanthus spp. C. paxii	Garu garu		small
Croton spp. C. argyratus	Kapas kapas	medium - heavy	small
Dimorphocalyx spp. D. muriana	Obah puteh		small
Drypetes spp. D. macrophylla	Odopon puteh		small
Elateriospermum spp. E. tapos	Perah	heavy	medium
Excoecaria spp. E. agallocha	Buta buta	light	small - medium
Endospermum spp. E. malaccense	Sendok sendok	light	medium
Gelonium spp. G. glomerulatum		medium - heavy	medium
Glochidion spp. G. rubrum	Obah nasi	medium	small - medium
Hevea spp. H. brasiliensis	Getah	light	medium
Homalanthus spp. H. populneus		light	small - medium
Koilodepas spp. K. longifolium	Kilas	heavy	small

Macaranga spp. M. hypoleuca	Sedaman	light	small - medium
Mallotus spp. M. leucodermis	Balek angin	heavy	medium
Neoscortechinia spp. N. forbesii	Agar agar		small
Ostodes spp. O. macrophylla	Pait pait	light - medium	
Ptychopyxis spp. P. kingii		medium	medium
Sapium spp. S. indicum	Apid apid	light	medium
Trigonopleura spp. T. malayana	Gambir hutan	medium	medium
Wetria spp. W. macrophylla		medium	small
Fagaceae Castanopsis spp. C. motleyana	Berangan		medium - large
Lithocarpus spp. L. echinifera	Mempening rambut		medium
Quercus spp. Q. elmeri	Mempening		large
Trigonobalanus spp. T. verticillatus	Mempening babi	medium	medium
Flacourtiaceae Elentherandra spp. E. pres-cervi		heavy	medium - large
Erythrospermum spp. E. candidum		light - medium	small - medium
Flacourtia spp. F. rukam	Rukam	heavy	small
Homalium spp. H. foetidum	Takaliu	heavy	medium
Hydnocarpus spp. H. woodii	Karpus wood	medium	medium - large

Osmelia spp. O. maingayi	Tambalikan	medium	small
pangium spp. P. edule	Kepayang	light - medium	medim - large
Ryparosa spp. R. acuminata	Giewei		small - medium
Scalopia spp. S. spinosa		medium - heavy	medium
Trichadenia spp. T. philiooinensis		heavy	medium - large
Xylosma spp. X. sumatrana			small - medium
Gonystylaceae Gonystylus spp. G. bancanus	Ramin	light - medium	medium
Guttiferae Calophyllum spp. C. canum	Bintangor merah	light - medium	large
Cratoxylon spp. C. arborenscens	Serungan	light	medium
Garcinia spp. G. mangostana	Manggis	heavy	small
Kayea spp. K. paniculata	Kaliwas (Philippines)		
Mesua spp. M. macrantha	Buntangor batu		small
Icacianaceae Stemonurus spp. S. corniculatus	Dedaru	heavy	medium
Juglandaceae Engelhardia spp. E. serrata	Dungun paya (P. Malaysia)	heavy	medium - large
Lauraceae Eusideroxylon spp. E. zwageri	Belian	heavy	medium - large
Actinodephne spp. A. glomerata	Medang serai	light	medium

Alseodaphne spp. A. bancana	Medang payong	medium	medium
Beilschmeidia spp. B. micrantha	Medang wangi	light	small - medium
Cinnamomum spp. C. iners	Kayu manis	light - medium	medium
Cryptocarya spp. C. griffithiana	Medang dering		small
Dehaasia spp. D. incrassata	Medang teras		medium
Endiandra spp. E. maingayai		heavy	small
Lindera spp. L. malaccensis	Medang sarukan		
Litsea spp. L. firma	Medang lada	medium	medium
Neolitsea spp. N. zeylanica	Medang pasir		medium
Notaphoebe spp. N. obovata	Lamau lamau		medium
Phoebe spp. P. macrophylla	Medang lada	medium	medium
Lecythidaceae Barringtonia spp. B. sacrostachys	Tampalang		medium
Planchonia spp. P. valida	Putat paya	medium - heavy	medium - large
Leguminosae Albizia spp. A. chinensis		light - medium	medium - large
Cynometra spp. C. inaequifolia	Kantong kantong	heavy	medium - large
Dialium spp. D. indum	Keranji	heavy	medium
Intsia spp. I. palembanica	Merbau	heavy	large

Koompassia spp. K. excelsa	Mengaris	heavy	large
Paraserianthes spp. P. falcataria	Batai	light	large
Pterocarpus spp. P. indicus	Angsana	medium - heavy	medium - large
Pseudosindora spp. P. palustris	Septir paya	medium	medium - large
Sindora spp. S. beccariana	Septir	medium	medium
Adenanthera spp. A. pavonina	Saga	heavy	medium
Cassia spp. C. nodosa	Busok busok	light - medium	medium
Ormosia spp. O. bancana	Saga	light - medium	small - medium
Parkia spp. P. roxburgii	Kupang	light - medium	medium
Peltophorum spp. P. racemosum	Timbarayong	light - meidum	medium
Pericopsis spp. P. mooniana	Ipil ayer	meidum - heavy	small - medium
Pongamia spp. P. pinnta	Marabahai	medium - heavy	small - medium
Samanea spp. S. saman	Rain tree	medium	medium - large
Serialbizzia spp. S. splendens	Kungkur	light - medium	medium - large
Sympetalandra spp. S. borneensis	Merbau laut	medium	medium - large
Loganiaceae Fagraea spp. F. fragrans	Tembusu	heavy	medium
Lythraceae Lagerstroemia spp. L. speciosa	Bungor	light - medium	medium

Melastomaceae Dactylocladus spp. D. stenostachys	Jongkong	light	medium - large
Meliaceae Azadirachta spp. A. excelsa	Limpaga	light	medium
Aglaia spp. A. odoratissima	Langsat langsat	medium	small - medium
Ammora spp. A. rubiginosa	Lantupak paya	light - medium	small - medium
Aphanamixis spp. A. rohituka		medium	medium
Chisocheton spp. C. beccarianus	Lantupak	light	small - medium
Dysoxylum spp. D. arborenscens	Lantupak	light - medium	small - medium
Toona spp. T. sureni	Limpaga	light	medium
Vavaca spp. V. amicorum	Chendana	light - medium	small - medium
Xylocarpus spp. X. granatum	Nyireh	medium	small
Moraceae Artocarpus spp. A. elasticus	Terap togop	light	medium - large
Parartocarpus spp. P. bracteata	Terap		medium - large
Prainea spp. P. limpato			small
Myristicaceae Gymnacranthera spp. G. contracta	Lanau		medium
Knema spp. K. laurina	Darah darah kerantu	light	small - medium
Myrtaceae Eugenia spp. E. acuminatissima	Obah		medium

Tristania spp. T. celemis	Pelawan pelawan	heavy	medium
Olacaceae Ochanostachys spp. O. amenthacea	Tanggal	heavy	small - medium
Scorodocarpus spp. S. borneensis	Bawang hutan	heavy	medium
Podocarpaceae Dacrydium spp. D. gibbsiae		medium	small
Phyllocladus spp. P. hypophyllus		medium	medium
Podocarpus spp. P. rumphii	Kayu china	light	medium
Rhizophoraceae Bruguiera spp. B. sexangula	Mata buaya	heavy	medium
Carallia spp. C. brachiata	Meransi	heavy	small - medium
Ceriops spp. C. tagal	Tegal	heavy	small
Combretocarpus spp. C. rotundatus	Perepat paya	heavy	medium - large
Rhizophora spp. R. apiculata	Bangkita	heavy	medium
Rubiaceae Anthocephalus spp. A. chinensis	Laran	light	medium
Nauclea spp. N. subdita	Bangkal kuning	medium	small - medium
Neonauclea spp. N. bernardoi	Bangkal merah	light - medium	medium
Adina spp. A. polycephala	Mengkeniab	medium - heavy	
Fackia spp. F. ornata		medium - heavy	

Sapindaceae Pometia spp. P. pinnata	Kasai	light - medium	medium - large
Sapotaceae Chrysophyllum spp. C. lanceolatum	Pepulut	medium	small - medium
Diploknema spp. D. sebifera	Nyatoh puteh		large
Ganua spp. G. motleyana	Nyatoh ketiau	medium	large
Madhuca spp. M. utilis	Nyatoh madhuca	heavy	medium - large
Mimusops spp. M. elengi	Mengkular	heavy	medium
Palaquium spp. P. gutta	Nyatoh taban merah	medium	medium
Payena spp. P. acuminata	Nyatoh taban puteh	medium	small - medium
Planchonella spp. P. obovata	Nyatoh laut	heavy	small - medium
Pouteria spp. P. luzonensis			
Simaroubaceae Irvingia spp. I. malayana	Pauh kijang	heavy	large
Sonneratiaceae Duabanga spp. D. moluccana	Magas	light	large
Sonneratia spp. S. alba	Pedada	medium	medium
Sterculiaceae Heritiera spp. H. simplicifolia	Kembang	medium	large
Kleinhovia spp. K. hospita	Timahar	light	medium
Pterocymbium spp. P. tinctorium	Keluak	light	medium

Pterospermum P. diversifolium	Bayor	medium	medium
Scaphium spp. S. macropodum	Kembang sumangkok	light - medium	large
Sterculia spp. S. foetida	Kelumpang	light - medium	medium
Theaceae Ploiarium spp. P. alternifolium	Sauma	heavy	small
Schima spp. S. wallichii	Gatal gatal	medium - heavy	medium - large
Tetramerista spp. T. glabra	Tuyot	heavy	medium
Thymelaeaceae Aquilaria spp. A. malaccensis	Gaharu	light	medium - large
Tiliaceae Pentace spp. P. adenophora	Takalis daun bulat	light - medium	medium
Verbenaceae Avicennia spp. A. alba	Api api	medium	medium
Vitex spp. V. pubescens	Kulimpapa	heavy	medium

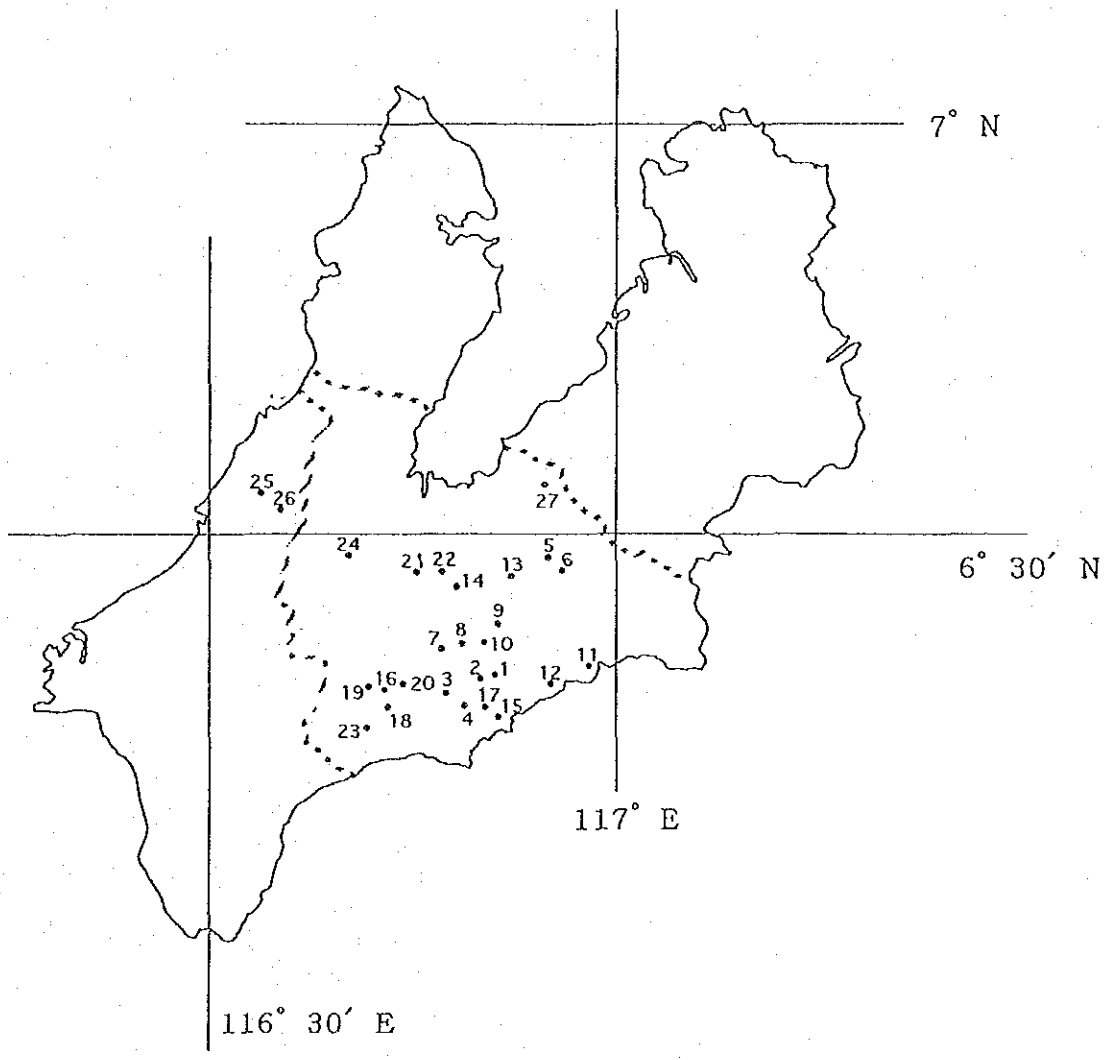


Fig. 18 Location Map of Natural Forest and Soil Survey in Phase I–2

Table 2 Summary of Natural Forest Inventory in Phase I-2

Plot No,	forest type	commercial volume/ha (m3)
1	B	92.67
2	B	288.96
3	A	208.58
4	C	111.54
5	A	434.36
6	B	272.73
7	B	176.01
8	C	177.16
9	B	184.35
10	C	155.16
11	out of aerial photograph	263.25
12	out of aerial photograph	161.08
13	C	69.87
14	C	73.09
15	B	225.97
16	F (shrub forest)	
17	B	288.10
18	F (shrub forest)	
19	F (shrub forest)	
20	E (low height forest)	39.30
21	glass land	
22	E (low height forest)	
23	E (low height forest)	37.65
24	D (middle height forest)	11.91
25	D (middle height forest)	8.37
26	B	289.73
27	F (shrub forest)	

	commercial volume/ha (m3)
Average of A	321.47
Average of B	227.31
Average of C	117.36
Average of D	10.14
Average of E	25.65
Average of F	0.00

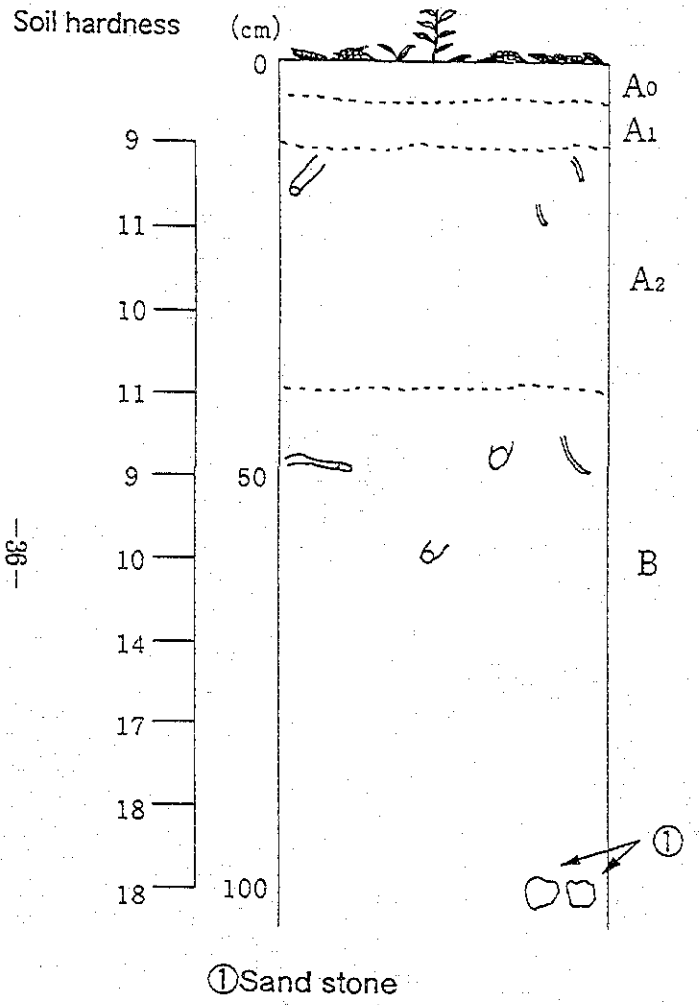
Plot No,1 Result of natural forest inventory

Date	8/3/93
Plot No.	No, 1
Area	Palulinging
Elevation	280m
Land condition	Slope land
Bearing	SE
Inclination	34°
Dominant species	Dipterocarpaceae
Crown density	Middle
Undergrowth	
Forest type	B
Remarks	Logging road pass westside of survey plot. Macaranga spp. are found in edge of forest stand.

