FINAL PROJECT REPORT PRESENTED TO THE
INTERNATIONAL TROPICAL TIMBER ORGANISATION (ITTO)

PROJECT PD 10/87 (F)

FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA

SUBMITTED BY
FORESTRY DEPARTMENT HEADQUARTERS
PENINSULAR MALAYSIA
KUALA LUMPUR

SEPTEMBER 1994

ERRATA TO FINAL REPORT

(ITTO/MAL PD 10/87 (F))

The attached pages and sections are to replace the similar pages and sections of the Final Report as errors were found in these sections.

We apologize for the inconvenience.

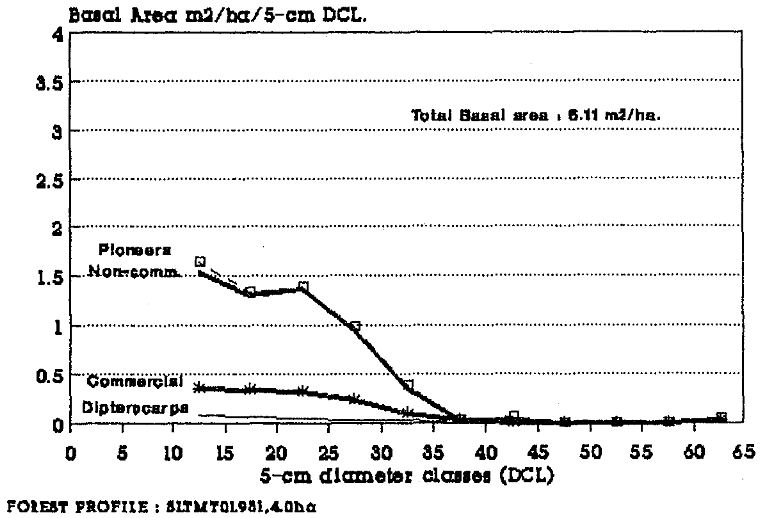
The Forestry Department Headquarters, Kuala Lumpur, Malaysia

May 1995.

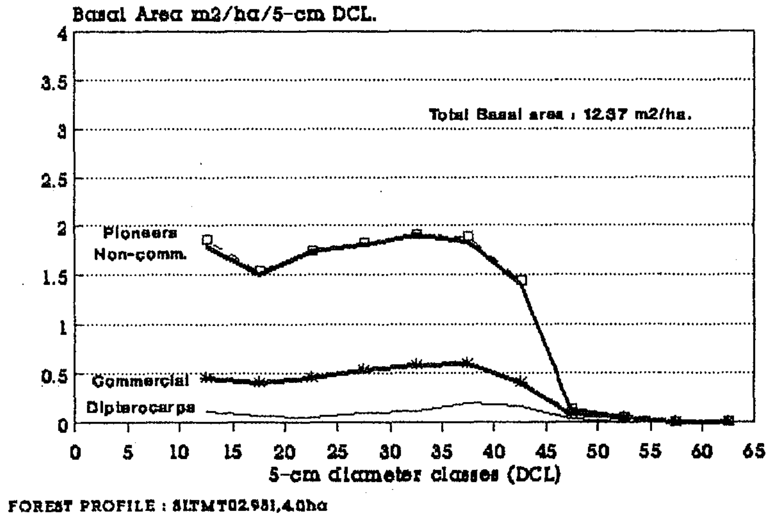
Svend Korsgaard

Svend Korsgaard
(ITTO consultant)

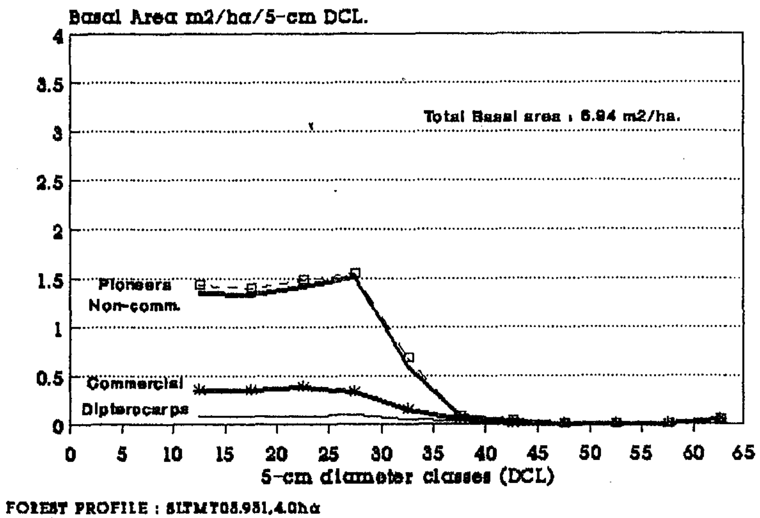
H.S. SG. LALANG Cpt. 50
Treatment 01 : CUT ALL)= 30 cm.



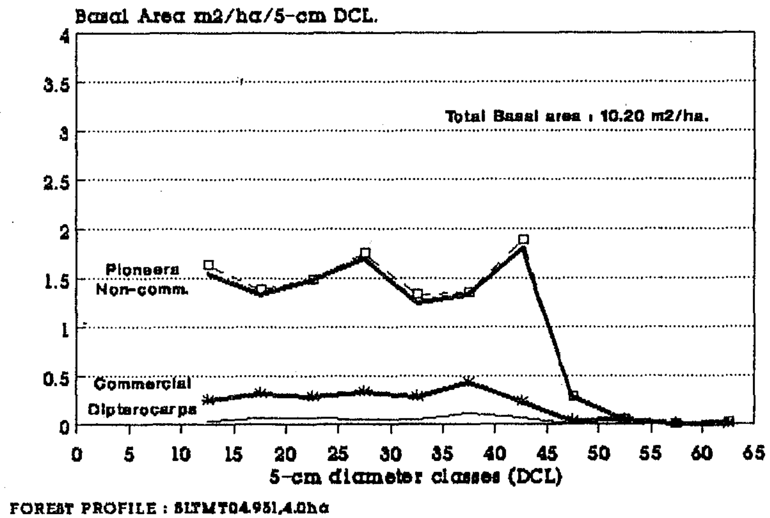
H.S. SG. LALANG Cpt. 50.
Treatment 02 : CUT ALL) = 45 cm.



H.S. SG. LALANG Cpt. 50
Tmt 03 : CUT DIPT)= 35 cm/N.DIPT)= 30 cm



H.S. SG. LALANG Cpt. 50
Tmt 04 : CUT DIPT)= 50 cm/N.DIPT)= 45 cm



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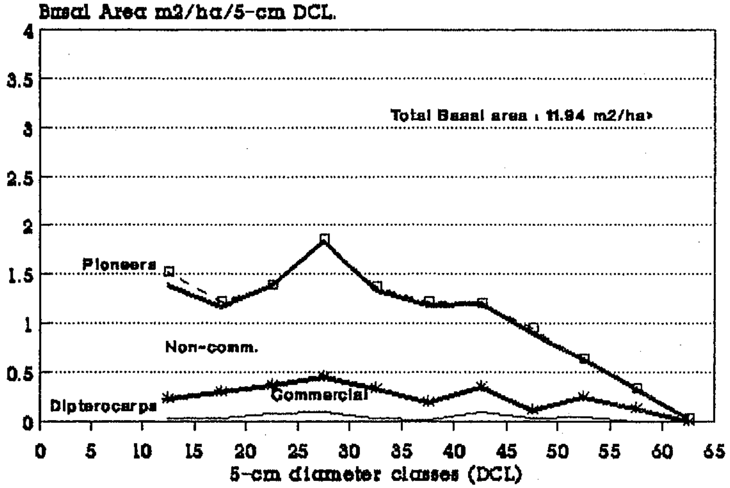
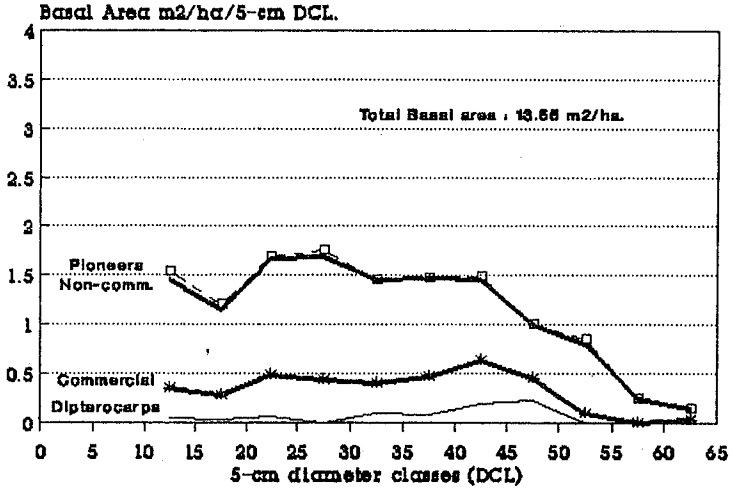
H.S. SG.LALANG Cpt. 50
Tmt 05 : CUT DIPT)= 65 cm/N.DIPT)= 60 cm



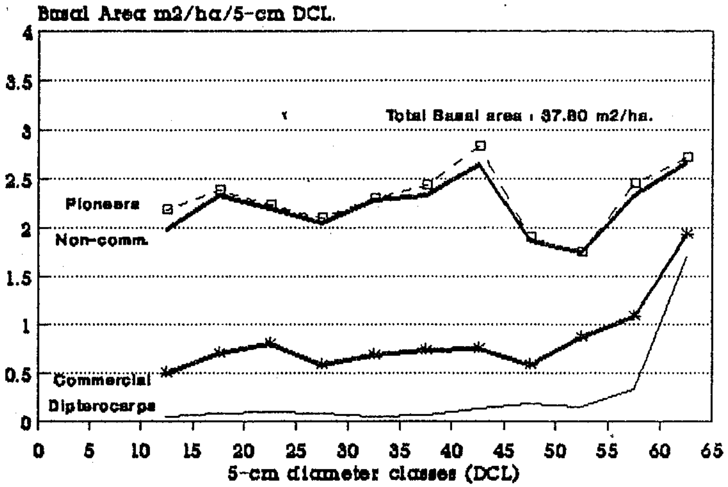
FOREST PROFILE : SLTMT05.951,4.0ha

H.S. SG. LALANG Cpt. 50
Tmt 06 : CUT DIPT)= 75 cm/N.DIPT)= 70 cm



FOREST PROFILE : SLTMT06.951,4.8ha

H.S. SG. LALANG Cpt. 50
Tmt 08 : NO LOGGING, VIRGIN CONTROL.



FOREST PROFILE : SLTMT08.951,4.0ha

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Correction to page 23, section 6.0 Data Analysis.

Please replace with the following section:

6.0 DATA ANALYSIS

Data collected from the study areas are continously entered into computer. A data management system for the project has been developed through an international ITTO consultancy. Computer programmes in FORTRAN have been written to edit, tabulate and analyse the data. In particular, attention is given to analyse the growth parameters such as diameter increment, mortality and the amount of new recruits under the different treatments as advocated by the studies. The programmes are duly documented and manuals for their use prepared, see Appendix D.

... KLEDANG SAIONG FOREST RESERVE, PERAK
FOR THE PERIOD OF 1991 – 2003

TREATMENT BLOCK	BLOCK NO	ENUMERATION/MEASUREMENT										REMARKS
		FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH	
CLIMBER/LIANA	02	JAN/91	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
CUTTING (CL)	07	JAN/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	Enumeration/measurement is carried out once
	08	JAN/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	a year for the first five years.
	15	JAN/91	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
POISON–GIRDLED	01	NOV/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
OF TREES AND	12	DEC/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	Enumeration/measurement is carried out once
CLIMBER/LIANA	13	DEC/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	a year for the first five years.
CUTTING (GCL)	16	DEC/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
GCL AND	03	JAN/91	*AUG/NOV/91	@JAN/OCT/92	#OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	1. Enumeration I – 3 month after planting
ENRICHMENT	05	JAN/91	AUG/DEC/91	JAN/OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	2. Enumeration II – 6 month after Enumeration I
PLANTING (EP)	09	JAN/91	AUG/DEC/91	JAN/OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	3. Enumeration III – 6 month after Enumeration II
	19	JAN/91	AUG/NOV/91	JAN/OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	4. The next enumeratiop is done for every year/two years
PLANTATION	04	DEC/90	*AUG/91	*JAN/92	#OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	1. Enumeration I – 3 month after planting
	11	DEC/90	AUG/91	JAN/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	2. Enumeration II – 6 month after Enumeration I
	14	JAN/91	AUG/91	JAN/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	3. Enumeration III – 6 month after Enumeration II
	17	JAN/91	AUG/91	JAN/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	4. The next enumeration is done for every year/two years
CONTROL	06	FEB/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
	10	FEB/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	Enumeration/measurement is carried out once
	18	FEB/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	a year for the first five years.
	20	MAC/91	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	

NOTES: TREATMENTS OF ENRICHMENT PLANTING AND PLANTATION

* = I. Replanting/refilling
II. Cleaning of planting lines
III. Poison–girdled of non–RS species on planting lines

@ = I. Replanting/refilling (if survival rate less than 80%)
II. Cleaning of planting lines

= II. Cleaning of planting lines
III. Poison–girdled of non–RS species which shaded the planting lines

Pruning = First pruning : 5 years after planting
Second pruning : 8 years after planting
Third pruning : 10 years after planting

PPSW/B4/A:PSP–194.WK3

Replace APPENDIX VII

... SCHEDULE OF PERMANENT SAMPLE PLOT
JOINT PROJECT BETWEEN MALAYSIA/ITTO, COMPARTMENT 39, CERUL FOREST RESERVE, TERENGGANU
FOR THE PERIOD OF 1991 – 2005

TREATMENT BLOCK	BLOCK NO	ENUMERATION/MEASUREMENT										REMARKS
		FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH	
CLIMBER/LIANA	01	OCT/91	JUL/94	JUL/95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/04	JUL/06	
CUTTING (CL)	12	SEPT/91	AUG/94	AUG/95	AUG/96	AUG/97	AUG/98	AUG/00	AUG/02	AUG/04	AUG/06	Enumeration/measurement is carried out once
	16	JUN/91	AUG/94	AUG/95	AUG/96	AUG/97	AUG/98	AUG/00	AUG/02	AUG/04	AUG/06	a year for the first five years.
	20	OCT/91	JUL/94	JUL/95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/06	JUL/06	
POISON–GIRDLED	08	JUN/91	AUG/94	AUG/95	AUG/96	AUG/97	AUG/98	AUG/00	AUG/02	AUG/04	AUG/06	
OF TREES AND	11	SEP/91	SEP/94	SEP/95	SEP/96	SEP/97	AUG/98	SEP/00	SEP/02	SEP/04	SEP/06	Enumeration/measurement is carried out once
CLIMBER/LIANA	15	JUL/91	SEP/94	SEP/95	SEP/96	SEP/97	AUG/98	SEP/00	SEP/02	SEP/04	SEP/06	a year for the first five years.
CUTTING (GCL)	18	AUG/91	AUG/94	AUG/95	AUG/96	AUG/97	AUG/98	AUG/00	AUG/02	AUG/04	AUG/06	
GCL AND	07	*MAY91/FEB92	@SEP93/JUL94	#JUL94/JUL95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/04	JUL/06	1. Enumeration I – 3 month after planting
ENRICHMENT	10	JUL91/FEB92	OCT94/AUG94	JUL94/JUL95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/04	JUL/06	2. Enumeration II – 6 month after Enumeration I
PLANTING (EP)	13	AUG91/FEB92	SEP93/JUL94	JUL94/JUL95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/04	JUL/06	3. Enumeration III – 6 month after Enumeration II
	19	OCT91/FEB92	SEP93/SEP94	JUL94/JUL95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/04	JUL/06	4. The next enumeration is done for every year/2 years.
PLANTATION	02	APR/93	SEP/93	JUN/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	1. Enumeration I – 3 month after planting
	03	APR/93	SEP/93	JUL/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	2. Enumeration II – 6 month after Enumeration I
	04	APR/93	SEP/93	JUL/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	3. Enumeration III – 6 month after Enumeration II
	06	APR/93	SEP/93	JUN/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	4. The next enumeration is done for every year/2 years.
CONTROL	05	JUL/91	JUL/94	JUL/95	JUL/96	JUL/97	JUL/98	JUL/00	JUL/02	JUL/04	JUL/06	
	09	MAR/92	AUG/94	AUG/95	AUG/96	AUG/97	AUG/98	AUG/00	AUG/02	AUG/04	AUG/06	Enumeration/measurement is carried out once
	14	JUL/91	SEP/94	SEP/95	SEP/96	SEP/97	SEP/98	SEP/00	SEP/02	SEP/04	SEP/06	a year for the first five years.
	17	FEB/92	AUG/94	AUG/95	AUG/96	AUG/97	AUG/98	AUG/00	AUG/02	AUG/04	AUG/06	

NOTES: TREATMENTS OF ENRICHMENT PLANTING AND PLANTATION

* = i. Replanting/refilling
ii. Cleaning of planting line
iii. Poison–girdled of non–RS species on planting line

@ = i. Replanting/refilling (if survival rate less than 80%)
ii. Cleaning of planting line

\# = ii. Cleaning of planting line
iii. Poison–girdled of non–RS species which shaded the planting line

Pruning = First pruning : 5 years after planting.
Second pruning : 8 years after planting.
Third pruning : 10 years after planting.

PPSWB8/A:PSP–39.WK3

Replace APPENDIX VIII

2.2 Girdling And Poisoning Of Trees (G)

2.2.1 The trees to be frill-girdled are as follows :-

i) Deformed RS species with diameter >45 cm (broken, hollow, knots, crocked), if they shade the RS trees.

ii) Others species (non-RS species) if :-

a) Deformed (broken, hollow, knots, crocket, which shade the RS seedlings; and

b) Bushy, heavy crown having diameter <30 cm which is not capable of producing logs of at least 5 m in length.

2.2.2 Palm tree such as Eugeissona triste (Bertam) and Arenga westerboutii (Langkap) which shade RS species have to be felled and poisoned, namely :-

i) Eugeissona triste (Bertam) fronds should be cut and put them in one place. Then poured the poison into it base or culm; and

ii) Arenga westerhoutii (Langkap) and other stemmed palms should be cut whereby a small hole can be made in their trunks to facilitate poisoning.

2.2.3 Fruit trees such as Parkia speciosa (Petai), Durio zibethinus (Durian), Baccaurea spp. (Rambai), Figs (Ara), Pithecellalobium bubalinum (Kerdas), Bouea spp. (Kundang), Lansium domesticum (Langsat) and Nephelium spp. (Rambutan) are not to be felled and poisoned. Bamboos (Buluh) Fern (Resam) or open area are left untreated.

3.0 PREPARATION BEFORE CARRY OUT 'CL' OR 'G'

3.1 Prior to the treatment, the group leader have to carry out reconnaisance of the study area to confirm the boundries and base lines and to determine the camping sites.

3.2 Group leaders or supervisors who will be carrying out the 'CL' or 'G', have to :-

i) To get instruction and written guidelines regarding treatment procedures to be carried out, in the

Insert Appendix F, page 3 of Species list.

20920	Keruing pipit	Dipterocarpus fagineus
20921	Keruing ropol	Dipterocarpus hasseltii
20922	Keruing sarawak	Dipterocarpus sarawakensis
20923	Keruing sendok	Dipterocarpus concavus
21001	Kapur	Dryobalanops aromatica
21002	Keladan	Dryobalanops oblongifolia
21101	Balau	Shorea spp. (Balau group)
21102	Balau bukit	Shorea foxworthyi
21103	Balau gajah	Shorea submontana
21104	Balau gunong	Shorea astylosa
21105	Balau hitam	Shorea atrinervosa
21106	Balau kumus	Shorea laevis
21107	Balau kumus hitam	Shorea maxwelliana
21108	Balau kuning	Shorea falcifera
21109	Balau laut	Shorea glauca
21110	Balau laut merah	Shorea kunstleri
21111	Balau membatu	Shorea guiso
21112	Balau membatu jantan	Shorea ochrophloia
21113	Balau merah	Shorea collina
21114	Balau pasir	Shorea materialis
21115	Balau putih	Shorea lumutensis
21116	Balau sengkawang ayer	Shorea sumatrana
21117	Balau sengkawang darat	Shorea scrobiculata
21118	Balau tembaga	Shorea exelliptica
21201	Chengal	Neobalanocarpus heimii
21301	Giam	Hopea nutans (Giam)
21302	Giam bayan	Hopea pachycarpa
21303	Giam hantu	Hopea coriacea
21304	Giam jantan	Hopea semicuneata
21305	Giam kanching	Hopea subalata
21306	Giam lintah bukit	Hopea helferi
21307	Giam malut	Hopea ferrea
21308	Giam melukut	Hopea apiculata
21309	Giam palong	Hopea pierre
21310	Giam rambai	Hopea polyalthioides
21401	Resak	Cotylelobium spp. & Vatica spp
21402	Resak bukit	Cotylelobium malayanum
21403	Resak tempurong	Cotylelobium melanoxylon
21404	Resak buah kana	Vatica ridleyana
21406	Resak daun runcing	Vatica cuspidata
21407	Resak degong	Vatica havilandii
21408	Resak gajah	Vatica sp. 'A'
21409	Resak gunong	Vatica heteroptera
21410	Resak julong	Vatica mangachapoi
21411	Resak kecil	Vatica pallida
21412	Resak keluang	Vatica belia
21413	Resak langgong	Vatica scortechinii
21414	Resak laru	Vatica pauciflora
21415	Resak laut	Vatica cinerea
21416	Resak letop	Vatica venulosa
21417	Resak lidi	Vatica maingayi
21418	Resak mempening	Vatica stapfiana
21419	Resak padi	Vatica flavida
21420	Resak paya	Vatica lobata

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INTERNATIONAL TROPICAL TIMBER ORGANISATION (ITTO)

PROJECT PD 10/87 (F)

FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA

Table of contents

EXECUTIVE SUMMARY

The project entitled "Forest Management of Natural Forest in Malaysia" was the first ITTO project implemented by Malaysia. This project which was approved by the Third Session of the ITTC held in Yokohama, Japan in November, 1987 became operational in August, 1988 and was completed in December, 1993.

The project had been successfully implemented with its major outputs achieved. This project which aims to study the response of residual stand under various management regimes in two (2) virgin forest areas and the regeneration capacity of dipterocarp forest under various silvicultural treaments in two (2) logged-over forest areas had resulted in the establishment of four (4) study areas, one each in the states of Pahang, Perak, Selangor and Terengganu. A total of 32 and 20 permanent sample plots of size 100 m x 100m (1 hectare) each were established in the virgin and logged-over forest areas respectively. All these permanent sample plots had been enumerated ranging from one to four times.

In the course of the project implementation, the project had encountered a number of problems and identified various deficiencies which need to be addressed in order to ensure the future usefulness and effectiveness of the project. In addition, the project has also strengthened the collaboration among the various forestry institutions which are involved in the project implementation.

In this report, only preliminary results are presented. The reasons being at the point of report preparation, not all data collected from the four (4) study areas have been entered into the computer and the need for these data to be verified and edited before they are ready for analysis.

Due to the long-term nature of this kind of project, a longer time frame would be required before definite trends in the development and recovery of the forest could be demonstrated. In view that the results of this project would not only benefit the forestry sector in Malaysia, but also other ITTO member countries having similar forest conditions towards achieving ITTO Objective Year 2000 of sustainable tropical forest management, it is recommended that this project be extended to Phase II.

I. INTRODUCTION

In November, 1987, Malaysia submitted a project proposal entitled "Forest Management of Natural Forest in Malaysia" for consideration and funding by the International Tropical Timber Organisation (ITTO). The project which was proposed under the Reforestation and Forest Management Programme was subsequently approved by the Third Session of the International Tropical Timber Council (ITTC) held in Yokohama, Japan from 11 - 20 November, 1987 for immediate implementation and financing with conditions/recommendations that certain amendments be made to the Project Document. The Session also agreed that the project should commence at the beginning of 1988.

Pursuant to the recommendations by the Permanent Committee on Reforestation and Forest Management, members from the Forestry Department Headquarters, Peninsular Malaysia; Forest Research Institute, Malaysia; and the Forestry Faculty, University of Agriculture, Malaysia met at the Ministry of Primary Industries, Malaysia on 9 January, 1988 to discuss the necessary amendments to be made to the Project Document. Another meeting was held on 23 January, 1988 to discuss in detail the contents of the Agreement Document between Malaysia and ITTO. The revised version of the Project and Agreement Documents were resubmitted to ITTO by the Ministry of Primary Industries, Malaysia on 11 February, 1988.

On 8 August, 1988, the Government of Malaysia and ITTO signed the Project and Agreement Documents in Kuala Lumpur, Malaysia. The total ITTO's contribution to the project was US$272,353 with US$25,000 being earmarked for the purpose of project monitoring and review by ITTO for the first three (3) years of the project while Malaysia's contribution was estimated at US$322,795 to be spread over a period of ten (10) years.

In addition, during the Eleventh ITTC Session which was held from 28 November to 4 December, 1991 in Yokohama, Japan, ITTO had approved the extension of the activities of the project until December, 1993 and an additional budget of US$ 180,000 was allocated to carry out the following activities:-

(i) engage an international consultant to develop a data management system to ensure the analysis of data collected under the project (US$ 30,000); and

(ii) conduct an international seminar to disseminate the project results (US$ 150,000).

As at the end of project implementation, only funding for activity (i) had been received and the activity was undertaken from April to July, 1993. Funding for activity (ii) was not made available.

II. OBJECTIVE

(a) Development Objective

To develop appropriate forest management systems so as to optimize the management objectives of equitable returns to both logger and forest owner; sustainability of the tropical rain forest and minimum forest development cost consistent with the need to safeguard environmental quality and ecological balance; and to take advantage of the tropical timber markets.

(b) Immediate Objective

The immediate objectives are fourfold which are as follows:-

i) to examine in detail the distribution of natural regeneration and the response of residual stand under various management (felling) regimes in two (2) virgin forest areas;

ii) to increase the understanding of the regeneration capacity of the dipterocarp forest under various silvicultural treatments in two (2) logged-over forest areas;

iii) to conduct comprehensive study in the establishment of forest plantation of indigenous tree species; and

iv) to contribute to the formulation and implementation of sound silvicultural forest management systems for the dipterocarp forest in Peninsular Malaysia.

III. BACKGROUND AND JUSTIFICATION

The tropical rain forest of Malaysia is one the most complex ecosystems in the world. It is a unique natural heritage which has evolved over millions of years, and is rich and varied in plant and animal life. There are over 8,000 species of flowering plants of which 2,500 are tree species; well over 200 species of mammals; 600 species of birds; about 110 species of snakes; 80 species of lizards and thousands of species of insects.

The tropical rain forest is not only a vast reservoir of untapped natural resources but more importantly an essential life support system. It has been an integral and vital part of the environment and an important source of food, fuel and materials for satisfying the basic needs of the people since time immemorial. In recent years, tropical forest resources have contributed significantly to the socio-economic development of many countries. Consequently there is a growing awareness of the importance and need to manage these forest resources sustainably.

In Malaysia, systematic forest management had been practised since the beginning of this century when the first Forest Officer was appointed in 1901. The earlier silvicultural forest management systems were primarily concerned with improving the existing timber crop for future production. Very few timber species were harvested and trees were felled selectively according to the requirements of good forest management, such as the removal of over-mature trees and trees that might compete with the favoured species.

With growing market for tropical hardwoods and a corresponding growth in sawmilling operations after Second World War, the Malayan Uniform System (MUS) was formulated. The MUS consists of removing the mature crop in one single felling of all trees down to 45 cm diameter at breast height (dbh) for all species and releasing the selected natural regeneration of varying ages which are mainly the light demanding medium and light hardwood species. This felling operation is followed by climber cutting and poison girdling of defective relics and non-commercial species down to a minimum dbh of 15 cm. Approximately 5 to 7 years after felling a linear strip sampling is carried out to verify the presence of sufficient regeneration on the ground and subsequently to determine suitable silvicultural treatments. This system has been succesfully applied to the lowland dipterocarp forest but has been found to be unsuitable in the hill dipterocarp forest because of the comparatively more difficult terrain, uneven stocking and the sparse natural regeneration. Furthermore, the risk of erosion on steep slopes and the incidence of Bertam (*Eugeissona triste*) and secondary growth could be increased by such a drastic opening of the canopy.

One of the major shifts in emphasis with respect to the management of the Malaysian tropical rain forest is the realisation that the diversity of our flora and timber species need not necessarily be disadvantageous to future wood production policies and strategies of the nation. On the contrary a mixed forest crop offers the best cover for soil and water conservation and the wood-based industry should be able to utilize a wider spectrum of timber species in the future. Technological innovations and sophistications in wood processing coupled with the changing pattern of wood use in the forestry sector will render a lot of presently uncommercial timber species merchantable in the future, both in the domestic and export markets. Consequently, the concept of Selective Management System (SMS) was introduced in 1972 to allow for more flexible timber harvesting regimes which are consistent with the need to safeguard the environment and at the same time to take advantage of the demands of the timber market. More importantly, it discourages the poison girdling of a lot of presently uncommercial species which will not only conserve the wood but also the genetic resources available in the forest, both for the present and future generations.

Under the SMS, a pre-felling forest inventory is carried out to provide reliable estimates of the population parameters which are needed to formulate the optimum management regime. Tentatively, minimum cutting limits of at least 45 cm dbh for the non-dipterocarps and 50 cm dbh for the dipterocarp species have been advocated for an average forest. The cutting limits selected for a particular forest should ideally ensure a net economic outturn and leave a residual stocking equivalent to at least 32 trees per hectare of trees having diameter 30 cm dbh and above, which could grow into commercial size for the next cut. The conservational forest management approach adopted in Malaysia under the SMS is expected to have the following beneficial effects:-

(i) conserve the dwindling forest resource;

(ii) ensure sustainability of the resource base;

(iii) preserve environmental quality;

(iv) reduce excessive damage;

(v) reduce excessive wastage; and

(vi) induce optimal utilization.

To further investigate the possibility of relying on advanced growth to produce the next crop as is advocated under the SMS, the first of a series of Growth and Yield experiments to study the economic and silvicultural implications of using various logging intensities and cutting regimes was established in about 150 hectares of hill forest in the State of Terengganu in 1974. Since then, many more such study areas were established in the states of Kelantan, Pahang, Johor and Negeri Sembilan to study and quantify the effects of different intensities of logging in hill dipterocarp forests on:-

(i) the timber and volume outturn under different intensities of logging;

(ii) the different parameters describing the growth of trees and stands;

(iii) the early growth responses of trees and stands under different logging intensities; and

(iv) the development of some functional relationships between growth parameters and logging intensities.

All these studies were conducted in initial virgin forests and that all the plots under various logging intensities are not subjected to any silvicultural treatments after initiation of the study. Hence this project is viewed as an extension of the projects currently being undertaken by the Forestry Department Peninsular Malaysia to include both the virgin and logged-over forests as well as to study the effects of silvicultural treatments on the growth of the residual stand.

IV. EXPECTED PROJECT OUTPUTS

The following outputs are envisaged from the project:-

(i) establishment of an information (data) - base on the growth potential of two (2) virgin forest areas under various intensities of logging and the response of two (2) logged-over forest areas under different types of silvicultural treatments;

(ii) formulation of suitable/optimum silvicultural forest management systems based on the intrinsic differences of species composition, soil and topography and variation in growth rates, so as to achieve sustained timber production especially in the Hill Dipterocarp Forest;

(iii) trained local expertise in formulating appropriate management (felling) regimes in virgin forest areas and in implementing suitable silvicultural treatments in logged-over forest areas;

(iv) complementing the global efforts to conserve and improve the world's tropical forest resources and environment; and

(v) the establishment of four permanent study sites with subplots under different management regimes. These sites will also serve as demonstration, training, and research areas that will not only cater to Malaysia, but also to other ITTO member countries.

V. PROJECT IMPLEMENTATION

(a) Selection of Study Areas

A total of four (4) study areas; namely two (2) virgin forest areas and two (2) logged-over forest areas were selected for the project. The two (2) virgin forest areas are located in the States of Pahang and Selangor while the two (2) logged-over forest areas are located in the States of Perak and Terengganu. The locations of the four (4) study areas are as shown in **Figures 1** and **2**. As requested by ITTO, all the four (4) study areas had been approved by the respective State Governments to be set aside for the purpose of this project for a duration of at least ten (10) years at the following dates:-

Study Area	Approval date
1. Compartments 171 & 172, Lesong Forest Reserve, Pahang.	11 October, 1989.
2. Compartment 50, Sungai Lalang Forest Reserve, Selangor.	6 July, 1988.
3. Compartment 39, Cherul Forest Reserve, Terengganu.	26 July, 1989.
4. Compartments 194 & 205, Kledang Saiong Forest Reserve, Perak.	21 June, 1989

(b) Technical Working Group

In order to facilitate the implementation of the project, a Technical Working Group on Forest Management of Natural Forest in Malaysia (TWG) comprising members from the Forestry Department Headquarters, Peninsular Malaysia; Forest Research Institute, Malaysia; Forestry Faculty, University of Agriculture, Malaysia; ASEAN Institute of Forest Management; and representatives from the State Forestry Departments of Pahang, Perak, Selangor and Terengganu where the study areas are located was formed and had its first meeting on 2 December, 1987. Meetings of the TWG were found to be most useful in the project implementation, right from project formulation to implementation where all practical and technical decisions were made by the TWG. In total, 13 TWG meetings were held with the last meeting being held at the State Forestry Department, Perak on 19 August, 1993. As was the tradition of the TWG meeting, members of the TWG visited the ITTO project study area located at Compartments 194 and 205, Kledang Saiong Forest Reserve prior to the meeting on 18 August, 1993.

Figure 1: Location Map of Study Areas in Peninsular Malaysia

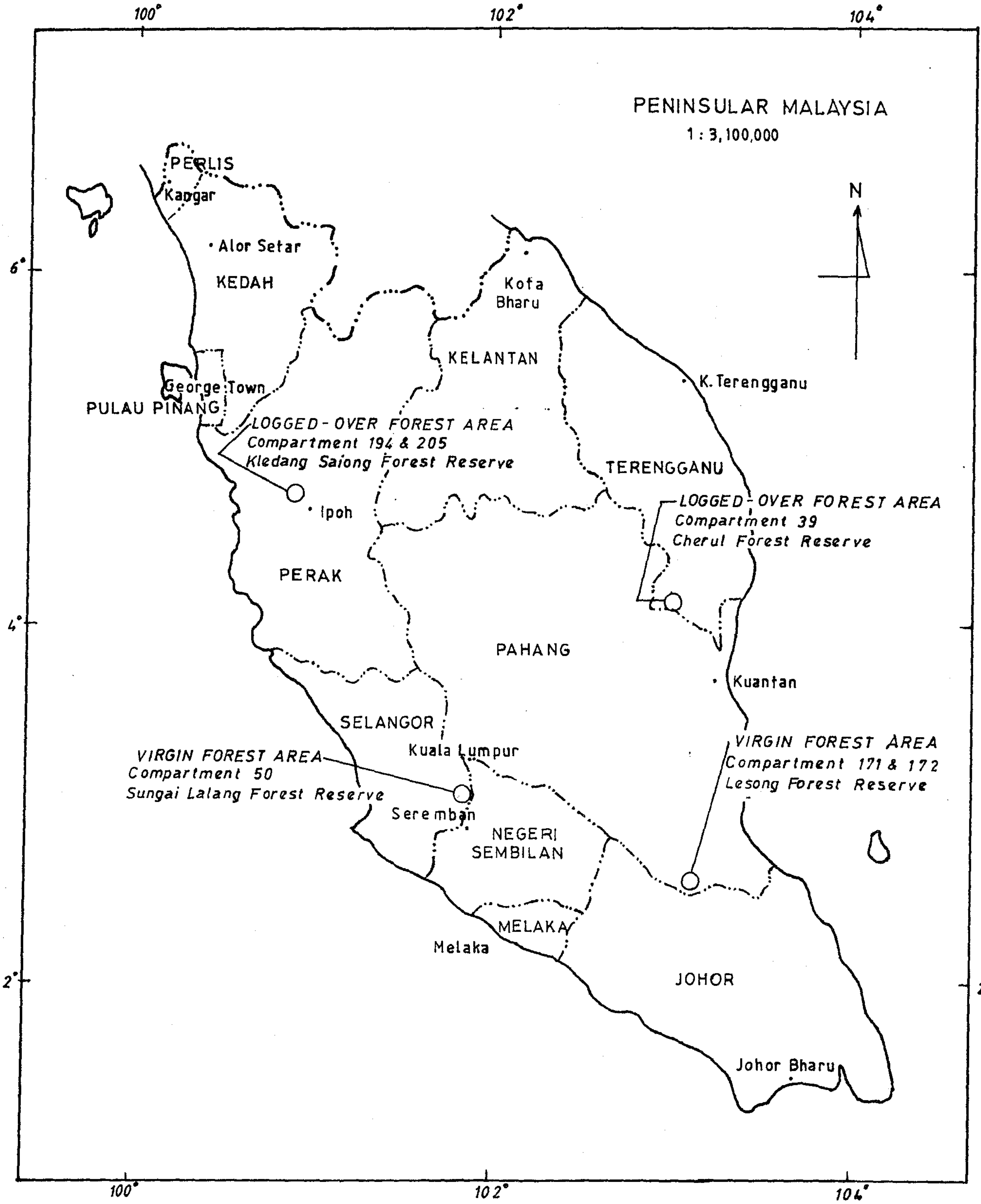
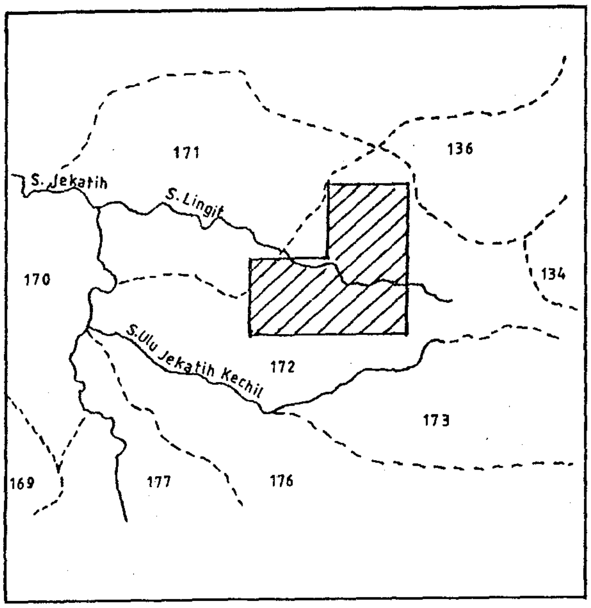
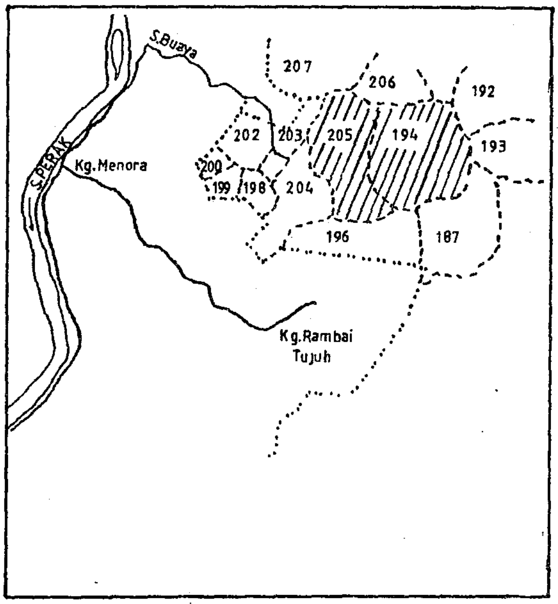


Figure 2: Detailed Location Map of Study Areas by States

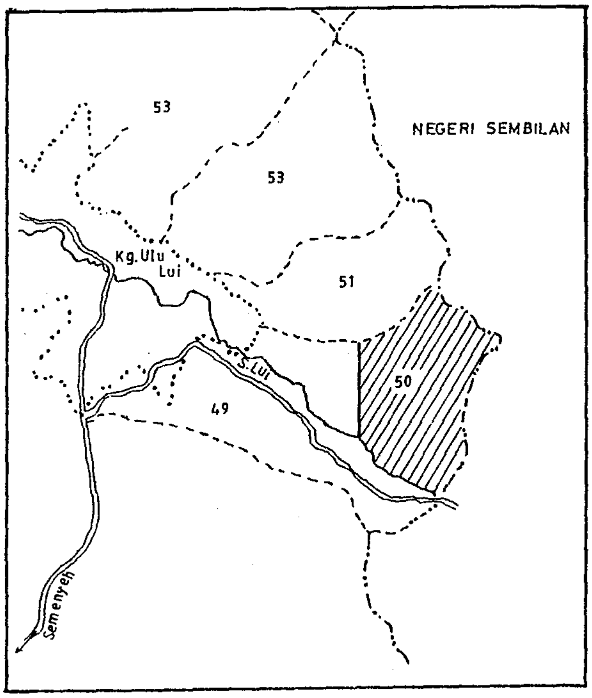
VIRGIN FOREST AREA
Compartment 171 & 172
Lesong Forest Reserve
Pahang
1:126,720



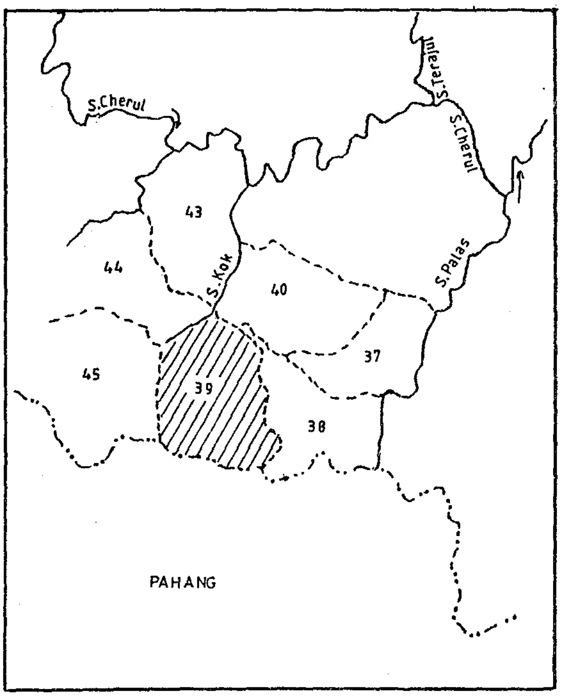
LOGGED - OVER FOREST AREA
Compartment 194 & 205
Kledang Saiong Forest Reserve
Perak
1:126,720



VIRGIN FOREST AREA
Compartment 50
Sungai Lalang Forest Reserve
Selangor
1:126,720



LOGGED - OVER FOREST AREA
Compartment 39
Cherul Forest Reserve
Terengganu
1:126,720



(c) **Physical Achievement**

The implementation of this project was based on the establishment procedures for the virgin and logged-over forest areas which were formulated by the TWG (**Appendices A** and **B**), as well as based on the Work Plan as outlined in ANNEX I of the project document. Under the Work Plan, a number of activities were scheduled to be carried out so as to achieve the intended outputs of the projects. In general, the project had been implemented successfully and according to schedule. The physical achievements of the project implementation for the virgin forest areas and logged-over forest areas are summarised in **Tables 1** and **2** respectively.

(d) **Data Analysis**

Through the project implementation, it was realised that the successful implementation of the project would entail the development of a data management system so as to ensure timely analysis of the data already collected under the project. In view of the complex nature of this project, it was felt that an international consultant should be engaged to undertake the task.

Hence a formal request was forwarded to the Eleventh Session of the ITTC and Ninth Session of the Permanent Committees to engage an international consultant for the task. The said Session which was held in Yokohama from 28 November to 4 December, 1991 approved the immediate release of an additional finance of US$30,000 soonest as it is being made available. The earmarked funding was made available during the Twelfth Session of the ITTC held in Yaounde, Cameroon from 6 - 14 May, 1992. Subsequently, Dr. Svend Korsgaard was engaged for the job for a duration of 3 months from 5 April to 4 July, 1993.

The consultancy had been successfully conducted with the following outputs achieved and documents produced:-

(i) Processing of forest research data: procedure for data entry (**Appendix C**);

(ii) A manual for the editing, maintenance and tabulation of enumeration data (**Appendix D**);

(iii) Suggestion for enhancement of the field enumeration (**Appendix E**); and

(iv) Manual of instructions for enumerating the permanent ITTO experimental plots (**Appendix F**).

Table 1 : Physical Achievement of Project Implementation in the two Virgin Forest Areas

Item	Activities	Date Completed	
		Pahang	Selangor
1.	Conduct Pre-Felling Forest Inventory (10%)	May, 1988	December, 1988
2.	Analysis of Pre-Felling forest inventory data by block	October, 1988	March, 1989
3.	Demarcation of forest area on the ground by block	June, 1989	May, 1989
4.	Tree marking for all trees to be felled based on prescribed cutting limits	June, 1989	September, 1989
5.	Felling of marked trees	June, 1990	August, 1991
6.	Setting up of 32 permanent sample plots	December, 1990	December, 1991
7.	Marking and tagging of sample trees (1st measurement)	July, 1991	February, 1992
8.	Selection of indigeous tree species and the establishment of plantation plots	March, 1989	November, 1991
9.	Refilling of seedling in plantation	August, 1991	-
10.	Carry out 2nd measurement	March, 1992	March, 1993
11.	Carry out 3rd measurement	February, 1993	-
12.	Carry out 4th measurement	December, 1993	-

Table 2 : Physical Achievement of Project Implementation in the two Logged-over Forest Areas

Item	Activities	Date Completed	
		Perak	Terengganu
1.	Conduct Post-Felling Forest Inventory (10%)	August, 1988	January, 1989
2.	Analysis of post-felling inventory data by block	May, 1989	February, 1990
3.	Stratification of study area into various basal area classes	May, 1989	February, 1990
4.	Demarcation of study areas into 20 blocks based on prescribed basal area classes	December, 1989	April, 1990
5.	Application of prescribed silvicultural treatments		
	(i) Girdling and climber cutting (GCL)	December, 1989	December, 1990
	(ii) Climber cutting (CL)	December, 1989	March, 1991
	(iii) Girdling and climber cutting and enrichment planting (GCL & EP)	March, 1990	December, 1990
	(iv) Plantation plots (PL)	June, 1992	June, 1990
6.	Establishment of 20 1-hectare permanent sample plots and conduct 1st measurement		
	(i) GCL plots	March, 1990	August, 1992
	(ii) CL plots	March, 1990	August, 1992
	(iii) EN plots	March, 1990	August, 1992
	(iv) PL plots	December, 1990	August, 1992
7.	Carry out 2nd measurement	September, 1991	August, 1993
8.	Carry out 3rd measurement	September, 1992	-
9.	Carry out 4th measurement	September, 1993	-

e) **Preliminary Results**

It is impossible at this juncture to present in detail the project findings. This is because not all data collected from the various study areas had been entered into the computer. Furthermore, all these data need to be verified and edited before they are ready for analysis. Hence only preliminary results of selected areas based on the immediate objectives of the project are described below:-

(i) species composition and the distribution of natural regeneration and the response of residual stand under various management regimes.

The species composition of the two (2) virgin forest areas by major species groups prior to forest harvesting based on the results of pre-felling forest inventory data for Pahang and Selangor are as shown in **Tables 3** and **4** respectively. Results of the studies indicated the predominance of the non-dipterocarp species which comprises 88 percent of the species composition. Detailed information on species composition for both study areas by blocks (32 of them) and species are also available and are currently being kept at Forest Management Unit, Forestry Department Headquarters, Peninsular Malaysia.

Both study areas were later subjected to harvesting based on the recommended management regimes (treatments). A total of eight (8) treatments were applied which are as follows:-

Treatment	Cutting Limit
01	Cut all trees $\geq$ 30 cm diameter at breast height (dbh);
02	Cut all trees $\geq$ 45 cm dbh;
03	Cut all dipterocarps $\geq$ 35 cm dbh and non-dipterocarps $\geq$ 30 cm dbh;
04	Cut all dipterocarps $\geq$ 50 cm dbh and non-dipterocarps $\geq$ 45 cm dbh;
05	Cut all dipterocarps $\geq$ 65 cm dbh and non-dipterocarps $\geq$ 60 cm dbh;
06	Cut all dipterocarps $\geq$ 75 cm dbh and non-dipterocarps $\geq$ 70 cm dbh;
07	Establishment of indigenous forest plantation (cut all trees $\geq$ 30 cm dbh); and
08	Control (no cutting).

Table 3: Species Composition by Major Species Groups and Diameter Class for the Virgin Forest Area in Pahang

Species Group		Diameter class (cm)						
		+15 - 30	+30 - 45	+45 - 50	+50 - 55	+55 - 60	+ 60	Total
I.Dipterocarp	a.	5.10	3.28	0.83	0.61	0.64	5.20	15.66
Meranti	b.	0.63	2.27	0.94	0.85	1.08	42.48	48.25
	c.	0.19	0.35	0.15	0.13	0.17	3.43	4.42
II.Dipterocarp	a.	1.03	0.27	0.07	0.07	0.02	0.32	1.78
Non-meranti	b.	0.12	0.18	0.08	0.10	0.04	2.26	2.78
(Light-hardwoods)	c.	0.04	0.03	0.01	0.02	0.01	0.18	0.29
III.Dipterocarp	a.	4.36	1.59	0.47	0.39	0.25	1.86	8.92
Non-meranti	b.	0.55	1.09	0.53	0.55	0.41	11.41	14.54
(Medium-hardwoods)	c.	0.17	0.17	0.08	0.09	0.06	0.94	1.51
IV.Dipterocarp	a.	1.27	0.39	0.02	0.05	0.07	1.00	2.80
Non-meranti	b.	0.17	0.27	0.03	0.07	0.13	8.44	9.11
(Heavy-hardwoods)	c.	0.05	0.04	0.00	0.01	0.02	0.68	0.80
V.Non-Dipterocarp	a.	28.63	5.81	1.03	0.59	0.69	2.18	38.93
(Light-hardwoods)	b.	16.46	3.83	1.17	0.83	1.15	14.67	38.11
	c.	2.01	0.59	0.18	0.13	0.18	1.22	4.31
VI.Non-Dipterocarp	a.	2.35	1.30	0.25	0.32	0.22	1.55	5.59
(Medium-hardwood)	b.	0.28	0.87	0.28	0.43	0.36	8.73	10.95
	c.	0.09	0.14	0.04	0.07	0.06	0.72	1.12
VII.Non-Dipterocarp	a.	2.11	0.66	0.12	0.15	0.27	1.47	4.78
(Heavy-hardwoods)	b.	0.28	0.44	0.14	0.22	0.46	9.71	11.25
	c.	0.09	0.07	0.02	0.03	0.07	0.80	1.08
VIII.Non-Dipterocarp	a.	113.77	27.67	5.17	2.33	2.16	4.95	156.05
(Partially	b.	12.97	18.46	5.88	3.27	3.64	26.22	70.44
Marketable)	c.	3.99	2.85	0.90	0.50	0.56	2.28	11.08
IX.Podo and Agathis Species.		-	-	-	-	-	-	-
	a.	11.76	5.53	1.39	1.12	0.98	8.38	29.16
Dipterocarp	b.	1.47	3.81	1.58	1.57	1.66	64.59	74.68
	c.	0.45	0.59	0.24	0.25	0.26	5.23	7.02
	a.	146.86	35.44	6.57	3.39	3.34	9.75	205.35
Non-Dipterocarp	b.	29.99	23.60	7.47	4.75	5.61	59.33	130.75
	c.	6.18	3.65	1.14	0.73	0.87	5.02	17.59
	a.	158.62	40.97	7.96	4.51	4.51	18.13	234.51
Total	b.	31.47	27.41	9.05	6.32	7.27	123.93	205.45
	c.	6.63	4.24	1.39	0.98	1.12	10.25	24.61

a: No. of trees per hectare

b: Gross volume per hetare (m^3)

c: Basal area per hectare (m^2)

Table 4: Species Composition by Major Species Groups and Diameter Class for the Virgin Forest Area in Selangor

		Diameter Class (cm)						
Species Group		+15 - 30	+30 - 45	+45 - 50	+50 - 55	+55 - 60	+ 60	Total
I.Dipterocarp	a.	2.90	2.46	0.72	0.65	0.68	8.53	15.94
Meranti	b.	26.90	1.72	0.82	0.90	1.14	78.96	110.44
	c.	2.15	0.27	0.13	0.14	0.18	6.35	9.22
II.Dipterocarp	a.	0.28	0.14	0.07	0.00	0.09	0.42	1.00
Non-meranti	b.	0.03	0.09	0.08	0.00	0.14	2.99	3.33
(Light-hardwoods)	c.	0.01	0.01	0.01	0.00	0.02	0.25	0.30
III.Dipterocarp	a.	0.49	0.23	0.05	0.00	0.09	0.56	1.42
Non-meranti	b.	23.45	0.16	0.06	0.00	0.15	3.13	26.95
(Medium-hardwoods)	c.	1.82	0.03	0.01	0.00	0.02	0.27	2.15
IV.Dipterocarp	a.	0.70	0.58	0.12	0.12	0.14	1.20	2.86
Non-meranti	b.	0.09	0.40	0.14	0.09	0.23	11.01	11.96
(Heavy-hardwoods)	c.	0.03	0.06	0.02	0.03	0.04	0.89	1.07
V.Non-Dipterocarp	a.	14.24	7.85	1.66	0.99	0.84	2.62	28.20
(Light-hardwoods)	b.	42.36	5.46	1.86	1.40	8.66	11.83	71.57
	c.	3.65	0.84	0.29	0.21	0.77	1.08	6.84
VI.Non-Dipterocarp	a.	1.99	2.74	0.58	0.24	0.21	1.00	6.76
(Medium-hardwood)	b.	0.31	1.98	0.64	0.34	0.33	5.12	8.72
	c.	0.09	0.30	0.10	0.05	0.05	0.46	1.05
VII.Non-Dipterocarp	a.	0.98	0.77	0.40	0.09	0.21	0.83	3.28
(Heavy-hardwoods)	b.	0.13	0.55	0.46	0.12	0.35	4.79	6.40
	c.	0.04	0.08	0.07	0.02	0.05	0.41	0.67
VIII.Non-Dipterocarp	a.	67.40	34.36	6.95	4.36	2.32	7.03	122.42
(Partially	b.	34.20	27.25	7.77	11.18	3.85	32.07	116.32
Marketable)	c.	4.60	3.92	1.20	1.32	0.59	2.99	14.62
IX.Podo and Agathis	a.	0.00	0.03	0.00	0.03	0.00	0.07	0.13
Species.	b.	0.00	0.02	0.00	0.05	0.00	0.71	0.78
	c.	0.00	0.00	0.00	0.01	0.00	0.06	0.07
	a.	4.37	3.41	0.96	0.77	1.00	10.71	21.22
Dipterocarp	b.	50.47	2.37	1.10	0.99	1.66	96.09	152.68
	c.	4.01	0.37	0.17	0.17	0.26	7.76	12.74
	a.	84.61	45.75	9.59	5.71	3.58	11.55	160.79
Non-Dipterocarp	b.	77.00	35.26	10.73	13.09	13.19	54.52	203.79
	c.	8.38	5.14	1.66	1.61	1.46	5.00	23.25
	a.	88.98	49.16	10.55	6.48	4.58	22.26	182.01
Total	b.	127.47	37.63	11.83	14.08	14.85	150.61	356.47
(All spesies)	c.	12.39	5.51	1.83	1.78	1.72	12.76	35.99

a: No. of trees per hectare

b: Gros volume per hectare (m^3)

c: Basal area per hectare (m^2)

Immediately after harvesting, 32 permanent sample plots (PSPs) measuring 100m by 100m (1 hectare) each were established in each study area to monitor the growth performance of the residual stand. The status of the forest immediately after harvesting by treatments is best reflected by graphical presentations (profile based on basal area) of the two (2) study areas based on enumeration data. Graphical presentations for the study areas in Pahang and Selangor based on the results of the second enumerations by treatments are as shown in **Figures 3** and **4**, respectively. The profile indicated clearly the effects of treatments on the residual stand. Examples of tabular presentation of results on mean number of trees, mean basal area and mean volume per hectare by diameter class for a selected treatment in the study area in Selangor are attached as **Tables 5, 6** and **7**, respectively.

(ii) Regeneration capacity of the dipterocarp forest under various silvicultural treatments in two logged-over forest areas.

The two logged-over forest areas are being subjected to the following silvicultural treatments:-

(i) Cutting of Liana (CL);

(ii) Girdling of trees and Cutting of Liana (GCL);

(iii) Girdling of trees and Cutting of Liana coupled with Enrichment Planting (GCL & EP);

(iv) Establishment of indigenous forest plantation; and

(v) Control (no treatment).

At this juncture, only data collected from the logged-over study area in the State of Perak had been partially analysed. The species composition of the study area by major species groups prior to the setting-up of this study based on the post-felling forest inventory is as shown in **Table 8**. Results of the inventory indicates the predominance of the non-dipterocarp species group which comprises about 82 percent of the species composition.

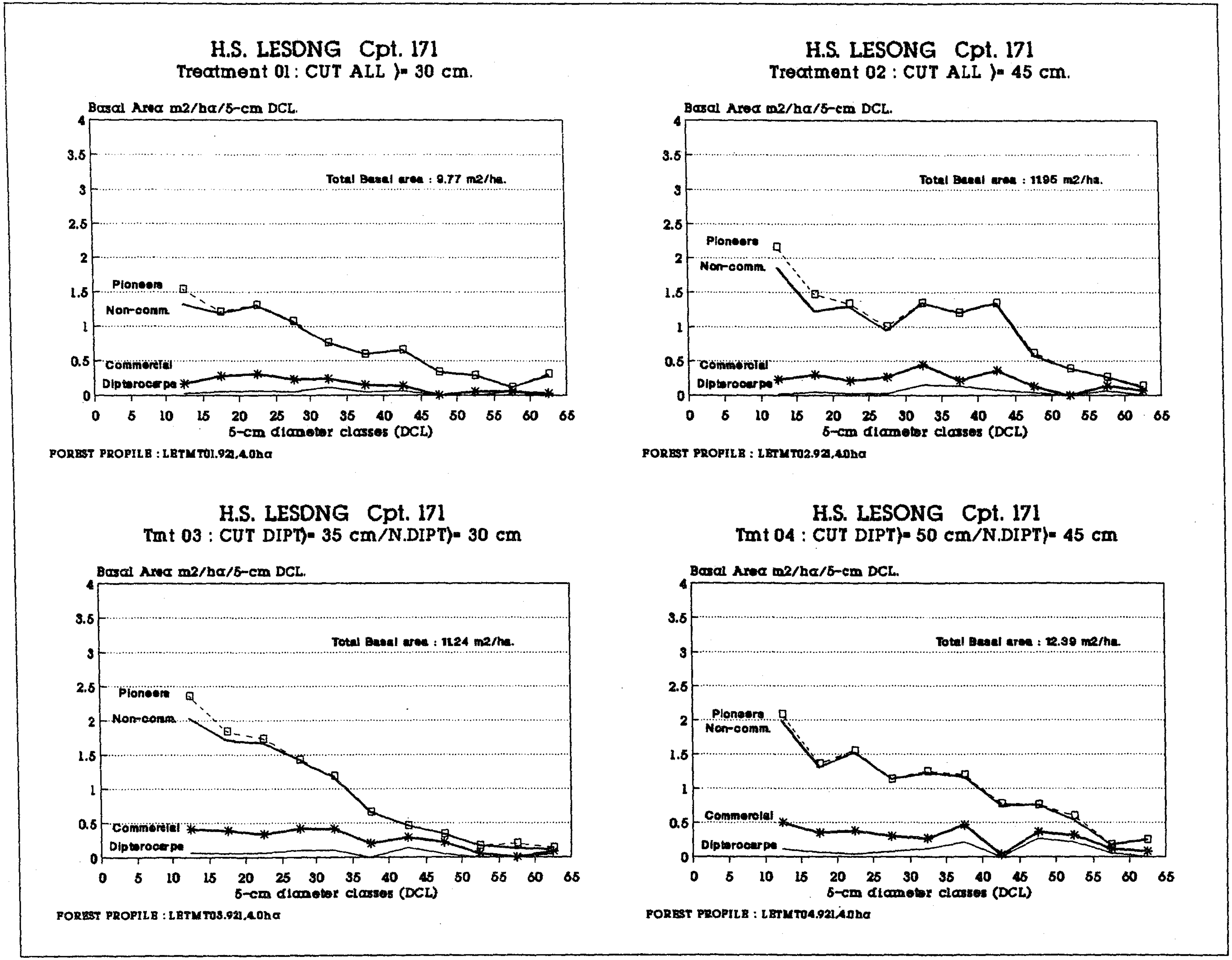
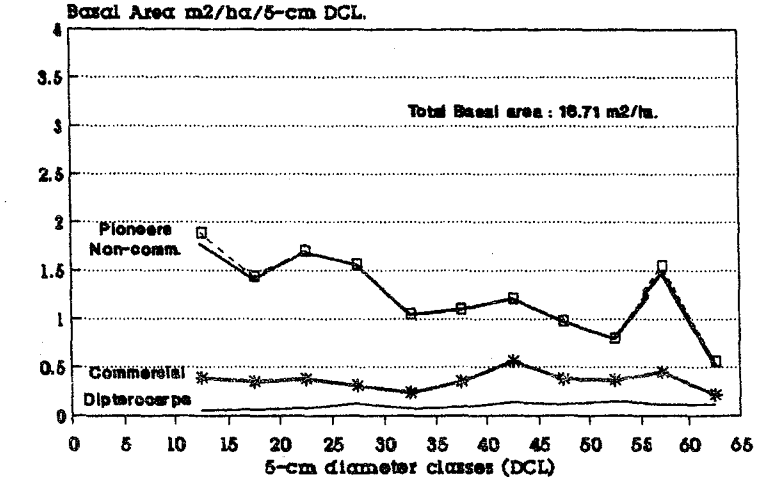


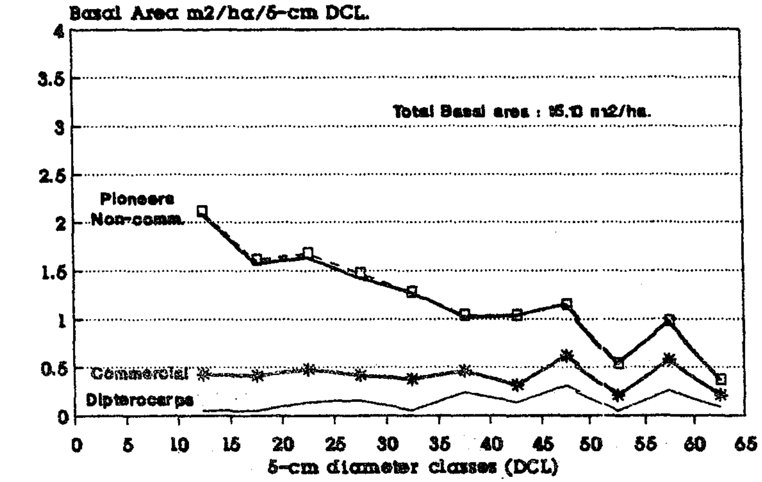
Figure 3: Profile of Study Area by Treatments based on Second Enumeration Data - Pahang

H.S. LESONG Cpt. 171
Tmt 05 : CUT DIPT)= 65 cm/N.DIPT)= 60 cm



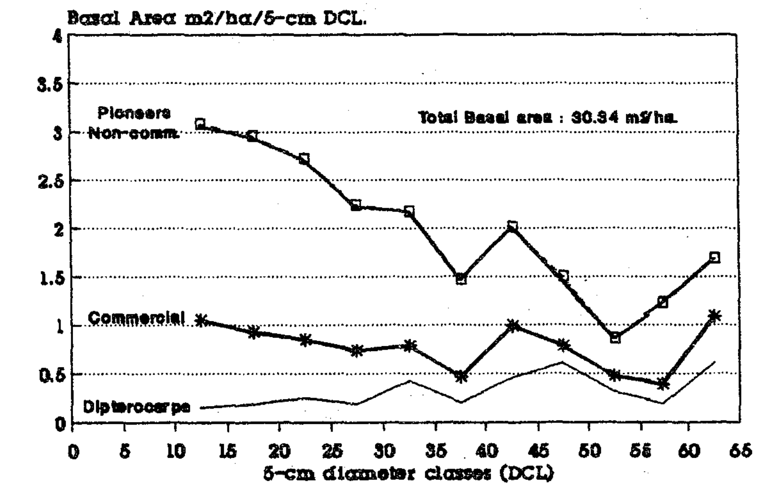
FOREST PROFILE : LETMT05.921.4.0ha

H.S. LESONG Cpt. 171
Tmt 06 : CUT DIPT)= 75 cm/N.DIPT)= 70 cm



FOREST PROFILE : LETMT06.921.4.0ha

H.S. LESONG Cpt. 171
Tmt 08 : NO LOGGING, VIRGIN CONTROL



FOREST PROFILE : LETMT08.921.4.0ha

Cont...

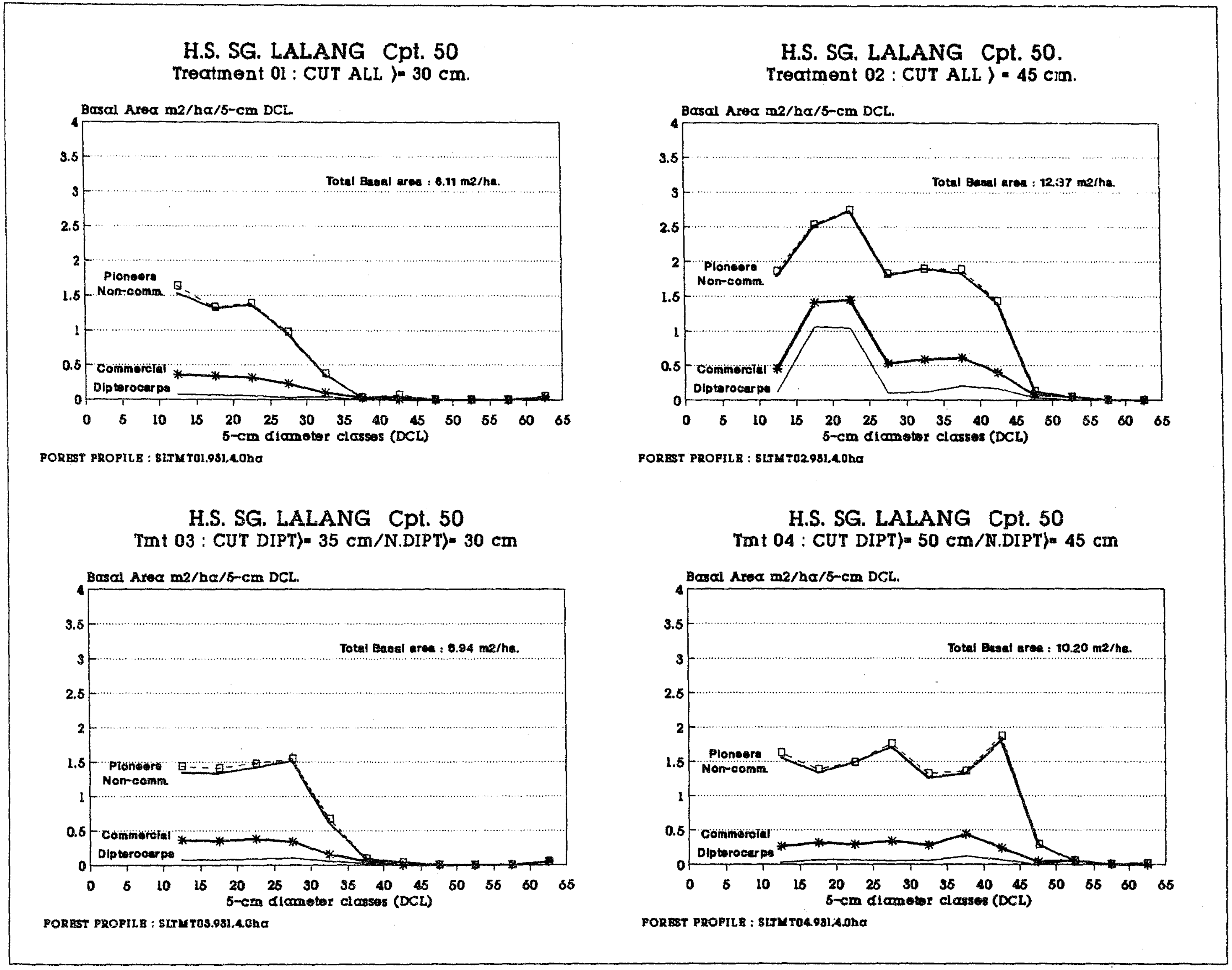
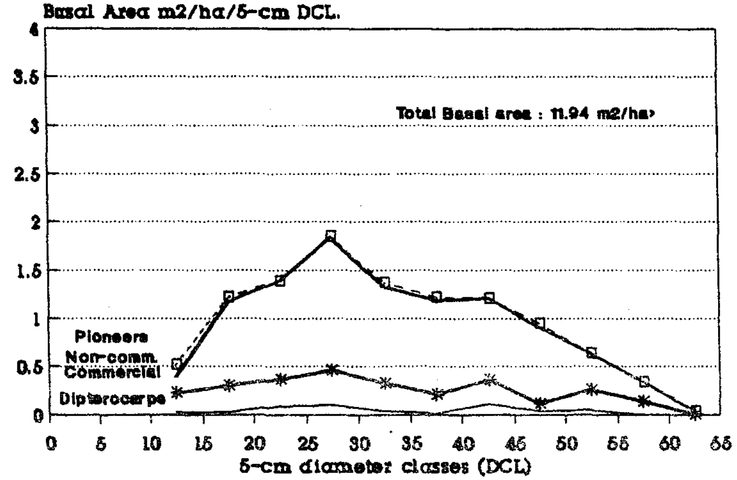


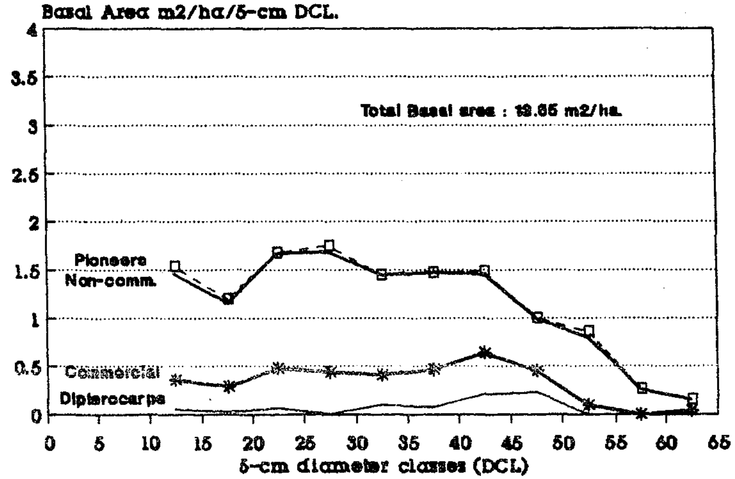
Figure 4: Profile of Study Area by Treatments based on Second Enumeration Data - Selangor

H.S. SG.LALANG Cpt. 50
Tmt 05 : CUT DIPT)= 65 cm/N.DIPT)= 60 cm



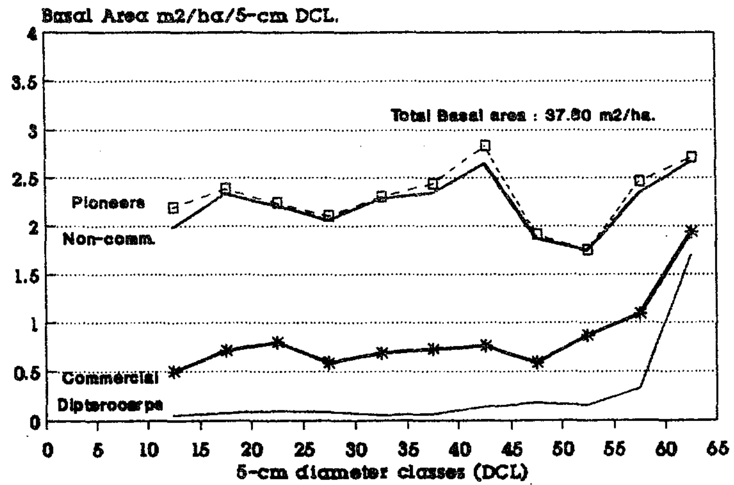
FOREST PROFILE : SLTMT05.93L4.0ha

H.S. SG. LALANG Cpt. 50
Tmt 06 : CUT DIPT)= 75 cm/N.DIPT)= 70 cm



FOREST PROFILE : SLTMT06.93L4.0ha

H.S. SG. LALANG Cpt. 50
Tmt 08 : NO LOGGING, VIRGIN CONTROL.



FOREST PROFILE : SLTMT08.93L4.0ha

Cont...

Table 5: Sample Computer Output of Data Analysis, Mean Number of Trees per Hectare

```
:AM ITTABSTD                                  **** S T A N D T A B L E ****
                                                  DATE : 11/08/1994
TRY DEPARTMENT H.Q. /ITTO, KUALA LUMPUR

05.931  ENUMERATED: 1993, SUNGEI LALANG F.R., SELANGOR          TRMT. 05 : CUT DIPT)=65/ NON-DIP.)=60 CM
K :   4,   8,  18,  31
ST CLASS            = ALL CLASSES
 IDENTITY CLASS     = 111
 *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+  T A B L E   1  *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+
CIES LIST           : NO CHECKS MADE
E VARIABLE NOT USED                                        NO. OF QUADRATS :  100,  AREA :  4.00 HA.
```

MEAN NUMBER OF TREES PER HECTARE
DIAMETER CLASSES IN CENTIMETRES

	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 -59.9	60.0 +	TOTAL	PER-CENT
WOOD QUALITY													
OUP 1	2.78	.25	1.00	1.00	.25		.25					5.53	1.88
OUP 2		.75	1.25	.75	.25	.25	.50	.25	.25			4.25	1.44
OUP 3	15.97	10.25	6.50	4.50	3.00	.75	1.00	.50	.50	.25	.25	43.47	14.77
OUP 4		.50	.75	1.00	.50	.50	.75		.50			4.50	1.53
)UP 5	.69	.25	.25	.25		.50				.25		2.19	.75
)UP 6	38.89	16.50	10.75	10.25	5.50	5.50	3.50	2.00	1.25	.50		94.64	32.16
UP 7	61.81	19.00	15.25	13.50	6 50	3.50	2.75	2.50	.50	.25	.50	126.06	42.83
UP 8	10.42	2.00		.25	.50	.25		.25				13.67	4.64
AL PER HA.	130.56	49.50	35.75	31.50	16.50	11.25	8.75	5.50	3.00	1.25	.75	294.31	100.00
CENT	44.36	16.82	12.15	10.70	5.61	3.82	2.97	1.87	1.02	.42	.25	100.00	
AL ALL PLOTS	188.	198.	143.	126.	66.	45.	35.	22.	12.	5.	3.	843.	

+

Table 6: Sample Computer Output of Data Analysis, Mean Basal Area per Hectare

PROGRAM ITTABSTD

**** S T A N D T A B L E ****

DATE : 11/08/1994

FORESTRY DEPARTMENT H.Q. /ITTO, KUALA LUMPUR

SLTMT05.931 ENUMERATED: 1993, SUNGEI LALANG F.R., SELANGOR TRMT. 05 : CUT DIPT)=65/ NON-DIP.)=60 CM

BLOCK : 4, 8, 18, 31

FOREST CLASS = ALL CLASSES

STEM IDENTITY CLASS = 111

*+ T A B L E 2 *+

SPECIES LIST : NO CHECKS MADE

PAGE VARIABLE NOT USED NO. OF QUADRATS : 100, AREA : 4.00 HA.

MEAN BASAL AREA PER HECTARE (SQUARE METRES)

DIAMETER CLASSES IN CENTIMETRES

	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 -59.9	60.0 +	TOTAL	PER-CENT
WOOD QUALITY													
GROUP 1	.03	.01	.04	.06	.02		.04					.19	1.58
GROUP 2		.02	.05	.04	.02	.02	.07	.04	.05			.32	2.69
GROUP 3	.19	.25	.25	.28	.25	.08	.14	.08	.10	.07	.08	1.78	14.87
GROUP 4		.01	.02	.06	.04	.05	.11		.11			.41	3.40
GROUP 5	.01	.01	.01	.02		.06				.07		.17	1.40
GROUP 6	.47	.40	.42	.59	.46	.60	.47	.35	.27	.13		4.15	34.78
GROUP 7	.69	.47	.60	.79	.54	.38	.38	.44	.11	.07	.18	4.63	38.80
GROUP 8	.13	.05		.01	.04	.03		.04				.30	2.48
TOTAL PER HA.	1.51	1.21	1.40	1.84	1.37	1.23	1.21	.95	.63	.33	.26	11.94	100.00
PER CENT	12.65	10.11	11.71	15.43	11.48	10.30	10.11	7.98	5.28	2.78	2.18	100.00	

+

Table 7: Sample Computer Output of Data Analysis, Mean Volume per Hectare

```
GRAM ITTABSTD                                   **** S T A N D T A B L E ****
                                                     DATE : 11/08/1994
ESTRY DEPARTMENT H.Q. /ITTO, KUALA LUMPUR

MTO5.931   ENUMERATED: 1993, SUNGEI LALANG F.R., SELANGOR          TRMT. 05 : CUT DIPT)=65/ NON-DIP.)=60 CM
OCK :   4,    8,  18,  31
REST CLASS            = ALL CLASSES
EM IDENTITY CLASS     = 111
    *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+   T A B L E    2    *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+
PECIES LIST           : NO CHECKS MADE
AGE VARIABLE NOT USED                                         NO. OF QUADRATS :  100,  AREA :  4.00 HA.

                                                 MEAN VOLUME PER HECTARE (CUBIC METRES)
                                                 DIAMETER CLASSES IN CENTIMETRES
```

	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 -59.9	60.0 +	TOTAL	PER-CENT
WOOD QUALITY													
GROUP 1	.14	.03	.22	.37	.16		.33					1.24	1.46
GROUP 2		.12	.31	.27	.17	.19	.64	.37	.46			2.53	2.96
GROUP 3	.76	1.37	1.54	1.96	1.92	.68	1.16	.74	.96	.65	.84	12.60	14.78
GROUP 4		.06	.14	.41	.32	.43	.96		1.01			3.32	3.90
GROUP 5	.03	.03	.06	.10		.49				.69		1.40	1.64
GROUP 6	1.93	2.23	2.57	3.99	3.46	4.89	4.00	3.18	2.54	1.28		30.06	35.26
GROUP 7	2.72	2.58	3.66	5.40	4.08	3.09	3.33	3.97	.99	.66	1.85	32.33	37.92
GROUP 8	.52	.26		.09	.27	.25		.40				1.78	2.09
TOTAL PER HA.	6.10	6.68	8.50	12.59	10.38	10.02	10.42	8.65	5.96	3.27	2.69	85.26	100.00
PER CENT	7.16	7.84	9.97	14.77	12.17	11.76	12.22	10.15	6.99	3.84	3.15	100.00	

```
 FUNCT. BASED ON DIAMETER ONLY
   *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+
```

Table 8: Species Composition by Major Species Groups and Diameter Class for the Logged-over Forest Area in Perak

SPECIES GROUP		DIAMETER CLASS +15 - 30	+30 - 45	+45 - 60	+60	+15
GROUP I	a.	2.58	1.89	1.12	0.73	6.32
Dipterocarp	b.	6.42	1.33	4.37	5.12	17.24
Meranti	c.	0.97	0.34	0.73	0.60	2.64
GROUP II	a.	0.49	0.22	0.16	0.16	1.03
Dipterocarp	b.	0.08	0.16	0.19	1.59	2.02
Non-meranti	c.	0.04	0.04	0.05	0.18	0.31
(Light-hardwoods)						
GROUP III	a.	0.32	0.30	0.24	0.08	0.94
Dipterocarp	b.	0.06	0.21	0.27	0.34	0.88
Non-meranti	c.	0.04	0.05	0.07	0.04	0.20
(Medium-hardwoods)						
GROUP IV	a.	2.13	1.36	0.83	0.42	4.74
Dipterocarp	b.	0.33	0.95	0.91	2.30	4.49
Non-meranti	c.	0.17	0.24	0.23	0.28	0.92
(Heavy-hardwoods)						
GROUP V	a.	6.78	3.96	1.59	0.62	12.95
Non-Dipterocarp	b.	22.90	2.76	1.86	2.06	29.58
(Light-hardwoods)	c.	3.32	0.71	0.47	0.29	4.79
GROUP VI	a.	1.12	0.77	0.38	0.38	2.65
Non-Dipterocarp	b.	0.16	0.55	0.43	1.46	2.60
(Medium-hardwoods)	c.	0.08	0.15	0.11	0.19	0.53
GROUP VII	a.	0.35	0.52	0.47	0.16	1.50
Non-Dipterocarp	b.	0.06	0.36	0.55	0.65	1.62
(Heavy-hardwoods)	c.	0.02	0.10	0.14	0.08	0.34
GROUP VIII	a.	25.48	10.74	5.05	1.17	42.98
Non-Dipterocarp	b.	17.38	7.35	5.68	6.21	36.62
(Partially Marketable)	c.	3.71	1.89	1.46	0.82	7.88
GROUP IX	a.	0.03	0.04	0.02	0.02	0.11
Podo and Agathis	b.	0.01	0.03	0.02	0.05	0.11
Species	c.	0.00	0.01	0.00	0.01	0.02
DIPTEROCARP	a.	5.53	3.77	2.34	1.39	13.03
	b.	6.89	2.64	5.75	9.35	24.63
	c.	1.21	0.68	1.08	1.10	4.07
NON DIPTEROCARP						
	a.	33.75	16.03	7.52	2.88	60.18
	b.	40.50	11.06	8.53	10.43	70.52
	c.	7.15	2.84	2.19	1.39	13.57
TOTAL	a.	39.28	19.80	9.86	4.27	73.21
(All species)	b.	47.39	13.70	14.28	19.78	95.15
	c.	8.36	3.52	3.27	2.49	17.64

a: No. of tree per hectare.
b: Gross volume per hectare.
c: Basal area per hectare.

summary/ytkd

Preliminary analysis of the data indicated that silvicultural treatments enhance growth performance. This is reflected by the higher growth rates attained by trees with treatments as compared to that of control as shown in **Table 9**.

Table 9: Basal area increment (m^2/ha/yr) of trees 10 cm dbh and above by treatments for logged-over forest area located at Perak after establishment

Year / Treatment	Year 1 (m2/ha)	Year 2 (m2/ha)	Year 3 (m2/ha)	Mean Annual Increment
CL	19.72	20.67	21.50	0.59
GCL	17.98	19.68	20.08	0.70
GCL + EP	19.41	20.18	21.06	0.55
Control	17.87	17.75	18.75	0.13

As indicated in Table 9, mean annual basal area increment was highest in the GCL plots (0.70 m2/ha/yr) followed by CL plots (0.59 m2/ha/yr), GCL & EP plots (0.55 m2/ha/yr) while the Control plots recorded the lowest increment of 0.13 m2/ha/yr.

(iii) Establishment of forest plantation of indigenous tree species.

The aim of this component of the study is to find out suitable indigenous tree species that could be used in forest plantation establishment. In this connection, four plantation plots were established in each study area. The species to be planted were based on prior information that these species are locally occurring to ensure some kind of species-site matching. In addition, the species must be of commercial species. In all, a total of 7 species were planted. The distribution of species planted by study areas are as shown below:-

Study Area	Species planted
Pahang	*Heritiera* spp. *Shorea pauciflora* *Shorea parvifolia* *Dipterocarpus cornutus* *Shorea acuminata* *Shorea leprosula*

Selangor	*Shorea parvifolia* *Shorea acuminata*
Perak	*Shorea leprosula* *Shorea parvifolia*
Terengganu	*Shorea parvifolia* *Dipterocarpus baudii*

The planting distance for the indigenous plantation is 3m x 6m allowing a maximum total of 561 seedlings to be planted. Prior to the planting of seedlings, all residual trees having 30 cm dbh and above within the permanent sample plots were cut and removed from the planting line. All seedlings planted were enumerated during remeasurement. For the initial measurement when the seedlings are less than 5cm in diameter, only total height is being measured. However, once the seedlings have achieved 5 cm diameter and greater, only diameter measurement will be taken. In addition, the total height of 30 dominant saplings, selected based on the tallest height recorded, for each species planted will also be measured.

Treatment and refiling are carried out at prescribed intervals with the recommended rate of survival being at least 80 percent.

Based on latest measurement undertaken, the survival percent of the seedlings planted for three of the study areas are as shown in **Table 10**. Current results indicated that most plots have achieved the recommended survival rate. However, efforts are on-going to refill dead seedlings for plots that are below the recommended survival rate.

(iv) Formulation and implementation of sound silvicultural forest manage ment systems.

This project aims to contribute to the formulation and implementation of the above-mentioned system. However, at this point of time, due to the long-term nature of this kind of study, many more years are needed before definite trends in the development and recovery of the forest could be demonstrated.

Table 10: Survival Percent of trees under the plantation plots

Study Area	Permanent Sample Plot No.	Total no. of trees planted	Total no. of trees survived	Survival percent
1. Compartment 171 & 172, Lesong Forest Reserve, Pahang	15	541	460	85.0
	16	537	440	81.9
	22	371	240	64.7
	23	527	429	81.4
2. Compartment 50, Sungai Lalang Forest Reserve, Selangor	13	452	318	70.4
	14	500	440	88.0
	15	481	391	81.3
	23	550	485	88.2
3. Compartment 194 & 205, Kledang Saiong Forest Reserve Perak	4	561	476	84.8
	11	561	489	87.2
	14	561	446	79.5
	17	561	480	85.6

plot/ytk32

(f) Financial Achievement

In order to enable ITTO to transfer funds for the project to the Government of Malaysia, a Trust Fund Account with account code 84405 was set up within the Accountant General's Office, Malaysia. As at the end of project implementation, the Malaysian Government had received all the contributions from ITTO totaling US$277,353 including US$ 30,000 as additional funding for the engagement of an international consultant.

The first ITTO's installment of US$14,390 was received on 24 November, 1990 while the second, third and fourth installments of US$102,017, US$60,793 and US$70,153 were received on 26 June, 1989; 8 June, 1990; and 24 September, 1991 respectively. The last installment of US$ 30,000 was received on 7 April, 1993. As at the end of project implementation (31 December, 1993), a total of US$277,310.57 was spent in implementing the various activities of the project leaving a balance of US$ 42.43. Details on the financial contributions and expenditures are as shown in Table **11**.

Table 11: Financial Contribution and Expenditure
(US$)

Period		Expected Contribution of fund by			Actual expenditure (until 31 December, 1993)		
Year	Month	ITTO	Malaysian Government	Total	ITTO's Contribution	Malaysian Government's Contribution	Total
1988	July-December	14,390	17,565	31,955	5,153.31	45,370.90	50,524.21
1989	January-June	44,716	56,092	100,808	18,604.28	51,034.26	69,638.54
	July-December	60,635	15,185	75,820	82,272.15	69,624.92	151,897.07
1990	January-June	60,793	69,067	129,860	24,698.29	47,663.88	72,362.17
	July-December	51,361	7,698	59,059	21,540.66	57,990.32	79,530.98
1991	January-June	25,458	18,762	44,220	8,391.75	13,265.81	21,657.56
July 1991-June 1998		20,000	138,426	153,426	116,650.13*	89,853.26*	206,503.39*
Total		277,353**	322,795	595,148	277,310.57	374,803.35	652,113.92

(Exchange rate: US$1 = M$2.5068)

* Expenditure as of 31 December, 1993.

** Include additional funding of US$30,000 for the engagement of consultant but exclude US$ 25,000 allocated for the monitoring and review of the project by ITTO.

Besides the ITTO's contributions, the Malaysian Government has also spent a total of US$374,803.35 in the form of imputed costs which include, among others, salaries of personnel involved in the project, cost of seedlings and inventory equipment, the maintenance of vehicles and the preparation of progress reports.

Hence, the accumulated expenditure for the project as of 31 December, 1993 was estimated at US$652,113.92.

As required both by the Malaysian Government and ITTO, the project's expenditures were subjected to annual auditing by the Office of the Auditor-General. The audited annual accounts for the period 1988-1993 are as shown in **Tables 12 - 17** respectively.

Table 12: TRUST ACCOUNT FOR THE PROJECT ON FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA UNDER THE SPONSORSHIP OF THE INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) AND THE GOVERNMENT OF MALAYSIA

KETUA PENGARAH PERHUTANAN
Diterima pada
5 JUN 1990
Buka Fail baharu
Masukkan dalam Fail
dan bagi kepada.................

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST. DECEMBER 1988 (KOD 84405)

RECEIPTS	$	PAYMENTS	$
Contribution from ITTO (US $14,390.00 @ M$ 2.6460	38,075.94	Travelling and overtime payments to staff of Forestry Department Peninsular Malaysia	12,918.31
		Balance as at 31.12.1988	25,157.63
	38,075.94		38,075.94

(IRENE LUNG)
Executive Acounting Officer
Forestry Department Peninsular Malaysia
Kuala Lumpur

(DATO' OTHMAN B. ABD. MANAN)
Deputy Director-General of Forestry
Peninsular Malaysia
Kuala Lumpur

TELAH DIPERIKSA

....
(Bahagian Persekutuan)
b.p. Ketua Audit Negara
Malaysia

Table 13: TRUST ACCOUNT FOR THE PROJECT ON FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA UNDER THE SPONSORSHIP OF THE INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) AND THE GOVERNMENT OF MALAYSIA

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST. DECEMBER 1989 (KOD 84405)

RECEIPTS	$	PAYMENTS	$
Balance as at 1.1.89	25,157.63	Bank charges	5.00
Contribution from ITTO (US $ 102,017.00 @ M$ 2.6910)	274,527.74	Travelling and overtime payments to staff of Forestry Department Peninsular Malaysia	206,670.12
		Other Payments	46,206.90
		Balance as at 31.12.1989	46,803.35
	299,685.37		299,685.37

TELAH DIPERIKSA

(Bahagian Persekutuan)
b.p. Ketua Audit Negara
Malaysia

(IRENE LUNG)
Executive Acounting Officer
Forestry Department Peninsular Malaysia
Kuala Lumpur

(DATO' OTHMAN B. ABD. MANAN)
Deputy Director-General of Forestry
Peninsular Malaysia
Kuala Lumpur.

Table 14: TRUST ACCOUNT FOR THE PROJECT ON FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA UNDER THE SPONSORSHIP OF THE INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO). AND THE GOVERNMENT OF MALAYSIA

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST. DECEMBER 1990 (KOD 84405)

RECEIPTS	$	PAYMENTS	$
Balance as at 1.1.90	46,803.35	Travelling and overtime payments to staff of Forestry Department Peninsular Malaysia	97,522.78
Contribution from ITTO (US$ 60,793.00 @ M$ 2.6960)	163,897.92	Other Payments	15,454.70
		Balance as at 31.12.1990	97,723.79
	210,701.27		210,701.27

(IRENE LUNG)
Executive Accounting Officer
Forestry Department Peninsular Malaysia
Kuala Lumpur.

(DATO' OTHMAN B. ABD. MANAN)
Deputy Director-General of Forestry
Peninsular Malaysia
Kuala Lumpur.

TELAH DIPERIKSA

....

(Bahagian Persekutuan)

Table 15: TRUST ACCOUNT FOR THE PROJECT ON FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA UNDER THE SPONSORSHIP OF THE INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) AND THE GOVERNMENT OF MALAYSIA

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST DECEMBER 1991 (KOD 84405)

Receipts	$	Payments	$
Balance as at 1.1.91	97,723.79	Travelling and overtime payments to staff of Forestry Department Peninsular Malaysia	129,076.39
Contribution from ITTO (USD 70,153.00 @ M$2.7570)	192,411.82	Other payments	62,490.40
		Balance as at 31.12.1991	99,568.82
	291,135.61		291,135.61

(IRENE LUNG)
Executive Accounting Officer
Forestry Department Peninsular Malaysia,
Kuala Lumpur.

(DATO' OTHMAN B. ABD. MANAN)
Deputy Director-General of Forestry,
Peninsular Malaysia,
Kuala Lumpur.

Table 16: TRUST ACCOUNT FOR THE PROJECT ON FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA UNDER THE SPONSORSHIP OF THE INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) AND THE GOVERNMENT OF MALAYSIA

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST DECEMBER 1992 (KOD 84405)

Receipts	M$	Payments	M$
Balance as at 1.1.92	99,568.82	Travelling and overtime payments to staff of Forestry Department Peninsular Malaysia	71,646.80
		Cost incurred in the establishment of indigenous forest plantation	20,000.00
		Other payments	271.75
		Balance as at 31.12.1992	7,650.27
	99,568.82		99,568.82

(IRENE LUNG)
Assistant Accountant
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Kuala Lumpur.

(DATO' OTHMAN B. ABD. MANAN)
Deputy Director-General of Forestry
Peninsular Malaysia,
Kuala Lumpur.

Table 17: AKAUN AMANAH BAGI PROJEK "PENGURUSAN HUTAN KE ATAS HUTAN ASLI DI MALAYSIA TAJAAN INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) DAN KERAJAAN MALAYSIA

PENYATA TERIMAAN DAN BAYARAN BAGI TAHUN BERAKHIR 31 DISEMBER 1993 (KOD 84405)

TERIMAAN	RM	BAYARAN	RM
Baki wang pada 1.1.93	7,650.27	Perbelanjaan perjalanan kakitangan Jabatan Perhutanan Semenanjung Malaysia (Lampiran A)	9,370.00
Peruntukan dari ITTO USD 30,000 @ 2.5630	76,890.00	Bayaran juruperunding	75,000.00
		Lain-lain Perbelanjaan (Lampiran A)	63.90
		Baki wang pada 31.12.1993	106.37
	84,540.27		84,540.27

(IRENE LUNG)
Penolong Akauntan
Ibu Pejabat Perhutanan
Kuala Lumpur.

(SHEIKH IBRAHIM B. SHEIKH ALI)
Timbalan Ketua Pengarah Perhutanan,
(Operasi Hutan)
Ibu Pejabat Perhutanan,
Kuala Lumpur.

VI. DISCUSSIONS

The long-term goal of natural forest management is to ensure the multiple functions of the forests including the sustained supply of logs to the forest industry while maintaining the integrity of the forest resource. In support of the production goal, substantial information on the growth and yield potential of the forest under different cutting regimes and silvicultural treatments are required. These information are needed in order to select forest harvesting regimes that are best suited to the different forest types as well as the best silvicultural treatments that would enhance the growth potential of the residual stand.

Compared to the amount of funding from ITTO, contributions from Malaysia both in terms of the number of study areas and in kind has been tremendous. Though this was the first ITTO project for Malaysia, Malaysia has ventured to undertake the study by her own, right from project design to implementation on the ground without any international inputs except at the final stage where an international consultant was engaged to design a data base management system. Instead of conducting the project over one study area, four sites covering different parts of Peninsular Malaysia were chosen. This is commendable and doubtlessly the Malaysians have benefited through this project both technically and administratively.

The implementation of this project had resulted in the establishment of four study areas each with a specified number of permanent sample plots. These study areas are subjected to remeasurement/enumeration at specified intervals. In this context, the study areas which are located in Pahang and Perak have been enumerated three times each while that in Selangor and Terengganu enumerated twice and once, respectively. Through out the project implementation, numerous challenges/problems were encountered and various deficiencies identified which are as follows:-

(i) study of this nature requires careful planning and scheduling, particularly for the two virgin forest areas that were harvested based on prescribed cutting regimes. A case in point was the study area in the state of Selangor where the harvesting was prolonged for a year due to the difficult terrain and rainy condition and the need to reharvest trees that are marked for felling but not felled;

(ii) the need for proper maintenance of study areas and the collection of quality data from the field. Three of the four study areas are located quite far inland where traveling by four wheel drive over long stretches of former logging roads are necessary. However, due to lack of use as well as the inherent high rainfall in the country, most of these roads are rather inaccessible rendering remeasurement work tough and tedious. This problem could contribute to low morale of field crews and affect the quality of field data collected. To ensure field data quality , there is a need to assign specific trained field crews to undertake the task of carrying out remeasurement work;

(iii) data entry, verification and analysis which are tedious and time consuming and requires skilled and trained personnel. In fact, this is one of the most crucial problems faced as without timely analysis, the usefulness of the project will be curtailed. Realising this setback, specialised training had been given to counterpart officers as well as research assistants in operating the computer programmes devised; and

(iv) better documentation of study areas especially in terms of pictorial presentation such as aerial photographs at relevant intervals. This documentation, in the long-term, would further contribute to the success of the project especially in assessing the successional development of the forest stands.

Despite the above setback, the project has been implemented successfully with its major outputs achieved as outlined in Section V(d). In addition, the project has also strengthened the collaboration among the various forestry institutions in Malaysia which are involved in project implementation, namely Forestry Department Headquarters, Peninsular malaysia; Forest Research Institute, Malaysia; ASEAN Institute of Forest Management; Faculty of Forestry, University of Agriculture, Malaysia; as well as the various State Forestry Departments where the study areas are located. In fact, the project had benefited tremendously from this collaboration as a total of 13 Technical Working Group meetings were held through out the project implementation to discuss all technical matters pertaining to project planning and implementation.

Besides, the Technical Working Group in recognition of the long-term research nature of the study has decided that the time horizon of the project should be extended from 10 years, as originally requested by ITTO to 50 years to ensure the permanency and security of the study areas. The request to extend the project period have been forwarded by the various State Forestry Departments to their respective State Governments for consideration.

Not withstanding the above, it must be acknowledged that study of this nature is invariably a complex one as it involves the monitoring of growth responses of trees and forests on different sites and subjected to different cutting regimes and silvicultural treatments and require a reasonable vast forest area. This is clearly reflected by the number of treatments and replications applied and the size of the study areas which ranges from 210 to 420 hectares. This is further confounded by the complex and heterogeneous nature of the tropical forest and their varying terrain conditions.

In this report, only preliminary results are presented. The reasons being at the point of report preparation, not all data collected have been entered into computer, verified and corrected. In addition, there is a need to further refine the computer programmes for growth parameter calculation. Hence the results presented here are at best indicative of the immediate response of the residual stand after treatment. More detailed data analysis will have to be undertaken.

The project also witnessed realistic budget proposal and the effective utilisation of project funds by the implementing agency. Sufficient funding was requested with all of them being fully utilised for project implementation.

VII. RECOMMENDATIONS AND CONCLUSIONS

Through project implementation, it has been found that the TWG has played a pivotal role in steering project implementation. Hence it is recommended that it should be made a permanent feature of all internationally funded projects. This TWG would ensure that project to be implemented are not only technically sound but capable of addressing current forestry needs in the country concerned.

The project also indicated various pertinent matters that should be given due consideration in order to ensure the ultimate success of the project. Hence it is recommended that every effort be taken to ensure:-

(i) the timely enumeration of all the four study areas on schedule;

(ii) timely analysis of all the data collected. This is pertinent as data entry, verification and analysis is a time consuming process and required skilled personnel. In this regard, tailored training programme should be carried out to provide incentives for the personnel involved to provide the necessary platform for continuity and advancement in data analysis;

(iii) proper documentation and presentation of project findings. This would enable information sharing and effective dissemination to interested parties ; and

(iv) the data management system developed should be fully operationalised.

At this point of time, it could be concluded that the project had been successfully implemented where the plots are correctly established and are being regularly enumerated according to predetermined schedule. The data collected are continuously being entered into computer, verified and edited to be analysed using computer programmes specifically designed for the studies. The immediate effects of logging and silvicultural treatments on the residual stands are also being studied and documented.

However, due to the long term nature of this kind of project, a longer timeframe would be required before definite trends in the development and in recovery of the forest could be demonstrated. In view that the results of the project would not only benefit the forestry sector in Malaysia, but also assist other ITTO member countries having similar forest conditions towards achieving ITTO Objective Year 2000 of sustainable tropical forest management, it is recommended that this project be extended to Phase II.

Appendix A

PROCEDURE FOR ESTABLISHMENT OF STUDY AREA IN VIRGIN FOREST

TABLE OF CONTENTS

JOINT PROJECT BETWEEN MALAYSIA - ITTO
ON
FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA

1.0 INTRODUCTION

In November, 1987, Malaysia submitted a project proposal entitled "Forest Management of Natural Forest in Malaysia" for consideration and possible funding by the International Tropical Timber Organisation (ITTO).

The Third Session of ITTO held in Yokohama, Japan 11 - 20 November, 1987 approved the Project for immediate implementation and financing with conditions that certain amendments be made to the Project Document as recommended by the Permanent Committee on Reforestation and Forest Management.

The revised Project Document was then resubmitted to ITTO and subsequently, the Contract Agreement for the implementation of the project was signed between the Government of Malaysia and ITTO on 8 August, 1988 in Kuala Lumpur, Malaysia.

Under this project, a total of four (4) study areas were established with two (2) of the study areas being located in the virgin forest while the remaining two (2) in logged-over forest. The main objectives of this project are fourfold which are as follows:-

(i) to examine in detail the distribution of natural regeneration and the response of residual stand under various management (felling) regimes in two (2) virgin forest areas;

(ii) to increase the understanding of the regeneration capacity of the dipterocarp forest under various silvicultural treatments in two (2) logged-over forest areas;

(iii) to conduct comprehensive study in the establishment of forest plantation of indigenous tree species; and

(iv) to contribute to the formulation and implementation of sound silvicultural forest management systems for the dipterocarp forest in Peninsular Malaysia.

This paper documents the procedures used in the establishment of the two (2) study areas located in the virgin forest.

2.0 ESTABLISHMENT OF STUDY AREA

To facilitate the implementation of the project, a 'Technical Working Group on Forest Management of Natural Forest in Malaysia' was formed to formulate establishment procedures, plan as well as discuss and solve technical matters pertaining to the project. The Technical Working Group comprises members from the Forestry Department Headquarters, Peninsular Malaysia; Forest Research Institute, Malaysia; ASEAN Institute of Forest Management; Forestry Faculty, University of Agriculture, Malaysia and representatives from the State Forestry Departments of Pahang, Perak, Selangor and Terengganu where the study areas were located. The list of technical decisions made by the Technical Working Group in the course of project implementation appears as Appendix I while the establishment procedures of the two (2) study areas in the virgin forest as drawn up by the Technical Working Group are as follows:-

2.1 SELECTION OF STUDY AREA

In the selection of the two (2) virgin forest areas for this project, the following criteria were taken into consideration:-

(i) the area must be located in the Permanent Forest Estate;

(ii) the forest cover must be undisturbed, i.e. virgin forest;

(iii) access must be reasonable, location must be within 10 to 16 kilometers from an all weather major (public) road;

(iv) the State Government must provide formal agreement to set aside the study area to be maintained by the Forestry Department for a period of at least 10 years; and

(v) specifications for the fellings and extraction of logs required for this project must be in accordance with the specifications as stipulated in the Project Document and must be agreed upon between the State Forestry Department and the logging contractor.

Based on the above considerations, two (2) virgin forest areas were selected for this project which were as follows :-

(i) Compartments 171 and 172,
Lesong Forest Reserve,
Pahang.

(ii) Compartment 50,
Sungai Lalang Forest Reserve,
Selangor.

Compartments 171 and 172, Lesong Forest Reserve are located in Rompin District at the South-Western part of Pahang, bordering the state of Johor within latitudes 103° 7'E to 103° 9'E and longitudes 2° 40'N to 2° 42'N. The total area of the two (2) compartments amounts to 2,822 hectares. However, only 410 hectares are utilised for the study. The study area is disected by Sungai Lingit and its many tributaries which flow in the North-West direction. The general topography of the study area is gentle and undulating with elevation ranging from 75m to 240m.

Compartment 50, Sungai Lalang Forest Reserve is located in the north-eastern part of Ulu Langat District bordering the state of Negeri Sembilan within latitudes 101° 56'E to 101° 58'E and longitudes 3° 7'N to 3° 9'N. The compartment covers a total area of 603 hectares. However, only 420 hectares of the Compartment is being utilised for the study. The general topography of the compartment is undulating to hilly with elevation ranging from 150m to 1000m above mean sea level. The locations of the two (2) study areas are as shown in Maps 1, 2 and 3 of Appendix II.

The two (2) study areas as mentioned-above was approved by the respective State Government to be set aside for the purpose of the project for a duration of at least ten (10) years as required by ITTO at the following dates :-

	Study area	Approval date
(i)	Compartments 171 and 172, Lesong Forest Reserve, Pahang.	11 October, 1989
(ii)	Compartment 50, Sungai Lalang Forest Reserve, Selangor.	6 July, 1988

2.2 PRE-FELLING FOREST INVENTORY

Prior to the demarcation and stratification of the study area into various forest stocking classes and the prescription of cutting limits, a pre-felling forest inventory was carried out to determine the stocking and structure of the forest. This inventory was carried out using systematic-line-plots of size 50m X 20m with four (4) sub-plots of size 25m X 20m, 10m X 10m, 5m X 5m and 2m X 2m. The sampling lines were parallel to one another at 100m apart with the 50m X 20m principal plots being 50m apart along each sampling line or 100m from one plot centre to the next as shown in Figure 1.

Details of the principal plot and sub-plots, their areas and respective equivalent sampling intensities are as follows:-

Description of Sample Plot	Area (ha)	Sampling Intensity (%)
(i) 50m X 20m principal plot	0.1000	10.00
(ii) 25m X 20m sub-plot	0.0500	5.00
(iii) 10m X 10m sub-plot	0.0100	1.00
(iv) 5m X 5m sub-plot	0.0025	0.25
(v) 2m X 2m sub-plot	0.0004	0.04

The size classes of trees to be enumerated within the principal and sub-plots are as follows:-

Sample Plot	Size Class	Description
(i) 50m X 20m	>45cm diameter at breast height (dbh) >30cm-45cm dbh	Big trees Small trees
(ii) 25m X 20m	>15cm-30cm dbh	Big poles
(iii) 10m X 10m	>5cm-15cm dbh	Small poles
(iv) 5m X 5m	>1.5m height (ht) - 5cm dbh	Saplings
(v) 2m X 2m	15cm ht-1.5m ht	Seedlings

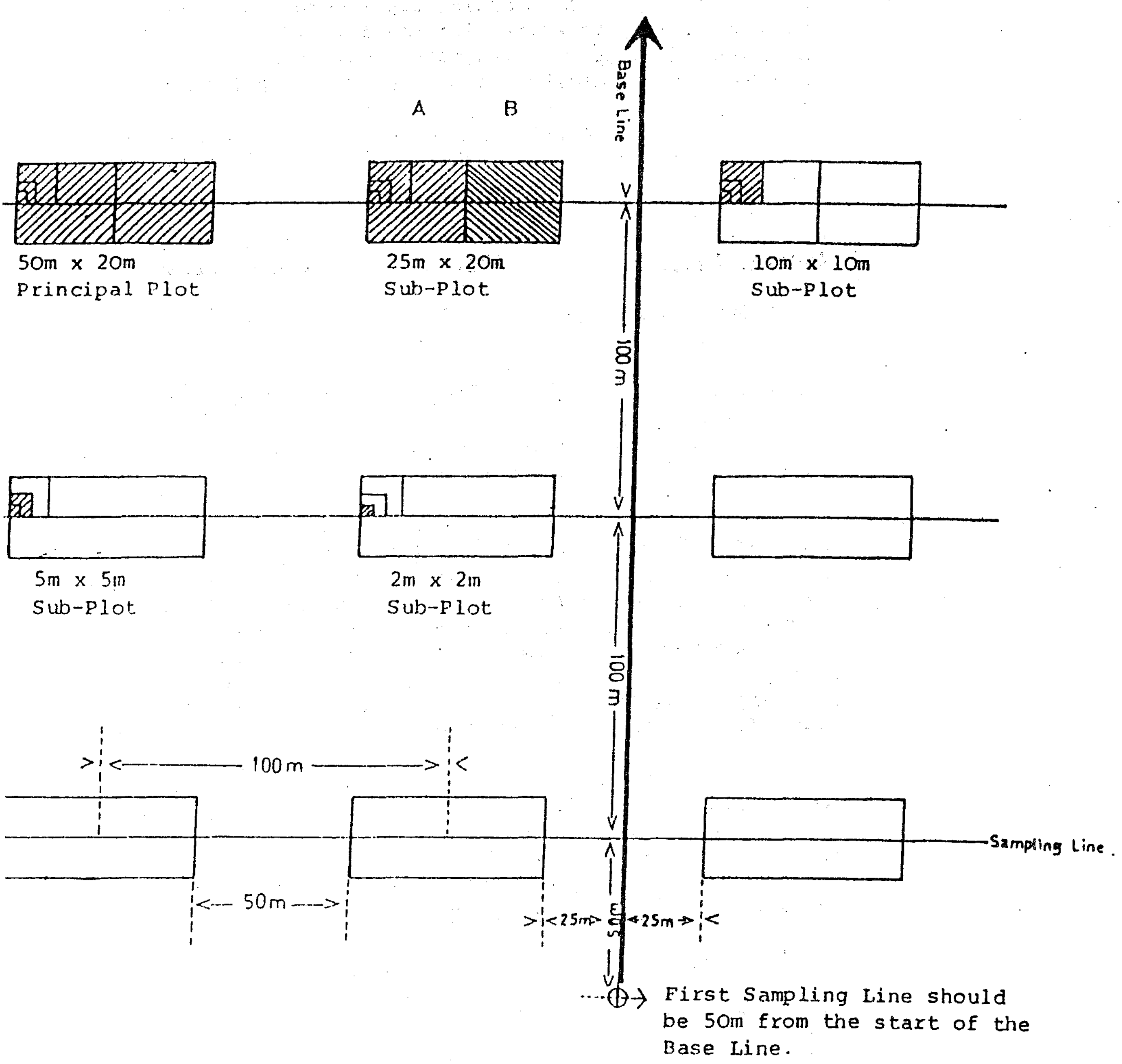


Figure 1 : LAYOUT OF SAMPLE PLOTS PRE-FELLING FOREST INVENTORY

All trees within the size class corresponding to the selected sample plot were enumerated by species as far as possible while sample trees having a minimum diameter at breast height (dbh) of 5cm were measured to the nearest one-tenth centimeter in diameter at 1.3m or 0.3m above buttress. In addition, the quality and number of logs were also being enumerated for each of the sample trees having 30cm dbh and above while the presence of climbers intertwining sample trees of diameter greater than 15cm were also being recorded together with their diameter measurements. The vigour and stem form for trees having diameter between >5cm to 15cm were also enumerated while only the number of trees present were recorded for saplings having diameter less than 5cm.

In addition to the above, the presence of rattans, bamboos, bertam (*Eugeissona triste*), palms and ferns were also being enumerated in the principal plot, together with other features such as slope, aspect, elevation, soil and forest types.

The forest inventory data were recorded in field sheet as shown in Appendix III. The inventory data were analysed and processed by computer which provided for each treatment block (which comprises a few pre-felling forest inventory sample plots) summaries of stand and stock tables showing gross and net number of trees per hectare; gross and net volume per hectare and basal area per hectare by species and/or species groups and by diameter classes and/or diameter limits.

The pre-felling forest inventory for the study area in Pahang was completed in May, 1988 while that for the study area located in Selangor was completed in December, 1988.

2.3 DETERMINATION OF CUTTING LIMITS

In determinig the cutting limits to be prescribed over the study area, the following factors were taken into consideration:-

(i) the cutting limits prescribed must reflect the existing forest management system in the country. Under the Selective Management System (SMS) which is currently being practised in Peninsular Malaysia, a split cut for the dipterocarp and non-dipterocarp trees has been advocated with the dipterocarp trees being prescribed a higher cutting limit; and

(ii) the possibility of utilising smaller diameter logs in the future as well as the prospect of establishing indigenous forest plantation.

A total of eight (8) treatments as outlined in the Project Document was agreed by the Technical Working Group on Forest Management of Natural Forest in Malaysia for implementation which were as follows:-

(i) cut all trees ≥30cm diameter at breast height (dbh);

(ii) cut all trees ≥45cm dbh;

(iii) cut all dipterocarps ≥35cm dbh and non-dipterocarps ≥30cm dbh;

(iv) cut all dipterocarps ≥50cm dbh and non-dipterocarps ≥45cm dbh;

(v) cut all dipterocarps ≥65cm dbh and non-dipterocarps ≥60cm dbh;

(vi) cut all dipterocarps ≥75cm dbh and non-dipterocarps ≥70cm dbh;

(vii) establishment of indigenous forest plantation; (cut all trees ≥30cm dbh); and

(viii) control (no cutting).

For the purposes of meaningful statistical analysis, each treatment above was being replicated four (4) times based on stocking classes (the whole study area was being stratified into four (4) different stocking classes).

2.4 NUMBER AND PLOT SIZE

In order to fulfill the requirement of treatments and replications as specified in Section 2.3, a total of 32 permanent sample plots were established in each study area. Each permanet sample plot measured 100m X 100m (1 ha). It was considered necessary that each permanent sample plot be surrounded by a buffer zone receiving exactly the same treatment as that of the plot. A treatment block of 10 ha with the following dimensions was then recommended.

Permanent Sample Plot	100m X 100m = 1 ha
Buffer Zone	108m width around sample = 216m total each side
Treatment block	Permanent sample plot + buffer zone = 316m X 316m = 10 ha

2.5 REPLICATION OF TREATMENTS AND STRATIFICATION OF STUDY AREA

It was considered essential and necessary that each treatment be replicated for meaningful statistical analysis. In this study, all the eight (8) treatments as mentioned in 2.3 were being replicated four (4) times.

For complete randomisation of each treatment in four (4) replications, homogeneity is required over practically the whole study area. However, this could not be achieved in the mixed tropical forests, which are heterogeneous in nature. Hence, a practical solution to this problem is to stratify the study area into four (4) classes of approximately homogeneous forest stocking (in terms of number of trees and gross volume per hectare by species and/or species groups and by diameter classes and/or diameter limits) and the locating of a full series of eight (8) treatments in each stocking class. It is then considered that each series of treatments is located in an area of approximately equal site conditions and growth potential. Any differences in actual growth detected in later stage analysis, could then be attributed to treatment differences within the series.

The stratification of the study area into four (4) different stocking classes was based on the analysis of the pre-felling forest inventory samples located in each treatment plot. Analysis of the inventory data and stratification of the study area in Pahang into four (4) different stocking classes was completed in October, 1988 while that in Selangor was completed in March, 1989. Figures 2A and 2B show the distribution of pre-felling forest inventory sample plots within each treatment plot for the study areas at Lesong Forest Reserve, Pahang and Sungai Lalang Forest Reserve, Selangor respectively.

Pre-felling sample plot data were analysed, and summarized into treatment block averages using computer programme developed by the Forestry Department Headquarters, Kuala Lumpur which provided for each treatment blocks summary stand and stock tables (both cumulative and non-cumulative) showing:-

(i)	Gross number of trees per hectare;	by species and/or species groups and by diameter classes and/or diameter limits.
(ii)	Net number of trees per hectare;	
(iii)	Gross volume per hectare;	
(iv)	Net volume per hectare;	
(v)	Basal area per hectare;	

In the analysis, all trees were grouped into nine (9) species groups with group 1 - 4 being dipterocarps and group 5 - 9 being non-dipterocarps. A detailed listing of the various species under each species group is as shown in Appendix III while an adapted version of the Non-cumulative and Cumulative summary stand and stock tables for treatment block 01, Lesong Forest Reserve, Pahang are as shown in Tables 1 and 2 respectively.

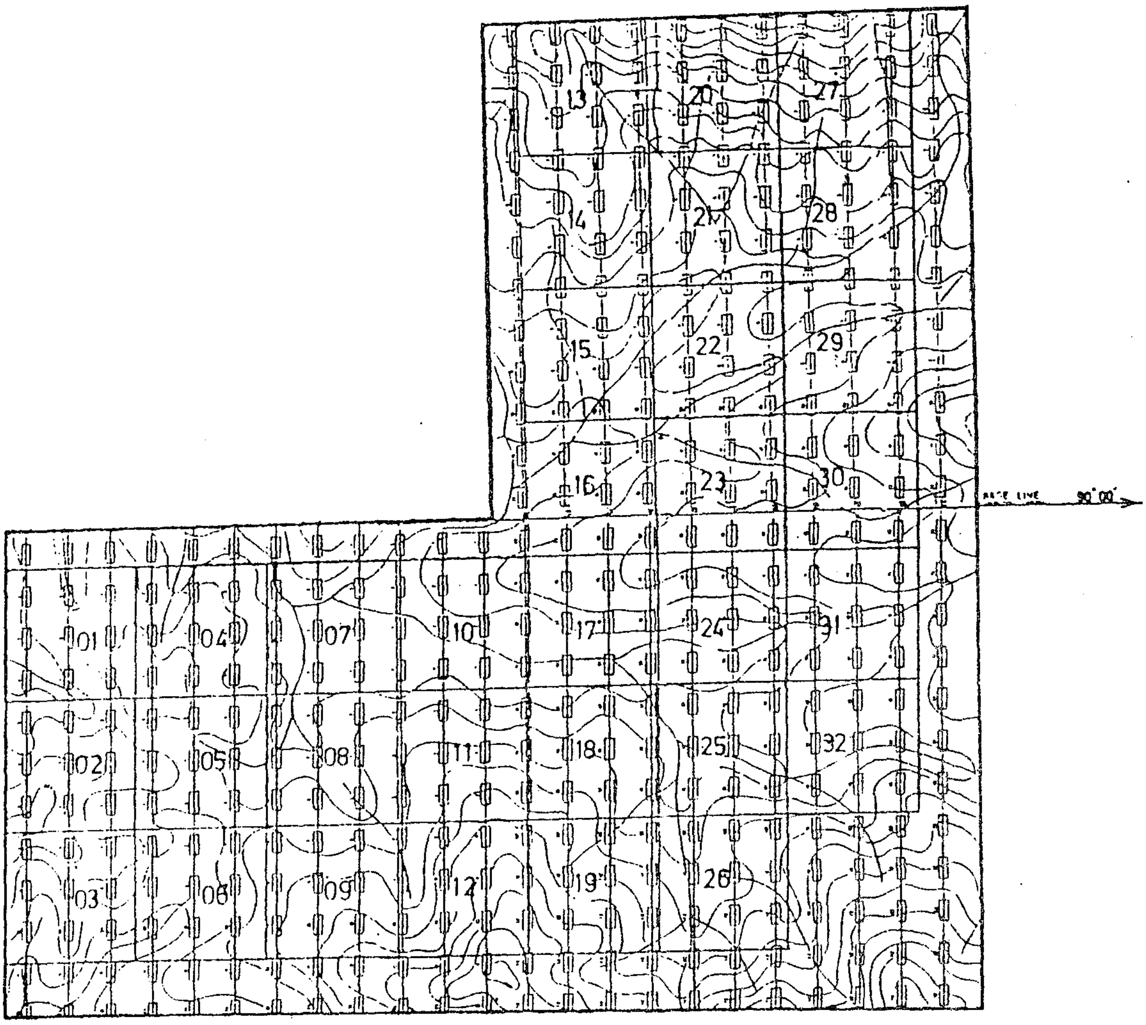
From the summary stand and stock tables details for fifteen (15) variables were compiled and listed for each treatment block which were as follows:-

Variables of Treatment Block (volume/ha)

(i)	>15 - 30cm	)	
(ii)	>30 - 45cm	)	Dipterocarps
(iii)	>45 - 60cm	)	
(iv)	>60cm	)	
(v)	>15 - 30cm	)	
(vi)	>30 - 45cm	)	Non-dipterocarps
(vii)	>45 - 60cm	)	
(viii)	>60cm	)	
(ix)	>15 - 30cm	)	
(x)	>30 - 45cm	)	
(xi)	>45 - 60cm	)	All species
(xii)	>15cm	)	
(xiii)	>30cm	)	
(xiv)	>60cm	)	
(xv)	Equivalent no. of trees/ha (for all trees >15cm dbh)*	)	(No/ha)

* The calculation of equivalent number of trees for all trees above 15cm dbh was based on the concept of SMS. Trees from the diameter class >30 - 45cm was taken as base and given an equivalent value of 1 while trees above 45cm dbh was considered more superior and thus given a conservative equivalent value of 2 and trees from the diameter class >15 - 30cm were given an equivalent value of 1/3. For example, a treatment block contains 30 trees/ha from the diameter class >15 - 30cm, 15 trees/ha from the diameter class >30 - 45cm and 8 trees/ha having diameter greater than 45cm, the total equivalent number of trees/ha in the treatment block was calculated as follows:-

Scale 1 : 18,000



LEGEND

Pre-felling samples

Blocks

Figure 2A : Distribution of Pre Felling Samples Within Treatment Plots Lesong Forest Reserve, Pahang

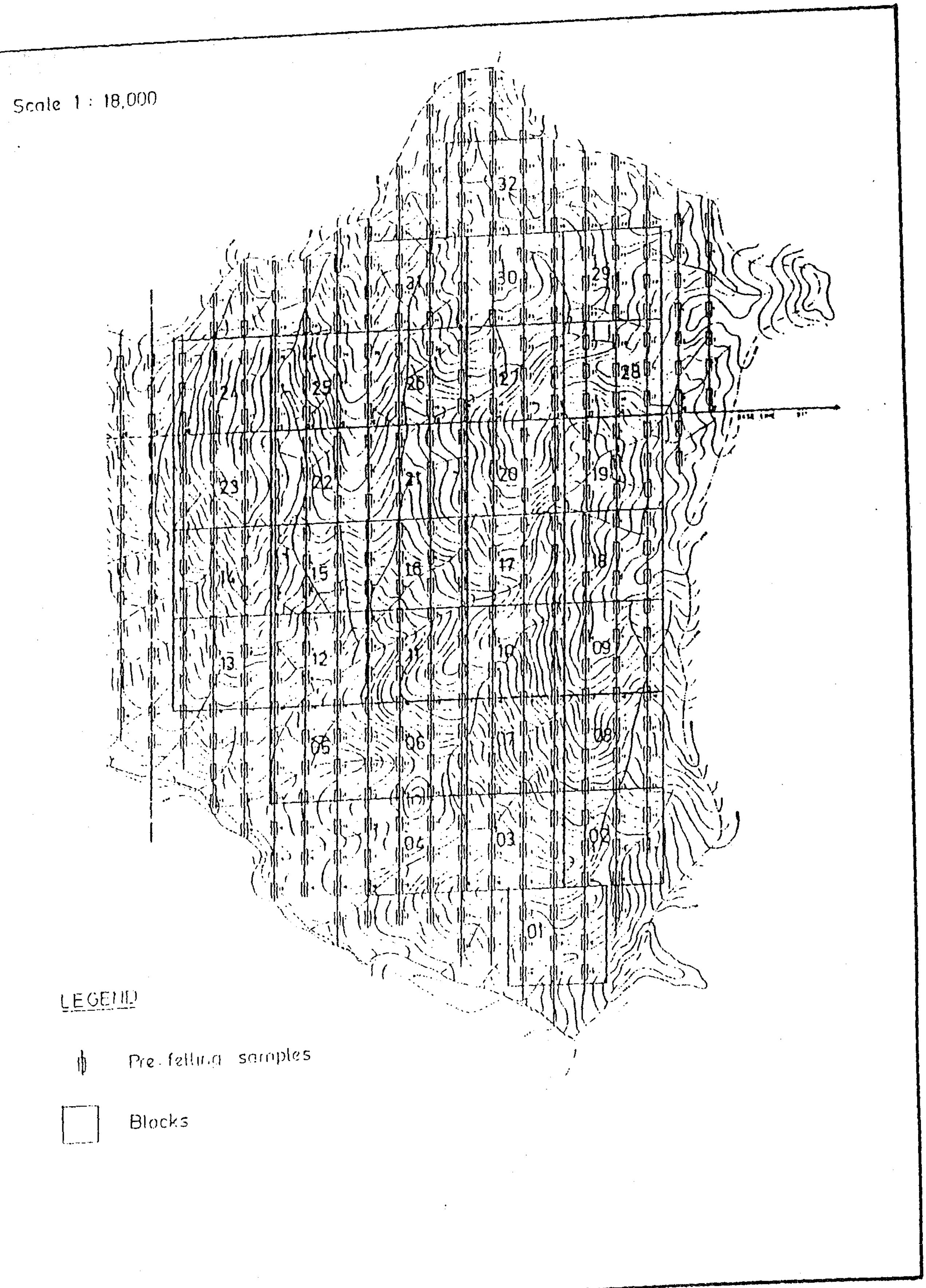


Figure 2B : DISTRIBUTION OF PRE-FELLING SAMPLES WITHIN TREATMENT PLOTS SUNGAI LALANG FOREST RESERVE, SELANGOR

FORESTRY DEPARTMENT HEADQUARTERS MALAYSIA.
PRE-FELLING FOREST INVENTORY.
LESONG FOREST RESERVE, PAHANG
TREATMENT BLOCK 1

TABLE 1 : NON-CUMULATIVE SUMMARY STAND AND STOCK TABLE.

SPECIES GROUP	DIAMETER CLASSES	35	30	45	50	55	60	65	70	75	80	85	>90	TOTA
GROUP 1	GROSS NO. OF TREES	15.56	5.56	.00	1.11	3.33	.00	.00	.00	.00	.00	.00	2.22	27.
	NET NO. OF TREES	7.78	3.33	.00	.78	2.33	.00	.00	.00	.00	.00	.00	1.78	16.
	GROSS VOLUME	1.82	3.97	.00	1.48	5.62	.00	.00	.00	.00	.00	.00	34.11	47.
	NET VOLUME	1.09	2.38	.00	.89	3.37	.00	.00	.00	.00	.00	.00	23.88	31.
	BASAL AREA	.56	.61	.00	.23	.86	.00	.00	.00	.00	.00	.00	2.62	4.
GROUP 2	GROSS NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.0
	NET NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.0
	GROSS VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.0
	NET VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.0
	BASAL AREA	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.0
GROUP 3	GROSS NO. OF TREES	2.22	.00	.00	3.33	1.11	1.11	1.11	.00	.00	1.11	.00	1.11	11.1
	NET NO. OF TREES	1.11	.00	.00	2.33	.78	.89	.89	.00	.00	.89	.00	.89	7.7
	GROSS VOLUME	.49	.00	.00	4.91	1.77	3.32	3.63	.00	.00	7.95	.00	10.39	32.4
	NET VOLUME	.29	.00	.00	2.95	1.06	2.33	2.54	.00	.00	5.56	.00	7.27	22.0
	BASAL AREA	.15	.00	.00	.76	.27	.34	.37	.00	.00	.61	.00	.80	3.3
GROUP 4	GROSS NO. OF TREES	.00	1.11	.00	.00	.00	.00	1.11	.00	.00	.00	.00	1.11	3.3
	NET NO. OF TREES	.00	.67	.00	.00	.00	.00	.89	.00	.00	.00	.00	.89	2.4
	GROSS VOLUME	.00	.79	.00	.00	.00	.00	3.76	.00	.00	.00	.00	12.63	17.1
	NET VOLUME	.00	.48	.00	.00	.00	.00	2.63	.00	.00	.00	.00	8.84	11.9
	BASAL AREA	.00	.12	.00	.00	.00	.00	.39	.00	.00	.00	.00	.97	1.4
GROUP 5	GROSS NO. OF TREES	17.78	6.67	1.11	.00	1.11	.00	.00	.00	.00	.00	.00	.00	26.6
	NET NO. OF TREES	8.89	4.00	.78	.00	.78	.00	.00	.00	.00	.00	.00	.00	14.4
	GROSS VOLUME	1.63	5.29	1.21	.00	1.73	.00	.00	.00	.00	.00	.00	.00	9.8
	NET VOLUME	.98	3.18	.73	.00	1.04	.00	.00	.00	.00	.00	.00	.00	5.9
	BASAL AREA	.50	.81	.19	.00	.27	.00	.00	.00	.00	.00	.00	.00	1.7
GROUP 6	GROSS NO. OF TREES	2.22	.00	.00	.00	.00	.00	.00	.00	1.11	.00	.00	.00	3.3
	NET NO. OF TREES	1.11	.00	.00	.00	.00	.00	.00	.00	.89	.00	.00	.00	2.0
	GROSS VOLUME	.19	.00	.00	.00	.00	.00	.00	.00	4.79	.00	.00	.00	4.9
	NET VOLUME	.11	.00	.00	.00	.00	.00	.00	.00	3.35	.00	.00	.00	3.4
	BASAL AREA	.06	.00	.00	.00	.00	.00	.00	.00	.49	.00	.00	.00	.5
GROUP 7	GROSS NO. OF TREES	.00	.00	.00	.00	.00	1.11	1.11	.00	.00	.00	.00	.00	2.2
	NET NO. OF TREES	.00	.00	.00	.00	.00	.89	.89	.00	.00	.00	.00	.00	1.7
	GROSS VOLUME	.00	.00	.00	.00	.00	3.30	3.59	.00	.00	.00	.00	.00	6.9
	NET VOLUME	.00	.00	.00	.00	.00	2.31	2.52	.00	.00	.00	.00	.00	4.8
	BASAL AREA	.00	.00	.00	.00	.00	.34	.37	.00	.00	.00	.00	.00	.7
GROUP 8	GROSS NO. OF TREES	133.33	31.11	10.00	2.22	1.11	2.22	2.22	1.11	.00	.00	.00	.00	183.3
	NET NO. OF TREES	66.67	18.67	7.00	1.56	.78	1.78	1.78	.89	.00	.00	.00	.00	99.11
	GROSS VOLUME	15.20	22.34	11.26	3.11	1.97	6.54	7.22	4.39	.00	.00	.00	.00	72.03
	NET VOLUME	9.12	13.41	6.76	1.86	1.18	4.58	5.06	3.07	.00	.00	.00	.00	45.03
	BASAL AREA	4.68	3.44	1.73	.48	.30	.67	.74	.45	.00	.00	.00	.00	12.49
GROUP 9	GROSS NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	BASAL AREA	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
DIPTEROCARP	GROSS NO. OF TREES	17.78	6.67	.00	4.44	4.44	1.11	2.22	.00	.00	1.11	.00	4.44	42.2
	NET NO. OF TREES	8.89	4.00	.00	3.11	3.11	.89	1.78	.00	.00	.89	.00	3.56	26.22
	GROSS VOLUME	2.31	4.76	.00	6.39	7.39	3.32	7.39	.00	.00	7.95	.00	57.13	96.65
	NET VOLUME	1.39	2.86	.00	3.84	4.43	2.33	5.17	.00	.00	5.56	.00	39.99	65.57
	BASAL AREA	.71	.73	.00	.98	1.14	.34	.76	.00	.00	.61	.00	4.39	9.67
NON DIPTEROCARP	GROSS NO. OF TREES	153.33	37.78	11.11	2.22	2.22	3.33	3.33	1.11	1.11	.00	.00	.00	215.56
	NET NO. OF TREES	76.67	22.67	7.78	1.56	1.56	2.67	2.67	.89	.89	.00	.00	.00	117.33
	GROSS VOLUME	17.02	27.63	12.47	3.11	3.70	9.84	10.82	4.39	4.79	.00	.00	.00	93.76
	NET VOLUME	10.21	16.58	7.48	1.86	2.22	6.89	7.57	3.07	3.35	.00	.00	.00	59.24
	BASAL AREA	5.24	4.25	1.92	.48	.57	1.01	1.11	.45	.49	.00	.00	.00	15.51
TOTAL	GROSS NO. OF TREES	171.11	44.44	11.11	6.67	6.67	4.44	5.56	1.11	1.11	1.11	.00	4.44	257.78
	NET NO. OF TREES	85.56	25.67	7.78	4.67	4.67	3.56	4.44	.89	.89	.89	.00	3.56	143.56
	GROSS VOLUME	19.33	32.40	12.47	9.50	11.09	13.16	18.21	4.39	4.79	7.95	.00	57.13	190.41
	NET VOLUME	11.60	19.44	7.48	5.70	6.65	9.21	12.75	3.07	3.35	5.56	.00	39.99	124.81
	BASAL AREA	5.95	4.98	1.92	1.46	1.71	1.35	1.87	.45	.49	.61	.00	4.39	25.18

FORESTRY DEPARTMENT HEADQUARTERS MALAYSIA.
PRE-FELLING FOREST INVENTORY.
LESONG FOREST RESERVE, PAHANG
TREATMENT BLOCK 1.

TABLE 2 : CUMMULATIVE SUMMARY STAND AND STOCK TABLE.

SPECIES GROUP	DIAMETER LIMITS	>15	>30	>45	>50	>55	>60	>65	>70	>75	>80	>85	>90
GROUP 1	GROSS NO. OF TREES	27.78	12.22	6.67	6.67	5.56	2.22	2.22	2.22	2.22	2.22	2.22	2.22
	NET NO. OF TREES	16.00	8.22	4.89	4.89	4.11	1.78	1.78	1.78	1.78	1.78	1.78	1.78
	GROSS VOLUME	47.00	45.18	41.22	41.22	39.74	34.11	34.11	34.11	34.11	34.11	34.11	34.11
	NET VOLUME	31.61	30.52	28.14	28.14	27.25	23.88	23.88	23.88	23.88	23.88	23.88	23.88
	BASAL AREA	4.89	4.33	3.72	3.72	3.49	2.62	2.62	2.62	2.62	2.62	2.62	2.62
GROUP 2	GROSS NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	BASAL AREA	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
GROUP 3	GROSS NO. OF TREES	11.11	8.89	8.89	8.89	5.56	4.44	3.33	2.22	2.22	2.22	1.11	1.11
	NET NO. OF TREES	7.78	6.67	6.67	6.67	4.33	3.56	2.67	1.78	1.78	1.78	.89	.89
	GROSS VOLUME	32.46	31.97	31.97	31.97	27.06	25.29	21.97	18.34	18.34	18.34	10.39	10.39
	NET VOLUME	22.00	21.71	21.71	21.71	18.76	17.70	15.38	12.84	12.84	12.84	7.27	7.27
	BASAL AREA	3.30	3.15	3.15	3.15	2.40	2.12	1.78	1.41	1.41	1.41	.80	.80
GROUP 4	GROSS NO. OF TREES	3.33	3.33	2.22	2.22	2.22	2.22	2.22	1.11	1.11	1.11	1.11	1.11
	NET NO. OF TREES	2.44	2.44	1.78	1.78	1.78	1.78	1.78	.89	.89	.89	.89	.89
	GROSS VOLUME	17.18	17.18	16.39	16.39	16.39	16.39	16.39	12.63	12.63	12.63	12.63	12.63
	NET VOLUME	11.95	11.95	11.47	11.47	11.47	11.47	11.47	8.84	8.84	8.84	8.84	8.84
	BASAL AREA	1.48	1.48	1.36	1.36	1.36	1.36	1.36	.97	.97	.97	.97	.97
GROUP 5	GROSS NO. OF TREES	26.67	8.89	2.22	1.11	1.11	.00	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	14.44	5.56	1.56	.78	.78	.00	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	9.86	8.23	2.94	1.73	1.73	.00	.00	.00	.00	.00	.00	.00
	NET VOLUME	5.92	4.94	1.76	1.04	1.04	.00	.00	.00	.00	.00	.00	.00
	BASAL AREA	1.77	1.27	.45	.27	.27	.00	.00	.00	.00	.00	.00	.00
GROUP 6	GROSS NO. OF TREES	3.33	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	.00	.00	.00
	NET NO. OF TREES	2.00	.89	.89	.89	.89	.89	.89	.89	.89	.00	.00	.00
	GROSS VOLUME	4.98	4.79	4.79	4.79	4.79	4.79	4.79	4.79	4.79	.00	.00	.00
	NET VOLUME	3.46	3.35	3.35	3.35	3.35	3.35	3.35	3.35	3.35	.00	.00	.00
	BASAL AREA	.55	.49	.49	.49	.49	.49	.49	.49	.49	.00	.00	.00
GROUP 7	GROSS NO. OF TREES	2.22	2.22	2.22	2.22	2.22	2.22	1.11	.00	.00	.00	.00	.00
	NET NO. OF TREES	1.78	1.78	1.78	1.78	1.78	1.78	.89	.00	.00	.00	.00	.00
	GROSS VOLUME	6.90	6.90	6.90	6.90	6.90	6.90	3.59	.00	.00	.00	.00	.00
	NET VOLUME	4.83	4.83	4.83	4.83	4.83	4.83	2.52	.00	.00	.00	.00	.00
	BASAL AREA	.71	.71	.71	.71	.71	.71	.37	.00	.00	.00	.00	.00
GROUP 8	GROSS NO. OF TREES	183.33	50.00	18.89	8.89	6.67	5.56	3.33	1.11	.00	.00	.00	.00
	NET NO. OF TREES	99.11	32.44	13.78	6.78	5.22	4.44	2.67	.89	.00	.00	.00	.00
	GROSS VOLUME	72.03	56.83	34.49	23.23	20.12	18.15	11.61	4.39	.00	.00	.00	.00
	NET VOLUME	45.03	35.91	22.51	15.75	13.89	12.70	8.13	3.07	.00	.00	.00	.00
	BASAL AREA	12.49	7.81	4.38	2.64	2.16	1.86	1.19	.45	.00	.00	.00	.00
GROUP 9	GROSS NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET VOLUME	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	BASAL AREA	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
DIPTEROCARP	GROSS NO. OF TREES	42.22	24.44	17.78	17.78	13.33	8.89	7.78	5.56	5.56	5.56	4.44	4.44
	NET NO. OF TREES	26.22	17.33	13.33	13.33	10.22	7.11	6.22	4.44	4.44	4.44	3.56	3.56
	GROSS VOLUME	96.65	94.34	89.57	89.57	83.18	75.79	72.47	65.08	65.08	65.08	57.13	57.13
	NET VOLUME	65.57	64.18	61.32	61.32	57.49	53.05	50.73	45.55	45.55	45.55	39.99	39.99
	BASAL AREA	9.67	8.96	8.23	8.23	7.24	6.10	5.76	5.01	5.01	5.01	4.39	4.39
NON-DIPTEROCARP	GROSS NO. OF TREES	215.56	62.22	24.44	13.33	11.11	8.89	5.56	2.22	1.11	.00	.00	.00
	NET NO. OF TREES	117.33	40.67	18.00	10.22	8.67	7.11	4.44	1.78	.89	.00	.00	.00
	GROSS VOLUME	93.76	76.75	49.11	36.64	33.53	29.83	19.99	9.17	4.79	.00	.00	.00
	NET VOLUME	59.24	49.03	32.45	24.97	23.10	20.88	13.99	6.42	3.35	.00	.00	.00
	BASAL AREA	15.51	10.28	6.03	4.11	3.63	3.06	2.05	.94	.49	.00	.00	.00
TOTAL	GROSS NO. OF TREES	257.78	86.67	42.22	31.11	24.44	17.78	13.33	7.78	6.67	5.56	4.44	4.44
	NET NO. OF TREES	143.56	58.00	31.33	23.56	18.89	14.22	10.67	6.22	5.33	4.44	3.56	3.56
	GROSS VOLUME	190.41	171.08	138.69	126.21	116.71	105.62	92.46	74.25	69.86	65.08	57.13	57.13
	NET VOLUME	124.81	113.21	93.77	86.29	80.59	73.93	64.72	51.98	48.90	45.55	39.99	39.99
	BASAL AREA	25.18	19.24	14.25	12,33	10.87	9.16	7.81	5.95	5.50	5.01	4.39	4.39

Total equivalent number of trees/ha

$$= 1/3 \times (\text{No. of trees} >15\text{-}30\text{cm}) + 1 \times (\text{No. of trees} >30\text{-}45\text{cm}) + 2 \times (\text{No. of trees greater than } 45\text{cm})$$

$$= 1/3 \times (30) + 1 \times (15) + 2(8)$$

$$= 10 + 15 + 16$$

$$= 41 \text{ trees/ha}$$

For each variable, all the treatment blocks were ranked accordingly, with treatment block having the lowest value (Volume/ha or No. of trees/ha) being assigned a rank number of 1 while that having the highest value being assigned a rank number of 32. Treatment blocks having the same value would be assigned equal rank number.

These rankings were carried out for all the fifteen (15) variables as mentioned-above and subsequently recompiled into nine (9) ranking lists for each treatment block as shown in Table 3.

From the nine (9) ranking lists the various blocks which fall in the lower uptill the higher one-quarter of the ranges of the nine (9) lists was determined. Borderline cases were decided individually.

Numerical examples of the full ranking procedures for the study areas at Lesong Forest Reserve, Pahang and Sungai Lalang Forest Reserve, Selangor are as shown in Appendices V and VI respectively.

3.0 RANDOMISATION OF TREATMENTS

For meaningful statistical analysis in later stage, the allocation of the various treatments within each stocking class was randomised. In this project all the treatments with the exceptions of indigenuous plantation establishment and control; the location of which were pre-determined to facilitate logging and planting were located within each of the four (4) stocking classes by drawing a random number. The pre-determined and randomised locations of the various treatments within the study area for both study areas at Lesong Forest Reserve, Pahang and Sungai Lalang Forest Reserve, Selangor are as shown in Figures 3A and 3B respectively.

Table 3: RANKING LIST FOR TREATMENT BLOCKS

Variables of Treatment Block (volume/ha)	Ranking of Treatment Blocks in Study Area	Ranking Lists
Dipterocarps		
(i) DBH 15 - 30cm	a	
(ii) DBH 30 - 45cm	b	
(iii) DBH 45 - 60cm	c	
(iv) DBH >60cm	d	
Total Scores	a+b+c+d	(1) Total scores Dipterocarp
Non-Dipterocarps		
(v) DBH 15 - 30cm	e	
(vi) DBH 30 - 45cm	f	
(vii) DBH 45 - 60cm	g	
(viii) DBH >60cm	h	
Total Scores	a+b+c+d+e...+h	(2) Total scores all species
All Species		
(ix) 15 - 30cm	i	(3) Total score 15 - 30cm
(x) 30 - 45cm	j	(4) Total score 30 - 45cm
(xi) 45 - 60cm	k	(5) Total score 45 - 60cm
(xii) >15cm	l	(6) Total score >15cm
(xiii) >30cm	m	(7) Total score >30cm
(xiv) >60cm	n	(8) Total score >60cm
(xv) Equivalent no. of trees (no/ha)	o	(9) Total score all trees >15cm dbh

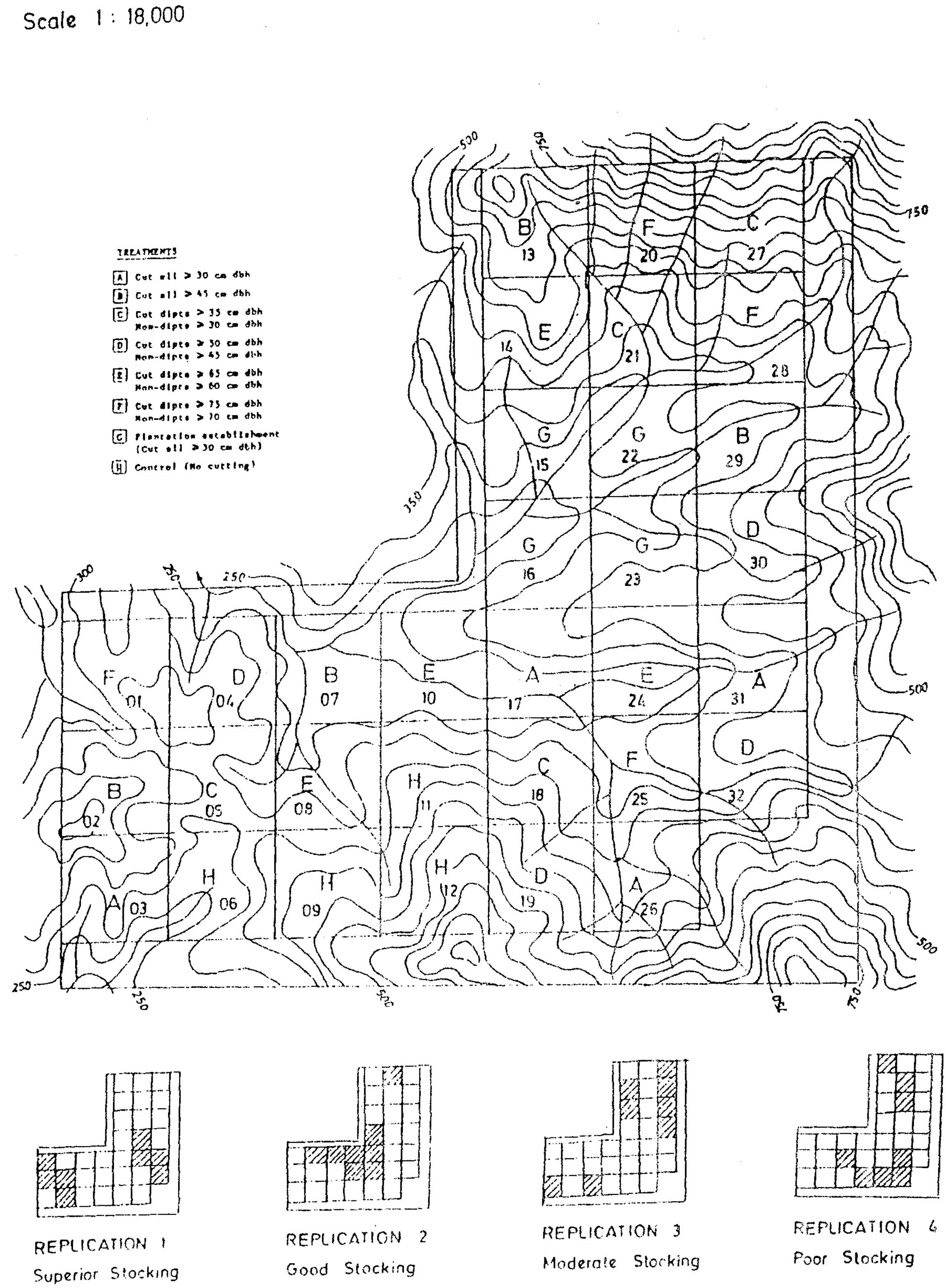


Figure 3A: Allocation of Treatments within Study Area
Lesong Forest Reserve, Pahang

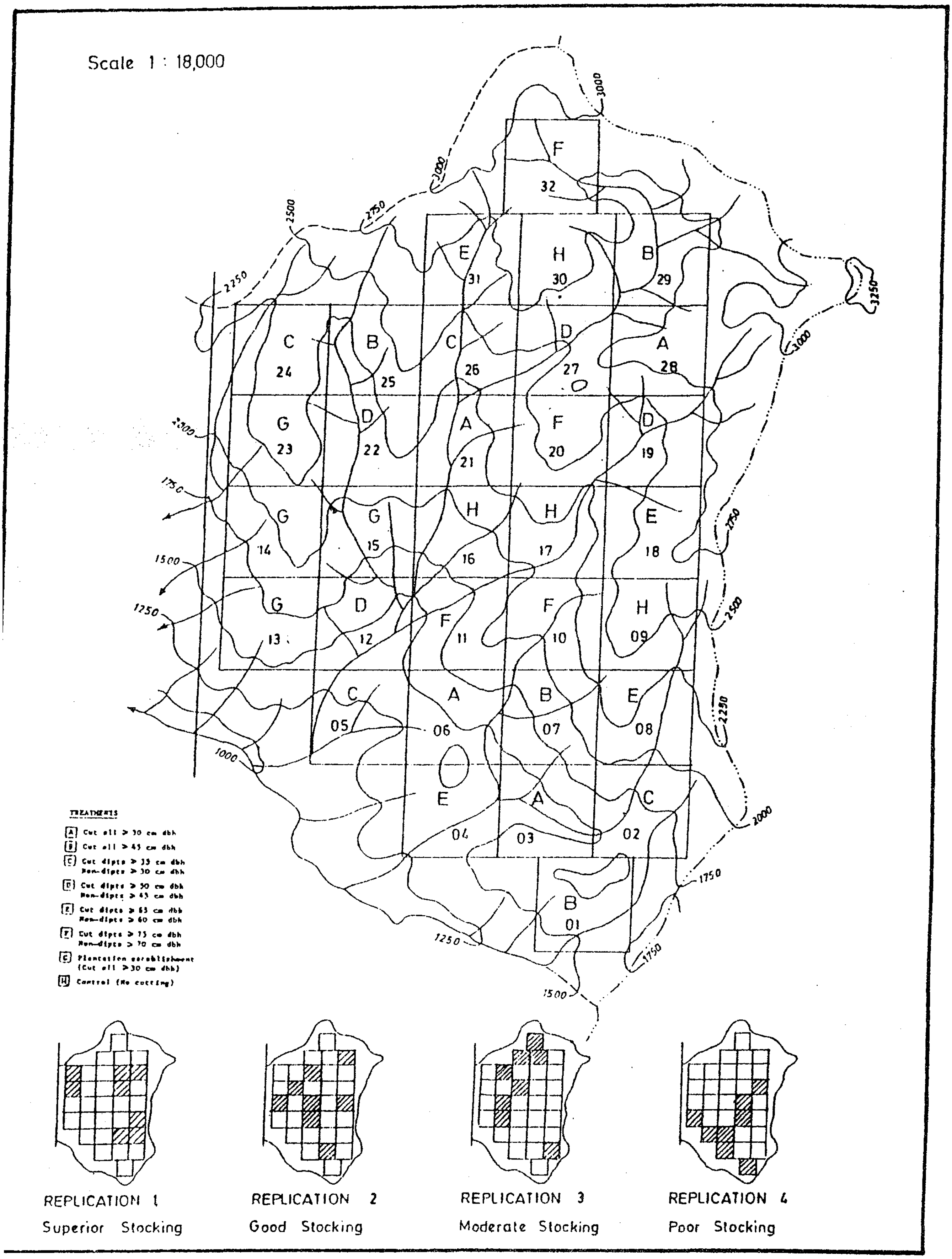


Figure 3B : Allocation of Treatments Within Study Area
Sungai Lalang Forest Reserve
Selangor

4.0 BOUNDARY DEMARCATION, TREE MARKING AND FOREST HARVESTING

Prior to the marking of trees to be felled, boundary demarcation (1 meter wide) for all treatment blocks were carried out. Along the boundary, all trees below 10cm dhb may be .cut while the four (4) corners of the treatment blocks were marked with 5cm diameter PVC pickets. In addition, circumferences of tree below 30cm dbh were painted yellow at breast height at a spacing of 10 meter along the boundary. Boundary demarcation and marking of all trees to be felled according to the cutting limits prescribed by blocks was completed in June, 1989 for the study area in Pahang while that for the study area in Selangor was completed in September, 1989.

All trees to be felled in each treatment blocks, as specified by the cutting limit, were located and marked as follows:-

- tree number (sequential per plot) was painted on metal tag at dbh level.

- tree number and the direction of felling (indicated by an arrow head) was painted at stump level.

Information for all trees to be felled in each treatment block were recorded using a tree marking and harvesting form as shown in Appendix VII. Before felling, only information on tree number, species name, species code, diameter at breast height were being recorded. Upon felling, the list was completed by entering for each tree the dimensions of logs bucked from the stem which were as follows:-

(i) total length of log;
(ii) large end diameter;
(iii) small end diameter;
(iv) length of log; and
(v) note and remarks if any.

Harvesting operations were carried out in all treatment blocks except the four (4) treatment blocks under control in accordance with the cutting limits prescribed. In Pahang, felling of marked trees in all blocks except the control blocks where no harvesting of trees was allowed commenced in July 1989 and was completed in June, 1990. Felling of all marked trees in Selangor commenced in mid-September, 1989. However, it was only completed in August 1991 due to difficult terrains and the necessity to call for a tender to cut the remaining trees which were not felled during the first harvesting operation. During the harvesting operations, staff from the Forestry Departments were in attendance to supervise as well as record the dimension of the stems after felling.

5.0 ESTABLISHMENT AND REMEASUREMENT OF PERMANENT SAMPLE PLOT

Immediately after completion of all harvesting operations, a permanent sample plot measuring 100m x 100m (1 ha) was laid out, as far as possible, in the centre of each treatment block. The design of the permanent sample plot is as shown in Figure 4.

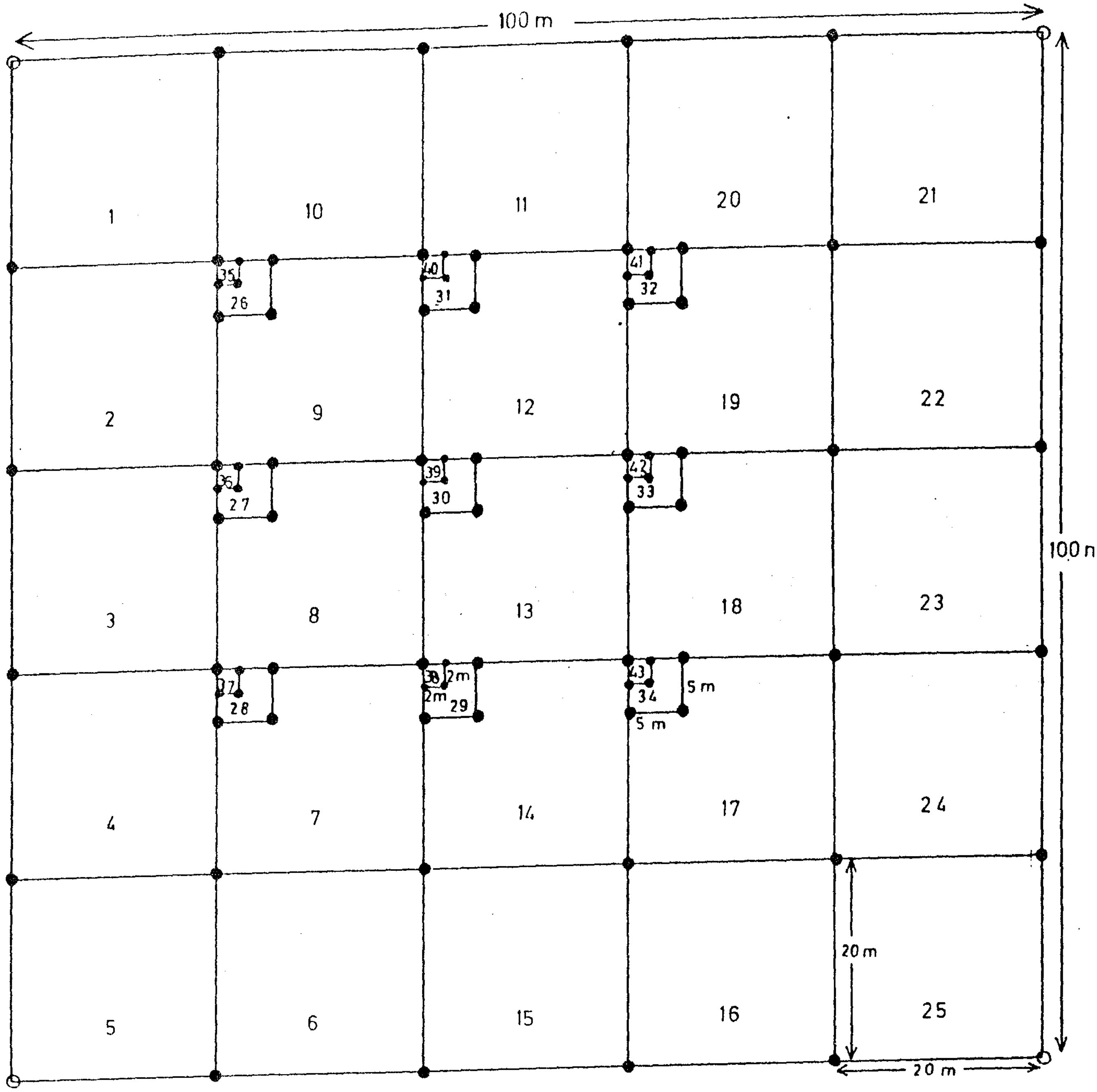
Each permanent sample plot consists of twenty five (25) quadrats (sub-plots) of size 20m x 20m, nine (9) quadrats of size 5m x 5m and nine (9) quadrats of size 2m x 2m.

The dimension of the various quadrats, quadrat number and the size classes of trees to be enumerated within each quadrat are as follows:-

Quadrat size	Quadrat number	Size class
20m x 20m	1, 2, 3, 4, 5, 6, 15, 16, 25, 24, 23, 22, 21, 20, 11, 10	> 15cm diameter
20m x 20m	7, 8, 9, 12, 13, 14, 17, 18, 19	> 5cm diameter
5m x 5m	26, 27, 28, 29, 30 31, 32, 33, 34	> 1.5m height - 5cm diameter
2m x 2m	35, 36, 37, 38, 39, 40, 41, 42, 43	15cm height - 1.5m height

All trees above 5cm dbh within each permanent sample plot were numbered with aluminium tag sequentially while number of seedlings 15cm high till sapling of size 5cm dbh were being counted. All trees within the size classes corresponding to the selected quadrats were enumerated to species level, as far as possible, while sample trees were measured to the nearest one-tenth of a centimeter in diameter and to the nearest centimeter in height. All diameters were measured at breast height (1.3m) or 0.3m above buttress. A set of the enumeration forms corresponding to the size classes of trees to be enumerated is as shown in Appendix VIII.

In addition, four(4) permanent sample plots were established as plantation plots. The design of the plantation plot is as shown in Figure 5. Each plantation plot measures 120m x 120m with 10m on each side acting as buffer area. Each plot consists of 17 planting lines with the distance between planting lines being 6m and between seedlings 3m. A total of 561 seedlings were planted within



Quadrat size	Quadrat number	Size class
20m x 20m	1, 2, 3, 4, 5, 6, 15, 16, 25, 24, 23, 22, 21, 20, 11, 10	> 15cm diameter
20m x 20m	7, 8, 9, 12, 13, 14, 17, 18, 19	> 5cm diameter
5m x 5m	26, 27, 28, 29, 30, 31, 32, 33, 34	> 1.5m height - 5cm diameter
2m x 2m	35, 36, 37, 38, 39, 40, 41, 42, 43	15cm height - 1.5m height

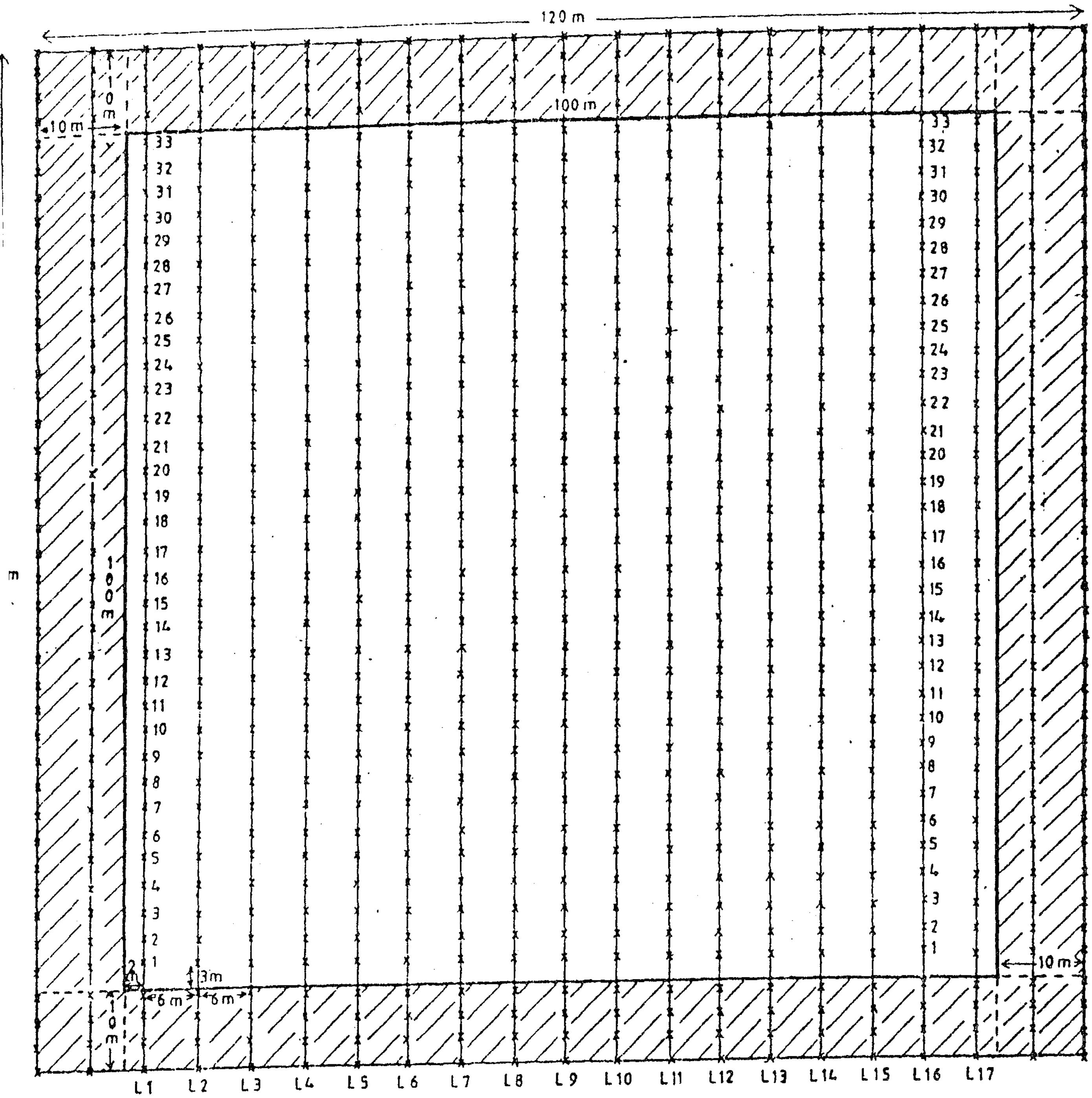
KEY:

O Yellow Painted Picket

● Red Painted Picket

Scale 1cm : 6 m

Figure 4: Design of Permanent Sample Plot



Buffer Zone

Planting Line

Permenent Sample Plot

Figure 5 : Layout of Permenent Sample Plot for Plantation Forest Establistment.

each plot. Initially, only height measurements will be undertaken for all seedlings planted until they reach 5cm diameter at breast height. Once this diameter size is achieved, only diameter measurements will be undertaken except for the 30 dominant saplings where their heights will continue to be monitored.

For all plots, a plot diagram showing the location as well as the number of trees within the quadrats was also being prepared to facilitate future remeasurement.

Demarcation and establishment of permanent sample plots of size 1 ha each, marking, tagging and first enumeration of sample trees within all plots were completed in March, 1990 for the study area in Pahang and in December, 1991 for the study area in Selangor. All these plots will be remeasured periodically to gather information on the growth and development of the residual stands after harvesting.

The permanent sample plots will be measured annually for the first five year of study; once in two years from the 7th year until the 15th year and there after once in five years. The schedule for remeasurement for the study areas located at Compartments 171 and 172, Lesong Forest Reserve, Pahang and Compartment 50, Sungai Lalang Forest Reserve, Selangor are as shown in Table 4 and Table 5, respectively.

Table 4: Schedule For Remeasurement For Compartments 171 and 172, Lesong Forest Reserve, Pahang

Measurement No.	Year of Remeasurement
1	1990
2	1991
3	1992
4	1993
5	1994
6	1996
7	1998
8	2000
9	2002
10	2004
11	2009
12	2014
13	2019
14	2024
15	2029

Table 5: Schedule For Remeasurement For Compartments 50, Sungai Lalang Forest Reserve, Selangor

Measurement No.	Year of Remeasurement
1	1992
2	1993
3	1994
4	1995
5	1996
6	1998
7	2000
8	2002
9	2004
10	2006
11	2011
12	2016
13	2021
14	2026
15	2031

6.0 DATA ANALYSIS

Data collected from the study areas will be entered into computers and a data management system for the project will be developed through an ITTO consultancy. Computer programmes in FORTRAN will be written to analyse the various growth components under different treatments as advocated by the studies and the programmes so written will be documented.

Appendix I

Technical Decisions Made During The Meetings of the Technical Working Group on Forest Management of Natural Forest in Malaysia

1. Experimental design for the virgin and logged-over forest areas is the randomised block design.

2. The cutting limits (regimes) for the virgin forest areas are as follows:-

    (a) Cut all trees having diameter $\geq$30cm at breast height;

    (b) Cut all trees having diameter $\geq$45cm at breast height;

    (c) Cut all dipterocarps and non-dipterocarps having diameter $\geq$35cm and $\geq$30cm at breast height respectively;

    (d) Cut all dipterocarps and non-dipterocarps having diameter $\geq$50cm and $\geq$45cm at breast height respectively;

    (e) Cut all dipterocarps and non-dipterocarps having diameter $\geq$65cm and $\geq$60cm at breast height respectively;

    (f) Cut all dipterocarps and non-dipterocarps having diameter $\geq$75cm and $\geq$70cm at breast height respectively;

    (g) Establishment of indigenous forest plantation (Cut all trees haging diameter $\geq$30cm at breast height followed by planting of indigeneous tree species); and

    (h) Control (no cutting).

3. For the logged-over forest area, the silvicultural treatments are as follows:-

    (a) Cutting of liana (CL);

    (b) Girdling of trees and cutting of liana (GCL);

    (c) Girdling of trees and cutting of liana coupled with enrichment planting;

(d) Establishment of indigenous forest plantation; and

(e) Control (no treatment).

4. Pre-Felling and Post-Felling forest inventories to be carried out in the virgin and logged-over forest area respectively shall be of 10% intensity.

5. The size of the permanent sample plots to be established shall be 100m x 100m (One hectare plot). The layout and design of the permenant sample plot (PSP) in the logged-over forest is the same as that in the virgin forest. However, a 10 m buffer zone surrounding the permanent sample plot which shall be subjected to the same treatment as the PSP is advocated for the logged-over forest.

6. The criteria for selecting species for the indigeneous forest plantation shall be as follows:-

(a) Dominant species found in the forest area; and

(b) Commercial species.