Plot No,1	Species		DBH	①	②	③	④	Remarks
30cm~	Rengas	Melanorrhoea wallichii	45	25	14	30	1.5463	
	OT		38	28	13	26	1.0455	
	Medang	Cinnamomum parthenoxylon	37	23	10	24	0.7306	
	Obah Suluk	Shorea pauciflora	31	32	14	28	0.9569	
	Burut Burut	Tabernaemontana macrocarpa	30	30	13	24	0.7443	
	Tarap Hutan	Artocarpus & Parartocarpus sp.	48	30	16	26	1.7203	
	Petai	Parkia speciosa	44	36	12	32	1.3609	
	Oungun Darat	Heritiera sp.	50	32	8	36	1.1618	
		Total	323	236	100	226	9.2667	
		Average	40.375	29.5	12.5	28.25	1.1583	
		Volume / ha (m3)					92.667	
20~29cm	Sedaman	Macaranga sp.	22	16				
	Bintangor	Calophllum sp.	20	25				
	Lantupak	Dysoxylum sp.	21	24				
	Kungkurad	Elacocarpus sp.	20	13				
	Kapur Paji	Dryobalanopus lanceolata	20	28				
	Obah	Eugenia sp.	26	28				
	Kapur Paji	Dryobalanopus lanceolata	24	30				
	Seraya kuning Barun	Shorea xanthophylla	25	24				
	Seraya Kuning	Richetia section of Shorea	21	30				
	Seraya Kuning	Richetia section of Shorea	23	30				
	Obah Nasi	Glochidion sp.	27	28				
	Sedaman	Macaranga sp.	21	18				
		Average	22.5	24.5				
5~19cm	Seraya Kuning	Richetia section of Shorea	13	22				
	OT		14	16				
	Sireh sireh	Pternandra coerulescens	15	14				
	Seraya Kuning	Richetia section of Shorea	7	7				
	Seraya Kuning	Richetia section of Shorea	14	24				
	Medang	Cinnamomum parthenoxylon	7	8				
	Bintangor	Calophllum sp.	6	12				
	Kapur Paji	Dryobalanopus lanceolata	16	20				
		Average	11.5	15.375				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



Date	8/3/93
Plot No,	1
Elevation	280m
inclination	Slope land/34°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A1	10YR6/8	Poor	Nil	Crumb	Wet	Nil	Nil	Nil	5.2	
A2	7.5YR6/8	Very poor	Nil	Crumb	Wet	Nil	Nil	Poor	5.4	
B	10YR7/8	Nil	Sand stone	Crumb	Wet	Nil	Nil	Poor	5.4	

Plot No,1 Soil profile and Result of soil survey (Natunal forest)

Plot No,2 Result of natural forest inventory

Date	8/3/93
Plot No,	N o , 2
Area	
Elevation	2 8 0 m
Land condition	Slope land
Bearing	N
Inclination	3 3 °
Dominant species	Resak (Vatica spp. Catylelobium spp.)
Crown density	Middle
Undergrowth	Party of Selaginella involveus Heladi hutan, Kebu
Forest type	B
Remarks	Dipterocarpaceae are remaining very few. Resak become dominant species.

Plot No,2	Species		DBH	①	②	③	④	Remarks
30cm~	Rengas	Malanorrhoea wallichii	78	50	17	60	6.3568	
	Burut Burut	Tabernaemontana macrocarpa	30	22	6	22	0.3186	
	Senkuang	Dracontomelon puberulum	59	45	24	25	3.3251	
	Seraya Punai	Shorea parvifolia	45	45	35	28	3.6622	
	Mempening	Lithocarpus sp. or Quercus sp.	63	45	12	50	3.0086	
	Minyak Belok	Xanthophyllum ellipticum	40	22	15	24	1.2064	
	Resak	Vatica or Cotylelobium sp.	36	40	30	22	1.9816	
	Kembang	Horitiera simplicifolia	70	34	28	30	5.4978	
	Resak	Vatica or Cotylelobium sp.	42	33	20	24	1.7106	
	Kayu Malam	Diospyros sp.	32	31	12	24	0.7389	
	Rengas	Malanorrhoea wallichii	40	32	12	28	1.0895	
		Total	535	399	211	337	28.896	
		Average	48.636	36.273	19.182	30.636	2.6269	
		Volume / ha (m3)					288.96	
20~29cm	Keruing	Dipterocarpus sp.	27	25				
	Mempisang	Alphonsea elliptica	21	22				
	Medang	Cinnamomum parthenoxylon	22	26				
	Urat mata beledu	Parashorea tomemtella	27	26				
	Burut Burut	Tabernaemontana macrocarpa	27	20				
	Lantupak	Dysoxylum sp.	22	26				
		Average	24.333	24.167				
5~19cm	Layang Layang	Parishia insefnis	6	12				
	Kiras	Koilodepas longifolium	10	10				
	Kopi Kopi(Koping koping?)	Aglaia argentea	10	9				
	Kunau Kunau	Baccaurea stipulata	9	7				
	OT		18	18				
	Minyak Belok	Xanthophyllum ellipticum	7	10				
	Ramin	Gonystylus bancanus	10	14				
		Average	10	11.429				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation V=π/4{(r1+r2)/2}^2・l/10000
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

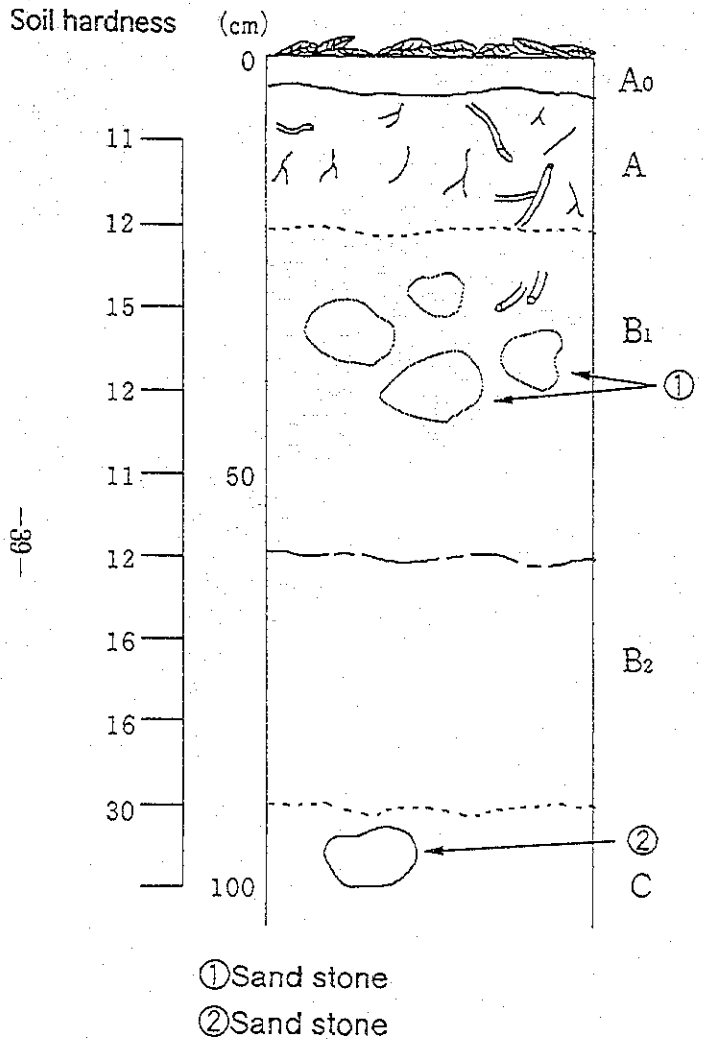
Plot No,3 Result of natural forest inventory

Date	3/4/93
Plot No.	No, 3
Area	Kg. Melangkap darat
Elevation	300m
Land condition	Ridge
Bearing	WNW
Inclination	Max 33°
Dominant species	Obah (Eugenia spp.)
Crown density	Low-density
Undergrowth	
Forest type	A
Remarks	Alternation of species progress still more. Dipterocarpaceae can not be found no more in here.

Plot No,3	Species		DBH	①	②	③	④	Remarks
30cm~	Obah	Eugenia sp.	33	35	20	24	1.2759	
	Terap Terap	Artocarpus or Parartocarpus sp.	62	42	18	40	3.6771	Fruits
	Manggis	Garcinia mangostana	45	35	20	24	1.8696	
	Medang	Cinnamomum parthenoxylon	34	30	20	20	1.1451	
	Obah	Eugenia sp.	30	30	12	20	0.5891	
	Obah	Eugenia sp.	40	35	15	22	1.1322	
	OT		35	34	5	28	0.3897	
	Obah	Eugenia sp.	36	34	6	24	0.4241	
	Terap Terap	Artocarpus or Parartocarpus sp.	30	28	10	20	0.4909	Fruits
	Obah	Eugenia sp.	38	30	8	30	0.7263	
	Obah	Eugenia sp.	53	28	13	32	1.8442	
	Obah	Eugenia sp.	32	28	8	20	0.4247	
	Kayu Malam	Diospyros sp.	35	35	12	28	0.9352	
	Kedondong	Canarium apertum	30	30	12	20	0.5891	
	Medang	Cinnamomum parthenoxylon	90	40	18	30	5.0894	
	Magkulat		31	30	4	26	0.2552	
		Total	654	524	201	408	20.858	
		Average	40.875	32.75	12.563	25.5	1.3036	
		Volume / ha (m3)					208.58	
20~29cm	Kayu Malam	Diospyros sp.	26	26				
	Obah	Eugenia sp.	27	28				
	Geronggang Bogoi	Cratoxylum cochinchinense	26	30				
	Geronggang Geronggang	Cratoxylum sp.	24	28				
	Durian Monyit	Neesia sp.	21	28				
	Durian Monyit	Neesia sp.	22	26				
	Lantopak	Dysoxylum sp.	24	26				
	Obah	Eugenia sp.	24	24				
	Perupok Bukit	Lophopetalum beccarianum	28	32				
	Assam	Mangifera sp.	29	30				
		Average	25.1	27.8				
5~19cm	Obah	Eugenia sp.	7	10				
	Karpus	Hydnocarpus sp.	7	11				
	Burut Burut	Tabernaemontana macrocarpa	8	13				
	Kopi Kopi(Koping koping?)	Aglaia argentea	5	6				
		Average	6.75	10				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



Date	8/4/93
Plot No,	3
Elevation	300m
inclination	Ridge/Max33°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	5YR4/6	Poor	Poor	Massive	Wet	Nil	Poor	Poor	5.4	
B1	5YR5/6	Nil	Poor	Massive	Wet	Nil	Poor	Nil	5.2	
B2	10YR7/6	Nil	Middle	Crumb	Litte wet	Nil	Nil	Nil	5.4	
C	2.5Y7/4	Nil	Sand stone	Granular	Litte wet	Nil	Nil	Nil	5.2	

Plot No,3 Soil profile and Result of soil survey (Natunal forest)

Plot No,4 Result of natural forest inventory

Date	8/4/93
Plot No.	No. 4
Area	
Elevation	320 m
Land condition	Slope land
Bearing	NW
Inclination	Max 35°
Dominant species	Kapur(Dryobalanops lanceolata ,Parashorea spp.), Ulat Mata
Crown density	Low-density
Undergrowth	Banana, Cassava
Forest type	C
Remarks	A mark of forest fire. Some Kapurs are remaining.