Based on the above criteria, the following plantation species were selected for the four (4) study areas:-

(i) <u>Pahang</u>

(a) Mengkulang (<u>Heritiera</u> spp.)

(b) Meranti Nemesu (<u>Shorea</u> <u>pauciflora</u>)

(c) Meranti Sarang Punai (<u>Shorea</u> <u>parvifolia</u>)

(d) Keruing Gombang (<u>Dipterocarpus</u> <u>cornutus</u>)

(e) Meranti Rambai Daun (<u>Shorea</u> <u>acuminata</u>)

(f) Meranti Tembaga (<u>Shorea</u> <u>leprosula</u>)

(ii) <u>Selangor</u>

(a) Meranti Sarang Punai (<u>Shorea</u> <u>parvifolia</u>)

(b) Meranti Rambai Daun (<u>Shorea</u> <u>acuminata</u>)

(iii) <u>Perak</u>

(a) Meranti Tembaga (<u>Shorea</u> <u>leprosula</u>)

(b) Meranti Sarang Punai (<u>Shorea</u> <u>parvifolia</u>)

(iv) <u>Terengganu</u>

(a) Meranti Sarang Punai (<u>Shorea</u> <u>parvifolia</u>)

(b) Keruing Bulu (<u>Dipterocarpus baudii</u>)

7. The planting distance for the indigeneous forest plantation is 3m x 6m while that of enrichment planting is 3m x 10m.

8. Selection of tree species for enrichment planting is to be based on the dominance/availability of the species in the study area and in accordance with the 'Regeneration Sampling List'.

9. Enrichment planting need not be carried out at planting sites if there is already the presence of the desired species. However, if the trees found at the planting sites are not of the desired species, enrichment planting of the desired/selected species should be carried out at a distance of 1 meter to the right of the planting site. All planting lines are to be aligned in an East-west direction and be cleared of all under-growth at a distance of 0.5m to the left and right of the line.

10. Priority is to be accorded to carry out enrichment planting in the Permenant sample plots (4 plots of 1 ha each) while the balance of the area (remaining 36 ha) shall be planted in stages depending on the availability of seedlings. It is decided that each planting line is to be planted by a specific species.

11. Treatment and refilling schedule for enrichment planting and indigenous forest plantation is as follows:-

(i)	Treatment and refilling 1	:	3 months after planting
(ii)	Treatment and refilling 2	:	9 months after planting
(iii)	Treatment and refilling 3	:	15 months after planting
(iv)	Treatment and refilling 4	:	27 months after planting

Subsequently, treatment is to be carried out yearly during remeasurement until the 5th year. Acceptable survival rate of seedling is 80%.

12. The total number of seedlings to be planted in the permanent sample plot of size 120m x 120m (inclusive of the buffer zone) under plantation establishment shall be 800 comprising not more than four (4) species. Each planting line shall be planted with a single species alternating with lines planted with other species in a sequential manner.

13. Prior to the planting of seedlings under plantation establishment, all residual trees 30 cm dbh and above within the Permanent Sample Plot (120m x 120m) shall be cut and removed from the planting line.

14. A total of 480 seedlings comprising not more than 4 species shall be planted in the permanent sample plot (120m x 120m) under enrichment planting. It is decided that each planting line shall be planted with a single species alternating with lines planted with other species in a sequential manner.

15. All seedlings planted under plantation establishment and enrichment planting will be enumerated during remeasurement. For the initial measurements when the seedlings are less than 5 cm dbh, only total height will be measured. However, once the seedlings have achieved 5 cm dbh and greater, only diameter measurement will be taken. In addition, the total height of 30 dominant saplings, selected based on the tallest height recorded, for each species planted will also be measured. In the event of death to a dominant sapling a year after measurement, it will be replaced by the next tallest sapling based on the latest height measurement before the sapling achieved 5 cm dbh. However, if the dominant sapling dies in subsequent years, it will be replaced by trees having the next biggest diameter measurement.

16. It was decided that for both plantation establishment and enrichment planting, only trees planted within the permanent sample plots will be enumerated during remeasurement. Tree planted within the buffer zone need not be enumerated.

17. A blanket silvicultural treatment of the virgin forest in the form of climber cutting (CL) shall be conducted 3 years and 10 years after harvesting in view of the findings that climbers are found to be most abundant during these periods.

18. Logging studies (harvesting cost) will be conducted over the whole study area. Average logging cost by treatment blocks will be obtained by proportioning the total logging costs incurred.

19. Assessment of stem and crown damage shall be conducted each time the remesurement is being carried out and preferrably by a specially trained and assigned team of crew.

20. The logged-over forest at Kledang Saiong Forest Reserve, Perak is to be divided into four (4) different residual basal area (BA) classes. The four (4) BA classes and the corresponding blocks for each BA class are as follows:-

	BA Class	Block No.
(a)	7 - 9 m^2/ha	4, 8, 12, 18, 19
(b)	>9 - 11 m^2/ha	5, 6, 13, 14, 15
(c)	>11 - 13 m^2/ha	2, 3, 16, 17, 20
(d)	>13 - 15 m^2/ha	1, 7, 9, 10, 11

21. The logged-over forest at Cherul Forest Reserve, Terengganu is to be divided into four (4) different residual basal area (BA) classes. The four BA classes and the corresponding blocks for each BA class are as follows:-

	BA Class	Block No.
(a)	7.5 - 9.5 m^2/ha	16, 04, 09, 10, 11
(b)	11.5 - 13.5 m^2/ha	19, 14, 08, 12, 02
(c)	>13.5 - 15.5 m^2/ha	03, 13, 15, 20, 17
(d)	>15.5 - 17.5 m^2/ha	05, 07, 18, 01, 06

22. It was decided that all trees marked for felling within the permanent sample plot (1 ha) are to be felled while at least 90% of all marked trees within the remaining treatment block (9 ha) for all treatment types should also be felled. Trees which pose danger to be felled shall be poison-girdled by using GARLON 250 (3, 5, 6 - Trichloro - 2 pyridyloxyacetic acid). Marked trees which are not felled should be recorded.

23. It was decided that the 2m x 2m quadrats will enumerate seedlings and saplings of size 15 cm height - 150 cm height instead of the earlier decision of size 15 mm height - 150 cm height.

24. The parameters that shall be taken into account during the analysis of data are as follows:-

(a) Diameter increment;

(b) Basal area increment;

(c) Volume increment;

(d) Ingrowth;

(e) Mortality rate;

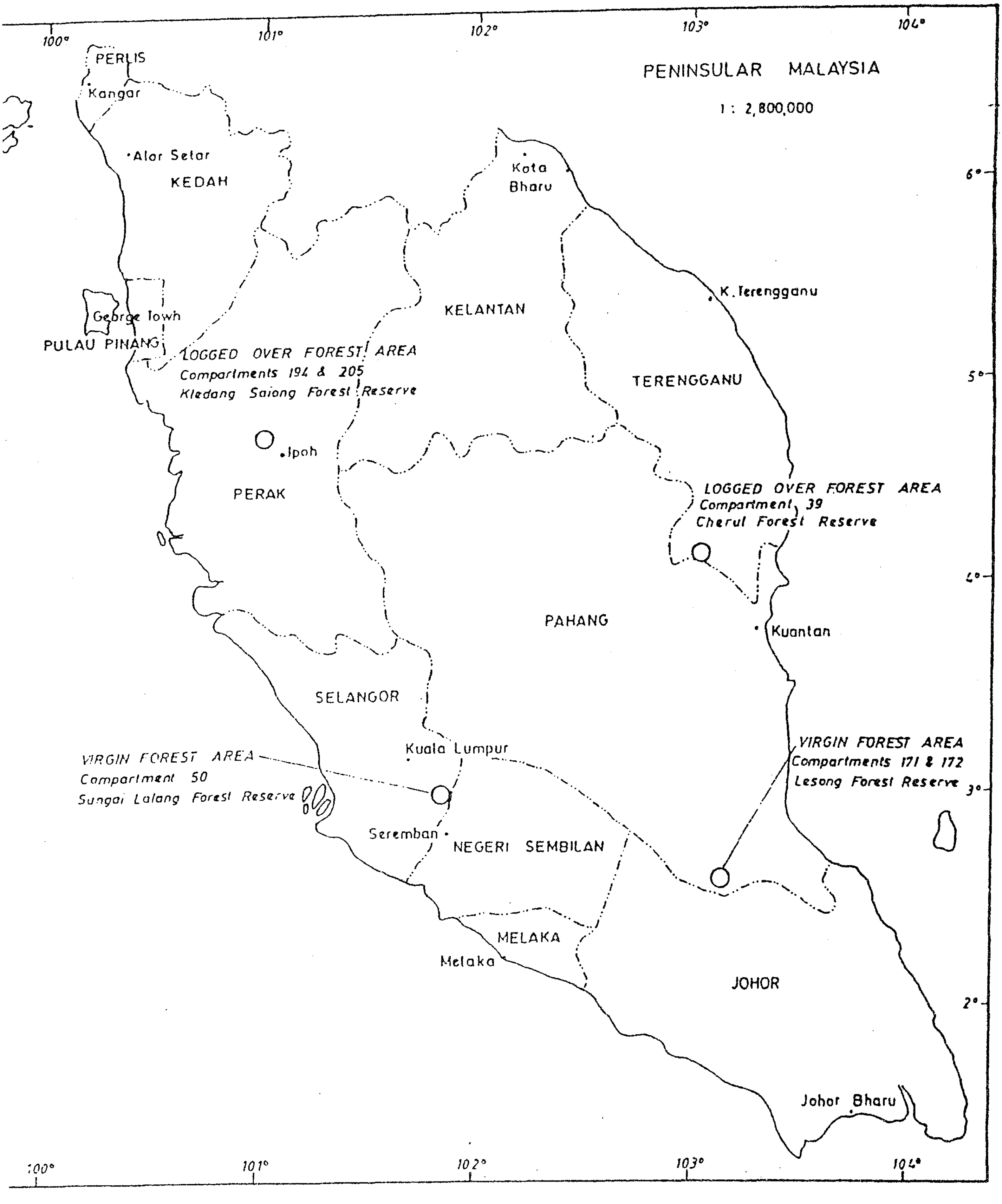
(f) Crown and stem damage;

(g) Road construction costs; and

(h) Harvesting cost.

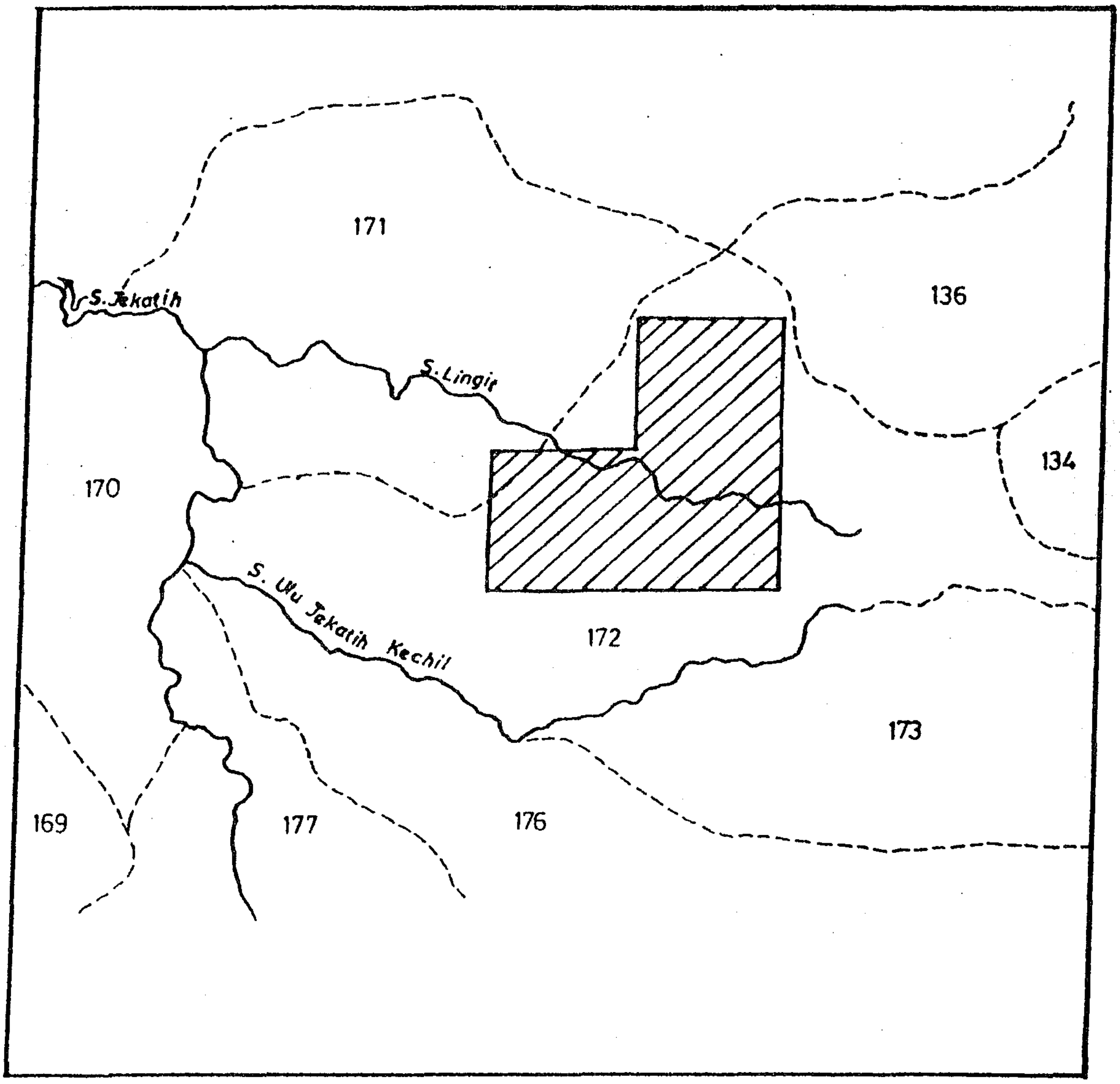
LOCATION MAP OF STUDY AREAS UNDER THE JOINT MALAYSIA - ITTO PROJECT

Map 1



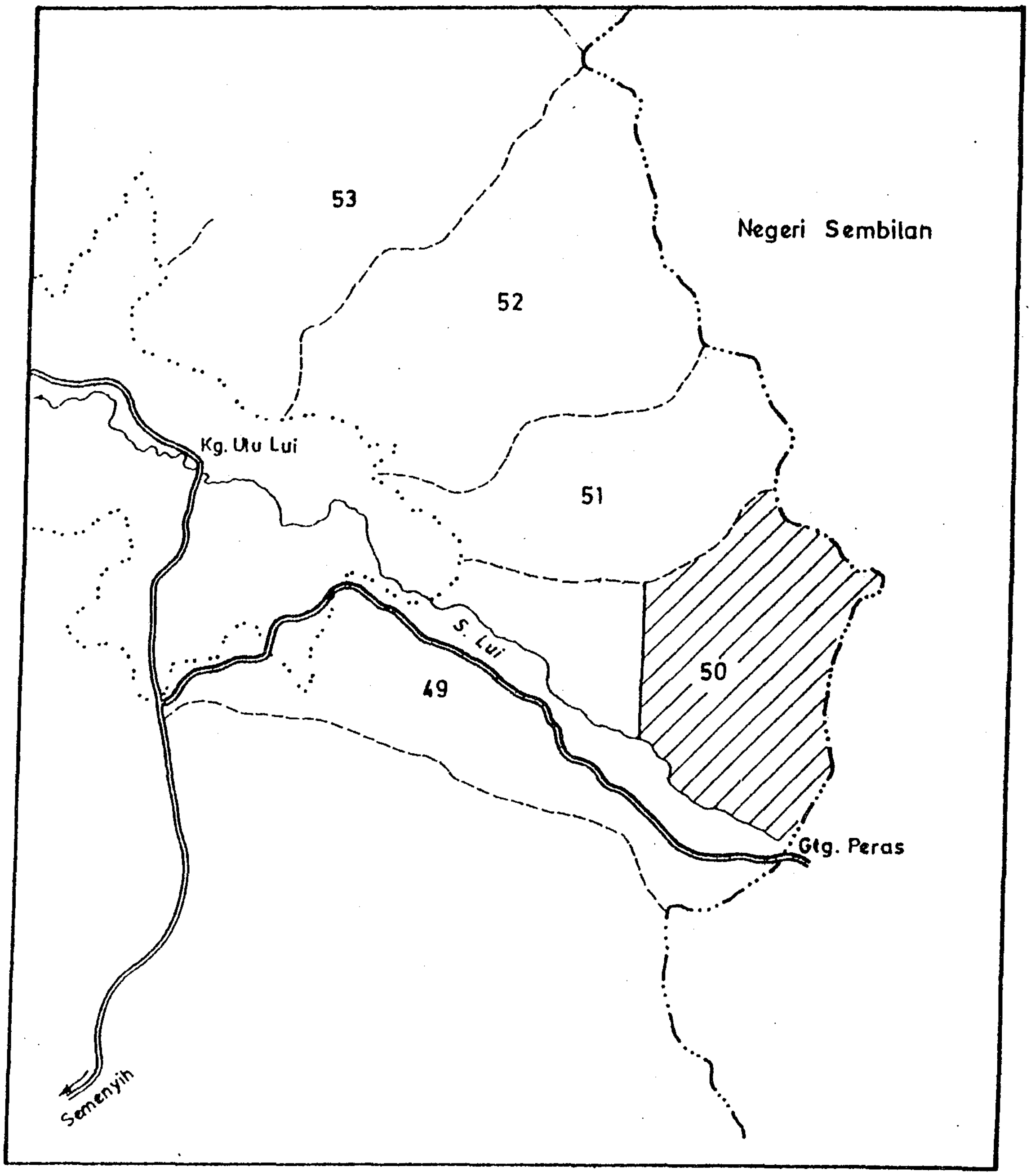
Map 2

VIRGIN FOREST AREA
Compartments 171 & 172
Lesong Forest Reserve
Pahang
1 : 63,360



Map 3

VIRGIN FOREST AREA
Compartment 50
Sungai Lalang Forest Reserve
Selangor
1:63,360



APPENDIX III

PRE-FELLING FOREST INVENTORY
FIELD SHEET
(OPERATIONAL LEVEL)

CREW LEADER:	DATE:	CARD NO.:
RECORDING OFFICER:	DATE:	
CHECKING CREW LEADER:	DATE:	

(A) GENERAL INFORMATIONS, RATTAN & BAMBOO

YEAR	STATE	FOREST RESERVE/ DISTRICT	COMPT./ BLOCK NUMBER	LINE NUMBER	PLOT NUMBER	FOREST TYPE	SOIL TYPE	GEOLOGY	FOREST'S CONDITION	SOIL'S CONDITION	ASPECT	SLOPE	SLOPE'S LOCATION	ALTITUDE	BERTAM	PALMS	FERN	RATTAN A	RATTAN B	RATTAN C	RATTAN D	RATTAN E	RATTAN F	RATTAN G	BAMBOO A	BAMBOO B	BAMBOO *C
1	2 3	4 5	6 7 8	9 10	11 12	13 14	15 16	17 18	19 20	21	22	23 24	25	26	27 28	29 30	31	32 33	34 35	36 37	38 39	40 41	42 43	44 45	46 47	48 49	50 51

(B) INFORMATIONS ON TREE AND CLIMBERS

	CODE	PLOT (50m x 20m) ALL TREES > 45cm	DIAMETER	LOG NUMBER	LOG QUALITY	CLIMBER DIAMETER	CLIMBER INTERTWINE	CODE	PLOT (50m x 20m) ALL TREES > 30cm – 45cm	DIAMETER	LOG NUMBER	LOG QUALITY	CLIMBER DIAMETER	CLIMBER INTERTWINE	CODE	PLOT (25m x 20m) SUB-PLOT A ALL TREES > 15cm – 30cm	DIAMETER	VIGOUR	CLIMBER DIAMETER	CLIMBER INTERTWINE
	1 2 3 4	SPECIES	5 6 7 8	9	10	11 12	13	14 15 16 17		18 19 20	21	22	23 24	25	26 27 28 29		30 31 32	33	34 35	36
A																				
B																				
C																				
D																				
E																				
F																				
G																				

	CODE	PLOT (25m x 20m) SUB-PLOT B ONLY TREES > 15cm – 30cm INTERTWINE WITH CLIMBER	DIAMETER	VIGOUR	CLIMBER DIAMETER	CLIMBER INTERTWINE	CODE	PLOT (10m x 10m) ALL TREES > 5cm – 15cm	DIAMETER	VIGOUR	CODE	PLOT (5m x 5m and 2m x 2m) ALL TREES ≤ 5cm	NUMBER + 1.5m ht. – 5cm dia.	NUMBER + 15cm ht. – 1.5cm ht.
	37 38 39 40		41 42 43	44	45 46	47	48 49 50 51		52 53 54	55	56 57 58 59		60 61	62 53
A														
B														
C														
D														
E														
F														
G														
H														
I														
J														

APPENDIX IV

Listing of Species Under the Various Species Groups

A. DIPTEROCARPS

Species Group	Vernacular Name	Botanical Equivalents
1	Dark Red Meranti	Shorea spp.
	Light Red Meranti	Shorea spp.
	White Meranti	Shorea spp.
	Yellow Meranti	Shorea spp.
	Meranti Melantai	Shorea spp.
2	Mersawa	Anisoptera spp.
	Merawan	Hopea spp.
	Gerutu	Parashorea spp.
3	Keruing	Dipterocarpus spp.
	Kapur	*Dryobalanops aromatica*
	Keladan	*Dryobalanops oblongifolia*
4	Balau	Shorea spp.
	Red Balau	Shorea spp.
	Chengal	*Neobalanocarpus heimii*
	Giam	Hopea spp.
	Resak	Cotylelobium spp. and Vatica spp.

B. NON-DIPTEROCARPS

Species Group	Vernacular Name	Botanical Equivalents
5 (All Light Hardwoods) (Fully Marketable)	Bengang	Neesia spp.
	Bintangor	Calophyllum spp.
	Durian	Durio spp.
	Geronggang	Cratoxylum spp.
	Jangkang	Xylopia spp.
	Jelutong	*Dyera costulata*
	Kedondong	Family of Burseraceae Canarium spp., Dacryodes spp., Santiria spp., *Triomma malaccensis* and *Scutinanthe brunnea*
	Kembang semangkok	Scaphium spp.
	Keredas	*Pithecellobium bubalinum*
	Kungkur	*Pithelellobium splendens*
	Machang	Mangifera spp.
	Ramin	Gonystylus spp.
	Mempisang	Annonaceae spp.

Species Group	Vernacular Name	Botanical Equivalents
	Nyatoh	Family of Sapotaceae Ganua spp., Palaquium spp., Payena spp., Pouteria spp., Planchonella spp., Madhuca spp. and *Manikara kauki*
	Pelong	Pentaspadon spp.
	Punggai	*Ceolostegia griffithii*
	Sepetir	Sindora spp.
	Sesenduk	*Eudospermum malaccense*
	Terentang	Campnosperma spp.
6 (All Medium Hardwoods) (Fully Marketable)	Cempedak	Artocarpus spp.
	Kempas	*Koompassia malaccensis*
	Keledang	Artocarpus spp.
	Mata ulat	Kokoona spp.
	Mengkulang	Heritiera spp.
	Nangka	*Artocarpus heterophyllus*
	Punah	*Tetramerista glabra*
	Simpoh	Dillenia spp.
	Sukun	*Artocarpus communis*
	Tualang	*Koompassia exelsa*
	Bangkong	*Artocarpus interger*
	Temponek	*Artocarpus rigidus*
	Tampang	Artocarpus spp.
7 (All Heavy Hardwoods) (Fully Marketable)	Bitis	*Madhuca utilis* and Palaquium spp.
	Kekatong	Cynometra spp.
	Keranji	Dialium spp.
	Merbau	Intsia spp.
8 (All Non-Dipterocarps) (Partially Marketable)		
i) Light hardwoods	Antoi	Cythocalyx spp.
	Ara	Ficus spp.
	Ara bertih bukit	*Parartocarpus bracteatus*
	Ara bertih paya	*Parartocarpus venenosus*
	Dedali	*Strombosia javanica*
	Ipoh	*Antiaris toxicaria*
	Kayu arang	Diospyros spp.
	Kasah	*Pterygota horsfieldii*
	Kelempayan	*Anthocephalus chinensis*
	Ludai	*Sapium baccatum*
	Mahang	Macaranga spp.

Species Group	Vernacular Name	Botanical Equivalents
	Medang	Family of Lauraceae Actinodaphne spp., Alseodaphne spp., Beilschemiedia spp., Cryptocarya spp., Dehaasia spp., Litsea spp., Phoebe spp., Cinnamomum spp and Nothaphoebe spp.
	Melunak	Pentace spp.
	Mengkundor	*Tetrameles nudifelora*
	Penarahan	Family of Myristicaceae Gymnacranthera spp., Hosfieldia spp., Knema spp. and Myristica spp.
	Perupok	Kokoona spp.
	Petai	*Parkia speciosa*
	Pulai	Alstonia spp.
	Sentang	*Azadirachta excelsa*
	Sengkuang	*Dracontomelon dao*
	Sentul	*Sandoricum koetjape*
	Terap	Artocarpus spp.
ii) Medium Hardwoods	Berangan	Castanopsis spp.
	Jelawai	Terminalia spp.
	Kasai	Pometia spp.
	Kelat	Eugenia spp.
	Kulim	*Scorodocarpus borneensis*
	Minyak berok	Xanthophyllum spp.
	Merbatu	Atuna spp.
	Merpauh	Swintonia spp.
	Mempening	Lithocarpus spp. and Quercus spp.
	Perah	*Elateriospermum tapos*
	Petaling	*Ochanostachys amentacea*
	Rengas	Gluta spp. and Melanochyla spp.
iii) Heavy Hardwoods	Derum	*Cratoxylum formosum*
	Bakau	Rhizophora spp.
	Leban	Vitex spp.
	Lotong	*Nephelium eriopetalum*
	Pauh kijang	*Irvingia malayana*
	Penaga	Mesua ferrea
	Pulasan	Nephelium spp.
	Rambutan	*Nephalium lappaceum*
	Redan	*Nephalium glabrum*
	Tembusu	Fagraea spp.
9 Conifers	Damar minyak	*Agathis borneensis*
	Podo	Podocarpus spp.

APPENDIX V

RANKING OF TREATMENT BLOCKS FOR DIPTEROCARP AND NON-DIPTEROCARP, LESONG FOREST RESERVE, PAHANG

Volume per hectare (m^3/ha)

Block Identity	Dipterocarp				Non-Dipterocarp				Sum Score Diptero-carp	Sum Score All Spe-cies
	15-30cm	30-45cm	45-60cm	+60cm	15-30cm	30-45cm	45-60cm	+60cm		
1	2.31 (27)	4.76 (19)	13.78 (31)	75.79 (24)	17.02 (19)	27.63 (24)	19.28 (18)	29.83 (4)	101	166
2	1.24 (13)	6.20 (28.5)	5.39 (22)	154.06 (32)	20.35 (30)	25.50 (19)	19.69 (19)	71.30 (26)	95.5	189.5
3	2.85 (32)	2.43 (12)	1.42 (4.5)	70.89 (21)	18.75 (25)	30.46 (31)	20.98 (22)	22.96 (1)	69.5	148.5
4	1.38 (15.5)	5.82 (24)	12.53 (30)	54.45 (14)	16.61 (15)	29.70 (27)	22.83 (26)	41.43 (8)	83.5	159.5
5	1.08 (12)	5.45 (23)	1.47 (6)	50.31 (12)	19.32 (28)	26.32 (22)	17.54 (16)	149.43 (31)	53	150
6	1.66 (20)	5.87 (25)	6.91 (25)	43.51 (9)	17.45 (20)	30.00 (28)	25.73 (30)	100.37 (30)	79	187
7	0.96 (10)	6.20 (28.5)	13.83 (32)	68.73 (20)	15.23 (10)	30.10 (29)	13.65 (9)	57.98 (16)	90.5	154.5
8	0.66 (7)	0.60 (2)	1.55 (7)	44.75 (11)	21.88 (32)	25.49 (18)	15.53 (11)	33.27 (5)	27	93
9	0.59 (5)	3.93 (17)	1.42 (4.5)	72.17 (22)	17.72 (21)	23.94 (15)	16.24 (14)	61.44 (21)	48.5	119.5
10	2.27 (26)	3.95 (18)	5.44 (23)	37.83 (5)	18.71 (24)	22.34 (12)	20.92 (21)	48.03 (10)	72	139
11	1.48 (17)	6.64 (30)	10.09 (28)	13.64 (2)	16.83 (13)	21.43 (10)	15.36 (10)	81.34 (29)	77	139
12	0.00 (1.5)	1.19 (5)	3.40 (12)	79.13 (29)	14.49 (7)	16.16 (2)	25.50 (28)	59.79 (18)	47.5	102.5
13	0.31 (4)	0.80 (3)	0.00 (1.5)	29.17 (4)	16.29 (14)	25.94 (21)	25.63 (29)	59.89 (19)	12.5	95.5
14	1.50 (18)	1.39 (6)	1.63 (8)	74.85 (23)	16.83 (16)	22.56 (13)	17.09 (15)	76.46 (28)	55	127
15	0.76 (8)	2.72 (14)	4.37 (15)	62.78 (17)	14.28 (6)	18.48 (5)	13.49 (8)	50.42 (12)	54	85
16	1.06 (11)	5.97 (26)	4.96 (21)	75.94 (25)	11.91 (2)	22.32 (11)	21.64 (23)	69.86 (24)	83	143
17	1.74 (21)	8.33 (32)	4.69 (19)	55.95 (15)	13.79 (5)	30.37 (30)	16.04 (13)	63.01 (23)	87	158
18	2.33 (28)	4.94 (20)	4.92 (20)	40.55 (7)	16.84 (17)	25.51 (20)	22.80 (25)	72.26 (27)	75	164
19	2.50 (29)	2.18 (10)	1.23 (3)	38.53 (6)	14.90 (9)	19.38 (6)	9.70 (4)	42.47 (9)	48	76
20	0.61 (6)	0.94 (4)	3.53 (13)	18.75 (3)	18.27 (22)	26.87 (23)	20.37 (20)	206.52 (32)	26	123
21	0.19 (3)	2.55 (13)	0.00 (1.5)	12.60 (1)	15.34 (11)	13.58 (1)	10.12 (5)	62.83 (22)	18.5	57.5
22	0.00 (1.5)	1.61 (8)	1.91 (9.5)	41.53 (8)	11.66 (1)	20.29 (7)	23.22 (27)	37.70 (6)	27	68
23	2.74 (30.5)	7.99 (31)	4.33 (14)	58.71 (16)	19.02 (26)	28.09 (25)	10.49 (6)	70.98 (25)	91.5	173.5
24	1.38 (15.5)	5.01 (21)	8.19 (26)	68.55 (19)	12.64 (3)	29.69 (26)	28.01 (32)	53.23 (13)	81.5	155.5
25	1.75 (22)	5.20 (22)	4.56 (16)	78.54 (28)	13.70 (4)	16.40 (3)	9.05 (3)	28.32 (3)	88	101
26	2.74 (30.5)	0.00 (1)	5.53 (24)	50.95 (13)	14.70 (8)	20.55 (8)	7.81 (1)	53.71 (14)	68.5	99.5
27	1.33 (14)	1.46 (7)	4.62 (17)	76.27 (26)	15.73 (12)	23.82 (14)	22.19 (24)	61.17 (20)	64	134
28	0.93 (9)	3.02 (15)	1.91 (9.5)	67.94 (18)	19.59 (29)	17.18 (4)	11.93 (7)	54.32 (15)	51.5	106.5
29	1.65 (19)	2.16 (9)	4.65 (18)	84.45 (30)	18.53 (23)	23.99 (16)	8.76 (2)	39.93 (7)	76	124
30	1.85 (23)	3.81 (16)	3.26 (11)	77.77 (27)	16.94 (18)	24.43 (17)	15.75 (12)	25.45 (2)	77	126
31	2.18 (24)	2.33 (11)	11.55 (29)	130.94 (31)	21.26 (31)	21.28 (9)	18.86 (17)	48.27 (11)	95	163
32	2.25 (25)	6.09 (27)	8.80 (27)	44.30 (10)	19.03 (27)	31.76 (32)	27.43 (31)	58.72 (17)	89	196

RANKING LIST FOR TREATMENT BLOCKS,
LESONG FOREST RESERVE, PAHANG

Block Identity	Ranking List								
	Sum Score Dipterocarp	Sum Score All Species	Volume Of All Species (m^3/ha)						Equivalent No-Of Trees (No/Ha)
			15-30cm	30-45cm	45-60cm	+15cm	+30cm	+60cm	
1	101 (32)	166 (28)	19.33 (22)	32.40 (24)	33.07 (29)	190.41 (17)	171.08 (17)	105.62 (13)	185.92 (26)
2	95.5 (31)	189.5 (31)	21.59 (28)	31.70 (22)	25.08 (17)	303.73 (32)	282.14 (32)	225.36 (32)	201.86 (32)
3	69.5 (15)	148.5 (20)	21.60 (29)	32.89 (25)	22.40 (15)	170.75 (12)	149.14 (10)	93.85 (7)	175.92 (21)
4	83.5 (24)	159.5 (25)	17.98 (15)	35.52 (27)	35.36 (30)	184.75 (15)	166.77 (15)	95.88 (9)	200.00 (31)
5	53 (10)	150 (21)	20.39 (24)	31.76 (23)	19.01 (12.5)	270.91 (30)	250.51 (30)	199.74 (30)	189.25 (27)
6	79 (21)	187 (30)	19.10 (20)	35.87 (28)	32.64 (28)	231.49 (28)	212.39 (28)	143.88 (26)	195.54 (29)
7	90.5 (28)	154.5 (22)	16.18 (9)	36.30 (30)	27.48 (24)	206.68 (24)	190.49 (24)	126.71 (21)	175.93 (22)
8	27 (4.5)	93 (5)	22.53 (31)	26.08 (12)	17.05 (8)	143.70 (4)	121.17 (3)	78.03 (2)	158.52 (14)
9	48.5 (8)	119.5 (11)	18.31 (16)	27.87 (17)	17.65 (9)	197.45 (19)	179.14 (20)	133.61 (23)	150.37 (9)
10	72 (16)	139 (17.5)	20.98 (26)	26.30 (14)	26.36 (21)	159.50 (8)	138.51 (5)	85.86 (5)	170.36 (20)
11	77 (19.5)	139 (17.5)	17.71 (14)	28.07 (18)	25.45 (19)	166.21 (9)	148.50 (9)	94.98 (8)	163.34 (18)
12	47.5 (6)	102.5 (9)	14.49 (4)	17.36 (2)	28.92 (26)	199.68 (21)	185.18 (22)	138.91 (25)	149.63 (8)
13	12.5 (1)	95.5 (6)	16.60 (10)	26.74 (15)	25.64 (20)	158.03 (7)	141.43 (7)	89.05 (6)	152.22 (10)
14	55 (12)	127 (15)	18.32 (17)	23.95 (10)	18.72 (11)	212.29 (26)	193.97 (26)	151.31 (28)	156.29 (12)
15	54 (11)	85 (4)	15.05 (5)	21.20 (5)	17.86 (10)	167.31 (10)	152.27 (12)	113.20 (16)	133.34 (5)
16	83 (23)	143 (19)	12.97 (2)	28.29 (20)	26.59 (22)	213.65 (27)	200.68 (27)	145.80 (27)	158.15 (13)
17	87 (25)	158 (24)	15.53 (7.5)	38.70 (32)	20.73 (14)	193.92 (18)	178.39 (19)	118.96 (17)	169.25 (19)
18	75 (17)	164 (27)	19.17 (21)	30.45 (21)	27.72 (25)	190.16 (16)	170.98 (16)	112.81 (15)	177.03 (23)
19	48 (7)	76 (3)	17.40 (12)	21.56 (6)	10.93 (2)	130.89 (2)	113.49 (2)	81.00 (4)	132.21 (3)
20	26 (3)	123 (12)	18.88 (19)	27.81 (16)	23.91 (16)	295.87 (31)	276.99 (31)	225.27 (31)	180.73 (25)
21	18.5 (2)	57.5 (1)	15.53 (7.5)	16.13 (1)	10.12 (1)	117.21 (1)	101.68 (1)	75.43 (1)	105.19 (1)
22	27 (4.5)	68 (2)	11.66 (1)	21.90 (8)	25.13 (18)	137.92 (3)	126.26 (4)	79.23 (3)	132.22 (4)
23	91.5 (29)	173.5 (29)	21.76 (30)	36.09 (29)	14.81 (7)	202.35 (22)	180.59 (21)	129.69 (22)	162.97 (17)
24	81.5 (22)	155.5 (23)	14.03 (3)	34.69 (26)	36.21 (31)	206.70 (25)	192.68 (25)	121.77 (18)	179.64 (24)
25	88 (26)	101 (8)	15.45 (6)	21.61 (7)	13.61 (5)	157.53 (6)	142.08 (8)	106.86 (14)	127.40 (2)
26	68.5 (14)	99.5 (7)	17.44 (13)	20.55 (4)	13.35 (3)	156.00 (5)	138.55 (6)	104.66 (12)	141.48 (6)
27	64 (13)	134 (16)	17.06 (11)	25.29 (11)	26.81 (23)	206.59 (23)	189.53 (23)	137.44 (24)	160.75 (16)
28	51.5 (9)	106.5 (10)	20.52 (25)	20.20 (3)	13.85 (6)	176.83 (13)	156.31 (13)	122.26 (19)	153.70 (11)
29	76 (18)	124 (13)	20.19 (23)	26.15 (13)	13.61 (4)	186.13 (14)	163.94 (14)	124.38 (20)	160.74 (15)
30	77 (19.5)	126 (14)	18.79 (18)	28.23 (19)	19.01 (12.5)	169.25 (11)	150.46 (11)	103.22 (11)	146.67 (7)
31	95 (30)	163 (26)	23.44 (32)	23.61 (9)	30.41 (27)	256.67 (29)	233.23 (29)	179.21 (29)	190.75 (28)
32	89 (27)	196 (32)	21.27 (27)	37.84 (31)	36.24 (32)	198.37 (20)	177.10 (18)	103.02 (10)	199.62 (30)

RANKING AND BLOCK ALLOCATIONS TO REPLICATIONS, LESONG FOREST RESERVE, PAHANG

List	High ← Ranking Of Block Identities			→ Low
Sum scores Dipterocarps	1, 2, 31, 23, 7, 32, 25, 17	4, 16, 24, 6, 11, 30, 29, 18	10, 3, 26, 27, 14, 15, 5, 28	9, 19, 12, 8, 22, 20, 21, 13
Sum scores all species	32, 2, 6, 23, 1, 18, 31, 4	17, 24, 7, 5, 3, 16, 10, 11	27, 14, 30, 29, 20, 9, 28, 12	25, 26, 13, 8, 15, 19, 22, 21
15 - 30cm	31, 8, 23, 3, 2, 32, 10, 28	5, 29, 1, 18, 6, 20, 30, 14	9, 4, 11, 26, 19, 27, 13, 7	17, 21, 25, 15, 12, 24, 16, 22
30 - 45cm	17, 32, 7, 23, 6, 4, 24, 3	1, 5, 2, 18, 16, 30, 11, 9	20, 13, 10, 29, 8, 27, 14, 31	22, 25, 19, 15, 26, 28, 12, 21
45 - 60cm	32, 24, 4, 1, 6, 31, 12, 18	7, 27, 16, 10, 13, 11, 22, 2	20, 3, 17, 5, 30, 14, 15, 9	8, 23, 28, 25, 29, 26, 19, 21
-15cm	2, 20, 5, 31, 6, 16, 14, 24	7, 27, 23, 12, 32, 9, 17, 1	18, 4, 29, 28, 3, 30, 15, 11	10, 13, 25, 26, 8, 22. 19, 21
-30cm	2, 20, 5, 31, 6, 16, 14, 24	7, 27, 12, 23, 9, 17, 32, 1	18, 4, 29, 28, 15, 30, 3, 11	25, 13, 26,10, 22, 8, 19, 21
-60cm	2, 20, 5, 31, 14, 16, 6, 12	27, 9, 23, 7, 29, 28, 24, 17	15, 18, 25, 1, 26, 30, 32, 4	11, 3, 13, 10, 19, 22, 8, 21
Equivalent No. of trees	2, 4, 32, 6, 31, 5, 1, 20	24, 18, 7, 3, 10, 17, 11, 23	27, 29, 8, 16, 14, 28, 13, 9	12, 30, 26, 15, 22, 19, 25, 21

Stocking Strata	Superior	Good	Moderate	Poor
Block Identities	31, 6, 2, 32, 1, 23, 24, 5	4, 20, 7, 17, 18, 16, 11, 10	14, 15, 27, 28, 29, 30, 3, 9,	12, 13, 8, 26, 25, 19, 22, 21
Replications	Replication 1	Replication 2	Replication 3	Replication 4

APPENDIX VI

RANKING OF TREATMENT BLOCKS FOR DIPTEROCARP AND NON-DIPTEROCARP, SUNGAI LALANG FOREST RESERVE, SELANGOR

Volume per hectare (m^3/ha)

Block Identity	Dipterocarp				Non-Dipterocarp				Sum Score Diptero-carp	Sum Score All Species
	15-30cm	30-45cm	45-60cm	+60cm	15-30cm	30-45cm	45-60cm	+60cm		
1	0.28 (11)	6.03 (27)	2.50 (11)	87.25 (15)	9.52 (8.5)	26.05 (8)	16.70 (3)	46.50 (13)	64	96.5
2	0.45 (14.5)	2.64 (13)	8.53 (27)	110.99 (20)	12.77 (24)	25.59 (6)	21.18 (11)	35.01 (6)	74.5	121.5
3	0.65 (22)	4.41 (25)	6.91 (24)	41.49 (4)	14.56 (27)	32.80 (16)	23.84 (17)	45.69 (12)	75	147
4	0.17 (8)	6.16 (30)	10.59 (30)	85.03 (13)	12.35 (21)	26.39 (9)	17.91 (6)	23.25 (1)	81	118
5	0.59 (17.5)	0.83 (5)	8.31 (26)	19.43 (2)	10.54 (15)	21.92 (2)	21.21 (12)	40.29 (10)	50.5	89.5
6	0.60 (19)	3.29 (20)	3.41 (16)	144.38 (26)	7.34 (3)	21.07 (1)	14.03 (1)	28.19 (2)	81	88
7	1.30 (30)	6.14 (28.5)	0.94 (3)	159.59 (27)	9.61 (10)	24.74 (4)	20.70 (9)	71.75 (26)	88.5	137.5
8	1.18 (28)	2.87 (16)	8.15 (25)	106.22 (18)	13.04 (25)	44.06 (29)	31.39 (25)	49.29 (15)	87	181
9	0.61 (20)	5.47 (26)	4.22 (19)	74.50 (8)	14.72 (28)	58.26 (32)	35.59 (26)	59.22 (18)	73	177
10	0.00 (3.5)	2.76 (14)	2.57 (12)	81.86 (10)	12.36 (22)	25.90 (7)	17.00 (4)	59.32 (19)	39.5	91.5
11	0.38 (13)	4.30 (24)	3.69 (17)	168.71 (29)	10.38 (13)	25.12 (5)	17.27 (5)	60.72 (20)	83	126
12	0.00 (3.5)	3.59 (21)	1.79 (9)	106.75 (19)	7.85 (5)	28.72 (11)	20.06 (8)	62.64 (21)	52.5	97.5
13	0.00 (3.5)	1.76 (9)	1.49 (8)	55.37 (5)	5.03 (1)	23.08 (3)	28.10 (20)	89.53 (30)	25.5	79.5
14	0.63 (21)	2.26 (12)	5.00 (22)	176.30 (30)	9.52 (8.5)	27.71 (10)	22.23 (13)	83.58 (29)	85	145.5
15	0.00 (3.5)	2.18 (11)	3.29 (15)	80.72 (9)	6.93 (2)	36.21 (23)	26.81 (18)	47.99 (14)	38.5	95.5
16	1.15 (27)	2.85 (15)	5.20 (23)	94.01 (16)	12.37 (23)	39.69 (24)	31.34 (24)	70.41 (25)	81	177
17	0.22 (10)	2.98 (18)	1.82 (10)	82.87 (11)	15.95 (31)	34.87 (20)	22.70 (15)	36.01 (7)	49	122
18	0.45 (14.5)	1.61 (6)	1.29 (5)	67.30 (7)	10.91 (18)	34.11 (18)	38.41 (28)	79.33 (28)	32.5	124.5
19	1.02 (25)	1.85 (10)	12.27 (31)	15.03 (1)	10.81 (17)	51.17 (31)	48.11 (32)	29.68 (4)	67	151
20	2.14 (32)	1.69 (8)	2.93 (14)	167.75 (28)	15.08 (29)	50.92 (30)	41.22 (30)	64.90 (24)	82	195
21	0.68 (23)	1.63 (7)	1.34 (6)	86.31 (14)	8.97 (7)	30.29 (13)	37.33 (27)	37.06 (8)	50	105
22	0.21 (9)	6.14 (28.5)	10.41 (29)	142.37 (25)	11.74 (19)	28.98 (12)	29.30 (23)	28.97 (3)	91.5	148.5
23	0.83 (24)	6.24 (31)	4.77 (21)	207.52 (32)	10.66 (16)	35.79 (22)	22.56 (14)	38.54 (9)	108	169
24	1.56 (31)	6.99 (32)	1.48 (7)	124.66 (21)	15.59 (30)	35.73 (21)	39.01 (29)	76.49 (27)	91	198
25	1.05 (26)	0.53 (3)	0.00 (1.5)	134.95 (23)	8.12 (6)	31.42 (15)	28.70 (22)	62.85 (22)	53.5	118.5
26	0.59 (17.5)	0.00 (1.5)	1.18 (4)	203.36 (31)	10.43 (14)	40.30 (25)	16.47 (2)	53.84 (17)	54	112
27	0.00 (3.5)	3.84 (22)	9.22 (28)	100.49 (17)	11.81 (20)	44.02 (27)	22.87 (16)	105.58 (32)	70.5	165.5
28	0.37 (12)	3.85 (23)	0.00 (1.5)	136.08 (24)	16.37 (32)	31.25 (14)	41.48 (31)	101.93 (31)	60.5	168.5
29	0.15 (7)	0.80 (4)	4.39 (20)	124.93 (22)	13.77 (26)	33.70 (17)	21.05 (10)	44.75 (11)	53	117
30	1.28 (29)	0.00 (1.5)	13.38 (32)	59.11 (6)	10.10 (12)	34.80 (19)	18.61 (7)	63.67 (23)	68.5	129.5
31	0.00 (3.5)	2.88 (17)	2.91 (13)	83.17 (12)	7.67 (4)	41.92 (26)	28.15 (21)	49.87 (16)	45.5	112.5
32	0.58 (16)	3.11 (19)	3.88 (18)	24.91 (3)	10.05 (11)	44.04 (28)	26.82 (19)	32.57 (5)	56	119

RANKING LIST FOR TREATMENT BLOCKS, SUNGAI LALANG FOREST RESERVE, SELANGOR

Block Identity	Ranking List								
	Sum Score Dipterocarp	Sum Score All Species	Volume Of All Species (m^3/ha)						Equivalent No-Of Trees (No/Ha)
			15-30cm	30-45cm	45-60cm	+15cm	+30cm	+60cm	
1	64 (15)	96.5 (6)	9.80 (8)	32.08 (11)	19.20 (3)	194.83 (6)	185.03 (7)	133.75 (12)	146.31 (5)
2	74.5 (20)	121.5 (15)	13.22 (23)	28.23 (4)	29.71 (16)	217.16 (14)	203.94 (13)	146.00 (15)	166.25 (12)
3	75 (21)	147 (22)	15.20 (27)	37.21 (19)	30.74 (19)	170.34 (4)	155.13 (3)	87.18 (4)	181.84 (20)
4	81 (23)	118 (12)	12.52 (22)	32.55 (13)	28.50 (12)	181.85 (5)	169.33 (5)	108.28 (5)	153.34 (7)
5	50.5 (8)	89.5 (3)	11.13 (14)	22.76 (1)	29.53 (14)	123.13 (1)	112.00 (1)	59.71 (3)	132.77 (3)
6	81 (23)	88 (2)	7.94 (5)	24.36 (2)	17.44 (1)	222.31 (15)	214.37 (15)	172.57 (22)	121.11 (1)
7	88.5 (29)	137.5 (20)	10.91 (12)	30.89 (8)	21.64 (6)	294.78 (25)	283.87 (25)	231.34 (27)	162.50 (11)
8	87 (28)	181 (30)	14.21 (26)	46.93 (27)	39.53 (25)	256.19 (20)	241.97 (20)	155.51 (17)	213.07 (25)
9	73 (19)	177 (28.5)	15.33 (28)	63.73 (32)	39.81 (28)	252.59 (19)	237.26 (19)	133.72 (11)	227.04 (29)
10	39.5 (4)	91.5 (4)	12.36 (21)	28.65 (5)	19.57 (4)	201.76 (9)	189.40 (8)	141.18 (13)	158.14 (8)
11	83 (26)	126 (18)	10.76 (11)	29.42 (6)	20.96 (5)	290.57 (24)	279.81 (24)	229.43 (26)	167.50 (13)
12	52.5 (9)	97.5 (7)	7.85 (4)	32.31 (12)	21.85 (7)	231.40 (16)	223.55 (17)	169.39 (19)	137.79 (4)
13	25.5 (1)	79.5 (1)	5.03 (1)	24.84 (3)	29.58 (15)	204.36 (12)	199.33 (12)	144.91 (14)	125.56 (2)
14	85 (27)	145.5 (21)	10.15 (9)	29.97 (7)	27.23 (10)	327.23 (30)	317.08 (31)	259.88 (32)	177.04 (19)
15	38.5 (3)	95.5 (5)	6.93 (2)	38.39 (21)	30.10 (17)	204.13 (11)	197.20 (11)	128.71 (9)	162.23 (10)
16	81 (23)	177 (28.5)	13.52 (24)	42.54 (24)	36.54 (23)	257.02 (21)	243.50 (21)	164.42 (18)	214.71 (27)
17	49 (6)	122 (16)	16.16 (29)	37.86 (20)	24.53 (8)	197.42 (7)	181.26 (6)	118.88 (6)	171.49 (16)
18	32.5 (2)	124.5 (17)	11.36 (15)	35.72 (18)	39.70 (26)	231.42 (17)	222.06 (16)	146.64 (16)	192.23 (23)
19	67 (16)	151 (24)	11.83 (19)	53.02 (31)	60.37 (32)	169.94 (3)	158.11 (4)	64.72 (1)	220.75 (28)
20	82 (25)	195 (31)	17.22 (32)	52.60 (30)	44.15 (31)	346.62 (32)	329.40 (32)	232.65 (28)	257.78 (32)
21	50 (7)	105 (8)	9.65 (7)	31.91 (9)	38.67 (24)	203.61 (10)	193.96 (10)	123.37 (8)	168.90 (15)
22	91.5 (31)	148.5 (23)	11.95 (20)	35.13 (17)	39.72 (27)	258.13 (22)	246.17 (22)	171.33 (21)	198.89 (24)
23	108 (32)	169 (27)	11.49 (17)	42.04 (23)	27.33 (11)	326.92 (29)	315.43 (30)	246.06 (30)	181.86 (21)
24	91 (30)	198 (32)	17.15 (31)	42.72 (25)	40.49 (29)	301.51 (27)	284.36 (26)	201.15 (24)	228.88 (30)
25	53.5 (11)	118.5 (13)	9.17 (6)	31.95 (10)	28.70 (13)	267.61 (23)	258.45 (23)	197.80 (23)	149.62 (6)
26	54 (12)	112 (9)	11.02 (13)	40.30 (22)	17.65 (2)	326.17 (28)	315.15 (29)	257.20 (31)	172.50 (17)
27	70.5 (18)	165.5 (25)	11.81 (18)	47.86 (29)	32.08 (22)	297.82 (26)	286.02 (27)	206.08 (25)	214.08 (26)
28	60.5 (14)	168.5 (26)	16.74 (30)	35.10 (16)	41.48 (30)	331.33 (31)	314.59 (28)	238.01 (29)	235.19 (31)
29	53 (10)	117 (11)	13.91 (25)	34.49 (14)	25.46 (9)	243.53 (18)	229.62 (18)	169.67 (20)	183.34 (22)
30	68.5 (17)	129.5 (19)	11.38 (16)	34.80 (15)	31.98 (21)	200.94 (8)	189.56 (9)	122.78 (7)	174.45 (18)
31	45.5 (5)	112.5 (10)	7.67 (3)	44.80 (26)	31.07 (20)	216.57 (13)	208.90 (14)	133.03 (10)	160.38 (9)
32	56 (13)	119 (14)	10.63 (10)	47.15 (28)	30.70 (18)	145.96 (2)	135.33 (2)	57.48 (2)	168.88 (14)

RANKING AND BLOCK ALLOCATIONS TO REPLICATIONS, SUNGAI LALANG FOREST RESERVE, SELANGOR

List	High ← Ranking of Block Identities → Low			
Sum scores Dipterocarps	23, 22, 24, 7, 8, 14, 11, 20	4, 6, 16, 3, 2, 9, 27, 30	19, 1, 28, 32, 26, 25, 29, 12	5, 21, 17, 31, 10, 15, 18, 13
Sum scores all species	24, 20, 8, 9, 16, 23, 28, 27	19, 22, 3, 14, 7, 30, 11, 18	17, 2, 32, 25, 4, 29, 31, 26	21, 12, 1, 15, 10, 5, 6, 13
15 - 30cm	20, 24, 28, 17, 9, 3, 8, 29	16, 2, 4, 10, 22, 19, 27, 23	30, 18, 5, 26, 7, 11, 32, 14	1, 21, 25,6, 12, 31, 15, 13
30 - 45cm	9, 19, 20, 27, 32, 8, 31, 24	16, 23, 26, 15, 17, 3, 18, 22	28, 30, 29, 4, 12, 1, 25, 21	7, 14, 11, 10, 2, 13, 6, 5
45 - 60cm	19, 20, 28, 24, 9, 22, 18, 8	21, 16, 27, 30, 31, 3, 32, 15	2, 13, 5, 25, 4, 23, 14, 29	17, 12, 7, 11, 10, 1, 26, 6
+15cm	20, 28, 14, 23, 26, 24, 27, 7	11, 25, 22, 16, 8, 9, 29, 18	12, 6, 2, 31, 13, 15, 21, 10	30, 17, 1, 4, 3, 19, 32, 5
+30cm	20, 14, 23, 26, 28, 27, 24, 7	11, 25, 22, 16, 8, 9, 29, 12	18, 6, 31, 2, 13, 15, 21, 30	10, 1, 17, 4, 19, 3, 32, 5
+60cm	14, 26, 23, 28, 20, 7, 11, 27	24, 25, 6, 22, 29, 12, 16, 8	18, 2, 13, 10, 1, 9, 31, 15	21, 30, 17, 4, 3, 5, 32, 19
Equivalent No. of trees	20, 28, 24, 9, 19, 16, 27, 8	22, 18, 29, 23, 3, 14, 30, 26	17, 21, 32, 11, 2, 7, 15, 31	10, 4, 25, 1, 12, 5, 13, 6

Stocking Strata	Superior	Good	Moderate	Poor
Block Identities	20, 24, 28, 27, 8, 23, 9, 7	16, 22, 3, 26, 18, 29, 11, 14	30, 2, 31, 32, 25, 15, 21, 12	4, 19, 13, 17, 6, 1, 10, 5
Replications	Replication 1	Replication 2	Replication 3	Replication 4

A) GENERAL INFORMATION

TREE MARKING AND HARVESTING FORM FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA	TEAM LEADER	YEAR		STATE		FOREST RESERVE/ DISTRICT		KOMPT. NO			TREATMENT BLOCK NO.		TREATMENT	CARD NO.
		1	2	3	4	5	6	7	8	9	10	11	12	

B) TREE INFORMATION

TREE NO.	SPECIES	SPECIES CODE	DIAMETER AT BREAST HEIGHT (cm)	TOTAL LENGTH OF LOG (m)	FIRST LOG					
					DIAMETER (cm)				LENGTH (m)	NOTE*
					B	K	DEFECT			
							B	K		
1 2 3		4 5 6 7	8 9 10 11	12 13 14	15 16 17 18	19 20 21 22	23 24 25 26	27 28 29 30	31 32 33	34

SECOND LOG						THIRD LOG						FOURTH LOG					
DIAMETER (cm)				LENGTH (m)	NOTE *	DIAMETER (cm)				LENGTH (m)	NOTE *	DIAMETER (cm)				LENGTH (m)	NOTE *
B	K	DEFECT				B	K	DEFECT				B	K	DEFECT			
		B	K					B	K					B	K		
35 36 37 38	39 40 41 42	43 44 45 46	47 48 49 50	51 52 53	54	55 56 57 58	59 60 61 62	63 64 65 66	67 68 69 70	71 72 73	74	75 76 77 78	79 80 81 82	83 84 85 86	87 88 89 90	91 92 93	94

* **NOTE**

Record whether the log is taken out (DK)
If not taken out (TK), elaborate on the reasons:-

Hollow (HL) **Damage log (DL)** **Crack/split log (CL)** **Others (LL)**
Twisted log (TL) **Multiple leaders (ML)** **No market (NM)**

B = Big end of log
K = Small end of log

APPENDIX VII

NAMA KETUA PASUKAN : ______	TARIKH : / /
NAMA PEGAWAI REKOD KAD : ______	TARIKH : / /
NAMA PEMERIKSA KAD : ______	TARIKH : / /

PROJEK BERSAMA MALAYSIA - ITTO
"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"
(HUTAN ASLI)

BORANG HA/1A
KUADRAT 20 m x 20 m
(UKURAN POKOK +15 cm DIAMETER)

NO. KAD

A. MAKLUMAT AM

TAHUN	BULAN	NEGERI	DAERAH	HUTAN SIMPAN	NO. KOMPARTMEN	JENIS RAWATAN	NO. PETAK	NO. KUADRAT	CERUN			MUKA TANAH	HAKISAN	KETINGGIAN	JENIS HUTAN	JENIS TANAH	GEOLOGI	SISA TEBANGAN	BIL. ROTAN	BIL. BULUH	BIL. BERTAM	BIL. PALMA	% RESAM	% HALIA	% PISANG
									%	TEMPAT	ASPEK														
1 2	3 4	5 6	7 8	9 10	11 12 13	14	15 16	17 18	19 20 21	22	23	24 25	26	27	28 29	30 31	32 33	34	35 36	37 38	39 40	41 42	43	44	45

B. MAKLUMAT POKOK

NO. POKOK	KOD SPESIES	NAMA SPESIES	DAHULU (1989)						SEKARANG (1990)						CATATAN
			K. POKOK	DIAMETER (cm)	BIL. BALAK	KUALITI B. 1	ROSAK BATANG	ROSAK SILARA	K. POKOK	DIAMETER (cm)	BIL. BALAK	KUALITI B. 1	ROSAK BATANG	ROSAK SILARA	
1 2 3	4 5 6 7		8	9 10 11 .12	13	14	15	16	17	18 19 20 .21	22	23	24	25	
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NAMA KETUA PASUKAN : ______________________ TARIKH : / /
NAMA PEGAWAI REKOD KAD : ______________________ TARIKH : / /
NAMA PEMERIKSA KAD : ______________________ TARIKH : / /

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI)

BORANG HA/1B
KUADRAT 20 m x 20 m
(UKURAN POKOK +5 cm DIAMETER)

NO. KAD

A. MAKLUMAT AM

TAHUN	BULAN	NEGERI	DAERAH	HUTAN SIMPAN	NO. KOMPARTMEN	JENIS RAWATAN	NO. PETAK	NO. KUADRAT	CERUN %	CERUN TEMPAT	CERUN ASPEK	MUKA TANAH	HAKISAN	KETINGGIAN	JENIS HUTAN	JENIS TANAH	GEOLOGI	SISA TEBANGAN	BIL. ROTAN	BIL. BULUH	BIL. BERTAM	BIL. PALMA	% RESAM	% HALIA	% PISANG
1 2	3 4	5 6	7 8	9 10	11 12 13	14	15 16	17 18	19 20 21	22	23	24 25	26	27	28 29	30 31	32 33	34	35 36	37 38	39 40	41 42	43	44	45

B. MAKLUMAT POKOK

NO. POKOK	KOD SPESIES	NAMA SPESIES	DAHULU ( ) K. POKOK	DAHULU DIAMETER (cm)	DAHULU BIL. BALAK	DAHULU KUALITI B. 1	DAHULU ROSAK BATANG	DAHULU ROSAK SILARA	SEKARANG ( ) K. POKOK	SEKARANG DIAMETER (cm)	SEKARANG BIL. BALAK	SEKARANG KUALITI B. 1	SEKARANG ROSAK BATANG	SEKARANG ROSAK SILARA	CATATAN
1 2 3	4 5 6 7		8	9 10 11 .12	13	14	15	16	17	18 19 20 .21	22	23	24	25	
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NAMA KETUA PASUKAN : ____________	TARIKH : / /
NAMA PEGAWAI REKOD KAD : ____________	TARIKH : / /
NAMA PEMERIKSA KAD : ____________	TARIKH : / /

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI)

BORANG HA/2
KUADRAT 5 m x 5 m
(UKURAN POKOK +150 cm TINGGI - 5 cm DIAMETER)

NO. KAD

A. MAKLUMAT AM

TAHUN	BULAN	NEGERI	DAERAH	HUTAN SIMPAN	NO. KOMPARTMEN	JENIS RAWATAN	NO. PETAK	NO. KUADRAT	CERUN %	CERUN TEMPAT	CERUN ASPEK	MUKA TANAH	HAKISAN	KETINGGIAN	JENIS HUTAN	JENIS TANAH	GEOLOGI	SISA TEBANGAN	BIL. ROTAN	BIL. BULUH	BIL. BERTAM	BIL. PALMA	% RESAM	% HALIA	% PISANG
1 2	3 4	5 6	7 8	9 10	11 12 13	14	15 16	17 18	19 20 21	22	23	24 25	26	27	28 29	30 31	32 33	34	35 36	37 38	39 40	41 42	43	44	45

B. MAKLUMAT POKOK

NO. POKOK	KOD SPESIES	NAMA SPESIES	DAHULU ( ) K. POKOK	DAHULU ( ) DIAMETER (cm)	DAHULU ( ) KETINGGIAN (m)	DAHULU ( ) KSN	SEKARANG ( ) K. POKOK	SEKARANG ( ) DIAMETER (cm)	SEKARANG ( ) KETINGGIAN (m)	SEKARANG ( ) KSN	CATATAN
1 2 3 4	5 6 7 8		9	10 . 11	12 13 . 14	15	16	17 . 18	19 20 . 21	22	
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NAMA KETUA PASUKAN : ______________________ TARIKH : / /
NAMA PEGAWAI REKOD KAD : ______________________ TARIKH : / /
NAMA PEMERIKSA KAD : ______________________ TARIKH : / /

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI)

BORANG HA/3
KUADRAT 2 m x 2 m
(UKURAN POKOK 15 cm - 150 cm TINGGI)

NO. KAD

A. MAKLUMAT AM

TAHUN		BULAN		NEGERI		DAERAH		HUTAN SIMPAN		NO. KOMPARTMEN			JENIS RAWATAN	NO. PETAK		NO. KUADRAT		CERUN					MUKA TANAH		HAKISAN	KETINGGIAN	JENIS HUTAN		JENIS TANAH		GEOLOGI		SISA TEBANGAN	BIL. ROTAN		BIL. BULUH		BIL. BERTAM		BIL. PALMA		% RESAM	% HALIA	% PISANG
																		%			TEMPAT	ASPEK																						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

B. MAKLUMAT POKOK

KOD SPESIES				NAMA SPESIES	BILANGAN ANAK POKOK			CATATAN
1	2	3	4		5	6	7	

B. MAKLUMAT POKOK

KOD SPESIES				NAMA SPESIES	BILANGAN ANAK POKOK			CATATAN
1	2	3	4		5	6	7	

NAMA KETUA PASUKAN : ______	TARIKH : / /
NAMA PEGAWAI REKOD KAD : ______	TARIKH : / /
NAMA PEMERIKSA KAD : ______	TARIKH : / /

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI)

BORANG HA/4 (LADANG)	NO. KAD

A. MAKLUMAT AM

TAHUN	BULAN	NEGERI	DAERAH	HUTAN SIMPAN	NO. KOMPARTMEN	JENIS RAWATAN	NO. PETAK	NO. GARISAN TANAMAN	MUKA TANAH	HAKISAN	KETINGGIAN	JENIS HUTAN	JENIS TANAH	GEOLOGI	TARIKH DITANAM		
															HARI	BULAN	TAHUN
1 2	3 4	5 6	7 8	9 10	11 12 13	14	15 16	17 18	19 20	21	22	23 24	25 26	27 28	29 30	31 32	33 34

B. MAKLUMAT POKOK

NO. POKOK	KOD SPESIES	NAMA SPESIES	( )				( )				CATATAN
			K. POKOK	DIAMETER (cm)	KETINGGIAN (m)	KSN	K. POKOK	DIAMETER (cm)	KETINGGIAN (m)	KSN	
1 2	3 4 5 6		7	8 9 10 . 11	12 13 . 14	15	16	17 18 19 . 20	21 22 . 23	24	
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Appendix B

PROCEDURE FOR ESTABLISHMENT OF STUDY AREA IN LOGGED OVER FOREST

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JOINT PROJECT BETWEEN MALAYSIA-ITTO ON "FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"

PROCEDURE OF ESTABLISHMENT OF STUDY AREA IN LOGGED-OVER FOREST

1.0 INTRODUCTION

In November 1987, Malaysia submitted a project proposal entitled "Forest Management of Natural Forest in Malaysia" for consideration and possible funding by the International Tropical Timber Organisation (ITTO).

The Third Session of ITTO held in Yokohama, Japan from 11-20 November 1987 approved the Project for immediate implementation and financing with conditions that certain amendments be made to the Project Document as recommended by the Permanent Committee on Reforestation and Forest Management.

The revised Project Document was then resubmitted to ITTO and subsequently, the Contract Agreement for the implementation of the Project was signed between the Government of Malaysia and ITTO on 8 August, 1988 in Kuala Lumpur, Malaysia.

Under this Project, a total of four (4) study areas will be established with two (2) of the study areas being located in virgin forest while the remaining two (2) in logged-over forest.

The main objectives of this Project are fourfold which are as follows:-

(i) to examine in detail the distribution of natural regeneration and the response of residual stand under various management (felling) regimes in two (2) virgin forest areas;

(ii) to increase the understanding of the regeneration capacity of the dipterocarp forest under various silvicultural treatments in two (2) logged-over forest areas;

(iii) to conduct a comprehensive study in the establishment of forest plantation of indigenous tree species; and

(iv) to contribute to the formulation and implementation of sound silvicultural forest management systems for the dipterocarp forest in Peninsular Malaysia.

This paper documents the procedures for establishing the two (2) study areas in logged-over forests in the following locations:-

(i) Compartments 194 and 205,
Kledang Saiong Forest Reserve,
Perak - 425 ha

(ii) Compartment 39,
Cherul Forest Reserve,
Terengganu, 380 ha

Compartments 194 and 205, Kledang Saiong Forest Reserve are located centrally in Kuala Kangsar District which lies along latitude 4° 45′ N and longitude 100° 45′ E and easily accessible by metal and laterite road. The total area of the two (2) compartments amounts to 425 hectares. However, only 200 hectares are utilized for the study. The study area is generally undulating to hilly, with elevations ranging from 150 m to 450 m above sea level and disected by Sungai Buaya and its many tributaries. This forest is considered as Keruing-Meranti forest and is managed under the selective management system.

Compartment 39, Cherul Forest Reserve is located in Kemaman District at the Southern part of Terengganu, bordering the state of Pahang which lies along latitude 4° 5′N and altitude 102° 55′E and easily accessible by metal and laterite road. The total area of the compartment amounts to 380 hectares. However, only 200 hectares are utilized for the study. The study area is generally undulating to hilly with elevations ranging from 60 m to 180 m above sea level and disected by Sungai Kok and its many tributaries. This forest is considered as Keruing-Meranti forest and is mananged under the selection management system.

The locations of the two (2) study areas are shown in Figure 1, 2 and 3.

The two (2) study areas as mentioned-above was approved by the respective State Governments to be set aside for the purpose of the project and for a duration of at least ten (10) years, as required by ITTO beginning from :-

	Study Area	Date Of Approval
(i)	Compartments 194 and 205 Kledang Saiong Forest Reserve Perak	21 June 1989
(ii)	Compartment 39, Cherul Forest Reserve, Terengganu	26 July 1989

2.0 ESTABLISHMENT OF STUDY AREA

For the purpose of this Project, a special committee called the "Technical Working Group on Forest Management of Natural Forest in Malaysia", comprising members from the Forestry Department Headquarters, Peninsular Malaysia, the State Forestry Departments of Pahang, Selangor, Perak and Terengganu, the Forest Research Institute of Malaysia (FRIM) and the Faculty of Forestry, University of Agriculture, Malaysia (UPM), was established to formulate establishment procedures as well as to plan and implement the Project. The list of technical decisions made by the Technical Working Group in the course of project implementation appears as Appendix I. The establishment procedures for the two study areas in the logged-over forest are as follow :-

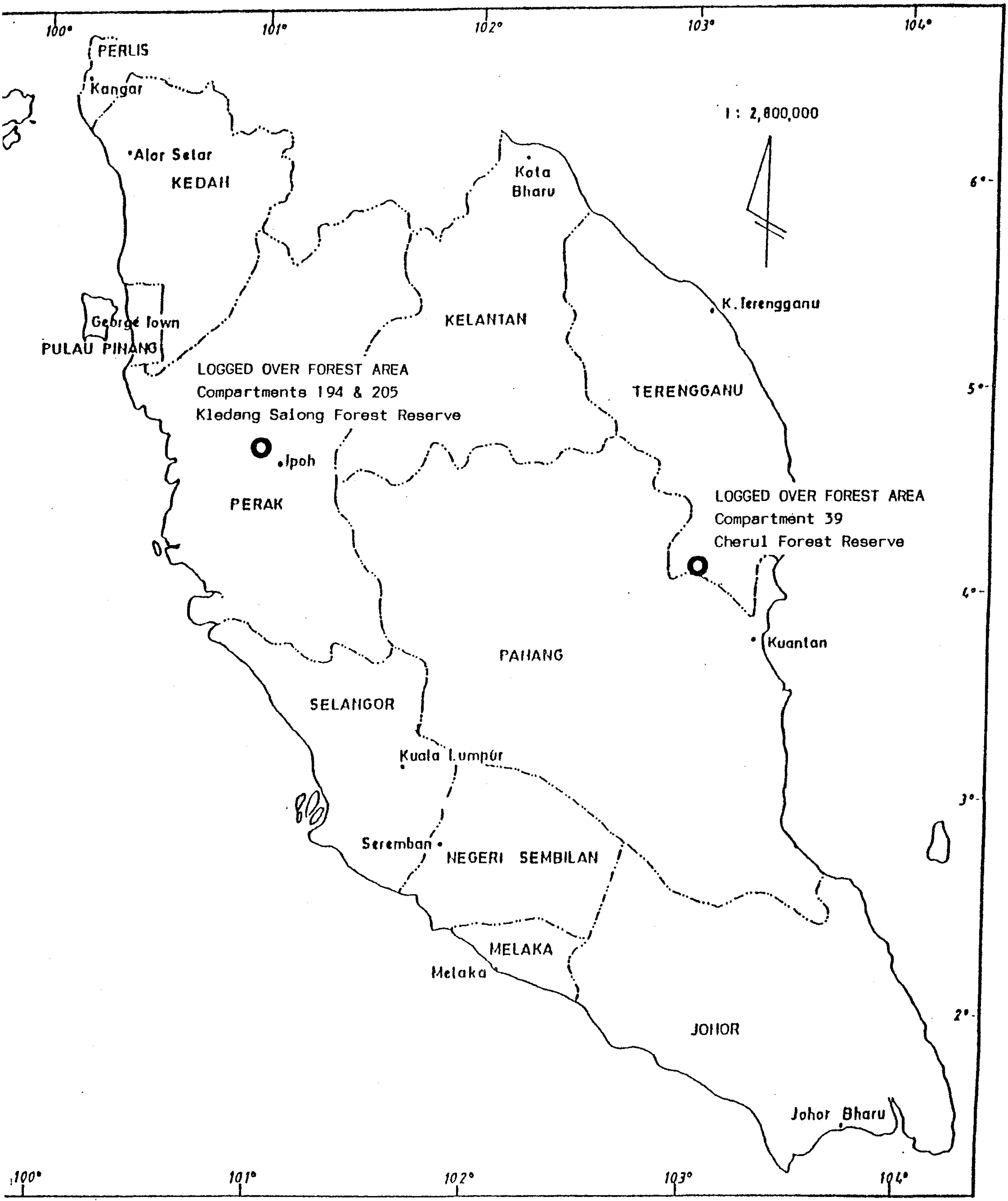


Figure 1 : Location Map Of Study Areas
Under The Joint Malaysia-ITTO Project
(Logged-Over Forest)

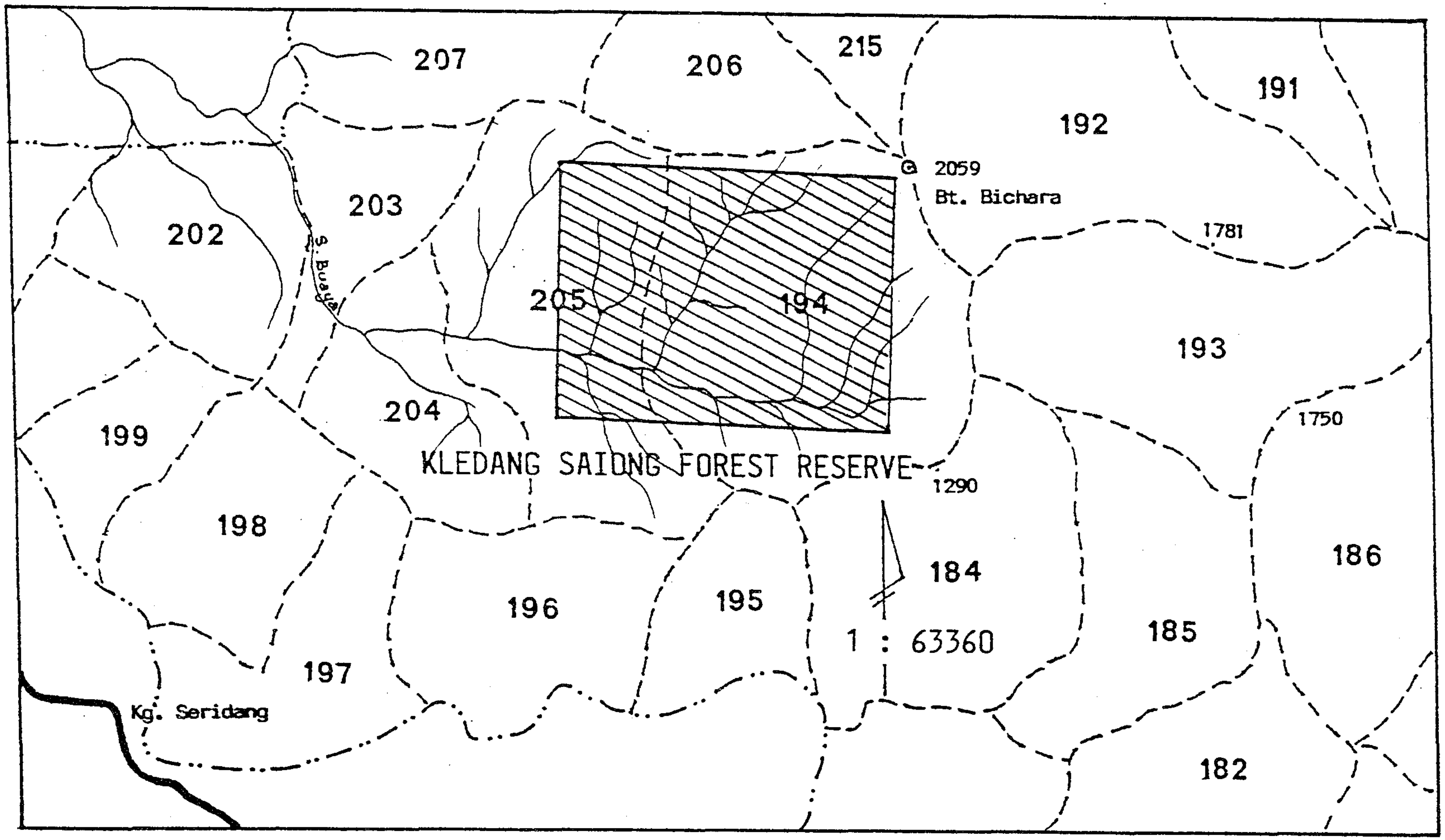


Figure 2 : Compartment 194 & 205
Kledang Siong Forest Reserve
Perak

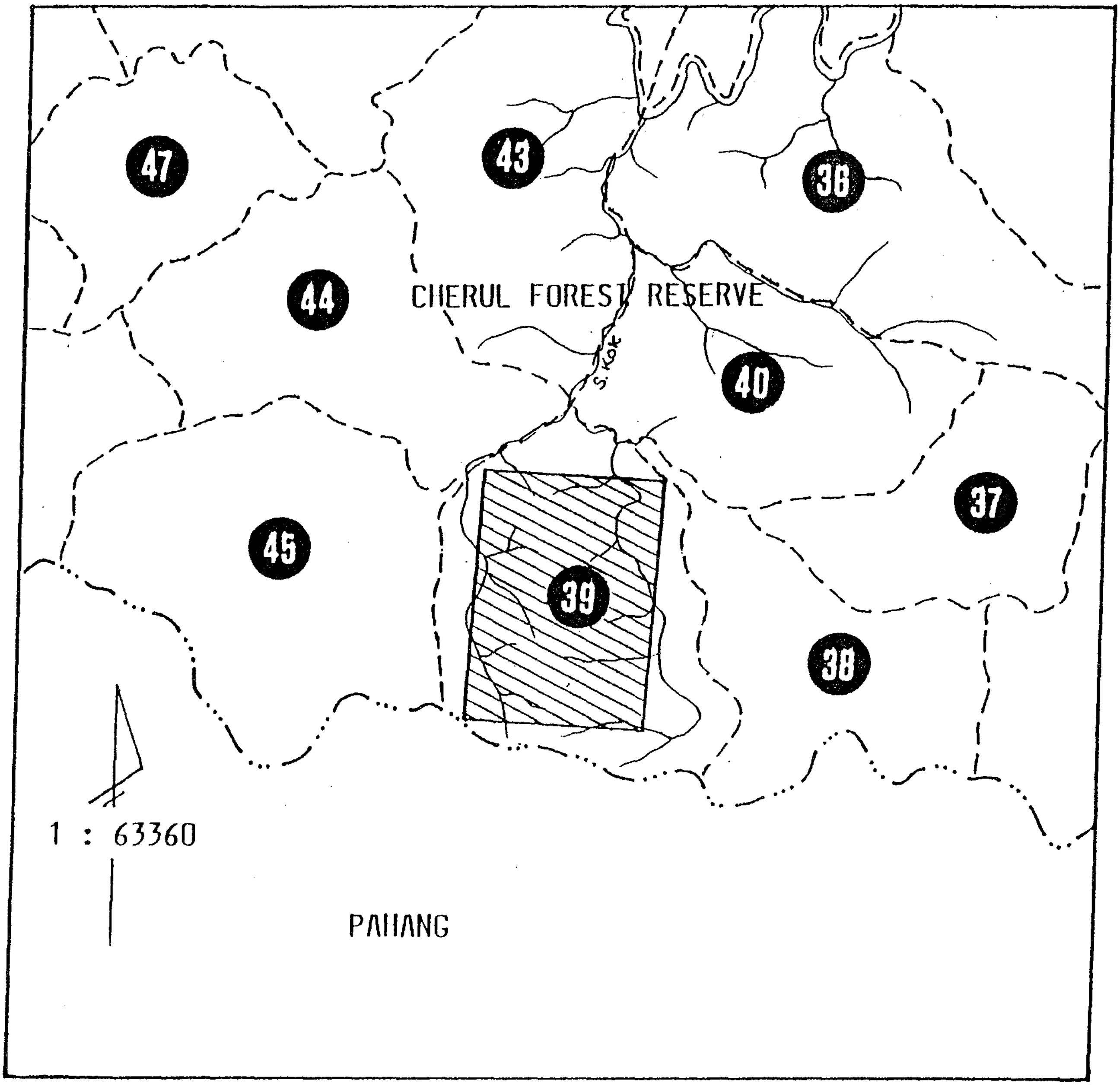


Figure 3 : Compartment 39
Cherul Forest Reserve
Terengganu

2.1 SELECTION OF STUDY AREA

In the selection of the study areas, the following criteria were considered :-

(i) the area must be within the Permanent Forest Estate;

(ii) the area must be a logged-over forest;

(iii) access must be reasonable ie. the location must be within 10 to 16km from an all-weather major (public) road; and

(iv) the respective State Governments must provide formal agreement to set aside the study area, to be maintained by the Forestry Department for a period of at least 10 years.

2.2 POST-FELLING FOREST INVENTORY

Prior to the demarcation and stratification of the study area into various stocking classes and subsequent silvicultural treatments a post-felling forest inventory was carried out to determine the stocking and structure of the forest. This inventory was carried out using systematic line-plots of size 50m x 20m with four (4) sub-plots of size 25m x 20m, 10m x 10m, 5m x 5m and 2m x 2m. The sampling lines were parallel to one another at 100m apart with the 50m x 20m principal plot being 50m apart, along each sampling line or 100m from one plot centre to the next as shown in Figure 4.

The description of the sample plots, area and respective equivalent sampling intensities are as follows:-

Description of sample plot	Area (ha)	Sampling Intensity (%)
50m x 20m principal plot	0.1000	10.00
25m x 20m sub-plot	0.0500	5.00
10m x 10m sub-plot	0.0100	1.00
5m x 5m sub-plot	0.0025	0.25
2m x 2m sub-plot	0.0004	0.04

The size classes of trees enumerated within the sample plots are as follows:-

Sample plot	Size class	Description
50m x 20m	>45cm dbh >30cm-45cm dbh	Big trees Small trees
25m x 20m	>15cm-30cm dbh	Big poles
10m x 10m	>5cm-15cm dbh	Small poles
5m x 5m	>1.5m ht-5cm dbh	Saplings
2m x 2m	15cm-1.5m ht	Seedlings

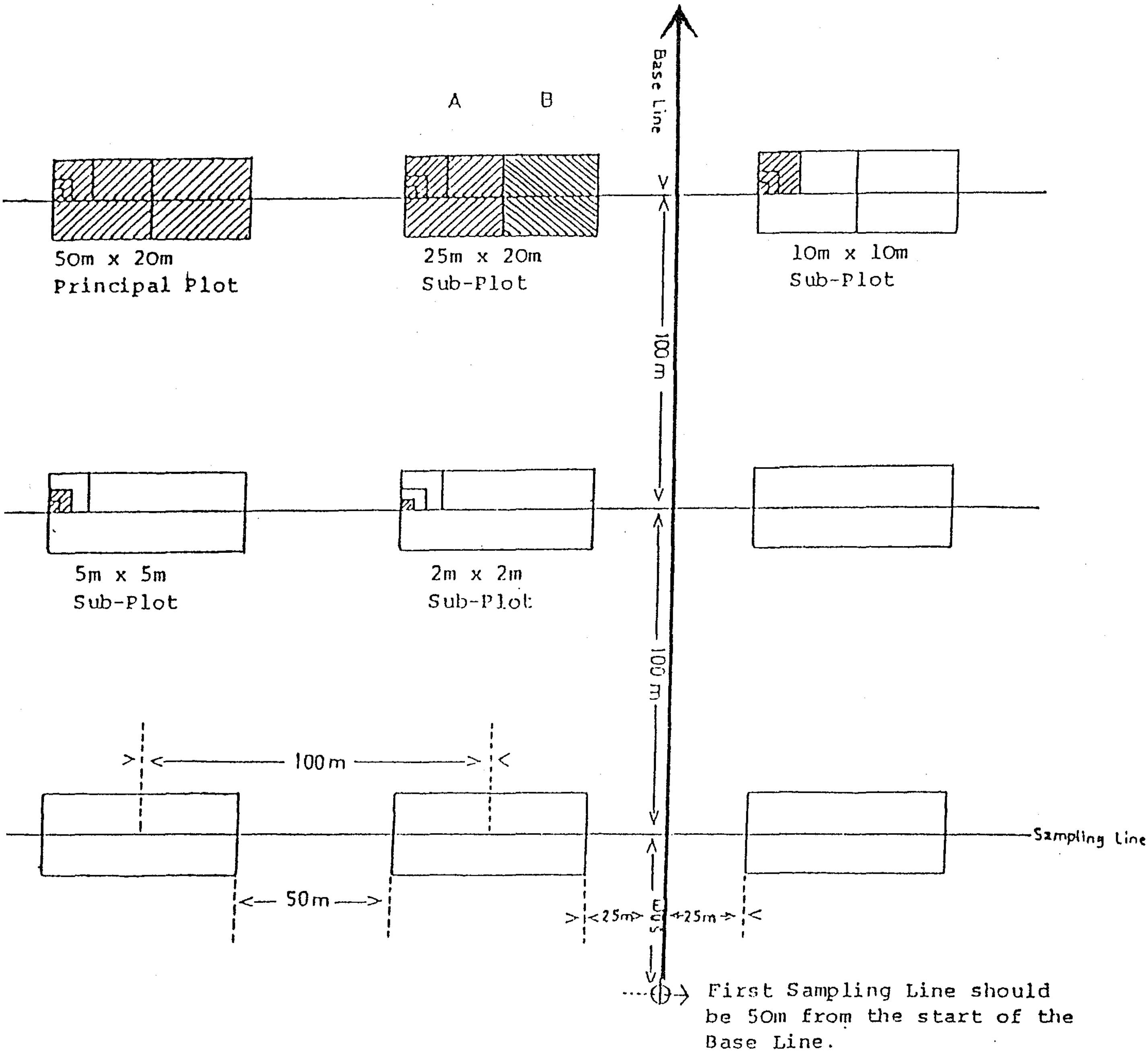


Figure 4 : Layout Of Post-Felling Forest Inventory Sample Plots

All trees within each size class corresponding to the selected sample plot, were enumerated by species while sample trees having a minimum diameter of 15cm dbh were measured to the nearest one-tenth centimetre at breast height (dbh) (1.3m above ground) or 0.3m above buttress. In addition, the quality and the number of logs were also enumerated for each of the sample trees classes of >15cm dbh. The presence of climbers intertwinning sample trees were also recorded. However, for trees class >5cm to 15cm dbh, vigour and stem form were recorded, while for trees <5cm dbh, only their presence were recorded.

In addition, the presence of Bertam (Eugeissona triste), bamboos, palms, ferns, gingers and wild bananas were also recorded together with other site information such as slope, aspect, elevation, soil and forest types.

The forest inventory data were recorded in field sheets as shown in Appendix II. The inventory data were processed and analysed by computer which provided for each of the treatment block (comprising of post-felling forest inventory sample plots) in the form of summaries of stand and stock tables, showing gross and net number of trees per ha, gross and net volume per ha and basal area per ha by species groups and diameter classes.

2.3 NUMBER AND SIZE OF TREATMENT BLOCKS AND PERMANENT SAMPLE PLOTS

According to the ITTO Agreement, five (5) silvicultural treatments are carried out in the study areas, viz:-

Treatment A: Cutting of liana (CL);

Treatment B: Girdling of trees and cutting of liana (GCL);

Treatment C: Girdling of trees and cutting of liana (GCL) coupled with enrichment planting;

Treatment D: Establishment of indigenous forest plantation; and

Treatment E: Control (no treatment).

It was agreed that each treatment be replicated four (4) times over an area of 200 ha. This amounted to 20 treatment blocks (5 treatments x 4 replications), each measuring approximately 316m x 316m (10 ha). In the centre of each treatment block a permanent sample plot measuring 100m x 100m (1 ha) would be established. The remaining area (9 ha) surrounding each permanent sample plot would be considered as the 'buffer zone'. There would therefore be a total of 20 permanent plots, within which all enumerations would be taken.

The details of which are as follows:-

Permanent Sample Plot	100m x 100m = 1 ha
Treatment Block	316m x 316m = 10 ha
Buffer Zone	Remaining 9 ha surrounding the permanent sample plot

Figure 5 shows the design of the treatment block.

2.4 REPLICATION OF TREATMENTS AND STRATIFICATION OF STUDY AREA

As mentioned earlier, it was considered essential that each treatment be replicated for meaningful statistical analysis. As agreed, for this study, all the five treatments as mentioned in para 2.3 would be replicated four times.

The stratification of the study area into four (4) different basal area categories; was based on the analysis of the post-felling forest inventory data of each treatment block. Figures 6 and 7 show the distribution of the post-felling forest inventory sample plots; within each treatment block for the study areas in Compartments 194 and 205, Kledang Saiong Forest Reserve and in Compartment 39 Cherul Forest Reserve, respectively.

The post-felling forest inventory data were analysed and summarized into treatment block averages,

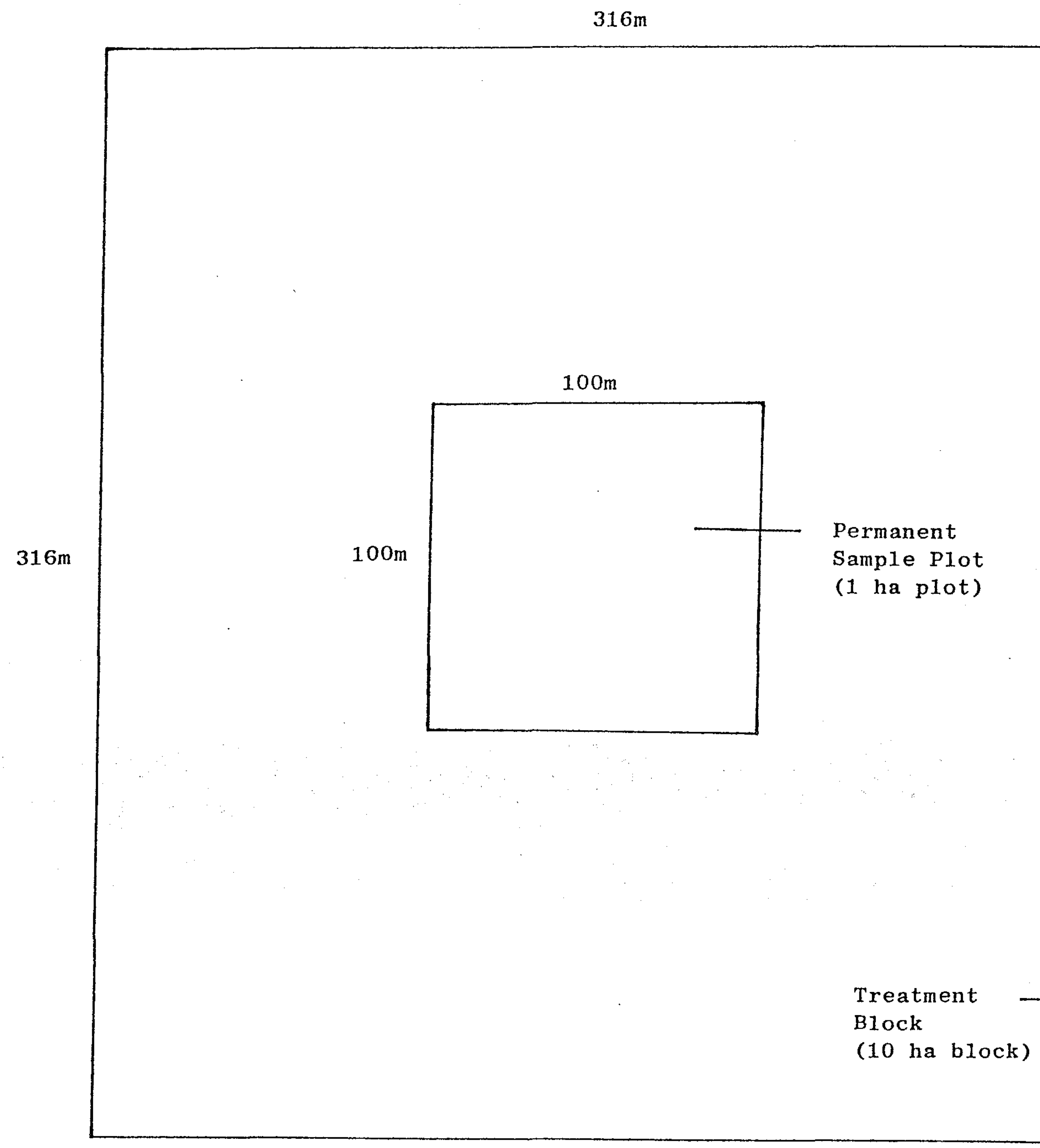
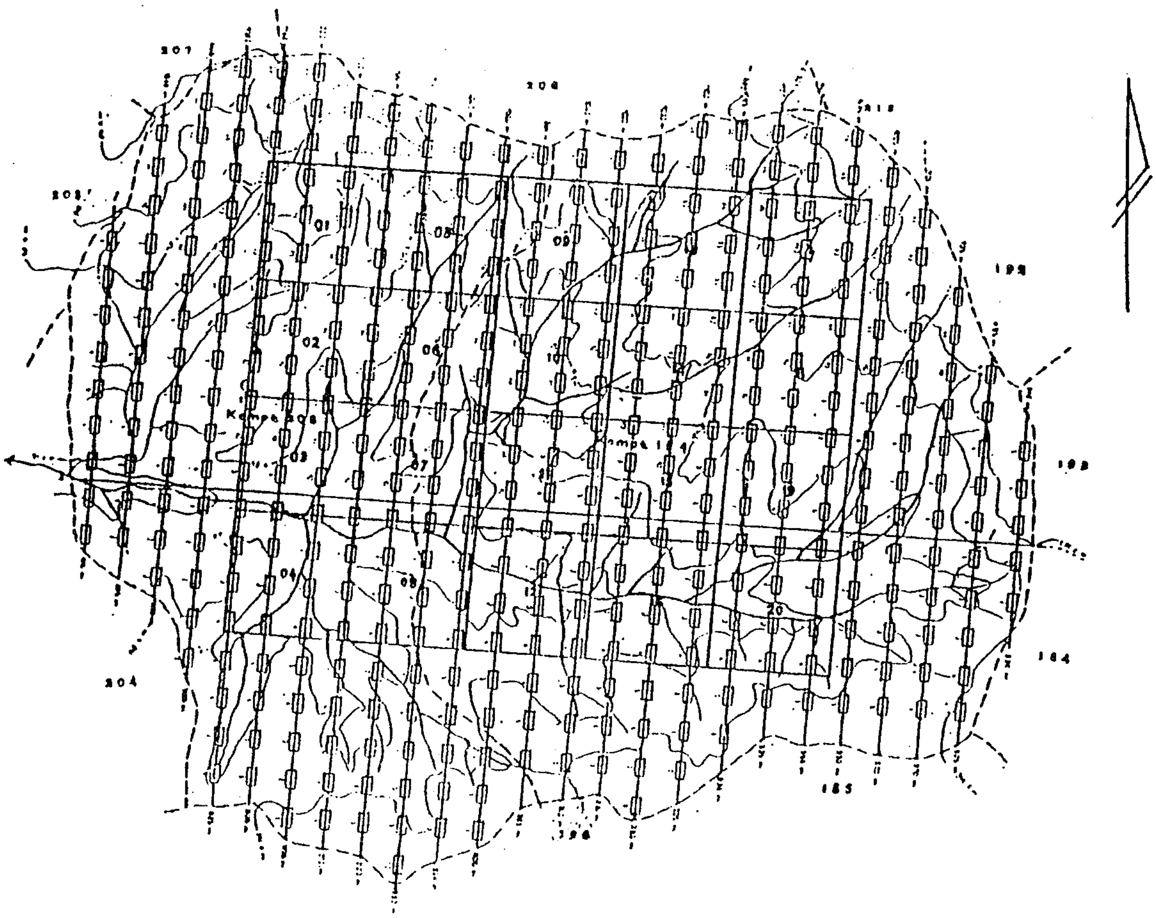


Figure 5 : Treatment Block Design

Scale 1:25,000



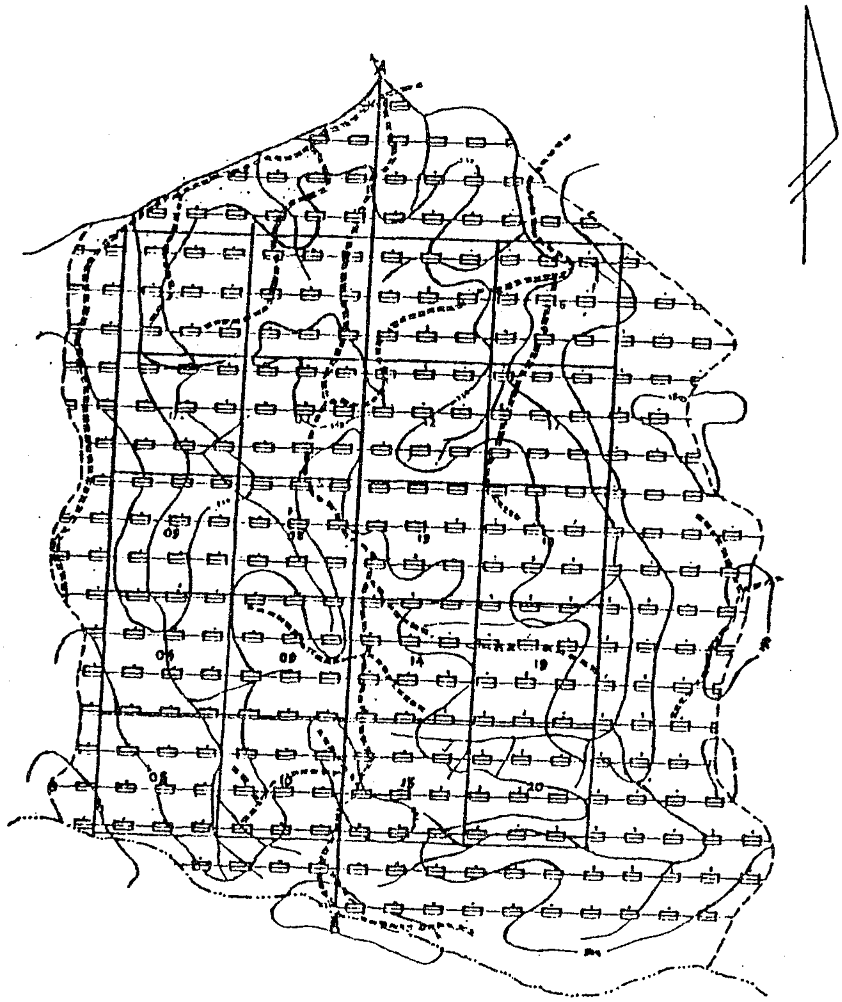
LEGEND

Post-felling Sample Plot

Treatment Block

Figure 6 : Distribution Of Post-Felling Forest Inventory Sample Plots For Study Area In Compartments 194 And 205, Kledang Saiong Forest Reserve, Perak

Scale 1:25,000



LEGEND

Post-felling Sample Plot

Treatment Block

Figure 7 : Distribution Of Post-Felling Forest Inventory Sample Plots For Study Area In Compartment 39, Cherul Forest Reserve, Terengganu

using the computer programme developed by the Forestry Department Headquarters, which provided for each treatment block summaries of stand and stock tables (both Cumulative and Non-cumulative) showing the following:-

a) gross number of trees per ha
b) net number of trees per ha
c) gross volume per ha
d) net volume per ha
e) basal area per ha

) by species groups and diameter classes

An adapted version of the Non-cumulative and Cumulative summaries of stand and stock tables for Treatment Block 01 in the Kledang Saiong Forest Reserve are shown in Tables 1 and 2 respectively.

For a complete randomisation of each treatment into four replications, homogenity is required over the whole study area. However, this is difficult to achieve in a mixed tropical forest which is heterogenous in nature. Hence, a practical solution to this problem was to stratify each study area into categories of approximately homogenous forest stocking (in terms of basal area/ha) and locating a full series of five treatments in each category. The basal areas obtained from the summaries of stand and stock tables (as shown in Tables 1 and 2) were classified into four (4) basal area categories. The decision to remove trees to

Table 1 : Non-Cumulative Summary Of Stand And Stock Table For Treatment Block 01, Compartments 194 And 205, Kledang Saiong Forest Reserve, Perak

CIES GROUP	DIAMETER CLASS (cm)	+15	+30	+45	+50	+55	+60	+65	+70	+75	+80	+85	+90
UP 1	GROSS NO. OF TREES	3.33	3.33	2.22	1.11	1.11	.00	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	2.22	2.22	1.56	.78	.78	.00	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	4.06	4.06	3.07	1.76	.00	.00	.00	.00	.00	.00	.00	.00
	NET VOLUME	2.44	2.44	1.84	1.06	1.06	.00	.00	.00	.00	.00	.00	.00
	BASAL AREA	.63	.63	.47	.27	.27	.27	.00	.00	.00	.00	.00	.00
UP 3	GROSS NO. OF TREES	1.11	1.11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	.67	.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	.56	.56	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	NET VOLUME	.34	.34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	BASAL AREA	.09	.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
JP 4	GROSS NO. OF TREES	18.89	5.56	4.44	2.22	2.22	1.11	1.11	1.11	1.11	1.11	1.11	1.11
	NET NO. OF TREES	10.56	3.89	3.32	1.67	1.67	.89	.89	.89	.89	.89	.89	.89
	GROSS VOLUME	22.74	21.39	20.52	18.16	18.16	16.34	16.34	16.34	16.34	16.34	16.34	16.34
	NET VOLUME	15.28	14.47	13.94	12.53	12.53	11.44	11.44	11.44	11.44	11.44	11.44	11.44
	BASAL AREA	2.45	2.03	1.90	1.54	1.54	1.26	1.26	1.26	1.26	1.26	1.26	1.26
P 5	GROSS NO. OF TREES	22.22	11.11	4.44	3.33	2.22	1.11	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	12.78	7.22	3.72	2.44	1.67	.89	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	13.56	12.22	8.17	6.95	5.38	3.36	.00	.00	.00	.00	.00	.00
	NET VOLUME	8.47	7.67	5.24	4.50	3.57	2.35	.00	.00	.00	.00	.00	.00
	BASAL AREA	2.13	1.71	1.06	.90	.66	.34	.00	.00	.00	.00	.00	.00
P 6	GROSS NO. OF TREES	2.22	2.22	1.11	1.11	1.11	1.11	1.11	1.11	1.11	.00	.00	.00
	NET NO. OF TREES	1.56	1.56	.89	.89	.89	.89	.89	.89	.89	.00	.00	.00
	GROSS VOLUME	7.12	7.12	6.60	6.60	6.60	6.60	6.60	6.60	6.60	.00	.00	.00
	NET VOLUME	4.93	4.93	4.62	4.62	4.62	4.62	4.62	4.62	4.62	.00	.00	.00
	BASAL AREA	.59	.59	.51	.51	.51	.51	.51	.51	.51	.00	.00	.00
7	GROSS NO. OF TREES	4.44	4.44	3.33	2.22	2.22	1.11	.00	.00	.00	.00	.00	.00
	NET NO. OF TREES	3.11	3.11	2.44	1.67	1.67	.89	.00	.00	.00	.00	.00	.00
	GROSS VOLUME	7.34	7.34	6.32	5.05	5.05	3.11	.00	.00	.00	.00	.00	.00
	NET VOLUME	4.72	4.72	4.10	3.34	3.34	2.18	.00	.00	.00	.00	.00	.00
	BASAL AREA	.97	.97	.81	.62	.62	.32	.00	.00	.00	.00	.00	.00
8	GROSS NO. OF TREES	73.33	31.11	15.56	10.00	4.44	2.22	1.11	1.11	1.11	1.11	.00	.00
	NET NO. OF TREES	41.56	20.44	11.11	7.22	3.33	1.78	.89	.89	.89	.89	.00	.00
	GROSS VOLUME	44.42	39.03	28.17	21.86	14.32	10.53	7.30	7.30	7.30	7.30	.00	.00
	NET VOLUME	27.70	24.47	17.96	14.17	9.64	7.37	5.11	5.11	5.11	5.11	.00	.00
	BASAL AREA	6.97	5.32	3.61	2.64	1.48	.89	.56	.56	.56	.56	.00	.00
ROCARP	GROSS NO. OF TREES	23.33	10.00	6.67	3.33	3.33	1.11	1.11	1.11	1.11	1.11	1.11	1.11
	NET NO. OF TREES	13.44	6.78	4.78	2.44	2.44	.89	.89	.89	.89	.89	.89	.89
	GROSS VOLUME	27.36	26.02	25.39	19.92	19.92	16.34	16.34	16.34	16.34	16.34	16.34	16.34
	NET VOLUME	18.05	17.24	15.79	13.59	11.44	11.44	11.44	11.44	11.44	11.44	11.44	11.44
	BASAL AREA	3.16	2.75	2.37	1.61	1.81	1.26	1.26	1.26	1.26	1.26	1.26	1.26
OCARP	GROSS NO. OF TREES	102.22	48.89	24.44	16.67	10.00	5.56	2.22	2.22	2.22	1.11	.00	.00
	NET NO. OF TREES	59.00	32.33	17.67	12.22	7.56	4.44	1.78	1.78	1.78	.89	.00	.00
	GROSS VOLUME	72.44	65.72	49.26	40.46	31.35	23.60	13.90	13.90	13.90	7.30	.00	.00
	NET VOLUME	45.82	41.79	31.92	26.64	21.17	16.52	9.73	9.73	9.73	5.11	.00	.00
	BASAL AREA	10.65	8.58	6.01	4.66	3.26	2.06	1.07	1.07	1.07	.56	.00	.00
	GROSS NO. OF TREES	125.56	58.89	31.11	20.00	13.33	6.67	3.33	3.33	3.33	2.22	1.11	1.11
	NET NO. OF TREES	72.44	39.11	22.44	14.67	10.00	5.33	2.67	2.67	2.67	1.78	.89	.89
	GROSS VOLUME	99.80	91.73	72.85	60.38	51.27	39.94	30.24	30.24	30.24	23.63	16.34	16.34
	NET VOLUME	63.88	59.03	47.70	40.22	34.76	27.96	21.17	21.17	21.17	16.54	11.44	11.44
	BASAL AREA	13.81	11.33	8.38	6.47	5.06	3.32	2.33	2.33	2.33	1.82	1.26	1.26

Table 2 : Cumulative Summary Of Stand And Stock Table For Treatment Block 01, Compartments 194 And 205, Kledang Saiong Forest Reserve, Perak

SPECIES GROUP	DIAMETER CLASS (cm)	15	30	45	50	55	60	65	70	75	80	85	90 +	T
GROUP 1	GROSS NO. OF TREES	.00	1.11	1.11	.00	1.11	.00	.00	.00	.00	.00	.00	.00	
	NET NO. OF TREES	.00	.67	.78	.00	.78	.00	.00	.00	.00	.00	.00	.00	
	GROSS VOLUME	.00	1.00	.09	.00	1.78	.00	.00	.00	.00	.00	.00	.00	
	NET VOLUME	.00	.60	.78	.00	1.06	.00	.00	.00	.00	.00	.00	.00	
	BASAL AREA	.00	.15	.20	.00	.27	.00	.00	.00	.00	.00	.00	.00	
GROUP 3	GROSS NO. OF TREES	.00	1.11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
	NET NO. OF TREES	.00	.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
	GROSS VOLUME	.00	.56	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
	NET VOLUME	.00	.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
	BASAL AREA	.00	.09	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
GROUP 4	GROSS NO. OF TREES	13.33	1.11	2.22	.00	1.11	.00	.00	.00	.00	.00	.00	1.11	1
	NET NO. OF TREES	6.67	.67	1.50	.00	.78	.00	.00	.00	.00	.00	.00	.89	1
	GROSS VOLUME	1.35	.87	2.30	.00	1.82	.00	.00	.00	.00	.00	.00	16.34	2
	NET VOLUME	.81	.52	1.42	.00	1.09	.00	.00	.00	.00	.00	.00	11.44	1
	BASAL AREA	.42	.13	.36	.00	.28	.00	.00	.00	.00	.00	.00	1.26	
GROUP 5	GROSS NO. OF TREES	11.11	6.67	1.11	1.11	1.11	.00	.00	.00	.00	.00	.00	..00	2
	NET NO. OF TREES	5.56	4.00	.78	.78	.78	.89	.00	.00	.00	.00	.00	.00	1
	GROSS VOLUME	1.34	4.06	1.22	1.56	2.03	3.36	.00	.00	.00	.00	.00	.00	1
	NET VOLUME	.80	2.43	.73	.91	1.22	2.35	.00	.00	.00	.00	.00	.00	
	BASAL AREA	.41	.62	.19	.24	.31	.34	.00	.00	.00	.00	.00	.00	
GROUP 6	GROSS NO. OF TREES	.00	1.11	.00	.00	.00	.00	.00	.00	1.11	.00	.00	.00	
	NET NO. OF TREES	.00	.67	.00	.00	.00	.00	.00	.00	.89	.00	.00	.00	
	GROSS VOLUME	.00	.51	.00	.00	.00	.00	.00	.00	6.60	.00	.00	.00	
	NET VOLUME	.00	.31	.00	.00	.00	.00	.00	.00	4.62	.00	.00	.00	
	BASAL AREA	.00	.08	.00	.00	.00	.00	.00	.00	.51	.00	.00	.00	
GROUP 7	GROSS NO. OF TREES	.00	1.11	1.11	.00	1.11	1.11	.00	.00	.00	.00	.00	.00	
	NET NO. OF TREES	.00	.67	.78	.00	.78	.89	.00	.00	.00	.00	.00	.00	
	GROSS VOLUME	.00	1.02	1.27	.00	1.93	3.11	.00	.00	.00	.00	.00	.00	
	NET VOLUME	.00	.61	.76	.00	1.16	2.18	.00	.00	.00	.00	.00	.00	
	BASAL AREA	.00	.16	.20	.00	.30	.32	.00	.00	.00	.00	.00	.00	
GROUP 8	GROSS NO. OF TREES	42.22	15.56	5.56	5.56	2.22	1.11	.00	.00	1.11	.00	.00	.00	7
	NET NO. OF TREES	21.11	9.33	3.89	3.89	1.56	.89	.00	.00	.00	.89	.00	.00	4
	GROSS VOLUME	5.38	10.86	6.31	7.55	3.79	3.23	.00	.00	.00	7.30	.00	.00	4
	NET VOLUME	3.23	6.52	3.78	4.53	2.27	2.26	.00	.00	.00	5.11	.00	.00	2
	BASAL AREA	1.66	1.71	.97	1.16	.58	.33	.00	.00	.00	.56	.00	.00	
DIPTEROCARP	GROSS NO. OF TREES	13.33	3.33	3.33	.00	2.22	.00	.00	.00	.00	.00	.00	1.11	2
	NET NO. OF TREES	6.67	2.00	2.33	.00	1.56	.00	.00	.00	.00	.00	.00	.89	1
	GROSS VOLUME	1.55	2.43	3.67	.00	3.58	.00	.00	.00	.00	.00	.00	16.34	2
	NET VOLUME	.81	1.46	2.20	.00	2.15	.00	.00	.00	.00	.00	.00	11.44	1
	BASAL AREA	.42	.37	.56	.00	.55	.00	.00	.00	.00	.00	.00	1.26	
NON-DIPTEROCARP	GROSS NO. OF TREES	53.33	24.44	7.78	6.67	4.44	3.33	.00	.00	1.11	1.11	.00	.00	10
	NET NO. OF TREES	26.67	14.67	5.44	4.67	3.11	2.67	.00	.00	.89	.00	.00	.00	5
	GROSS VOLUME	6.72	16.46	8.80	9.11	7.75	9.70	.00	.00	6.60	7.30	.00	.00	7
	NET VOLUME	4.03	9.87	5.28	5.47	4.65	6.79	.00	.00	4.62	5.11	.00	.00	4
	BASAL AREA	2.07	2.57	1.35	1.40	1.19	.99	.00	.00	.51	.56	.00	.00	1
TOTAL	GROSS NO. OF TREES	66.67	27.78	11.11	6.67	6.67	3.33	.00	.00	1.11	1.11	.00	1.11	12
	NET NO. OF TREES	33.33	16.67	7.78	4.67	2.67	.00	.00	.00	.89	.89	.00	.89	7
	GROSS VOLUME	8.07	18.89	12.46	9.11	11.34	9.70	.00	.00	6.60	7.30	.00	16.34	9
	NET VOLUME	4.81	11.33	7.48	5.47	6.80	6.79	.00	.00	4.62	5.11	.00	11.44	6
	BASAL AREA	2.48	2.94	1.92	1.40	1.74	.99	.00	.00	.51	.56	.00	1.26	1

reduce the basal area of a particular treatment block was based on the ability to classify the basal area of that treatment block into one of the four categories. If the basal area of the particular treatment block could be so classified, then no removal of trees to reduce the basal area was recommended. On the other hand, if the treatment block could not be classified into any of the basal area categories, then trees in this block would have to be removed so as to reduce the basal area to a level capable of being classified into one of the categories. However, no trees were required to be removed from both the study areas. Table 3 shows the categorisation and allocation of treatments for treatment blocks for the study area in Compartments 194 and 205, Kledang Saiong Forest Reserve while Table 4 shows the similar categorisation and allocation for the study area in Compartment 39, Cherul Forest Reserve. All the treatment blocks were ranked accordingly for each of the categories.

TABLE 3 : CATEGORISATION AND ALLOCATION OF TREATMENTS FOR TREATMENT BLOCKS IN COMPARTMENTS 194 & 205 KLEDANG SAIONG FOREST RESERVE, PERAK

BASAL AREA CATEGORY (m. sq./ha)	TREATMENT BLOCK NUMBER	TREATMENT
> 13.0 - 15.0	01	GCL
	07	CL
	09	GCL & EP
	10	Control
	11	Plantation
> 11.0 - 13.0	02	CL
	03	GCL & EP
	16	GCL
	17	Plantation
	20	Control
> 9.0 - 11.0	05	GCL & EP
	06	Control
	13	GCL
	14	Plantation
	15	CL
> 7.0 - 9.0	04	Plantation
	08	CL
	12	GCL
	18	Control
	19	GCL & EP

Note:

GCL - Girdling and Cutting of Liana
CL - Cutting of Liana
EP - Enrichment Planting

TABLE 4 : CATEGORISATION AND ALLOCATION OF TREATMENTS FOR TREATMENT BLOCKS IN COMPARTMENT 39, CHERUL FOREST RESERVE, TERENGGANU

BASAL AREA CATEGORY (m.sq/ha)	TREATMENT BLOCK NUMBER	TREATMENT
> 7.5 - 9.5	04	Plantation
	10	GCL & EP
	11	GCL
	16	CL
> 11.5 - 13.5	02	Plantation
	08	GCL
	12	CL
	14	Control
	19	GCL & EP
> 13.5 - 15.5	03	Plantation
	13	GCL & EP
	15	GCL
	17	Control
	20	CL
> 15.5 - 17.5	01	CL
	05	Control
	06	Plantation
	07	GCL & EP
	18	GCL

Note:

GCL - Girdling and Cutting of Liana
CL - Cutting of Liana
EP - Enrichment Planting

3.0 RANDOMISATION OF TREATMENTS

For meaningful statistical analysis at a later stage, the allocation of various treatments for treatment blocks within each basal area category was randomised, except for the establishment of indigenous forest plantation. The allocation of the treatment blocks for forest plantation was pre-determined based on slope conditions and accessibility. The pre-determined and randomised location of the various treatments within the study areas at Kledang Saiong Forest Reserve and Cherul Forest Reserve are as shown in Figures 8 and 9 respectively.

4.0 BOUNDARY DEMARCATION OF TREATMENT BLOCKS

Boundary demarcation (1m wide) for all the treatment blocks was carried out. Along the boundaries, all trees below 10cm dbh were removed while the four corners of each treatment block were marked by 5cm diameter PVC pickets. In addition, circumferences of trees below 30cm dbh were painted red at breast height at intervals of 10m along the boundaries.

5.0 SETTING UP OF PERMANENT SAMPLE PLOTS AND DATA COLLECTION

5.1 CL, GCL AND CONTROL TREATMENT BLOCKS

A permanent sample plot (PSP) measuring 100m x 100m (1 ha) was set up in each CL, GCL and Control treatment block. The exact location of PSP are as shown

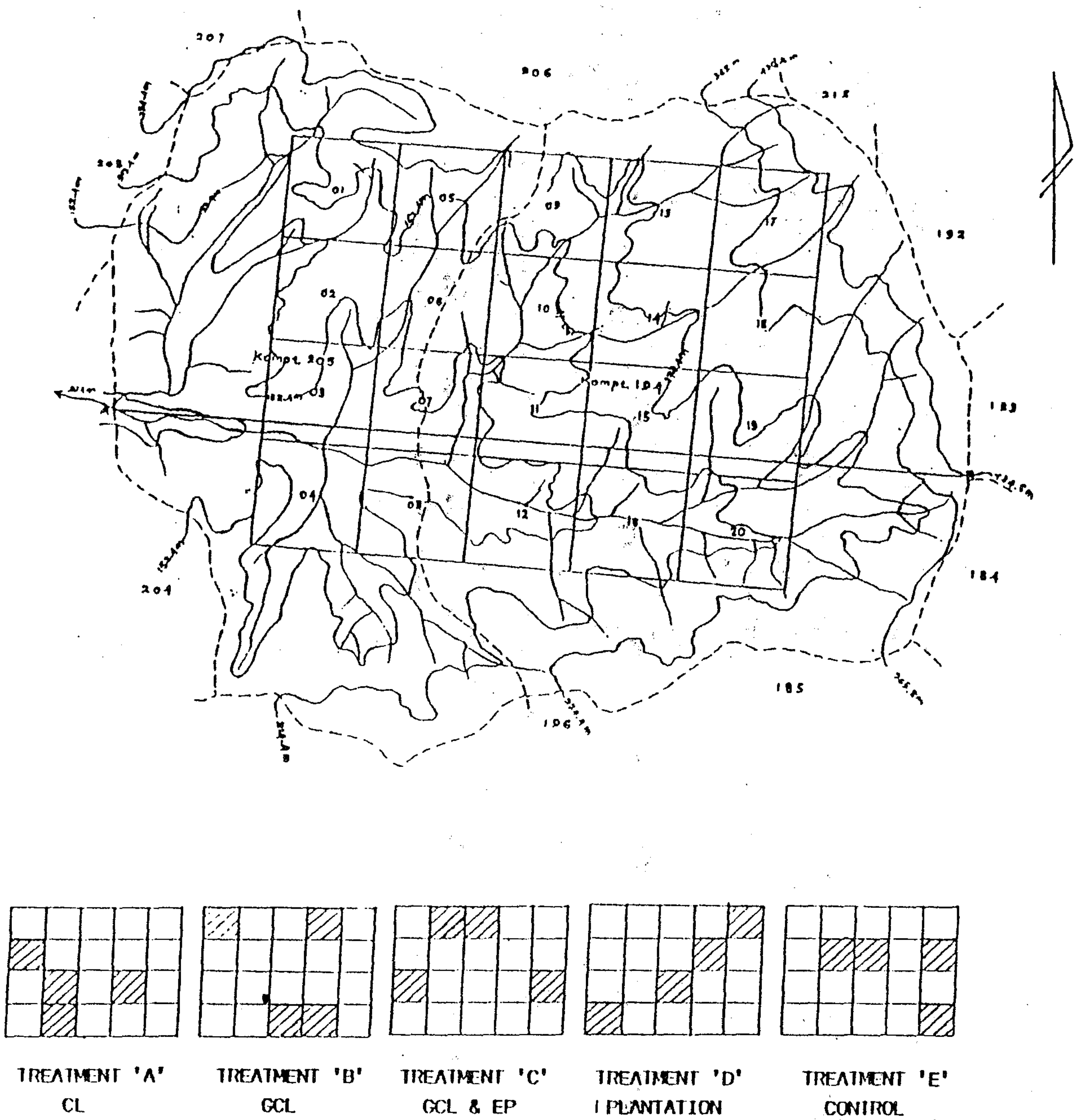


Figure 8 : Location Of Various Treatments Within The Study Area In Kledang Saiong Forest Reserve, Perak

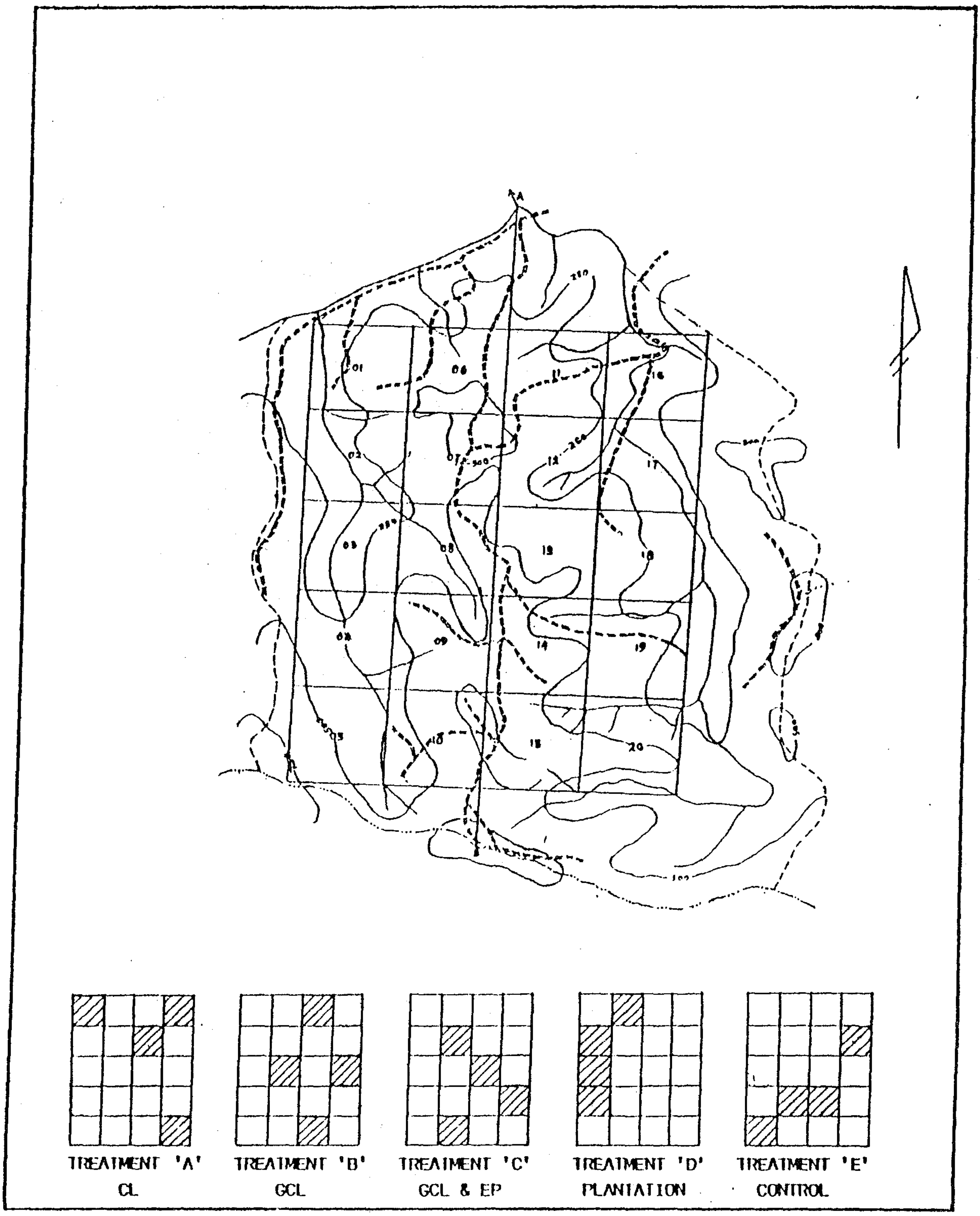


Figure 9 : Location Of Various Treatments Within The Study Area In Cherul Forest Reserve, Terengganu

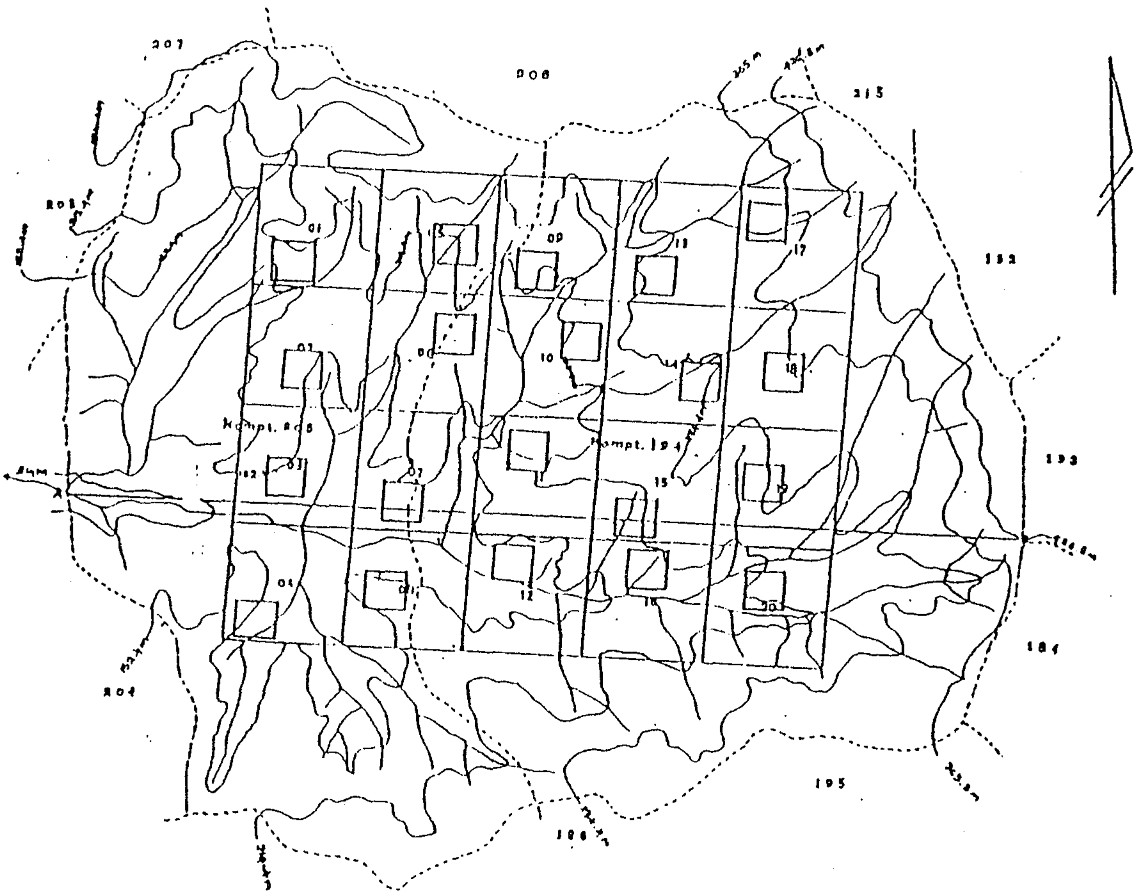
in Figure 10 and 11. The design of the permanent sample plot is shown in Figure 12.

Each permanent sample plot consists of twenty-five (25) quadrats (sub-plots) of size 20m x 20m (quadrat 1-25), nine (9) quadrats of size 5m x 5m (quadrat 26 -34), and nine (9) quadrats of size 2m x 2m (quadrat 35-43).

The dimension of the various quadrats, the quadrat numbers, the size class of trees to be enumerated within each quadrat and the enumeration forms to be used are as follows:-

Quadrat Size	Quadrat Number	Size Class	Enumeration Form
20m x 20m	1,2,3,4,5,6,10, 11,15,16,20,21, 22,23 24,25	>15cm dbh	HB/1A
20m x 20m	7,8,9,12,13,14, 17,18,19.	> 5 cm dbh	HB/1B
5m x 5m	26,27,28,29,30, 31,32,33,34.	150cm height - 5cm dbh	HB/2
2m x 2m	35,36,37,38,39, 40,41,42,43.	15cm - 150cm height	HB/3

All trees above 5cm dbh within each permanent sample plot were numbered sequentially using aluminium tags and the dbh recorded, while only the number of seedlings 15cm high to saplings of size 5cm dbh were recorded. All trees within the size class corresponding to the selected quadrats were identified to species level as far as possible while diameter measurements



Legend:

Treatment Block 316 m x 316 m (10 ha)

Permanent Sample Plot 100 m x 100 m (1 ha)

Figure 10 : Location Of Permanent Sample Plot In Kledang Saiong Forest Reserve, Perak

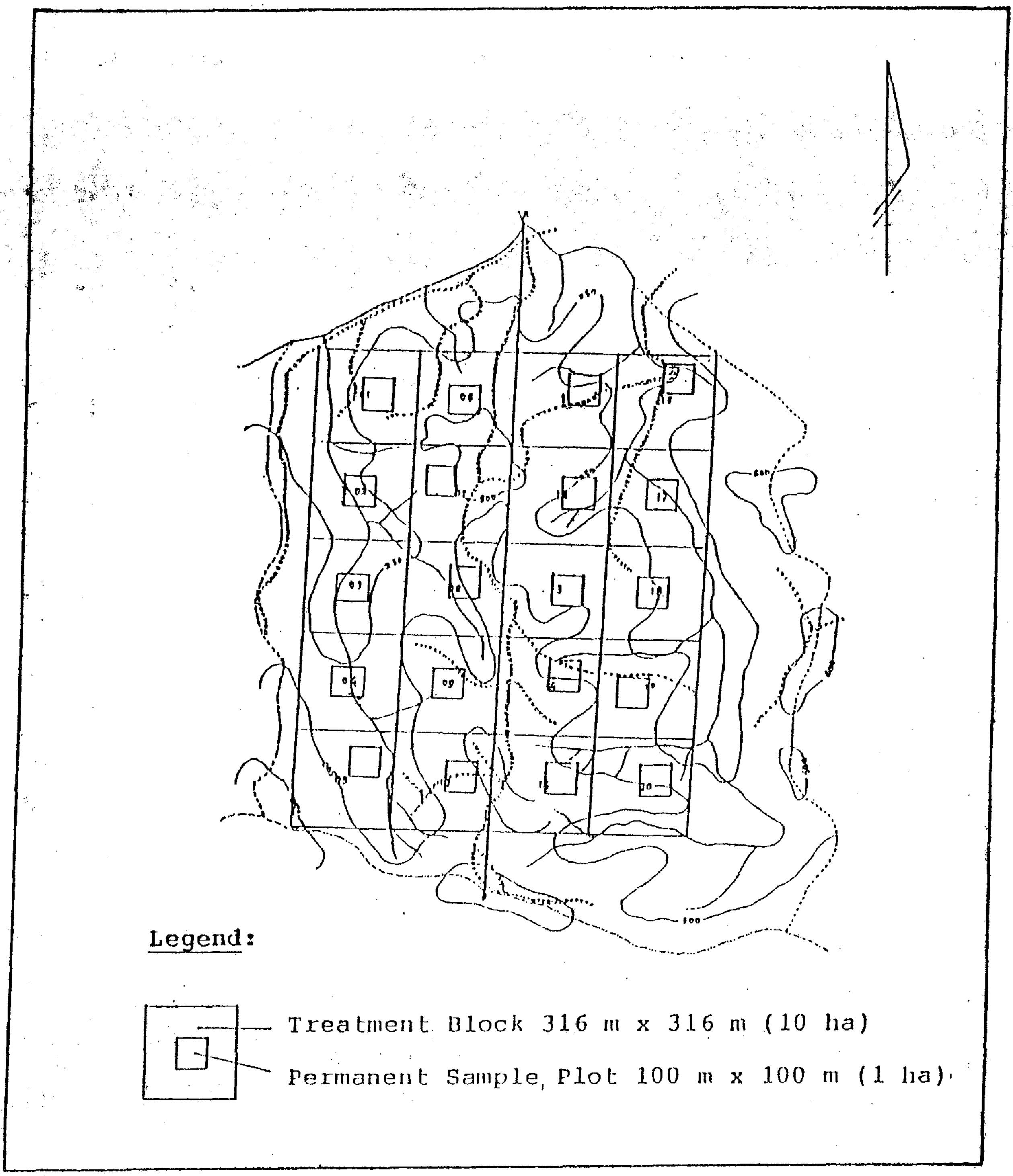
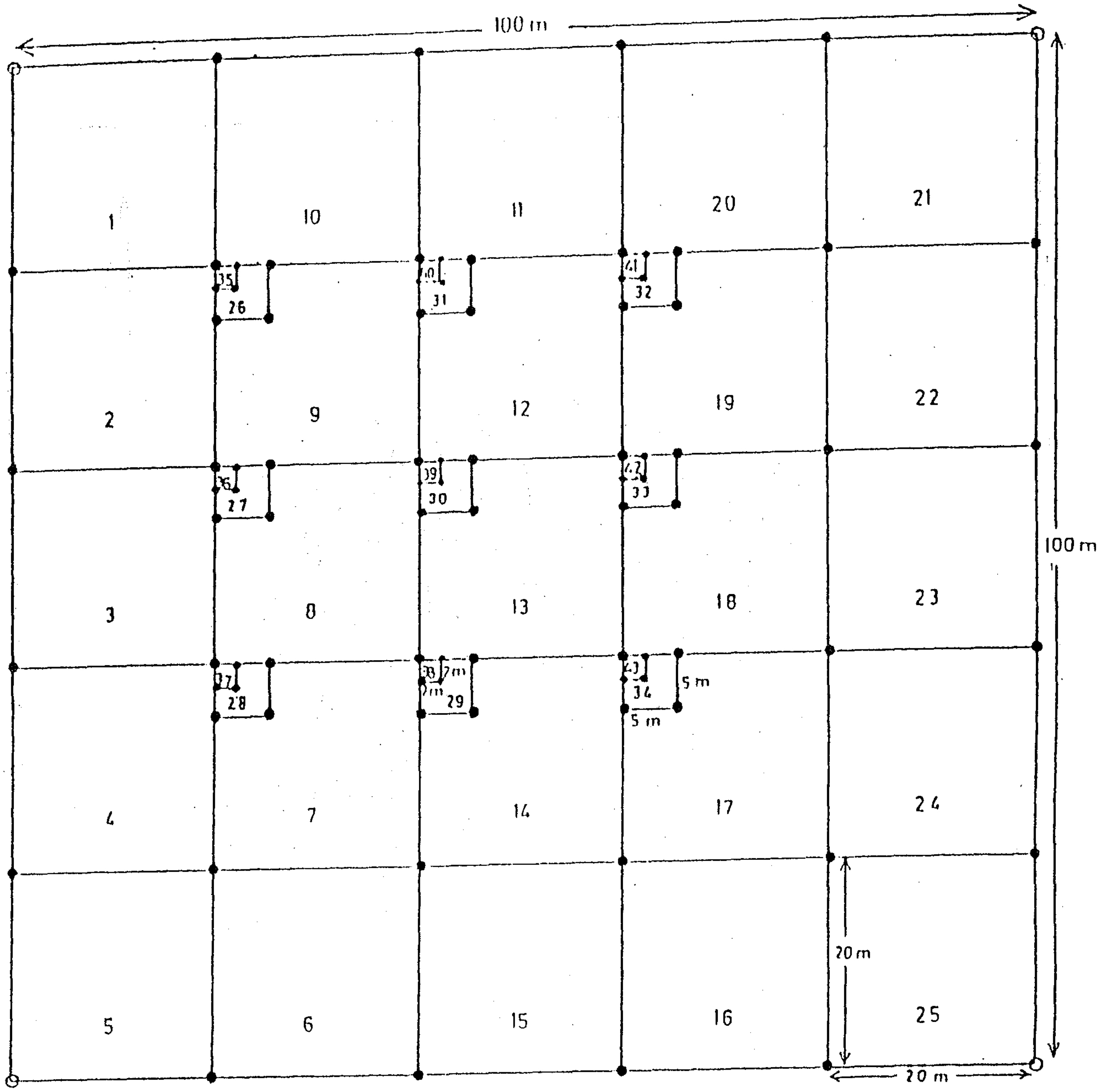


Figure 11 : Location Of Permanent Sample Plot
In Cherul Forest Reserve,
Terengganu



Quadrat size	Quadrat number	Size class
20m x 20m	1, 2, 3, 4, 5, 6, 10, 11, 15, 16, 20, 21, 22, 23, 24, 25	+ 15 cm dbh.
20m x 20m	7, 8, 9, 12, 13, 14, 17, 18, 19	+ 5 cm dbh
5m x 5m	26, 27, 28, 29, 30, 31, 32, 33, 34	150 cm height - 5 cm dbh
2m x 2m	35, 36, 37, 38, 39, 40, 41, 42, 43	15 cm - 150 cm height

KEY:

O Yellow Painted Picket

● Red Painted Picket

• Yellow Painted Picket

Scale 1cm : 6 m

Figure 12 : Permanent Sample Plot Design
For CL, GCL And Control

were taken to the nearest one-tenth of a centimetre and height to the nearest centimetre. All diameters were measured at breast height (1.3m above ground) or 0.3m above buttress.

In addition, a plot diagram showing the location as well as the number of trees enumerated within each quadrat was also prepared to facilitate future remeasurements.

The proposed measurement schedule is once every year for the first five years of study, once in two years until the 15th year and thereafter once in five years until the recommended time. The enumeration forms HB/1A, HB/1B, HB/2 and HB/3 used are shown in Appendices III, IV, V and VI respectively. Enumeration/measurement schedules are shown in Appendices VII and VIII.

Prior to the setting up of the permanent sample plots, CL and GCL silvicultural treatments were carried out in the respective treatment blocks. Basically, CL involved the cutting of all liana, while GCL involved the girdling of defect or damaged trees and the cutting of palms that shade the saplings and natural regeneration of the preferred species, besides the cutting of all liana. The chemical used for girdling in both the study areas was Escort 60 DF. The trees girdled were identified by species and dbh measured.

The location of trees girdled in each PSP is shown in the respective plot diagrams. Details are outlined in the Operational Manual for the Girdling of Trees and Cutting of Liana (GCL) as shown in Appendix IX.

5.2 ENRICHMENT PLANTING (EP) TREATMENT BLOCK

A permanent sample plot measuring 100m x 100m (1 ha) with 10 planting lines was set up in each Enrichment Planting treatment block. The design of the plot is as shown in Figure 13. In addition, a plot diagram showing the location as well as the number of trees planted within the permanent sample plot was also prepared to facilitate future remeasurements. Two different indigenous species were planted in the east-west direction, at a planting distance of 3m x 10m. The species planted are Meranti sarang punai (*Shorea parvifolia*) and Meranti tembaga (*Shorea leprosula*) in Kledang Saiong Forest Reserve and Meranti rambai daun (*Shorea acuminata*), Keruing kertas (*Dipterocarpus chartaceus*) and Sesendok (*Endospermum malaccense*) in Cherul Forest Reserve. No planting was carried out if a preferred species sapling was found within 1m from the planting spot.

Based on the proposed measurement schedule, the first measurement was carried out three months after planting. This was followed by the second measurement in

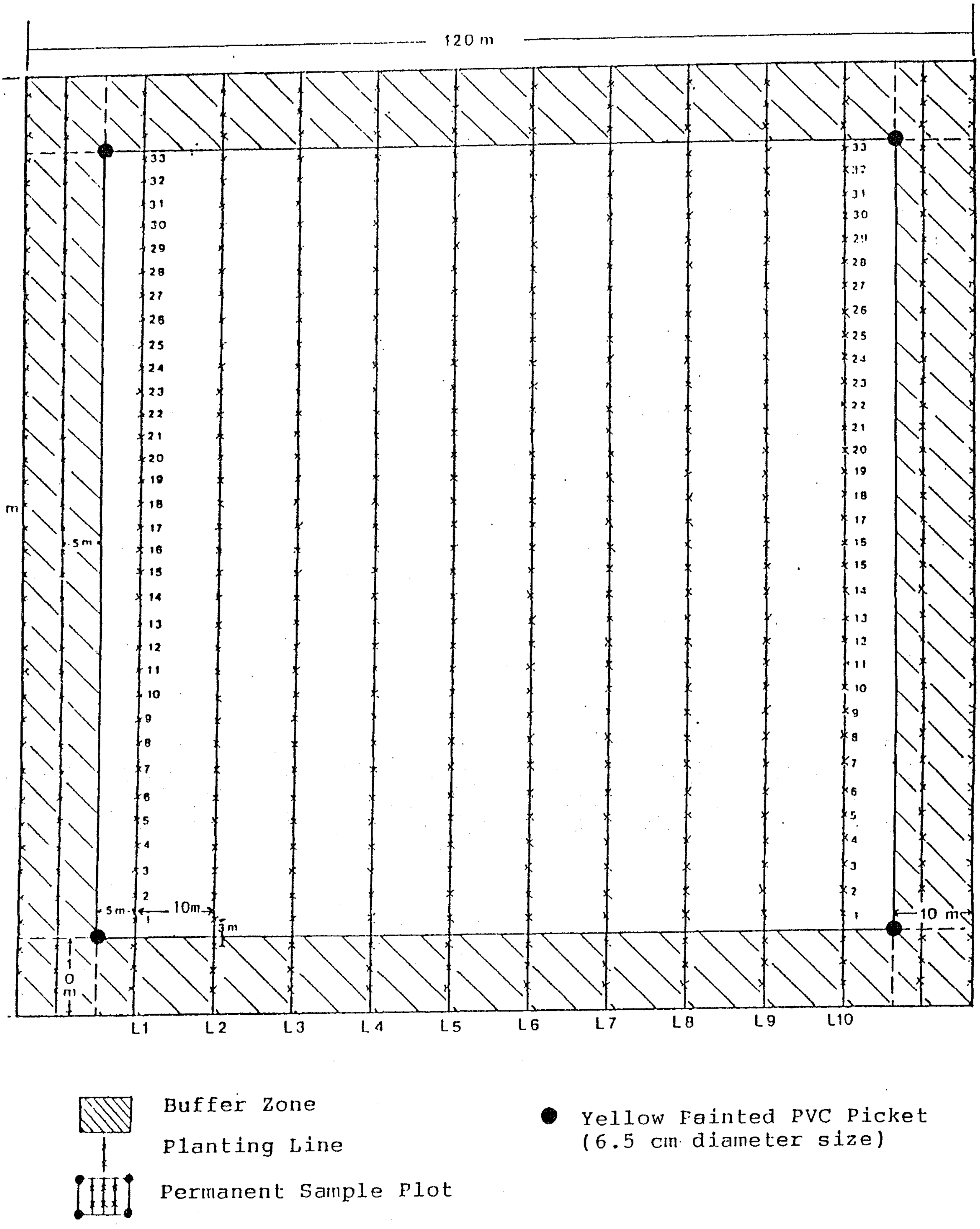


Figure 13 : Permanent Sample Plot Design For Enrichment Planting Treatment Block (3m x 10 m)

the 9th month, the third in the 15th month and the fourth in the 27th month. Subsequent measurements are to be carried out on an annual basis, after the last measurement until the rotation age. The enumeration form HB/5 used is as shown in Appendix X. The Operational Manual for Enrichment Planting is described in Appendix XI.

5.3 INDIGENOUS FOREST PLANTATION TREATMENT BLOCK

5.3.1 A permanent sample plot measuring 100m x 100m (1 ha) with 17 planting lines was set up in each plantation treatment block. The design of the plot is as shown in Figure 14. Prior to planting, all trees 30cm dbh and above were removed and planting lines cleared. Planting using two different species was carried out in the east-west direction at a planting distance of 3m x 6m.

5.3.2 The measurement schedule, tending of planted stock and the enumeration form HB/4 (Appendix XII) used are basically similar to those for enrichment planting, except that 3 years after planting, the residual forest stand within the permanent sample plot is to be gradually cleared. First pruning is to be carried out in the 5th year after planting, followed by the second pruning in year 8 and the third pruning in year 10.

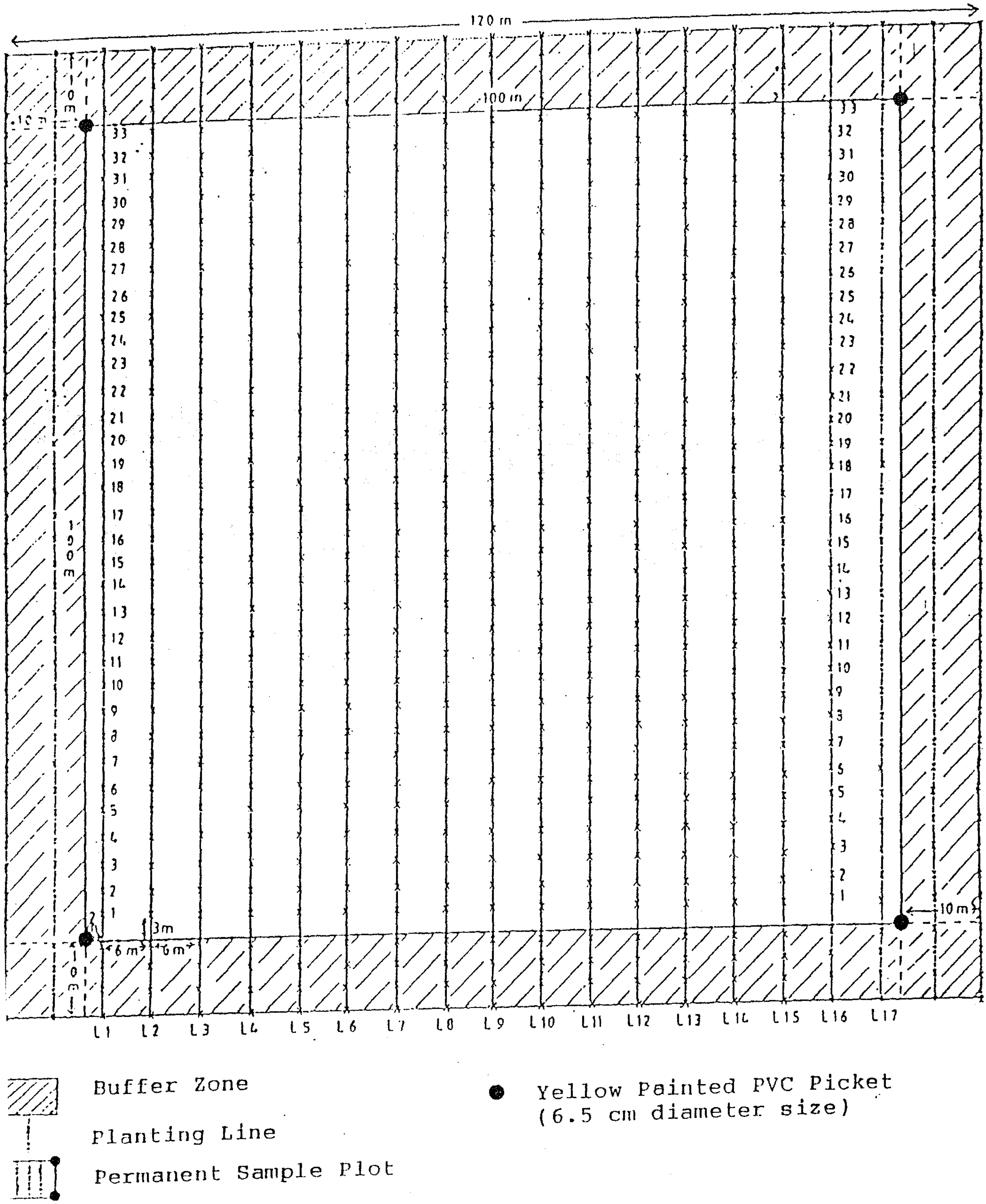


Figure 14 : Permanent Sample Plot Design For Indigenous Plantation Treatment Block (3m x 6 m)

APPENDIX I

Technical Decisions Made During The Meetings Of The Technical Working Group On Forest Management Of Natural Forest In Malaysia

1. Experimental design for the virgin and logged-over forest areas is the randomised block design.

2. The cutting limits (regimes) for the virgin forest areas are as follows :-

   (a) Cut all trees having diameter $\geq$30 cm at breast height;

   (b) Cut all trees having diameter $\geq$45 cm at breast height;

   (c) Cut all dipterocarps and non-dipterocarps having diameter $\geq$35 cm and $\geq$30 cm at breast height respectively;

   (d) Cut all dipterocarps and non-dipterocarps having diameter $\geq$50 cm and $\geq$45 cm at breast height respectively;

   (e) Cut all dipterocarps and non-dipterocarps having diameter $\geq$65 cm and $\geq$60 cm at breast height respectively;

   (f) Cut all dipterocarps and non-dipterocarps having diameter $\geq$75 cm and $\geq$70 cm at breast height respectively;

   (g) Establishment of indigenous forest plantation (Cut all trees having diameter $\geq$30 cm at breast height followed by planting of indigenous tree species); and

   (h) Control (no cutting).

3. For the logged-over forest area, the silvicultural treatments are as follows :-

   (a) Cutting of liana (CL);

   (b) Girdling of trees and cutting of liana (GCL);

   (c) Girdling of trees and cutting of liana coupled with enrichment planting;

   (d) Establishment of indigenous forest plantation; and

   (e) Control (no treatment).

4. Pre-Felling and Post-Felling forest inventories to be carried out in the virgin and logged-over forest area respectively shall be of 10% intensity.

5. The size of the permanent sample plots to be established shall be 100 m x 100 m (One hectare plot). The layout and design of the permanent sample plot (PSP) in the logged-over forest is the same as that in the virgin forest. However, a 10 m buffer zone surrounding the permanent sample plot which shall be subjected to the same treatment as the PSP is advocated for the logged-over forest.

6. The criteria for selecting species for the indigenous forest plantation shall be as follows :-

   (a) Dominant species found in the forest area; and

   (b) Commercial species.

   Based on the above criteria, the following plantation species were selected for the four (4) study areas :-

   i) Pahang

      (a) Mengkulang (Heritiera spp.)

      (b) Meranti nemusu (*Shorea pauciflora*)

      (c) Meranti sarang punai (*Shorea parvifolia*)

      (d) Keruing gombang (*Dipterocarpus cornutus*)

      (e) Meranti rambai daun (*Shorea acuminata*)

      (f) Meranti tembaga (*Shorea leprosula*)

   ii) Selangor

      (a) Meranti sarang punai (*Shorea parvifolia*)

      (b) Meranti rambai daun (*Shorea acuminata*)

   iii) Perak

      (a) Meranti tembaga (*Shorea leprosula*)

      (b) Meranti sarang punai (*Shorea parvifolia*)

   iv) Terengganu

      (a) Meranti sarang punai (*Shorea parvifolia*)

      (b) Meranti rambai daun (*Shorea acuminata*)

(c) Keruing kertas (Dipterocarpus chartaceus)

(d) Sesendok (Endospermum malaccense)

7. The planting distance for the indigenous forest plantation is 3 m x 6 m while that of enrichment planting is 3 m x 10 m.

8. Selection of tree species for enrichment planting is to be based on the dominance/availability of the species in the study area and in accordance with the 'Regeneration Sampling List'.

9. Enrichment planting need not be carried out at planting sites if there is already the presence of the desired species. However, if the trees found at the planting sites are not of the desired species, enrichment planting of the desired/selected species should be carried out at a distance of 1 meter to the right of the planting site. All planting lines are to be aligned in an east-west direction and be cleared of all under-growth at a distance of 0.5 m to the left and right of the line.

10. Priority is to be accorded to carry out enrichment planting in the Permanent Sample Plots (4 plots of 1 ha each) while the balance of the area (remaining 36 ha) shall be planted in stages depending on the availability of seedlings. It is decided that each planting line is to be planted by a specific species.

11. Treatment and refilling schedule for enrichment planting and indigenous forest plantation is as follows :-

    i) Treatment and refilling 1 : 3 months after planting

    ii) Treatment and refilling 2 : 9 months after planting

    iii) Treatment and refilling 3 : 15 months after planting

    iv) Treatment and refilling 4 : 27 months after planting

    Subsequently, treatment is to be carried out yearly during remeasurement until the 5th year. Acceptable survival rate of seedling is 80%.

12. The total number of seedlings to be planted in the Permanent Sample Plot of size 120 m x 120 m (inclusive of the buffer sone) under plantation establishment shall be 800 comprising not more than four (4) species. Each planting line shall be planted with a single species alternating with lines planted with other species in a sequential manner.

13. Prior to the planting of seedlings under plantation establishment, all residual trees 30 cm dbh and above within the Permanent Sample Plot (120 m x 120 m) shall be cut and removed from the planting line.

14. A total of 480 seedlings comprising not more than 4 species shall be planted in the Permanent Sample Plot (120 m x 120 m) under enrichment planting. It is decided that each planting line shall be planted with a single species alternating with lines planted with other species in a sequential manner.

15. All seedlings planted under plantation establishment and enrichment planting will be enumerated during remeasurement. For the initial measurements when the seedlings are less than 5 cm dbh, only total height will be measured. However, once the seedlings have achieved 5 cm dbh and greater, only diameter measurement will be taken. In addition, the total height of 30 dominant saplings, selected based on the tallest height recorded, for each species planted will also be measured. In the event of death to a dominant sampling a year after measurement, it will be replaced by the next tallest sapling based on the latest height measurement before the sapling achieved 5 cm dbh. However, if the dominant sampling dies in subsequent years, it will be replaced by trees having the next biggest diameter measurement.

16. It was decided that for both plantation establishment and enrichment planting, only trees planted within the Permanent Sample Plots will be enumerated during remeasurement. Tree planted within the buffer zone need not be enumerated.

17. A blanked silvicultural treatment of the virgin forest in the form cutting of liana (CL) shall be conducted 3 years and 10 years after harvesting in view of the findings that liana are found to be most abundant during these periods.

18. Logging studies (harvesting cost) will be conducted over the whole study area. Average logging cost by treatment blocks will be obtained by proportioning the total logging costs incurred.

19. Assessment of stem and crown damage shall be conducted each time the remeasurement is being carried out and preferrably by a specially trained and assigned team of crew.

20. The logged-over forest at Kledang Saiong Forest Reserve, Perak is to be divided into four (4) different residual basal area (BA) classes. The four (4) BA classes and the corresponding blocks for each BA class are as follows :-

BA Class	Block No.
(a) >7 - 9 m^2/ha	4, 8, 12, 18, 19
(b) >9 - 11 m^2/ha	5, 6, 13, 14, 15
(c) >11 - 13 m^2/ha	2, 3, 16, 17, 20
(d) >13 - 15 m^2/ha	1, 7, 9, 10, 11

21. The logged-over forest at Cherul Forest Reserve, Terengganu is to be divided into four (4) different residual basal area (BA) classes. The four BA classes and the corresponding blocks for each BA class are as follows :-

BA Class	Block No.
(a) >7.5 - 9.5 m^2/ha	16, 04, 09, 10, 11
(b) >11.5 - 13.5 m^2/ha	19, 14, 08, 12, 02
(c) >13.5 - 15.5 m^2/ha	03, 13, 16, 20, 17
(d) >15.5 - 17.5 m^2/ha	05, 07, 18, 01, 06

22. It was decided that all trees marked for felling within the Permanent Sample Plot (1 ha) are to be felled while at least 90% of all marked trees within the remaining treatment block (9 ha) for all treatment types should also be felled. Trees which pose danger to be felled shall be poison-girdled by using GARLON 250 (3, 5, 6 - Trichloro - 2 pyridyloxyacetic acid). Marked trees which are not felled should be recorded.

23. It was decided that the 2 m x 2 m quadrats will enumerate seedlings and samplings of size 15 cm height - 150 cm height instead of the earlier decision of size 15 mm height - 150 cm height.

24. The paremeters that shall be taken into account during the analysis of data are as follows :-

(a) Diameter increment;
(b) Basal area increment;
(c) Volume increment;
(d) Ingrowth;
(e) Mortality rate;
(f) Crown and stem damage;
(g) Road construction costs; and
(h) Harvesting cost

POST-FELLING INVENTORY FIELD SHEET	CREW LEADER	DATE	CARD NO.
	RECORDING OFFICER	DATE	
	CHECKING CREW LEADER	DATE	

YEAR	STATE		FOREST RESERVE/ DISTRICT		COMP/ BLOCK NUMBER			LINE NUMBER		PLOT NUMBER		FOREST TYPE		SOIL TYPE	ASPECT	SLOPE		SLOPE'S LOCATION	ALTITUDE	BERTAM	BAMBOO	PALMS	FERN	WILD GINGER	WILD BANANA
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

CODE				TREES +45 cm ABOVE	DIAMETER				LOGS NO.	LOGS QUAL	STATUS	CROWN	DOMINANT	CLIMBERS
27	28	29	30	SPECIES	31	32	33	34	35	36	37	38	39	40

CODE				TREES +30cm-45cm	DIAMETER			LOGS NO.	LOGS QUAL	STATUS	CROWN	DOMINANT	CLIMBERS
41	42	43	44	SPECIES	45	46	47	48	49	50	51	52	53

CODE				TREES +15cm -30cm	DIAMETER			LOGS NO.	LOGS QUAL	STATUS	CROWN	DOMINANT	CLIMBERS
54	55	56	57	SPECIES	58	59	60	61	62	63	64	65	66

CODE				TREES +5cm -15cm	DIAMETER			VIGOUR
67	68	69	70	SPECIES	71	72	73	74

CODE				TREES 5 cm AND BELOW	NO. 150cm		NO. 15 cm	
75	76	77	78	SPECIES	79	80	81	82

POST-FELLING INVENTORY

OFFICE USE

CREW LEADER
DATE
CODE RECORDING OFFICER
DATE

	U	H	HJ	B	C	KU	O	M	KO
COLOR CODE	☐	☐	☐	☐	☐	☐	☐	☐	☐

OPERATOR KEY PUNCH ☐

VERIFIER ☐

APPENDIX II

CREW LEADER : ______________________ DATE : / /
CARD RECORDER : ______________________ DATE : / /
CARD VERIFIER : ______________________ DATE : / /

JOINT PROJECT MALAYSIA - ITTO
"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"
LOGGED-OVER FOREST

FORM MA/1A
QUADRAT 20 m x 20 m
(MEASURE TREE +15 cm DIAMETER)

CARD NO.

A. GENERAL INFORMATION

YEAR		MONTH		STATE		DIST-RICT		FOREST RESERVE		COMPARTMENT NO.			TREAT-MENT NO.	PLOT NO.		QUADRAT NO.		SLOPE					SOIL SURFACE		EROSION	ALTITUDE	FOREST TYPE		SOIL TYPE		GEOLOGY	
																		%			POSI'N	ASP'T										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

TYPE/NO. RATTAN														TYPE/NO. BAMBOO						NO. BERTAM		NO. PALM		% FERN	% WILD GINGER	% WILD BANANA
A		B		C		D		E		F		G		A		B		C								
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

B. TREE INFORMATION

TREE NO.			SPECIES CODE				SPECIES NAME	PREVIOUS ( )										CURRENT ( )										REMARKS
								TREE COND.	DIAMETER (cm)			NO. LOGS	LOG 1 QUALITY	STATUS	CROWN	DOMINANT		TREE COND.	DIAMETER (cm)			NO. LOGS	LOG 1 QUALITY	STATUS	CROWN	DOMINANT		
1	2	3	4	5	6	7		8	9	10	11 .12	13	14	15	16	17		18	19	20	21 .22	23	24	25	26	27		
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APPENDIX III

CREW LEDAER : ______________	DATE : / /	
CARD RECORDER : ______________	DATE : / /	
CARD VERIFIER : ______________	DATE : / /	

JOINT PROJECT MALAYSIA - ITTO
"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"
LOGGED-OVER FOREST

FORM MA/1B
QUADRAT 20 m x 20 m
(MEASURE TREE +5 cm DIAMETER)

CARD NO.

A. GENERAL INFORMATION

YEAR		MONTH		STATE		DIST-RICT		FOREST RESERVE		COMPARTMENT NO.			TREAT-MENT NO.	PLOT NO.		QUADRAT NO.		SLOPE					SOIL SURFACE		EROSION	ALTITUDE	FOREST TYPE		SOIL TYPE		GEOLOGY	
																		%			POSI'N	ASP'T										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

TYPE/NO. RATTAN														TYPE/NO. BAMBOO						NO. BERTAM		NO. PALM		% FERN	% WILD GINGER	% WILD BANANA
A		B		C		D		E		F		G		A		B		C								
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

B. TREE INFORMATION

TREE NO.			SPECIES CODE				SPECIES NAME	PREVIOUS ( )										CURRENT ( )										REMARKS
								TREE COND.	DIAMETER (cm)				NO. LOGS	LOG 1 QUALITY	STATUS	CROWN	DOMINANT	TREE COND.	DIAMETER (cm)				NO. LOGS	LOG 1 QUALITY	STATUS	CROWN	DOMINANT	
1	2	3	4	5	6	7		8	9	10	11	.12	13	14	15	16	17	18	19	20	21	.22	23	24	25	26	27	

CREW LEADER : ______	DATE : / /	JOINT PROJECT MALAYSIA - ITTO "FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA" LOGGED-OVER FOREST	FORM MA/2 QUADRAT 5 m x 5 m (MEASURE TREE >150 cm HEIGHT - 5 cm DIAMETER)	CARD NO.
CARD RECORDER : ______	DATE : / /			
CARD VERIFIER : ______	DATE : / /			

A. GENERAL INFORMATION

YEAR		MONTH		STATE		DIST-RICT		FOREST RESERVE		COMPARTMENT NO.			TREAT-MENT NO.	PLOT NO.		QUADRAT NO.		SLOPE %			SLOPE POSI'N	SLOPE ASP'T	SOIL SURFACE		EROSION	ALTITUDE	FOREST TYPE		SOIL TYPE		GEOLOGY	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

TYPE/NO. RATTAN A		B		C		D		E		F		G		TYPE/NO. BAMBOO A		B		C		NO. BERTAM		NO. PALM		% FERN	% WILD GINGER	% WILD BANANA
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

B. TREE INFORMATION

TREE NO.				SPECIES NO.				SPECIES NAME	PREVIOUS ( ) TREE COND.	DIAMETER (cm)		HEIGHT (m)			VIGOUR	CURRENT ( ) TREE COND.	DIAMETER (cm)		HEIGHT (m)			VIGOUR	REMARKS
1	2	3	4	5	6	7	8		9	10 .	11	12	13 .	14	15	16	17 .	18	19	20 .	21	22	
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APPENDIX V

CREW LEADER : ________________ DATE : / /
CARD RECORDER : ________________ DATE : / /
CARD VERIFIER : ________________ DATE : / /

JOINT PROJECT MALAYSIA - ITTO
"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"
LOGGED-OVER FOREST

FORM NA/3
QUADRAT 2 m x 2 m
(MEASURE SAPLING 15 cm - 150 cm HEIGHT)

CARD NO.