Plot No,4	Species		DBH	①	②	③	④	Remarks
30cm~	Mempening	Lithocarpus sp. or Quercus sp.	41	35	6	36	0.6985	
	Selangan Batu	Shorea section of Shorea	40	38	16	30	1.5394	Friuts
	Ulat Mata beledu	Parashorea tomentella	30	33	22	26	1.3547	
	Kapur Paji	Dryobalanops lanceolata	40	42	30	20	2.1206	
	Kapur Paji	Dryobalanops lanceolata	42	38	28	20	2.1134	
	Kapur Paji	Dryobalanops lanceolata	41	35	22	20	1.6074	
	Seraya Melantai	Shorea macroptera	44	25	16	30	1.7203	
		Total	278	246	140	182	11.154	
		Average	39.714	35.143	20	26	1.5935	
		Volume / ha (m3)					111.54	
20~29cm	Obah	Eugenia sp.	20	20				
	Seraya Kuning	Richetia section of shorea	27	28				
	Merbau Lalat	Sympetalandra borneensia	20	20				
	Obah	Eugenia sp.	23	25				
	Talap Hutan	Artocarpus or Parartocarpus sp.	26	22				
	Obah	Eugenia sp.	29	29				
	Urat Mata Daun Kechil	Parashorea parvifolia	26	30				
	Seraya Kuning	Richetia section of shorea	27	28				
	Assam	Manifera sp.	29	33				
	Obah	Eugenia sp.	20	24				
	Mempisang	Alphonsea elliptica	26	27				
	Lantupak	Dysoxylum sp.	26	30				
	Lantupak	Dysoxylum sp.	21	23				
	Resak	Vatica or Cotylelobium	22	23				
	Kapur Paji	Dryobalanops lanceolata	21	20				
	Kapur Paji	Dryobalanops lanceolata	24	26				
		Average	24.188	25.5				
5~19cm	Dawai dawai	Zizyphus calophylla	7	13				
	Mallotus	Mallotus sp.	13	17				
	Oba Suluk	Shorea pauciflora	18	24				
	Kayu Malam	Diospyros sp.	11	17				
	Bintangor	Calophyllum sp.	9	14				
		Average	11.6	17				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

Plot No,5 Result of natural forest inventory

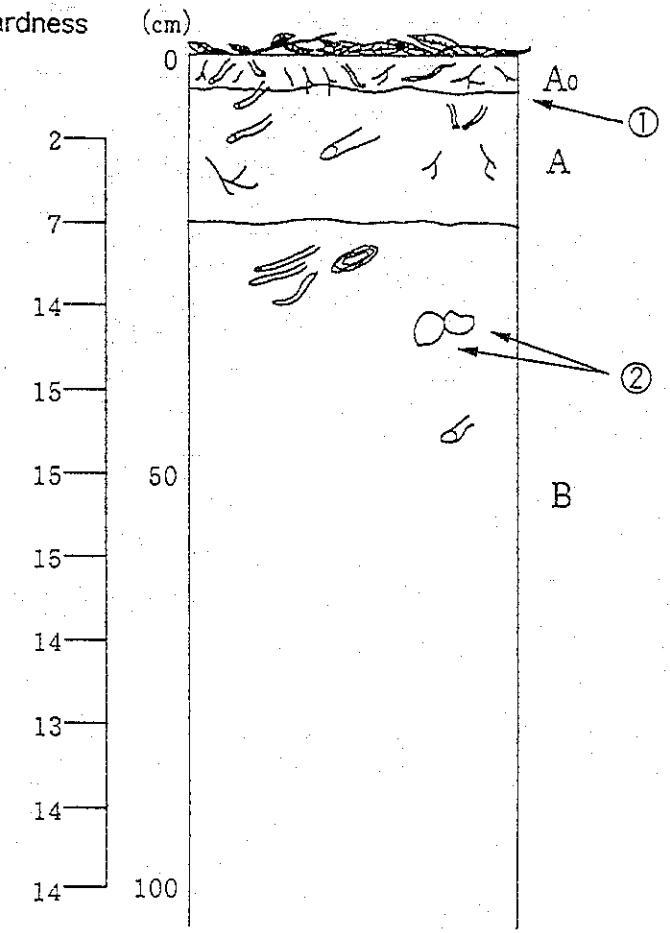
Date	8/5/93
Plot No.	No, 5
Area	
Elevation	780m
Land condition	Slope land
Bearing	N
Inclination	Max 22°
Dominant species	Serangan Batu (Shorea spp.)
Crown density	High density
Undergrowth	Forest inside is dark like virgin forest.
Forest type	A
Remarks	This plot logged fewtimes but succeeding tree are saved good condition.

Plot No,5	Species		DBH	①	②	③	④	Remarks
30cm~	Obah	Eugenia sp.	40	28	18	34	1.9354	
	Lantupak	Dysoxylum sp.	40	35	14	28	1.2711	Fruits
	Bintangor	Calophyllum sp.	44	36	15	35	1.8381	
	Selangan Batu Hitam	Shorea atrinervosa	62	40	22	38	4.3197	
	Rasak	Vatica or Cotylelobium sp.	39	38	18	32	1.7816	
	Obah	Eugenia sp.	38	25	14	30	1.2711	
	Selangan Batu Bersisik	Shorea foxworthyii	75	30	16	45	4.5239	
	Lantupak	Dysoxylum sp.	33	28	15	28	1.0959	
	OT		36	30	13	26	0.9812	
	Macang		68	42	32	46	8.1656	Fruits
	Sepetir	Sindora irpicina	50	40	14	35	1.9861	
	Medang	Cinnamomum parthenoxylon	40	34	24	28	2.179	
	Manggis Hutan	Garcinia mangostana	48	35	18	42	2.8628	
	Seraya sp	Shorea sp.	50	38	26	32	3.4327	
	Obah	Eugenia sp.	30	26	15	26	0.9236	
	Selangan Batu Terendak	Shorea seminis	44	40	25	34	2.9865	
	Kayu Malam	Diospyros sp.	40	36	22	26	1.8817	
		Total:	777	581	321	565	43.436	
		Average:	45.706	34.176	18.882	33.235	2.5551	
		Volume / ha (m3):					434.36	
20~29cm	Merbatu	Parinari oblongfolia	21	35				
	Kayu Malam	Diospyros sp.	21	22				
	Obah	Eugenia sp.	20	24				
	Obah	Eugenia sp.	30	26				
	Mallotus	Mallotus sp.	20	26				
	Seraya punai	Shorea parvifolia	22	24				
	Karpus	Hydonocarpus sp.	26	30				
	Mallotus	Mallotus sp.	21	23				
	Obah	Eugenia sp.	22	30				
		Average:	22.556	26.667				
5~19cm	Gawie	Ryparosa hulletii	8	9				
	Kayu Malam	Diospyros sp.	12	16				
	Nyatoh	Ganua,madhuca,Palaquium sp.	10	17				
	Takalis Daum Halus	Pentace laxiflora	8	12				
	Seraya Kuning	Richetia section of Shorea	7	7				
	Mempisang	Alphonsea elliptica	12	16				
	Gawie	Ryparosa hulletii	6	9				
	Obah	Eugenia sp.	9	7				
	Seraya Melantai	Parashorea malaanonan	5	7				
	Mallotus	Mallotus sp.	9	8				
	Kayu Malam	Diospyros sp.	7	6				
	Kayu Malam	Diospyros sp.	7	13				

	Seraya Kuning	Richetia section of Shorea	18	23			
	Minyak Belok	Xanthophyllum ellipticum	15	19			
	Resak Bukit	Vatica dulitensis	9	11			
	OT		6	9			
	Minyak Berok	Xanthophyllum ellipticum	7	7			
	Mempening	Lithocarpus or Quercus sp.	6	10			
	Resak Bukit	Vatica dulitensis	6	8			
	Seaya Melantai	Parashorea malaanonan	9	11			
	Darah Darah	Horsfieldia sp. Myristica sp.	10	14			
	Belimbing Hutan	Baccaurea angulata	12	16			
		Average	9	11.591			

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



①Rootlet
②Resin

Date	8/5/93
Plot No,	5
Elevation	785m
inclination	Slope land/22°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	7.5YR3/4	Poor	Nil	Granular	Wet	Nil	Nil	Poor	5.6	
B	10YR6/8	Nil	Nil	Nutty	Little wet	Nil	Nil	Poor	5.6	

Plot No,5 Soil profile and Result of soil survey (Natunal forest)

Plot No,6 Result of natural forest inventory

Date	8/5/93
Plot No.	No. 6
Area	
Elevation	660m
Land condition	Valley
Bearing	W
Inclination	Max 21°
Dominant species	Serangan Batu (Shorea spp.)
Crown density	Low density
Undergrowth	Bamboo,Rattan,Mallotus
Forest type	B
Remarks	Some gaps was made by logging. And sunlight find its away into inside forest. Therefore quite various plants,which are a party of Bamboo,palm and rattan are growing up in this plot. But regeneration is in progress,to find succeeding tree which upper middle diameter. Agathis live in corner of this plot.

Plot No,6	Species		DBH	①	②	③	④	Remarks
30cm~	Agathis	Agathis sp.	40	35	6	30	0.5773	
	Medang	Cinnamomum parthenoxylon	34	26	8	26	0.5655	
	Merbatu	Parinari oblongifolia	54	36	25	38	4.1548	
	Selangan Batu	Shorea sp.	60	38	10	50	2.3758	
	OT		31	30	4	26	0.2552	
	Rasak	Vatica or Cotylelobium sp.	48	36	8	40	1.2164	
	Medang	Cinnamomum parthenoxylon	33	30	3	26	0.205	
	Medang	Cinnamomum parthenoxylon	38	35	22	24	1.6605	
	Tambong	Geunsia pentandra	42	36	18	28	1.7318	
	Seraya Kuning	Richetia section of Shorea	48	38	26	35	3.5169	
	Seraya Melantai	Shorea macroptera	38	32	18	26	1.4476	
	Nyatoh	Ganua,Madhuca,Palaquium,Payena	35	28	15	24	1.0252	
	Mempening	Lithocarpus spp. or Quercus sp.	34	30	4	30	0.3217	
	Selangan Batu daun Halus	Shorea superba	46	35	20	32	2.3892	
	Selangan Batu	Shorea sp.	42	32	20	30	2.0358	
	Assam	Mangifera sp.	32	28	20	26	1.321	
	Merbatu	Parinari oblongifolia	33	34	15	26	1.0252	
	Seraya Kuning Siput	Shorea faguetiana	36	30	18	28	1.4476	
		Total	724	589	260	545	27.273	
		Average	40.222	32.722	14.444	30.278	1.5151	
		Volume / ha (m3)					272.73	
20~29cm	Chempaka	Talauma sp.	20	18				
	OT		22	21				
	Obah	Eugenia sp	28	30				
	Gawie	Ryparosa hulletii	25	30				
	Mempening	Lithocarpus sp. or Quercus sp.	20	18				
	Tampalang	Barringtonia sp.	26	28				
	Obah	Eugenia sp	22	22				
	Resak Bukit	Vatica dulitensis	23	22				
	Tarap Hutan	Artocarpus or parartocarpus sp.	22	9				Truncated tree
	Mellotus	Mallotus sp.	22	26				
		Average	23	22.4				
5~19cm	Dungun Darat	Heritiera sp.	13	17				
	Obah	Eugenia sp.	10	14				
	Takaliu	Homalium foetidum	5	5				Truncated tree
	OT		13	14				
	Bintangor	Calophyllum sp.	11	17				
	Medang	Cinnamomum parthenoxylon	16	15				
	Medang	Cinnamomum parthenoxylon	6	8				
	Surusop	Ardisia elliptica	7	9				
		Average	10.125	12.375				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

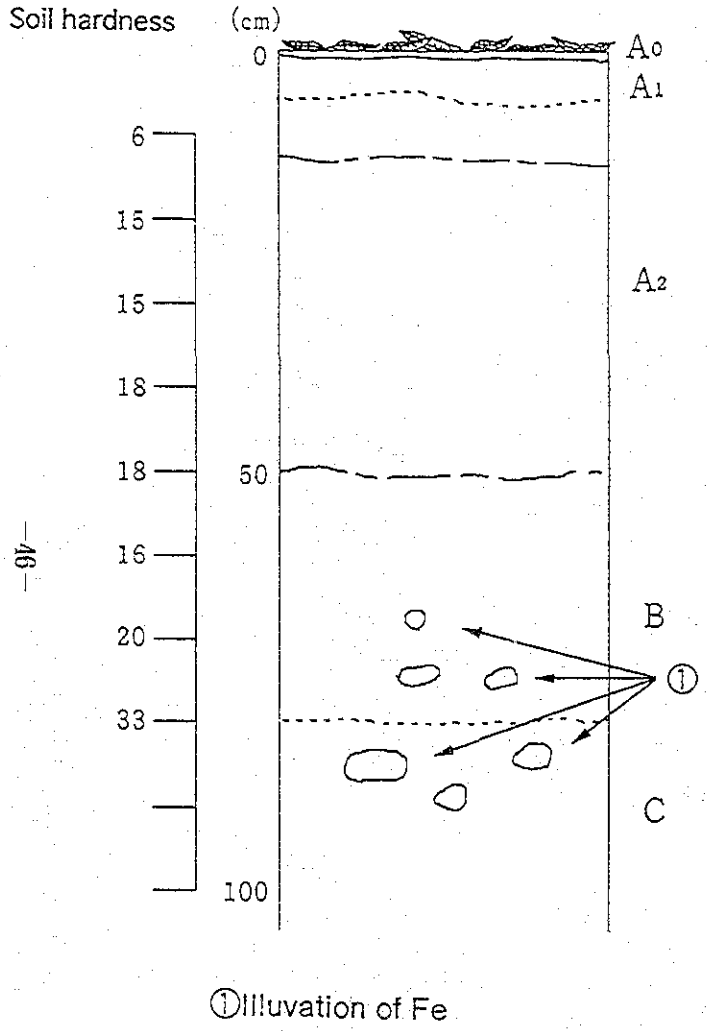
Plot No,7 Result of natural forest inventory

Date	8/6/93
Plot No.	No, 7
Area	
Elevation	560m
Land condition	ridge
Bearing	NNW
Inclination	Max 38°
Dominant species	Serangan Batu (Shorea spp.)
Crown density	Middle
Undergrowth	
Forest type	B
Remarks	Some dead tree for fire of shifting cultivation are found in this plot. This plot is located at small streamside. Many middle diameter tree (macaranga spp,etc.) are found instead of stump of large diameter tree. Sapling of Selangan batu regenerated in forest bed.

Plot No,7	Species		DBH	①	②	③	④	Remarks
30cm~	Mempening	Lithocarpus sp. or Quercus sp.	44	38	14	40	1.9396	
	Mempening	Lithocarpus sp. or Quercus sp.	45	36	28	28	2.9298	
	Banjutan	Shorea multiflora	41	32	22	26	1.9391	
	Selangan Batu Terendak	Shorea seminis	57	40	30	28	4.2559	
	Selangan Batu Laut	Shorea glaucescens	66	42	32	36	6.537	
		Total	253	188	126	158	17.601	
		Average	50.6	37.6	25.2	31.6	3.5203	
		Volume / ha (m3)					176.01	
20~29cm	Obah	Eugenia sp.	26	18				
	Obah	Eugenia sp.	26	16				
	Medang	Cinnamomum parthenoxylon	27	18				
	Kubin	Macaranga gigantifolia	20	14				
	Sedaman	Macaranga sp.	20	26				
		Average	23.8	18.4				
5~19cm	Mallotus	Mallotus sp.	8	11				
	Obah	Eugenia sp.	10	12				
	Kopi-Kopi(Koping koping?)	Aglaia argentea	8	9				
	Sireh-Sireh	Pternandra coerulescens	18	18				
	Selangan Batu sp	Shorea sp.	13	16				
	Mempening	Lithocarpus sp. or Quercus sp.	12	16				
	Pisang-Pisang	Mezettia leptopoda	10	9				
	Obah	Eugenia sp.	7	7				
	Mallotus	Mallotus sp.	7	7				
	Medang	Cinnamomum parthenoxylon	10	13				
	Pisang-Pisang	Mezettia leptopoda	5	6				
		Average	9.8182	11.273				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



①Illuvation of Fe

Date	8/6/93
Plot No,	7
Elevation	570m
inclination	Ridge/Max38°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A1	10YR4/4	Middle	Poor	Little crumb	Little wet	Nil	Nil	Rich	5.8	
A2	10YR6/6	Poor	Poor	Little crumb	Little wet	Nil	Nil	Poor	5.6	
B	10YR7/6	Nil	Rich	Massive	Little wet	Fe	Nil	Nil	5.4	
C	2.5Y7/3	Nil	Rich	Masive	Little wet	Fe	Nil	Nil	5.4	

Plot No,7 Soil profile and Result of soil survey (Natunal forest)

Plot No,8 Result of natural forest inventory

Date	8/6/93
Plot No.	No. 8
Area	
Elevation	560m
Land condition	Slope land
Bearing	W
Inclination	Max 20°
Dominant species	
Crown density	Low density
Undergrowth	Rattan, Miscellaneous trees(tree height 6~8m)
Forest type	C
Remarks	Down part:gulley head Hauling road~ forest 100m inside

Plot No,8	Species		DBH	①	②	③	④	Remarks
30cm~	Lantupak	Dysoxylum sp.	70	38	26	56	8.1049	
	Obah	Eugenia sp.	55	42	14	36	2.2764	Buttress (under4m)
	Selangan Batu sp	Shorea sp.	43	34	24	28	2.3755	
	Lantupak	Dysoxylum sp.	31	28	10	26	0.6379	
	Bintangor	Calophyllum sp.	48	38	22	32	2.7646	
	Kayu Malam	Diospyros sp.	34	26	10	28	0.7548	
	Obah	Eugenia sp.	32	28	14	22	0.8016	
	Nyatoh	Ganua,Madhuca,Palaquium,Payena	43	24			0	Truncated tree
		Total	356	258	120	228	17.716	
		Average	44.5	32.25	17.143	32.571	2.2145	
		Volume / ha (m3)					177.16	
20~29cm	Medang	Cinnamomum parthenoxylon	27	32				
	Obah nasi	Glochidion sp.	22	26				
	Selangan Batu sp	Shorea sp.	23	24				
	Bintanbor	Calophyllum sp.	25	24				
	Obah	Eugenia sp.	28	15				
	Resak	Vatica or Cotylelobium	29	16				
	Medang	Cinnamomum parthenoxylon	27	24				
		Average	25.857	23				
5~19cm	Mempening	Lithocarpus sp. or Quercus sp.	7	9				
	Medang	Cinnamomum parthenoxylon	9	8				
	Keruing	Dipterocarpus sp.	7	8				
	Mangis Hutan(Manggis?)	Garcinia mangostana	6	7				
	Resak	Vatica or Cotylelogium sp.	7	12				
	Obah	Eugenia sp.	18	18				
	Seraya Kuning Siput	Shorea faguetiana	17	25				
	Resak	Vatica or Cotylelogium sp.	12	12				
		Average	10.375	12.375				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

Plot No,9 Result of natural forest inventory

Date	8/6/93
Plot No.	No, 9
Area	
Elevation	610m
Land condition	Ridge
Bearing	NW
Inclination	Max 33°, Average 25°
Dominant species	
Crown density	Middle
Undergrowth	
Forest type	B
Remarks	Large diameter trees are remaining in this plot. Forest bed of this plot is look like virgin forest one. Sapling of Dipterocarpaceae are found.

Plot No,9	Species		DBH	①	②	③	④	Remarks
30cm~	Kayu Malam	Diospyros sp.	30	26	20	18	0.9048	
	Obah	Eugenia sp.	42	40	30	30	3.0536	
	Selangan Batu Laut	Shorea glaucescens	155	46	30	100	38.303	
	Kayu Ara (Ficus)	Ficus sp.	80	44	30	60	11.545	
	Sareya Kuning	Richetia section of Shorea	70	42	36	40	8.553	
	Rasak	Vatica sp. or Cotylelobium sp.	46	40	32	40	4.6471	
	Obah	Eugenia sp.	31	36	25	20	1.2768	
		Total	454	274	203	308	68.284	18.43524
		Average	64.857	39.143	29	44	9.7548	3.687049
		Volume / ha (m3)					682.84	184.3524
20~29cm	Mempening	Lithocarpus sp. or Quercus sp.	26	30				
	Mempening	Lithocarpus sp. or Quercus sp.	25	30				
	Medang	Cinnamommum parthenoxylon	23	34				
	Medang	Cinnamommum parthenoxylon	29	28				
	Mempening	Lithocarpus sp. or Quercus sp.	26	34				
	Medang	Cinnamommum parthenoxylon	21	26				
	Kayu Malam	Diospyros sp.	26	34				
	Seraya Tembaga	Shorea leprosula	25	32				
	Resak	Vatica sp. or Cotylelobium sp.	20	24				
	Resak	Vatica sp. or Cotylelobium sp.	28	36				
	Mallotus spp.	Mallotus	27	30				
	Kayu Malam	Diospyros sp.	28	34				
	Mempening	Lithocarpus sp. or Quercus sp.	26	36				
	Nyatoh	Gauna,Madhuca,Palaquium,Payena	21	20				
		Average	25.071	30.571				
5~19cm	Selangan Batu	Shorea sp.	17	16				
	Kiras	Koilodepus longifolium	10	12				
	Kopi-Kopi(Kopin kpoing?)	Aglaia argentea	7	10				
	Jaring-Jaring	Pithecellobium jiringa	5	6				
	Kayu Malam	Diospyros sp.	13	18				
	Mallotus spp.	Mallotus	16	17				
	Medang	Cinnamommum parthenoxylon	5	9				
	Medang	Cinnamommum parthenoxylon	9	16				
	Obah	Eugenia sp.	7	10				
	Rusak	Vatica sp. or Cotylelobium sp.	8	14				
	Koroi-Koroi		6	8				
	Salangan Batu	Shorea sp.	6	11				
		Average	9.0833	12.25				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

※ Numerical value of remarks are except Shorea glaucescens,Ficus spp.one

Plot No,10 Result of natural forest inventory

Date	8/6/93
Plot No.	No, 10
Area	
Elevation	630m
Land condition	Slope land
Bearing	W
Inclination	Max 30°
Dominant species	Large diameter trees are hardly.
Crown density	Middle
Undergrowth	Rattan scattered.
Forest type	C
Remarks	Some tree was injured top end when cut around tree. Many sapling are found here. Seeding condition is excellent.

Plot No,10	Species		DBH	①	②	③	④	Remarks
30cm~	Resak	Vatica or Cotylelobium sp.	30	32	10	24	0.5726	
	Kayu Malam	Diospyros sp.	39	30	18	24	1.4028	
	Obah	Eugenia sp.	32	32	10	26	0.6605	
	Durian	Heritiera sp.	37	32	20	28	1.6592	
	Selangan Batu	Shorea sp.	87	40	20	62	8.7183	
	Nyatoh	Gauna,Madhuca,Palaquim,Payena	43	32	18	26	1.6827	
	Resak	Vatica or Cotylelobium sp.	35	18	12	24	0.8202	
		Total	303	216	108	214	15.516	
		Average	43.286	30.857	15.429	30.571	2.2166	
		Volume / ha (m3)					155.16	
20~29cm	Darah Darah	Horsfieldia sp. Myristica sp.	20	16				
	Resak	Vatica or Cotylelobium sp.	24	18				
	Obah	Eugenia sp.	41	22				
	Resak	Vatica or Cotylelobium sp.	22	20				
	Resak	Vatica or Cotylelobium sp.	25	26				
	Bintangor	Calophyllum sp.	24	30				
	Resak	Vatica or Cotylelobium sp.	26	32				
	Obah	Eugenia sp.	26	30				
	Nyatoh	Gauna,Madhuca,Palaquim,Payena	27	26				
	Resak	Vatica or Cotylelobium sp.	25	14				
	Resak	Vatica or Cotylelobium sp.	26	26				
		Average	26	23.636				
5~19cm	Obah	Eugenia sp.	10	14				
	Jaring-Jaring	Pithecellobuim jiringa	7	10				
	Resak	Vatica or Cotylelobium sp.	13	12				
	Rengas	Melanorrhoea wallichii	7	8				
	Resak	Vatica or Cotylelobium sp.	14	20				
	Selangan Batu	Shorea sp.	11	22				
	Medang	Cinnamomum parthenoxylon	10	20				
	Resak	Vatica or Cotylelobium sp.	8	11				
	Resak	Vatica or Cotylelobium sp.	7	14				
	Medang	Cinnamomum parthenoxylon	13	24				
	Resak	Vatica or Cotylelobium sp.	5	13				
		Average	9.5455	15.545				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

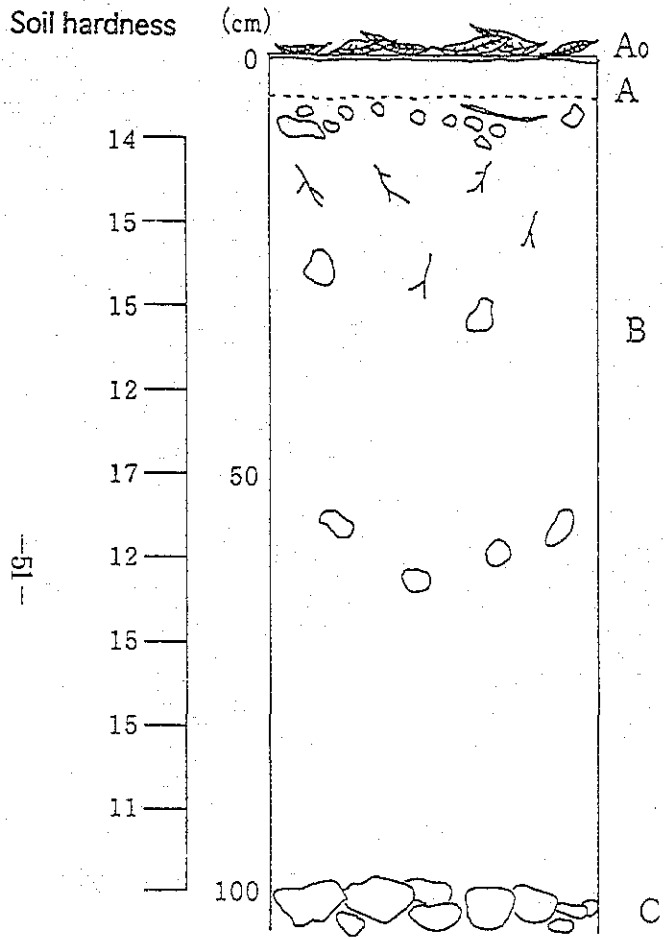
Plot No,11 Result of natural forest inventory

Date	8/7/93
Plot No.	No, 11
Area	
Elevation	870m
Land condition	Slope land
Bearing	S
Inclination	35°
Dominant species	Medang (Cinnamomum parthenoxylon) & Dipterocarpaceae
Crown density	Middle
Undergrowth	
Forest type	B
Remarks	This plot is located at gulley head. Many rocks expose which place. Light demanders appear at gap for logging. Sapling of succeedings are hardly.

Plot No,11	Species		DBH	①	②	③	④	Remarks
30cm~	Seraya Punai	Shorea parvifolia	32	30	20	20	1.0619	
	Obah	Eugenia sp.	47	38	20	30	2.3283	
	Urat mata Beledu	Parashorea romentella	39	36	28	20	1.9138	
	Resak	Melanorrhoea wallichii	56	40	36	40	6.5144	
	Medang	Cinnamomum parthenoxylon	50	32	26	26	2.9487	
	Medang	Cinnamomum parthenoxylon	38	38	28	28	2.3948	
	Medang	Cinnamomum parthenoxylon	44	40	30	30	3.2256	
	Seraya Majau	Shorea johorensis	80	40	21	40	5.9376	
		Total	386	294	209	234	26.325	
		Average	48.25	36.75	26.125	29.25	3.2906	
		Volume / ha (m3)					263.25	
		(cm)	5~9	10~14	15~19	20~24	25~29	
	Karai Puteh	Polyalthia sumatrana	1					
	Medang	Cinnamomum parthenoxylon				1		
	Kopi-Kopi(Koping koping?)	Aglaia argentea	1					
	Selangan Jangkang(Hopea)	Hopea nervosa		1				
	Lantupak	Dysoxylum sp.		1				
	Seraya Melantai	Shorea macroptera	1					
	Lantupak	Dysoxylum sp.		1				
	Bintangor	Calophyllum sp.		1				
	Rengas	Melanorrhoea wallichii		1				
	Bintangor Batu	Mesua macrantha		1				
		Total	3	6	0	1	0	

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



Date	8/7/93
Plot No,	11
Elevation	870m
inclination	Slope land/35°

Horizon	Colour	Humus	Gravel	Structure	Moisture	illuvation	Mycorrhiza	Root	pH	Remark
A	10YR5/4	Rich	Poor	Crumb	Wet	Nil	Nil	Rich	5.8	
B	10YR5/6	Poor	Rich	Little crumb	Wet	Nil	Nil	Rich	5.6	
C	10YR5/8	Nil	Very rich	Massive	Wet	Nil	Nil	Poor	5.6	

Plot No,11 Soil profile and Result of soil survey (Natunal forest)

Plot No,12 Result of natural forest inventory

Date	8/7/93
Plot No.	No. 12
Area	
Elevation	680m
Land condition	Slope land
Bearing	SW
Inclination	35°
Dominant species	
Crown density	Low-density
Undergrowth	Rattan
Forest type	
Remarks	

Plot No,12	Species		DBH	①	②	③	④	Remarks
30cm~	Selangan Batu	Shorea sp.	54	16	15	23	1.7462	
	Assam	Mangifera sp.	44	47	20	33	2.3283	
	Tekalis Daun Bulat	Pentace adenophora	52	48	16	30	2.1124	
	Ramin	Gonystylus bancanus	42	46	16	35	1.8627	
	Selangan Batu	Shorea sp.	39	46	25	26	2.0739	
	Mempening	Lithocarpus sp. or Quercus sp.	58	50	25	30	3.8013	
	Tarap Hutan	Artocarpus or Parartocarpus sp.	32	28	9	24	0.5542	
	Nyatoh Sidang	Palaquium rostratum	40	46	16	32	1.6286	Truncated
		Total	361	327	142	233	16.108	
		Average	45.125	40.875	17.75	29.125	2.0135	
		Volume / ha (m3)					161.08	
20~29cm	Mempening	Lithocarpus sp. or Quercus sp.	22	23				
	Durian Monyit	Neesia sp.	21	20				
	Medang	Cinnamomum parthenoxylon	24	26				
	Selangan Batu	Shorea sp.	22	21				
	Selangan Batu Laut	Shorea glaucescens	28	32				
	Selangan Batu	Shorea sp.	20	25				
	Mempening	Lithocarpus sp. or Quercus sp.	20	30				
	Mempening	Lithocarpus sp. or Quercus sp.	28	24				
	OT		26	27				
	Surusop	Ardisia elliptica	20	14				
	OT		21	30				
	OT		23	25				
	OT		24	26				
	Mempening	Lithocarpus sp. or Quercus sp.	24	20				
		Average	23.071	24.5				
5~19cm	Medang	Cinnamomum parthenoxylon	14	20				
	Medang	Cinnamomum parthenoxylon	18	18				
	Obah	Eugenia sp.	11	9				
	Mempening	Lithocarpus sp. or Quercus sp.	7	7				
	Mempening	Lithocarpus sp. or Quercus sp.	6	5				
	Tarap Hutan	Artocarpus or Parartocarpus sp.	7	7				
	Mempening	Lithocarpus sp. or Quercus sp.	11	11				
	Mempening	Lithocarpus sp. or Quercus sp.	14	13				
	Obah	Eugenia sp.	17	16				
	Medang Sasi	Litsea odorifera	5	6				
		Average	11	11.2				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