A. GENERAL INFORMATION

YEAR		MONTH		STATE		DIST-RICT		FOREST RESERVE		COMPARTMENT-NO.			TREAT-MENT NO.	PLOT NO.		QUADRAT NO.		SLOPE					SOIL SURFACE		EROSION	ALTITUDE	FOREST TYPE		SOIL TYPE		GEOLOGY	
																		%			POSI'N	ASP'T										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

TYPE/NO. RATTAN														TYPE/NO. BAMBOO						NO. BERTAM		NO. PALM		% FERN	% WILD GINGER	% WILD BANANA
A		B		C		D		E		F		G		A		B		C								
34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

B. TREE INFORMATION

SPECIES CODE				SPECIES NAME	NO. SAPLING			REMARKS
1	2	3	4		5	6	7	

B. TREE INFORMATION

SPECIES CODE				SPECIES NAME	NO. SAPLING			REMARKS
1	2	3	4		5	6	7	

ENUMERATION/MEASUREMENT SCHEDULE OF PERMANENT SAMPLE PLOT
JOINT PROJECT BETWEEN MALAYSIA/ITTO, COMPARTMENT 194/205 KLEDANG SAIONG FOREST RESERVE, PERAK
FOR THE PERIOD OF 1991 – 2003

TREATMENT BLOCK	BLOCK NO	ENUMERATION/MEASUREMENT										REMARKS
		FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH	
CLIMBER/LIANA CUTTING (CL)	02	JAN/91	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
	07	JAN/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	Enumeration/measurement is carried out once
	08	JAN/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	a year for the first five years.
	15	JAN/91	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
POISON–GIRDLED OF TREES AND CLIMBER/LIANA CUTTING (GCL)	01	NOV/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
	12	DEC/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	Enumeration/measurement is carried out once
	13	DEC/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	a year for the first five years.
	16	DEC/90	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
GCL AND ENRICHMENT PLANTING (EP)	03	JAN/91	*AUG/NOV/91	@JAN/OCT/92	#OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	1. Enumeration I – 3 month after planting
	05	JAN/91	AUG/DEC/91	JAN/OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	2. Enumeration II – 6 month after Enumeration I
	09	JAN/91	AUG/DEC/91	JAN/OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	3. Enumeration III – 6 month after Enumeration II
	19	JAN/91	AUG/NOV/91	JAN/OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	4. The next enumeration is done for every year/two years
PLANTATION	04	DEC/90	*AUG/91	*JAN/92	#OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	1. Enumeration I – 3 month after planting
	11	DEC/90	AUG/91	JAN/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	2. Enumeration II – 6 month after Enumeration I
	14	JAN/91	AUG/91	JAN/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	3. Enumeration III – 6 month after Enumeration II
	17	JAN/91	AUG/91	JAN/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	4. The next enumeration is done for every year/two years
CONTROL	06	FEB/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	
	10	FEB/91	DEC/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	Enumeration/measurement is carried out once
	18	FEB/91	AUG/92	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	a year for the first five years.
	20	MAC/91	NOV/91	OCT/92	OCT/93	OCT/94	OCT/95	OCT/97	OCT/99	OCT/01	OCT/02	

NOTES: TREATMENTS OF ENRICHMENT PLANTING AND PLANTATION

* = i. Replanting/refilling
ii. Cleaning of planting lines
iii. Poison–girdled of non–RS species on planting lines

@ = i. Replanting/refilling (if survival rate less than 80%)
ii. Cleaning of planting lines

\# = ii. Cleaning of planting lines
iii. Poison–girdled of non–RS species which shaded the planting lines

PPSWB8/A:PSP–194.WK3

ENUMERATION/MEASUREMENT SCHEDULE OF PERMANENT SAMPLE PLOT
JOINT PROJECT BETWEEN MALAYSIA/ITTO, COMPARTMENT 39, CERUL FOREST RESERVE, TERENGGANU
FOR THE PERIOD OF 1991 – 2005

TREATMENT BLOCK	BLOCK NO	ENUMERATION/MEASUREMENT										REMARKS
		FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH	
CLIMBER/LIANA CUTTING (CL)	01	OCT/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	
	12	AUG/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	Enumeration/measurement is carried out once
	16	JUN/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	a year for the first five years.
	20	AUG/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	
POISON–GIRDLED OF TREES AND CLIMBER/LIANA CUTTING (GCL)	08	JUN/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	
	11	SEP/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	Enumeration/measurement is carried out once
	15	JUL/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	a year for the first five years.
	18	AUG/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	
GCL AND ENRICHMENT PLANTING (EP)	07	*MAY/SEP/91	@FEB/AUG/92	#AUG92/AUG93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	1. Enumeration I – 3 month after planting
	10	JUL/OCT/91	FEB/AUG/92	AUG92/AUG93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	2. Enumeration II – 6 month after Enumeration I
	13	APR/AUG/91	FEB/AUG/92	AUG92/AUG93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	3. Enumeration III – 6 month after Enumeration II
	19	MAY/SEP/91	FEB/AUG/92	AUG92/AUG93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	4. The next enumeration is done for every year/2 years.
PLANTATION	02	APR/93	OCT/93	APR/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	1. Enumeration I – 3 month after planting
	03	APR/93	OCT/93	APR/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	2. Enumeration II – 6 month after Enumeration I
	04	APR/93	OCT/93	APR/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	3. Enumeration III – 6 month after Enumeration II
	06	APR/93	OCT/93	APR/94	APR/95	APR/96	APR/97	APR/99	APR/01	APR/03	APR/05	4. The next enumeration is done for every year/2 years.
CONTROL	05	JUL/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	
	09	OCT/92	OCT/93	OCT/94	OCT/95	OCT/96	OCT/97	OCT/99	OCT/01	OCT/03	OCT/05	Enumeration/measurement is carried out once
	14	JUL/91	AUG/92	AUG/93	AUG/94	AUG/95	AUG/96	AUG/98	AUG/00	AUG/02	AUG/04	a year for the first five years.
	17	OCT/92	OCT/93	OCT/94	OCT/95	OCT/96	OCT/97	OCT/99	OCT/01	OCT/03	OCT/05	

NOTES: TREATMENTS OF ENRICHMENT PLANTING AND PLANTATION

* = i. Replanting/refilling
ii. Cleaning of planting line
iii. Poison–girdled of non–RS species on planting line

@ = i. Replanting/refilling (if survival rate less than 80%)
ii. Cleaning of planting line

\# = ii. Cleaning of planting line
iii. Poison–girdled of non–RS species which shaded the planting line

PPSWB8/A:PSP–39.WK3

APPENDIX VIII

APPENDIX IX

PERATION MANUAL FOR THE GIRDLING OF TREES AND CUTTING OF LIANA (GCL)

1.0 INTRODUCTION

1.1 These activities are to assist the residual stand after logging by cutting of liana and girdling of deformed trees (G) which shade the RS species.

1.2 The treatment will result in the opening of the forest canopy to selected species. Some of the benefits are as follows:-

i) To encourage the rapid growth of RS species;

ii) To reduce the competition from other trees having no commercial value;

iii) To improve the economic status of forest stand with selected species.

2.0 'CL' AND 'G' GUIDELINE

The intensity of 'CL' and 'G' are different due to differences of forest types. The guidelines for carrying out 'CL' and 'G' are as follows:-

2.1 Cutting of Liana (CL)

2.1.1 This operation involves the cutting of all liana found in the area. The cutting should be carried out in two parts ie. at the bottom, close to the ground and in the upper part, as high as possible. Liana having >1.5 cm dbh need to be poisoned.

2.2 Girdling And Poisoning Of Trees (G)

2.2.1 The trees to be frill-girdled are as follows:-

i) Deformed RS species with diameter >45 cm (broken, hollow , knots, crocked), if they shade the RS trees.

ii) Others species (non-RS species) if:-

a) Deformed (broken, hollow, knots, crocked, which shade the RS seedlings; and

b) Bushy, heavy crown having diameter <30 cm which is not capable of producing logs of at least 5 m in length.

2.2.2 Palm trees such as <u>Eugeissona</u> <u>triste</u> (Bertam) and <u>Arenga</u> <u>westerhoutii</u> (Langkap) which shade RS species have to be felled and poisoned, namely:-

i. <u>Eugeissona</u> <u>triste</u> (Bertam) fronds should be cut and put them in one place. Then poured the poison into it base or culm; and

ii. <u>Arenga</u> <u>westerhoutii</u> (<u>Langkap</u>) and other stemmed palms should be cut whereby a small hole can be made in their trunks to facilitate poisoning.

2.2.3 Fruit trees such as <u>Parkia</u> <u>speciosa</u> (Petai), <u>Durio</u> <u>zibethinus</u> (Durian), <u>Baccaurea</u> spp. (Rambai), <u>Figs</u> (Ara), <u>Pithecellalobium</u> <u>bubalinum</u> (Kerdas), <u>Bouea</u> spp. (Kundang), <u>Lansium</u> <u>domesticum</u> (Langsat) and <u>Nephelium</u> spp. (Rambutan). Bamboos (Buluh), Fern (Resam) or open area.

3.0 PREPARATION BEFORE CARRY OUT 'CL' OR 'G'

3.1 Prior to the treatment, the group leader have to carry out reconnaisance of the study area to confirm the boundries and base lines and to determine the camping sites.

3.2 Group leaders or supervisors who will be carrying out the 'CL' or 'G', have to :-

i) To get instruction and written guidelines regarding treatment procedures to be carried out, in the study block area;

ii) To prepare a plan of the study area (scale 1 cm : 80 cm) which shows:-

a) Study block boundries;

b) Base line;

c) Survey lines at interval 50 cm;

d) Section of study block which is not required to be treated. This block should be marked with yellow colour.

3.3 Base lines and survey lines are used as a guide to determine treatment blocks. It is to ensure that the CL and G are carried out systematically. If the previous base and survey lines are unavailable, new lines should be established.

3.4 The frill-girdle trees should be marked on the plan according to their positions on the ground with the symbols below:-

X - RS species with diameter of >30 cm

+ - RS species with diameter of <30 cm

O - Non-RS species with diameter of >30 cm

- Non-RS species with diameter of <30 cm

* - Palm trees

3.5 When the treatments are completed, the group leader has to submit the data as mentioned in 3.2 (ii) and 3.4, together with the closing report and the summary of expenditure to the supervisor.

4.0 THE 'G'

4.1 The 'G' will be implemented:-

- At a convenient height, normally at about waist height.

- Above the buttresses for the buttressed trees. If the buttress is high, the frill-girdle will be carried out at the buttress.

- Below the irregularities of tree.

- Below the coppice stems for coppiced tree.

4.2 Instruments required :-

- Light and short-hardled axe.

- A 'parang' for small stems.

- Large gouge or chisel for the frill-girdle in corners of buttresses.

4.3 The frill-girdle cutting must be:-

- An angle of about 45^{o} with the vertical and should not twisting or prising, when withdrawing the axe.

- Up to 1.5 cm deep of the cambium part for trees.

- Should be as horizontal as possible, so that the poison does not run along the girdle and overflow at the low points.

4.4 For species with copious latex, especially big trees, the cuts should be made wider and deeper as described in para 4.3, and two cuts or frill-girdle about 30 cm apart be made. The lower channel or girdle should be made first and the poison solution should be directed at both girdle.

4.5 Multi-stemmed strangling figs should be similarly treated (para 4.4), with the exception that all stems that can be conveniently severed should be dealt with in the same manner as for woody liana (para 2.2).

4.6 Palms with stem, such as Oncosperma horrida (Bayas), Arenga westerhoutii (Langkap), etc. are poisoned by cutting, with an axe or gouge, a small hole or notch reaching in the soft pith, at 45^{o} angle and the poison solution are then poured into the hollow.

4.7 Some stemmed palms, such as Corypha elata (Kabung), Livistona cochinchinensis (Serdang) have a very hard stem, which is difficult to notch and kill, is left untouched. However, attempts should still be made to carry out the operation, if the palms occur in abundance and their presence are silviculturally undersirable.

4.8 Each man will be provided with a poison-can and will poison each tree as soon as it has been frill-girdle. As soon as drops of poison appear at the edges (overlaps) of the axe cuts, sufficient poison has been applied. The 'CL' and 'G' works should be carried out during the drought season.

4.9 Besides latex producing species, other species known to be resistant to frill girdling are Ixonanthes icosandra (Pagar anak), Milletia atropurpurea (Tulang daing), Irvingia malayana (Pauh kijang), Macaranga spp. (Kubin) and Gluta spp. (Rengas) are difficult to kill by poisoning. In this event para 4.4 is applicable.

5.0 POISON USED

5.1 The concentration of poison used is based on the types of poison. Suitable poison for this operation are as follows:-

Type Of Poison	Ratio Of Mixture
Garlon 250	1 : 3
Ally (Escort 60 DF)	12.5 gm : 1 liter

5.2 For safety in handling the poison, every workers should always followed the procedure as indicated earlier.

6.0 AREAS TO BE AVOIDED FROM POISONING ACTIVITY

6.1 In the 'G' operation, make sure that the area of 10 m wide along the primary roads, secondary roads, rivers tributaries,and valleys are free for poisoning activity. It is to avoid polluting the water courses.

7.0 POISON-GIRDLED OF TREES AND CUTTING OF LIANA (GCL) OPERATION

7.1 Poison-girdled trees and cutting of liana are a combinations of 'CL' and 'G'. The GCL operation is the same as the operation manual for 'CL' and '

CREW LEADER : ______________	DATE :	/ /
CARD RECORDER : ______________	DATE :	/ /
CARD VERIFIER : ______________	DATE :	/ /

JOINT PROJECT MALAYSIA - ITTO
"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"
LOGGED-OVER FOREST

FORM HB/5
(ENRICHMENT PLANTING)

CARD NO.

A. GENERAL INFORMATION

YEAR		MONTH		STATE		DIST-RICT.		FOREST RESERVE		COMPARTMENT NO.			TREAT-MENT NO.	PLOT NO.		PLANT'G LINE NUMBER		SOIL SURFACE		EROSION	ALTITUDE	FOREST TYPE		SOIL TYPE		GEOLOGY		DATE PLANTED					
																												DAY		MONTH		YEAR	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34

B. TREE INFORMATION

TREE NO.		SPECIES CODE				SPECIES NAME	PREVIOUS ( )							CURRENT ( )							REMARKS
							TREE COND.	DIAMETER (cm)			HEIGHT (m)		VIGOUR	TREE COND.	DIAMETER (cm)			HEIGHT (m)		VIGOUR	
1	2	3	4	5	6		7	8	9	10 .11	12	13 . 14	15	.16	17	18	19 .20	21	22 . 23	24	
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APPENDIX X

APPENDIX XI

OPERATIONAL MANUAL FOR ENRICHMENT PLANTING

1.0 INTRODUCTION

This guideline is intended to give some description about Enrichment Planting activity under the Joint Project between Malaysia-ITTO on "Forest Management of Natural Forest in Malaysia" (logged-over forest). In this guideline, the description includes:-

i) Transportation and conditioning of seedlings;

ii) Planting;

iii) Enumeration/measurement activity; and

iv) Stock maps.

Selection of trees for planting is based on the marketable species, which is found in the forest area. In this project, the suitable species such as Shorea parvifolia (Meranti sarang punai), Shorea curtisii (Meranti seraya), Shorea Leprosula (Meranti tembaga), Dipterocarpus chartaceus (Keruing kertas), Dyera costulata (Jelutong), Endospermum malaccense (Sesendok) and Anisoptera spp (Mersawa) are selected for planting. In the nursery, the seedlings selected for planting is selected on the basis of good vigour and potential growth.

2.0 TRANSPORTATION AND CONDITIONING OF SEEDLINGS

2.1 The seedlings must be placed in closed units to prevent them from swaying, sliding or falling, during in transit in the vehicle.

2.2 The vehicle transporting the seedlings should be sufficiently covered to reduce desiccation by the sun and the wind. It should also have adequate ventilation to prevent overheating within the storage chamber, due to the respiration energy of the seedlings.

2.3 Transportation of seedlings should be carried out before 10.00 am and after 5.00 pm.

2.4 Seedlings must be throughly watered prior to despatch to the planting site. At the planting site, the seedlings must be stored undershade and watered for at least two weeks before planting.

3.0 PLANTING ACTIVITIES

3.1 Planting Season

All planting should be carried out during the rainy season. Planting should be stopped, in event of three consecutive dry-spell days occuring.

3.2 Planting Distance

For this project, the planting distant is 3m x 10m (see Diagram 1).

3.3 Planting Lines/Base Lines

3.3.1 The alignments of planting lines should be at east-west direction. This is to ensure that the planted trees will received maximum sun-shine.

3.3.2 Planting lines are laid out at 90^{o} to the base lines and 1m wide. Trees having diameter of less than 10cm dbh should be cut as near as to the ground, except for RS species.

3.4 Planting Operation

3.4.1 Once the planting lines are prepared, the planting operation must be carried out immediately. Each planting spot should be marked with 1m height stick. The planting spot need not be fixed rigidly; move the planting spot in any direction to avoid rocks, large stumps, gulleys etc. with priority given to 1m left and right of the planting lines. Similarly, if natural regeneration of the desirable species occurs anywhere within the radius of not more than 1 m around the planting spot, do not plant and treat as planted trees; space the next planting spot from there.

3.4.2 Planting holes size is 12 cm in diameter and 26 cm deep (Diagram 2). Before planting, fertilizer (rock phosphate) is applied to the planting holes at approximately 50 gm per hole.

4.0 ENUMERATION/MEASUREMENT ACTIVITY

4.1 Enumeration/measurement of seedlings after planting is carried out to determine the growth status of planted seedlings as well as natural regeneration. In addition, mortality rate can also be determined and refilling can be carried out. The sequence of such enumeration/ measurement is as follows :-

4.1.1 First enumeration/measurement is carried out after 3 months after planting. From the enumeration/measurement, the growth status and numbers of dead seedlings can be determined. However, it is necessary to carry out refilling as soon as possible (see para 3.1). At this stage, the percentage of survival should be 100% and planting lines must be cleaned.

4.1.2 Second enumeration/measurement is carried out 6 months after the first enumeration/ measurement. From this enumeration/measurement, the dead seedlings must be refilled. At this stage, percentage of survival should be 100%. Crown opening and clearing of planting lines must be carried out. The non - RS species with diameter >10 cm along the planting lines should be frill-girdled.

4.1.3 Third enumeration/measurement is carried out 6 months after the second enumeration/measurement. If the enumeration results show that the survival rates are less than 80%, the refilling must be carried out.

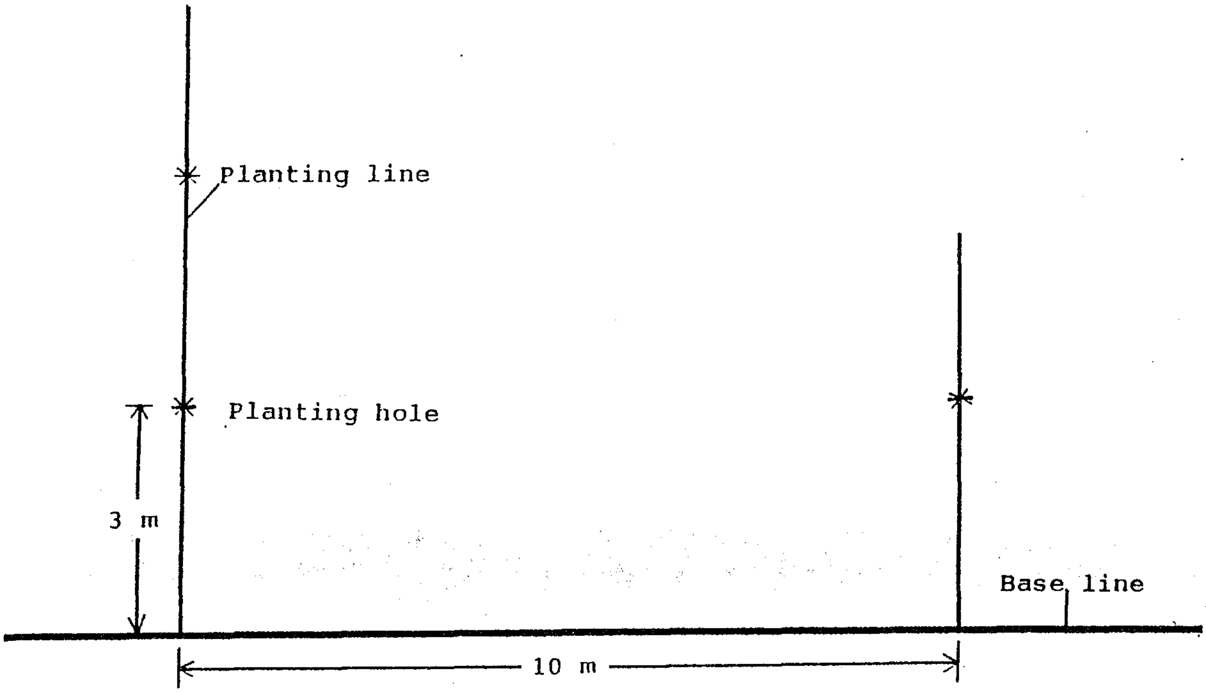

Diagram 1 : Planting Distance

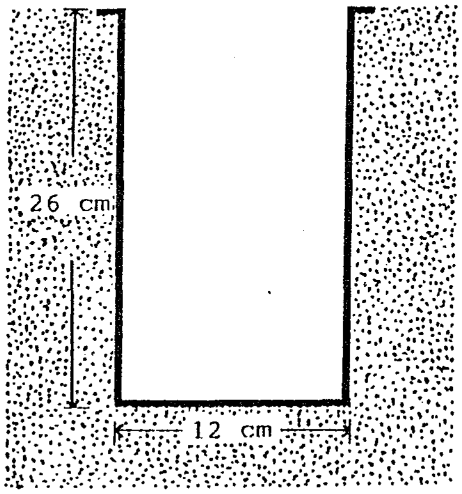

Diagram 2 : Planting hole

4.1.4 Fourth enumeration/measurement is carried out 12 months after the third enumeration/measurement. If survival rate of seedlings is less than 80%, refilling is carried out and this is the last refilling operation. At this stage the frill-girdle of non - RS species which shaded the seedlings must be carried out. In addition, the planting lines must be cleaned.

4.1.5 For the next 5 years, enumeration/measurement is carried out after 12 months of the last enumeration/measurement.

4.2 Summary of enumeration/measurement sequence are as follows:-

SUMMARY OF ENUMERATION/MEASUREMENT SEQUENCE

Enumeration/ Measurement	Months After Planting	Types Of Treatment
First	3	i) Refilling (if the survival rate is less than 100%). ii) Clearing of planting lines.
Second	9	i) Refilling (if the survival rate is less than 100%). ii) Clearing of planting lines. iii) Frill-girdle of non-RS species which shadeds the seedling.
Third	15	i) Refilling (if the survival rate is less than 80%). ii) Clearing of planting lines. iii) Frill-girdle of non-RS species which shade the seedlings.
Fourth	27	i) Refilling (if the survival rate is less than 80%. ii) Clearing of planting lines. iii) Frill-girdle of non-RS. species which shade the planting lines.

- Enumeration/measurement for the next 5 years is carried out after 12 months of the last enumeration/measurement.

- Tending should be determined on the basis of needs, as mentioned for each of the above sequence of operation.

5.0 STOCK MAPS

5.1 The stock maps (scale 1cm : 40 cm) should be prepared. It should show planting lines and position of planted trees. The colour codes used are as follows:-

Colour	Remark
Green	- Planted trees; live
Yellow	- Natural regeneration; live
Red	- Planted trees; dead
Violet	- Natural regeneration; dead
Blank	- Unplanted site

5.2 Prepared stock maps after every survival enumeration.

CREW LEADER : ________________	DATE : / /
CARD RECORDER : ________________	DATE : / /
CARD VERIFIER : ________________	DATE : / /

JOINT PROJECT MALAYSIA - ITTO
"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"
LOGGED-OVER FOREST

FORM NA/4 FOREST PLANTATION	CARD NO.

A. GENERAL INFORMATION

YEAR		MONTH		STATE		DISTRICT		FOREST RESERVE		COMPARTMENT NO.			TREATMENT NO.	PLOT NO.		PLANT'G LINE NUMBER		SOIL SURFACE		EROSION	ALTITUDE	FOREST TYPE		SOIL TYPE		GEOLOGY		DATE PLANTED					
																												DAY		MONTH		YEAR	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34

B. TREE INFORMATION

TREE NO.		SPECIES CODE				SPECIES NAME	PREVIOUS (1989)							CURRENT (1990)							REMARKS
							TREE COND.	DIAMETER (cm)			HEIGHT (m)		VIGOUR	TREE COND.	DIAMETER (cm)			HEIGHT (m)		VIGOUR	
1	2	3	4	5	6		7	8	9	10 . 11	12	13 . 14	15	16	17	18	19 . 20	21	22 . 23	24	
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APPENDIX XII

Appendix C

PROCESSING OF FOREST RESEARCH DATA
PROCEDURE FOR DATA ENTRY

JOINT PROJECT BETWEEN MALAYSIA - ITTO

ON

"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"

PROCESSING OF FOREST RESEARCH DATA

PROCEDURE FOR DATA ENTRY

by

Svend Korsgaard

(Consultant)

Management Unit

Forestry Department Headquarters

Kuala Lumpur

(Draft, June, 1992)

PROCESSING OF FOREST RESEARCH DATA

PROCEDURE FOR DATA ENTRY

by

Svend Korsgaard

(Consultant)

Table of Contents

1. Introduction.

The background for the Joint Project between Malaysia - ITTO can be found in some of the previous reports produced by the Forestry Department Headquarters.

This paper briefly describe the procedure for entering the data from the field cards to the computer.

The format of the computer data files are designed for easy data entry. At a later stage the initial raw data files will be rearranged to be compatible with the computer processing system envisaged for implementation in 1993.

The FILENAME conventions given are important in order to uniquely identify the data files and what type of data they contain, from which enumeration and which area.

There are tree main types of data files :

- The files containing the descriptive information for each quadrat.

  Since the descriptions are the same for the quadrat irrespective of the size of trees enumerated, there is only one file per plot containing the quadrat information.

- The files containing the enumeration data for the individual trees, poles, saplings, seedlings and planted wildlings.

  Since the descriptions are different for the different sizes of trees there are one file for each of Trees/poles, saplings, seedlings and planted wildlings.

- During the harvesting of trees in the Virgin forest areas the felled trees were measured for volume. These data are kept in a special file for volume calculations.

2. Layout of Experiments and Sampling Units

The detailed descriptions of the Forest study areas and the experimental layout are given in previous documents.

2.1 Layout of Experiments

There are four locations and two main types of experiments :

1) Logging intensity and plantation establishment in a virgin forest.

   - H.S. Lesong, compt. 171 and 172, State of Pahang

   - H.S. Sungai Lalang, compt. 50, State of Selangor

2) Silvicultural treatments and plantation establishment in a logged over forest.

   - H.S. Kledang Saiong , compt. 194 and 205, State of Perak

     Selectively logged in 1986 under the SMS prescriptions with cutting limits for dipterocarps $\geq$ 60 cm DBH and for non-dipterocarps $\geq$ 45 cm DBH.

   - H.S. Cherul, compt. 39, State of Terengganu

     Selectively logged in 1984/85 under the SMS prescriptions with cutting limits for dipterocarps $\geq$ 55 cm DBH and for non-dipterocarps $\geq$ 50 cm DBH.

The treatments applied and the block numbers are :

, = Logging intensity and plantation establishment in a virgin forest.

'reatment	Block Numbers H.S. Lesong	H.S. S. Lalang
) Cut all > 30 cm DBH	03,17,26,31	03,06,21,28
) Cut all > 45 cm DBH	02,07,13,29	01,07,25,29
) Cut Dipt > 35 cm DBH Non-Dipt > 30 cm DBH	05,18,21,27	02,05,24,26
) Cut Dipt > 50 cm DBH Non-Dipt > 45 cm DBH	04,19,30,32	12,19,22,27
) Cut Dipt > 65 cm DBH Non-Dipt > 60 cm DBH	08,10,24,14	04,08,18,31
) Cut Dipt > 75 cm DBH Non-Dipt > 70 cm DBH	01,20,25,28	10,11,20,32
Cut all > 30 cm DBH Plantation of Wildlings	15,16,22,23	13,14,15,23
Virgin, no cutting Control	06,09,11,12	09,16,17,30

= Silvicultural treatments and plantation establishment in a logged over forest.

eatment	Block Numbers H.S. Kledang S.	H.S. Cherul
Climber Cutting (CL)	02,07,08,15	01,04,12,20
Girdling + CL (GCL)	01,12,13,16	08,11,15,18
GCL + Enrichment Planting (Wildlings)	03,05,09,19	07,10,13,19
Cut all > 30 cm DBH Plantation of Wildlings	04,11,14,17	02,06,09,17
Logged-over, no Treatment Control	06,10,18,20	03,05,14,16

2.2 Layout of Sampling Units.

The main Sampling Unit is the Plot of 100 m by 100 m = 1 ha located in the center of each Treatment Block.

There are 6 different layouts of Quadrats, Subplots and Planting Lines within each 1-ha Sampling Unit :

Number	Type	Size	Area ha	Enumeration of	Field Card No
1) 25	Quadrat	20 x 20 m	0.04	Trees ≥ 15 cm D	1A, L ; 1A, S
2) 9	Quadrat	20 x 20 m	0.04	Poles ≥5, <15 cm	1B, L ; 1B, S
3) 9	Subplot	5 x 5 m	0.0025	Saplings, Height ≥ 150 cm < 5 cm D	2 L/S
4) 9	Subplot	2 x 2 m	0.0004	Seedlings, Height ≥ 15 cm < 150 cm	3 L/S
5) 17	Planting Line	6 x 100 m	0.06	Wildlings	4 L/S
6) 10	Planting Line	10 x 100 m	0.1	Wildlings	5 S

The Field Cards 1A and 1B for trees and Poles are different for
L = Logging of Virgin Forest and
S = Silvicultural Treatment of Logged-over Forest

The other Field Cards are the same with regard to the individual entries for saplings, seedlings and wildlings.

Field Card 5 S for enrichment planting is only used in the Silvicultural experiment.

3. Data Entry

3.1 Quadrat Information

The Field card contain information describing the geological and ecological status of each quadrat. This information is entered from the Field Cards 1A or 1B, directly as it appears on the Field Card.
The information on the other Field Cards is the same as for Field Cards 1A and 1B and is not entered.

The Field Cards for enrichment planting and plantation establishment contain the date of planting. This information must be recorded in a report and not in a computer file.

The Record Length for the Quadrat Information is

For Logging : 45 bytes
For Silviculture : 60 Bytes

3.1.1 File Name Convention for Quadrat Information

It is important that the file names are unique and give the required information to identify the type and content of the data file.

The file name is 11 bytes long and consist of 6 parts :

Bytes 1 and 2 : The Forest Reserve : LE = H.S. Lesong, Pahang
SL = H.S. Sungai Lalang, Selangor
KS = H.S. Kledang Saiong, Perak
CH = H.S. Cherul, Terengganu

" 3 to 5 : The letters BLK : indicating the Block number

" 6 an 7 : The actual block numbers, For Logging : 01 to 32
For Silviculture : 01 to 20

" 8 : a Dot = '.' required by DOS as a separator.

" 9 and 10: The year of enumeration : 90 or 91 etc.

" 11 : The letter 'Q' to indicate Quadrat information file.

Example : LEBLK01.91Q : H.S. Lesong, Block 01, enumerated 1991, Quadrat Information.
KSBLK18.92Q : H.S. Kledang Saiong, Block 18, enumerated 1992 Quadrat Information.

The file will contain 25 records, one record for each quadrat in the Plot.

3.2 Tree/Pole, Sapling, Seedling and Wildling Information

When the Quadrat Information is recorded, the data for the individual trees etc. is entered from the Field Cards.

Only the Treatment Number, Plot Number and Quadrat Number is entered from the "Maklumat Am" information in front of every tree record.

Layout of all the types of field cards and the data entry format is given in the Appendix.

3.2.1 File Name Convention for Trees/Poles, Saplings, Seedlings and Wildlings (Plantation)

The File Name Convention is similar to that of the Quadrat Information.

It is important that the file names are unique and give the required information to identify the type and content of the data file.

The file name is 11 bytes long and consist of 6 parts :

Bytes 1 and 2 : The Forest Reserve : LE = H.S. Lesong, Pahang
SL = H.S. Sungai Lalang, Selangor
KS = H.S. Kledang Saiong, Perak
CH = H.S. Cherul, Terengganu

" 3 to 5 : The letters BLK : indicating the Block number

" 6 an 7 : The actual block numbers, For Logging : 01 to 32
For Silviculture : 01 to 20

" 8 : a Dot = '.' required by DOS as a separator.

" 9 and 10: The year of enumeration : 90 or 91 etc.

" 11 : 1 = File containing Trees/Poles, Field Cards 1A and 1B
: 2 = (Not presently used)
: 3 = File containing Saplings, Field Card 2
: 4 = File containing Seedings, Field Card 3
: 5 = File containing Wildlings, (Enrichment Planting and Plantation Establishment), Field Cards 4 and 5

Example : SLBLK25.911 : H.S. Sungai Lalang, Block 25, Enumerated 1991, Trees.

CHBLK13.925 : H.S. Cherul, Block 13, Enumerated 1992, Wildlings, (Enrichment Planting)

3.3 Volume Information for Felled Trees

The Field Cards containing the information on the log outturn from the felled trees is entered into the computer exactly as it appears on the Field Cards.

The data will be used for volume calculations.

The File Name convention follow that given above, except that the last byte position 11 is 'V'

Example : SLBLK09.89V : H.S. Sungai Lalang, Block 09, Measured 1989, Volume information

Appendix

Examples of Field Cards and Data Entry Formats

DATA FILE FORMAT FOR INITIAL DATA ENTRY

TREES/POLES "LOGGING OF VIRGIN FOREST"

Data File Column	Field Card 1A/1B		
1	A	14	Treatment Number
2, 3	A	15, 16	Plot number
4, 5	A	17, 18	Quadrat Number
6, 7, 8	B	1, 2, 3	Tree Number
9, 10, 11, 12	B	4, 5, 6, 7	Species Code
13	B	17	STEM IDENTITY
14, 15, 16, 17	B	18, 19, 20, 21	Diameter DBH. (NO DECIMAL POINT) MILLIMETERS
18	B	22	No. of Logs
19	B	23	Log Quality
20	B	24	Stem Damage
21	B	25	Crown Damage

DATA FILE FORMAT FOR INITIAL DATA ENTRY

TREES / POLES "SILVICULTURAL TREATMENT OF LOGGED-OVER FOREST"

Data File Column	Field Card 1A/1B	
1	A 14	Treatment Number
2 3	A 15 16	Plot Number
4 5	A 17 18	Quadrat Number
6 7 8	B 1 2 3	Tree Number
9 10 11 12	B 4 5 6 7	Species Code
13	B 18	Stem Identity
14 15 16 17	B 19 20 21 22	Diameter DBH (NO DECIMAL POINT) Millimeter
18	B 23	No. of Logs
19	B 24	Log Quality
20	B 25	Status (Crop tree)
21	B 26	Crown Form
22	B 27	Crown Dominance

APPENDIX II

DATA FILE FORMAT FOR INITIAL DATA ENTRY

SAPLINGS, (Same for both experiments)

Data File Column		Field Card 2	
1	A	14	Treatment Number
2	A	15	Plot Number
3		16	
4	A	17	Quadrat Number
5		18	
6		A	(Fixed "A")
7	B	2	Sapling Number
8		3	
9		4	
10	B	5	Species Code
11		6	
12		7	
13		8	
14	B	16	Stem Identity
15	B	17	Diameter Millimeter (NO Decimal Point)
16		18	
17	B	19	Stem Height Decimeter (NO Decimal Point)
18		20	
19		21	
20	B	22	Vigour

DATA FILE FORMAT FOR INITIAL DATA ENTRY

SEEDLINGS (Same for both Experiments)

Data File Column	1	2 3	4 5	6 7 8 9	10 11 12
Field Card 3	A 14	A 15 16	A 17 18	B 1 2 3 4	B 5 6 7
	Treatment Number	Plot Number	Quadrat Number	Species Code	Number of Seedlings per Species code (Seedling Count)

DATA FILE FORMAT FOR INITIAL DATA ENTRY

PLANTATION / ENRICHMENT PLANTING (Same for both Experiments)

Data File Column	Field Card 4/5	Field Card 4/5 columns	
1	A	14	Treatment Number
2 3	A	15 16	Plot Number
4 5	A	17 18	Transect or Line Number
6 7	B	1 2	Plant Number
8 9 10 11	B	3 4 5 6	Species Code
12	B	16	Stem Identity
13 14 15 16	B	17 18 19 20	Diameter millimeters (NO decimal point)
17 18 19	B	21 22 23	Height Decimeters (NO decimal point)
20	B	24	Vigour

Appendix D

A MANUAL FOR THE EDITING, MAINTENANCE AND TABULATION OF ENUMERATION DATA

PROCESSING OF FOREST RESEARCH DATA

A MANUAL FOR THE EDITING, MAINTENANCE AND TABULATION OF ENUMERATION DATA FROM THE ITTO - EXPERIMENTAL PLOTS

by

Svend Korsgaard

(Consultant)

ITTO/MAL/PD 10/87 (F)
Field Document No. 2.1

JOINT PROJECT BETWEEN MALAYSIA - ITTO

ON

"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"

PROCESSING OF FOREST RESEARCH DATA

A MANUAL FOR THE EDITING, MAINTENANCE AND TABULATION OF ENUMERATION DATA FROM THE ITTO - EXPERIMENTAL PLOTS

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JULY, 1993

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1. Introduction.

This manual is specifically designed to provide the necessary instructions to run the data processing programmes to edit, correct and tabulate the enumeration data collected in the four ITTO permanent plots (Sungei Lalang FR., Selangor State; Lesong FR., Pahang State; Kledang Saiong FR., Perak State and Cherul FR., Terengganu State.); the plot established in Piah FR., Perak State which utilizes the same layout and method of enumeration.

The layout of the plots, the description of the treatments applied and the initial schedule of enumerations are given in two papers by the Forestry Department Headquarters :

- "Procedure for Establishment of Study Area in Virgin Forest"
- "Procedure for Establishment of Study Area in Logged-over Forest" (Forest Dept., 1993 a and b.)

The instructions for the field enumerations are similarly given in two papers for the two types of experiments (Forest Dept,. 1990 and 1991).

During the ITTO consultancy in Data Processing from April to July 1993, it was suggested, and subsequently accepted by the Technical Working Group of The Department, to introduce some enhancements to the enumerations and to change the layout of the field form (Korsgaard, 1993 a). The enhancements will provide for a more detailed description of the status of the individual trees and the status of the surrounding forest. The changes to the layout of the field form will cater for the enhanced codes as well as making it simpler to input the data directly for computer processing.
The complete system of enumeration is documented in Korsgaard 1993 b.

The system of enumeration and the manuals of instructions are based on similar manuals prepared by the FAO project UNDP/FAO/MAL/89/001 "Forest Inventory and Management Systems as Part of Forest Resources Conservation Programme", (Korsgaard, 1992 a and b).

Copies of version no. 2 of the field forms are given in Appendix IV.

In the index of programmes below, the first two programmes are required in order to convert the "old" data, as enumerated according to the initial version of the field card, into a format compatible with the "new", enhanced version. In this way, the same programmes can be used, and full compatibility assured, for the two versions of the enumerations.

A flowchart outlining the sequence of the procedures and the linkages between programmes and files is given in a separate paper : Field Document 2.2 "Flowcart for Computer Processing of the ITTO Experimental Plots"

2. Index of Programmes.

Correction programmes :

Programmes for Production of Tables :

Programmes for Growth and Yield.

Standtable Projections

3. Computer Programme Instructions

This section gives the instructions on how to use the individual programmes to edit the datafiles and prepare them for production running.

The field cards must first be thoroughly checked manually according to the "Manual of Instructions for Enumerating the Permanent ITTO Experimental Plots" (Korsgaard, S., ITTO PD 10/87 (F), Field Document No. 1, July, 1993).

When the field cards have been checked and ordered, the data is entered into the computer. The data entry process can be done either at the Forestry Department or by a contracted company.

It is important that the data entry is verified by having the data entered twice by two independent keyboard operators where any discrepancies are immediately rectified.

The layout of the datafiles must follow exactly the layout of the field cards. The first few programmes given below are used to check that the datafiles are in working order subsequent to the data entry procedure. Since two sets of fieldcards are used, the first two programmes below are used to bring data entered from Fieldcard Version No. 1 to the same datafile format as the data entered directly from Fieldcard Version No. 2.

3.1 Programmes used to Check and Rearrange Data from Fieldcard Version No. 1.

ITCHRAW.FOR

This programme is used to check the contents and order of the raw datafiles before any further processing is attempted. The programme lists:

- Year of enumeration
- Month - " -
- Compartment no.
- Treatment no.
- Block no.
- Quadrat no. and
- Number of entries (trees, saplings etc.) per quadrat.

The programme will print a message each time any of the above variables changes. As the datafiles are supposed to be entered one block at a time, only the quadrat number should change.

In order to ascertain the correct function of the next programme, ITSPLIT, it is important that the sequence of the quadrats is sorted in ascending order from 1 to 43 in all bloc except for plantation blocks where the order is from 1 to 17 a enrichment planting blocks where the order is from 1 to 10.

The year may change from f.ex. 91 to 92 provided the month changes from 11 to 01 indicating that the enumeration stretche over the new year period. Otherwise the month may change from to 11 or from 03 to 02 indicating that the enumeration stretch over two months. The compartment may also change in the cases where the field crews note that a block crosses a compartment boundary.

NOTE: It must be stressed that for the purpose of the experimen the compartment boundary is irrelevant and any reference the data to the compartment no. must be ignored. (This ha caused some confusion during initial data entry).

If treatment and block change, it indicates an error.

Check carefully that all quadrats are present and correctly sorted before proceeding.

The programme will request the filename for checking and the devise for listing, usually the lineprinter (PRN).

ITSPLIT.FOR

This programme is used to split the raw datafiles entered from Fieldcard Version 1. into separate files according to the format used in Fieldcard Version 2. and a separate file containing the Quadrat information.

There are three main types of files:

- Logging in Virgin Forest: (Quadrat info = 45 bytes)

- Trees/Poles :	Record Length	: 45 + 25 = 70 bytes
- Saplings :	" "	: 45 + 22 = 67 "
- Seedlings :	" "	: 45 + 7 = 52 "

- Silvicultural treatment of Logged-over Forest: (Quadrat info = 60 bytes)

- Trees/Poles :	Record Length	: 60 + 27 = 87 bytes
- Saplings :	" "	: 60 + 22 = 82 "
- Seedlings :	" "	: 60 + 7 = 67 "

- Plantation / Enrichment Planting: (Quadrat info = 34 bytes)

- Wildlings :	Record Length	: 34 + 24 = 58 bytes

The files are split into 3 types of quadrat information files with record length given above, and 4 types of enumeration files:

- Trees/Poles :	Record Length :	40 bytes
- Saplings :	" " :	33 bytes
- Seedlings :	" " :	27 bytes
- Wildlings :	" " :	40 bytes

The program also checks the species code and assign the Wood Quality Group (WQG) and the Stem Identity Class (SIC) (see Korsgaard, 1993). In some cases where 'present' enumeration information is missing, the information is transferred from 'previous' enumeration.

The filename for the split files is constructed as follows: The part of the filename preceding the "point" '.' is maintained, the extension following the '.' contain the year of enumeration from the first record of the un-split file for trees/poles, saplings, seedling and wildlings respectively. It is therefore important to check the output from ITCHRAW to make sure that the years are correct.

The last digit is used to identify what the file contains:

- Quadrat information : --------.--Q
- Trees/Poles : --------.--1
- Saplings : --------.--2
- Seedlings : --------.--3
- Planted Wildlings : --------.--4

A valid filename after the split is performed may be :
LES0193.93Q for quadrat information or KSBLK01.921 for trees

A printed report provides information on the quadrat numbers a: the number of trees transferred as well as a few error comment like: illegal Stem Identity Class or Species Code not found. These errors will also be picked up by the edit programme ITED described below.

The programme asks for filename to split and asks if the file has been properly checked by running the ITCHRAW programme fir and if the necessary corrections has been made.

When the individual blocks have been split successfully they must be joined together to form the complete datafile by treatment. This is best done by the DOS COPY command. F. ex. treatment 01 in Sungei Lalang consist of the 4 blocks 3, 6, 21 and 28. The following command will make up the tree/pole file SLTMT01.921:

```
COPY SLBLK03.921+SLBLK06.921+SLBLK21.921+SLBLK28.921 SLTMT01.921
```

The filenaming conventions are :

- First two letters : Location name,
  SL = Sungei Lalang, LE = Lesong, PI = Piah
  KS = Kledang Saiong, CH = Cherul

- The next three letters are TMT = Treatment

- The next two digits are the treatments applied :

  01 = CUT ALL > = 30 CM
  02 = CUT ALL > = 45 CM
  03 = CUT DIPT>=35/ NON-DIP.>=30 CM
  04 = CUT DIPT>=50/ NON-DIP.>=45 CM
  05 = CUT DIPT>=65/ NON-DIP.>=60 CM
  06 = CUT DIPT>=75/ NON-DIP.>=70 CM
  07 = CUT ALL>=30 CM/PLANT WILDLING
  08 = NO LOGGING, VIRGIN CONTROL
  11 = CLIMBER CUTTING (CL)
  12 = GIRDLING + CLIMBER CUTTING (GCL)
  13 = GCL (+ ENRICHMENT PLANTING)
  14 = CUT ALL>=30 CM/PLANT WILDLING
  15 = CONTROL, LOGGED, NOT TREATED
  16 = ENRICHMENT PLANTING

3.2 Programmes for File Listings and Preparations for Editing

ITCRTSRP.FOR :

This programme is used to create a small testfile from a main data file. This is useful for checking that the files after data entry are in the proper format.
A small test file is also useful during programme development when errors in the programme may damage the data file.

Input : A main data file containing trees, poles/saplings or seedlings.

Commands :

CREATE A SMALL TESTFILE. FILENAME=

Give the required filename.

HOW MANY LINES ?

Give the number of lines needed, f. ex. 100.

Output : A testfile with filename beginning with TS....

Copy the testfile to the required directory where needed.

ITLIST.FOR :

This programme is used to list data files on the screen or on paper or to a new disk file.

Use this programme to list the data file on the screen to check that the file is in good working order and that the record length is correct and that the variables are in the right columns.

In case of serious problems check with those who did the data entry and check that the instructions were followed.

The programme will list any ASCII (DOS) datafile.

Input : Any ASCII datafile.

Commands :

THIS PROGRAM LIST ASCII-FILES
GIVE FILENAME :

Give the filename.

GIVE TOTAL RECORD LENGTH :

Give the record length of the data file if known. Els give the length as 76 so the output will fill the screen and count the record length from there.

GIVE LENGTH OF CODE NUMBER :

Give the length of the code number if used. For the species list it is 5 digits. Else give 0 if a code number is not included.

GIVE SIZE OF DESCRIPTION :

Give the number of bytes for the rest of the record. For the species list it is 61. Else give the size equal to the total record length.

LISTING ON SCREEN = 1
LISTING ON PAPER = 2
NEW DISKFILE = 3

Answer as appropriate.

When the screen is full this command appear :

TO CONTINUE = 1 FINISH = 2

Answer as appropriate.

When a list to a new diskfile is requested the filename must be given :

GIVE NEW FILENAME :

Give the filename of a new file.
When the listing is finished this question appears :

ANOTHER LIST = 1
ANOTHER FILE = 2
FINISH = 3

Answer as appropriate.

Output : A list of the file on the screen or a list of the file on the line printer or a new disk file.

ITLSFILE.FOR :

This programme is used to produce a hard copy listing of the data files on paper (A4) for checking and safekeeping. It can also be useful during editing when unexpected errors occur like when codes are keyed in the wrong columns.

This is the only programme that tabulates the quadrat information. There is no checking on the quadrat file, this must be done manually. Statistical programme packages can then be used to make frequency distributions, means etc. of the information as required.

Input : A main data file, quadrats, trees, saplings, seedlings or wildlings.
: The species list, SPECIES.DAT

Commands :

```
THERE ARE 4 TYPES OF DATA FILES AND
3 TYPES OF QUADRAT FILES :

DATA FILE FOR TREES/POLES        = 1
DATA FILE FOR SAPLINGS           = 2
DATA FILE FOR SEEDLINGS          = 3
DATA FILE FOR PLANTED WILDLINGS  = 4

QUADRAT FILE FOR LOGGING IN VIRGIN FOREST      = 5
QUADRAT FILE FOR SILV. TRMT. OF LOGGED FOREST  = 6
QUADRAT FILE FOR PLANTATION/ENRICHMENT PLOTS   = 7 :
```

Give the number corresponding to the type of file to be listed.

```
INPUT FILENAME FOR LISTING :
```

Give the file name.

Output : A printed list of every record in the file.

ITLINO.FOR :

This programme inserts a consecutive record number in the first 5 bytes of each record in the main data files (trees/poles, saplings, seedlings or wildlings).

When, during editing, records or blocks of records (like misplaced quadrats, trees etc.) have been moved or deleted, remember to renumber the data file by running this program before continuing work on the data file.

Input : A main data file.

Command :

INPUT FILENAME : (FX : SLTMT05.921)

Give the filename.

Output : A renumbered main datafile, filename unchanged.

3.3 Programmes for Data File Editing.

Having made sure that the file is properly organized and that record numbers are inserted, the file is ready for the editing process.

The editing process consists of a number of steps to check errors of different kinds in the file. The procedure has been developed through "trial and error the hard way" since 1978 and has now proven very efficient to detect some very tricky errors usually overlooked by normal "one-pass" edit programmes.

It is important to do one step at a time and to ensure that all errors listed are properly checked against the field cards and corrected as required before proceeding to the next step.

ITLSBLCK.FOR :

This is the very important first edit check.

The programme list the number of quadrats per block per treatment.

IMPORTANT : Any discrepancies in number of quadrats must be checked, f. ex. by ITQUCHCK, and corrected before editing continues. Refer to Appendix III for a list of treatments and corresponding block numbers per research area.

The errors may be due to the file not being properly organized or the columns being shifted in the middle of the file, or the field crew forgot to fill the code.

Check that the blocks are listed in the correct ascending order.

Input : A main data file, trees/poles, saplings or seedlings.

Command :

INPUT FILENAME: (FX: SLTMT04.921)

Give the filename

Output : A printed list giving treatment no., the block numbers and the number of quadrats.

ITQDRNEW.FOR :

This programme is used during initial editing after ITLSBLCK, when the number of quadrats per block per treatment is correct. The programme creates a file containing the treatment no., bloc no. and quadrat no. in correct sorted sequence for use by the ITQUCHCK programme.

NOTE : This programme uses three filenames to contain the output. There are 3 options:-

	Filename
- layout for trees/poles and wildlings	*******.QTR
- layout for saplings	*******.QSA
- layout for seedlings	*******.QSE

As this programme creates quadrat lists for several types of layouts it is important to have a clear and correct idea of the layout and numbering system of the treatments, blocks and quadrats/planting lines before running the programme. Use ITLIS to list the result to check that the numbers and their sequence is correct.

Input : There is no input file

Commands :

```
    >>>  I T Q D R N E W  <<<

 THIS PROGRAM CREATES A TRMT-BLK-QDR/LINE -FILE

 PLOT LAYOUT FOR TREES/POLES/WILDLINGS = 1
           LAYOUT FOR SAPLING SUBPLOTS = 2
      OR LAYOUT FOR SEEDLING SUBPLOTS = 3 :
```

Give number corresponding to the layout.

```
 GIVE FILENAME FOR TREATMENT PLOT (NO EXTENSION)
 F.ex.: SLTMT01 :
```

Give the filename.

```
  HOW ARE THE QUADRATS ARRANGED :
  CONSECUTIVELY (IN SQUARE PLOTS OR PLANT. LINES) = 1
  INDIVIDUALLY  (LIKE SAPL./SEEDL. SUBPLOTS)      = 2 :
```

For trees/poles and for the plantation and enrichment planting plots the block contain either 25 quadrats c 17 or 10 planting lines respectively.

The saplings and seedlings are enumerated in 9 central quadrats and has the quadrat numbers from 26 to 34 and from 35 to 43 respectively.

Give the number (1 or 2) as required.

GIVE THE NUMBER OF QUADRATS/PLANT LINES :
TREE/POLES HAS 25 QUADRATS PER PLOT
PLANT. LINES EITHER 17 OR 10 LINES :

Answer as appropriate.

- Section creating quadrat file for tree/poles and wildlings:

GIVE TREATMENT NO AND FIRST BLOCK NO
Fx. SLTMT02 : 2, 01

Refer to Appendix III to find the block numbers per treatment and check with the output from ITLSBLCK.

ARE THERE MORE BLKS (Y/N) ?
(YES, USUALLY MORE F.ex.: BLOCK= 02, 13, 21, ETC)

Answer Y or N as required

GIVE NEXT BLOCK NUMBER :

Give only one block number at a time.

- Section creating quadrat file for the subplots:

GIVE THE FIRST AND LAST SUBPLOT NOS:
Fx. SLTMT03 SAPL : 26,34 OR SEEDL : 35,43)

Give the subplot quadrat numbers.

GIVE TREATMENT NO AND FIRST BLOCK NO
Fx. SLTMT02 : 2, 01

Refer to Appendix III to find the block numbers per treatment and check with the output from ITLSBLCK.

ARE THERE MORE BLKS (Y/N) ?
(YES, USUALLY MORE F.ex.: BLOCK= 02, 13, 21, ETC)

Answer Y or N as required

GIVE NEXT BLOCK NUMBER :

Give only one block number at a time.

Output : An internal diskfile containing a correct list of treatment no., block numbers and quadrat/plant line numbers.

YOUR TRMT/BLK/QDR FILE IS NAMED : (f.ex SLTMT01.QTR)

DO YOU WISH TO CREATE ANOTHER QUAD. FILE (Y/N)

To continue with another creation or stop.

ITQUCHCK.FOR :

This programme is the very important next step in the editing process. The program checks that all quadrats are present in the correct sorted sequence and that, within each quadrat, ever tree number occur only once, and that empty quadrats contain only one record with the correct stocking code. It is also checked that the Forest Class does not change in the middle of quadrat.

The programme detects very tricky errors involving double tree numbers, duplicated records and cases where two forest classes are found in the same quadrat, which may - in fact - be due to incorrect quadrat numbering or fieldcards misplaced during data entry. These and other errors are very difficult to detect otherwise and they have previously given serious trouble when running the ITGROWTH program.

Input : A main data file, trees/poles, saplings or seedlings.

Command :

INPUT FILENAME: (Fx.: SLTMT01.921)

Give filename as required.

Output : A printed list containing a list of all the quadrat in the data file indicating errors if any and a list of missing quadrats, and a list of all records in quadrats where errors are found.

NOTE : It is very important that all errors are checked and corrected before editing continues, Rerun the ITQUCHCK programme until no more errors are listed, and a clean quadrat list is printed.

ITEDIT.FOR :

This programme is the main editing and error checking programme for new data from the field. Run this program after the codes have been updated and the quadrats have been checked. It will produce a list of illegal codes, codes not found and other inconsistencies in the file. Some errors listed must be corrected whereas other errors or inconsistencies cannot be corrected or do no harm.

After correction, rerun the ITEDIT programme to check for remaining errors.

Input : A main data file, trees/poles, saplings or seedlings.

Command :

INPUT FILENAME : EX. SLTMT03.921

Give filename.

There are two different types of plots, 'Logging in Virgin Forest' and 'Silvicultural Treatment of Logged-over Forest'. Since some of the variables scored differ in the two different sets of data, it is required to give the information as to which data set needs editing:

```
        LOGGING OF VIRGIN FOREST = 1
SILV. TRMT OF LOGGED OVER FOREST = 2 :
```

Answer as appropriate.

Output : A printed list of all the records that need to be checked, with a message of the possible error. However, the actual error may not be the one flagged, but may lay elsewhere in the record. Check against the fieldcards also from previous years and use the imagination.

NOTE : It might be necessary to change or update this programme if the instructions or the variables are changed for new enumerations.

3.4 Programmes for File Corrections

ITINDEX.FOR :

This programme is used to create an index-file to a main data file containing, treatment no., block no., quadrat number and start record for each quadrat in the main data file. The index file XQ*****.*** is used by ITGROWTH, ITGRORAT and ITCORR.

NOTE : Before running this programme the file must be properly numbered by the ITLINO programme, as the index gives the start record of each quadrat in the file.

Input : A main data file.

Command :

INPUT FILENAME: (EX: SLTMT03.921)

Give file name.

Output : An indexfile XQ... to a main data file, where ... the remainder of the filename taken from the main da file.

ITCORR.FOR :

This programme is used to make error corrections in the data files during editing. It will normally work on a record by record basis, but it is also possible to look for a treatment/ block/quadrat number to list all records of a quadrat for checking.

Try the programme on a test file first to get acquainted with how it works as the programme replaces the erroneous records i the datafile with the corrected record. For treatment/ block/ quadrat access mode the index file XQ --- to a data file is required, see program ITINDEX above.

Input : A main data file, trees/poles, saplings or seedlings.

: The corresponding index file XQ---

Commands :

```
OPTIONS :
     CORRECTION  WORK = 1
DELETE MARKED RECORDS = 2
```

For normal correction work select option = 1.
To delete records already marked for deletion, selec option = 2.

```
GIVE FILENAME :

           Give filename

GIVE ACCESS MODE :
   RECORD NUMBER = 1
OR TRMT/BLK/QUAD = 2
```

If the work only requires record by record correction select access mode = 1.
However, if it is needed to list a whole quadrat to check forest classes or tree numbers etc. then select access mode = 2. When access mode = 2 is selected, the XQ --- file must exist.

Having selected mode of access the actions to be taken are requested :

```
ACTION :
           FINISH = 0,0
      LIST RECORD = LN,1
       CORRECTION = LN,2
  SAME CORRECTION = LN,3
     LIST QUADRAT = 0,4
MARK RECORD DELETE = LN,5

GIVE : RECORD-NUMBER (LN), ACTION
```

For corrections select action : LN,2
For example if record 5 needs to be corrected answer : 5,2

The line is listed :

```
000051435010100201111643000225141121

GIVE : START-BYTE, END-BYTE, 'CORRECT-STRING'
```

For example to correct an error in species code, column 24 to 26 :

```
24,26,'203'
000051435010100201111642030225141121
```

If the same correction is needed in other records for example the species code in record 14 has the same error as no. 5, then give : 14,3

```
000141225010100502111643000102075221
000141225010100502111642030102075221
```

To delete records, the record is first marked delete by action : LN,5 :

The word DELETE is inserted in the record. When all records have been marked for deletion give action 0,0 to finish and then the following options are given :

```
CHANGE MODE OF ACCESS = 1
       ANOTHER OPTION = 2
       ANOTHER FILE   = 3
       END OF SESSION = 4
```

Select ANOTHER OPTION = 2 and select
DELETE MARKED RECORDS = 2

The file is read through and the records **not** marked delete are transferred to a new file.
When that is done use DOS to delete the original file and then rename the new file to the original filename.
Then rerun the ITLINO and ITINDEX programmes.

When ACCESS MODE : TRMT/BLK/QUAD = 2 is selected, it is possible to list a whole quadrat to check for errors affecting other records in the quadrat like Forest Class errors by selecting

ACTION :
LIST QUADRAT = 0,4

The command 0,4 will result in this question

GIVE TRMT,BLK,QUAD NUMBER :

For ex. to list quadrat 14 in block 3 of treatment 1 give :

1,3,14

The quadrat is listed :

```
003461423010301401111751010165054111
003471423010301402111718020262104222
003481423010301403111891020185065211
003491532010301404111700000122083321 <-- error in FCL
003501423010301405111751010182084312
003511423010301406413900120100000000
003521423010301407413900120100000000
```

ANOTHER QUADRAT = 1 , CORRECTIVE ACTION = 2

Answer 1 to list another quadrat or 2 if there are errors to be corrected, the list of ACTIONS will appear.

To finish the error correction session give ACTION :

FINISH = 0,0

The answer 0,0 will make the commands given under delete record above appear. Select :

END OF SESSION = 4

Output : A main data file, hopefully with less errors inside than when the session was started.

ITCHCKLN.FOR :

This programme is used to find trees that correspond to certain requirements and list them on the screen for checking. It can be useful to make this listing before attempting to correct systematic errors using ITMASCOR, see below.

Input : A main data file.

Commands :

FIRST CHECK, GIVE :
START BYTE, END BYTE, 'CHECK STRING'

Answer f. ex. 20, 22, '134' that is : look for all occurrences of Stem Identity Class '134' (cut stumps).

SECOND CHECK, GIVE :
START BYTE, END BYTE, 'CHECK STRING'

Answer f. ex. 32, 33, '00' that is : bole height is 0 m.

FOR SECOND CHECK, GIVE RELATION
.LT. = 1, .EQ. = 2, .GT. = 3 :

Answer f. ex. 3.

Output : In this example, the programme will list, on the screen, all occurrences of cut stumps having bole height of more than 0 meters, i.e. for cut stumps bole heights are not measured, but if so, there is most likely an error in the Stem Identity Class.

The programme is mainly used during editing.

ITMASCOR.FOR

This programme is used when a unique code has to be changed to another code throughout a file. This can be particularly usefu: for species codes.
When in doubt run the ITCHCKLN programme (see above) to check that only those codes that require change are listed.

Input : A main data file.

Command :

GIVE : START-BYTE, END-BYTE, 'OLD-STRING','NEW STRING'

F.ex. change sp. code 70605 to 60605 give :

23,27,'70605'.'606Q5'

Output : The change is done throughout the file.

This programme is mainly used during editing and when it has been decided to make a general change of a code, like a specie: being assigned another Wood Quality Group.

3.5 Programmes for the Production of Tables

When editing is completed there are a number of programmes used to produce different kinds of tables summarizing the data :

FDFCLQNO (ITFCL).FOR :

This programme make an output table of the number of Forest Classes found, the percentage distribution and the description of the Forest Class. The programme check for illegal Forest Classes and change of Forest Class in the middle of a quadrat. The programme is used once per data file immediately before the file is finally edited and released for production running. Same for ITSIC.

Input : A main data file.

Commands :

INPUT FILENAME (FX. SLTMT01.931)

Give the filename.

WHICH BLOCK ?
ALL BLOCKS = 0
OR BLOCK NO :

Answer as appropriate.

For statistical analysis it is sometimes required to get the variation within the area in which case each block needs to be listed separately.

Output : A printed list giving a summary of the Forest Classes.

(Note : this programme is not yet adapted, as the version 1 of the field card does not contain a score for Forest Class.)

ITSIC.FOR :

This programme counts the number of stems for each Stem Identi Class and makes a list of every class encountered. The program also checks for illegal Stem Identity Classes.
Like ITFCL, this programme is run immediately before the editi is finished.

Input : A main data file.

Commands :

INPUT FILENAME: (FX. SLTMT06.921)

Give the file name.

The two types of output tables , Forest Classes and Stem Identity Classes, are useful in providing an overview of what the file contains and for guiding detailed studies of Forest Classes and Stem Identity Classes later on.

ITTABSTD.FOR :

This is the standard programme for tabulating trees according to various specifications.
In order to ease the interactive communication defining the table, when many similar tables are produced from several data files, it is possible to keep the commands in a small file called FCOMSTD.DAT. Use DOS EDIT or any other editor to update. An example is given in the Appendix.

Input : A main data file, trees only.
: A species list f.ex. SPECIES.DAT, if needed.
: The file containing the plot location names
: FORRESV.DAT.
: The file containing the treatments : TABTREA.DAT
: The command file FCOMSTD.DAT if needed.

Commands :

```
COMMANDS FROM KEYBOARD    = 5
OR FROM FILE FCOMSTD.DAT = 4
```

Then the data filename is requested :

```
INPUT FILENAME: (Fx. SLTMT02.921)
```

Then comes the interactive session defining the standtable to be produced :

```
MAX. NUMBER OF BLOCKS (BLCK)   = 4
FOREST CLASSES (FCL)           = 10
STEM IDENTITY CLASSES (SIC)    = 10.

FOR MEAN/SUMMARY OF ALL CLASSES ANSWER : 0

GIVE THE NUMBER OF : BLCK, FCL, SIC
EX : 0,0,1
```

When 0.0.0 is selected the table will contain the combined average for all blocks, all Forest Classes and all Stem Identity Classes.

When 1 or another number is selected the table will contain the average of only those blocks or classes specified below.

In the example (0,0,1) all blocks and all Forest Classes are included but only one Stem Identity Class will be included.

If block number is requested :

GIVE THE BLOCK NUMBERS : Fx. 2,3,4

In this example the table will be the average of blocks 2, 3 and 4.

If the Forest Class is selected, it is possible to get a table for a combination of individual Forest Classes (maximum is 10) or a number of Main Forest Classes :

USE INDIVIDUAL FCL"S LIKE 432,434,532,533, ETC = 1
OR USE MAIN FCL"S LIKE 100,200,300, ETC = 2 :

Answer as appropriate, then :

GIVE THE FOREST CLASS CODES (MAX= AVERAGE OF 10)
F.ex. 100,200,300 OR 432,434,532,533 :

Give the codes.

If the Stem Identity class is selected :

GIVE THE STEM IDENTITY CODES (MAX= AVERAGE OF 10)
F. EX. : 111 OR 114,124,134,144

If, as an example SIC = 111 is selected, the table will contain information on living standing complete trees only.

The diameter class interval and the minimum diameter is selected as needed. There are 11 diameter classes in the output table.

GIVE THE LOWEST DIAMETER, & CLASS INTERVAL IN MM.
F. EX. : 100,50 OR 150,150

If the answer is 100,100 the minimum diameter is 10 cm and the diameter class interval is 10 cm, and consequently the upper diameter class is 110 + cm.

For the analysis of the various parameters measured, it is possible to get special output where one parameter takes the rows (horizontally) of the table and another parameter is given page by page. The diameter classes are always fixed as 11 columns.

CHOOSE TWO OF THE FOLLOWING - HORIZONTAL AND PAGE VARIABLE
LOG QUALITY = 1
CROP TREE STATUS = 2
CROWN FORM = 3
CROWN DOMINANCE = 4
STEM DAMAGE = 5
CROWN DAMAGE = 6
EFFECT OF CLIMBERS = 7
WOOD QUALITY = 8
NO PAGE VARIABLE = 9

Answer f.ex : 8,9

For normal table output the Wood Quality Group = 8 by row is selected, the page variable is not used = 9

If, for example, the table should show the correlation between crown dominance and crown form the following options are given :

3,4

That will give one page for each crown form with the rows being the crown dominance classes.

The codes for which output is wanted is given next in two steps, first give how many code numbers and then the actual codes to be included :

GIVE THE NUMBER OF CLASSES FOR EACH VARIABLE SELECTED

In the first example it will be :

8,0

i.e. one row for each wood quality group, and nothing for the pages.

In the second example it will be :

4,5

Then the actual codes are given :

GIVE THE CODES FOR HORIZONTAL VARIABLE

F.ex: 1,2,3,4,5,6,7,8

or: 1,2,3,4

And similarly:

GIVE THE CODES FOR PAGE VARIABLE

F.ex: 1,2,3,4,5

ANY SPECIES CHECK REQUIRED ?
(NO CHECK = 0, SPECIES.DAT = 1, OTHER LIST = 2)

It is possible, for special investigations, to provide a list of species (genera) for which an output table is needed, it may f.ex. be the occurrence of fruit bearing trees for wild-life. In this case the list is made up using an editor programme and the filename for that species list supplied.

GIVE SPECIES LIST FILENAME :

For normal running, when all species are needed, no checks are required. Selecting the full species list (SPECIES.DAT) gives an additional check on the validity of the species codes in the file.

It is possible to produce the output table for either:

a) number of stems per ha and basal area per ha or
b) volume in m3 per ha and the number of stems included in the volume calculations.

TABLES FOR :
NUMBER OF STEMS AND BASAL AREA = 1
    - " - AND VOLUME = 2

If output is selected for volume, there are two volume functions applied. The first function is based on quadratic diameter at breast height (DBHob) alone and is used when heights have not been measured. The second function is based on both diameter and height and is taken from the FAO/ Forest Department's National Forest Inventory of 1971/72 for the average volume in logged over forest. When a tree height is missing the first function is automatically applied.

For the enumerations done before 1993, using version 1 of the field card, the number of logs are scored. Each log section is 5 meters in length. The number of logs is converted to meters before applying the second equation. If the number of logs is less than 2, the first function is used, as 1 log is scored for small trees even if the clear bole is less than 5 meters.

```
SELECT VOLUME FUNCTION :
BASED ONLY ON DIAMETER (HEIGHTS NOT MEASURED)                : 1
BASED ON BOTH DIAM AND HEIGHT (HEIGHT IS MEASURED: M)  : 2
BASED ON BOTH DIAM AND NUMBER OF LOGS (1 LOG = 5M)      : 3 :
```

The table is then processed.

Output : The standtable giving number of trees per hectare is printed out, but it is possible to suppress the printing of the basal area table.

```
PRINT THE TABLES OF BASAL AREA/VOLUME ? (Y/N)
```

Continuing:

In order to save time, it is possible to select option 1 which produces another table using exactly the same layout.

```
ANOTHER FILE = 1
      FINISH = 2 :
```

ITTABWQS.FOR :

This is the programme for tabulating trees per "Species Code" (Vernacular Name) using the standard species list SPECIES.DAT or any special species list.
The interactive communication is similar to that of ITTABSTD, except that for the tables output the rows (horizontally) are always taken by the Wood Quality Groups/ Species name.
The use of the page option is not possible and the table will contain the combined average of the codes specified. F. ex if Log Grades 1 and 2 are requested the output will be the combined average of the two Log Grades.

Input : A main data file, trees only.
: A species list f.ex. SPECIES.DAT, or a special species list.
: The file containing the forest location names : FORRESV.DAT.
: The file containing the treatments : TABTREA.DAT
: The command file FCOMWQS.DAT if needed.

Commands :

```
COMMANDS FROM KEYBOARD    = 5
OR FROM FILE FCOMWQS.DAT = 4
```

Then the data filename is requested :

```
INPUT FILENAME: (Fx. SLTMT01.921)
```

Then comes the interactive session defining the standtable to be produced :

```
MAX. NUMBER OF BLOCKS (BLCK)  = 4
FOREST CLASSES (FCL)          = 10
STEM IDENTITY CLASSES (SIC)   = 10.

MEAN/SUMMARY OF ALL CLASSES   = 0

HOW MANY : BLCK"S, FCL"S, SIC"S
EX : 0,0,1 :
```

When 0 is selected the table will contain the combined average for all blocks or all Forest Classes or all Stem Identity Classes.

When 1 or another number is selected the table will contain the average of only those blocks or classes specified below.

In this example (0,0,1) all blocks and all Forest Classes are included but only one Stem Identity Class will be included.

If block number is requested :

GIVE THE BLOCK NUMBERS : Fx. 2,3,4

F. ex. answer 3,12 and the table will contain the average of the two blocks requested

If Forest Class is selected it is possible to get a table for a combination of individual Forest Classes (maximum is 10) or a number of Main Forest Classes :

```
USE INDIVIDUAL FCL"S LIKE 432,434,532,533,ETC. = 1
OR USE MAIN FCL"S LIKE 100,200,300,ETC         = 2
```

Answer as appropriate, then :

GIVE THE FOREST CLASS CODES (MAX = AVERAGE OF 10)

Give the codes.

If the Stem Identity class is selected :

GIVE THE STEM IDENTITY CODES (MAX = AVERAGE OF 10)

If, as an example SIC = 111 is selected, the table will contain information on living standing complete trees only.

The diameter class interval and the minimum diameter is selected as needed. There are 11 diameter classes in the output table.

GIVE THE LOWEST DIAMETER, & CLASS INTERVAL IN MM.

If the answer is 100,100 the minimum diameter is 10 cm and the diameter class interval is 10 cm, and consequently the upper diameter class is 110 + cm.

```
WOOD QUALITY/ SPECIES TAKE THE ROWS/PAGES.
IF A VARIABLE IS SELECTED, THE TABLE WILL CONTAIN THE
MEAN/SUMMARY OF THE CODES GIVEN.
I.E. NO PAGE BY PAGE OUTPUT LIKE IN ITTABSTD.

SELECT ONE OF THE FOLLOWING VARIABLES
LOG QUALITY         = 1
CROP TREE STATUS    = 2
CROWN FORM          = 3
CROWN DOMINANCE     = 4
STEM DAMAGE         = 5
CROWN DAMAGE        = 6
EFFECT OF CLIMBERS  = 7
NO SELECTION        = 9
```

Answer f.ex : 9

I.e. no variable is selected and the output will be the combined average of all.

If for ex. the table should give the distribution of commercial species having the good Log Qualities 1 and 2 the following is given :

1

The codes for which output is wanted is given next :

GIVE THE NUMBER OF CLASSES FOR :
WOOD QUALITY GROUPS AND THE VARIABLE SELECTED

In the first example it will be :

8,0

i.e. one row for each wood quality group, and no selection.

In the second example it will be :

5,2

Then the actual codes are given :

GIVE THE CODES FOR WOOD QUALITY GROUPS

F.ex: 1,2,3,4,5,6,7,8

or: 1,2,3,4,5

And similarly:

GIVE THE CODES FOR SELECTED VARIABLE

F.ex: 1,2

GIVE SPECIES CHECK
SPECIES.DAT = 1, OTHER LIST = 2)

It is possible for special investigations to provide a list of species (genera) for which an output table is needed, it may f.ex. be the occurrence of fruit bearing trees for wild-life. In this case the list is made up using an editor programme and the filename for that species list supplied. For normal running when all species are needed the standard species list (SPECIES.DAT) is selected.

Select if output should give local or latin names

LOCAL NAME = 1, SCIENTIFIC NAME : 2 :

As for ITTABSTD, it is possible to tabulate the volume per species.

```
TABLES FOR :
NUMBER OF STEMS AND BASAL AREA = 1
   -    "   -     AND VOLUME     = 2
```

Answer as needed.

If output is requested for volume, the volume function to be used is selected as explained under ITTABSTD above.

```
SELECT VOLUME FUNCTION :
BASED ONLY ON DIAMETER (HEIGHTS NOT MEASURED)           : 1
BASED ON BOTH DIAM AND HEIGHT (HEIGHT IS MEASURED: M)  : 2
BASED ON BOTH DIAM AND NUMBER OF LOGS (1 LOG = 5M)     : 3 :
```

The table is then processed.

Output : The standtable giving number of trees per hectare by species (Vernacular name) is printed out. It is possible to suppress the printing of the basal area table.

```
DO YOU WISH TO PRINT THE BASAL AREA (Y/N)
```

ITTABSAP.FOR :

This programme is used to produce output tables for saplings, seedlings and planted wildlings.
The interactive communication is similar to that of FDTABWQS above. The option by species is included in the programme.

Input : A main data file, Saplings, Seedlings or planted Wildlings.
: A species list f.ex. SPECIES.DAT, or a special species list if needed.
: The file containing the forest location names : FORRESV.DAT.
: The file containing the treatment descriptions : TABTREA.DAT.
: The command file FCOMSAP.DAT if needed.

Commands :

```
COMMANDS FROM KEYBOARD    = 5
OR FROM FILE FCOMSAP.DAT = 4
```

In the cases where a number of tables are needed using the same pattern of output, it is an advantage to create the command file FCOMSAP.DAT, using a text editor, to contain the commands.

Then the data filename is requested :

```
INPUT FILENAME: EG. SLTMT06.922
```

Then comes the interactive session defining the standtable to be produced :

```
MAX. NO. OF BLOCKS (BLCK) = 4,
FOREST CLASS (FCL)        = 10
STEM IDENTITY CLASS (SIC) = 10

HOW MANY : BLOCK"S, FCL"S, SIC"S
0 = MEAN/SUMMARY OF ALL, EX : 0,0,1
```

When 0 is selected the table will contain the combined average for all blocks or all Forest Classes or all Stem Identity Classes.

When 1 or another number is selected the table will contain the average of only those blocks or classes specified below.

In the example (0,0,1) all blocks and all Forest Classes are included but only one Stem Identity Class will be included.

If block number is requested :

GIVE : BLOCK NUMBERS
Fx. 2,10 OR 13,14,23

Example : 2,10

In this example the table will be the average of the two blocks : 2 and 10.

If the Forest Class is selected it is possible to get a table for a combination of individual Forest Classes (maximum is 10) :

GIVE THE FOREST CLASS CODES (MAX= AVERAGE OF 10)

Give the codes.

If the Stem Identity class is selected :

GIVE THE STEM IDENTITY CODES (MAX= AVERAGE OF 10)
Ex. 211 (SAPL. COMPL.), 311 (SEEDL./WILDL COMPL.) ETC.

If, as an example SIC = 211 is selected, the table will contain information on living standing complete saplings only.

The diameter classes are fixed at 1 cm intervals from 0 to < 2.0, 2.0 to < 3.0, 3.0 to < 4.0 and 4.0 cm and above. Max. diam for saplings is 5 cm. However, in the case of wildlings, some fast growing plants may reach 5 cm and more. Seedlings are counted and neither diameter nor height is measured.

GIVE THE NUMBER OF CLASSES FOR :
THE WOOD QUALITY GROUPS :

For example, to include all species :

8

Then the actual codes are given :

GIVE THE CODES FOR WOOD QUALITY GROUPS

F.ex: 1,2,3,4,5,6,7,8

TABLES NOT BY VIGOUR CLASS = 1
OR TABLES BY VIGOUR CLASS = 2 :

Select 2 if tables are needed by vigour class, one table for each of the 3 classes will be produced. For saplings and planted wildlings only.

TABLES BY DIAMETER CLASS = 1
OR TABLES BY HEIGHT CLASS = 2 :

In the cases where heights are measured for saplings and planted wildlings it is possible to tabulate the height classes.

GIVE SPECIES LIST
TABLE PER WQG ONLY : NO CHECK = 0
TABLES PER SPECIES : SPECIES.DAT = 1
TABLES FOR OTHER SPECIES LIST = 2

It is possible for special investigations to provide a list of species (genera) for which an output table is needed, it may f.ex. be the occurrence of fruit bearing trees for wild-life. In this case the list is made up using an editor programme and the filename for that species list supplied.

GIVE SPECIES LIST FILENAME :

For normal running, when all species are needed, no checks are required. For a list of all species the full species list (SPECIES.DAT) is used.

Select if output should give local or latin names

LOCAL NAMES = 1, SCIENTIFIC NAMES = 2

The subplot sizes used in this programme are :

For sapling subplots	= 0.0025 ha
for seedling subplots	= 0.0004 ha
for plantation plots (17 plant lines) = (1/17)	= 0.0588 ha
for enrichment planting plots (10 plant lines)	= 0.01 ha

Output : A standtable by diameter or height class giving number of saplings or seedlings or wildlings per hectare and possibly by species (Vernacular name).

ITHEIGHT.FOR

This programme produces a table of bole heights or number of logs per diameter class per Wood Quality Group for either all log qualities or log quality 1 or 2. It also gives the number of trees for which bole height or number of logs is scored.

Input : A main data file, trees only

Commands :

GIVE THE LOWEST DIAMETER CLASS, AND CLASS INTERVAL (IN MM)

Usually 10 cm diameter classes starting from 10 are needed :

100,100

GIVE FILENAME :

Give the file name of a tree-file.

ALL LOGGRADES : 1
OR ONLY LOGGRADES 1 AND 2 : 2

The commercial Loggrades are 1 and 2.

In the earlier enumerations using version 1 of the field card number of logs were estimated. In field card version 2 used from 1993, the commercial or clear bole height is measured in meters.

TABLE OF TRUNK (COMM.) HEIGHT : 1
OR NUMBER OF LOGS : 2

Output : A printed table giving either bole heights or number of logs by diameter class and the number of trees.

ITSPSUM.FOR :

This programme produces a listing of the number of trees per species code (vernacular name) per hectare for the enumerated areas specified in file ITSPSUM.DAT, (update/change by text editor). An example is given in the Appendix. The summary is stored and updated in the unformatted file SPECIES.SUM

This program is useful for comparing the "species" diversity between different areas at different points in time after harvesting and having received different treatments.

Input : A main data file.
: The file containing the data filenames and enumerated area : ITSPSUM.DAT
: The file containing the summary : SPECIES.SUM
: The species list : SPECIES.DAT

Commands :

DO YOU WISH TO ZEROFILL THE SPECIES SUMMARY (Y/N)

Answer yes (Y) if a completely new list is needed. If only an update or addition is needed answer no (N).

The file SPECIES.DAT is used as the species list.

FILE NAME FOR SPECIES SUMMARY :
Fx: SLTMT01.921

Give the file name of a file that is already included with its enumerated area size in ha in the file ITSPSUM.DAT
If the filename is not included this message appears :

FILENAME NOT INCLUDED, TRY AGAIN!

In order to avoid duplicating the species summary for a file the programme check if the file has already been used. If so this message appears :

```
FILE ALREADY USED, TRY ANOTHER = 1
                   OR GET MENU = 2
```

Answer 1 and give another file name or answer 2 to get the menu (see below).

```
START OR ANOTHER FILE      : 1
CHANGE DIRECTORY           : 2
WRITE THE SPECIES SUMMARY  : 3
FINISH                     : 4
```

Answer as required.

For the printed output the species summary can be presented in different ways.
The complete list can be printed or a subset can be printed containing only those species that in the total column occur with a minimum and maximum number of trees. In this way a summary of the more common species (Vernacular names) can easily be obtained.

Output : A printed list according to the specifications given :

USE LOCAL NAMES : 1, LATIN NAMES : 2

Answer as appropriate.

LIST ALL SPECIES : 1
OR GIVE RANGE : 2

Answer 1 to print the full list or 2 for a subset.

GIVE RANGE OF NUMBER OF TREES PER HECTARE
(MIN,MAX) EX : 10,100 OR 2,5 :

Give the range required. F. ex. 10, 100 will cause a list to be printed for all the species containing 10 trees or more per hectare as an average of all plots. The range applies to the total column, not the individual locations.
If 2, 5 is given only those species containing from 2 up to 5 trees per hectare (incl.) are printed out.

NOTE : For tree/pole files, the per ha figure is calculated correctly. Poles (5 - 15 cm DBH) are only enumerated in the 9 central quadrats. The area factor per pole is thus 25/9, which is incorporated in the programme calculations.

3.6 Programmes for the Production of Growth and Yield Tables

In addition to the standtable programmes listed above, the package also includes programmes to calculate growth and mortality in permanent plots having a similar layout.

This includes a special edit programme used in detecting inconsistencies between two or more enumerations of the same plot.

ITGROEDT.FOR :

This programme is used to compare the same tree in from 2 up t 5 enumerations of the same plot. The following items are checked:

- Whether the tree is found or not. If the tree is not foun in a subsequent enumeration it may be because the tree is dead or because of an error.
- If the tree is not found in a previous enumeration it may be because it is a new recruit or an error.
- A special summary of new recruits per vernacular name can be requested.
- The species code number is checked, no changes are accepted.
- The Stem Identity Class Code is checked, unlikely changes are listed.

This programme has proved very useful for final editing of a n enumeration of a plot before attempting to run the Growth program. The list of new recruits produced by a special secti of this program has also proved very useful.

```
GROWTH EDITING / LISTING OF INCOMPATIBLE TREES

CHECK : WQG/SPECIES CODE
        IMPROVEMENT IN SIC
        NEW RECRUITS AND TREES NOT FOUND.

GIVE FILENAME FOR BASEYEAR : Fx. SLTMT02.921

          Give the filename, then

NUMBER OF YEARS TO BE CHECKED : (INCL. BASEYEAR)
MIN 2, MAX 5 ENUMERATIONS

          Give the number of years (enumerations)
```

GIVE ENUMERATION YEAR(S), (NOT BASEYEAR)
EX. 91,93 :

Give the years, except for the base-year that has already been given. The years can be in any order, they are sorted internally in the correct order by the programme.

The species list is used to check the validity of the species codes. Species not found are listed as errors. For the printout either local or scientific names can be used:

VERNACULAR NAMES = 1, SCIENTIFIC NAMES = 2

When the baseyear is not the first year, new recruits can be listed individually tree by tree or a summary per species can be requested. For big files it is suggested just to make the summary. Serious errors are always listed.

SUMMARY OF NEW RECRUITS = 1
LIST ALL NEW RECRUITS = 2

Normally answer 1

NOTE : The summary of new recruits gives the actual number, not the per ha, per year figure. There is no area correction for poles. The number of new recruits is thus a mixture of new recruits over the 5 cm pole boundary and the 15 cm tree boundary. For a correct calculation of the number of new recruits per ha, per year use the programme ITINGROW.

For later years dead trees are not remeasured and therefore the list of trees not found can be very long. However, for two subsequent enumerations, one or two years apart, the check for trees not found can be very useful to ensure that all trees are included in the files.

EXCLUDE TREES NOT FOUND FROM LIST = 1
LIST ALL TREES NOT FOUND = 2

The output may contain real errors that must be corrected before continuing. But there may also be cases where a broken tree recovers its crown which is listed as SIC improvement from 112 to 111, this has to be accepted. However, if a dead tree suddenly becomes alive it must be checked, like if SIC changes from 132 to 111.
When all errors have been corrected, output of growth, mortality, and ingrowth can be produced using the different growth programmes.

ITGROWTH.FOR :

This programme is used to calculate the mean annual diameter increment between two enumerations of the same permanent sample pl(the base-year and the growth-year. The options and the layout are similar to the ITTABSTD programme. In addition to the diameter growth, the mean annual mortality percent is calculated based on tl number of trees that has died since the previous enumeration selec1 as base-year. It is possible to select two different mortality rat€ commercial, and biological.
The commercial mortality include, in the mortality figure, all tre€ that change SIC, like broken, and fallen trees, even if the trees ɛ still alive. In most cases these trees, where the crown is broken (even if they survive, will develop hart rot and, from a commercial point of view, they have no value.