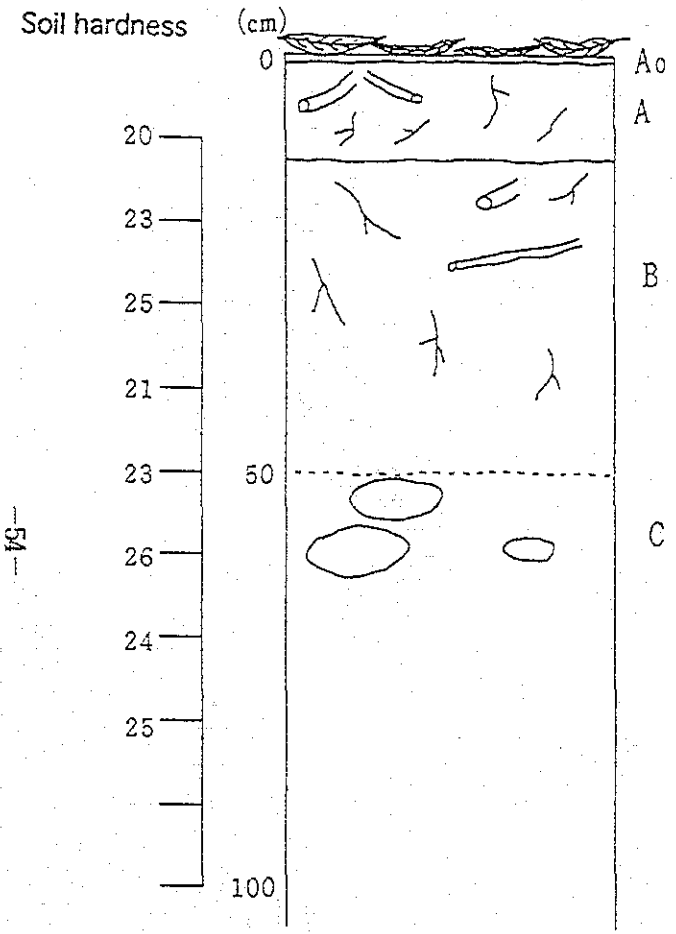
Plot No,13 Result of natural forest inventory

Date	8/11/93
Plot No.	No, 13
Area	
Elevation	630m
Land condition	Slope land
Bearing	S S W
Inclination	24°
Dominant species	
Crown density	Low density
Undergrowth	Rattan, Banana
Forest type	C
Remarks	A mark of shifting cultivation. One logging road passes near by in this plot.

Plot No,13	Species		DBH	①	②	③	④	Remarks
30cm~	*Seraya Punal*	*Shorea parvifolia*	40	42	20	24	1.6085	
	Sepatir	Sindora irpicina	31	20	8	25	0.4926	
	Seraya Punal	Shorea parvifolia	37	42	14	30	1.234	
	Medang	Cinnamomum parthenoxylon	36	32	14	28	1.1259	
	Urat Mata Beledu	Parashorea tomentella	32	15	4	30	0.3019	
	OT		38	33	26	28	2.2238	
		Total	214	184	86	165	6.9867	
		Average	35.667	30.667	14.333	27.5	1.1645	
		Volume / ha (m3)					69.867	
20~29cm	Resak Bukit	Vatica dulitensis	25	15				
	Mempening	Lithocarpus sp .or Quercus sp.	27	23				
	Magas	Duabanga moluccana	28	22				
	Gagil	Hopea sangal	20	25				
	Gagil	Hopea sangal	21	27				
	Gagil	Hopea sangal	26	30				Truncated
	Kandis	Garcinia parvifolia	23	25				
		Average	24.286	23.857				
5~19cm	OT		6	14				
	OT		6	9				
	Mempening	Lithocarpus sp .or Quercus sp.	11	14				
	OT		14	16				
	Mempisang	Alphonsea ellipticum	9	13				
	Mempisang	Alphonsea ellipticum	6	5				
	Lantupak	Dysoxylum sp.	6	8				
	Mallotus	Mallotus sp.	5	6				
	OT		10	13				
	Gagil	Hopea sangal	10	16				
	Bangkal	Nauclea orientalis	8	15				
		Average	8.2727	11.727				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



Date	8/11/93
Plot No,	13
Elevation	630m
inclination	Slope land/24°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	7.5YR4/3	Rich	Nil	Crumb	Little wet	Nil	Nil	Rich	5.4	
B	10YR7/6	Poor	Nil	Massive	Little wet	Nil	Nil	Rich	5.2	
C	2.5Y7/4	Nil	Middle	Massive	Wet	Fe	Nil	Very poor	5.2	

Plot No,13 Soil profile and Result of soil survey (Natunal forest)

Plot No,14 Result of natural forest inventory

Date	8/11/93
Plot No.	No, 14
Area	Interior of Kg.Sunsui
Elevation	450m
Land condition	Slope land
Bearing	SW
Inclination	28°
Dominant species	
Crown density	Low-density
Undergrowth	Wild bananas are growing thick.
Forest type	C
Remarks	This plot a mark of shifting cultivation. It extends from ridge to small valley. Many dead trees for effect of logging are found here.

Plot No,14	Species		DBH	①	②	③	④	Remarks
30cm~	Kembang	Horitiera simplicifolia	44	35	17	26	1.6356	
	Obah	Eugenia sp.	30	28	10	20	0.4909	
	Nyatoh	Ganua,Madhuca,Palaquium,Payena	34	28	10	25	0.6835	
	Durian Moyit	*Neesia sp.*	48	40	14	35	1.8937	
	Assam-Assam	mangifera sp.	32	35	6	26	0.3963	
	OT		45	46	20	30	2.2089	
		Total	233	212	77	162	7.3089	
		Average	38.833	35.333	12.833	27	1.2182	
		Volume / ha (m3)					73.089	
20~29cm	Melapi	Shorea bractelata	27	19				
	Seraya Melapi		26	21				
	OT		26	18				
	Karpus	Hydnocarpus sp.	20	19				
		Average	24.75	19.25				
5~19cm	Darah-Darah	Horsfieldia or Myristica sp.	12	15				
	Lambunu		12	8				
	Karpus	Hydnocarpus sp.	5	6				
	Medang	Cinnamomum parthenoxylon	5	6				
		Average	8.5	8.75				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

Plot No,15 Result of natural forest inventory

Date	8/12/93
Plot No.	No. 15
Area	
Elevation	910m
Land condition	Slope land
Bearing	S
Inclination	30°
Dominant species	Sedaman (Macaranga sp.)
Crown density	Middle
Undergrowth	
Forest type	B
Remarks	Regenerated sapling of Dipterocarpaceae occupy in this area about 60%. But Macaranga spp.invate into gap. Moisture condition of soil is a little dry.

Plot No,15	Species		DBH	①	②	③	④	Remarks
30cm~	Obah	Eugenia sp.	30	23	12	23	0.6619	
	Obah Suluk	Shorea pauciflora	78	23	8	45	2.3765	
	Seraya Kuning	Richetia section of Shorea	76	28	15	44	4.2412	
	Selangan Batu Daun Halus	Shorea superba	120	22	13	75	9.7061	
	OT		70	26	20	32	4.0857	
	Melapi	Shorea bractelata	44	25	18	28	1.8322	
	OT		66	30	22	36	4.4942	
	OT		51	28	14	32	1.8937	
	Assam	Mangifera sp.	30	25	12	26	0.7389	
	OT		41	30	13	28	1.2153	
	Durian Monyit	Neesia spp.	34	24	15	26	1.0603	
		Total	640	284	162	395	32.306	22.59971
		Average	58.182	25.818	14.727	35.909	2.9369	2.259971
		Volume / ha (m3)					323.06	225.9971
20~29cm	OT		25	18				
	Sedaman	Macaranga sp.	20	16				
	Takalis Daun Halus	Pentace laxiflora	22	22				
	Takalis Daun Halus	Pentace laxiflora	24	25				
	Seraya Kuning	Richetia section of Shorea	22	18				
	OT		23	20				
	Nyatoh Sidang	Palaquium rostratum	20	23				
	Mempisang	Alphonsea elliptica	20	18				
		Average	22	20				
5~19cm	Mempening	Lithocarpus sp. or Quercus sp.	6	5				
	Seraya Kuning Siput	Shorea faubuetiana	5	5				
	Takalis Daun Halus	Pentace laxiflora	10	20				
	OT		10	13				
	OT		5	6				
	Obah	Eugenia sp.	11	16				
	Kayu Malam	Diospyros sp.	9	13				
	Darah Darah	Horsfieldia or Myristica sp.	6	11				
	Katok	Stemonurus scorpioides	8	12				
	Nyatoh King	Ganua kingiana	8	17				
	Bintangor	Calophyllum sp.	7	9				
	Takalis Daun Halus	Pentace laxiflora	12	14				
		Average	8.0833	11.75				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

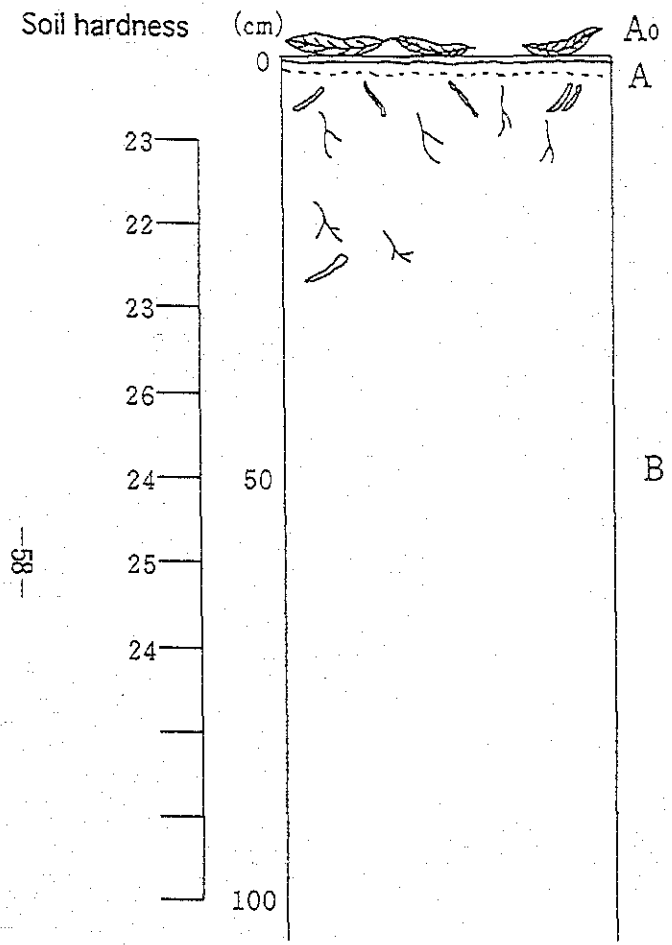
※ Numerical value of remarks are except Shorea superba one

Plot No,16 Result of natural forest inventory

Date	8/12/93
Plot No.	No. 16
Area	Kg. Marak Parak
Elevation	230m
Land condition	Flat
Bearing	W
Inclination	6°
Dominant species	
Crown density	Middle
Undergrowth	A lot of lalang, A party of Alpinia spp, Eupatorium odoratum, Labunai A party of Scleria levis.
Forest type	F (shrub forest)
Remarks	A mark of forest fire. No wetland and small stream near by in this plot. But it is most suitable place for reforestation.

Plot No,16		DBH	①	②	③	④	Remarks
5cm~	Species	9					
	Obah (Eugenia sp.)	5					
		6					
	Average tree height	7					
	5m	6					
		9					
	① Tree height	5					
	② Clear length	7					
	③ Top end doameter	5					
	④ Commercial volume	7					
		7					
		8					
		7					
		6					
		6					
		6					
		7					
		8					
		6					
		5					
		6					
		7					
		5					
		5					
		5					
		7					
		9					
		6					
		5					
		5					
		9					
		7					
		7					
		6					
		9					
		5					
		5					
		10					
		8					
		5					
		6					
	Total (cm)	269					
	Average (cm)	6.561					

Unit of DBH and top end diameter is (cm)



Date	8/12/93
Plot No,	16
Elevation	230m
inclination	Flat/6°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	7.5YR4/3	Poor	Nil	Crumb	Little dry	Nil	Nil	Middle	5.6	
B	5YR5/8	Nil	Nil	Massive	Wet	Nil	Nil	Poor	5.4	

Plot No,16 Soil profile and Result of soil survey (Natunal forest)

Plot No,17 Result of natural forest inventory

Date	8/12/93
Plot No.	No, 17
Area	
Elevation	350m
Land condition	Slope land
Bearing	N
Inclination	33～35°
Dominant species	Bangkal (Nauclea orientalis), Binuang (Octomeles sumatrana)
Crown density	Middle
Undergrowth	
Forest type	B
Remarks	This plot is very steeply. Many rocks are exposured. Succeeding and sapling of Dipterocarpaceae are not found. Many traces,which are made by villager to take a sprout of Polod are found inside forest.

Plot No,17	Species		DBH	①	②	③	④	Remarks
30cm～	Bangkal	Naucleaorientalis	32	28	13	24	0.8005	
	Medang	Cinnamomum parthenoxylon	35	23	11	22	0.7017	
	Karpus	Hydnocarpus sp.	32	28	12	22	0.6871	
	Seraya Punai	Shorea parvifolia	39	30	14	20	0.9569	
	Bangkal	Nauclea orientalis	30	24	12	20	0.5891	
	Binuang	Octomeles sumatrana	64	45	34	42	7.501	
	Binuang	Octomeles sumatrana	76	40	16	50	4.9876	
	Terap Hutan	Artocarpus or Parartocarpus sp.	36	24	3	30	0.2566	
	Bangkal	Nauclea orientalis	41	28	14	20	1.0229	
	Bangkal	Nauclea orientalis	32	20	10	18	0.4909	
	OT		39	30	18	18	1.1483	
	Bangkal	Naucleaorientalis	50	35	16	28	1.9113	
	Medang	Cinnamomum parthenoxylon	30	28	10	20	0.4909	
	Bangkal	Nauclea orientalis	53	34	22	26	2.6959	
	OT		72	36	17	45	4.5693	
		Total	661	453	222	405	28.81	
		Average	44.067	30.2	14.8	27	1.9207	
		Volume / ha (m3)					288.1	
20～29cm	Seraya Punai	Shorea parvifolia	28	30				
	Buruni	Artocarpus dadah	20	15				
	Bangkal	Nauclea orientalis	20	20				
	OT		26	15				
	Seraya Punai	Shorea parvifolia	26	24				
		Average	24	20.8				
5～19cm	Linkabau(Linkabong?)	Macaranga tanarius	13	10				
	Mempisang	Alphonsea ellipticum	12	16				
	Medang	Cinnamomum parthenoxylon	9	12				
	Medang	Cinnamomum parthenoxylon	13	12				
	Membuakat	Paranephelium nitidum	17	16				
		Average	12.8	13.2				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

Plot No,18 Result of natural forest inventory

Date	8/12/93
Plot No,	No, 18
Area	Kg. Marak Parak
Elevation	240m
Land condition	Flat
Bearing	SE
Inclination	5°
Dominant species	
Crown density	Middle
Undergrowth	Eupatorium odoratum, A party of Alpinia spp, A party of Scleria levis. Lalang. Melastoma are not found.
Forest type	F (Scrub forest)
Remarks	A mark of forest fire. Soil condition like en-tout-cas (drain well). No wetland and small stream near by in this plot. But it is most suitable place for reforestation.