The biological mortality only include trees that are actually dead that are not to be found and therefore considered dead. Trees that are broken or fallen, but still alive are considered living.

Input : A main data file, trees only, as baseyear.
: A subsequent enumeration of the same plot as growt year
: A species list f.ex. SPECIES.DAT, or a special species list when output per species is requested.
: The file containing the forest location names : FORRESV.DAT.
: The file containing the treatments : TABTREA.DAT
: The file ??DATES.DAT containing decimal date of enumeration.
: The command file FCOMWQS.DAT if needed.

Commands :

COMMANDS FROM KEYBOARD = 5
OR FROM FILE FCOMGRO.DAT = 4

Select as appropriate, for producing several tables the same layout, it saves time to use the file FCOMGRO.DAT to contain the commands, use a text edit to update.

GIVE FILENAME FOR BASE YEAR: EX. PITMT01.901

After giving the filename for the base-year the yea1 of the subsequent enumeration of the same plot for which the growth need to be calculated is requested (only the year like '93' is given)

GIVE GROWTH YEAR: EX. 92

The indexfile to the growth year is then read, if th file does not exist an error message occurs. Run ITINDEX to create the index file to growth year.

Then give the decimal date for baseyear and growth year, the decimal dates are kept in the file ??DATES.DAT in the same directory as the datafile where ?? stands for the two first letters of the datafile name: f.ex. SLTMT01.921, the Sungei Lalang plot, the dates are kept and updated in SLDATES.DAT

The following conversation is similar to ITTABSTD and is just repeated here as a reminder without comments.

```
'    MAX. NO. OF BLOCKS (BLCK)  = 4'
'  FOREST CLASS (FCL)           =10'
'  STEM IDENTITY CLASS (SIC)    =10'
'  FOR MEAN/SUMMARY OF ALL CLASSES ANSWER : 0'
'  GIVE THE NUMBER OF BLCK"S, FCL"S, SIC"S'
'  Fx. 0,0,1 :'

' GIVE THE BLOCK NUMBERS, Fx. 4,10'

'  GIVE THE FOREST CLASS CODES (MAX = 10)'

'  GIVE THE STEM IDENTITY CODES (MAX=10)'

'  GIVE THE LOWEST DIAMETER CLASS, AND CLASS INTERVAL (IN MM.)'
```

The growth and mortality can be tabulated for all species or for a subset of the species as required.

```
' ANY SPECIES CHECK REQUIRED ?'
' (NO CHECK = 0, SPECIES.DAT = 1, OTHER LIST = 2)'
```

If no species list is given the tables will be by wood Quality Group, and the page option can be used.

If a species check is required using another species list, give the species list filename.

```
' GIVE SPECIES LIST FILENAME :'
```

Select vernacular or scientific names for output :

```
' LOCAL NAME = 1, SCIENTIFIC NAME =2'

' CHOOSE TWO OF THE FOLLOWING - HORIZONTAL AND PAGE VARIABLE'
    LOG QUALITY          = 1
    CROP TREE STATUS     = 2
    CROWN FORM           = 3
    CROWN DOMINANCE      = 4
    STEM DAMAGE          = 5
    CROWN DAMAGE         = 6
    EFFECT OF CLIMBERS = 7
    WOOD QUALITY (WQG) = 8
    NO PAGE VARIABLE     = 9
```

If the output is requested by species only one Wood Quality Group can be requested per run due to array size limitations.

```
' OUTPUT IS PER SPECIES, WOOD QUALITY BY PAGE NOT POSSIBLE'

' GIVE THE NO OF CLASSES FOR EACH VARIABLE SELECTED'

' GIVE THE CODES FOR HORIZONTAL VARIABLE'

' GIVE THE CODES FOR PAGE VARIABLE'
```

As a check for unlikely growth rates, maximum and minimum annual growth rates are given. Trees are listed when the mean annual increment falls outside the range.

```
' GIVE MAX. AND MIN. GROWTH PER YEAR IN MM.'
```

normally 50,-10 mm should be OK.

```
' TABLES FOR COMMERCIAL MORTALITY = 1',
'     OR FOR BIOLOGICAL MORTALITY = 2 :'
```

answer as requested.

```
'      TABLES FOR DIAMETER INCREMENT = 1'
' OR TABLES FOR BASAL AREA INCREMENT = 2 :'
```

In one run either diameter increment or basal area increment is produced.

The list of trees excluded should be listed on the lineprinter for checking the first time a new set of files are used, later it is OK to have the error file listed on the screen.

```
' EDIT LIST ON PRINTER : LP = 2'
' OR ON SCREEN         : LP = 6 :'
```

The processing then continues, and the growth table is printed.

ITGRORAT.FOR :

It is often of interest to tabulate the number of trees and the size class distribution by growth rate. Of particular interest is the proportion of trees that shows no or very slow growth rates (Quiescence).
The program tabulates diameter increments by growth rate. There are 10 growth rates : (Mean annual increment per year in millimeters.)

```
     < 0
     = 0
   0 < 2
   2 < 4
   4 < 6
   6 < 8
   8 < 10
  10 < 12
  12 <
```

The programme conversation is similar to that of ITGROWTH.
However, the growth rates always take the rows. The horizontal variable is converted to a selection variable, ie. the table will be a summary of the codes specified. The individual page by page output is possible for all variables including by species. But be aware that, by selecting species as page variable, the output can be very lengthy although only one Wood Quality Group is allowed per run.

```
CHOOSE TWO OF THE FOLLOWING - SELECTION AND PAGE VARIABLE'
    LOG QUALITY          = 1
    CROP TREE STATUS     = 2
    CROWN FORM           = 3
    CROWN DOMINANCE      = 4
    STEM DAMAGE          = 5
    CROWN DAMAGE         = 6
    EFFECT OF CLIMBERS   = 7
    WOOD QUALITY (WQG)   = 8
    NO SELECTION VAR     = 9
    NO PAGE VARIABLE     = 10
```

The rest of the conversation is similar to that of ITGROWTH.

ITINGROW.FOR :

This programme is used to tabulate ingrowth. Ingrowth is defined as trees that are found above the minimum diameter in baseyear, but below that diameter or not found in a previous enumeration (ingrowt year).
NOTE : the base-year is a later enumeration and the ingrowth-year i a previous enumeration, ie. the opposite of ITGROWTH and ITGRORAT. Otherwise the conversation is similar to that of ITGROWTH.

The minimum diameter is the diameter limit over which ingrowth is defined. The diameter class interval should be set quite narrow, 20 or 10 mm, to follow closely how the new recruits develop over the diameter classes.

When the minimum diameter is selected below 15 cm DBHob only the 9 central quadrats in each block, where trees are measured above 5 cm are included to avoid definition problems.

ITSELECT.FOR :

This programme prepares the data from the permanent research plots a form that can be read by statistical analysis programme packages and other commercial software.
This programme is useful, as the other programmes only tabulates th data without giving any statistical information.

The output is a blank (' ') separated, fixed format datafile in ASCII.

The programme will combine data from up to five enumerations of the same permanent sample plot. The variables to be included are select through interactive communication in a similar way as for the ITGROWTH programme. A documentation of which variables were selecte and included in the ASCII file is printed out for reference.

It is advisable to plan carefully the type of analysis to be conducted and to reduce the number of variables to be included in order to keep the output file to a manageable size.

Commands :

GIVE FILENAME FOR BASE YEAR: EX.SLTMT01.921

> The baseyear is the first year of the growth period be analyzed.

NUMBER OF YEARS TO BE INCLUDED
MIN.: 1, MAX.: 4 LATER ENUMERATIONS

> Give how many years (files) to use for the output.

```
GIVE ENUMERATION YEAR(S), (NOT BASEYEAR)
EX. 93,94 :
```

The years can be given in any sequence, they are sorted internally.

The decimal dates are needed for the printed documentation, they are not part of the output ASCII file. They are taken from the file --DATES.DAT where -- are the two first letters identifying the area like SL = Sungei Lalang.

In order to limit the output it is possible to exclude trees that die or cannot be found in a later enumeration.

```
EXCLUDE BIOLOGICALLY DEAD TREES
AND TREES NOT FOUND FROM THE OUTPUT LIST = 1
                       INCLUDE ALL TREES = 2
```

The following selection procedure follow closely the standard and is not repeated here, see ITGROWTH. No selection means that everything is included.

```
'    MAX. NO. OF BLOCKS (BLCK) = 4'
'  FOREST CLASS (FCL)          =10'
'  STEM IDENTITY CLASS (SIC)   =10'
'  NO SELECTION FOR CLASS ANSWER: 0'
'  GIVE THE NUMBER OF BLCK,FCL,SIC'
'  Fx. 0,4,1 :'
```

The minimum and maximum diameter define the diameter range of the trees in the baseyear that are written to the output file. Trees having diameters (DBHob) outside the range given are not included : (Giving a large maximum diameter means that there is in fact no upper limit i.e. all sizes included.)

```
GIVE THE MINIMUM AND MAXIMUM DIAMETER (IN MM.)
Ex: 200,4000  OR  50,150 :
```

As the statistical analysis will often be done at species level it is possible to create a small file containing only the species codes needed, no local or scientific name is required, only the 5 digit Wood Quality Group, Family, and Genera code number.

```
SELECTION OF CERTAIN SPECIES
FROM A SPECIAL FILE          = 1
ALL OR NO SPECIES SELECTION = 0
```

The actual variables to be written to the output file is then requested, first for the baseyear, then for the growth years.

The variables for the growth years need not be the same as for the baseyear, but the variables will be the same for all growth years if more than one growt year is selected.

GIVE VARIABLES FOR STATISTICAL OUTPUT FOR BASEYEAR
EXCLUDE = 0 , INCLUDE = 1 :

FOREST CLASS
TRMT
BLOCK
STEM IDENTITY CLASS
WOOD QUALITY GROUP
FAMILY
GENERA
DIAMETER DBHob
COMMERCIAL HEIGHT
LOG QUALITY
CROP TREE STATUS
CROWN FORM
CROWN DOMINANCE
STEM DAMAGE
CROWN DAMAGE
WINES/ CLIMBERS

For the growth years, TRMT, BLOCK, WQG., FAMILY, and GENERA cannot be selected for output.

GIVE VARIABLES FOR STATISTICAL OUTPUT FOR GROWTH YEARS
EXCLUDE = 0 , INCLUDE = 1 :

FOREST CLASS
STEM IDENTITY CLASS
DIAMETER DBHob
COMMERCIAL HEIGHT
LOG QUALITY
CROP TREE STATUS
CROWN FORM
CROWN DOMINANCE
STEM DAMAGE
CROWN DAMAGE
WINES/ CLIMBERS

As it is easy to make errors in the selection it is possible to do the selection all over again :

DO YOU WISH TO MAKE CHANGES = 1, ACCEPT = 2

Finally the filename for the output file is requeste select a meaningful name, a filename that already exist cannot be used.

GIVE FILENAME FOR OUTPUT Ex : STATTxx.DAT

The output file is then assembled, and a report printed giving information as to what the output file contains.

3.7 The Wood Quality Groups (for output)

In Appendix I, examples are given of the various types of printed output produced by the programmes. In the examples, reference is often given to Group 1, Group 2, ect. The Groups referred to are the Wood Quality Groups. All species are grouped into 8 Wood Quality Groups mainly according to the marketability of the timber.

The Wood Quality Groups (WQG) are :

1) Dipterocarps of the Meranti group

2) Dipterocarps, Non-Meranti

Non-Dipterocarps :

3) Fully marketable, light hard woods (LHW)

4) " - " - , medium hard woods (MHW)

5) " - " - , heavy hard woods (HHW)

6) Other woods, partially marketable

7) Other woods, non-commercial and unidentified

8) Light demanding pioneer species

4. Support Data Files

The listings are contained in Appendix II.

FDAFCL.DAT :

Contain the Forest Class Codes and the descriptions.

ITSICTXT.DAT :

Contain the Stem Identity Class codes and the descriptions for trees/poles.

ITSICTX2.DAT :

Same as above for saplings, seedlings and wildlings.

SPECIES.DAT :

Contain the Wood Quality Group/Botanical code number and vernacular names used for data processing for the ITTO Study in Peninsular Malaysia.

FCOM???.DAT :

File containing the commands needed to run a tables programme, saves time and errors the same type of output is needed from several data files.

FORRESV.DAT :

File contains the list of locality names, forest reserves, wher(the plots are located.

TABTREA.DAT :

File contains the list of treatments applied in the different experimental plots.

??DATES.DAT :

File contains the decimal dates for the enumeration of the experimental plots. In some cases the year of the filename may not correspond to the year of the enumeration, when the enumeration was extended over the new year. F.ex. PITMT01.901 has the decimal date of 91.08.

ITSPSUM.DAT :

File containing the list of filenames and the associated enumerated area in hectares for use by the ITSPSUM programme.

5. Standtable Projection Simulation Model

STANDPRO.FOR :

The Standtable Projection Simulation Model is used to project a stand into the future in order to estimate the development of the forest and the likely production.

The projections will form part of the Methodology for the Management Site Productivity Classification.
The present version of the Model is fully documented complete with instructions on how to run the programme in :

Korsgaard, S, 1988 : "A Manual for the Standtable Projection Simulation Model", Danish Land Development Service, Viborg, first edition 1984, revised 1988, 75pp.

A copy of the manual is with the Forestry Department H.Q. in Kuala Lumpur.

The projection model will be updated in 1993 and will incorporate some of the suggestions made by the consultants from CTFT in France in their consultancy report (CTFT, "Report on Consultancy", Project PNUD/FAO/MAL/89/001, Forest Inventory and Management System, Malaysia - 1 to 13 April 1992).

A sample data input file is provided :

SLT0192.DAT

Contain a sample input-file to test the operation of the projection model STANDPRO above from a forest harvested down to 30 cm under the ITTO research prescriptions.

Appendix I : Examples of printed output

I.1 ITCHRAW : Part of listing raw datafile information from fieldcard version no. 1.

```
PROGRAM ITCHRAW. LISTING OF QUADRATS IN RAW DATAFILES FOR CHECKING, FILE = KSBLK07.9

 YEAR MONTH  CMPT  TRMT  BLCK  QUAD
HAPPY NEW YEAR !
    91    12   194     1     7     1
NUMBER OF TREES : 15
QUAD NO.   2 HAS QUADRAT NUMBER :  2
    91    12   194     1     7     2
NUMBER OF TREES : 11
QUAD NO.   3 HAS QUADRAT NUMBER :  3
    91    12   194     1     7     3
NUMBER OF TREES : 10
QUAD NO.   4 HAS QUADRAT NUMBER :  4
    91    12   194     1     7     4
NUMBER OF TREES :  8
QUAD NO.   5 HAS QUADRAT NUMBER :  5
    91    12   194     1     7     5
NUMBER OF TREES : 14
QUAD NO.   6 HAS QUADRAT NUMBER :  6
    91    12   194     1     7     6
NUMBER OF TREES : 10
QUAD NO.   7 HAS QUADRAT NUMBER :  7
    91    12   194     1     7     7
NUMBER OF TREES : 29
QUAD NO.   8 HAS QUADRAT NUMBER : 28
    91    12   194     1     7    28
NUMBER OF TREES : 20
QUAD NO.   9 HAS QUADRAT NUMBER : 37
    91    12   194     1     7    37
NUMBER OF TREES :  6
QUAD NO.  10 HAS QUADRAT NUMBER :  8
    91    12   194     1     7     8
NUMBER OF TREES : 31
QUAD NO.  11 HAS QUADRAT NUMBER : 27
    91    12   194     1     7    27
NUMBER OF TREES : 15
QUAD NO.  12 HAS QUADRAT NUMBER : 36
    91    12   194     1     7    36
NUMBER OF TREES :  5
QUAD NO.  13 HAS QUADRAT NUMBER :  9
    91    12   194     1     7     9
```

Misplaced quadrats

I.2 ITSPLIT : Part of listing information from splitting raw data file from fieldcard version no. 1.

```
PROGRAM ITSPLIT,  ITTO/MALAYSIA JOINT PROJECT
DATE : 19/ 7/1993

INPUT FILE : SGL0193.DAT

 --- TREE QUADRATS ---
QUADRAT NUMBER : 01 NUMBER OF RECORDS :  9
QUADRAT NUMBER : 02 NUMBER OF RECORDS :  9
QUADRAT NUMBER : 03 NUMBER OF RECORDS :  7
QUADRAT NUMBER : 05 NUMBER OF RECORDS :  8
QUADRAT NUMBER : 06 NUMBER OF RECORDS :  5
9301100600050PLT:201 Q:07 TRNO:014 4440 SPECIES CODE NOT FOUND!
QUADRAT NUMBER : 07 NUMBER OF RECORDS : 15
QUADRAT NUMBER : 08 NUMBER OF RECORDS : 21
QUADRAT NUMBER : 09 NUMBER OF RECORDS : 43
QUADRAT NUMBER : 10 NUMBER OF RECORDS : 10
QUADRAT NUMBER : 11 NUMBER OF RECORDS :  4
QUADRAT NUMBER : 12 NUMBER OF RECORDS : 28
QUADRAT NUMBER : 13 NUMBER OF RECORDS : 30
9301100600050PLT:201 Q:14 TRNO:030 0000 SPECIES CODE NOT FOUND!
QUADRAT NUMBER : 14 NUMBER OF RECORDS : 46
QUADRAT NUMBER : 15 NUMBER OF RECORDS :  9
QUADRAT NUMBER : 16 NUMBER OF RECORDS :  5
QUADRAT NUMBER : 17 NUMBER OF RECORDS : 39
QUADRAT NUMBER : 18 NUMBER OF RECORDS : 33
QUADRAT NUMBER : 19 NUMBER OF RECORDS : 43
QUADRAT NUMBER : 20 NUMBER OF RECORDS :  7
QUADRAT NUMBER : 21 NUMBER OF RECORDS : 10
QUADRAT NUMBER : 22 NUMBER OF RECORDS :  7
QUADRAT NUMBER : 23 NUMBER OF RECORDS : 12
QUADRAT NUMBER : 24 NUMBER OF RECORDS : 10
QUADRAT NUMBER : 25 NUMBER OF RECORDS : 12
  422 TREE-RECORDS WRITTEN TO FILE : SGL0193.931

 --- SAPLING QUADRATS ---
QUADRAT NUMBER : 26 NUMBER OF RECORDS : 11
QUADRAT NUMBER : 27 NUMBER OF RECORDS :  6
QUADRAT NUMBER : 28 NUMBER OF RECORDS :  2
9301100600050PLT:201 Q:29 TRNO:018 0219 SPECIES CODE NOT FOUND!
QUADRAT NUMBER : 29 NUMBER OF RECORDS : 18
QUADRAT NUMBER : 30 NUMBER OF RECORDS :  7
QUADRAT NUMBER : 31 NUMBER OF RECORDS :  7
```

I.3 ITLIST : Part of a main datafile.

```
PROGRAM FDLIST               DATE : 20/07/1993
LISTING OF TSTMT06.911        PAGE :  1

00001   100006010010011117350101980110
00002   100006010010021113320103870210
00003   100006010010031113600105820220
00004   100006010010041117868501860120
00005   100006010010051116560101710120
00006   100006010010061117350101550120
00007   100006010010071115021601520120
00008   100006010020011116420105240110
00009   100006010020021113320101760110
00010   100006010020031116500102310110
00011   100006010020041342120110050000
00012   100006010020051115021604340210
00013   100006010020051116480103220120
00014   100006010020061116480103220120
00015   100006010020071112140105140210
```

I.4.1 ITLSFILE : Part of a main datafile.

```
PROGRAM ITLSFILE. JOINT ITTO/MALAYSIA PROJECT                    PAGE :    1

                                        *** LISTING OF TREES/POLES ***
FILENAME = LETMT06.911 DATE : 20-07-1993

REC=RECNO, S=STOCKED, FCL=FOREST CLASS, T=TRMT, B=BLOCK, Q=QUADRAT,
TN=TREE NO, SIC=STEM IDENT.CLASS WQS=WQ/SPEC., DBH=DIAM. BREAST HT.(MM), STH=STEM HGT(M)
LG=LOGGRADE, STA=STATUS, CFD=CROWN FORM & DOM., DAM=LOG & CROWN DAMAGE, CL=CLIMBERS.

           10          20                                       30               40
12345 6 789 01 23 456 789 012 34567                           8901  23  4   5  67  89 0
  REC S FCL  T  B   Q  TN SIC  WQS          SPECIES            DBH STH LG STA CFD DAM W

 QUADRAT NUMBER :   1
    1 1   0  6  1   1   1 111 73501 Kelat                       198   1  1   0  00  12 0
    2 1   0  6  1   1   2 111 33201 Kedondong                   387   2  1   0  00  12 0
    3 1   0  6  1   1   3 111 36001 Pelong                      582   2  2   0  00  22 0
    4 1   0  6  1   1   4 111 78685 Tempinis                    186   1  2   0  00  12 0
    5 1   0  6  1   1   5 111 65601 Merpauh                     171   1  2   0  00  22 0
    6 1   0  6  1   1   6 111 73501 Kelat                       155   1  2   0  00  22 0
    7 1   0  6  1   1   7 111 50216 Meranti melantai            152   1  2   0  00  22 0

 QUADRAT NUMBER :   2
    8 1   0  6  1   2   1 111 64201 Kulim                       524   1  1   0  00  22 0
    9 1   0  6  1   2   2 111 33201 Kedondong                   176   1  1   0  00  11 0
   10 1   0  6  1   2   3 111 65001 Mempening                   231   1  1   0  00  11 0
   11 1   0  6  1   2   4 134 21201 Chengal                    1005   0  0   0  00  00 0
   12 1   0  6  1   2   5 111 50216 Meranti melantai            434   2  1   0  00  21 0
   13 1   0  6  1   2   5 111 64801 Medang, M. pepijat          322   1  2   0  00  22 0
   14 1   0  6  1   2   6 111 64801 Medang, M. pepijat          322   1  2   0  00  22 0
   15 1   0  6  1   2   7 111 21401 Resak                       514   2  1   0  00  22 0
   16 1   0  6  1   2   8 111 64201 Kulim                       251   1  2   0  00  33 0
   17 1   0  6  1   2   9 111 79999 Lain-lain                   333   1  3   0  00  22 0
   18 1   0  6  1   2  10 111 73501 Kelat                       575   2  1   0  00  22 0

 QUADRAT NUMBER :   3
   19 1   0  6  1   3   1 111 66201 Penarahan                   256   2  1   0  00  12 0
   20 1   0  6  1   3   2 111 73501 Kelat                       264   1  1   0  00  22 0
   21 1   0  6  1   3   3 111 78685 Tempinis                    205   1  2   0  00  23 0
   22 1   0  6  1   3   4 111 81501 Ara, A. kelepong            176   1  2   0  00  22 0
   23 1   0  6  1   3   5 111 65401 Merbatu                     289   1  2   0  00  22 0
   24 1   0  6  1   3   6 111 78685 Tempinis                    166   1  2   0  00  22 0
   25 1   0  6  1   3   7 111 65401 Merbatu                     207   1  1   0  00  22 0
```

I.4.2 ITLSFILE : Part of a Quadrat information file fr the old fieldcard version no.1.

PROGRAM IFLSFILE. JOINT ITTO/MALAYSIA PROJECT PAGE : 1

*** LISTING OF QUADRATS "LOGGING IN VIRGIN FOREST" ***

FILENAME = LES0191.91Q DATE : 20-07-1993

YR=YEAR, MH=MONTH, ST=STATE, DI=DISTRICT, FR= FOREST RESERVE, CPT=COMPARTMENT, T=TREATMENT, BL=BLOCK, SL=SLOPE %, P=POSITION, A=ASPECT, SS=SOIL SURFACE, E=EROSION, H=ALTITUDE, FT=FOREST TYPE, ST=SOIL TYP D=LOGGIN DEBRIS, RA=RATTAN, BB=BAMBOO, PB=BERTAM, PM=OTHER PALMS, F=FERN, G=GINGER, BA=BANANAS.

BLOCK NUMBER : 1

					10				20							30					40				
12	34	56	78	90	123	4	56	78	901	2	3	45	6	7	89	01	23	4	56	78	90	12	3	4	5
YR	MH	ST	DI	FR	CPT	T	BL	QU	SL%	P	A	SS	E	H	FT	ST	GO	D	RA	BB	PB	PM	F	G	BA
TREE/POLE QUADRATS (20*20 M)																									
91	10	6	9	0	171	6	1	1	10	3	8	0	0	0	0	0	0	0	4	0	2	4	0	0	0
91	10	6	9	0	171	6	1	2	20	3	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	3	15	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	4	13	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	5	40	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	6	15	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	7	25	2	7	6	1	2	0	0	0	3	0	0	0	0	0	1	0
91	10	6	9	0	171	6	1	8	12	2	6	6	1	2	0	0	0	3	0	0	0	0	0	1	0
91	10	6	9	0	171	6	1	9	10	3	2	6	1	2	0	0	0	4	0	0	0	0	0	1	0
91	10	6	9	0	171	6	1	10	10	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	11	15	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	12	15	4	1	6	1	2	0	0	0	3	2	0	0	0	0	0	0
91	10	6	9	0	171	6	1	13	10	2	6	6	1	0	0	0	0	3	3	0	0	0	0	0	0
91	10	6	9	0	171	6	1	14	10	3	6	6	1	2	0	0	0	1	0	0	0	4	0	1	0
91	10	6	9	0	171	6	1	15	13	4	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	16	15	4	6	0	0	0	0	0	0	0	0	0	0	0	0	4	0
91	10	6	9	0	171	6	1	17	25	1	7	6	1	2	0	0	0	1	1	0	0	0	0	1	0
91	10	6	9	0	171	6	1	18	20	4	1	6	1	2	0	0	0	3	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	19	54	2	0	6	1	2	0	0	0	3	1	0	0	0	0	1	1
91	10	6	9	0	171	6	1	20	154	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
91	10	6	9	0	171	6	1	21	17	5	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0
91	10	6	9	0	171	6	1	22	18	1	2	0	0	0	0	0	0	0	3	0	0	2	0	0	0
91	10	6	9	0	171	6	1	23	40	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	24	7	1	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	25	10	2	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0
SAPLING QUADRATS (5*5 M)																									
91	10	6	9	0	171	6	1	26	15	3	8	6	1	2	0	0	0	1	0	0	0	0	0	0	0
91	10	6	9	0	171	6	1	27	7	2	6	6	1	2	0	0	0	1	0	0	0	0	0	1	0

I.5 ITLSBLCK : A treatment, block, no. of Quadrat's list.

PROGRAM ITLSBLCK

DATE : 20/ 7/1993

THIS PROGRAM TABULATES THE NUMBER OF QUADRATS
FOR EACH BLOCK PER TREATMENT
CHECK CAREFULLY FOR ANY MISSING QUADRATS OR OTHER ERRORS IN THE FILE.

LISTING OF NUMBER OF QUADRATS PER BLOCK IN FILE : LETMT06.911

	TREATMENT	BLOCK	NUMBER OF QUADRATS
	06	01	25
	06	20	25
	06	25	25
	06	28	25
TOTAL :		4	100

I.6 ITQUCHCK : Part of a clean Quadrat list.

```
                                                              DATE :  20/07/1993
PROGRAM ITQUCHCK
ITTO/MALAYSIA JOINT PROJECT *** QUADRATS CHECK *** FOR  LETMT06.90
```

TREAT	BLOK	QDR	FCL	TREES/Q	START-L	Q-CNT	TRNO-ERR	FCL/STK-ER
06	01	001	000	4	1	1	0	0
06	01	002	000	10	5	2	0	0
06	01	003	000	7	15	3	0	0
06	01	004	000	15	22	4	0	0
06	01	005	000	12	37	5	0	0
06	01	006	000	16	49	6	0	0
06	01	007	000	35	65	7	0	0
06	01	008	000	15	100	8	0	0
06	01	009	000	20	115	9	0	0
06	01	010	000	6	135	10	0	0
06	01	011	000	6	141	11	0	0
06	01	012	000	43	147	12	0	0
06	01	013	000	39	190	13	0	0
06	01	014	000	21	229	14	0	0
06	01	015	000	14	250	15	0	0
06	01	016	000	12	264	16	0	0
06	01	017	000	18	276	17	0	0
06	01	018	000	55	294	18	0	0
06	01	019	000	30	349	19	0	0
06	01	020	000	7	379	20	0	0
06	01	021	000	10	386	21	0	0
06	01	022	000	12	396	22	0	0
06	01	023	000	4	408	23	0	0
06	01	024	000	4	412	24	0	0
06	01	025	000	13	416	25	0	0
06	20	001	000	11	429	26	0	0
06	20	002	000	10	440	27	0	0
06	20	003	000	10	450	28	0	0
06	20	004	000	3	460	29	0	0
06	20	005	000	1	463	30	0	0
06	20	006	000	3	464	31	0	0
06	20	007	000	29	467	32	0	0
06	20	008	000	25	496	33	0	0
06	20	009	000	34	521	34	0	0
06	20	010	000	11	555	35	0	0
06	20	011	000	5	566	36	0	0
06	20	012	000	29	571	37	0	0

I.7 ITEDIT : An edit list.

```
EDIT OF FILE : LETMT06.901           DATE : 20/ 7/1993
     S                       W                L T C C S C W
 LINO T FCL TM BL QNO NOS SIC Q BOT   DBH  HG G S F I D D C

   17 1 000  6/ 1/  3   3 111 78685  196   0 0 0 0 0 0 0 0 CHECK NUMBER OF LOGS
   17 1 000  6/ 1/  3   3 111 78685  196   0 0 0 0 0 0 0 0 CHECK LOG QUALITY
   17 1 000  6/ 1/  3   3 111 78685  196   0 0 0 0 0 0 0 0 ILLEGAL STEM DAMAGE
   17 1 000  6/ 1/  3   3 111 78685  196   0 0 0 0 0 0 0 0 ILLEGAL CROWN DAMAGE
   31 1 000  6/ 1/  4  10 111 78685  210   1 2 0 0 0 2 0 0 ILLEGAL CROWN DAMAGE
   46 1 000  6/ 1/  5  10 111 78685  165   0 2 0 0 0 0 2 0 CHECK NUMBER OF LOGS
   46 1 000  6/ 1/  5  10 111 78685  165   0 2 0 0 0 0 2 0 ILLEGAL STEM DAMAGE
   60 1 000  6/ 1/  6  12 111 79999  196   0 0 0 0 0 0 0 0 CHECK NUMBER OF LOGS
   60 1 000  6/ 1/  6  12 111 79999  196   0 0 0 0 0 0 0 0 CHECK LOG QUALITY
   60 1 000  6/ 1/  6  12 111 79999  196   0 0 0 0 0 0 0 0 ILLEGAL STEM DAMAGE
   60 1 000  6/ 1/  6  12 111 79999  196   0 0 0 0 0 0 0 0 ILLEGAL CROWN DAMAGE
   63 1 000  6/ 1/  6  15 111 78685  235   0 0 0 0 0 0 0 0 CHECK NUMBER OF LOGS
   63 1 000  6/ 1/  6  15 111 78685  235   0 0 0 0 0 0 0 0 CHECK LOG QUALITY
   63 1 000  6/ 1/  6  15 111 78685  235   0 0 0 0 0 0 0 0 ILLEGAL STEM DAMAGE
   63 1 000  6/ 1/  6  15 111 78685  235   0 0 0 0 0 0 0 0 ILLEGAL CROWN DAMAGE
   66 1 000  6/ 1/  7   2 111 33201  350   0 0 0 0 0 0 0 0 CHECK NUMBER OF LOGS
   66 1 000  6/ 1/  7   2 111 33201  350   0 0 0 0 0 0 0 0 CHECK LOG QUALITY
```

I.8 ITFCL : Part of a list of Forest Classes.
(Not yet included)

I.9 ITSIC : A list of Stem Identity Classes.

PROGRAM ITSIC
DATE OF PRODUCTION : 20/07/1993

SUMMARY OF STEM IDENTITY CLASSES FROM FILE : LETMT06.911

	SIC CODE	NO. OF STEMS	PERCENT	
	000	5	--	(EMPTY QUADRATS)
	111	1408	88.1	TREE ALIVE- STANDING- COMPLETE TRUNK
	131	147	9.2	TREE DEAD- STANDING- COMPLETE TRUNK
	134	44	2.8	CUT STUMP- STANDING- DEAD
TOTAL :	4	1599	100.1	

I.10 ITTABSTD : A stand table, number of trees/poles and basal area.

ROGRAM ITTABSTD **** S T A N D T A B L E ****
DATE : 20/07/1993

ORESTRY DEPARTMENT H.Q. /ITTO, KUALA LUMPUR

.TMT02.921 ENUMERATED: 1992, SUNGEI LALANG F.R., SELANGOR TRMT. 02 : CUT ALL > = 45 CM
BLOCK = ALL BLOCKS
'OREST CLASS = ALL CLASSES
ITEM IDENTITY CLASS = 111

*+ T A B L E 1 *+

SPECIES LIST : NO CHECKS MADE
PAGE VARIABLE NOT USED NO. OF QUADRATS : 100, AREA : 4.00 HA.

MEAN NUMBER OF TREES PER HECTARE
DIAMETER CLASSES IN CENTIMETRES

	5.0 -9.9	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 +	TOTAL	PER-CENT
WOOD QUALITY													
GROUP 1	6.25	4.17	1.00	.50	1.50	1.00	1.25	.50				16.17	2.44
GROUP 2	4.17	4.17	2.25	.50	.50	.50	1.00	.25				13.33	2.01
GROUP 3	48.61	25.69	11.50	8.50	5.75	5.25	2.50	1.00	.25			109.06	16.44
GROUP 4	2.78	2.78	3.50	.75	1.00	1.50	.50	1.00				13.81	2.08
GROUP 5	2.78	.69	.25	.25	.50	.25		.25				4.97	.75
GROUP 6	95.83	42.36	20.75	13.50	6.25	9.00	3.75	4.25	.25	.25		196.19	29.57
GROUP 7	154.86	56.25	24.75	22.00	16.00	8.25	6.00	4.00	.50			292.61	44.10
GROUP 8	10.42	4.17	1.50	.25	.25		.50	.25				17.33	2.61
TOTAL PER HA.	325.70	140.28	65.50	46.25	31.75	25.75	15.50	11.50	1.00	.25		663.48	100.00
PER CENT	49.09	21.14	9.87	6.97	4.79	3.88	2.34	1.73	.15	.04		100.00	
TOTAL ALL PLOTS	469.	202.	262.	185.	127.	103.	62.	46.	4.	1.	0.	1461.	

*+

PROGRAM ITTABSTD **** S T A N D T A B L E ****
DATE : 20/07/1993

FORESTRY DEPARTMENT H.Q. /ITTO, KUALA LUMPUR

SLTMT02.921 ENUMERATED: 1992, SUNGEI LALANG F.R., SELANGOR TRMT. 02 : CUT ALL > = 45 CM
BLOCK = ALL BLOCKS
FOREST CLASS = ALL CLASSES
STEM IDENTITY CLASS = 111

*+ T A B L E 2 *+*

SPECIES LIST : NO CHECKS MADE
PAGE VARIABLE NOT USED NO. OF QUADRATS : 100, AREA : 4.00 HA.

MEAN BASAL AREA PER HECTARE (SQUARE METRES)
DIAMETER CLASSES IN CENTIMETRES

	5.0 -9.9	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 +	TOTAL	PER-CENT
WOOD QUALITY													
GROUP 1	.03	.04	.02	.02	.09	.08	.14	.07				.50	3.63
GROUP 2	.02	.06	.05	.02	.03	.04	.11	.04				.37	2.66
GROUP 3	.21	.28	.27	.32	.33	.42	.27	.13	.04			2.27	16.57
GROUP 4	.02	.03	.08	.03	.06	.13	.05	.14				.54	3.97
GROUP 5	.01	.01	.01	.01	.03	.02		.03				.12	.84
GROUP 6	.39	.50	.47	.53	.36	.73	.40	.59	.05	.05		4.07	29.66
GROUP 7	.62	.67	.58	.86	.94	.68	.64	.54	.09			5.61	40.95
GROUP 8	.04	.04	.03	.01	.02		.06	.03				.24	1.72
TOTAL PER HA.	1.33	1.64	1.51	1.80	1.84	2.11	1.68	1.57	.17	.05		13.71	100.00
PER CENT	9.69	11.97	11.04	13.13	13.44	15.38	12.25	11.48	1.27	.36		100.00	

*+

I.11 ITTABSTD : A stand table, volume.

OGRAM ITTABSTD **** S T A N D T A B L E ****
DATE : 20/07/1993

RESTRY DEPARTMENT H.Q. /ITTO, KUALA LUMPUR

TMT02.921 ENUMERATED: 1992, SUNGEI LALANG F.R., SELANGOR TRMT. 02 : CUT ALL > = 45 CM
LOCK = ALL BLOCKS
)REST CLASS = ALL CLASSES
TEM IDENTITY CLASS = 111

*+ T A B L E 2 *+

SPECIES LIST : NO CHECKS MADE
'AGE VARIABLE NOT USED NO. OF QUADRATS : 100, AREA : 4.00 HA.

MEAN VOLUME PER HECTARE (CUBIC METRES)
DIAMETER CLASSES IN CENTIMETRES

	5.0 -9.9	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 +	TOTAL	PER-CENT
WOOD QUALITY													
GROUP 1	.08	.17	.13	.13	.86	.72	1.26	.58				3.91	14.17
GROUP 2	.06	.25	.42	.29	.20	.36	.92	.44				2.93	10.62
GROUP 3	.52	1.09	1.64	2.23	2.35	3.85	2.58	1.14	.35			15.75	57.03
GROUP 4	.05	.33	.46	.19	.54	1.00	.47	1.15				4.20	15.18
GROUP 5	.02	.04	.03	.06	.20	.19		.28				.83	3.00
TOTAL PER HA.	.72	1.89	2.68	2.90	4.16	6.11	5.22	3.59	.35			27.63	100.00
PER CENT	2.61	6.83	9.69	10.51	15.04	22.12	18.90	13.01	1.28			100.00	

. FUNCT. BASED ON DIAMETER AND NO. OF LOGS
*+

I.12 ITTABWQS : Part of a stand table by species.

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PROGRAM ITTABWQS                                  **** S T A N D T A B L E ****
JOINT ITTO/MALAYSIA PROJECT                            DATE : 20/07/1993

SLTMT02.971  ENUMERATED: 1992, SUNGEI LALANG F.R., SELANGOR          TRMT. 02 : CUT ALL > = 45 CM
 BLOCK       = ALL BLOCKS
 FOREST CLASS           = ALL CLASSES
 STEM IDENTITY CLASS    = 111
      *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+ WOOD QUALITY GROUP :   1   *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*
  SPECIES LIST          : CHECK ON SPECIES.
  N' SELECTION                                  NO. OF QUADRATS : 100,  AREA :  4.00 HA.
```

MEAN NUMBER OF TREES PER HECTARE
DIAMETER CLASSES IN CENTIMETRES

SPECIES CODE	5.0 -9.9	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 +	TOTAL	PE CE
1 102 Shorea platyclados			.50			.25						.75	4.[illegible]
1 103 Shorea pauciflora	1.39	1.39			.50	.25	.25					3.78	23.[illegible]
1 105 Shorea sinkawang	.69	.69										1.39	8.5
1 106 Shorea curtisii	.69		.25	.50	.25							1.69	10.4
1 211 Shorea acuminata	.69	.69					.25					1.64	10.1
1 212 Shorea parvifolia					.25		.25					.50	3.0
1 214 Shorea leprosula	.69	.69										1.39	8.5
1 308 Shorea bracteolata							.25					.25	1.5
1 401 Shorea spp. (Yellow)	2.08	.69	.25		.50	.50	.25	.50				4.78	29.5
TOTAL PER HA.	6.25	4.17	1.00	.50	1.50	1.00	1.25	.50				16.17	
PER CENT	38.66	25.77	6.19	3.09	9.28	6.19	7.73	3.09				100.00	100.0

+

I.13.1 ITTABSAP : A stand table, saplings.

PROGRAM ITTABSAP **** S T A N D T A B L E ****
- S A P L I N G S -
JOINT MALAYSIA - ITTO PROJECT DATE : 20/07/1993
SLTMT02.922 ENUMERATED: 1992 SUNGEI LALANG F.R., SELANGOR
TREATMENT : 02 = CUT ALL > = 45 CM
BLOCK = ALL BLOCKS
FOREST CLASS = ALL CLASSES
STEM IDENTITY CLASS = 211
ALL VIGOUR CLASSES
+*+*+*+*+*+*+*+*++*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+
SPECIES LIST : NO SP. CHECK
NUMBER OF SUBPLOTS : 36 ENUMERATED AREA : .0900 HA.

MEAN NUMBER OF STEMS PER HECTARE
DIAMETER CLASSES IN CENTIMETRES

	.0 -1.9	2.0 -2.9	3.0 -3.9	4.0 +	TOTAL	PER-CENT
WOOD QUALITY GROUP						
GROUP 1	211.1		11.1	11.1	233.3	7.2
GROUP 2	211.1			11.1	222.2	6.9
GROUP 3	300.0		22.2		322.2	10.0
GROUP 4						
GROUP 5	33.3				33.3	1.0
GROUP 6	500.0	44.4	66.7	55.6	666.7	20.6
GROUP 7	877.8	188.9	188.9	111.1	1366.7	42.3
GROUP 8	333.3	22.2	22.2	11.1	388.9	12.0
TOTAL PER HA.	2466.6	255.5	311.1	200.0	3233.3	100.0
PER CENT	76.3	7.9	9.6	6.2	100.0	

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I.13.2 ITTABSAP : Height table for planted wildlings.

PROGRAM ITTABSAP **** S T A N D T A B L E ****
- W I L D L I N G S -

JOINT MALAYSIA - ITTO PROJECT DATE : 20/07/1993
LETMT07.924 ENUMERATED: 1992 LESONG F.R., PAHANG
TREATMENT : 07 = CUT ALL>=30 CM/PLANT WILDLING
BLOCK = ALL BLOCKS
FOREST CLASS = ALL CLASSES
STEM IDENTITY CLASS = 311
ALL VIGOUR CLASSES

+*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*+

SPECIES LIST : NO SP. CHECK
NUMBER OF SUBPLOTS : 68 ENUMERATED AREA : 4.0000 HA.

MEAN NUMBER OF STEMS PER HECTARE
HEIGHT CLASSES IN METRES

	.0 -.9	1.0 -1.9	2.0 -2.9	3.0 +	TOTAL	PER-CENT
WOOD QUALITY GROUP						
GROUP 1	73.0	125.0	57.2	10.7	266.0	64.2
GROUP 2	21.7	27.2	1.2		50.2	12.1
GROUP 4	45.0	34.5	16.0	2.7	98.2	23.7
TOTAL PER HA.	139.7	186.7	74.4	13.4	414.4	100.0
PER CENT	33.7	45.0	18.0	3.2	99.9	

+*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*++*+*+*+*+*+*+*+*+

I.14 ITHEIGHT : A table of tree heights (number of logs).

PROGRAM : ITHEIGHT DATE : 21: 7:1993
FORESTRY DEPARTMENT HQ, ITTO, KUALA LUMPUR

RESEARCH PLOT : SLTMT08.921 NUMBER OF LOGS BY DIAMETER CLASS

ITEM IDENTITY CLASS = 111
ONLY LOG GRADES 1 AND 2

AVERAGE NUMBER OF LOGS
15-CM DIAMETER CLASSES

	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0	150.0	165.0	180.0	MEAN NO. OF LOGS
OD QUALITY	29.9	44.9	59.9	74.9	89.9	104.9	119.9	134.9	149.9	164.9	179.9	+	TOTAL NO OF TREES
OUP 1	1.1	2.4	2.4	3.0	3.0	3.0	3.3	2.3	.0	.0	.0	3.3	2.1
OF TREES :	28	5	5	3	7	4	8	3	0	0	0	3	66
OUP 2	1.1	2.2	2.6	4.0	2.8	3.0	2.0	3.5	2.0	.0	.0	.0	1.9
OF TREES :	30	6	8	1	5	3	2	2	1	0	0	0	58
OUP 3	1.1	1.8	2.6	2.7	3.0	.0	.0	.0	.0	.0	.0	.0	1.3
OF TREES :	321	50	19	3	3	0	0	0	0	0	0	0	396
UP 4	1.1	1.4	2.5	2.0	3.0	.0	.0	.0	.0	.0	.0	.0	1.3
OF TREES :	44	16	2	3	1	0	0	0	0	0	0	0	66
UP 5	1.0	2.3	1.8	3.0	2.0	.0	.0	.0	.0	.0	.0	.0	1.5
OF TREES :	21	6	11	2	1	0	0	0	0	0	0	0	41
UP 6	1.0	1.6	2.0	2.4	2.2	3.0	2.5	.0	.0	.0	.0	.0	1.2
OF TREES :	595	89	43	14	5	2	2	0	0	0	0	0	750
UP 7	1.1	1.6	1.9	2.7	2.0	3.0	2.0	.0	.0	.0	.0	.0	1.2
OF TREES :	501	63	19	7	3	2	1	0	0	0	0	0	596
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
NO. OF LOGS	1.1	1.7	2.2	2.6	2.6	3.0	2.8	2.8	2.0	.0	.0	3.3	1.3
L NO OF TREES:	1606	243	110	35	25	11	13	5	1	0	0	3	1973

I.15 ITSPSUM : Species summary, where range was given as 5, 1(

PROGRAM ITSPSUM DATE : 21/07/1993

SUMMARY OF THE OCCURANCE OF SPECIES (GENERA) FOR SELECTED FOREST AREAS

FOREST / TRMT :		SLTMT01	SLTMT02	SLTMT03	SLTMT04	SLTMT05	SLTMT06	SLTMT08
ENUMERATED YEAR:		.921	.921	.921	.921	.921	.921	.921
AREA (HA):	28.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
SPECIES	TOTAL							
3 1901 Calophyllum spp.								
	13.64	14.61	13.17	8.50	9.00	5.28	12.44	32.47
3 3201 Family of burseraceae								
	26.82	10.94	28.61	15.94	24.00	37.92	31.58	38.75
3 5101 Annonaceae spp.								
	26.49	26.47	26.47	26.97	22.50	13.17	22.61	47.25
3 5801 Family of sapotaceae								
	12.31	8.81	16.22	7.28	10.19	10.47	11.56	21.67
6 3001 Pometia spp.								
	13.91	10.19	6.61	13.72	25.69	7.17	12.83	21.14
6 3101 Diospyros spp.								
	12.73	9.39	10.14	7.81	18.25	8.11	12.22	23.22
6 5001 Lithocarpus spp.								
	11.56	7.50	11.39	9.69	12.83	12.39	8.06	19.03
6 5701 Xanthophyllum spp.								
	12.75	15.44	11.42	14.50	8.19	12.17	13.11	14.44
6 6201 Family of Myristicaceae								
	16.96	8.42	24.31	9.11	11.33	14.81	22.36	28.39
7 3501 Eugenia spp.								
	78.40	62.19	75.50	84.67	79.44	71.17	70.33	105.50
7 8635 Barringtonia spp.								
	7.12	8.69	5.36	8.64	10.72	1.44	6.06	8.94
7 8670 Millettia atropurpurea								
	6.22	6.11	14.00	3.08	3.14	6.28	3.58	7.36
8 4301 Vitex spp.								
	11.38	7.19	6.81	4.47	7.06	8.25	4.72	41.19
8 4601 Macaranga spp.								
	11.35	14.25	5.81	10.58	10.28	16.67	7.44	14.44
NOT FOUND	.00	.00	.00	.00	.00	.00	2.78	5.56
TOT SPEC.	152.00	83.00	100.00	84.00	88.00	77.00	91.00	105.00

I.16 ITGROEDT : List of inconsistencies and "new recruits".

```
'ROGRAM ITGROEDT     FORESTRY DEPARTMENT H.Q., JOINT MALAYSIA - ITTO PROJECT
                                     *** LIST OF INCOMPATIBLE TREES ***

ESEARCH PLOT : PITMT02              21/ 7/1993          PAGE :  1
ASEYEAR = 1992

STEM ID. CLASS (SIC) IN BASEYEAR = 111 (LIVING - STANDING - COMPLETE)
WQ = WOOD QUALITY GROUP/SPECIES CODE, TR = TREE NO., L = RECORD NO., D = DIAM (MM)

(BASEYEAR INFO)                              BASE YEAR
UADRAT TR.NO. SPECIES CODE     1991            1992

202  3     8  7 8655        SIC131 WQ78655  DIAM : 151
anggis, M. hutan, Kandis     TR:  8 L:  25  TR:  8 L:  25

202  5     6  6 4801         8 4601 D: 167  DIAM : 175
edang, M. pepijat            TR:  6 L:  45  TR:  6 L:  46

202  5    14  3 6001         8 8001 D: 240  DIAM : 262
long                         TR: 14 L:  53  TR: 14 L:  54

202  6     8  2  501        SIC131 WQ2 501  DIAM : 263
rsawa                        TR:  8 L:  61  TR:  8 L:  63

02 19      7  6 4801         6 6801 D:  69  DIAM :  77
dang, M. pepijat             TR:  7 L: 343  TR:  7 L: 350

02 23      3  3 5101         5 3401 D: 
mpisang
```

```
RESEARCH PLOT : PITMT02                              PAGE :    3

 LIST OF NEW RECRUITS BY SPECIES IN BASEYEAR : PITMT02.921
 ACTUAL NUMBER  >5CM / >15CM  BETWEEN 1992 AND SINCE :
```

WQ SPCODE		1991
3 5801	Nyatoh	1
4 3902	Tualang	1
6 3001	Kasai	2
6 4801	Medang, M. pepijat	3
6 5701	Minyak berok	1
6 6201	Penarahan	1
6 8401	Terap	1
7 3501	Kelat	2
7 6401	Perah	1
7 7301	Rambutan	1
7 8635	Putat	1
7 9999	Lain-lain	8
8 4301	Leban	1
8 4401	Ludai	1
8 4601	Mahang, Mersepat	1

NUMBER OF GENERA/SPECIES : 15

I.17 ITGROWTH : A growth table.

```
PROGRAMME : ITGROWTH
NUMBER OF TREES EXCLUDED                      =   0
NO. OF TREES WITH NO GROWTH RATE, BUT LIVING =   1

FORESTRY DEPARTMENT H.Q. / ITTO          **** I T G R O W T H ****          DATE 21/07/1993   PAGE :  1
 PITMT01.901   BASE YEAR   1991.08   PIAH F.R., PERAK                  TRMT : 1   CUT ALL > = 30 CM
 PITMT01.921   GROWTH YEAR 1992.86   GROWTH PERIOD =  1.78 YEARS
    BLOCK      = ALL BLOCKS
    FOREST CLASS          = ALL CLASSES
    STEM IDENTITY CLASS   = 111
    MINIMUM GROWTH        =  -10  MAXIMUM GROWTH =   50
 *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+   T A B L E   1   *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*
                                                                   NO. OF QUADRATS :  75,  AREA :  3.00 HA
   SPECIES LIST          : NO CHECKS MADE
   VARIABLE NOT USED     :
```

MEAN ANNUAL DIAMETER INCREMENT IN CENTIMETRES
DIAMETER CLASSES IN CENTIMETRES

WOOD QUALITY	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 -59.9	60.0 +	AVER-AGE
1	3.03	1.35	.90	4.27								2.59
LIVING TREES PER HA.	.93	.33	.33	.33								1.93
DEAD,FALLEN OR BROKEN												
MEAN ANNUAL MORTALITY PCT.												
2			1.18									1.18
LIVING TREES PER HA.			.33									.33
DEAD,FALLEN OR BROKEN												
MEAN ANNUAL MORTALITY PCT.												
3	1.25	.67	.91	.65	1.00		2.42					.93
LIVING TREES PER HA.	12.04	11.33	4.33	5.00	2.33		.33					35.37
DEAD,FALLEN OR BROKEN	1.85	.67	.33		.67	1.33						4.85
MEAN ANNUAL MORTALITY PCT.	7.49	3.12	4.01		12.48	56.18						6.78
4			.79	.39								.59
LIVING TREES PER HA.			.33	.33								.67
DEAD,FALLEN OR BROKEN												
MEAN ANNUAL MORTALITY PCT.												
5		1.57	1.08									.76
LIVING TREES PER HA.	.93	.33	1.33									2.59
DEAD,FALLEN OR BROKEN				.33							.33	.67
MEAN ANNUAL MORTALITY PCT.				56.18							56.18	11.49
6	.82	.83	.64	.68	.56							.77
LIVING TREES PER HA.	26.85	15.00	10.33	6.00	1.00						.33	59.52
DEAD,FALLEN OR BROKEN	2.78	2.00	1.67	1.33		1.00				.33		9.11
MEAN ANNUAL MORTALITY PCT.	5.27	6.61	7.80	10.21		56.18				56.18		7.46

7	.86	.49	.76	.68	.38							.71
LIVING TREES PER HA.	21.30	13.33	16.67	10.00	2.00							63.30
DEAD,FALLEN OR BROKEN	.93	3.00	2.67	.67	1.67	.33	1.33	.67	.33	.33	.67	12.59
MEAN ANNUAL MORTALITY PCT.	2.34	10.32	7.75	3.51	25.54	56.18	56.18	56.18	56.18	56.18	56.18	9.32
8		2.84	1.44	.17								1.69
LIVING TREES PER HA.		.67	1.00	.33								2.00
DEAD,FALLEN OR BROKEN			.33									.33
MEAN ANNUAL MORTALITY PCT.			14.04									8.03
TOTAL : AVERAGE PER HA.	.94	.72	.78	.72	.69		2.42					.81
LIVING TREES PER HA.	62.04	41.00	34.67	22.00	5.33		.33				.33	165.70
DEAD,FALLEN OR BROKEN	5.56	5.67	5.00	2.33	2.33	2.67	1.33	.67	.33	.67	1.00	27.56
MEAN ANNUAL MORTALITY PCT.	4.62	6.82	7.08	5.39	17.10	56.18	44.94	56.18	56.18	56.18	42.13	8.01

*+

I.18 ITINGROW : An ingrowth table.

```
PROGRAM ITINGROW                                   **** I N - G R O W T H ****
FORESTRY DEPT. H.Q., JOINT ITTO/MALAYSIA PROJECT        DATE 21/07/1993                    PAGE :   1

PITMT01.921   BASE YEAR       1992.86 PIAH F.R., PERAK                          TRMT =  1 : CUT ALL > = 30 CM
PITMT01.901   IN-GROWTH YEAR  1991.08 IN-GROWTH PERIOD =  1.78 YEARS

  BLOCK     = ALL BLOCKS
  FOREST CLASS          = ALL CLASSES
  STEM IDENTITY CLASS   = 111
*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+  T A B L E   1  *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+
  SPECIES LIST          : NO CHECKS MADE
  PAGE VARIABLE NOT USED                                                  NO. OF QUADRATS :  75,  AREA :  3.00 H
```

TOTAL NO. OF NEW RECRUITS FROM 90 TO 92
DIAMETER CLASSES IN CENTIMETRES, AVERAGE PER HA

WOOD QUALITY	15.0 -16.9	17.0 -18.9	19.0 -20.9	21.0 -22.9	23.0 -24.9	25.0 -26.9	27.0 -28.9	29.0 -30.9	31.0 -32.9	33.0 -34.9	35.0 +	MEAN ANNU INGROWTH
1	.33											.19
2												
3	2.00	.67										1.50
4												
5	.33											.19
6	2.00	.67	1.00									2.06
7	2.33	.33	.67									1.87
8	.33	.67	.33									.75
TOTAL : AVERAGE PER HA.	7.33	2.33	2.00									6.55

*+

I.19 ITGRORAT : A table of growth rates.

```
OGRAMME : ITGRORAT           NUMBER OF TREES EXCLUDED =    0
RESTRY DEPARTMENT H.Q. / ITTO                 **** G R O W T H - R A T E S ****     DATE 21/07/1993    PAGE :   1
ITMT01.901   BASE YEAR   1991.08   PIAH F.R., PERAK                        TRMT :  1   CUT ALL > = 30 CM
ITMT01.921   GROWTH YEAR 1992.86   GROWTH PERIOD =  1.78 YEARS

 BLOCK     = ALL BLOCKS
 FOREST CLASS          = ALL CLASSES
 STEM IDENTITY CLASS   = 111
+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+   T A B L E   1   *+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+*+
SPECIES LIST           : NO CHECKS MADE                                      NO. OF QUADRATS :  75  AREA :  3.00 HA
SELECTION OF VARIABLES : NO SELECTION VAR.
NO PAGE VARIABLE       : TABLE IS ALL INCLUSIVE
                                               MEAN ANNUAL DIAMETER INCREMENT IN CENTIMETRES
                                               DIAMETER CLASSES IN CENTIMETRES
```

OWTH RATES MM	10.0 -14.9	15.0 -19.9	20.0 -24.9	25.0 -29.9	30.0 -34.9	35.0 -39.9	40.0 -44.9	45.0 -49.9	50.0 -54.9	55.0 -59.9	60.0 +	AVER- AGE	PER- CENT
< 0		-.15	-.33	-.56	-.45							-.32	
VING TREES PER HA.		2.33	3.33	1.00	1.00							7.67	4.63
= 0													
VING TREES PER HA.	.93	1.00	1.00	.33							.33	3.59	2.17
0 < 2	.12	.12	.12	.11	.14							.12	
/ING TREES PER HA.	8.33	4.67	3.00	4.33	.67							21.00	12.67
2 < 4	.31	.30	.34	.31	.28							.31	
'ING TREES PER HA.	15.74	9.33	3.33	2.67	.67							31.74	19.16
4 < 6	.47	.48	.49	.50	.49							.49	
'ING TREES PER HA.	2.78	4.00	5.33	3.33	1.00							16.44	9.92
6 < 8	.71	.69	.71	.74								.71	
ING TREES PER HA.	8.33	3.33	4.33	3.00								19.00	11.47
8 < 10	.89	.90	.93	.89	.90							.90	
ING TREES PER HA.	4.63	5.00	2.67	2.33	.33							14.96	9.03
10 < 12	1.08	1.07	1.13	1.09								1.10	
ING TREES PER HA.	3.70	3.33	5.00	1.67								13.70	8.27
12 <	2.09	1.76	1.93	2.04	1.83		2.42					1.98	
ING TREES PER HA.	17.59	8.00	6.67	3.33	1.67		.33					37.59	22.69
AGE GROWTH RATE :	.94	.72	.78	.70	.69		2.42					.81	
NG TREES PER HA.	62.04	41.00	34.67	22.00	5.33		.33				.33	165.70	100.00
,FALLEN OR BROKEN	5.56	5.67	5.00	2.33	2.33	2.67	1.33	.67	.33	.67	1.00	27.56	
ANNUAL MORTALITY PCT.	4.62	6.82	7.08	5.39	17.10	56.18	44.94	56.18	56.18	56.18	42.13	8.01	

+*+

I.20 ITSELECT : Documentation of output.

```
JOINT ITTO/MALAYSIA PROJECT   **** I T S E L E C T ****   DATE 13/07/1993

 BASE YEAR : PITMT01.901  ENUMERATED : 1990 DECIMAL DATE : 91.08


 NUMBER OF RECORDS SELECTED FROM BASEYEAR =        5
 OF WHICH      5 WERE OUTPUT AND     0 EXCLUDED
    BLOCK      = ALL BLOCKS
    FOREST CLASS            = ALL CLASSES
    STEM IDENTITY CLASS     = 111
    MINIMUM DIAMETER        =   50
    MAXIMUM DIAMETER        = 2000
    WOOD QUALITY GROUP      =  1, 2
    SPECIES LIST            : ALL SPECIES

 THE FOLLOWING VARIABLES HAVE BEEN INCLUDED FOR BASEYEAR :

 BLOCK
 STEM IDENTITY CLASS
 WOOD QUALITY GROUP
 FAMILY
 GENERA
 DIAMETER DBHob
 LOG QUALITY
 STEM DAMAGE
 CROWN DAMAGE

 THE FOLLOWING VARIABLES HAVE BEEN INCLUDED FOR
 GROWTH YEAR ENUMERATED : 1991 DECIMAL DATE =91.87

 STEM IDENTITY CLASS
 DIAMETER DBHob
 LOG QUALITY
 STEM DAMAGE
 CROWN DAMAGE

 THE FOLLOWING VARIABLES HAVE BEEN INCLUDED FOR
 GROWTH YEAR ENUMERATED : 1992 DECIMAL DATE =92.86

 STEM IDENTITY CLASS
 DIAMETER DBHob
 LOG QUALITY
 STEM DAMAGE
 CROWN DAMAGE

  OUTPUT FILE = STATT02.DAT

** END OF LIST ***
```

Appendix II : Listing of Support Data Files.

The Support Data Files contain different lists like Forest Classes, Species codes etc. and are used by the programmes for checking and for printed output.

In order to ease the documentation some of the lists exist in two versions :

- A version to be used for computer processing with the file name extension of .... .DAT

- A version to be used by Word Perfect for documentation with the file name extension of ... .LIS

When changes or additions are made, remember to update both versions.

The species list also exist in two other versions : The complete species list SPECIES.LIS that contain multiple entries where the same species has several vernacular names used in the field. And the SPECIES.DAT that is used during processing and only contain one entry per code number.

II.1 List of Forest Classes, FDAFCL.DAT
(Not yet adapted)

II.2 List of Stem Identity Classes, ITSICTXT.DAT and ITSICTX2.DAT

111	TREE ALIVE- STANDING- COMPLETE TRUNK
112	TREE ALIVE- STANDING- BROKEN STEM
113	TREE ALIVE- STANDING- BROKEN STUMP
114	CUT STUMP- STANDING- ALIVE
115	TREE ALIVE- STANDING- POISSON GIRDLED
119	TREE ALIVE- STANDING- NOT FOUND
121	TREE ALIVE- FALLEN- COMPLETE TRUNK
122	TREE ALIVE- FALLEN- BROKEN STEM
123	TREE ALIVE- FALLEN- BROKEN STUMP
124	CUT STUMP- FALLEN- ALIVE
125	TREE ALIVE- FALLEN- POISSON GIRDLED
129	TREE ALIVE- FALLEN- NOT FOUND
131	TREE DEAD- STANDING- COMPLETE TRUNK
132	TREE DEAD- STANDING- BROKEN STEM
133	TREE DEAD- STANDING- BROKEN STUMP
134	CUT STUMP- STANDING- DEAD
135	TREE DEAD- STANDING- POISSON GIRDLED
139	TREE DEAD- STANDING- NOT FOUND
141	TREE DEAD- FALLEN- COMPLETE TRUNK
142	TREE DEAD- FALLEN- BROKEN STEM
143	TREE DEAD- FALLEN- BROKEN STUMP
144	CUT STUMP- FALLEN- DEAD
145	TREE DEAD- FALLEN- POISSON GIRDLED
411	PALM ALIVE- STANDING- SINGLE TRUNK
412	PALM ALIVE- STANDING- CLUMP/CLUSTER
413	PALM ALIVE- STANDING- STEMLESS

211	SAPLING-STANDING LIVING-COMPLETE TRUNK
212	SAPLING-STANDING LIVING-BROKEN STEM
214	SAPLING-STANDING LIVING-CUT STUMP
216	SAPLING-GROWN TO POLE OR TREE SIZE
219	SAPLING-NOT FOUND
221	SAPLING-FALLEN LIVING-COMPLETE TRUNK
222	SAPLING-FALLEN LIVING-BROKEN STEM
224	SAPLING-FALLEN LIVING-CUT STUMP
231	SAPLING-DEAD-STANDING
232	SAPLING-DEAD-BROKEN STEM
234	SAPLING-DEAD CUT STUMP
241	SAPLING-DEAD-FALLEN
311	SEEDL.-STANDING LIVING-COMPLETE STEM
312	SEEDL.-STANDING LIVING-BROKEN STUMP
314	SEEDL.-STANDING LIVING-CUT STUMP
318	SEEDL.-NOT PLANTED
319	SEEDL.-NOT FOUND
331	SEEDL.-DEAD
511	MEDIUM PALM- LIVING- SINGLE STEM
512	MEDIUM PALM- LIVING- CLUMP/CLUSTER
513	MEDIUM PALM- LIVING- STEMLESS
611	SMALL PALM- LIVING- SINGLE STEM
612	SMALL PALM- LIVING- CLUMP/CLUSTER
613	SMALL PALM- LIVING- STEMLESS

II.3 Species List, SPECIES.DAT

This species list is sorted by code number and contain one entry per code no. The species list with multiple entries sorted by vernacular name is given in the "Manual of Instructions for Enumerating the Permanent 'ITTO' Experimental Plots", Field Document No. 1.

Code	Vernacular Name	Scientific Name
10101	Meranti Merah Tua	Shorea spp. (Dark red)
10102	Meranti bukit	Shorea platyclados
10103	Meranti nemesu	Shorea pauciflora
10104	Meranti sengkawang bulu	Shorea sinkawang
10105	Meranti sengkawang merah	Shorea sinkawang
10106	Meranti seraya	Shorea curtisii
10107	Meranti seraya daun besar	Shorea curtisii
10201	Meranti Merah/Merah Muda	Shorea spp. (Red/light red)
10202	Meranti bakau	Shorea uliginosa
10203	Meranti batu	Shorea dasyphylla
10204	Meranti bunga	Shorea teysmanniana
10205	Meranti daun besar	Shorea hemsleyana
10206	Meranti kepong	Shorea ovalis
10207	Meranti kepong hantu	Shorea macrantha
10208	Meranti langgong	Shorea lepidota
10209	Meranti paya	Shorea platycarpa
10210	Meranti pepijat	Shorea johorensis
10211	Meranti rambai daun	Shorea acuminata
10212	Meranti sarang punai	Shorea parvifolia
10213	Meranti sarang punai bukit	Shorea ovata
10214	Meranti tembaga	Shorea leprosula
10215	Meranti tengkawang ayer	Shorea palembanica
10301	Meranti Putih	Shorea spp. (White)
10302	Meranti belang	Shorea resinosa
10303	Meranti bumbong	Shorea dealbata
10304	Meranti jerit	Shorea henryana
10305	Meranti lapis	Shorea lamellata
10306	Meranti laut	Shorea gratissima
10307	Meranti mengkai	Shorea bentongensis
10308	Meranti pa'ang	Shorea bracteolata
10309	Meranti pipit	Shorea assamica
10310	Meranti temak	Shorea hypochra
10311	Meranti temak nipis	Shorea roxburghii
10401	Meranti Kuning/Damar Hitam	Shorea spp. (Yellow)
10402	Damar hitam bulu	Shorea longisperma
10403	Damar hitam gajah	Shorea gibbosa
10404	Damar hitam katup	Shorea dolichocarpa
10405	Damar hitam kelim	Shorea blumutensis
10406	Damar hitam pipit	Shorea multiflora
10407	Damar hitam sengkawang putih	Shorea maxima
10408	Damar hitam siput	Shorea faguetiana
10409	Damar hitam siput besar	Shorea kuantanensis
10410	Damar hitam siput jantan	Shorea hopeifolia
10411	Damar hitam telepok	Shorea peltata

20501	Mersawa	Anisoptera spp.
20502	Mersawa durian	Anisoptera laevis
20503	Mersawa gajah	Anisoptera scaphula
20504	Mersawa kesat	Anisoptera costata
20505	Mersawa kuning	Anisoptera curtisii
20506	Mersawa merah	Anisoptera megistocarpa
20507	Mersawa paya	Anisoptera marginata
20601	Merawan	Hopea spp. (Merawan)
20602	Merawan batu	Hopea beccariana
20603	Merawan bunga	Hopea pubescens
20604	Merawan daun bulat	Hopea latifolia
20605	Merawan gunong	Hopea montana
20606	Merawan jangkang	Hopea nervosa
20607	Merawan jantan	Hopea griffithii
20608	Merawan jeruai	Hopea lanceolata
20609	Merawan kelabu	Hopea cescens
20610	Merawan mata kucing beludu	Hopea myrtifolia
20611	Merawan mata kucing bukit	Hopea cellata
20612	Merawan mata kucing hitam	Hopea dryobalanoides
20613	Merawan mata kucing merah	Hopea ferruginea
20614	Merawan mata kucing pipit	Hopea johorensis
20615	Merawan meranti	Hopea sulcata
20616	Merawan palit	Hopea dyeri
20617	Merawan penak	Hopea mengarawan
20618	Merawan siput	Hopea sangal
20619	Merawan siput jantan	Hopea odorata
20620	Merawan ungu	Hopea bracteata
20701	Gerutu	Parashorea spp.
20702	Gerutu gerutu	Parashorea stellata
20703	Gerutu pasir	Parashorea densiflora
20704	Gerutu pasir daun besar	Parashorea globosa
20801	Keruing (Berminyak)	Dipterocarpus spp. (oily)
20802	Keruing bulu	Dipterocarpus baudii
20803	Keruing gombang	Dipterocarpus cornutus
20804	Keruing gondol	Dipterocarpus kerrii
20805	Keruing kertas	Dipterocarpus chartaceus
20806	Keruing merah	Dipterocarpus verrucosus
20807	Keruing sol	Dipterocarpus lowii
20808	Keruing ternek	Dipterocarpus palembanicus
20809	Keruing etoi	Dipterocarpus dyeri
20810	Keruing mempelas	Dipterocarpus crinitus
20901	Keruing (Tidak Berminyak)	Dipterocarpus spp. (non-oily)
20902	Keruing baran	Dipterocarpus eurynchus
20903	Keruing beledu	Dipterocarpus obtusifolius
20904	Keruing belimbing	Dipterocarpus grandiflorus
20905	Keruing bukit	Dipterocarpus costatus
20906	Keruing cogan	Dipterocarpus rigidus
20907	Keruing gasing	Dipterocarpus caudatus
20908	Keruing gombang merah	Dipterocarpus kunstleri
20909	Keruing gunong	Dipterocarpus retusus

20910	Keruing kelabu	Dipterocarpus pseudofagineus
20911	Keruing kerut	Dipterocarpus sublamellatus
20912	Keruing kesat	Dipterocarpus gracilis
20913	Keruing kipas	Dipterocarpus costulatus
20914	Keruing latek	Dipterocarpus apterus
20915	Keruing mengkai	Dipterocarpus rotundifolius
20916	Keruing neram	Dipterocarpus oblongifolius
20917	Keruing padi	Dipterocarpus semivestitus
20918	Keruing paya	Dipterocarpus coriaceus
20919	Keruing perak	Dipterocarpus perakensis
20920	Keruing pipit	Dipterocarpus fagineus
20921	Keruing ropol	Dipterocarpus hasseltii
20922	Keruing sarawak	Dipterocarpus sarawakensis
20923	Keruing sendok	Dipterocarpus concavus
21001	Kapur	Dryobalanops aromatica
21002	Keladan	Dryobalanops oblongifolia
21101	Balau	Shorea spp. (Balau group)
21102	Balau bukit	Shorea foxworthyi
21103	Balau gajah	Shorea submontana
21104	Balau gunong	Shorea astylosa
21105	Balau hitam	Shorea atrinervosa
21106	Balau kumus	Shorea laevis
21107	Balau kumus hitam	Shorea maxwelliana
21108	Balau kuning	Shorea falcifera
21109	Balau laut	Shorea glauca
21110	Balau laut merah	Shorea kunstleri
21111	Balau membatu	Shorea guiso
21112	Balau membatu jantan	Shorea ochrophloia
21113	Balau merah	Shorea collina
21114	Balau pasir	Shorea materialis
21115	Balau putih	Shorea lumutensis
21116	Balau sengkawang ayer	Shorea sumatrana
21117	Balau sengkawang darat	Shorea scrobiculata
21118	Balau tembaga	Shorea exelliptica
21201	Chengal	Neobalanocarpus heimii
21301	Giam	Hopea nutans (Giam)
21302	Giam bayan	Hopea pachycarpa
21303	Giam hantu	Hopea coriacea
21304	Giam jantan	Hopea semicuneata
21305	Giam kanching	Hopea subalata
21306	Giam lintah bukit	Hopea helferi
21307	Giam malut	Hopea ferrea
21308	Giam melukut	Hopea apiculata
21309	Giam palong	Hopea pierre
21310	Giam rambai	Hopea polyalthioides
21401	Resak	Cotylelobium spp. & Vatica spp
21402	Resak bukit	Cotylelobium malayanum
21403	Resak tempurong	Cotylelobium melanoxylon
21404	Resak buah kana	Vatica ridleyana
21405	Resak daun panjang	Vatica nitens
21406	Resak daun runcing	Vatica cuspidata

21407	Resak degong	Vatica havilandii
21408	Resak gajah	Vatica sp. 'A'
21409	Resak gunong	Vatica heteroptera
21410	Resak julong	Vatica mangachapoi
21411	Resak kecil	Vatica pallida
21412	Resak keluang	Vatica belia
21413	Resak langgong	Vatica scortechinii
21414	Resak laru	Vatica pauciflora
21415	Resak laut	Vatica cinerea
21416	Resak letop	Vatica venulosa
21417	Resak lidi	Vatica maingayi
21418	Resak mempening	Vatica stapfiana
21419	Resak padi	Vatica flavida
21420	Resak paya	Vatica lobata
21421	Resak pipit	Vatica lowii
21422	Resak putih	Vatica perakensis
21423	Resak ranting kesat	Vatica odorata
31701	Bengang	Neesia spp.
31901	Bintangor	Calophyllum spp.
31902	Bintangor batu	Calophyllum inophylloide
31903	Bintangor bukit	Calophyllum symingtonianum
31904	Bintangor bunga	Calophyllum curtisii
31905	Bintangor bunut	Calophyllum macrocarpum
31906	Bintangor daun karat	Calophyllum rubiginosum
31907	Bintangor daun panjang	Calophyllum incrassatum
31908	Bintangor gambut	Calophyllum retusum
31909	Bintangor gasing	Calophyllum pulcherrimum
31910	Bintangor gunong daun besar	Calophyllum coriaceum
31911	Bintangor gunong daun kecil	Calophyllum cuneatum
31912	Bintangor jangkang	Calophyllum sclerophyllum3
31913	Bintangor kelim	Calophyllum scriblitifolium
31914	Bintangor kuning	Calophyllum floribundum
31915	Bintangor laut	Calophyllum inophyllum
31916	Bintangor lekok	Calophyllum depressinervosum
31917	Bintangor lilin	Calophyllum wallichianum
31918	Bintangor merah	Calophyllum canum
31919	Bintangor putih	Calophyllum alboramulum
32101	Damar minyak	Agathis borneensis
32301	Durian, D. hantu	Durio spp.
32302	Durian batang	Durio malaccensis
32303	Durian beludu	Durio oxleyanus
32304	Durian bujor	Durio singaporensis
32305	Durian daun	Durio lowianus
32306	Durian daun besar	Durio macrophyllus
32307	Durian daun tajam	Durio pinangianus
32308	Durian ijau laut	Durio wyatt-smithii
32309	Durian kampong	Durio zibethinus
32310	Durian merah	Durio graveolens
32311	Durian paya	Durio carinatus
32312	Durian tupai	Durio griffithii
32401	Ekor	Dacrydium spp.

32501 Geronggang	Cratoxylum spp.
32502 Geronggang derum	Cratoxylum formosum
32503 Geronggang derum bukit	Cratoxylum maingayi
32504 Geronggang derum seluncor	Cratoxylum cochinchinense
32505 Geronggang geronggang	Cratoxylum arborescens
32601 Jangkang, Banitan	Xylopia spp.
32602 Jangkang bukit	Xylopia ferruginea
32603 Jangkang paya	Xylopia fusca
32801 Jelutong	Dyera costulata
33201 Kedondong	Family of burseraceae
33202 Kedondong bulan	Canarium littorale
33203 Kedondong bulan bulu	Canarium littorale tomentosum
33204 Kedondong gergaji	Canarium littorale forma
33205 Kedondong kemasul	Canarium apertum
33206 Kedondong keruing	Canarium megalanthum
33207 Kedondong putih	Canarium littorale forma
33208 Kedondong senggeh	Canarium pseudosumatranum
33209 Kedondong kerut	Dacryodes rostrata
33210 Kedondong matahari	Dacryodes rugosa
33211 Kedondong mempelas	Dacryodes laxa
33212 Kedondong serong	Dacryodes puberula
33213 Kedondong kerantai	Santiria spp.
33214 Kedondong kerantai bulu	Santiria tomentosa
33215 Kedondong kerantai licin	Santiria laevigata
33216 Kedondong sengkuang	Scutinanthe brunnea
33217 Kedondong kijai	Triomma malaccensis
33801 Kembang semangkok	Scaphium spp.
33802 Kembang semangkok bulat	Scaphium linearicarpum
33803 Kembang semangkok jantong	Scaphium macropodum
34101 Keredas	Pithecellobium bubalinum
34102 Kungkur	Pithecellobium splendens
34501 Machang	Mangifera spp.
34502 Lanjut	Mangifera lagenifera
34503 Machang machang	Mangifera longipes
34504 Mangga	Mangifera indica
34505 Rawa	Mangifera microphylla
35101 Mempisang	Annonaceae spp.
35801 Nyatoh	Family of sapotaceae
35802 Nyatoh ketiau	Ganua motleyana
35803 Nyatoh gunong	Palaquium reginamontium
35804 Nyatoh jambak	Palaquium hexandrum
35805 Nyatoh kabu	Palaquium xanthochymum
35806 Nyatoh mayang	Palaquium sukoei
35807 Nyatoh pipit	Palaquium microphyllum
35808 Nyatoh putih	Palaquium obovatum
35809 Nyatoh semaram	Palaquium semaram
35810 Nyatoh sidang	Palaquium rostratum
35811 Nyatoh surin	Palaquium impressinervium
35812 Nyatoh taban merah, Taban	Palaquium gutta
35813 Nyatoh taban putih	Palaquium oxleyanum
35814 Nyatoh tembaga	Palaquium maingayi

35815	Nyatoh tembaga kuning	Palaquium hispidum
35816	Nyatoh durian	Payena maingayi
35817	Nyatoh ekor	Payena lanceolata
35818	Nyatoh sundek	Payena obscura
35819	Nyatoh nangka kuning	Pouteria malaccensis
35820	Nyatoh nangka merah	Planchonella maingayi
36001	Pelong	Pentaspadon spp.
36002	Pelong beludu	Pentaspadon velutinus
36003	Pelong licin	Pentaspadon motleyi
36901	Podo	Podocarpus spp.
36902	Podo bukit	Podocarpus neriifolius
36903	Podo cucor atap	Podocarpus imbricatus
36904	Podo kebal musang	Podocarpus motleyi
36905	Podo kebal musang gunong	Podocarpus wallichianus
36906	Podo laut	Podocarpus polystachy
37201	Punggai, Durian punggai	Ceolostegia griffithii
37202	Punggai daun besar	Ceolostegia borneensis
37401	Ramin	Gonystylus spp.
37402	Ramin dara elok	Gonystylus affinis
37403	Ramin daun tebal	Gonystylus brunnescens
37404	Ramin melawis	Gonystylus bancanus
37405	Ramin pinang muda	Gonystylus confusus
37406	Ramin pipit	Gonystylus maingayi
37901	Sepetir	Sindora spp.
37902	Sepetir beludu besar	Sindora velutina
37903	Sepetir daun nipis	Sindora echinocalyx
37904	Sepetir daun tebal	Sindora wallichii
37905	Sepetir licin	Sindora coriacea
37906	Sepetir mempelas	Sindora siamensis
38501	Terentang	Campnosperma spp.
38502	Terentang daun besar	Campnosperma auriculatum
38503	Terentang daun kecil	Campnosperma squamatum
38504	Terentang simpoh	Campnosperma coriaceum
43601	Keledang	Artocarpus spp.
43602	Keledang babi	Artocarpus anisophyllus
43603	Keledang bangkong	Artocarpus integer silvestris
43604	Keledang keledang	Artocarpus lanceifolius
43605	Keledang tampang	Artocarpus nitidus
43606	Keledang tampang bulu	Artocarpus dadah
43607	Keledang tampang gajah	Artocarpus fulvicortex
43608	Keledang tampang hitam	Artocarpus gomezianus
43609	Temponek, Keledang temponek	Artocarpus rigidus
43610	Miku	Artocarpus lowii
43611	Nangka	Artocarpus heterophyllus
43612	Pudu	Artocarpus kemando
43614	Sukun	Artocarpus communis
43901	Kempas	Koompassia malaccensis
43902	Tualang	Koompassia excelsa

45201	Mengkulang	Heritiera spp.
45202	Mengkulang jari	Heritiera javanica
45203	Mengkulang jari bulu	Heritiera sumatrana
45204	Mengkulang siku keluang	Heritiera simplicifolia
47101	Punah	Tetramerista glabra
48101	Simpoh	Dillenia spp.
48102	Simpoh ayer	Dillenia suffruticosa
48103	Simpoh beludu	Dillenia ovata
48104	Simpoh daun merah	Dillenia grandifolia
48105	Simpoh gajah	Dillenia reticulata
48106	Simpoh padang	Dillenia obovata
48107	Simpoh paya	Dillenia pulchella
48108	Simpoh putih	Dillenia albiflos
48109	Simpoh ungu	Dillenia excelsa
48660	Meransi	Carallia spp.
49101	Delek	Anisophyllea spp.
49105	Mata keli	Gynotroches spp.
49110	Membuloh	Pellacalyx spp.
50216	Meranti melantai	Shorea macroptera
52001	Bitis	Palaquium spp.
52002	Bitis bitis	Palaquium spp.
52003	Bitis bukit	Palaquium stellatum
52004	Bitis paya	Palaquium ridleyi
53401	Kekatong	Cynometra spp.
53402	Kekatong kekatong	Cynometra malaccensis
53403	Kekatong laut	Cynometra iripa
54001	Keranji	Dialium spp.
54002	Keranji bulu	Dialium kingii
54003	Keranji kuning besar	Dialium platysepalum
54004	Keranji kuning kecil	Dialium wallichii
54005	Keranji paya	Dialium patens
54006	Keranji tebal besar	Dialium laurinum
54007	Keranji tebal kecil	Dialium maingayi
54008	Keranji tunggal	Dialium procerum
55501	Merbau	Intsia palembanica
61801	Berangan	Castanopsis spp.
62201	Dedali	Strombosia javanica
62202	Kamap	Strombosia maingayi
63001	Kasai	Pometia spp.
63002	Kasai daun besar	Pometia pinnata
63003	Kasai daun kecil	Pometia pinnata alnifolia
63004	Kasai daun licin	Pometia ridleyi
63101	Kayu arang, Meribut, Tuba buah	Diospyros spp.
63613	Cempedak	Artocarpus interger
64201	Kulim	Scorodocarpus borneensis
64801	Medang, M. pepijat	Family of Lauraceae
64802	Medang payong	Actinodaphne maingayi
64803	Medang kemangi	Cinnamomum porrectum
64804	Medang teja	Cinnamomum javanicum
64901	Melunak	Pentace spp.

64902	Melunak bukit	Pentace curtisii
64903	Melunak pusat beludu	Pentace triptera
65001	Mempening	Lithocarpus spp.
65401	Merbatu	Family of Atuna
65402	Merbatu pipit	Parinari costata
65601	Merpauh	Swintonia spp.
65602	Merpauh daun runcing	Swintonia penangiana
65603	Merpauh daun tebal	Swintonia spicifera
65604	Merpauh periang, Pauh p.	Swintonia schwenkii
65701	Minyak berok	Xanthophyllum spp.
65901	Pauh kijang	Irvingia malayana
66201	Penarahan	Family of Myristicaceae
66301	Penarahan arang	Myristica cinnamomea
66302	Penarahan arang ayer	Myristica elliptica
66303	Penarahan arang bukit	Myristica maingayi
66304	Penarahan arang gambut	Myristica lowiana
66801	Petaling	Ochanostachys amentacea
67501	Rengas	Family of Anacardiaceae
67502	Rengas ayer	Gluta elegans
67503	Rengas kerbau jalang	Gluta aptera
67701	Sentang	Azadirachta excelsa
68301	Tembusu	Fagraea spp.
68302	Tembusu hutan	Fagraea gigantea
68303	Tembusu padang	Fagraea fragrans
68401	Terap	Family of Moraceae
68402	Terap hitam	Artocarpus scortechinii
68403	Terap nasi	Artocarpus elasticus
68404	Ipoh	Antiaris toxicaria
71601	Ara berteh	Parartocarpus spp.
71602	Ara berteh bukit	Parartocarpus bracteatus
71603	Ara berteh paya	Parartocarpus venenosus
72701	Jelawai	Terminalia spp.
72702	Jelawai jaha	Terminalia subspathulata
72703	Jelawai ketapang	Terminalia catappa
72704	Jelawai mempelam babi	Terminalia phellocarpa
72705	Jelawai mentalun	Terminalia calamansanai
72901	Kasah, Kangsar	Pterygota horsfieldii
73301	Kekabu hutan	Bombax valetonii
73501	Kelat	Eugenia spp.
73502	Kelat gelam	Eugenia cerina
73503	Kelat jambu laut	Eugenia grandis
73504	Kelat merah	Eugenia chorantha
73505	Kelat paya	Eugenia papillosa
74103	Jering	Pithecellobium jeringa
74701	Mata ulat	Kokoona spp.
75101	Antoi	Cyathocalyx spp.
75301	Mengkun	Tetrameles nudifelora
76101	Penaga	Mesua ferrea
76401	Perah	Elateriospermum tapos

76501	Perah ikan	Pimeleodendron griffithianum
76601	Perupok	Lophopetalum spp.
76701	Petai	Parkia spp.
76702	Petai kerayong	Parkia javanica
76703	Petai meranti	Parkia singularis
76704	Petai petai	Parkia speciosa
77301	Rambutan	Sapindaceae spp.
77302	Rambutan hutan	Nephelium lappaceum
77303	Lotong, Sanggol lotong	Nephelium spp.
77304	Redan	Nephelium glabrum
77305	Pulasan	Nephelium spp.
77306	Rambutan pacat, Kikir buntal	Xerospermum spp.
77504	Rengas padi	Melanochyla auriculata
77601	Sengkuang	Dracontomelon dao
77801	Sentul	Sandoricum koetjape
78201	Surian	Cedrela/Toona spp.
78202	Surian batu	Chukrassia tabularis
78203	Surian bawang	Cedrela serrata
78204	Surian wangi	Cedrela sureni
78605	Bayur	Pterospermum spp.
78610	Chempaka	Aromadendron elegans
78615	Karas	Aquilaria malaccensis
78620	Kelumpang	Sterculia spp.
78625	Sepul	Parishia spp.
78630	Mertas	Ctenolophon parvifolius
78635	Putat	Barringtonia spp.
78640	Sena	Pterocarpus indicus
78645	Melembu	Scaphium javanicum
78650	Bekak, Telur Belangkas	Aglaia (Amoora) spp.
78655	Manggis, M. hutan, Kandis	Garcinia spp.
78665	Samak, Kelat samak	Theaceae spp.
78666	Samak pulut	Gordonia concen.
78670	Tulang daing	Millettia atropurpurea
78675	Pelawan	Tristania spp.
78680	Setumpul	Hydnocarpus spp.
78685	Tempinis	Streblus spp.
79201	Gelugor, Asam gelugor	Garcinia spp.
79205	Asam pupoi	Sarcotheca spp.
79210	Bayor bukit	Schoutenia spp.
79215	Bebusuk, Busok busok, Jahar	Cassia spp.
79220	Langsat, L. hutan, Duku h.	Lansium spp.
79225	Gapis	Saraka spp.
79230	Jelutong bedak	Tabernaemontana spp.
79235	Meraga	Pertusadina spp.
79240	Otak udang	Buchanania spp.
79245	Pagar anak, Inggir burong	Ixonantes spp.
79250	Pepauh	Iuodia spp.
79260	Tampoi, Rambai h., Setambun	Baccaurea spp.
79265	Rukam	Flacourtia spp.
79270	Saga, S. daun bulat	Adenanthera
79275	Sendudok	Astronia spp.
79280	Tapak itik	Euodia spp.
79999	Lain-lain	Misc. non-commercial spp.

81501	Ara, A. kelepong	Ficus spp.
83701	Kelempayan	Anthocephalum chinensis
84301	Leban	Vitex spp.
84401	Ludai	Sapium baccatum
84601	Mahang, Mersepat	Macaranga spp.
84602	Kubin, Mahang gajah	Macaranga gigantea
84603	Mahang merah	Macaranga triloba
84604	Mahang putih	Macaranga hypoleuca
87001	Pulai	Alstonia spp.
87002	Pulai basong	Alstonia spatulata
87003	Pulai penipu bukit	Alstonia macrophylla
87004	Pulai penipu paya	Alstonia angustifolia
87005	Pulai pulai	Alstonia angustiloba
88001	Sesendok	Endospermum malaccense
89802	Balik angin	Mallotus spp.
89805	Berembang bukit	Duabanga spp.
89810	Gambir, G. hutan	Maesa spp.
89815	Hampas tebu	Gironniera spp.
89820	Hujan panas	Breynia spp.
89825	Kenidai, Kernam	Bridellia spp.
89830	Mengkirai, Menarong	Trema spp.
89835	Mendong	Eleocarpus spp.
89840	Nipis Kulit	Memecylon spp.
89845	Sial menahun	Pternandra spp.
89850	Tinjau Belukar	Porterandia spp.
89855	Ubah	Glochidion spp.

II.4 Example of a Command File, FCOMSTD.DAT

This example of FCOMSTD.DAT will yield a standtable containing the volumes of all species with Stem Identity Class = 111, diameter DBHob of 30 cm and above in 5 cm diameter classes using the NFI 1 volume function for trees where number of logs is scored, there is no check against the species list.

FCOMSTD.DAT	: Description
0,0,1	: all blocks, all FCL's, one SIC
111	: SIC = 111
300,50	: min dbh = 30 cm, diameter class interval = 5 cm
8,9	: Wood Quality Group by row, no page variable
8,0	: 8 Wood Quality Groups (all excl. palms), no page
1,2,3,4,5,6,7,8	: " " " "
0	: No species check
2	: Table containing volumes
3	: Use NFI 1 volume function, number of logs

The command files are kept in \FORT\ITPROG\

II.5 List of Forest Locations, FORRESV.DAT

SL SUNGEI LALANG F.R., SELANGOR
LE LESONG F.R., PAHANG
CH CHERUL F.R., TERENGGANU
KS KLEDANG SAIONG F.R. PERAK
PI PIAH F.R., PERAK

II.6 List of treatments applied, TABTREA.DAT

01 CUT ALL > = 30 CM
02 CUT ALL > = 45 CM
03 CUT DIPT>=35/ NON-DIP.>=30 CM
04 CUT DIPT>=50/ NON-DIP.>=45 CM
05 CUT DIPT>=65/ NON-DIP.>=60 CM
06 CUT DIPT>=75/ NON-DIP.>=70 CM
07 CUT ALL>=30 CM/PLANT WILDLING
08 NO LOGGING, VIRGIN CONTROL
11 CLIMBER CUTTING (CL)
12 GIRDLING + CLIMBER CUTTING (GCL)
13 GCL (+ ENRICHMENT PLANTING)
14 CUT ALL>=30 CM/PLANT WILDLING
15 CONTROL, LOGGED, NOT TREATED
16 ENRICHMENT PLANTING

II.7 List of Dates of Enumeration, PIDATES.DAT

```
PITMT01.901 91.08
PITMT01.911 91.87
PITMT01.921 92.86
```

To be expanded as required.

II.8 Example of Filenames and Enumerated Area, ITSPSUM.DAT

```
'SLTMT01.921', 4.0
'SLTMT02.921', 4.0
'SLTMT03.921', 4.0
'SLTMT04.921', 4.0
'SLTMT05.921', 4.0
'SLTMT06.921', 4.0
'SLTMT08.921', 4.0
```

To be expanded as required.

Appendix III.

List of Treatments and Block Numbers by Research Area.

L = Logging intensity and plantation establishment in a virgin forest. (Dipt = the botanical tree family Dipterocarpaceae)

Treatment	Block Numbers Lesong F.R.	Sungei Lalang F.R.
1) Cut all > 30 cm DBH	03,17,26,31	03,06,21,28
2) Cut all > 45 cm DBH	02,07,13,29	01,07,25,29
3) Cut Dipt > 35 cm DBH Non-Dipt > 30 cm DBH	05,18,21,27	02,05,24,26
4) Cut Dipt > 50 cm DBH Non-Dipt > 45 cm DBH	04,19,30,32	12,19,22,27
5) Cut Dipt > 65 cm DBH Non-Dipt > 60 cm DBH	08,10,24,14	04,08,18,31
6) Cut Dipt > 75 cm DBH Non-Dipt > 70 cm DBH	01,20,25,28	10,11,20,32
7) Cut all > 30 cm DBH Plantation of Wildlings	15,16,22,23	13,14,15,23
8) Virgin, no cutting Control	06,09,11,12	09,16,17,30

S = Silvicultural treatments and plantation establishment in a logged-over forest.

Treatment	Block Numbers Kledang Saiong F.R.	Cherul F.R.
11) Climber Cutting (CL)	02,07,08,15	01,12,16,20
12) Girdling + CL (GCL)	01,12,13,16	08,11,15,18
13) GCL(+Enrichment Planting)	03,05,09,19	07,10,13,19
14) Cut all > 30 cm DBH Plantation of Wildlings	04,11,14,17	02,03,04,06
15) Logged-over, no Treatment Control	06,10,18,20	05,09,14,17
16) Enrichment Planting Planted wildlings	03,05,09,19	07,10,13,19

The plot in Piah Forest Reserve uses the same experimental layout as the ITTO plots. There are 3 replications per treatment (4 treatments of logging in virgin forest + control, no logging):

Treatment	Block Numbers Piah F.R.
1) Cut all > 30 cm DBH	04,10,12
2) Cut all > 45 cm DBH	02,03,13
4) Cut Dipt > 50 cm DBH Non-Dipt > 45 cm DBH	06,08,07
5) Cut Dipt > 65 cm DBH Non-Dipt > 60 cm DBH	01,09,15
8) Virgin, no cutting Control	05,11,14

Appendix IV :

The Fieldcards Version Number 2.

1 : The fieldcard for enumerating trees/poles.

2 : The fieldcard for enumerating saplings.

3 : The fieldcard for enumerating seedlings.

4 : The fieldcard for enumerating planted wildlings.

PROJEK BERSAMA MALAYSIA – ITTO (HUTAN ASLI / DIBALAK)

LOKASI HUTAN : CHERUL

BORANG 1

POKOK-POKOK ≥ 5cm Diameter

NO. KAD: 1

PEGAWAI REKOD : Svend Korsgaard

TARIKH : 29/6-93

PEMERHATIAN KUADRAT:

LAKARAN PETA KUADRAT (20m x 20m)

20m

20m

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A	Keadaan Hutan B	Rawatan C	Tahun D	E
C4	BLK	01	93	1

MAKLUMAT KUADRAT

Isi kandungan Kuadrat
Tiada = 0;
Ada Pokok ≥ 15 cm = 1(k.b.);
Ada Pokok ≥ 5 cm = 1 (k.k.)

6	Kelas Hutan 7 8 9	No. Rawatan 10 11	No. Petak 12 13	No. Kuadrat 14 15 16
1	523	01	03	001

MAKLUMAT POKOK DAHULU (T /B)

MAKLUMAT POKOK SEKARANG Tahun 93 Bulan 06

Nombor Pokok (17 18 19)	Kelas Pokok (20 21 22)	K. Dagang (23)	Kumpulan (24 25)	Spesis (26 27)	Perepang Paras Dada Luar Kulit (mm) (28 29 30 31)	Nombor Pokok (17 18 19)	Kelas Pokok (20 21 22)	CATATAN: NAMA POKOK	CATATAN	K. Dagang (23)	Kumpulan (24 25)	Spesis (26 27)	Perepang Paras Dada Luar Kulit (mm) (28 29 30 31)	Tinggi Batang Bersih (Meter) (32 33)	Gred Btg (34)	Status Pk (35)	Bentuk Sil (36)	Pencahayaan Sil (37)	Rosak Btg (38)	Rosak Sil (39)	Pepanjat (40)
001	111				0169	1	111	Meranti Bukit		1	01	02	0174	05	1	1	2	3			5
2	111				0315	2	112	Mempisang	broken	3	51	01	0316	00	0	0	0	0			0
3	112				0190	3	132	Perah	Dead broken	7	64	01	0190	00	0	0	0	0			0
5	131				0530	~~5~~	~~133~~	Closed	Record												
6	134				0930	~~6~~	~~134~~	Closed	Record												
7	111				0215	7	111	Kelampayan		8	37	01	0231	12	1	3	1	1			1
8	112				0161	8	112	Terap	broken	6	84	01	0162	00	0	0	0	0			0
9	122				0200	~~9~~	~~142~~	Closed	~~Record~~												
10	111				0153	10	111	Kubin		8	46	02	0212	06	1	3	1	3			1
11	113				0151	11	113	Mahang		8	46	01	0161	00	0	0	0	0			0
						12	111	Meranti Tembaga	New	1	02	14	0151	03	1	1	1	4			1
						13	111	Sesendok	New	8	80	01	0162	04	1	3	2	2			2

REKOD DITUTUP	NO/TAHUN			
	4/92	5/93	6/93	9/93

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI / DIBALAK)

LOKASI HUTAN : ____________________

BORANG 2

ANAK POKOK
150 cm Tinggi - 5 cm Diameter

NO. KAD: /

PEGAWAI REKOD :

TARIKH :

LAKARAN PETA KUADRAT (5m x 5m)

5m

5m

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan		Rawatan	Tahun	
A	B	C	D	E
				2

PEMERHATIAN KUADRAT:

MAKLUMAT KUADRAT
Isi kandungan Kuadrat
Tiada = 0;
Ada Anak Pokok = 1.

6	Kelas Hutan 7 8 9	No. Rawatan 10 11	No. Petak 12 13	No. Kuadrat 14 15 16

MAKLUMAT POKOK DAHULU (T /B)

MAKLUMAT POKOK SEKARANG Tahun Bulan

CATATAN :

Bil Anak Pokok (17 18 19)	Kelas Anak Pokok (20 21 22)	K. Dagang (23)	Kumpulan (24 25)	Spesis (26 27)	Perep. Paras Dada Luar Kulit (mm) (28 29)	Tinggi Pokok Dalam (dm) (30 31 32)	Bil Anak Pokok (17 18 19)	Kelas Anak Pokok (20 21 22)	NAMA POKOK	CATATAN	K. Dagang (23)	Kumpulan (24 25)	Spesis (26 27)	Perep. Paras Dada Luar Kulit (mm) (28 29)	Tinggi Pokok Dalam (dm) (30 31 32)	Ksn (33)
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									
A							A									

REKOD NO/TAHUN
DITUTUP

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI / DIBALAK)

LOKASI HUTAN : ____________________

BORANG 3

ANAK BENIH
15 cm - 150 cm Tinggi

NO. KAD: /

PEGAWAI REKOD :

TARIKH :

LAKARAN PETA KUADRAT (2m x 2m)

2m :

2m

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A | B	Rawatan C	Tahun D	E
			3

PEMERHATIAN KUADRAT:

MAKLUMAT KUADRAT

Isi kandungan Kuadrat
Tiada = 0;
Ada Anak Benih = 1.

6

Kelas Hutan 7 8 9

No. Rawatan 10 11

No. Petak 12 13

No. Kuadrat 14 15 16

MAKLUMAT POKOK SEKARANG Tahun Bulan

Bil Anak Benih			Kelas Anak Benih			CATATAN :		K. Dagang	Kumpulan		Spesis	
17	18	19	20	21	22	NAMA POKOK	CATATAN	23	24	25	26	27

MAKLUMAT POKOK SEKARANG Tahun Bulan

Bil Anak Benih			Kelas Anak Benih			CATATAN :		K. Dagang	Kumpulan		Spesis	
17	18	19	20	21	22	NAMA POKOK	CATATAN	23	24	25	26	27

REKOD DITUTUP NO/TAHUN

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI / DIBALAK)

LOKASI HUTAN : ____________________

BORANG 4

POKOK-POKOK
Ladang/Tanaman Mengaya

NO. KAD: /

PEGAWAI REKOD :

TARIKH :

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A	Keadaan Hutan B	Rawatan C	Tahun D	E
				4

PEMERHATIAN KUADRAT:

MAKLUMAT KUADRAT

Isi kandungan Garisan Tanaman
Tiada = 0;
Ada Pokok Tanaman = 1

6	Kelas Hutan 7	8	9	No. Rawatan 10	11	No. Petak 12	13	No. Garisan 14	15	16
	0	0	0							

MAKLUMAT POKOK DAHULU (T /B)

MAKLUMAT POKOK SEKARANG Tahun Bulan

CATATAN :

Nombor Pokok (17 18 19)	Kelas Pokok (20 21 22)	K. Dagang (23)	Kumpulan (24 25)	Spesis (26 27)	Perepang Paras Dada Luar Kulit (mm) (28 29 30 31)	Nombor Pokok (17 18 19)	Kelas Pokok (20 21 22)	NAMA POKOK	CATATAN	K. Dagang (23)	Kumpulan (24 25)	Spesis (26 27)	Perepang Paras Dada Luar Kulit (mm) (28 29 30 31)	Tinggi Pokok (dm) (32 33 34)	Ksn (35)	Bentuk Sil (36)	Pencah Sil (37)	Tapak (38)	(39)	Pepanjat (40)
																			0	
																			0	
																			0	
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REKOD DITUTUP NO/TAHUN

Appendix V : Layout of the Data-files Incorporating Fieldcards Version No. 1 and 2.

ITTO

LAYOUT OF DATA FILES

Corresponding columns for Fieldcard version 1/Version 2

TREES AND POLES

Description V.2	Rec. No.	STK	FCL	Tmt	Blk	Quad	Tr. No.	SIC	WQG	BOT	DBH	Hgt	Log Grade	Tree Status	Crown Form	Crown Dominance	Stem Damage	Crown Damage	Woody Climbers
File Column	1 - 5	6	7 - 9	10 11	12 13	14 - 16	17 - 19	20 - 22	23	24 - 27	28 - 31	32 33	34	35	36	37	38	39	40
Fieldcard column V.I L	0 0 0 0 0	1	0 0 0	A 14	15 16	0 17 18	B 1 - 3	0 0 B17	0	B 4 - 7	B 18 - 21	0 22	23	0	0	0	24	25	0
Fieldcard column V.I S	0 0 0 0 0	1	0 0 0	A 14	15 16	0 17 18	B 1 - 3	0 0 B18	0	B 4 - 7	B 19 - 22	0 23	24	25	26	27	0	0	0
Plantation L&S	0 0 0 0 0	1	0 0 0	A 14	15 16	0 17 18	B 1 - 2	0 0 B16	0	B 3 - 6	B 17 - 20	21 22	23	24	0	0	0	0	0

* STK: If field card contain no. trees STK = 0

SAPLINGS

Description V. 2	Rec. No.	STK	FCL	Tmt	Blk	Quad	Tr. No.	SIC	WQG	BOT	DBH	Hgt	Vg
File Column	1 - 5	6	7 - 9	10 11	12 13	14 - 16	17 - 19	20 - 22	23	24 - 27	28 29	30 - 32	33
Fieldcard Column L&S	0 0 0 0 0	*	0 0 0	A 14	15 16	0 17 18	B 2 - 4	0 0 B 16	0	B 5 - 8	17 18	19 - 21	22

* : If quad. contain minimum 1 sapl. STK = 1, if no. sapl. STK = 0

SEEDLINGS

Description V. 2	Rec. No.	STK	FCL	Tmt	Blk	Quad	Tr. No.	SIC	WQG	BOT
File Column	1 - 5	6	7 - 9	10 11	12 13	14 - 16	17 - 19	20 - 22	23	24 - 27
Fieldcard Column L&S	0 0 0 0 0	*	0 0 0	A 14	15 16	0 17 18	B 5 - 6	0 0 0	0	B 1 - 4

L: Fieldcard for " Logging in Virgin Forest "   S: Fieldcard for " Silvicultural Treatment

Appendix VI : References:

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" - " - - " - , 1993 a: "Procedure for Establishment of Study Area in Virgin Forest", Joint Project between Malaysia - ITTO on Forest Management of Natural Forest in Malaysia, PD 10/87 (F) Series No. 1, Management Unit, Kuala Lumpur, 45 pp.

" - " - - " - , 1993 b: "Procedure for Establishment of Study Area in Logged-over Forest", Joint Project between Malaysia - ITTO on Forest Management of Natural Forest in Malaysia, PD 10/87 (F) Series No. 2, Silviculture Unit, Kuala Lumpur, 35 pp. + 12 App.

Korsgaard, S., 1992 a: "Manual of Instructions for the Field Enumeration", Forest Inventory and Management Systems as Part of Forest Resources Conservation Programme, UNDP/FAO/MAL/89/001, Field Document no. 2, Forest Dept. HQ., Kuala Lumpur, 56 pp.

- " - , 1992 b: "Manual for Field Data Processing. Computer Programme Instructions / Flowchart for Computer Processing", Forest Inventory and Management Systems as Part of Forest Resources Conservation Programme, UNDP/FAO/MAL/89/001, Technical Notes no. 6.1 / 6.2, Forest Dept. HQ., Kuala Lumpur, 79 pp / 7pp.

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Appendix E

SUGGESTION FOR ENHANCEMENT OF THE FIELD ENUMERATION

ITTO/MAL/PD 10/87 (F)
Technical note No. 2

JOINT PROJECT BETWEEN MALAYSIA - ITTO

ON

"FOREST MANAGEMENT OF NATURAL FOREST IN MALAYSIA"

PROCESSING OF FOREST RESEARCH DATA

SUGGESTION FOR ENHANCEMENT OF THE FIELD ENUMERATION

by

Svend Korsgaard

(Consultant)

Management Unit

Forestry Department Headquarters

Kuala Lumpur

APRIL, 1993 (DRAFT)

PROCESSING OF FOREST RESEARCH DATA

PROCEDURE FOR DATA ENTRY

by

Svend Korsgaard

(Consultant)

Table of Contents

1. Introduction.

The present form of the field card and the items to be enumerated (Unit Pengurusan Hutan, 1991 and Unit Silvikultur, undated) may be enhanced to a more efficient field card layout, where the data files, as entered in the computer, can be directly used in the processing.

Some of the items recorded, like the soil and terrain characteristics, need only to be recorded once. Other items, now recorded individually, may be combined in one code. The different items scored, for the individual trees in the silvicultural treatment plots and the logging of virgin forest plots, should be combined so that only one type of field card is used for all plots.

The field card layout and the items to be recorded will be similar to those recorded by the FAO management study (Korsgaard, 1992) as well as the permanent sample plots established by each State (Unit Pengurusan Hutan, 1992).

The original design was developed during an earlier FAO project in Sarawak during the period 1978 to 1981 (Hutchinson, 1982 and Korsgaard, 1982).

Below is a description of each new field card entry and the corresponding entries for the present field card.

2. Suggestion for Enhanced Layout

PROPOSED NEW FIELD CARD LAYOUT	PRESENT FIELD CARD
COLUMN	COLUMN
Written information, not part of the computer file.	A 1 to 13, date and place
(Column 1 to 5 will contain a file record number)	
6. Quadrat stocked or empty (See below)	Not recorded
7-9 Forest Class (See below)	Combination of columns A 34-45 and additional information not presently recorded.
10-11 Treatment number	A 14 Treatment number
12-13 Plot number	A 15-16 Plot number
14-16 Quadrat or plant line number	A 17-18 Quadrat or plant line number
17-19 Tree number/Seedling count Palm/Bamboo count (See Below)	B 1-3/ B 5-7/ B 1-2 Tree number/ Seedling count/ Wildling plant number.

20-22 Stem Identity Class (See below)	B 17/ B 16 Tree Class.
23 Wood Quality Group (See details of groups below)	Not recorded.
24-27 Botanical code (List to be extended)	B 4-7/ B 5-8/ B 3-6 Species code
28-31 Diameter Breast Height	B 18-21/ B 17-18/ B 17-20 Diameter DBHob
32-33 Height in Meters (See below)	B 22 Number of logs/ B 19-21 Sapling height in decimeters/B 21-23 Wildling height in decimeters.
34 Log grade (See below)	B 23 1st log quality.
35 Status crop tree	(S) B 24 Status crop tree
36 Crown form (See below)	(S) B 25 Crown form
37 Crown illumination (See below)	(S) B 26 Crown dominance
38 Stem damage	(L) B 24 Stem damage
39 Crown damage	(L) B 25 Crown damage
40 Woody climbers on tree (See below)	Not recorded
	A 19 - 33 Terrain and geology information, need only to be recorded once. It is now kept in a separate file for future processing.

3. Description of the New Codes

3.1 Quadrat Stocked or Empty.

The code "quadrat stocked" provide information as to whether the quadrat contain any tree or pole (alive or dead), palm or bamboo to be enumerated. Alternatively, there is no such tree etc. to be enumerated, i.e. the quadrat is considered empty.

Two code numbers are used: (0, and 1):

YES, tree ≥ 15.0 cm = 1 :

If the Quadrat is stocked and trees DBHob of 15.0 cm and above are to be measured the code is = 1. This for Quadrats 1, 2, 3, 4, 5, 6, 10, 11, 15, 16, 20, 21, 22, 23, 24, 25.

YES, trees and poles ≥ 5.0 cm = 1 :

If the Quadrat is stocked and trees and poles of DBHob of 5.0 cm and above are to be measured the code is = 1. This is for Quadrats 7, 8, 9, 12, 13, 14, 17, 18, 19.

NO = 0 :

If no tree, pole, palm or bamboo appear to be measured in a Quadrat, the Quadrat is empty and the code is = 0

If the quadrat is empty, the remaining information is recorded like Forest Class (FCL) and identification of the Quadrat.

3.2 Forest Class (FCL)

The term Forest Class (FCL) is used to distinguish this classification from the Forest Type used by the inventory. The classification is derived from the system developed by Hutchinson (1982).

In the field, the classifications are made according to the following instructions:

The classification into "Forest Classes" (FCL) is applied to the individual 20 m by 20 m Quadrat. Areas of this size have a high probability of being homogeneous. At least they are small enough for the recorder to see clearly what they contain. The classification is not intended to be applied to larger areas of forest which are varied in composition.

The scoring of FCL is done by looking at the situation within the quadrat, on the ground and in the air directly above the quadrat.

The codes to be used are given in Tables 1 and 2 overleaf.

FOREST CLASS, FCL

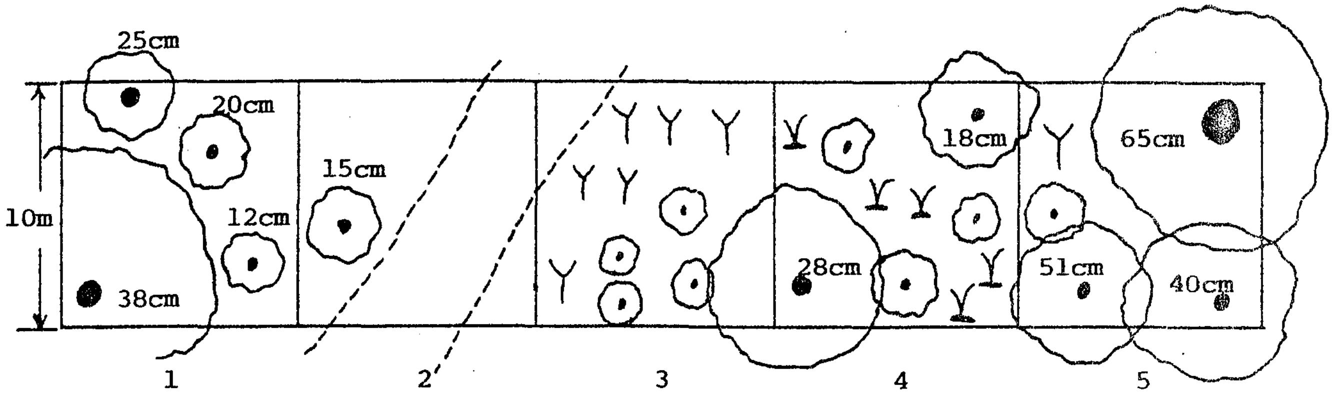
	Over Head Crown Cover of trees> 30 cm DBH from inside or outside Quadrat First and Second Code Digit		
	0 - 33% X1X Full sun light	33 - 66% X2X Part shaded	66 - 100% X3X Complete shade
Mature Forest 1XX Tree >50 cm DBH, SIC = 111, and Log Grade 1 or 2	11X	12X	13X
Immature Forest 2XX Trees 30 cm <50 CM DBH, SIC = 111, and Log Grade 1 or 2	21X	22X	23X
Immature Forest 3XX Trees 30 cm <50 cm DBH, SIC = 111, at Log Grade 1 or 2 Dominance of Pioneer spp.	31X	32X	33X
Regenerating Forest 4XX Trees <30 cm DBH, SIC = 111, and Log Grade 1 or 2	41X	42X	43X
Regenerating Forest 5XX Trees <30 cm DBH, SIC = 111, and Log Grade 1 or 2 Dominance of Pioneer spp.	51X	52X	53X
Temporary Opening 6XX Few or no trees ≥15 cm DBH, SIC = 111, at Log Grade 1 or 2	61X	62X	63X
Temporary Opening 7XX Few or no trees ≥15 cm DBH, SIC = 111, and Log Grade 1 or 2 Dominance of pioneer spp.	71X	72X	73X
Temporary Opening due to 8XX human activity, cultivation, and burning	81X	82X	83X
Unproductive long term open 9XX space, natural or man-made	91X	92X	93X

Table 1.

FOREST CLASS, FCL

Third Code Digit	% of Area Covered	Code
No Impeders, good site	>75 %	XX1
Vines and Climbers are impeding	>25 %	XX2
Palms, stem/stemless, clusters, all species	>25 %	XX3
Bamboo present	>25 %	XX4
Bananas, large Gingers	>25 %	XX5
Ferns, Bracken, Lalang	>25 %	XX6
Fallen trees, crowns, debris, burning	>25 %	XX7
Water, Swamp, slope, rock, poor site	>25 %	XX8
Track, Road, Landing, pool	>25 %	XX9

Table 2.



Quadrat 1	FCL :	221 :	Immature forest, 66% - 35% crown cover. No Impeders, good site.
Quadrat 2	FCL :	919 :	Unproductive, long term open space, 33 - 0% crown cover, Track, Road, Landing.
Quadrat 3	FCL :	715 :	Temporary Opening, Dominance of Pioneer spp., 33 - 0% Crown cover, Bananas, Larger gingers.
Quadrat 4	FCL :	513 :	Regenerating Forest, Dominance of Pioneer spp., 33 - 0% crown cover, Bertam Palms.
Quadrat 5	FCL :	131 :	Mature Forest, 100 - 66% Crown cover, No impeders, good site.

Fig. 1. Examples of Forest Classes

Description of the Forest Class (FCL) codes:

3.2.1 First Code Digit:

The first code digit gives a general description of the quadrat.

1 : Mature Forest, Tree ≥50 cm DBH.

There is at least one tree of any species having Stem Identity Class (SIC, see below) of 111 and Loggrade 1 or 2 with a DBH of 50 cm or more inside the quadrat.

2 : Immature Forest, Trees 30 cm <50 cm DBH.

There is at least one tree of any species having SIC 111 and loggrade 1 or 2 with a DBH of between 30 cm and 50 cm inside the quadrat.

3 : Same as 2, except that, within the quadrat among the poles >5 cm DBH, there is a dominance of pioneer species like Macaranga, etc.

For the remaining classes, 4, 5, 6, 7 and 8, the Forest class that occupy 50% or more of the quadrat is to be scored. If there are more than two classes present score the most dominant class.

4 : Regenerating forest, Trees <30 cm DBH

The are no trees >30 cm of SIC = 111 and log grade 1 or 2 inside the quadrat. But there are trees of SIC 111 with a diameter between 15 cm and 30 cm DBH. At least 1 tree must be inside the quadrat.

5 : Same as 4, except that within the quadrat among the trees and poles there is a dominance of pioneer species.

6 : Temporary Opening, Few or no trees >15 cm DBH

The quadrat is either without trees or there are only a few trees ≥ 15 cm DBH. Poles, seedlings or saplings may be present or the conditions of the site is such that regeneration will appear within a few years.

7 : Same as 6, except that within the quadrat there is a dominance of pioneer species of poles, saplings or seedlings.

8 : Same as 6, except that within the quadrat, the open space is created by human activity like logging, logging debris, crowns, shifting cultivation, burning, garden etc. If left undisturbed it will regenerate naturally, f. ex: seedlings through logging debris.

9 : Unproductive, Long term open space

There may be a few trees $\geq$15 cm but more than 50% of the quadrat is considered unproductive and will remain unproductive for many years. It may be tractor track, road, landing, stream, pool, swamp, steep slope, rocks, alang-alang, palms, bamboo, rattan, banana, fern, etc. The actual situation is described by the third digit.

3.2.2 Second Code Digit

The second code digit is used to describe the tree crown cover of the quadrat. Only the crowns from living trees 30 cm DBH and larger of any species are considered. The trees may be based both inside and outside the quadrat.

Look into the air above the quadrat and if the crown of trees $\geq$30 cm DBH cover:

from 0 to 33 % of the Quadrat score: Code = 1

from 33 to 66 % of the Quadrat score: Code = 2

from 66 to 100 % of the Quadrat score: Code = 3

3.2.3 The Third Code Digit

The third code digit is used to describe the ground condition of the Quadrat, roads, etc. and the presence of impeding vegetation like palm, vines, banana, etc.

1 : No impeders, good site

Score only if 75% or more of the ground cover of the quadrat is free of tracks, roads and impeding vegetation and the site has a good productive capacity. If Wines and climbers are actually impeding the growth of some trees but the extent is difficult to assess, probably less than 25%, use code 2.

2 : Vines and Climbers Impeding

Score if Vines and/or climbers, including rattan, impedes 25% or more of the quadrat. However, if the Vines etc. actively impede the growth of trees inside the quadrat use this code even if the area is less than 25%.

3 : Palms, Stem/Stemless, Clusters

Score if the fronds of Palms, both single stemmed, stemless or in clusters, cover more than 25% of the quadrat even if the palms are rooted outside the quadrat.

4 : Bamboo Present.

Score if bamboo cover more than 25% of the quadrat even if the bamboo is rooted outside the quadrat.

5 : Bananas, Large Gingers

Score if Bananas and/or large gingers cover more than 25% of the quadrat. Include only the ginger if it actually impede the regeneration of seedlings and saplings.

6 : Ferns, Bracken, Lalang

Score if ferns, bracken or/and Lalang grass cover more than 25% of the quadrat.

7 : Fallen Trees, Crowns, Debris

Score when fallen trees, crowns, debris from either natural causes like windfall or from logging activities, cover more than 25% of the quadrat.

8 : Natural impediment : Water, Swamp, Slope, rock, poor site

Score if more than 25% of the quadrat is naturally unproductive due to stream, stream bed, natural water pool, swamp, steep slope, rocks or a natural poor site without vegetation.

9 : Man made impediment : Track, Road, Landing, pool

Score if more than 25% of the quadrat is unproductive due to the effect of logging activities, present as well as before. These are tractor tracks, skid trails, roads, landings, and impounded water or pools due to road construction and blockage of natural water flow. However logging debris is considered under code 7.

In the case where more than two classes are present, score the class that will have the most long term effect on the development of the forest or the class considered most adverse to the growth of the trees.

It is difficult to give a fixed priority list. The final scoring will be left to the judgement of the field crew leader.

3.3 Consecutive Tree Number.

The consecutive tree number is recorded as usual for trees and poles. However, for palms and bamboo there is no consecutive individual numbering. Rather the number of clumps or stems by species group is counted and recorded similar to the seedling count. The counted number of stems/clumps/clusters per species group is recorded in these positions of the fieldcard.

3.4 Stem Identity Class (SIC)

It is strongly recommended that all trees or stems are recorded whether they are living or dead, broken, fallen or cut. The information collected is very useful for the overall ecological analysis of the data, particularly when estimating logging damage or damage caused by local felling activities, shifting cultivation, silvicultural treatments etc.

The Stem Identity Class consists of a 3-digit code number constructed in the following manner:

The first digit:

1 : Tree species, Trees, DBHob = 15.0 cm or larger.

1 : " " , Poles, DBHob = 5.0 cm up to > 15.0 cm.

4 : Palm species, large palms, total height 3 meters or larger.

4 : Bamboo, total height 3 meters or larger.

The second digit:

1 : Stem living, standing.

2 : Stem living, fallen.

3 : Stem dead, standing.

4 : Stem dead, fallen.

The third digit:

For Trees:

1 : Complete stem with crown.

2 : Broken stem, point of breakage 4.5 meters or higher above the ground.

3 : Broken stump, point of breakage up to 4.5 meters above the ground.

4 : Cut stump, stem cut by human activity: logging, shifting cultivation etc. no height limits up or down.

5 : Stem ringed, girdled or poison girdled as part of silvicultural treatment.

9 : Not found, stem recorded in previous enumeration, now disappeared without trace.

NOTE : Only consider that part of the stem to which the root is still attached.

Do not consider broken or fallen dead stems that are totally decayed.

Use the classification of broken stem/stump SIC = 112 or 113 when the main crown is broken off and only a few branches and coppice survive. If the breakage is in the crown itself score SIC = 111 and use Crown Form codes (CF) = 4 or 5 to describe the damage.

Palms :

The third digit indicate the growth habit of the palms:

1 : Single stemmed palm.

2 : Palms with a habit of growing in clusters or clumps.

3 : Stemless palms.

NOTE : Some palm species start as being stemless but later develops a stem. Score the actual growth habit as encountered.

Bamboo :

4 : All species of bamboo.

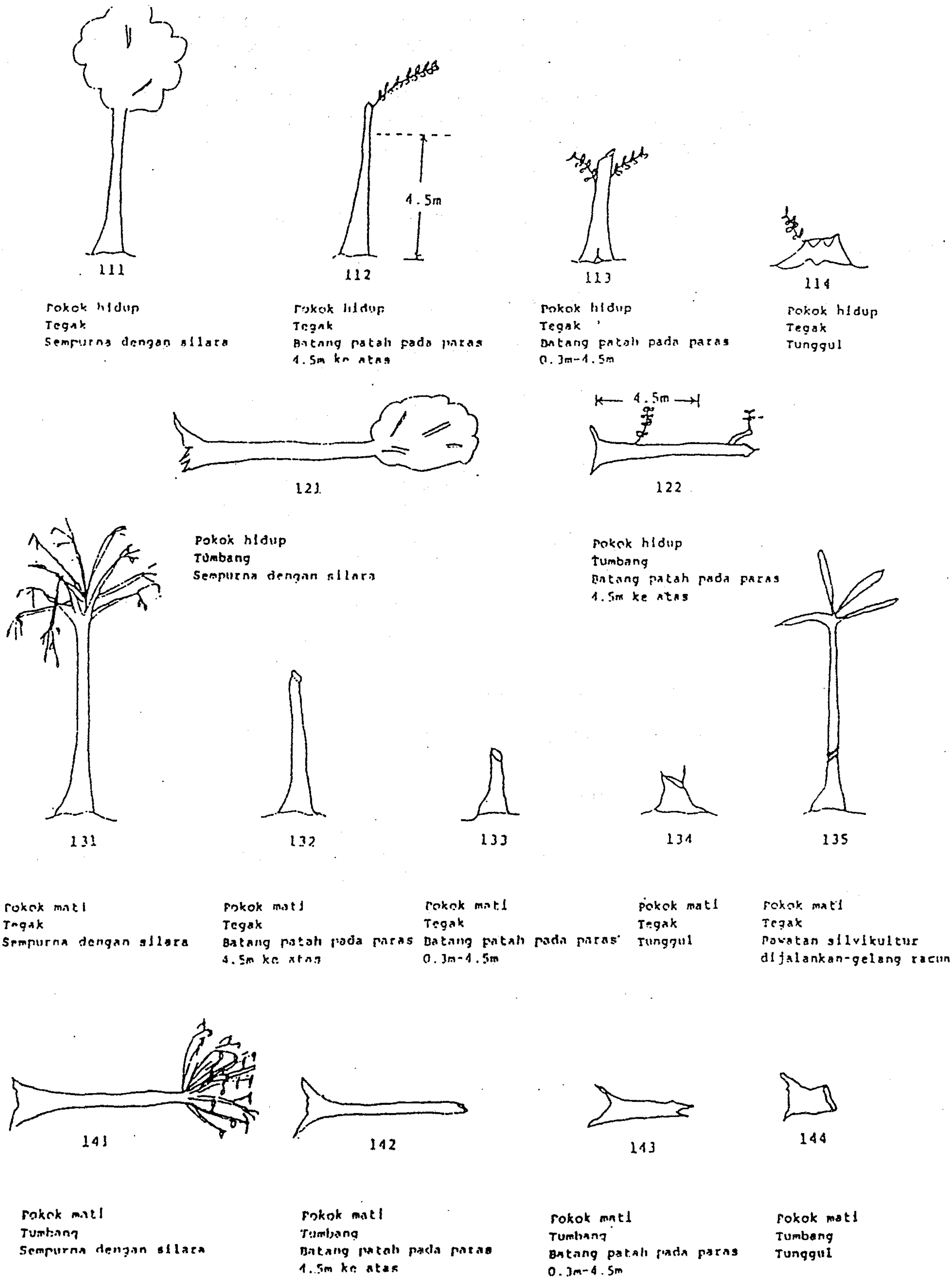
The complete table of stem identity classes can then be constructed, refer to Table 3 below.

	XX1	XX2	XX3	XX4	XX5	XX9
	Compl. Stem	Broken Stem	Broken Stump	Cut Stump	Girdl Stem	Not Found
a) TREE SPECIES, LIVING STEMS						
Standing	111	112	113	114	115	(119)
Fallen	121	122	123	124	125	(129)
b) TREE SPECIES, DEAD STEMS						
Standing	131	132	(133)	(134)	135	(139)
Fallen	(141)	(142)	(143)	(144)	(145)	
	Single Stem	Cluster Clump	Stem-less	Bamboo		
c) PALMS/ BAMBOO LIVING						
Standing	411	412	413	414		

Table 3. Table of Stem Identity Classes.

The codes placed in parentheses are "Record to be closed". That is, when a stem reach a SIC code in one of those fields, the stem no longer occupy an important position in the forest. The stem is not to be recorded in future enumerations. Refer to section 3.13.

Fig. 2. Examples of Stem Identity Classes (SIC)



3.5 Wood Quality Group (WQG)

For most practical purposes it is sufficient to present the results of the analysis in some broad groups depending on the commercial value of the trees.
However, for silvicultural purposes it is important to know which species are becoming dominant when the forest is opened up. This may be both commercial or non-commercial species as well as the light-demanding pioneer species.

The Wood Quality Groups follow the groupings used by the Forest Department.

WQG		Description	
0	:	Dead, unidentified stems.	
1	:	Dipterocarp, Meranti	Fully Marketable
2	:	Dipterocarp, Non-Meranti.	Fully Marketable
3	:	Non-Dipt. Light Hardwood.	Fully Marketable
4	:	Non-Dipt. Medium Hardwood	Fully Marketable
5	:	Non-Dipt. Heavy Hardwood	Fully Marketable
6	:	Other species, partially marketable.	
7	:	Other species, not presently marketable.	
8	:	Light-demanding, pioneer species, "weeds".	
9	:	Palms/Bamboo.	

The wood quality group is part of the botanical identification and does not indicate the actual commercial status of the tree being enumerated. The Log Grade of the tree, which is explained in section 3.8 below, indicate the potential for the tree to yield a commercial log.

3.5.1 WQG, Group, Division.

For a detailed analysis of the data, the actual botanical identification of the trees are given by a five-digit code number. There is one digit available for the Wood Quality and two digits available for each of Group and Division.

The Wood Quality Group (WQG), the Group and the Division Code give a unique identification of each tree to the level of genera.

For the purpose of this investigation, the emphasis is focused on the commercial value of the forest. WQG's "1", "2", "3", "4" and "5" are only assigned to those species generally accepted as fully marketable. Those species of partial marketability and with a low or no market value, are given WQG "6" or "7".

However, the species list used by the Department is not detailed enough for the group: miscellaneous species. The group contains fast growing pioneers as well as slow growing shade tolerant trees. For a correct assessment of the ecological development of the forest it is important to have specific information of this large group of species. There is room in the present species list to expand the codes now grouped together under "99.99". The number series from "90.00" to "99.98" is available.

Stems that cannot be identified are given the code "7.99.99".

The Wood Quality code for palms and bamboo is "9".

3.6 Diameter Breast Height over bark (DBHob).

For trees and poles the diameter is measured and recorded as usual.

For palms and bamboo, there is no diameter to record, instead, for purposes of programming convenience, a fixed diameter of 150 mm is inserted into the file for palms and bamboo.

3.7 Trunk Height.

In order to estimate the volume the height is measured on selected trees and estimated on all other trees. Height is only taken on trees with SIC = 111 and a diameter of 15.0 cm and above. The height is measured as clear bole height from the ground up to the crown point.

The point of the crown is at the point where the trunk divides into branches and where the tree will be cut during normal felling operations. Minor branches may occur below the crown point. Major branches may reduce the Trunk Height if they occur less than 2.5 meters below the obvious crown point.

3.7.1 Trunk Height, measured

The selection of trees where the Trunk Height is to be measured is done as follows:

In the Quadrats where trees with a DBHob of 15.0 cm and above are measured (i.e. quadrats no. 1, 2, 3, 4, 5, 6, 10, 11, 15, 16, 20, 21, 22, 23, 24, 25.) the trunk height is measured to the crown point on tree no. 5 or less, with SIC = 111 and log grade 1 or 2. The measurement must be accurate using a good quality instrument.

3.7.2 Trunk Height, estimated

On all other trees and poles with SIC = 111 and DBHob $\geq$ 5.0 cm the trunk height is estimated. This is done using the height of the measured trunks as a guidance and a gauge stick of 2 meters or 6 meters in length against which the trunk height is estimated.

3.8 Log Grade.

The log Grade is recorded for all living, standing, complete trees and poles (SIC = 111) $\geq$5 cm DBHob.

The classification of Log Grade is used to give an indication of the timber production potential of the forest. It is similar to the quality of the first log presently scored, but takes the whole trunk into account, and does not differentiate between peeler log and saw log, as that also depend on species.

Each tree is classified according to whether it, immediately or in the future, will be able to yield at least one straight, well-formed and sound piece of clear-bole. The log should be acceptable by the industry for conversion into sawn timber or veneer, irrespective of the species of the log.

In the future more and more species will be accepted by the log market. The log grade is, therefore, not in any way connected to the botanical identification of the tree.

The classification is made by assessing the status of the tree at the time of recording.

There are five Log Grade Classification:

Code No.	Description
1 :	Good Loggrade, no defects.
2 :	Acceptable Log grade, some defects or small size.
3 :	No Log, Stem Deformed
4 :	No Log, Stem Damaged
5 :	No Log, Stem Decayed

1 : Good Loggrade, no defects.

The bole of the tree is straight and well-formed, without defects, injury or decay from the end of buttress to crown point. The tree may be of commercial size now or will in the future grow to commercial size. Minimum acceptable trunk height is 4 meters, if the trunk has no defects but is shorter than 4 meters use code 2.

2 : Acceptable Log grade, some defects or small size.

The tree contains at least one straight and well-formed section of clear bole that either now or in the future will yield one piece of sawlog. The rest of the bole contains some deformity, injury, damage or decay. If the tree has no defects but the trunk height is less than 4 meters, use this code.

3 : No Log, Stem Deformed

The tree does not contain any section of the bole which is of sawlog quality neither now nor in the future. The reason is that the bole is bend, crooked, fluted, branched, twisted, spiralled or with heavy buttresses. Use this code for trees with a heavy lean >45°.

4 : No Log, Stem Damaged

Physical injury to the stem has damaged the bole to the extent that no possibilities remain for using the bole as a sawlog, neither now nor in the future.

5 : No Log, Stem Decayed

Due to decay or rot the tree does not contain one sound section of the bole 5 meters long. In the cases where a tree is both deformed and/or damaged and/or decayed, give priority to recording the decay. In cases where heart rot or hollow stems are suspected, but cannot be positively verified from looking at the tree from the outside, disregard the suspicion and record the tree as sound. No boring is to be done.

3.9 Crown Form (CF).

The crown form is recorded for all living, standing, complete trees and poles (SIC = 111), ≥5 cm DBH.

The crown form is important for the growth of the tree. The distribution of crown forms before and after a logging operation also indicate the amount of damage inflicted on the crowns of the remaining trees.
The classification is the same as at present with the addition of coppice crown.

There are five Crown Form classes :

Code No.	Description
1 :	Complete Circle. Circular, symmetrical and complete or almost complete.
2 :	Half Circle. Distinctly asymmetrical or thin, but capable of improvement if room is available or provided by treatment.
3 :	Less Than Half Circle. Unsatisfactory, with extensive dieback, strong asymmetry, small but likely to survive.
4 :	Only a Few Branches. Suppressed, degenerating or badly damaged, not likely to grow or survive.
5 :	Mainly coppice. Main part of crown originating from coppice sprung from broken branches and the trunk after severe damage.

If the crown is broken off but the tree is still alive record the appropriate Stem Identity Class (SIC = 112 or 113).

3.10 Crown Illumination or Dominance (CI).

The crown illumination or dominance is recorded for all living, standing, complete trees and poles (SIC = 111), ≥ 5 cm DBH.

The crown illumination describes the amount of sunlight received by the crown and is one of the significant factors affecting the growth of the tree. The codes for crown dominance are essentially the same.

When estimating the influence of neighbouring vegetation, disregard dead and broken trees, but do assess the shade given by palms and bamboo.

There are five Crown Illumination/dominance classes :

Code No.	Description
1 :	Emergent/ Dominant. Full light reaches the sides of the crown at an angle of at least 45 degrees from the vertical.
2 :	Full Overhead Light/ Co-dominant. Upper part of crown fully exposed to overhead light, but sides of crown do not receive full light. Surrounding co-dominant trees of good quality.
3 :	same as 2 except surrounding co-dominant trees are mainly of poor quality or maybe palms and bamboo.
4 :	Mostly Sidelight or no Direct Light/ Suppressed. The crown receives no vertical light. Part of the crown may receive side light. Overtopped by trees of good quality.
5 :	same as 4, except surrounding co-dominant trees are mainly of poor quality or maybe palms and bamboo.

3.11 Impeding Vines and Climbers

The impeders are recorded for all living, standing complete trees and poles (SIC = 111) of DBHob 5 cm or larger.

The purpose of this classification is to assess the way in which impeders such as woody climbers and vines invade the different forest types and to see how logging and silvicultural treatment effect the occurrence of impeders.

The classification is as follows:

Code No.	Description
1 :	Impeders not Present. No Climbers or Vines on the Tree.
2 :	Impeders Present but not Affecting the Tree. Climbers and/or vines are present, but they do not hinder or restrict the normal growth and development of the tree and its crown.
3 :	Impeders Restricting the Growth. The normal growth and development of the tree is restricted by impeders growing on the trunk or competing for light in the crown. However, the continued life of the tree is not yet affected.

4 : <u>Impeders Seriously Affecting the Growth</u>.

It left unchecked, the impeders are likely to be seriously deforming or even killing the tree. Branches are already dead in the crown or the trunk has already been deformed.

5 : <u>Impeders Recently Cut and Dead</u>.

A few may still be living, but as long as they no longer harm the tree, use this code to indicate a successful treatment by climber cutting.

6 : <u>Impeders Recently Cut but Treatment not Successful</u>.

Remaining climbers whether living or dead, still restrict the growth of the tree.

Note : The effects of the strangler figs, if found, are recorded under this classification.

3.12 Enumeration of Large Palms and Bamboo.

The Enumeration of palm species should be included in this study. Measurements for large palms are only to be recorded for living palms; (SIC = 411, 412 or 413):

SIC:

411 - Single stem palms where the top of the fronds reach more than 3 m or more above ground.

412 - Palm cluster or clumps where the top of the fronds reach more than 3 meters above ground.

413 - Stemless palms, where the top of the fronds reach more than 3 meters above ground.

414 - Bamboo, where the top of the leaves reach more than 3 meters above ground

For all palms/bamboo: single stem, cluster, clumps and stemless (palms SIC = 411, 412, 413 and bamboo SIC = 414) record the species name (vernacular name) count the number of stems for single stem palms or the number of clusters or clumps for other palms and bamboo of the same species and write the number under "consecutive tree number" and write "0150" in the columns for DBH. Palms and bamboo are not to be individually numbered.

3.13 Record Closed.

For permanent sample plots, in order to record in an orderly manner the final entry of a stem, which no longer occupies a position in the stand, the following procedure for "Closing the record" of that stem should be followed.

When a stem, due to a change in stem identity class, enters one of the bracketed or cross-hatched SIC-classes in the table, the record for that stem is to be closed. That is, enter the stem on the fieldcard in the usual manner writing the DBHob of the latest enumeration. Then, at the bottom of the fieldcard write the consecutive stem number and the year of the enumeration. Following that, no further records will be made of that particular stem in future assessments.

The consecutive stem number of any stem thus entered in "Record Closed" should never be used again in that Quadrat.

Write the words "Records Closed" in the line for the stem under the stem descriptions. The record is to be closed when the stem enters one of the following SIC classes :

Tree, not found	:	119, 129, 139
Tree, dead standing, broken stump or cut stump	:	133, 134
Tree, dead fallen, all types	:	141, 142, 143 144, 145

3.14 Recording Saplings, Seedlings and Wildlings.

There are a few enhancements proposed for these stems. For saplings the mixing of diameter and height is confusing.

It would be more consistent if the definition of a sapling was given as having a diameter DBHob from including 20 mm up to 50 mm, and seedlings from 30 cm height up to 20 cm diameter DBHob.

This clarification will also make the output tables consistent, where the sapling population can be added to the pole population.
As far as planted wildlings are concerned, their height development is important. It is therefore proposed that the field card layout used for trees and poles be used for the planted wildlings as well, as it is the intention to follow the development of the plants from the seedling stage over saplings to poles and, eventually, mature trees.

Wildlings that were not planted must be given a specific Stem Identity Class to calculate correctly the survival rate among the wildlings actually planted. Stem Identity Class 318 is proposed.

SIC 318 : Wildling not planted

4. Discussion.

Although the enhancements suggested above looks like a major chance, the actual difference between the suggestions and the present system are in fact minor. The amendments will, however, facilitate a more detailed analysis of the data and the system of enumeration will be uniform and therefore directly comparable between the different enumerations carried out.

There are presently 11 field cards used in the study, the suggestion will reduce this to ideally 1 field card layout, but for practical reasons 3 formats will be proposed. One for trees and poles, one for saplings and one for seedlings.

It is the experience that the enumeration of seedlings and saplings in small subplots is very difficult, not least to the 'blow-up-factor' of 278 for seedlings and 44 for saplings. One plant missed or wrongly included has a large effect. Furthermore, the representation error is difficult to assess.

It is the suggestion that seedlings and saplings be excluded from this study and a dedicated special study of seedling and sapling development with respect to various ecological factors be carried out separately.

5. REFERENCES

Hutchinson, I.D., 1982: "Field Enumeration of Permanent Sample Plots in the Mixed Dipterocarp Forest in Sarawak", UNDP/FAO/MAL/76/008, Field Document No. 16, The Forest Department, Kuching, 136 pp.

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APPENDICES :

I. The Fieldcard for Trees and Poles

II. The Field Code Descriptions

III. The Species List

Appendix F

MANUAL OF INSTRUCTIONS FOR ENUMERATING THE PERMANENT ITTO EXPERIMENTAL PLOTS

PROCESSING OF FOREST RESEARCH DATA

MANUAL OF INSTRUCTIONS FOR ENUMERATING THE PERMANENT ITTO EXPERIMENTAL PLOTS

by

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1. INTRODUCTION

This manual gives the instructions for enumerating the permanent sample plots established by the Joint Malaysia - ITTO project on "Forest Management of Natural Forest in Malaysia".

The establishment and design of the permanent experimental plots are given in two publications by the Forestry Department Headquarters, (1993 a and b). The instructions for the enumerations up till 1993 using the first version of the fieldcard are similarly given in two papers by the Department (Forestry Department Headquarters, 1990 and 1991).

It has been agreed by the Technical Working Group for the ITTO project to enhance the system of enumeration and to adopt a new version for the fieldcard (Korsgaard, 1993).

The study, to which this manual of instructions refers, is made in order to establish guidelines for forest management and silvicultural activities. Since the logging operation is part of forest management, the study includes areas harvested by various intensities of felling and areas previously harvested and then silviculturally treated. For further details of the establishment procedure, please refer to the two papers by the Forestry Department Headquarters mentioned above.

The enumerations follow similar procedures previously established to study the Mixed Dipterocarp Forest in Malaysia (UNDP/FAO/MAL/76/008 "Forest Development Project, Sarawak", Field Document No. 16, Hutchinson, 1982, and UNDP/FAO/MAL/89/001 "Forest Inventory and Management Systems as part of Forest Resources Conservation Programme", Field Document No. 2, Korsgaard, 1992).

2. DESIGN OF THE EXPERIMENTS

The experimental layout is that of a stratified random block design of 32 blocks for experimental logging in virgin forest and 20 blocks for the silvicultural treatment of logged-over forest. Inside each block the actual permanent sample plot consists of a square 100 meters by 100 meters in size making 1 hectare. The 1 ha. sample is located inside the main block such as not to be obstructed by streams or main logging roads.

2.1 The Enumeration Quadrat

The basic unit of enumeration is a square, 20 meters by 20 meters, called a Quadrat.

Quadrats are marked on the ground by permanent plastic tubes. Corrections are made for slope.

Note: All posts and stakes must be cut outside the Quadrats and outside the sample plot. Disturbance of the Quadrat should be as little as possible, no line clearing, no cutting, no breaking, no trampling etc. This is particularly important for the sapling and seedling subplots.

2.2 Identification of the Experiments and the Computer Datafiles.

In order to uniquely identify each Experiment and the Treatments applied, the following system is used:

Each forest locality is given a five-character code consisting of two letters, the letters refer to the main experimental area.

'Logging in Virgin Forest' :

"SL" : Sungei Lalang Forest Reserve, Selangor.
"LE" : Lesong Forest Reserve, Pahang.
"PI" : Piah Forest Reserve, Perak. (Not an ITTO experiment).

'Silvicultural Treatment of Logged-over Forest' :

"CH" : Cherul Forest Reserve, Terengganu.
"KS" : Kledang Saiong Forest Reserve, Perak

Each treatment is given an individual number:

'Logging in Virgin Forest' :

01 : CUT ALL > = 30 CM
02 : CUT ALL > = 45 CM
03 : CUT DIPT>=35/ NON-DIP.>=30 CM
04 : CUT DIPT>=50/ NON-DIP.>=45 CM
05 : CUT DIPT>=65/ NON-DIP.>=60 CM
06 : CUT DIPT>=75/ NON-DIP.>=70 CM
07 : CUT ALL>=30 CM/PLANT WILDLING
08 : NO LOGGING, VIRGIN CONTROL

'Silvicultural Treatment of Logged-over Forest' :

11 : CLIMBER CUTTING
12 : GIRDLING + CLIMBER CUTTING (GCL)
13 : GCL (+ ENRICHMENT PLANTING)
14 : CUT ALL>=30 CM/PLANT WILDLING
15 : CONTROL, LOGGED, NOT TREATED
16 : ENRICHMENT PLANTING

NOTE : The code numbers for 'Silvicultural treatment of logged-over forest' are different to those given in previous papers in order to make them unique.

The computer filename is constructed by the experimental area code, the letters 'TMT' (for treatment), the treatment code numbers, a dot ('.') and the year of enumeration and a number giving the size of the trees enumerated :

1 : Trees/poles enumerated in the whole Quadrat.
2 : Saplings enumerated in a 5 meters by 5 meters subplot.
3 : Seedlings enumerated in a 2 meters by 2 meters subplot.
4 : Wildlings planted as plantation or as enrichment.

A complete unique filename is thus constructed : SLTMT02.921 = Sungei Lalang, Treatment no. 2, enumerated in 1992 containing trees/poles enumerated in the whole quadrat.

2.2.1 Identification of Quadrats and Subplots.

Within the 1 ha. sample plots, the Quadrats are numbered consecutively from 1 to 25. The tags on the posts are marked accordingly.

In the outer 16 quadrats (Nos 1,2,3,4,5,6,10,11,15,16,20,21, 22,23,24,25) all trees having a diameter at breast height over bark (DBHob) of 15 cm or more are individually numbered, tagged and enumerated. In the central 9 quadrats (Nos 7,8,9,12,13,14,17,18,19) all trees and poles having a DBHob of 5 cm and more are individually numbered, tagged and enumerated.

The 5 by 5 meter sapling subplots are placed at the corner of each of the 9 central quadrats and are numbered 26,27,28,29,30,31,32, 33,34. All saplings being 1.5 meter high up to 5 cm DBHob are individually numbered, tagged and enumerated.

The 2 by 2 meter seedling subplots are placed at the corner of each of the 9 central quadrats inside the 5 by 5 meter sapling subplot and are numbered 35,36,37,38,39,40,41,42,43. All seedlings from 15 cm to 150 cm total height are counted species by species.

The wildlings in the plantation plot and in the enrichment planting are planted in lines. For plantation there are 17 lines and for enrichment planting there are 10 lines per sample plot. There are 33 planting positions per line. The lines and positions are individually numbered.

3. DESIGN OF THE FIELDCARDS VERSION NO. 2.

There are four types of fieldcards (Refer to Appendix No. I) (DBHob: Diameter at Breast Height (1.3 m) over bark) :-

E - 1. The fieldcard for recording the data from trees and poles, covering the whole Quadrat. (Trees $\geq$ 15.0 cm , Poles $\geq$ 5.0 cm DBHob).

E - 2. The fieldcard for recording the data from saplings in the 5 by 5 meter subplot. (150 cm in total height to < 5.0 cm DBHob).

E - 3. The fieldcard for recording the data from seedlings in the 2 by 2 meter subplot. (From 15 cm to 150 cm total height).

E - 4. The fieldcard for recording wildlings planted in lines.

3.1 The Fieldcard for Recording Trees/Poles in a Quadrat

There is one separate fieldcard to be used for each Quadrat. Under no circumstances must data from another quadrat be recorded on the same fieldcard. Even if there are no trees to enumerate, there must be an individual fieldcard indicating the presence of the Quadrat. For practical purposes such a Quadrat is termed an "empty" Quadrat.

The fieldcard is divided into four parts. (Refer to Appendix No. I).

(a) Text Information:- (MUST be written on each and every fieldcard

- Location, Forest Reserve and compartment.
- Name of the officer making the recordings.
- The exact date of the recordings in the forest.
- Any observations in the quadrat like: road, stream, landing traces of encroachment, cultivation, wildlife, logging etc.

It is important that the name of the fieldcard recorder is written on each fieldcard together with the exact date of the recording.

(b) Forest Locality (Filename):-

A,B - Information identifying the experimental area.

C - The type of treatment applied (See codes in section 2.2).

D - The year of this enumeration.

This information applies to every batch of fieldcards and the coded information is used when identifying the files during computer processing.

(c) Quadrat Information:-

(1-5) - (Will contain a consecutive record number to be inserted during computer data editing).

6 - Stocking of Quadrat (STK).

7-9 - Forest class of Quadrat (FCL).

10-11 - Treatment code (same as for Locality information, refer to section 2.2).

12,13 - Block number.

14,16 - Quadrat number.

(d) Tree Information:-

The lines on the Fieldcard are used to record the individual information for trees to be enumerated. There is one line or record per tree. In order for the fieldcrews to check the recording while in the field, key information from the previous enumeration is transferred to this years fieldcard :

- Previous enumeration (Give year / month)

(17-19) - Consecutive Tree Number (CTN).

(20-22) - Tree Identity Class (SIC).

(23) (- Wood Quality Group (WQG).) | Not transferred

(25-27) (- Botanical code.) | Not transferred

(28-31) - Diameter at Breast-Height over bark (DBHob).

- Vernacular name or local name. (Written in full)

- Current enumeration (Give year / month)

17-19 - Consecutive Tree Number (CTN).

20-22 - Tree Identity Class (SIC).

- Vernacular name or local name. (Transferred in full)

23 - Wood Quality Group (WQG) from 'SPECIES.LIS'

24-27 - Botanical code. 4 digits from 'SPECIES.LIS'

28-31 - Diameter at Breast-Height over bark (DBHob), in mm.

32-33 - Trunk height to Crown Point in meters.

34 - Log Grade (LG).

35 - Crop Tree Status

36 - Crown Form (CF).

37 - Crown Illumination / Dominance (CI).

38 - Stem Damage.

39 - Crown Damage.

40 - Impeding Climbers and Wines (CL).

3.2 Details of Fieldcard Entries, Trees/Poles

The following sections give a brief description of the individual items to be recorded on the fieldcard for trees 15.0 cm DBHob or larger and poles 5.0 cm DBHob and larger.

The observations made in the field are converted to code numbers on the fieldcard. The code numbers to be used are given in the sections below. The species list SPECIES.LIS for the botanical codes is given in Appendix No. II.

a) Locality Information, Computer file Identification.

The codes identifying the experimental area, the treatments applied and the year of enumeration are described in section 2.2 above.

The code "1", printed on the form, indicate that the fieldcard is used only for trees/poles with a diameter at breast-height over bark DBHob of 15.0/5.0 cm or more.

Note : The complete code is to be written on <u>each and every</u> fieldcard.

The code is used as the computer file identification or the "Filename" = "SLTMT03.921". The code is not part of the individual record. Each computer file will have its own unique Filename.

3.3 Quadrat Information.

The quadrat information gives a broad description of the type of forest found inside the Quadrat,the Forest Class (FCL) and give a unique identification of each individual quadrat.

Other relevant information such as soil characteristics and slope of terrain, drainage etc. was enumerated on fieldcard version no. 1 and is kept in a separate computer file for each individual block. The filename is identified by the last character that is a 'Q', example : 'SLBLK01.92Q'.

The small numerals on the fieldcard (6, 7, 10, etc) are used during data entry for computer processing. The numbers specify the column in the data file. The first five positions are used for a record number that is automatically generated during data processing. (Program ITLINO)

- Quadrat Stocked : 6

The code "quadrat stocked" provides information as to whether the quadrat contains any tree or pole to be measured. Two code numbers are used: (0 and 1):

YES, tree $\geq$ 15.0 cm = 1.

YES, trees and poles $\geq$ 5.0 cm = 1.

If the Quadrat is stocked and trees / poles of DBHob of 15.0 or 5.0 cm and above are to be measured the code is = 1.

Refer to section 2.2.1 for a list of the quadrat where only trees are to be enumerated and the quadrats where both poles and trees are to be enumerated.

NO = 0 :

If no trees or poles appear to be measured in a Quadrat, the Quadrat is empty and the code is = 0

If the quadrat is empty, record the remaining information and identification of the Quadrat. Write "EMPTY" in the first line of the Individual Line Entries and continue with the next Quadrat on a new fieldcard.

3.4 The Forest Class (FCL) : 7,8,9

The term Forest Class (FCL) is used to distinguish this classification from the Forest Type used by the inventory. The classification is inspired by the descriptions given in Hutchinson (1982).

In the field, the classifications are made according to the following instructions:

The classification into "Forest Classes" (FCL) is applied to the individual 20 m by 20 m Quadrat. Areas of this size have a high probability of being homogeneous. At least they are small enough for the recorder to see clearly what they contain. The classification is not intended to be applied to larger areas of forest which are varied in composition.

The scoring of FCL is done by looking at the situation within the quadrat, on the ground and in the air directly above the quadrat.

The codes to be used are given in Tables 1 and 2. Figure 3 gives some examples of different forest classes.

FOREST CLASS, FCL

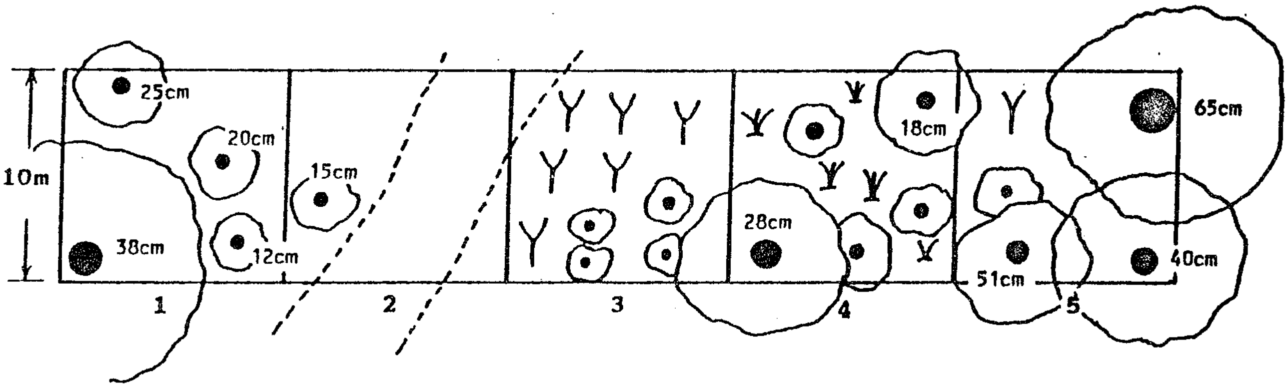
	Over Head Crown Cover of trees> 30 cm DBH from inside or outside Quadrat First and Second Code Digit		
	0 - 33% X1X Full sun light	33 - 66% X2X Part shaded	66 - 100% X3X Complete shade
Mature Forest 1XX Tree >50 cm DBH, SIC = 111, and Log Grade 1 or 2	11X	12X	13X
Immature Forest 2XX Trees 30 cm <50 CM DBH, SIC = 111, and Log Grade 1 or 2	21X	22X	23X
Immature Forest 3XX Trees 30 cm <50 cm DBH, SIC = 111, at Log Grade 1 or 2 Dominance of Pioneer spp.	31X	32X	33X
Regenerating Forest 4XX Trees <30 cm DBH, SIC = 111, and Log Grade 1 or 2	41X	42X	43X
Regenerating Forest 5XX Trees <30 cm DBH, SIC = 111, and Log Grade 1 or 2 Dominance of Pioneer spp.	51X	52X	53X
Temporary Opening 6XX Few or no trees ≥10 cm DBH, SIC = 111, at Log Grade 1 or 2	61X	62X	63X
Temporary Opening 7XX Few or no trees ≥10 cm DBH, SIC = 111, and Log Grade 1 or 2 Dominance of pioneer spp.	71X	72X	73X
Temporary Opening due to 8XX human activity, cultivation, and burning	81X	82X	83X
Unproductive long term open 9XX space, natural or man-made	91X	92X	93X

Table 1.

FOREST CLASS, FCL

Third Code Digit	% of Area Covered	Code
No Impeders, good site	>75 %	XX1
Vines and Climbers are impeding	>25 %	XX2
Palms, stem/stemless, clusters, all species	>25 %	XX3
Bamboo present	>25 %	XX4
Bananas, large Gingers	>25 %	XX5
Ferns, Bracken, Lalang	>25 %	XX6
Fallen trees, crowns, debris, burning	>25 %	XX7
Water, Swamp, slope, rock, poor site	>25 %	XX8
Track, Road, Landing, pool	>25 %	XX9

Table 2.



Quadrat 1	FCL :	221 :		Immature forest, 66% - 35% crown cover. No Impeders, good site.
Quadrat 2	FCL :	919 :		Unproductive, long term open space, 33 - 0% crown cover, Track, Road, Landing.
Quadrat 3	FCL :	715 :		Temporary Opening, Dominance of Pioneer spp., 33 - 0% Crown cover, Bananas, Larger gingers.
Quadrat 4	FCL :	513 :		Regenerating Forest, Dominance of Pioneer spp., 33 - 0% crown cover, Bertam Palms.
Quadrat 5	FCL :	131 :		Mature Forest, 100 - 66% Crown cover, No impeders, good site.

Figure 3. Examples of Forest Classes

3.4.1 Description of the Forest Class (FCL) Codes:

- First Code Digit : 7

The first code digit gives a general description of the quadrat.

1 : Mature Forest, Tree $\geq$50 cm DBH.

There is at least one tree of any species having Tree Identity Class 111 and Loggrade 1 or 2 with a DBH of 50 cm or more inside the quadrat.

2 : Immature Forest, Trees 30 cm <50 cm DBH.

There is at least one tree of any species having SIC 111 and loggrade 1 or 2 with a DBH of between 30 cm and 50 cm inside the quadrat.

3 : Same as 2, except that within the quadrat among the trees > 15 cm DBH there is a dominance of pioneer species like Macaranga, etc.

For the remaining classes, 4, 5, 6, 7 and 8, the Forest class that occupy 50% or more of the quadrat is to be scored. If there are more than two classes present score the most dominant class.

4 : Regenerating Forest, Trees <30 cm DBH

The are no trees > 30 cm of SIC = 111 and log grade 1 or 2 inside the quadrat. But the quadrat is influenced by crowns of trees SIC 111 with a diameter between 15 cm and 30 cm DBH. At least 1 such tree must be inside the quadrat.

5 : Same as 4, except that within the quadrat among the trees, poles and saplings there is a dominance of pioneer species.

6 : Temporary Opening, Few or no Trees > 15 cm DBH

The quadrat is either without trees or there are only a few trees $\geq$ 15 cm DBH. Poles, seedlings or saplings may be present or the conditions of the site is such that regeneration will appear within a few years.

7 : Same as 6, except that within the quadrat there is a dominance of pioneer species of poles, saplings or seedlings.

8 : Same as 6, except that within the quadrat, the open space is created by human activity like logging, logging debris, felled crowns, shifting cultivation, garden etc. If left undisturbed it will regenerate naturally, f. ex. by seedlings growing through logging debris.

9 : Unproductive, Long Term Open Space

There may be a few trees $\geq$ 15 cm but more than 50% of the quadrat is considered unproductive and will remain unproductive for many years. It may be tractor track, road, landing, stream, pool, swamp, steep slope, rocks, alang-alang, palms, bamboo, rattan, banana, fern, etc. The actual situation is described by the third digit.

- Second Code Digit : 8

The second code digit is used to describe the tree crown cover of the quadrat. Only the crowns from living trees 30 cm DBH and larger of any species are considered. The trees may be based both inside and outside the quadrat.

Look into the air above the quadrat and if the crown of trees $\geq$30 cm DBH cover:

0 to 33 %	Code = 1
33 to 66 %	Code = 2
66 to 100 %	Code = 3

- The Third Code Digit : 9

The third code digit is used to describe the ground condition of the quadrat, roads, etc. and the presence of impeding vegetation like palm, wines, banana, etc.

1 : No Impeders, Good Site

Score only if 75% or more of the ground cover of the quadrat is free of tracks, roads and impeding vegetation and the site has a good productive capacity. If Wines and climbers are actually impeding the growth of some trees but the extent is difficult to assess, probably less than 25%, use code 2.

2 : Wines and Climbers Impeding

Score if wines and/or climbers, including rattan, impedes 25% or more of the quadrat. However, if the Vines etc. actively impede the growth of trees inside the quadrat use this code even if the area is less than 25%.

3 : Palms, Stem/Stemless, Clusters

Score if the fronds of palms, both single stemmed, stemless or in clusters, cover more than 25% of the quadrat even if the palms are rooted outside the quadrat.

4 : Bamboo Present

Score if bamboo cover more than 25% of the quadrat even if the bamboo is rooted outside the quadrat.

5 : Bananas, Large Gingers

Score if bananas and/or large gingers cover more than 25% of the quadrat. Score large ginger only if they actually impede the regeneration of seedlings and saplings.

6 : Ferns, Bracken, Lalang

Score if ferns, bracken or/and Lalang grass cover more than 25% of the quadrat.

7 : Fallen Trees, Crowns, Debris

Score when fallen trees, crowns or debris from either natural causes like windfall or from logging activities, cover more than 25% of the quadrat.

8 : Water, Swamp, Slope, Rock, Poor Site

Score if more than 25% of the quadrat is naturally unproductive due to stream, stream bed, natural water pool, swamp, steep slope, rocks or a natural poor site without vegetation.

9 : Track, Road, Landing, Pool

Score if more than 25% of the quadrat is unproductive due to the effect of logging activities, present as well as before. These are tractor tracks, skid trails, roads, landings, and impounded water or pools due to road construction and blockage of natural water flow. Note, however, that logging debris is considered under code 7.

In cases where more than two classes are present, score the class that will have the most long term effect on the development of the forest or the class considered most adverse to the growth of the trees.

If in doubt look outside the quadrat and select the class most abundant in the vicinity.

It is difficult to give a fixed priority list. The final scoring will be left to the judgement of the field crew leader.

Rattans are not recorded except if they actually impede the growth of trees and regeneration of seedlings and saplings.

3.4.2 Sequence of Scoring

The scoring is done digit by digit. First look for trees SIC=111, loggrade 1 or 2, DBHob $\geq$ 30 cm inside the quadrat. If at least one such tree is found the first digit is 1, 2 or 3, according to the instruction.

If no such tree is found the first digit is either 4, 5, 6, 7, 8 or 9, according to the instructions.

However, code no. 9, unproductive, long term open space is to be used if more than 50% of the quadrat falls in this category even if there are a few trees ≥30 cm present.

Secondly, look into the air above the quadrat and score the crown cover of the quadrat from living trees $\geq$ 30 cm DBH.

Finally, look at the ground and the space inside the quadrat and score the third digit.

Burned soil is only scored using the first code digit = 8, the land may actually be productive, i.e third digit = 1, if left to recover.

3.5 Quadrat Identification

Treatment Number : 10,11

The treatment number, as part of the quadrat identification, is the same number as appears as part of the filename, since each treatment is kept in separate computer files. The treatment code numbers are given in section 2.2 above.

Block Number : 12,13

In the experiments, there are different types of treatments, the block number refers to a block having received the same treatment The blocks are one hectare square in size. There are four blocks or replications per treatment, except for the Forestry Departments experiment in Piah Forest Reserve where there are three blocks per treatment.

Quadrat no. : 14,15,16

Each Quadrat is given an individual number, and there must be at least one fieldcard per Quadrat. Each Quadrat is 20 m by 20 meters in size and there are 25 Quadrats per block. The Quadrats are numbered consecutively from 001 to 025.

The quadrat Identification must always be recorded on each and every fieldcard.

4 INDIVIDUAL TREE ENTRIES

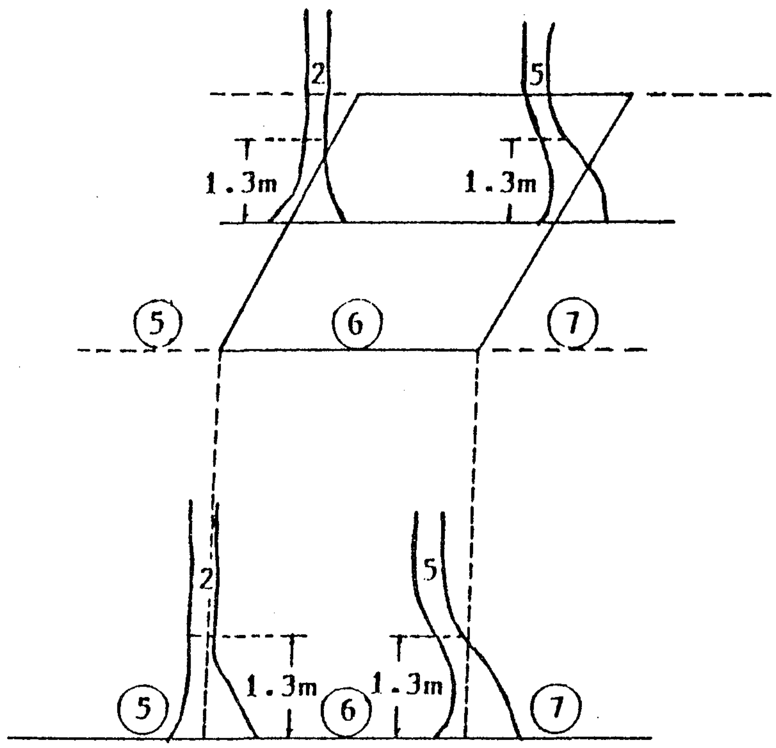
This section describes the information to be collected with regard to the trees inside the Quadrat.

4.1 When to include Border Trees.

Because the Quadrats are laid out in a consecutive manner, a tree is to be included in the Quadrat if half or more of its base is inside the Quadrat, see Figure 4 below.

Note : The point of measurement has no consequence, it is only the position of the base of the tree at ground level that counts.

Paint an arrow on the tree towards the Quadrat where the tree is recorded.



Tree no. 2 belongs to Quadrat no. 06.
Tree no. 5 belongs to Quadrat no. 07.

Figure 4. Illustration of trees on a Quadrat border

Whenever records for a Quadrat also requires the use of a second fieldcard, write "CONTINUED" on the last line of the first fieldcard and on the first line of the second fieldcard.

On the line below the last entry for the Quadrat write "END".

If there are no items to record in the Quadrat, i.e. the stocking code is "0", write "EMPTY" on the first line of the fieldcard.

4.2 Consecutive Tree Number : 17,18,19

Each individual tree, whether living or dead, complete or broken, is assigned a unique number that is written on the tag on the tree. Cut stumps are also numbered.

The consecutive tree number is part of the record for the tree and is only used to identify that particular tree.

In the permanent experimental plots, when the tree is no longer to be enumerated and the record for that tree is closed, the number must never be used again. (For "Record Closed" refer to section 5). The number and tag must be regarded as an 'Identity Card' for that tree alive as well as dead.

When new recruits enter the Quadrat, i.e. when a sapling eventually grows to the size of a tree or pole of 15.0 cm or 5.0 cm DBHob or larger, then the new tree is assigned its own number which must be unique and never before used in the Quadrat. In the case of new recruits originating from tagged and enumerated saplings in subplots (see section 6.2), the sapling number beginning with the letter 'A' is discarded and the 'successful sapling' assigned a new number in the series of tree numbers.

Numbers are both painted and tagged to each tree in a conspicuous and lasting manner in order to facilitate the reassessments. Be sure that the string used to tie the tag is loose enough to allow the tree to grow freely. This is particularly important for the poles and saplings.

Note: Never change a consecutive Tree Number. Never change the quadrat in which the tree was initially recorded. Even if it is found at a later enumeration that the tree was recorded in the wrong Quadrat, the error is negligible compared to the trouble caused by changing all the previous records.

4.3 Tree Identity Class (SIC) : 20,21,22

All trees are recorded whether they are living or dead, broken, fallen or cut.

The information collected is very useful for the analysis of the data, particularly when estimating logging damage or the damage caused by silvicultural treatments or by natural events.

The Tree Identity Class consists of a 3-digit code number constructed in the following manner:

- The first digit : 20

1 : Tree species, Trees, DBHob = 15.0 cm or larger.

1 : " " , Poles, DBHob = 5.0 cm up to > 15.0 cm.

- The second digit : 21

1 : Tree living, standing.

2 : Tree living, fallen.

3 : Tree dead, standing.

4 : Tree dead, fallen.

- The third digit : 22

1 : Complete tree with crown.