Plot No,18		DBH	①	②	③	④	Remarks
5cm~	Speces	6					
	Teling gaja	8					
	(Crypteronia griffithii)	5					
		5					
	Averave tree height	5					
	5m	7					
		6					
	① Tree height	7					
	② Clear length	5					
	③ Top end doameter	5					
	④ Commercial volume	6					
		11					
		5					
		5					
		6					
		7					
		5					
		5					
		5					
		5					
		8					
		12					
		7					
		5					
		9					
		5					
		5					
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		7					
		8					
		7					
		11					
		6					
		5					
		5					
		8					
		9					
		7					
		6					
		5					
		5					
	Total (cm)	380					
	Average (cm)	6.4407					

Plot No,19 Result of natural forest inventory

Date	8/12/93
Plot No,	No, 19
Area	Kg. Marak Parak
Elevation	230m
Land condition	Flat
Bearing	NW
Inclination	9°
Dominant species	
Crown density	High-density
Undergrowth	Eupatorium odoratum, Melastoma, Lalang are few.
Forest type	F (Srub forest)
Remarks	No wetland near in this plot. It is suitable for aforestation.

Plot No,19		DBH	①	②	③	④	Remarks
5cm~	Species	8					
		7					
		7					
	Average tree height	9					
	5m	5					
		6					
	① Tree height	6					
	② Clear length	10					
	③ Top end doameter	8					
	④ Commercial volume	8					
		6					
		5					
		7					
		7					
		5					
		6					
		5					
		5					
		5					
		5					
		8					
		6					
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		5					
		9					
		8					
		5					
		5					
		7					
		5					
		8					
		11					
		8					
		10					
		5					
		6					
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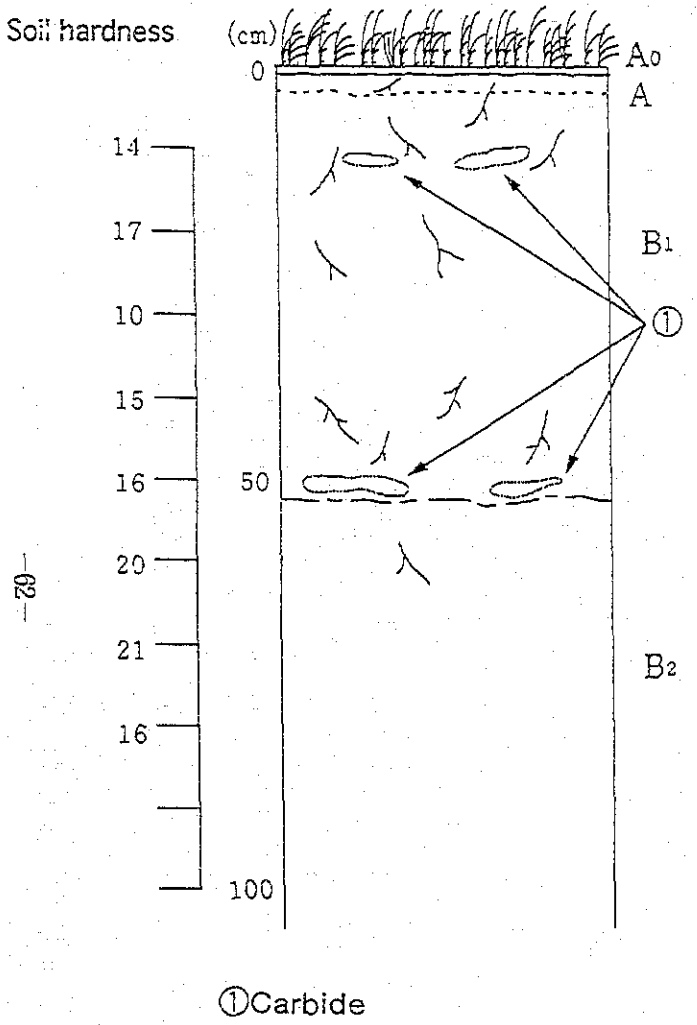
		5					
		6					
		7					
		7					
		5					
		7					
		6					
		9					
		5					
	Total (cm)	372					
	Average (cm)	6.5263					



Date	8/12/93
Plot No,	19
Elevation	230m
inclination	Slope land (gently) /9°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	5YR4/6	Poor	Nil	Little crumb	Wet	Nil	Nil	Rich	5.6	
B1	2.5YR4/6	Nil	Nil	Little crumb	Wet	Nil	Nil	Middle	5.4	
B2	2.5YR5/8	Nil	Nil	Massive	Wet	Nil	Nil	Poor	5.4	

Plot No,19 Soil profile and Result of soil survey (Natunal forest)

Plot No,20 Result of natural forest inventory

Date	8/12/93
Plot No,	No, 20
Area	Kg. Marak Parak
Elevation	120m
Land condition	Flat
Bearing	NE
Inclination	13°
Dominant species	
Crown density	Low-density
Undergrowth	A party of Alpinia, Sedge, Lalang extend under sunlight.
Forest type	E (Low-height forest)
Remarks	A mark of forest fire. Soil colour is red. (like en-tout-cas) No wetland and small stream near by in this plot. But it is most suitable place for aforestation. But place of Lalang living needs cultivation. Many peoples live near by in this plot therefore supply of labor is impossible.

Plot No,20	Species		DBH	①	②	③	④	Remarks
30cm~	OT		42	23	6	30	0.6107	
	Seraya Putih	Parashorea malaanonan, P.plicata	47	28	6	35	0.7922	
	Tolok	Inocarpus edulis	40	18	10	20	0.7069	
	Seraya Putih	Parashorea malaanonan, P.plicata	36	28	6	33	0.5609	
	Selangan Batu	Shorea sp.	30	22	12	18	0.5429	
	Seraya Putih	Parashorea malaanonan, P.plicata	45	26	6	33	0.7168	
		Total	240	145	46	169	3.9303	
		Average	40	24.167	7.6667	28.167	0.655	
		Volume / ha (m3)					39.303	
5~30cm	Tampalang	Barringtonia sp.	16					
	Tampalang	Barringtonia sp.	16					
			15					
			15					
			5					
			10					
			6					
			5					
			5					
			6					
			5					
			6					
			7					
			7					
			7					
			7					
		Average	8.625					

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)

Plot No,21 Result of natural forest inventory

Date	8/13/93
Plot No.	No. 21
Area	Kg. Sunsui
Elevation	350m
Land condition	Slope land
Bearing	SW
Inclination	12°
Dominant species	
Crown density	
Undergrowth	Lalang and Bracken are grow thick.
Forest type	Lalang
Remarks	

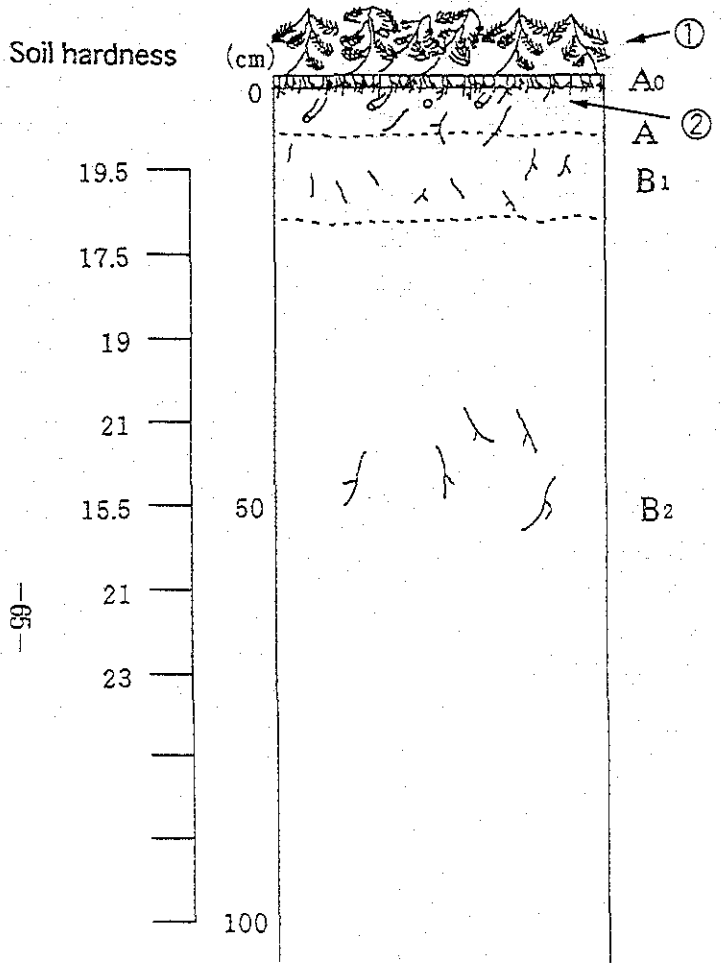
Plot No,21	Species	DBH	①	②	③	④	Remarks
		7	8				
		3	5				

No. of Bracken (1m×1m)	
Live	15
Die	25

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Height of Bracken	
1	2.8
2	1.9
3	2.4
4	2.8
5	2.4
Average	2.46 m

Unit of DBH and top end diameter is (cm)
Unit of tree height is (m)



①Bracken
②Root of Bracken

Date	8/13/93
Plot No,	21
Elevation	260m
inclination	Slope land (gently) /12°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	10YR7/6	Poor	Nil	Massive	Wet	Nil	Nil	Very rich	5.2	
B1	10YR6/8	Poor	Nil	Massive	Wet	Nil	Nil	Rich	4.8	
B2	7.5YR6/8	Poor	Nil	Massive	Wet	Nil	Nil	Poor	4.8	

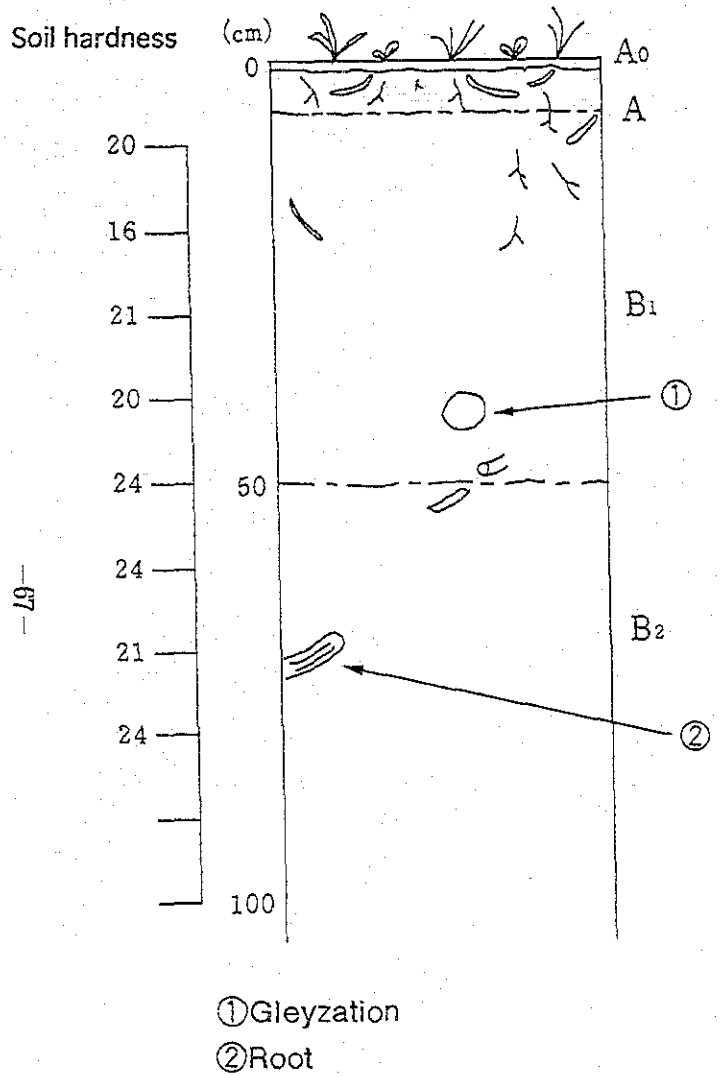
Plot No,21 Soil profile and Result of soil survey (Natunal forest)

Plot No,22 Result of natural forest inventory

Date	8/13/93
Plot No.	No, 22
Area	Kg. Sunsui
Elevation	350m
Land condition	Spole land
Bearing	N
Inclination	24°
Dominant species	
Crown density	Low-density
Undergrowth	Bracken, Fern, A party of Scleria levis, Macarangaspp. Height of Bracken 3. 0m, A party of Scleria levis 3. 0m
Forest type	E (Low-height forest)
Remarks	Secondary forest (A mark of forest fire)

Plot No,22		DBH	①	②	③	④	Remarks
15cm~		22	18				
		28	22				
		26	19				
		20	21				
	Total	96	80				
	Average	24	20				
~14cm	Species	6					
		6					
		5					
	Average height 10m	10					
		6					
	① Tree height	12					
	② Clear length	7					
	③ Top end doameter	7					
	④ Commercial volume	7					
		9					
		12					
		7					
		7					
		7					
	Average (cm)	7.7143					

Unit of DBH and top end diameter is (cm)
Unit of tree height is (m)



Date	8/13/93
Plot No,	22
Elevation	420m
inclination	Slope land /24°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	10YR5/6	Poor	Nil	Little crumb	Little dry	Nil	Nil	Rich	5.4	
B1	10YR6/8	Nil	Nil	Massive	Little wet	Nil	Nil	Middle	5.2	
B2	7.5YR5/8	Nil	Nil	Massive	Little wet	Nil	Nil	Nil	5.2	

Plot No,22 Soil profile and Result of soil survey (Natunal forest)