2 : Broken tree, point of breakage 4.5 meters or higher above the ground.

3 : Broken stump, point of breakage up to 4.5 meters above the ground.

4 : Cut stump, tree cut by human activity, logging, shifting cultivation etc. no height limits up or down.

5 : Tree ringed, girdled or poison girdled as part of silvicultural treatment.

9 : Not found, tree recorded in previous enumeration, now disappeared without trace.

NOTE : Only consider that part of the tree to which the root is still attached.

Do not consider broken or fallen dead trees that are totally decayed.

Use Classification of Broken Tree/Stump SIC = 112 or 113 only when main crown is broken of and only few branches or coppice survive.

If the breakage is in the crown itself score SIC = 111 and use crown forms (CF) = 4, 5 or 6

The complete table of tree identity classes can then be constructed, refer to Table 5 below.

	XX1	XX2	XX3	XX4	XX5	XX9
	Compl. Tree	Broken Tree	Broken Stump	Cut Stump	Girdl Tree	Not Found
a) TREE SPECIES, LIVING TREES						
Standing	111	112	113	114	115	(119)
Fallen	121	122	123	124	125	(129)
b) TREE SPECIES, DEAD TREES						
Standing	131	132	(133)	(134)	135	(139)
Fallen	(141)	(142)	(143)	(144)	(145)	

Table 5. Table of Tree Identity Classes

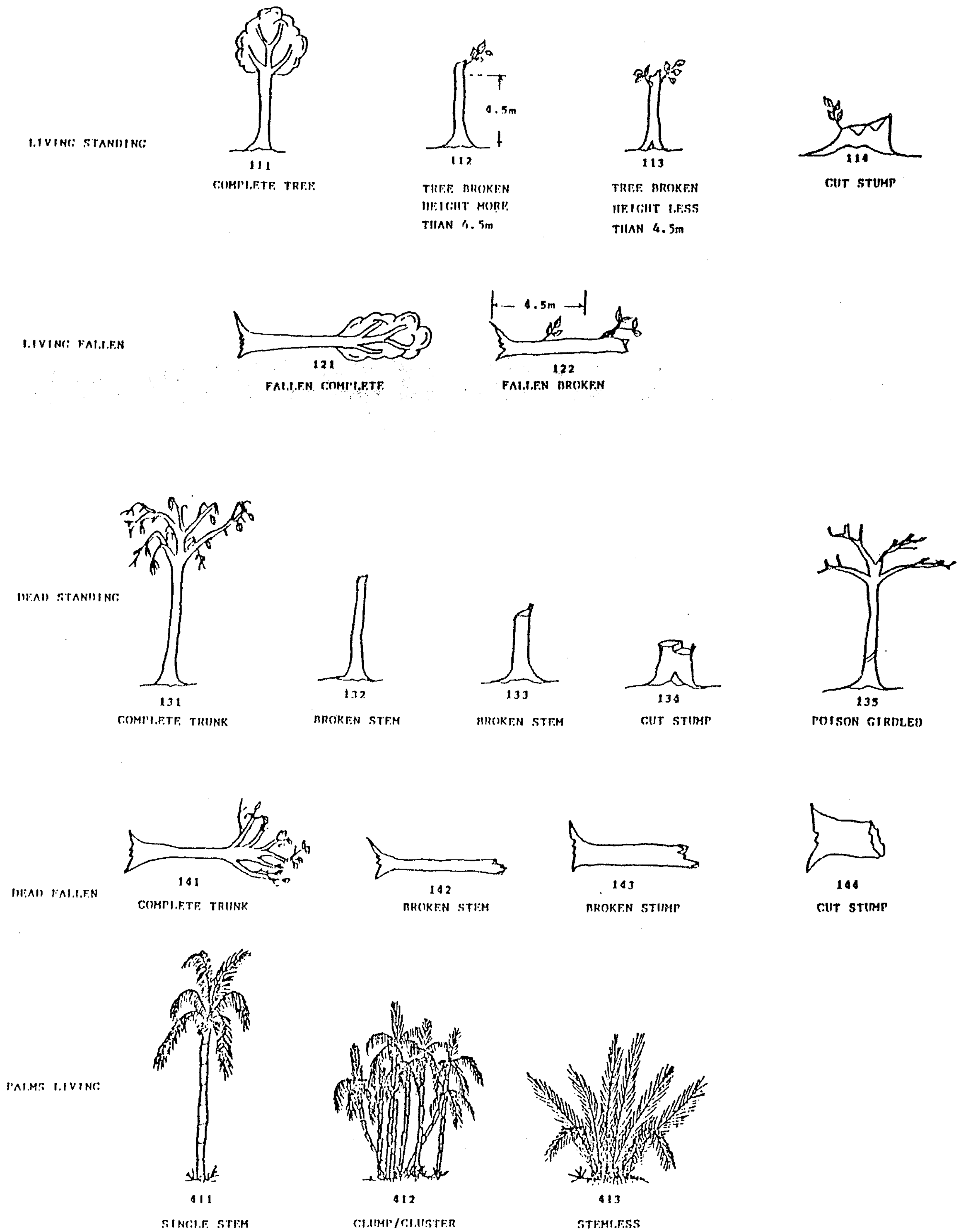
The codes placed in parentheses are "Record to be closed". That is, when a tree reach a SIC code in one of those fields, the tree no longer occupy an important position on the forest. The tree is not to be recorded in future enumerations. Refer to section 5. 'Record Closed'.

Be careful to ascertain whether leafless trees are alive or dead.

When making the description, always stand at a distance from the tree and look at the tree from all sides.

Record as a fallen tree a tree leaning against other trees but that would fall to the ground if the other trees were removed.

Figure 6. Examples of Tree Identities.



4.4 Botanical Identification

The botanical identification is the most important item on the fieldcard - and the most difficult.

The largest single source of error when comparing two subsequent enumerations of the same plot is the botanical identification. (Korsgaard, 1982 and Mohd. Idris, 1991).

The SPECIES.LIS is given in Appendix II.

The identification provides four items to be recorded:

(i) During the field works:
- Vernacular or local name.

(ii) When in the camp:
- Wood Quality Group (WQG).
- Group.
- Division.

Note: Check the vernacular name and the correct conversion to the botanical codes before sending the fieldcards for data entry. See section 9.5.

4.4.1 Vernacular or Local Name

This is the only item to record in the field. Refer to the SPECIES.LIS in Appendix No. II.

Use only standard and accepted local names. In cases where a local name is not known, write the scientific name, even if only the family can be identified, and collect leaf specimen.

In cases where the tree cannot be identified write : Unidentified. Be sure to collect flower or leaf specimens for later identification in the herbarium.

The vernacular name should be double checked in the field by the fieldcard recorder and the tree identifier. The correct spelling of the name on the fieldcard should also be checked. Please use only the names given in the species list.

The conversion of the vernacular name to the five- digit botanical code number is most efficiently done at the camp rather than in the field. Be sure to use the correct latest edition of the species list. Destroy all previous editions of the species list whenever an updated species list is provided.

4.4.2 Wood Quality Group (WQG) : 23

For most practical purposes, it is sufficient to present the results of the analysis in some broad groups depending on the commercial value of the trees. However, for silvicultural purposes it is important to know which species are becoming dominant when the forest is opened up. This may be both commercial or non-commercial species as well as the light-demanding pioneer species.

The Wood Quality Groups follow the groupings used by the Forest Department.

WQG		Description	
0	:	Dead, unidentified stems.	
1	:	Dipterocarp, Meranti	Fully Marketable
2	:	Dipterocarp, Non-Meranti.	Fully Marketable
3	:	Non-Dipt. Light Hardwood.	Fully Marketable
4	:	Non-Dipt. Medium Hardwood	Fully Marketable
5	:	Non-Dipt. Heavy Hardwood	Fully Marketable
6	:	Other species, partially marketable.	
7	:	Other species, not presently marketable / un-identified.	
8	:	Light-demanding, pioneer species, "weeds".	
9	:	Palms / Bamboo.	

The wood quality group is part of the botanical identification and does not indicate the actual commercial status of the tree being enumerated. The Log Grade of the tree, which is explained in section 4.7 below, indicate the potential for the tree to yield a commercial log.

4.4.3 WQG, Group, Division : 24,25,26,27

For a detailed analysis of the data, the actual botanical identification of the trees are given by a five-digit code number. There is one digit available for the Wood Quality and two digits available for each of Group and Division. The Wood Quality Group (WQG), the Group and the Division Code give a unique identification of each tree to the level of genera.

For the purpose of this investigation the emphases is focused on the commercial value of the forest. WQG's "1", "2", "3", "4" and "5" are only assigned to those species generally accepted as fully marketable. Those species of partial marketability and those with a low or no market value, are given WQG "6" or "7" respectively.

The species codes are based on the vernacular names and the Forestry Departments system of Family, Genera, Species. For this study identification to the level of genera is considered sufficient.

Dead stems that cannot be identified are given the code number "0.00.00".

All other trees retain their botanical identity as long as they are recorded, even after they die. Stems that cannot be identified are given the code "7.00.00".

When new species are found, that are not included in the species list, collect leaf specimen and make a note on the fieldcard. The proper code numbers will be decided later in the office, based on the identification in the herbarium.

4.5 Diameter at Breast-Height Over Bark : 28,29,30,31

The diameter at breast-height over bark (DBHob) is defined as the diameter measured by a diameter tape (Steel tape) directly on the fixed bark of the stem at a point 1.3 meter above ground level. On a slope the point is measure on the uphill side of the stem. All readings are recorded to the nearest millimeter. For example, readings that fall between 151 mm and 152 mm are recorded as 151 mm.

Trees having a DHBob of less than 150 mm (or 50 mm in the 9 central Quadrats where poles are sampled) are excluded. All other trees must be measured. Broken stumps and cut stumps with a total height of less than 1.3 meters are measured at the highest possible point. At the point of measurement, the stem is cleaned of wines, thorns, moss, loose flakes of bark and surface vegetation. However, be careful not to wound the tree.

If the tree is deformed at the point of measurement, move the point to a place above the deformity, swelling, bump or forked branch to the nearest approximation of what the diameter at breast height would be. In the case of buttressed stems, make the point of measurement 30 cm above the end of the buttress.

Note : It may be required to use a small lightweight ladder or a special instrument in order to measure the diameter above buttresses accurately.

(Refer to Fig. 7 for examples of the point of measurement).

Diameter estimations should be avoided.

In the permanent experimental plots, where the plots are remeasured periodically in order to calculate the growth, it is of particular importance to make accurate measurements.

The point of measurement must be marked clearly as a "T" mark by using a good quality paint that will last at least five years. Important: Do not alter the point of measurement of any stem. However, if forced by circumstances to change the point of measurement, make a clear note on the fieldcard as to why the change was unavoidable.

It is important to use the outmost care when recording the diameter. The measurements should be carefully checked and repeated loudly by the crew leader/fieldcard recorder.

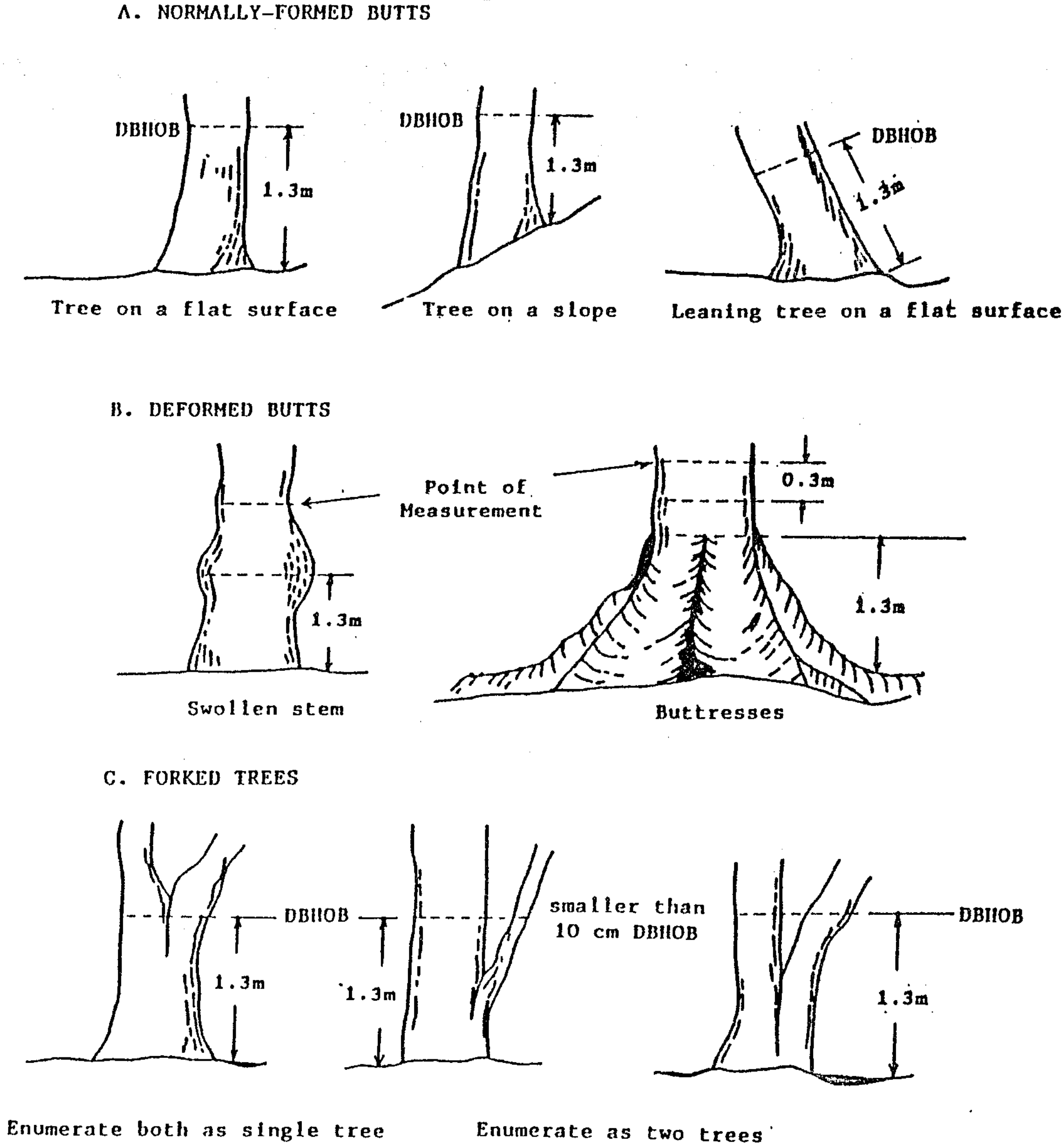


Figure 7 : The Measurement of Diameter at Breast-Height

4.6 Trunk Height : 32,33

In order to estimate the volume the height is measured on selected trees and estimated on all other trees. Height is only taken on trees with SIC = 111 and a diameter of 15.0 cm and above. The height is commercial trunk height from the ground up to the first large branch.

The point of height measurement is at the point where the trunk divides into branches and where the tree will be cut during normal felling operations. Minor branches may occur below the crown point. Major branches may reduce the Trunk Height if they occur less than 2.5 meters below the obvious crown point. Do not consider minor defects when measuring the height. Defects are scored under Log Grade, section 4.7.

4.6.1 Trunk Height, Measured

The selection of trees where the Trunk Height is to be measured is done as follows:

In each Quadrat one tree is selected for accurate height measurement. The trunk height is measured to the crown point on the largest tree with SIC = 111 and log grade 1 or 2 where the crown point can be clearly defined. The measurement must be accurate using a good quality instrument such as the Haga or Clinometer.

4.6.2 Trunk Height, Estimated

On all other trees with SIC = 111 and DBHob ≥ 15.0 cm the trunk height is estimated. This is done using the measured tree as a guide and a gauge stick of 2 meters or 6 meters in length against which the other trunk heights are estimated.

4.7 Log Grade : 34

The log Grade is recorded for all living, standing, complete trees (SIC = 111) ≥15 cm DBH.

The classification of Log Grade is used to give an indication of the timber production potential of the forest.

Each tree is classified according to whether it, immediately or in the future, will be able to yield at least one straight, well-formed and sound piece of clear-bole. The log should be acceptable by the industry for conversion into sawn timber or veneer, irrespective of the species of the log.

In the future more and more species will be accepted by the log market. The log grade is, therefore, not in any way connected to the botanical identification of the tree.

The classification is made by assessing the status of the tree at the time of recording.

There are five Log Grade Classification:

Code No. Description

1 : Good Log Grade, No Defects.

The bole of the tree is straight and well-formed, without defects, injury or decay from the end of buttress to crown point. The tree may be of commercial size now or will in the future grow to commercial size, minimum acceptable trunk height is 5 meters.

2 : Acceptable Log Grade, Some Defects.

The tree contains at least one straight and well-formed section of clear bole that either now or in the future will yield one piece of sawlog. The rest of the bole contains some deformity, injury, damage or decay. If the tree is alright but the trunk height is less than 5 meters, use this code.

3 : No Log, Stem Deformed

The tree does not contain any section of the bole which is of sawlog quality neither now nor in the future. The reason is that the bole is bend, crooked, fluted, branched, twisted, spiralled or with heavy buttresses. Use this code for trees with a heavy lean >45°.

4 : No Log, Stem Damaged

Physical injury to the stem has damaged the bole to the extent that no possibilities remain for using the bole as a sawlog, neither now nor in the future.

5 : No Log, Stem Decayed

Due to decay or rot the tree does not contain one sound section of the bole 4 meters long. In the cases where a tree is both deformed and/or damaged and/or decayed, give priority to recording the decay. In cases where heart rot or hollow stems are suspected, but cannot be positively verified from looking at the tree from the outside, disregard the suspicion and record the tree as sound. No boring is to be done.

4.8 Crop Tree Status : 35

The crop tree status is only scored in the 'Silvicultural Treatment of Logged-over Forest' plots where the crop tree status is recorded for all living, standing, complete trees (SIC = 111), $\geq$ 15 cm DBH. In the other plots the code is zero-filled.

There are 3 classes :

1 : Crop Tree is sound and straight without defects and the species belong to the list of preferred species. The tree will grow to yield a good grade of timber.

2 : Potential Crop Tree is sound and straight without defects and the species belong to the list of potentially acceptable species.

3 : Non-Crop Tree is not able to yield at least one good log 5 meters in length, or the species is not listed as preferred or acceptable.

4.9 Crown Form : 36

The crown form is recorded for all living, standing, complete trees (SIC = 111), ≥15 cm DBH.

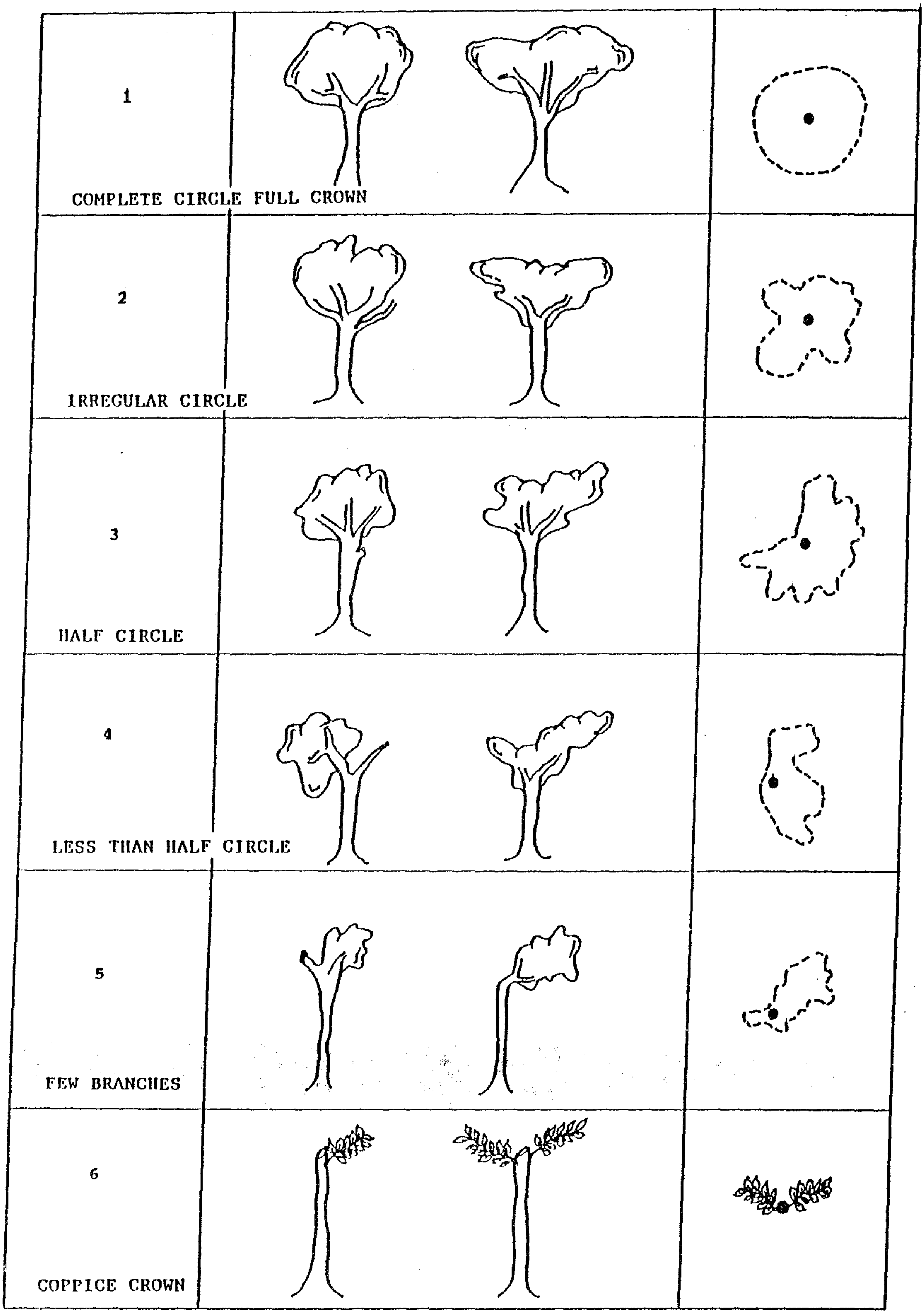
The crown form is important for the growth of the tree. The distribution of crown forms before and after a logging operation also indicates the amount of damage inflicted on the crowns of the remaining trees.

There are six Crown Forms classes :

Code No.	Description
1 :	Complete Circle. Circular and symmetrical.
2 :	Irregular Circle. Slight defects of symmetry and some dead branch tips.
3 :	Half Circle. Distinctly asymmetrical or thin, but capable of improvement if room is available or provided by treatment.
4 :	Less Than Half Circle. Unsatisfactory, with extensive dieback, strong asymmetry, a few living branches, likely to survive.
5 :	Only a Few Branches. Suppressed, degenerating or badly damaged, not likely to grow or survive.
6 :	Mainly coppice. Main part of crown originating from coppice sprung from broken branches after severe damage.

Refer to Fig. 8 for examples of crown form classes.

Figure 8. Crown Form Classes



4.10 Crown Illumination/Dominance : 37

The crown illumination/dominance is recorded for all living, standing, complete trees (SIC = 111), $\geq$ 15 cm DBH.

The crown illumination/dominance describes the amount of sunlight received by the crown and the crowns competitive status. It is one of the significant factors affecting the growth of the tree.

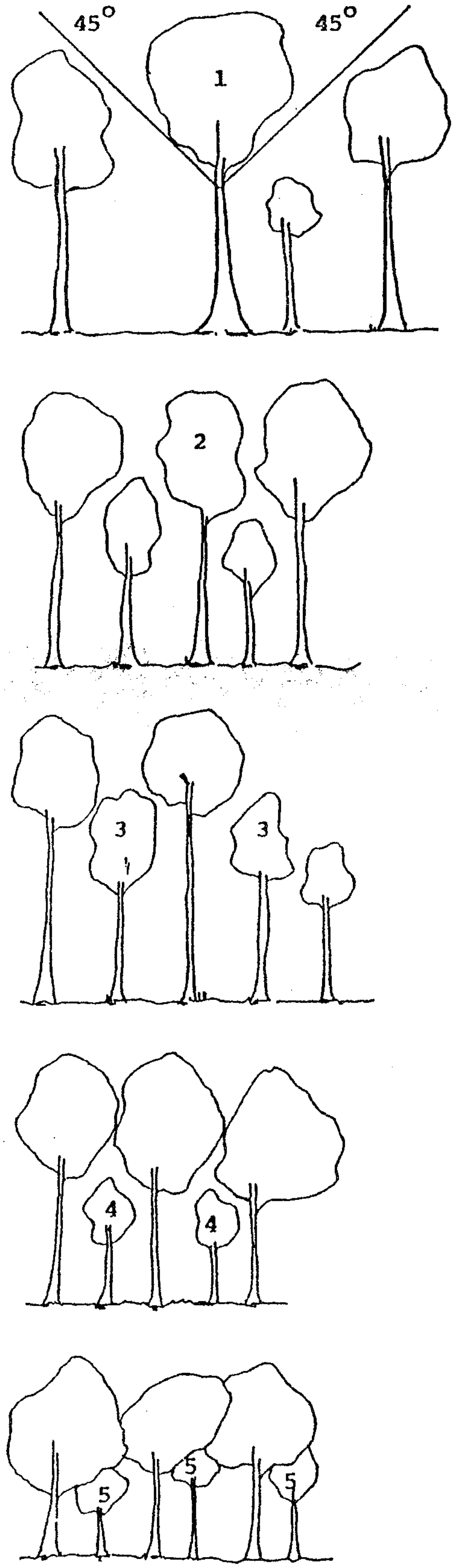
When estimating the influence of neighbouring vegetation, disregard dead and broken trees, but do assess the shade given by palms and bamboo.

There are four Crown Illumination/Dominance classes :

Code No.	Description
1 :	Emergent/dominant. Full light reaches the sides of the crown at an angle of at least 45 degrees from the vertical.
2 :	Full Overhead Light/Co-dominant. Upper part of crown fully exposed to overhead light, but sides of crown do not receive full light due to competition from other co-dominant crowns.
3 :	Some Overhead Light/Dominated. Part of the crown is exposed to vertical light, but part is shaded from dominant crowns above.
4 :	No Direct Light/Suppressed. The crown is suppressed and receives only light filtered through the crowns of other trees and other vegetation.

Refer to Figure 9 for examples of crown illumination/ dominance.

Figure 9. Crown Illumination, Dominance.



1. Emergent/Dominant

2. Full Overhead Light/
Co-dominant

3. Some Overhead Light/
Dominated

4. No Direct Light

5. No Direct Light
Suppressed/Intertwined

4.11 Stem Damage : 38

The stem damage is recorded for all living, standing, complete trees (SIC = 111), $\geq$ 15 cm DBH.

Only recent, fresh damage is recorded, old damage that has turned to rot is scored under the Log Grade, broken stems are recorded through the Tree Identity Class (SIC : 112 or 113).

There are 4 classes :

Code No.	Description
1 :	No Damage to the Stem.
2 :	Slight Bark Damage of less than 1 meter in extent.
3 :	Medium Bark Damage either 2 damages of less than 1 meter or 1 damage of from 1 to 3 meters in extent.
4 :	Heavy Bark Damage either 3 damages of less than 1 meter or 2 damages of from 1 to 3 meters or 1 damage of more than 3 meters in extent.

4.12 Crown Damage : 39

The crown damage is recorded for all living, standing, complete trees (SIC = 111), $\geq$ 15 cm DBH.

Only recent, fresh crown damage is recorded, old damage is recorded through the crown form class. Broken stems, where most of the crown is broken off, are recorded through the Tree Identity Class (SIC : 112 or 113).

There are 5 classes :

Code No.	Description
1 :	Less than 5% damage to the crown.
2 :	From 5% to less than 25 % damage to the crown.
3 :	From 25% to less than 50 % damage to the crown.
4 :	From 50% to less than 75 % damage to the crown.
5 :	From 75 % to less than 100 % damage to the crown. If 100 % of the crown is damaged consider it as at broken stem of SIC 112 or 113.

4.13 Impeding Wines and Climbers : 40

The impeders are recorded for all living, standing complete trees (SIC = 111) $\geq$ 15 cm DBHob.

The purpose of this classification is to assess the way in which impeders such as woody climbers and vines invade the different forest types and to see how logging and silvicultural treatment effect the occurrence of impeders.

The classification is as follows:

Code No.	Description
1 :	Impeders not Present. No Climbers or Wines on the Tree.
2 :	Impeders Present but not Affecting the Tree. Climbers and or wines are present, but they do not hinder or restrict the normal growth and development of the tree and its crown.
3 :	Impeders Restricting the Growth. The normal growth and development of the tree is restricted by impeders growing on the trunk or competing for light in the crown. However, the continued life of the tree is not yet affected.
4 :	Impeders Seriously Affecting the Growth. It left unchecked, the impeders are likely to be seriously deforming or even killing the tree. Branches are already dead in the crown or the trunk has already been deformed.
5 :	Impeders Recently Cut and Dead. A few may still be living, but as long as they no longer harm the tree, use this code to indicate a successful treatment by climber cutting.
6 :	Impeders Recently Cut but Treatment not Successful. Remaining climbers whether living or dead, still restrict the growth of the tree.

Note : The effects of the strangler figs, if found, are recorded under this classification.

5 RECORD CLOSED.

For the permanent experimental plots, in order to record in an orderly manner the final entry of a stem which no longer occupies a position in the stand, the following procedure for "Closing the record" of that stem must be followed.

When a tree, due to a change in tree identity class, enters one of the bracketed or cross-hatched SIC-classes in the table, the record for that stem is to be closed. That is, enter the stem on the fieldcard in the usual manner writing the DBHob of the latest enumeration. Then, at the bottom of the fieldcard, write the consecutive tree number and the year of the enumeration. Following that, no further records will be made of that particular stem in future assessments.

The consecutive tree number of any stem thus entered in "Record Closed" must never be used again in that Quadrat.

Write the words "Records Closed" in the line for the stem under the stem descriptions. The record is to be closed when the stem enters one of the following SIC classes :

Tree, not found	:	119, 129, 139
Tree, dead standing, broken stump or cut stump	:	133, 134
Tree, dead fallen, all types	:	141, 142, 143 144, 145

6. RECORDING POLES, SAPLINGS, SEEDLINGS AND WILDLINGS

In order to get information on advanced regeneration, poles with a DBHob of 5.0 cm or more are enumerated in the 9 central quadrats. This information is important for the correct assessment of the future recruitment and productive potential of the site.

6.1 Definition of Poles

A pole is defined as a stem of tree species having a diameter at breast-height over bark (1.3 m) from 5.0 cm up to but not including 15.0 cm.

The pole may originate from a seed, root-sucker, coppice or otherwise, it is only the diameter at breast-height that counts. Only living poles are enumerated, dead poles are not considered.

6.1.2 Details of the Fieldcard Entries for the Recording of Poles

Poles are recorded on the same fieldcards as trees. For the Quadrats where poles are enumerated the stocking code is = 1. However if there are no poles, nor trees to be recorded, i.e. the quadrat is empty, the stocking code is = 0.

For the poles, only the following information is recorded:

Consecutive Tree Number
Stem Identity Class, same as for trees
Botanical name and code
Diameter at Breast Height over bark

The following items are <u>not</u> to be recorded:

Height
Log Grade
Crop tree status
Crown Form
Crown Illumination/Dominance
Stem damage
Crown damage
Woody Climbers

Whenever records for the Quadrat also requires the use of a second fieldcard, write "continued" on the last line of the first fieldcard, and on the first line of the second fieldcard.

On the line below the last entry for a subplot write "End". When a pole dies or disappears, the procedure for "Record Closed" is followed as for trees, see section 5.

6.2 Definition of Saplings

A sapling is defined as having a total height of 150 cm or more and a diameter at breast height of up to 5.0 cm. The saplings are individually tagged and numbered. In order to differentiate the sapling numbers from the tree numbers the number is preceded by the letter "A".

6.2.1 The Sapling Subplot.

The sapling subplot is placed at the northwest corner of the Quadrat and is 5 meters by 5 meters square. It is marked by 4 plastic tubes. In order to avoid cutting and trembling along the Quadrat boundary, a plastic ribbon is strung between the 3 corner tubes.

6.2.2 Details of the Fieldcard Entries for the Recording of Saplings

For the recording of saplings, fieldcard version no. 2, card number 2, is used, refer to Appendix I.2.

The locality information / filename is the same as for trees. The subplot identification is constructed in a similar manner, the subplot numbers run consecutively from 26 to 34. The forest class is scored separately from the quadrat to reflect the situation in the subplot. The same codes are used.

All the entries up to and including the botanical codes are similar to those for trees and poles except for stem identity class (SIC).

STEM IDENTITY CLASS for SAPLINGS Height > 150 cm DBH up to 5.0 cm	XX1	XX2	XX4	XX9
	Compl. Stem	Broken Stem	Cut Stump	Not Found
a) TREE SPECIES, LIVING STEMS ONLY				
Standing	211	212	214	(219)
Fallen	221	222	224	(229)
Successful Sapling :	216			

Figure 10. Stem Identity Classes for Saplings.

- Diameter DBHob : 28,29

  The diameter is measured for all saplings reaching 2.0 cm at breast height over bark and up to 5.0 cm. In the case where the sapling diameter is exactly 5.0 cm or larger it is considered a successful sapling and it is not recorded in the future on the sapling fieldcard but included among the poles on the tree / pole fieldcard and given a new unique number in the tree / pole series (see section 4.2). For a successful sapling the last entry on the sapling fieldcard is the SIC = 216 and the diameter.

- Total Sapling Height : 30,31,32

  The total sapling height is measured in decimeters for saplings from 150 cm in height and until the sapling reaches a diameter of 2.0 cm, thereafter only the diameter is measured.

- Vigour : 33

  The last entry for saplings is the vigour :

  1 : Stem of good form and sound.

  2 : Stem not of good form but sound; or of good form but not sound.

  3 : Stem of poor form, unsound, damaged or rotten. If broken, use stem identity class 212. If fallen, use the appropriate stem identity class. Dead saplings are not recorded.

6.3 Definition of Seedlings

Seedlings are defined as plants of tree-species from a height above ground to top of stem (terminal bud) from 15 cm up to 150 cm.

6.3.1 The Seedling Subplot.

The seedling subplot is placed at the northeast corner of the Quadrat inside the sapling subplot and is 2 meters by 2 meters square. It is marked by 4 plastic tubes. In order to avoid cutting and trembling inside the seedling subplot, a plastic ribbon is strung between the 4 corner tubes all around the seedling subplot.

6.3.2 Details of the Fieldcard Entries for Recording Seedlings

For the recording of seedlings, fieldcard version no. 2, card number 3 is used, refer to Appendix I.3.

The locality information / filename is the same as for trees. The Subplot identification is constructed in a similar manner, the subplot numbers run consecutively from 35 to 43. The forest class is scored separately from the quadrat to reflect the situation in the subplot. The same codes are used.

The seedlings are not individually numbered and on the fieldcard the number of seedlings found per species is counted. The stem identity class (SIC) used are as given below, only living standing seedlings are counted.

STEM IDENTITY CLASS for SEEDLINGS Height > 15 cm up to 150 cm	XX1	XX2	XX4
	Compl. Stem	Broken Stem	Cut Stump
TREE SPECIES, LIVING STEMS ONLY Standing	311	312	314

Figure 11. Stem Identity Classes for Seedlings.

When a seedling reaches a total height of 150 cm it is no longer counted as a seedling but numbered and enumerated among the saplings.

6.4 Recording of Planted Wildlings

In both experiments, wildlings are planted to investigate the performance of plantation establishment and enrichment planting. For the layout refer to the "Procedure for Establishment of Study Area ..." (Forestry Department, 1993 a and b)

6.4.1 Details of the Fieldcard Entries for Recording Wildlings

For the recording of planted wildlings, fieldcard version no. 2, card number 4 is used, refer to Appendix I.4.

The locality information / filename is the same as for trees. The planting line identification is constructed in a similar manner, the planting line numbers run consecutively from 1 to 17 for plantation establishment and from 1 to 10 for enrichment planting. The forest class is not scored for the planting lines, the FCL is zero filled.

The Wildlings are individually numbered on the fieldcard and tagged in the forest. On the fieldcard all the possible plant positions are numbered from 1 to 33 per line. In the cases where a wildling could not be planted due to stream, rocks, swamp etc. the stem identity class (SIC) is 318. The other stem identity classes (SIC) are as given below.

STEM IDENTITY CLASS for WILDLINGS	XX1	XX2	XX4
	Compl. Stem	Broken Stem	Cut Stump
LIVING STEMS Standing Fallen	 311 321	 312 322	 314 324
DEAD STEMS Standing Fallen Not Planted	 331 341 318	 332 342	 334 344

Figure 12. Stem Identity Classes for Wildlings.

When a wildling reaches a diameter at breast height of 50 mm it is no longer regarded as a seedling but given the SIC for a tree / pole as appropriate.

The botanical code for the planted Wildlings are given as for trees and poles.

- Diameter DBHob : 28,29,30,31

  The diameter is measured for all wildlings reaching 5.0 cm at breast height over bark and up. When the wildling diameter reach exactly 5.0 cm or larger it is considered a successful wildling. Only the SIC changes to that of a tree / pole, the remaining information is scored unaltered and on the same fieldcard number 4.

- Total Wildling Height / Trunk Height : 32,33,34

  The total wildling height is measured on all wildlings from 15 cm and until the wildling reaches a diameter of 5.0 cm. For wildlings larger than 5.0 cm DBHob only the total height of 30 dominant wildlings is measured to the nearest meter. The first 30 wildlings reaching above 5.0 cm are considered dominant. If a dominant wildling dies, the height of the largest (DBHob) non-dominant wildling is included.
  In order to get a fixed point from where to measure the height of the small wildlings, a ring is painted around the stem 10 cm above the ground at time of planting. The ring is repainted at the same spot at each enumeration until the wildling reach 5.0 cm DBHob.

- Vigour : 35

The vigour is scored for the wildlings below 5.0 cm DBHob :

1 : Stem of good form and sound.

2 : Stem not of good form but sound; or of good form but not sound.

3 : Stem of poor form, unsound, damaged or rotten. If broken use stem identity class 312. If fallen or dead use the appropriate stem identity class.

Vigour will not be scored for wildlings reaching 5.0 cm DBHob once it is being replaced by the Log Grade.

- Log Grade : 35

The Log Grade replaces vigour and will only be scored for wildlings having a diameter of 5.0 cm and above and with SIC = 111.

The Log Grades are the same as for trees, section 4.7.

- Crown Form : 36

Crown form is scored for all living small wildlings having SIC = 311, 312 and 314 and for large wildlings of 5.0 cm DBHob or more having SIC = 111.

The Crown Form codes are the same as for trees, section 4.9.

- Crown Illumination / Dominance : 37

Crown Illumination / Dominance is scored for all living small wildlings having SIC = 311, 312 and 314 and for large wildlings of 5.0 cm DBHob or more having SIC = 111.

When scoring the crown illumination / dominance the surrounding vegetation is taken into account. This will provide an indication of the need for a liberation treatment to release the wildlings from competition.
The crown illumination / dominance codes are the same as for trees, section 4.10.

- Site Condition : 38

The site condition is scored for all wildlings living, fallen or dead of all stem identity classes, as a means of explaining the fate of the wildling.

The site condition codes are :

1 : Good site, no restrictions

2 : Good site, but with restricting vegetation, (other trees, palms, bamboo, ferns etc.)

3 : Poor site/ rocky/ steep slope

4 : Visible erosion on forest floor

5 : Land slip or land slide, earth moving

6 : Stream, stream bed, swamp, impounded water

7 : Tractor track, skid trail, no erosion

8 : Tractor track, skid trail, with erosion

9 : Log landing, main road

Score the site condition at the planting spot and the immediate vicinity. This code serves the same purpose as the forest class.

- (Column 39, reserved for future use)

- Woody Climbers : 40

Woody climbers are scored for living, standing wildlings of SIC = 311, 312, 314 and 111 only.

The codes for woody climbers are the same as for trees.

7. SKETCH-MAP OF THE QUADRAT

Printed on the fieldcard is a representation of the Quadrat at a scale of 1:400. The Quadrat is subdivided into units of 4 meters by 4 meters on the fieldcard for trees/poles.

Record the approximate position of each tree and its consecutive stem number. This is very useful for finding the trees during a reassessment of the plot when some years have passed. Mark fallen trees and cut stumps. Then mark any distinct terrain features, such as rock outcroppings, rivers and streams, tracks and roads.

This information will assist in making the proper conclusions when analyzing the data in the office.

From the sketch-map of the Quadrats a composite map of the whole block can be drawn.

Remember to orientate the fieldcard correctly according to the geographical orientation of the block.

On the fieldcards for saplings and seedlings, the location of the subplot is drawn for information only, no sketch or location of saplings and seedlings is required.

For the planted wildlings, special location maps are prepared separately.

8. PRACTICAL INSTRUCTIONS

The practical side of the job is well known from similar work. The instructions given below are given only as a guideline.

The permanent posts of plastic tube are placed in the ground and marked by metal tags. The flag stakes marking the Quadrat are also set out.

NOTE : Do not cut any stakes or any lines of sight inside the 100 meter by 100 meter Block. If line of sight is obstructed, use a denser spacing of flag stakes cut from outside the block. Check the correct straight line using the compass.

If nylon ropes are used they must be checked every day against the steel tape.

Make sure to disturb as little as possible inside the Quadrats and subplots.

An exact logbook and compass card giving all details required to relocate the blocks is prepared. The logbook and compass cards must be carefully kept and filed for future reference.

8.1 Crews for the Enumeration Work

The number of crews for the enumeration work will depend on how many experienced staff are available. At least two crews should be available per forest location. Each crew consist of 3 staff and 3 to 5 labourers, as a minimum requirement.

Staff : 3 skilled and experienced foresters.

One <u>Crew Leader</u> and fieldcard recorder, who is responsible for the work.
One <u>Tree Measurer</u> and identifier, who will measure and describe the trees according to the instructions. He must be the best man available for the botanical identification.

One <u>compass leader</u> who is responsible for the location of the Blocks and the staking out and marking of the quadrats.

The 3 staff must be able to cooperate and assist each other in the enumeration work.

Labourers : Three to five

The labourers will assist the staff in the practical task of setting up the stakes and flag poles, checking that trees inside the quadrat are enumerated and other tasks as required.

The laboures must be clearly instructed not to cut anything inside the block, quadrats and subplots. All stakes and posts are to be cut in the surrounding forest at least 10 meters from the boundary of the block.

8.2 Training Course and Supervision

Before the start of the field season a 3 day training course for all field crews are given. The course consist of a one-day thorough presentation and explanation of the instructions for the enumeration work and a full explanation of the measurements and scoring to be used for the forest classification and the individual tree measurements.

The theoretical part is followed by two days of practice in the forest where all the staff take turns to do all the tasks and where the work is carefully supervised, corrected and evaluated.

It is important that the staff has a uniform comprehension of the measurements and the scoring of the various parameters in order to get reliable information for the growth and yield calculations. In order to facilitate the uniform and reliable field enumerations the crews must be continuously supervised and monitored by Senior forest Officers who has a full understanding of the enumeration work and the importance of maintaining reliable records in permanent sample plots. In addition a skilled forest botanist should be employed to supervise and check in the botanical identification, which is one of the most difficult part of the fieldwork.

8.3 Checking the Recording in the Field

The first time these instructions are used, the fieldwork should be checked and adjusted if necessary. When a few quadrats have been enumerated, the crews should change place and enumerate at least 10 Quadrats in another block previously enumerated by the other crew. A new set of fieldcard specially marked for the purpose is handed out to the crews. The crews are not to have access to the original fieldcards during the checking.

When the Quadrats have been reassessed the two sets of fieldcards are compared and any differences are discussed. If there is anything indicating that the reason for the differences is caused by a misunderstanding of the instructions, these must be explained more clearly. Suggestions should also be made to upgrade the instructions in order to avoid misunderstandings in the future. Any systematical type of difference must be carefully analyzed and the cause corrected. For an investigation of this type, however, differences due to subjective judgement cannot be completely avoided.

It is important to conduct training courses before the start of each field season and whenever new crews are taken in. As many questions as possible should be resolved during the training courses.

8.4 Organizing the Work

The enumeration work should progress systematically. When more than one crew is available they should work in different blocks and the crew should finish one block before moving to the next.

The crew should first identify in which block they are going to work and the layout and numbering system used for the Quadrats and subplots. Then make sure that the flag stakes are situated correctly along the Quadrat boundaries.

The heading information of the fieldcard is recorded, except the forest class of the Quadrat which is carefully assessed last. Now proceed to record the trees. All the line entries should be completed for one tree at a time before moving to the next. All descriptions must be carefully announced by the tree measurer and clearly repeated by the fieldcard recorder. When converting the description to the code number, check the manual. The botanical codes are to be filled in later in the camp.

When all the previously tagged trees have been enumerated, look carefully to check for new recruits that have passed over the minimum diameter for the quadrat. The minimum diameter for new recruits in the 16 outer quadrats is 15.0 cm and for the 9 central quadrats is 5.0 cm. The new recruits are numbered individually using a new unique number that has never before been used in the quadrat. For successful saplings that previously had a sapling number beginning with an "A", the "A" number is discarded and the sapling given a new number in the Trees / Poles series.
The correct unique numbering is very important for the analysis of the data.

When all trees / poles and new recruits have been recorded on the fieldcard, write "End" below the last entry. When it is required to use more than one fieldcard, write "Continued" on the last line of the first fieldcard and on the first line of the second fieldcard.

Now record the Forest Class as all information to score correctly the Forest Class is available.

Before moving to the next Quadrat check that all items on the fieldcard are completed.

The number of Quadrats that a crew can manage to enumerate during a day's work is about 20 to 40 depending on the terrain and the density of the forest.

9. CHECKING THE FIELDCARD RECORDS

A careful and systematic check of the items recorded on the fieldcard while still in the field, assists greatly towards simplifying and reducing the expense of editing and error correction work in the office and during data processing.
To ensure the best result, check the days work after returning to the base-camp. Exchange fieldcards so that crews are not checking their own work.

9.1 The Fieldcards

Check to ensure that data from only one Quadrat recorded on each fieldcard. Make sure that the word "End" is written below the last entry for each Quadrat. Whenever more than one fieldcard is required, check the presence of the "Continued" below the last entry on the first fieldcard and above the first entry on the second fieldcard and check that the fieldcard bear the number 2/1, 2/2 or 3/1, 3/2, 3/3 etc. when more than one fieldcard is needed.

9.2 Locality Information

In addition to the date of enumeration, check that the following information and code numbers appear correctly on each fieldcard for both Quadrats and subplot.

- Forest locality
- Type of treatment
- Year of enumeration
- Date of fieldwork
- Crew leader

9.3 Quadrat Information

Stocking of Quadrat

Check that if the code for stocking is "0" then nothing is recorded under the individual line entries and that the word "Empty" is written in the first line.

Check that if the stocking code is "1" then at least one tree, alive or dead is recorded under the individual line entries. Check that the minimum diameter is 150 mm or 50 mm.

Forest Class of Quadrat

Check that a valid code for forest class is entered on each fieldcard.

Check that the rules for Forest Class are followed i.e. that the size of the largest tree SIC = 111, loggrade = 1 or 2 correspond to the main Forest Class, and, if there are a number of pioneer species, that this is reflected in the Forest Class according to the instructions.

Logging roads and landings take precedence over the other codes.

9.4 Quadrat Identification

Check the presence and correctness of:-

- Treatment number
- Block number
- Quadrat number / subplot number / plant line number

Check that the Quadrats appear in the right sequence within each block. Check that all Quadrats are present and that no Quadrat appear more than once.

Errors of this type always causes serious trouble during data processing, so check carefully.

For this study, the Quadrats containing pole measurements (DBHob 50 mm and above) have been fixed at the 9 central Quadrats. Check that only these quadrats contain pole measurements.

9.5 Individual Tree Entries

- Quadrats

a) Consecutive Tree Number

Check that no consecutive stem number appears more than once. During reassessments also check that none of the numbers recorded under "Record Closed" are used for new stems.

b) Tree Identity Class

Check that the tree identity classes are valid codes. During reassessments check for unlikely changes in SIC such as when a previously dead stem is now recorded as a living tree. Check that the descriptions for:-

- Trunk Height
- Tree Status
- Log Grade
- Crown form
- Crown illumination / dominance
- Stem damage
- Crown damage
- Woody climbers

are only recorded for SIC = 111 and trees DBHob of 150 mm and above.

c) Vernacular name, Wood Quality Group and Botanical Code

Check carefully the conversion of Vernacular name to wood Quality group and botanical code according to the species list provided. Check that only vernacular names that are on the species list are used. Avoid names used only in a local dialect.

In cases where new species are encountered COLLECT SPECIMEN, the code numbers to be used will be decided later in the office. Check that a separate list is made of the new species and in which Quadrats they are found. Check the correct labeling of the specimens collected.

During later reassessments, check that the botanical identification is the same as previously recorded for the same stem. If not, an explanation must appear on the fieldcard and supported by leaf specimen.

Check that only dead unidentified stems have the botanical code 0.00.00. Living unidentified stems are given the botanical code 7.00.00.

Errors in the code numbers for wood quality group and for botanical identification are the most common types of errors found during data processing.

d) Diameter at Breast-Height Over Bark

Check that no diameter below 150 mm for trees and 50 mm for poles millimeters are recorded. Check for unlikely large diameters.

For reassessments, check that the diameter increment is within reasonable limits. Negative growth or no growth may occur for broken or dead stems or for trees with poor crown form and illumination. Excessive growth may be due to errors in the measurements or to a change of the point of measurement. All changes of the point of measurement must be noted on the fieldcard giving very good reasons for the change.

e) Trunk Height

Check that height measurement is recorded for all trees SIC = 111, and DBHob of 150 mm and above, check for unlikely diameter/height relationships

f) Log Grade

g) Crop tree status

h) Crown Form

i) Crown Illumination / dominance

j) Stem damage

k) Crown damage

i) Woody climbers

Check that all the above codes are only recorded for SIC = 111 and DBHob of 150 mm and above.

A good checking in the field, while it is still possible in the case of serious doubt to go back and check on the ground, save a lot of trouble later in the office. It also saves a lot of time checking and correcting errors during data processing and make the results more reliable.

It is well worth the effort.

10. REFERENCES

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APPENDICES :

I. The Fieldcards

I.1 Trees and Poles
I.2 Saplings
I.3 Seedlings
I.4 Wildlings

II. The Species List

PROJEK BERSAMA MALAYSIA – ITTO (HUTAN ASLI / DIBALAK)

LOKASI HUTAN : CHERUL.

BORANG 1

POKOK-POKOK ≥ 5cm Diameter

NO. KAD: 1/1

PEGAWAI REKOD : Svend Korsgaard

TARIKH : 29/6-93

LAKARAN PETA KUADRAT (20m x 20m)

20m

20m

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A | B	Rawatan C	Tahun D	E
C H B L K	0 1	9 3	1

PEMERHATIAN KUADRAT:

Rocky Steep, Palms.

MAKLUMAT KUADRAT

Isi kandungan Kuadrat
Tiada = 0;
Ada Pokok ≥ 15 cm = 1(k.b.);
Ada Pokok ≥ 5 cm = 1 (k.k.)

6	Kelas Hutan 7 8 9	No. Rawatan 10 11	No. Petak 12 13	No. Kuadrat 14 15 16
1	5 2 3	0 1	0 3	0 0 1

MAKLUMAT POKOK DAHULU (T92/B06)

MAKLUMAT POKOK SEKARANG Tahun 93 Bulan 06

MAKLUMAT POKOK DAHULU (T92/B06):

Nombor Pokok (17–19)	Kelas Pokok (20–22)	K. Dagang (23)	Kumpulan (24–25)	Spesis (26–27)	Perepang Paras Dada Luar Kulit (mm) (28–31)
001	111				0169
2	111				0315
3	112				0190
5	131				0530
6	134				0930
7	111				0215
8	112				0161
9	122				0200
10	111				0153
11	113				0151

MAKLUMAT POKOK SEKARANG (Tahun 93, Bulan 06):

Nombor Pokok (17–19)	Kelas Pokok (20–22)	CATATAN: NAMA POKOK	CATATAN	K. Dagang (23)	Kumpulan (24–25)	Spesis (26–27)	Perepang Paras Dada Luar Kulit (mm) (28–31)	Tinggi Batang Bersih (Meter) (32–33)	Grade Btg (34)	Status Pk (35)	Bentuk Sil (36)	Pencahayaan Sil (37)	Rosak Btg (38)	Rosak Sil (39)	Penjalat (40)
1	111	Meranti Bukit		1	01	02	0174	05	1	1	2	3			5
2	112	Mempisang	broken	3	51	01	0316	00	0	0	0	0			0
3	132	Perah	Dead broken	7	64	01	0190	00	0	0	0	0			0
5	133	closed	Record												
6	134	closed	Record												
7	111	Kelempayan		8	37	01	0231	12	1	3	1	1			1
8	112	Terap	broken	6	84	01	0162	00	0	0	0	0			0
9	142	closed	Record												
10	111	Kubin		8	46	02	0212	06	1	3	1	3			1
11	113	Mahang		8	46	01	0161	00	0	0	0	0			0
12	111	Meranti Tembaga	New	1	02	14	0151	03	1	1	1	4			1
13	111	Sesendok	New.	8	80	01	0162	04	1	3	2	2			2

REKOD DITUTUP NO/TAHUN	4/92	5/93	6/93	9/93

Tree no.4, Poison girdled 1991 SIC = 115, Dead in 1992 SIC = 135, Record Closed.

PROJEK BERSAMA MALAYSIA – ITTO (HUTAN ASLI / DIBALAK)	LOKASI HUTAN :	BORANG 2	ANAK POKOK 150 cm Tinggi – 5 cm Diameter	NO. KAD: /
	PEGAWAI REKOD :	TARIKH :	LAKARAN PETA KUADRAT (5m x 5m)	

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A	Keadaan Hutan B	Rawatan C	Tahun D	E
				2

PEMERHATIAN KUADRAT:

5m

5m

MAKLUMAT KUADRAT

Isi kandungan Kuadrat Tiada = 0; Ada Anak Pokok = 1. (6)	Kelas Hutan (7 8 9)	No. Rawatan (10 11)	No. Petak (12 13)	No. Kuadrat (14 15 16)

MAKLUMAT POKOK DAHULU (T /B)

MAKLUMAT POKOK SEKARANG Tahun Bulan

CATATAN :

Bil Anak Pokok			Kelas Anak Pokok			K. Dagang	Kum-pulan		Spesis		Perep. Paras Dada Luar Kulit (mm)		Tinggi Pokok Dalam (dm)			Bil Anak Pokok			Kelas Anak Pokok					K. Dagang	Kum-pulan		Spesis		Perep. Paras Dada Luar Kulit (mm)		Tinggi Pokok Dalam (dm)			Ksn
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	17	18	19	20	21	22	NAMA POKOK	CATATAN	23	24	25	26	27	28	29	30	31	32	33
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REKOD DITUTUP NO/TAHUN

PROJEK BERSAMA MALAYSIA - ITTO
(HUTAN ASLI / DIBALAK)

LOKASI HUTAN :

BORANG 3

ANAK BENIH
15 cm - 150 cm Tinggi

NO. KAD: /

PEGAWAI REKOD :

TARIKH :

LAKARAN PETA KUADRAT (2m x 2m)
2m ; 2m

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A	Keadaan Hutan B	Rawatan C	Tahun D	E
C H	B L K	0 1	9	3

PEMERHATIAN KUADRAT:

MAKLUMAT KUADRAT
Isi kandungan Kuadrat
Tiada = 0;
Ada Anak Benih = 1.

6

Kelas Hutan 7 8 9

No. Rawatan 10 11

No. Petak 12 13

No. Kuadrat 14 15 16

MAKLUMAT POKOK SEKARANG Tahun Bulan

MAKLUMAT POKOK SEKARANG Tahun Bulan

Bil Anak Benih			Kelas Anak Benih			CATATAN :		K. Dagang	Kumpulan		Spesis	
17	18	19	20	21	22	NAMA POKOK	CATATAN	23	24	25	26	27

Bil Anak Benih			Kelas Anak Benih			CATATAN :		K. Dagang	Kumpulan		Spesis	
17	18	19	20	21	22	NAMA POKOK	CATATAN	23	24	25	26	27

REKOD NO/TAHUN
DITUTUP

PROJEK BERSAMA MALAYSIA – ITTO
(HUTAN ASLI / DIBALAK)

LOKASI HUTAN : ______________________

BORANG 4

POKOK-POKOK
Ladang/Tanaman Mengaya

NO. KAD: /

PEGAWAI REKOD :

TARIKH :

MAKLUMAT HUTAN (FILE NAME)

Keadaan Hutan A	Keadaan Hutan B	Rawatan C	Tahun D	E
				4

PEMERHATIAN KUADRAT:

MAKLUMAT KUADRAT
Isi kandungan Garisan Tanaman
Tiada = 0;
Ada Pokok Tanaman = 1

6	Kelas Hutan 7	8	9	No. Rawatan 10	11	No. Petak 12	13	No. Garisan 14	15	16
	0	0	0							

MAKLUMAT POKOK DAHULU (T /B)

MAKLUMAT POKOK SEKARANG Tahun ☐☐ Bulan ☐☐

Nombor Pokok			Kelas Pokok			K. Dagang	Kumpulan		Spesis		Perepang Paras Dada Luar Kulit (mm)				Nombor Pokok			Kelas Pokok			CATATAN :		K. Dagang	Kumpulan		Spesis		Perepang Paras Dada Luar Kulit (mm)				Tinggi Pokok (dm)			Ksn	Bentuk Sil	Pencah Sil	Tapak		Pepanjat
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	17	18	19	20	21	22	NAMA POKOK	CATATAN	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
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REKOD DITUTUP NO/TAHUN

Appendix No. II

ITTO

FORESTRY DEPARTMENT HEADQUARTERS, KUALA LUMPUR

(SPECIES.LIS)
SPECIES LIST FOR ITTO ENUMERATIONS, DATE 6/8/1993

A) DIPTEROCARPS

10101	Meranti Merah Tua	Shorea spp. (Dark red)
10102	Meranti bukit	Shorea platyclados
10103	Meranti nemesu	Shorea pauciflora
10104	Meranti sengkawang bulu	Shorea sinkawang
10105	Meranti sengkawang merah	Shorea sinkawang
10106	Meranti seraya	Shorea curtisii
10107	Meranti seraya daun besar	Shorea curtisii
10201	Meranti Merah/Merah Muda	Shorea spp. (Red/light red)
10202	Meranti bakau	Shorea uliginosa
10203	Meranti batu	Shorea dasyphylla
10204	Meranti bunga	Shorea teysmanniana
10205	Meranti daun besar	Shorea hemsleyana
10206	Meranti kepong	Shorea ovalis
10207	Meranti kepong hantu	Shorea macrantha
10208	Meranti langgong	Shorea lepidota
10209	Meranti paya	Shorea platycarpa
10210	Meranti pepijat	Shorea johorensis
10211	Meranti rambai daun	Shorea acuminata
10212	Meranti sarang punai	Shorea parvifolia
10213	Meranti sarang punai bukit	Shorea ovata
10214	Meranti tembaga	Shorea leprosula
10215	Meranti tengkawang ayer	Shorea palembanica
10301	Meranti Putih	Shorea spp. (White)
10302	Meranti belang	Shorea resinosa
10303	Meranti bumbong	Shorea dealbata
10304	Meranti jerit	Shorea henryana
10305	Meranti lapis	Shorea lamellata
10306	Meranti laut	Shorea gratissima
10307	Meranti mengkai	Shorea bentongensis
10308	Meranti pa'ang	Shorea bracteolata
10309	Meranti pipit	Shorea assamica
10310	Meranti temak	Shorea hypochra
10311	Meranti temak nipis	Shorea roxburghii
10401	Meranti Kuning/Damar Hitam	Shorea spp. (Yellow)
10402	Damar hitam bulu	Shorea longisperma
10403	Damar hitam gajah	Shorea gibbosa
10404	Damar hitam katup	Shorea dolichocarpa
10405	Damar hitam kelim	Shorea blumutensis
10406	Damar hitam pipit	Shorea multiflora
10407	Damar hitam sengkawang putih	Shorea maxima
10408	Damar hitam siput	Shorea faguetiana
10409	Damar hitam siput besar	Shorea kuantanensis
10410	Damar hitam siput jantan	Shorea hopeifolia
10411	Damar hitam telepok	Shorea peltata
20502	Mersawa durian	Anisoptera laevis
20503	Mersawa gajah	Anisoptera scaphula
20504	Mersawa kesat	Anisoptera costata

20505	Mersawa kuning	Anisoptera curtisii
20506	Mersawa merah	Anisoptera megistocarpa
20507	Mersawa paya	Anisoptera marginata

20601	Merawan	Hopea spp. (Merawan)
20602	Merawan batu	Hopea beccariana
20603	Merawan bunga	Hopea pubescens
20604	Merawan daun bulat	Hopea latifolia
20605	Merawan gunong	Hopea montana
20606	Merawan jangkang	Hopea nervosa
20607	Merawan jantan	Hopea griffithii
20608	Merawan jeruai	Hopea lanceolata
20609	Merawan kelabu	Hopea cescens
20610	Merawan mata kucing beludu	Hopea myrtifolia
20611	Merawan mata kucing bukit	Hopea cellata
20612	Merawan mata kucing hitam	Hopea dryobalanoides
20613	Merawan mata kucing merah	Hopea ferruginea
20614	Merawan mata kucing pipit	Hopea johorensis
20615	Merawan meranti	Hopea sulcata
20616	Merawan palit	Hopea dyeri
20617	Merawan penak	Hopea mengarawan
20618	Merawan siput	Hopea sangal
20619	Merawan siput jantan	Hopea odorata
20620	Merawan ungu	Hopea bracteata

20701	Gerutu	Parashorea spp.
20702	Gerutu gerutu	Parashorea stellata
20703	Gerutu pasir	Parashorea densiflora
20704	Gerutu pasir daun besar	Parashorea globosa

20801	Keruing (Berminyak)	Dipterocarpus spp. (oily)
20802	Keruing bulu	Dipterocarpus baudii
20803	Keruing gombang	Dipterocarpus cornutus
20804	Keruing gondol	Dipterocarpus kerrii
20805	Keruing kertas	Dipterocarpus chartaceus
20806	Keruing merah	Dipterocarpus verrucosus
20807	Keruing sol	Dipterocarpus lowii
20808	Keruing ternek	Dipterocarpus palembanicus
20809	Keruing etoi	Dipterocarpus dyeri
20810	Keruing mempelas	Dipterocarpus crinitus

20901	Keruing (Tidak Berminyak)	Dipterocarpus spp. (non-oily)
20902	Keruing baran	Dipterocarpus eurynchus
20903	Keruing beledu	Dipterocarpus obtusifolius
20904	Keruing belimbing	Dipterocarpus grandiflorus
20905	Keruing bukit	Dipterocarpus costatus
20906	Keruing cogan	Dipterocarpus rigidus
20907	Keruing gasing	Dipterocarpus caudatus
20908	Keruing gombang merah	Dipterocarpus kunstleri
20909	Keruing gunong	Dipterocarpus retusus
20911	Keruing kerut	Dipterocarpus sublamellatus
20912	Keruing kesat	Dipterocarpus gracilis
20913	Keruing kipas	Dipterocarpus costulatus
20914	Keruing latek	Dipterocarpus apterus
20915	Keruing mengkai	Dipterocarpus rotundifolius
20916	Keruing neram	Dipterocarpus oblongifolius
20917	Keruing padi	Dipterocarpus semivestitus
20918	Keruing paya	Dipterocarpus coriaceus
20919	Keruing perak	Dipterocarpus perakensis

21421	Resak pipit	Vatica lowii
21422	Resak putih	Vatica perakensis
21423	Resak ranting kesat	Vatica odorata

B) NON-DIPTEROCARPS

75101	Antoi	Cyathocalyx spp.
71601	Ara berteh	Parartocarpus spp.
71602	Ara berteh bukit	Parartocarpus bracteatus
71603	Ara berteh paya	Parartocarpus venenosus
81501	Ara, A. kelepong	Ficus spp.
79201	Asam gelugor	Garcinia spp.
79205	Asam pupoi	Sarcotheca spp.
89802	Balik angin	Mallothus spp.
43603	Bakong, Keledang bangkong	Artocarpus integer silvestris
32601	Banitan, Jangkang	Xylopia spp.
79210	Bayor bukit	Schoutenia spp.
78605	Bayur	Pterospermum spp.
79215	Bebusuk, Busok busok, Jahar	Cassia spp.
78650	Bekak, Telur Belangkas	Aglaia (Amoora) spp.
31701	Bengang	Neesia spp.
61801	Berangan	Castanopsis spp.
89805	Berembang bukit	Duabanga spp.
31901	Bintangor	Calophyllum spp.
31902	Bintangor batu	Calophyllum inophylloide
31903	Bintangor bukit	Calophyllum symingtonianum
31904	Bintangor bunga	Calophyllum curtisii
31905	Bintangor bunut	Calophyllum macrocarpum
31906	Bintangor daun karat	Calophyllum rubiginosum
31907	Bintangor daun panjang	Calophyllum incrassatum
31908	Bintangor gambut	Calophyllum retusum
31909	Bintangor gasing	Calophyllum pulcherrimum
31910	Bintangor gunong daun besar	Calophyllum coriaceum
31911	Bintangor gunong daun kecil	Calophyllum cuneatum
31912	Bintangor jangkang	Calophyllum sclerophyllum3
31913	Bintangor kelim	Calophyllum scriblitifolium
31914	Bintangor kuning	Calophyllum floribundum
31916	Bintangor lekok	Calophyllum depressinervosum
31917	Bintangor lilin	Calophyllum wallichianum
31918	Bintangor merah	Calophyllum canum
31919	Bintangor putih	Calophyllum alboramulum
52001	Bitis	Palaquium spp.
52002	Bitis bitis	Palaquium spp.
52003	Bitis bukit	Palaquium stellatum
52004	Bitis paya	Palaquium ridleyi
79999	Bungor	Lagerstroemia spp.
3613	Cempedak	Artocarpus interger
9999	Cemperai	Champereia spp.
9305	Cenderai, Dedamak	Grewia spp.
8610	Chempaka	Aromadendron elegans
2101	Damar minyak	Agathis borneensis
2201	Dedali	Strombosia javanica
9305	Dedamak, Cenderai	Grewia spp.
9101	Delek	Anisophyllea spp.
9220	Duku hutan, Langsat	Lansium spp.
2301	Durian, D. hantu	Durio spp.

32302	Durian batang	Durio malaccensis
32303	Durian beludu	Durio oxleyanus
32304	Durian bujor	Durio singaporensis
32305	Durian daun	Durio lowianus
32306	Durian daun besar	Durio macrophyllus
32307	Durian daun tajam	Durio pinangianus
32308	Durian ijau laut	Durio wyatt-smithii
32309	Durian kampong	Durio zibethinus
32310	Durian merah	Durio graveolens
32311	Durian paya	Durio carinatus
37201	Durian punggai, Punggai	Ceolostegia griffithii
32312	Durian tupai	Durio griffithii
32401	Ekor	Dacrydium spp.
89810	Gambir, G. hutan	Maesa spp.
79225	Gapis	Saraka spp.
79201	Gelugor, Asam gelugor	Garcinia spp.
32501	Geronggang	Cratoxylum spp.
32502	Geronggang derum	Cratoxylum formosum
32503	Geronggang derum bukit	Cratoxylum maingayi
32504	Geronggang derum seluncor	Cratoxylum cochinchinense
32505	Geronggang geronggang	Cratoxylum arborescens
89815	Hampas tebu	Gironniera spp.
89820	Hujan panas	Breynia spp.
79245	Inggir burong, Pagar anak	Ixonantes spp.
68404	Ipoh	Antiaris toxicaria
32601	Jangkang, Banitan	Xylopia spp.
32602	Jangkang bukit	Xylopia ferruginea
32603	Jangkang paya	Xylopia fusca
72701	Jelawai	Terminalia spp.
72702	Jelawai jaha	Terminalia subspathulata
72703	Jelawai ketapang	Terminalia catappa
72704	Jelawai mempelam babi	Terminalia phellocarpa
72705	Jelawai mentalun	Terminalia calamansanai
32801	Jelutong	Dyera costulata
79230	Jelutong bedak	Tabernaemontana spp.
79999	Jenjulung	Agrostistachys spp.
74103	Jering	Pithecellobium jeringa
79215	Jahar, Busok busok	Cassia spp.
62202	Kamap	Strombosia maingayi
78655	Kandis, Manggis	Garcinia spp.
72901	Kangsar, Kasah	Pterygota horsfieldii
78615	Karas	Aquilaria malaccensis
72901	Kasah, Kangsar	Pterygota horsfieldii
63001	Kasai	Pometia spp.
63002	Kasai daun besar	Pometia pinnata
63003	Kasai daun kecil	Pometia pinnata alnifolia
63004	Kasai daun licin	Pometia ridleyi
63101	Kayu arang, Meribut, Tuba buah	Diospyros spp.
33201	Kedondong	Family of burseraceae
33202	Kedondong bulan	Canarium littorale
33203	Kedondong bulan bulu	Canarium littorale tomentosum
33204	Kedondong gergaji	Canarium littorale forma
33205	Kedondong kemasul	Canarium apertum

33206	Kedondong keruing	Canarium megalanthum
33207	Kedondong putih	Canarium littorale forma
33208	Kedondong senggeh	Canarium pseudosumatranum
33209	Kedondong kerut	Dacryodes rostrata
33210	Kedondong matahari	Dacryodes rugosa
33211	Kedondong mempelas	Dacryodes laxa
33212	Kedondong serong	Dacryodes puberula
33213	Kedondong kerantai	Santiria spp.
33214	Kedondong kerantai bulu	Santiria tomentosa
33215	Kedondong kerantai licin	Santiria laevigata
33216	Kedondong sengkuang	Scutinanthe brunnea
33217	Kedondong kijai	Triomma malaccensis
73301	Kekabu hutan	Bombax valetonii
53401	Kekatong	Cynometra spp.
53402	Kekatong kekatong	Cynometra malaccensis
53403	Kekatong laut	Cynometra iripa
73501	Kelat	Eugenia spp.
73502	Kelat gelam	Eugenia cerina
73503	Kelat jambu laut	Eugenia grandis
73504	Kelat merah	Eugenia chorantha
73505	Kelat paya	Eugenia papillosa
78665	Kelat samak, Samak	Theaceae spp.
43601	Keledang	Artocarpus spp.
43602	Keledang babi	Artocarpus anisophyllus
43604	Keledang keledang	Artocarpus lanceifolius
43605	Keledang tampang	Artocarpus nitidus
43606	Keledang tampang bulu	Artocarpus dadah
43607	Keledang tampang gajah	Artocarpus fulvicortex
43608	Keledang tampang hitam	Artocarpus gomezianus
43609	Keledang temponek	Artocarpus rigidus
33701	Kelempayan	Anthocephalum chinensis
78620	Kelumpang	Sterculia spp.
33801	Kembang semangkok	Scaphium spp.
33802	Kembang semangkok bulat	Scaphium linearicarpum
33803	Kembang semangkok jantong	Scaphium macropodum
9999	Kemenyan, Kemian	Styrax spp.
3901	Kempas	Koompassia malaccensis
9999	Kemuning	Hunteria spp.
9825	Kenidai, Kernam	Bridellia spp.
4001	Keranji	Dialium spp.
4002	Keranji bulu	Dialium kingii
4003	Keranji kuning besar	Dialium platysepalum
4004	Keranji kuning kecil	Dialium wallichii
4005	Keranji paya	Dialium patens
4006	Keranji tebal besar	Dialium laurinum
4007	Keranji tebal kecil	Dialium maingayi
4008	Keranji tunggal	Dialium procerum
4101	Keredas	Pithecellobium bubalinum
9825	Kernam, Kenidai	Bridellia spp.
7306	Kikir buntal, Rambutan pacat	Xerospermum spp.
4602	Kubin, Mahang gajah	Macaranga gigantea
4201	Kulim	Scorodocarpus borneensis
9999	Kundang, K. rumania	Bouea spp.
4102	Kungkur	Pithecellobium splendens
9220	Langsat, L. hutan, Duku h.	Lansium spp.
4502	Lanjut	Mangifera lagenifera
4301	Leban	Vitex spp.
9999	Limau, Merlimau	Citrus spp.

77303	Lotong, Sanggol lotong	Nephelium eriopetalum
84401	Ludai	Sapium baccatum
34501	Machang	Mangifera spp.
34503	Machang machang	Mangifera longipes
84601	Mahang, Mersepat	Macaranga spp.
84602	Mahang gajah, Kubin	Macaranga gigantea
84603	Mahang merah	Macaranga triloba
84604	Mahang putih	Macaranga hypoleuca
34504	Mangga	Mangifera indica
78655	Manggis, M. hutan, Kandis	Garcinia spp.
49105	Mata keli	Gynotroches spp.
79999	Mata kuching	Dimocarpus (Euphoria) spp.
74701	Mata ulat	Kokoona spp.
64801	Medang, M. pepijat	Family of Lauraceae
64802	Medang payong	Actinodaphne maingayi
64803	Medang kemangi	Cinnamomum porrectum
64804	Medang teja	Cinnamomum javanicum
79265	Melokam, Rokam	Flacourtia spp.
64901	Melunak	Pentace spp.
64902	Melunak bukit	Pentace curtisii
64903	Melunak pusat beludu	Pentace triptera
49110	Membuloh	Pellacalyx spp.
65001	Mempening	Lithocarpus spp.
35101	Mempisang	Annonaceae spp.
79999	Mempoyan	Rhodamnia spp.
89830	Menarong, Mengkirai	Trema spp.
89835	Mendong	Eleocarpus spp.
89830	Mengkirai, Menarong	Trema spp.
79999	Mengkudu, M. hutan	Morinda spp.
45201	Mengkulang	Heritiera spp.
45202	Mengkulang jari	Heritiera javanica
45203	Mengkulang jari bulu	Heritiera sumatrana
45204	Mengkulang siku keluang	Heritiera simplicifolia
75301	Mengkun	Tetrameles nudifelora
79235	Meraga	Pertusadina spp.
48660	Meransi	Carallia spp.
50216	Meranti melantai	Shorea macroptera
65401	Merbatu	Family of Atuna
65402	Merbatu pipit	Parinari costata
55501	Merbau	Intsia palembanica
63101	Meribut, Tuba buah, Kayu arang	Diospyros spp.
79999	Merlimau, Limau	Citrus spp.
65601	Merpauh	Swintonia spp.
65602	Merpauh daun runcing	Swintonia penangiana
65603	Merpauh daun tebal	Swintonia spicifera
65604	Merpauh periang, Pauh p.	Swintonia schwenkii
84601	Mersepat, Mahang, Musafat	Macaranga spp.
78630	Mertas	Ctenolophon parvifolius
79999	Merumbung, Gambong	Vernonia spp.
43610	Miku	Artocarpus lowii
65701	Minyak berok	Xanthophyllum spp.
43611	Nangka	Artocarpus heterophyllus
79999	Nemali, Mali-mali	Leea spp.
89840	Nipis Kulit	Memecylon spp.
35801	Nyatoh	Family of sapotaceae
35802	Nyatoh ketiau	Ganua motleyana
35803	Nyatoh gunong	Palaquium reginamontium

35804	Nyatoh jambak	Palaquium hexandrum
35805	Nyatoh kabu	Palaquium xanthochymum
35806	Nyatoh mayang	Palaquium sukoei
35807	Nyatoh pipit	Palaquium microphyllum
35808	Nyatoh putih	Palaquium obovatum
35809	Nyatoh semaram	Palaquium semaram
35810	Nyatoh sidang	Palaquium rostratum
35811	Nyatoh surin	Palaquium impressinervium
35812	Nyatoh taban merah, Taban	Palaquium gutta
35813	Nyatoh taban putih	Palaquium oxleyanum
35814	Nyatoh tembaga	Palaquium maingayi
35815	Nyatoh tembaga kuning	Palaquium hispidum
35817	Nyatoh ekor	Payena lanceolata
35818	Nyatoh sundek	Payena obscura
35819	Nyatoh nangka kuning	Pouteria malaccensis
35820	Nyatoh nangka merah	Planchonella maingayi
79240	Otak udang	Buchanania spp.
79245	Pagar anak, Inggir burong	Ixonantes spp.
79999	Pasak bumi, Tongkat ali	Eurycoma
65901	Pauh kijang	Irvingia malayana
78675	Pelawan	Tristania spp.
36001	Pelong	Pentaspadon spp.
36002	Pelong beludu	Pentaspadon velutinus
36003	Pelong licin	Pentaspadon motleyi
76101	Penaga	Mesua ferrea
66201	Penarahan	Family of Myristicaceae
66301	Penarahan arang	Myristica cinnamomea
66302	Penarahan arang ayer	Myristica elliptica
66303	Penarahan arang bukit	Myristica maingayi
66304	Penarahan arang gambut	Myristica lowiana
79250	Pepauh	Iuodia spp.
79999	Pepulut	Chrysophyllum spp.
76401	Perah	Elateriospermum tapos
6501	Perah ikan	Pimeleodendron griffithianum
6601	Perupok	Lophopetalum spp.
6701	Petai	Parkia spp.
6702	Petai kerayong	Parkia javanica
6703	Petai meranti	Parkia singularis
6704	Petai petai	Parkia speciosa
6801	Petaling	Ochanostachys amentacea
6901	Podo	Podocarpus spp.
6902	Podo bukit	Podocarpus neriifolius
6903	Podo cucor atap	Podocarpus imbricatus
6904	Podo kebal musang	Podocarpus motleyi
6905	Podo kebal musang gunong	Podocarpus wallichianus
6906	Podo laut	Podocarpus polystachy
3612	Pudu	Artocarpus kemando
7001	Pulai	Alstonia spp.
7002	Pulai basong	Alstonia spatulata
003	Pulai penipu bukit	Alstonia macrophylla
004	Pulai penipu paya	Alstonia angustifolia
005	Pulai pulai	Alstonia angustiloba
305	Pulasan	Nephelium spp.
101	Punah	Tetramerista glabra
201	Punggai, Durian punggai	Ceolostegia griffithii
202	Punggai daun besar	Ceolostegia borneensis
635	Putat	Barringtonia spp.

79260	Rambai, R. hutan, R. tikus	Baccaurea spp.
77301	Rambutan	Sapindaceae spp.
77302	Rambutan hutan	Nephelium lappaceum
77306	Rambutan pacat, Kikir buntal	Xerospermum spp.
37401	Ramin	Gonystylus spp.
37403	Ramin daun tebal	Gonystylus brunnescens
37404	Ramin melawis	Gonystylus bancanus
37405	Ramin pinang muda	Gonystylus confusus
37406	Ramin pipit	Gonystylus maingayi
34505	Rawa	Mangifera microphylla
77304	Redan	Nephelium glabrum
67501	Rengas	Family of Anacardiaceae
67502	Rengas ayer	Gluta elegans
67503	Rengas kerbau jalang	Gluta aptera
77504	Rengas padi	Melanochyla auriculata
79265	Rukam, Rokam, Melokam	Flacourtia spp.
79270	Saga, S. daun bulat	Adenanthera
78665	Samak, Kelat s.	Theaceae spp.
78666	Samak pulut	Gordonia concen.
77303	Sanggol lotong	Nephelium spp.
79999	Sebasah	Aporusa spp.
79999	Selada	Goniothalamus spp.
78640	Sena	Pterocarpus indicus
79275	Sendudok	Astronia spp.
77601	Sengkuang	Dracontomelon dao
67701	Sentang	Azadirachta excelsa
77801	Sentul	Sandoricum koetjape
37901	Sepetir	Sindora spp.
37902	Sepetir beludu besar	Sindora velutina
37903	Sepetir daun nipis	Sindora echinocalyx
37904	Sepetir daun tebal	Sindora wallichii
37905	Sepetir licin	Sindora coriacea
37906	Sepetir mempelas	Sindora siamensis
78625	Sepul	Parishia spp.
88001	Sesendok	Endospermum malaccense
79260	Setambun, S. tahi, Tampoi, etc	Baccaurea spp.
78680	Setumpul	Hydnocarpus spp.
89845	Sial menaun	Pternandra spp.
48101	Simpoh	Dillenia spp.
48102	Simpoh ayer	Dillenia suffruticosa
48103	Simpoh beludu	Dillenia ovata
48104	Simpoh daun merah	Dillenia grandifolia
48105	Simpoh gajah	Dillenia reticulata
48106	Simpoh padang	Dillenia obovata
48107	Simpoh paya	Dillenia pulchella
48108	Simpoh putih	Dillenia albiflos
48109	Simpoh ungu	Dillenia excelsa
43614	Sukun	Artocarpus communis
78201	Surian	Cedrela/Toona spp.
78202	Surian batu	Chukrassia tabularis
78203	Surian bawang	Cedrela serrata
78204	Surian wangi	Cedrela sureni
35812	Taban, Nyatoh taban merah	Palaquium gutta
79260	Tambun taik, Tampoi, Setambun	Baccaurea spp.
79260	Tampoi, Rambai h., Setambun	Baccaurea spp.
79280	Tapak itik	Euodia spp.
68301	Tembusu	Fagraea spp.

68302	Tembusu hutan	Fagraea gigantea
68303	Tembusu padang	Fagraea fragrans
78685	Tempinis	Streblus spp.
43609	Temponek, Keledang temponek	Artocarpus rigidus
68401	Terap	Family of Moraceae
68402	Terap hitam	Artocarpus scortechinii
68403	Terap nasi	Artocarpus elasticus
38501	Terentang	Campnosperma spp.
38502	Terentang daun besar	Campnosperma auriculatum
38503	Terentang daun kecil	Campnosperma squamatum
38504	Terentang simpoh	Campnosperma coriaceum
89850	Tinjau Belukar	Porterandia spp.
79999	Tongkat ali, Penawar pahit	Eurycoma
43902	Tualang	Koompassia excelsa
63101	Tuba buah, Kayu arang, Meribut	Diospyros spp.
78670	Tulang daing	Millettia atropurpurea
89855	Ubah	Glochidion spp.