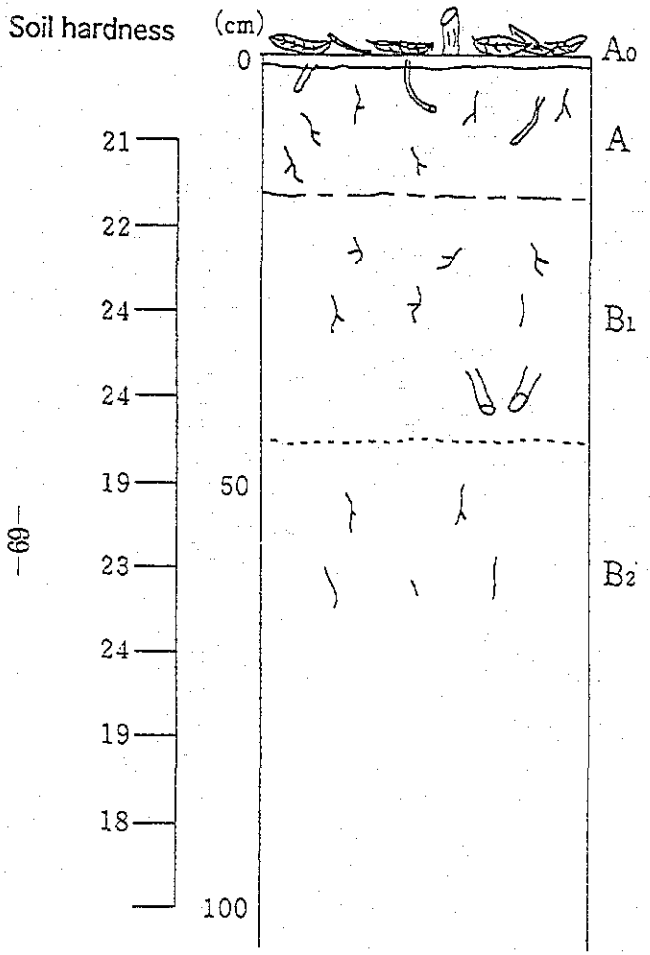
Plot No,23 Result of natural forest inventory

Date	8/12/93
Plot No.	No, 23
Area	
Elevation	310m
Land condition	Slope land
Bearing	NE
Inclination	15°
Dominant species	
Crown density	Low-density
Undergrowth	A party of Alpiniaspp. A party of Scleria levis, Bracken.
Forest type	E (Low-height forest)
Remarks	Pioneer plants, Banana

Plot No,23	Species		DBH	①	②	③	④	Remarks
30cm~	Membuakat	Paranephelium nitidum	40	36	13	22	0.9812	
	Selangan Batu Hitam	Shorea atrinervosa	52	43	8	40	1.3295	
	Mempening	Lithocarpus sp or Quercus sp.	38	32	12	20	0.7926	
	Obah	Eugenia sp.	31	30	12	22	0.6619	
		Total	161	141	45	104	3.7652	
		Average	40.25	35.25	11.25	26	0.9413	
		Volume / ha (m3)					37.652	
20~29cm	Obah	Eugenia sp.	23	24				
	Sireh-Sireh	Pternandra coerulescens	26	16				
		Average	24.5	20				
5~19cm	Topou		8	9				
	Topou		6	7				
	Topou		7	8				
	Tambong	Geunsia pentandra	18	13				
	Tambong	Geunsia pentandra	14	13				
	Randagong	Trema orientalis	5	5				
	Pakudita	Alphitonia incana	7	6				
	Topou		5	5				
	Ara Belukar	Ficus sp.	6	8				
	Ara Belukar	Ficus sp.	5	4				
		Average	8.1	7.8				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



Date	8/16/93
Plot No,	23
Elevation	310m
inclination	Slope land (gently) /15°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	5YR5/8	Poor	Nil	Crumb	Wet	Nil	Nil	Poor	5.6	
B1	5YR5/8	Very poor	Nil	Massive	Wet	Nil	Nil	Poor	5.4	
B2	5YR5/8	Very poor	Nil	Massive	Wet	Nil	Nil	Poor	5.4	

Plot No,23 Soil profile and Result of soil survey (Natunal forest)

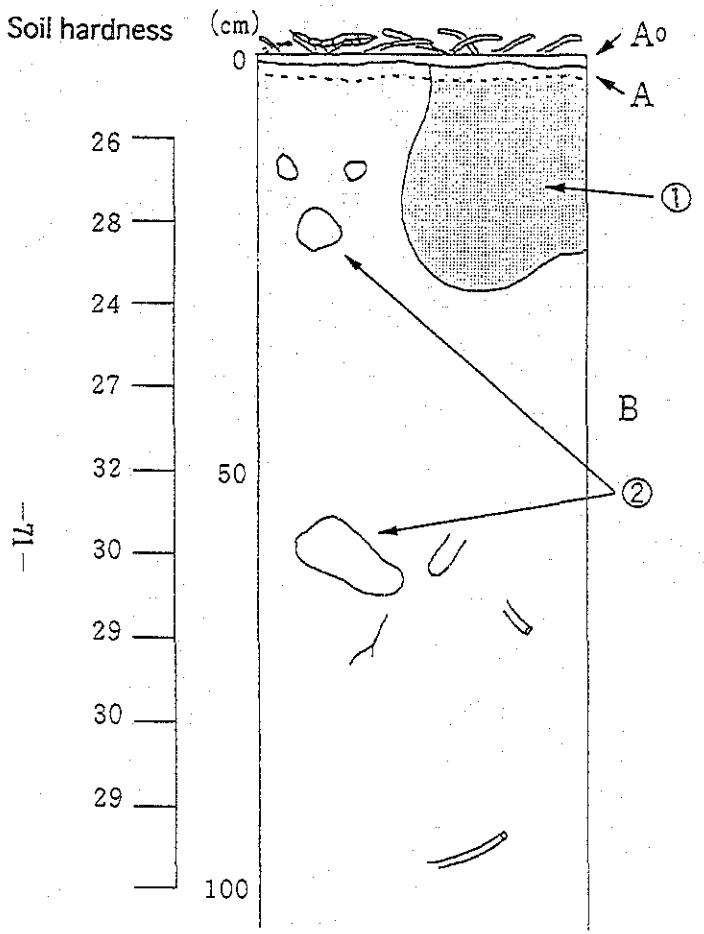
Plot No,24 Result of natural forest inventory

Date	8/19/93
Plot No.	No. 24
Area	Kg. Marak Parak
Elevation	610m
Land condition	Slope land
Bearing	ENE
Inclination	15°
Dominant species	
Crown density	Low-density
Undergrowth	
Forest type	D (Middle-heigh forest)
Remarks	

Plot No,24	Species		DBH	①	②	③	④	Remarks
30cm~	Randagong	Trema orientalis	43	20	6	32	0.6627	
	Sedaman	Macaranga sp.	32	19	8	26	0.5284	
		Total	75	39	14	58	1.1911	
		Average	37.5	19.5	7	29	0.5955	
		Volume / ha (m3)					11.911	
20~29cm	Topou		25	17				
	Randagong	Trema orientalis	25	20				
	Sedaman	Macaranga sp.	25	18				
	Randagung	Trema orientalis	26	22				
	Randagung	Trema orientalis	24	17				
	Sedaman	Macaranga sp.	26	18				
	Sedaman	Macaranga sp.	24	18				
		Average	25	18.571				
5~19cm	Sedaman	Macaranga sp.	6	9				
	Topou		6	5				
	Topou		8	9				
	Topou		13	9				
	Topou		10	9				
	Topou		8	8				
	Topou		7	8				
	Topou		9	10				
	Topou		6	7				
	Topou		10	12				
	Topou		11	14				
	Topou		14	12				
	Sedaman	Macaranga sp.	5	9				
	Sedaman	Macaranga sp.	14	15				
	Topou		9	15				
	Sedaman	Macaranga sp.	8	9				
	Sedaman	Macaranga sp.	5	7				
	Linkabong	Macaranga tanarius	1	18				
	Topou		5	14				
	Topou		15	17				
		Average	8.5	10.8				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



①Colour 7.5YR 5/3
Soil hardness 20
②Weathering sandstone

Date	8/16/93
Plot No,	24
Elevation	600m
inclination	Slope land

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	7.5YR7/4	Poor	Nil	Crumb	Dry	Nil	Nil	Poor	5.6	
B	7.5YR6/6	Poor	Breccia	Granular	Dry	Nil	Nil	Poor	5.6	

Plot No,24 Soil profile and Result of soil survey (Natunal forest)

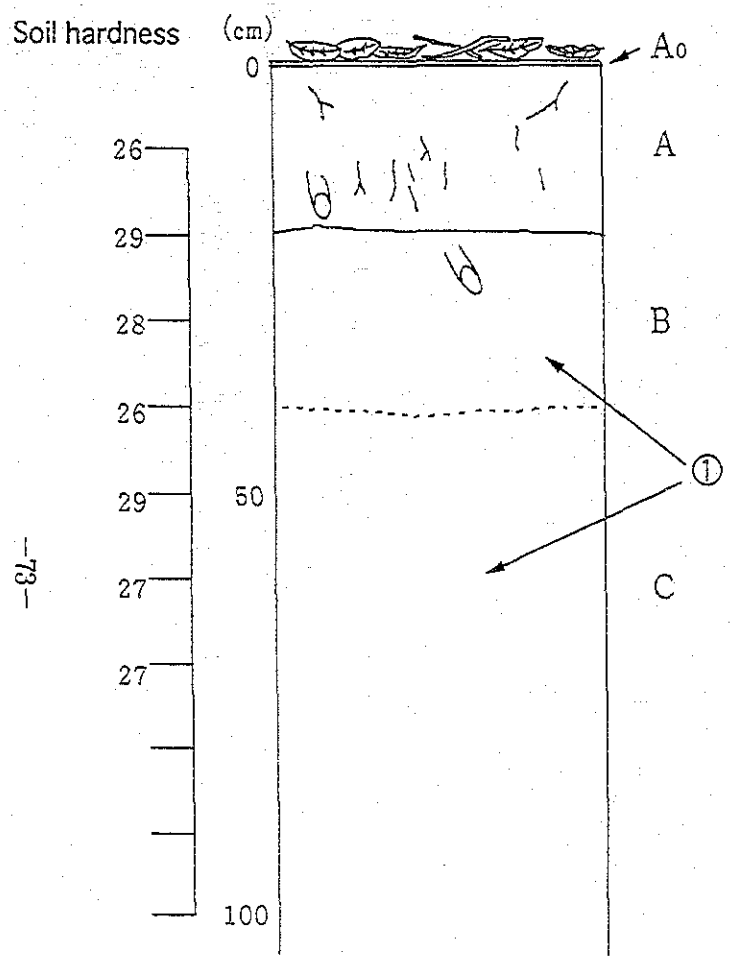
Plot No,25 Result of natural forest inventory

Date	8/16/93
Plot No.	No. 25
Area	Kg. Ulu Kukut
Elevation	250m
Land condition	Slope land
Bearing	NW
Inclination	5°
Dominant species	
Crown density	Low-density
Undergrowth	A party of Scleria levis, A party of Alpinia spp, A party of Lygodium spp. A party of Smilax spp.
Forest type	D (Middle height forest)
Remarks	

Plot No,25	Species		DBH	①	②	③	④	Remarks
30cm~	Tamborg	Geunsia pentandra	40	25	8	33	0.8371	
		Total	40	25	8	33	0.8371	
		Average	40	25	8	33	0.8371	
		Volume / ha (m3)					8.3708	
20~29cm	Pakudita	Alphitonia incana	24	14				
	Pakudita	Alphitonia incana	21	24				
	Monompuru	Actinodaphne sp.	21	20				
	Tombung	Geunsia pentandra	27	16				
	Tangkapon		20	17				
	Kulimpapa	Vitex pubescens	25	15				
	Pakudata	Alphitonia incana	22	19				
	Pakudata	Alphitonia incana	22	20				
		Average	22.75	18.125				
5~19cm	Penatan	Aporusa elmeri	14	15				
	Bagil	Aporusa nitida	11	14				
	Marambalawan		6	8				
	Topou		8	12				
	Penatan	Aporusa elmeri	14	18				
	Penatan	Aporusa elmeri	15	18				
	Lindos	Lindara pipericarpa	18	20				
	Bagil	Aporusa nitida	5	9				
	Bagil	Aporusa nitida	5	11				
		Average	10.667	13.889				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4\{(r1+r2)/2\}^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



①Ferrous integration

Date	8/17/93
Plot No,	25
Elevation	250m
inclination	Slope land (gently) /5°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	5YR5/2	Poor	Nil	Massive	Wet	Nil	Nil	Poor	5.6	
B	5YR7/2	Poor	Nil	Massive	Wet	Nil	Nil	Nil	5.2	
C	5YR6/4	Poor	Poor	Massive	Wet	Nil	Nil	Nil	5.4	

Plot No,25 Soil profile and Result of soil survey (Natunal forest)

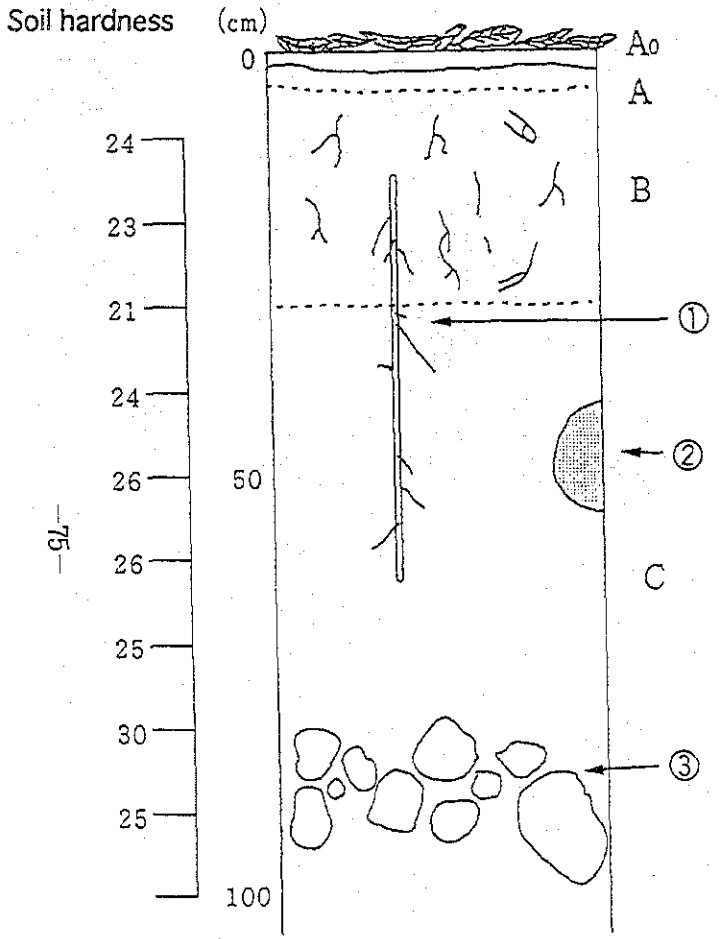
Plot No,26 Result of natural forest inventory

Date	8/17/93
Plot No.	No, 26
Area	Kg. Ulu Kukut
Elevation	630m
Land condition	Slope land (gently)
Bearing	N
Inclination	5°
Dominant species	
Crown density	Low-density
Undergrowth	A party of Alpiniaspp., BananaRattan. Aparty of Scleria levis (very few)
Forest type	B
Remarks	

Plot No,26	Species		DBH	①	②	③	④	Remarks
30cm~	Rengas	Melanorrhoea wallichii	38	29	10	26	0.8042	
	Resak	Vatica or Cotylelobium sp.	34	30	14	22	0.8621	
	Resak	Vatica or Cotylelobium sp.	44	36	15	32	1.7012	
	Seraya Kuning Barun	Shorea xanthophylla	34	28	15	20	0.8588	
	Nyatoh	Ganua,Madhuca,Palaquium,Payena	72	35	20	50	5.8449	
	Medang	Cinnamomum parthenoxylon	20	23	8	18	0.2268	
	Obah Nasi	Glochidion sp.	36	32	20	24	1.4137	
	Seraya Kuning Barun	Shorea xanthophylla	33	32	8	26	0.5468	
	Kembang	Horitiera simplicifolia	60	38	13	52	3.2019	
	Seraya Kuning Barun	Shorea xanthophylla	52	35	24	40	3.9886	
	Takalis Daun Halus	Pentace laxiflora	35	36	15	28	1.169	
	Obah	Eugenia sp.	52	43	25	40	4.1548	
	Medang	Cinnamomum parthenoxylon	54	40	20	42	3.6191	
	Takalis Daun Halus	Pentace laxiflora	35	27	7	30	0.5807	
		Total	599	464	214	450	28.973	
		Average	42.786	33.143	15.286	32.143	2.0695	
		Volume / ha (m3)					289.73	
20~29cm	Medang	Cinnamomum parthenoxylon	20	23				
	OT		21	12				
	Saeraya Kuning Barun	Shorea xanthophylla	28	28				
	Kembang	Horitiera simplicifolia	20	25				
		Average	22.25	22				
5~19cm	Kiras	Koilodepus longifolium	18	16				
	Katok	Stemonurus scorpioides	8	7				
	Obah Nasi	Glochidion sp.	13	12				
	Giewei	Ryporosa acuminata	8	13				
	Nyatoh	Ganua,Madhuca,Palaquium,Payena	8	12				
	Sedaman	Macaranga sp.	8	10				
	Ara Belukar	Ficus sp.	14	16				
	Takalis Daun Halus	Pentace laxiflora	11	13				
	Tampoi	Baccaurea sp.	6	7				
	Rengas	Melanorrhoea wallichii	5	6				
	Burut-Burut	Ervatamia macrocarpa	14	12				
	Seraya Kuning Barun	Shorea xanthophylla	8	10				
	Takalis Daun Halus	Pentace laxiflora	8	10				
	Seraya Kuning Barun	Shorea xanthophylla	6	8				
	Macaranga	Macaranga sp.	6	7				
		Average	9.4	10.6				

※ ① Tree height
② Clear length
③ Top end doameter
④ Commercial volume

Volume equation $V=\pi/4[(r1+r2)/2]^2 \cdot l/10000$
V : ④ r1 : DBH r2 : ③ l : ②
Unit of DBH and top end diameter is (cm)
Unit of tree height and clear length is (m)
Unit of volume is (m3)



Date	8/17/93
Plot No,	26
Elevation	630m
inclination	Slope land

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	7.5YR6/6	Poor	Nil	Granular	Dry	Nil	Nil	Poor	5.4	
B	7.5YR6/7	Poor	Nil	Massive	Wet	Nil	Nil	Poor	5.2	
C	7.5YR6/8	Poor	Poor	Massive	Wet	Nil	Nil	Poor	5.2	

①Root
②Nest of Isoptera
③Sand stone

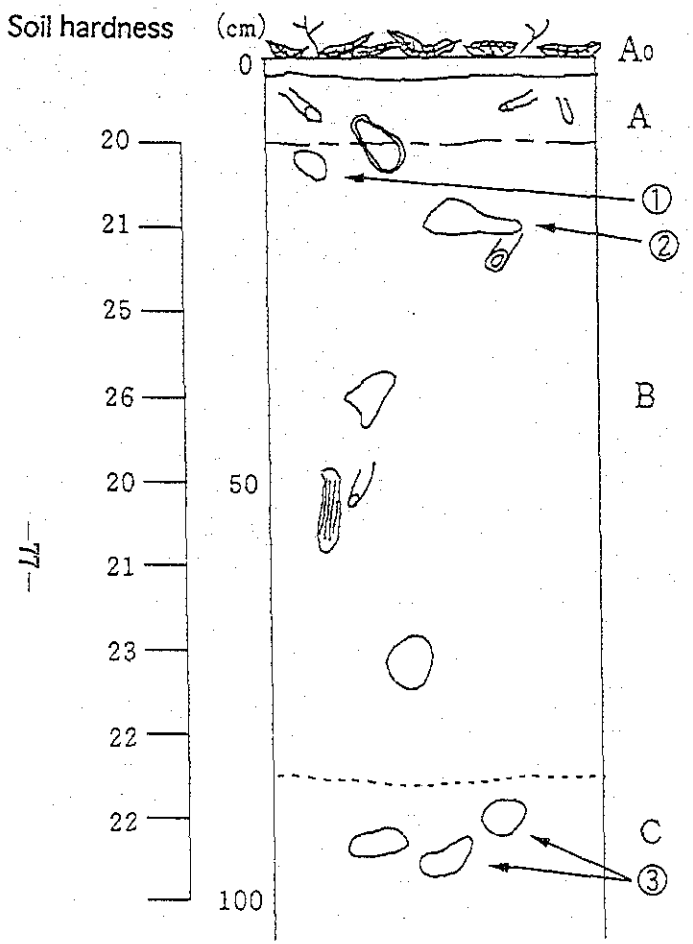
Plot No,26 Soil profile and Result of soil survey (Natunal forest)

Plot No,27 Result of natural forest inventory

Date	8/20/93
Plot No.	No, 27
Area	Kg. Tindek
Elevation	380m
Land condition	Slope land
Bearing	SW
Inclination	18°
Dominant species	
Crown density	密
Undergrowth	Melastoma, A party of Scleria levis, small Braken, Rattan.
Forest type	F (Srub forest)
Remarks	

Plot No,27	Species	DBH	①	②	③	④	Remarks
30cm~	Nil						
20~29cm	Nil						
5~19cm		5	5				
	① Tree height	5	4				
	② Clear length	5	6				
	③ Top end doameter	5	4				
	④ Commercial volume	10	11				
		6	7				
		6	4				
		7	5				
		5	5				
		13	13				
		5	4				
		5	3				
	Average	6.4167	5.9167				

Unit of DBH and top end diameter is (cm)
Unit of tree height is (m)



①Damar
②Hole
③Sand stone

Date	8/20/93
Plot No,	27
Elevation	380m
inclination	Slope land/18°

Horizon	Colour	Humus	Gravel	Structure	Moisture	Illuvation	Mycorrhiza	Root	pH	Remark
A	10YR5/4	Middle	Nil	Crumb	Little wet	Nil	Nil	Poor	5.4	
B	10YR7/8	Poor	Nil	Massive	Wet	Nil	Nil	Poor	5.2	
C	10YR7/8	Poor	Sand stone	Massive	Wet	Nil	Nil	Nil	4.8	

Plot No,27 Soil profile and Result of soil survey (Natunal forest)

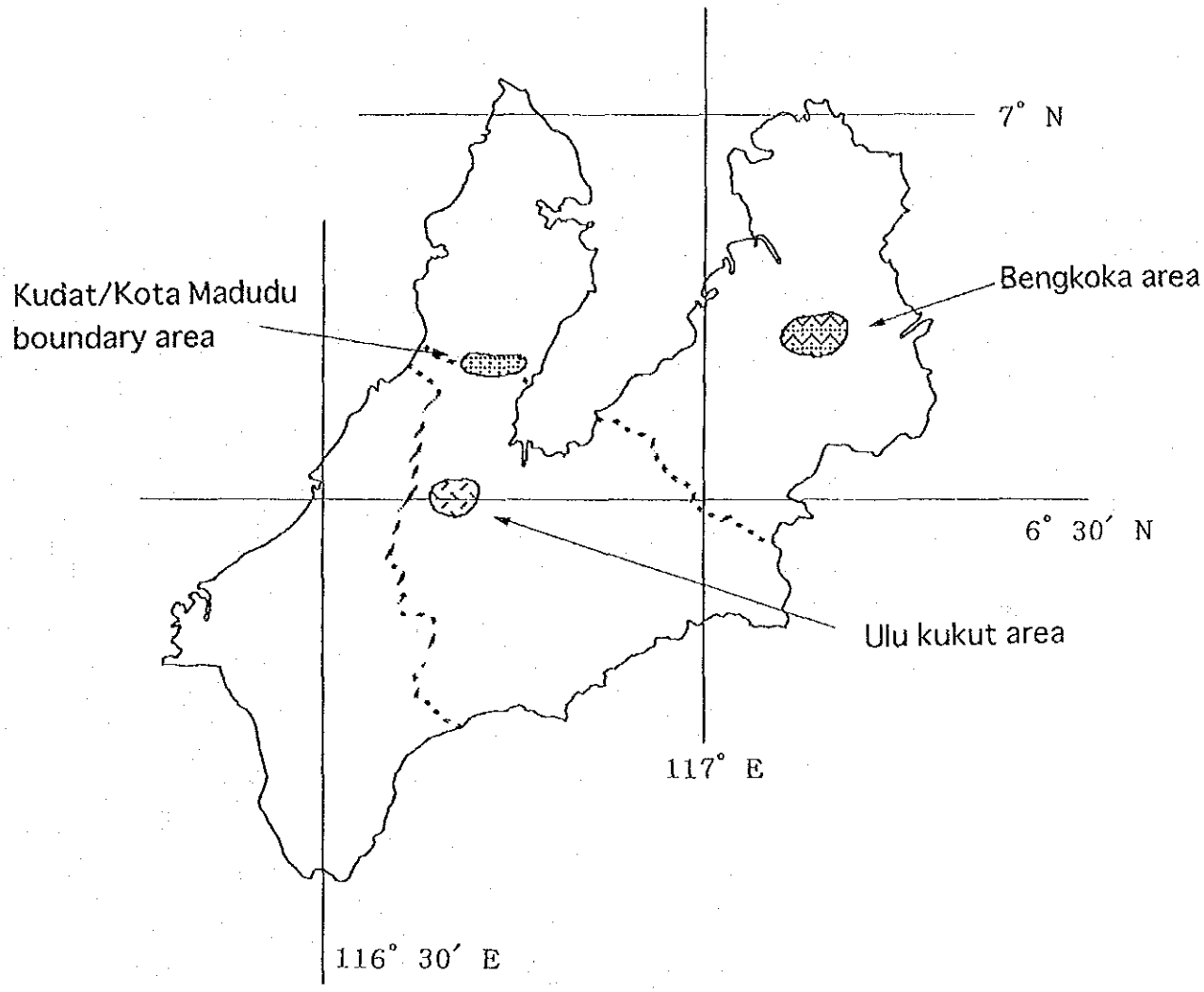


Fig. 19 Location Map of Artificial Forest and Soil Survey in Phase I–2

Table 3 Summary of Artificial Forest Inventory in Phase I-2

Plot No,	place	planted age	remarks	volume / ha (m3)	tree heiht (m)
Plot No,1	Bengkoka	1986.Dec. (7.5years)	fertilizing(planted)	157.579	18.00
Plot No,2	Bengkoka	1987.Feb. (6.5years)	fertilizing(planted)	169.618	18.00
Plot No,3	Bengkoka	1985.Nov. (7.8years)	fertilizing(planted)	153.735	17.00
Plot No,4	Bengkoka	1983.Dec. (9.7years)		184.723	19.00
Plot No,5	Bengkoka	1983.Dec. (9.7years)	50%thinning(1987)	168.953	19.28
Plot No,6	Bengkoka	1988.Jan. (5.6years)		79.204	13.08
Plot No,7	Bengkoka	1981.Oct. (11.9years)		152.140	20.29
Plot No,8	Bengkoka	1983.Dec. (9.7years)		145.544	16.80
Plot No,9	Bengkoka	1983.Dec. (9.7years)		86.774	14.67
Plot No,10	Bengkoka	1981~2. (11.6years)	50%thinning(1987)	123.862	20.23
Plot No,11	Bengkoka	1982~3. (10.6years)		129.798	19.31
Plot No,12	Bengkoka	1984~5. (8.6years)	50%thinning(1988)	96.160	18.88
Plot No,13	Bengkoka	1987.Dec. (5.8years)	50%thinning(1987)	96.863	18.09
Plot No,14	Bengkoka	1982~3. (10.6years)		91.423	17.40
Plot No,15	Bengkoka	1988.Feb. (5.5years)	thinning	90.904	17.00
Plot No,16	Ulu Kukut	1968. (25years)	Pinas caribaea	277.700	19.00
Plot No,17	Ulu Kukut	1983.natural regeneration(10years)	forest fire (1983)	126.987	15.00
Plot No,18	Ulu Kukut	1971~2. (21.6years)	hybrid (A.mangium & A.auricaliformis)	231.950	18.00
Plot No,19	Ulu Kukut	1985.Oct. (7.年10years)		114.778	15.00
Plot No,20	Ulu Kukut	1983.natural regeneration(10years)	forest fire (1983)	178.984	16.00
Plot No,21	Ulu Kukut	1986.Oct.~Dec. (6.9years)		86.260	18.00
Plot No,22	Ulu Kukut	1983.natural regeneration(10years)	hybrid (A.mangium & A.auricaliformis)	213.705	21.00
Plot No,23	Kudat/Kota Marudu	1990.natural regeneration(3years)	Re-generation	82.159	10.00
Plot No,24	Kudat/Kota Marudu	1986.Dec. (6.7years)		154.213	18.00
Plot No,25	Kudat/Kota Marudu	1986.Dec. (6.7years)	weeding every a half year (total 3 times)	144.119	18.00
Plot No,26	Kudat/Kota Marudu	1984.Jan. (9.6years)	weeding every a half year (total 3 times)	215.560	21.00
Plot No,27	Kudat/Kota Marudu	1983.natural regeneration(10years)	forest fire (1983)	188.666	19.00
Plot No,28	Kudat/Kota Marudu	1983.natural regeneration(10years)	forest fire (1983)	151.163	19.00
Plot No,29	Kudat/Kota Marudu	1983.natural regeneration(10years)	forest fire (1983)	225.026	18.00
Plot No,30	Kudat/Kota Marudu	1980.natural regeneration(13years)		218.993	24.00
Plot No,31	Kudat/Kota Marudu	1980.natural regeneration(13years)		152.001	23.00
Plot No,32	Kudat/Kota Marudu	1980.natural regeneration(13years)		246.521	22.00

average in Bengkoka	128.485	17.80
average in Ulu Kukut (contain Pinas caribaea & Hybrid)	175.766	17.43
average in Ulu Kukut (except Pinas caribaea & Hybrid)	126.752	16.00
average in Ulu Kukut (only Pinas caribaea)	277.700	19.00
average in Ulu Kukut (only Hybrid)	222.828	19.50
average in Kudat / Kota Marudu	177.842	19.20

Volume equation for SAFODA

$$V = \alpha 1 \cdot D^{\alpha 2} \cdot H^{\alpha 3}$$

V : Actual volume under bark (m3)
D : D・B・H (cm)
H : Tree heiht (m)
$\alpha 1, \alpha 2, \alpha 3$: Parameter
$\alpha 1$: 0.000113
$\alpha 2$: 1.7840
$\alpha 3$: 0.7772

(source : Acacia mangium tree volume and taper - November 1988,W.j.Hayward, NZFP Forest Limited, P.8)

Following tables are similar.