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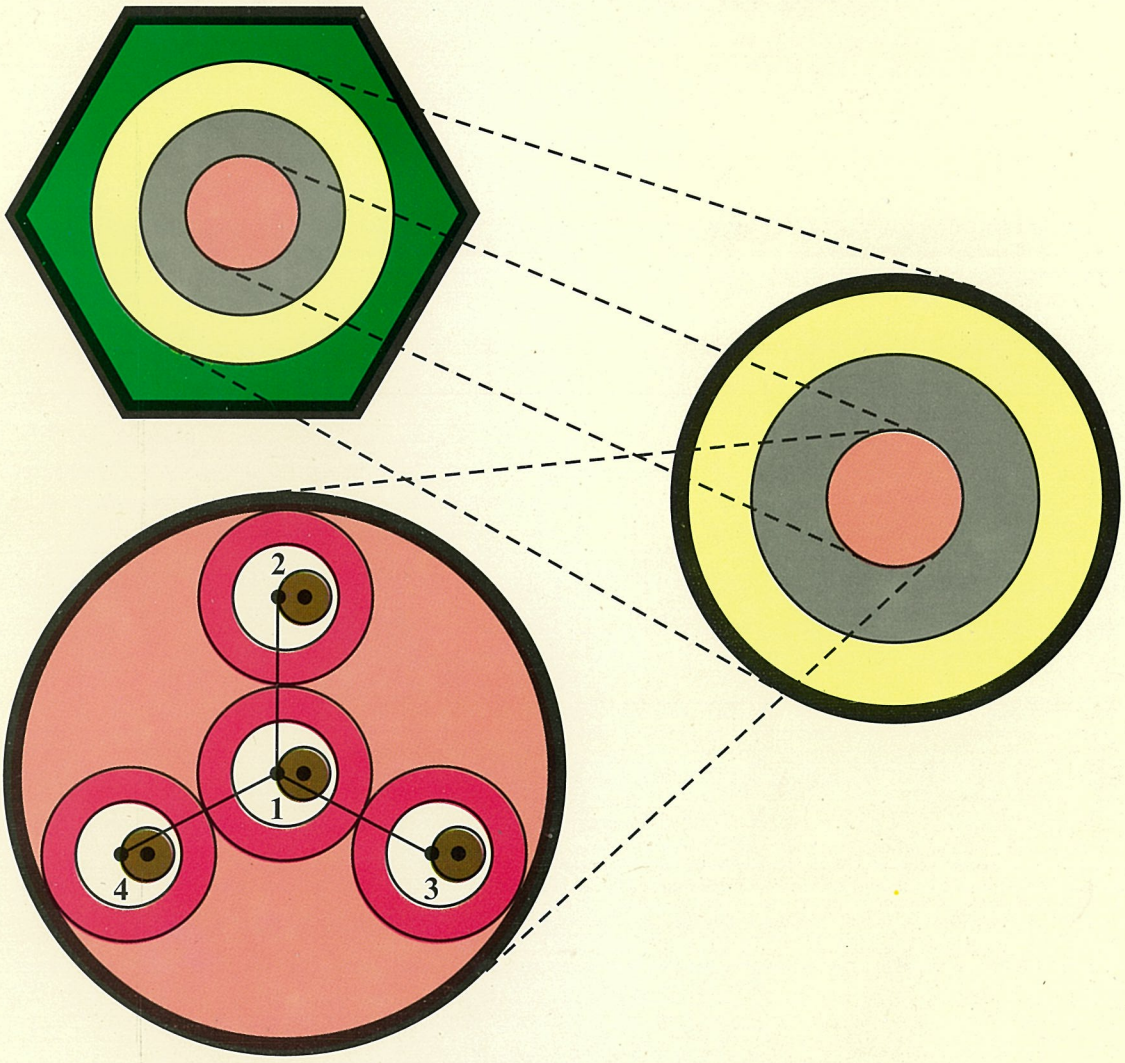
ITTO PROJECT NO. PD 16/95 REV.2 (F)

FOREST HEALTH MONITORING TO MONITOR THE SUSTAINABILITY OF INDONESIAN TROPICAL RAIN FOREST

COMPLETION REPORT



International Tropical Timber Organization
in cooperation with
MOF-SEAMEO-BIOTROP-USDA Forest Service

Project Executing Agency
SEAMEO-BIOTROP
Jl. Raya Tajur Km. 6, Bogor
March 31, 2001

Front cover :
Forest Health Monitoring plot lay out is designed around four points (USDA-Forest Service, 1997).

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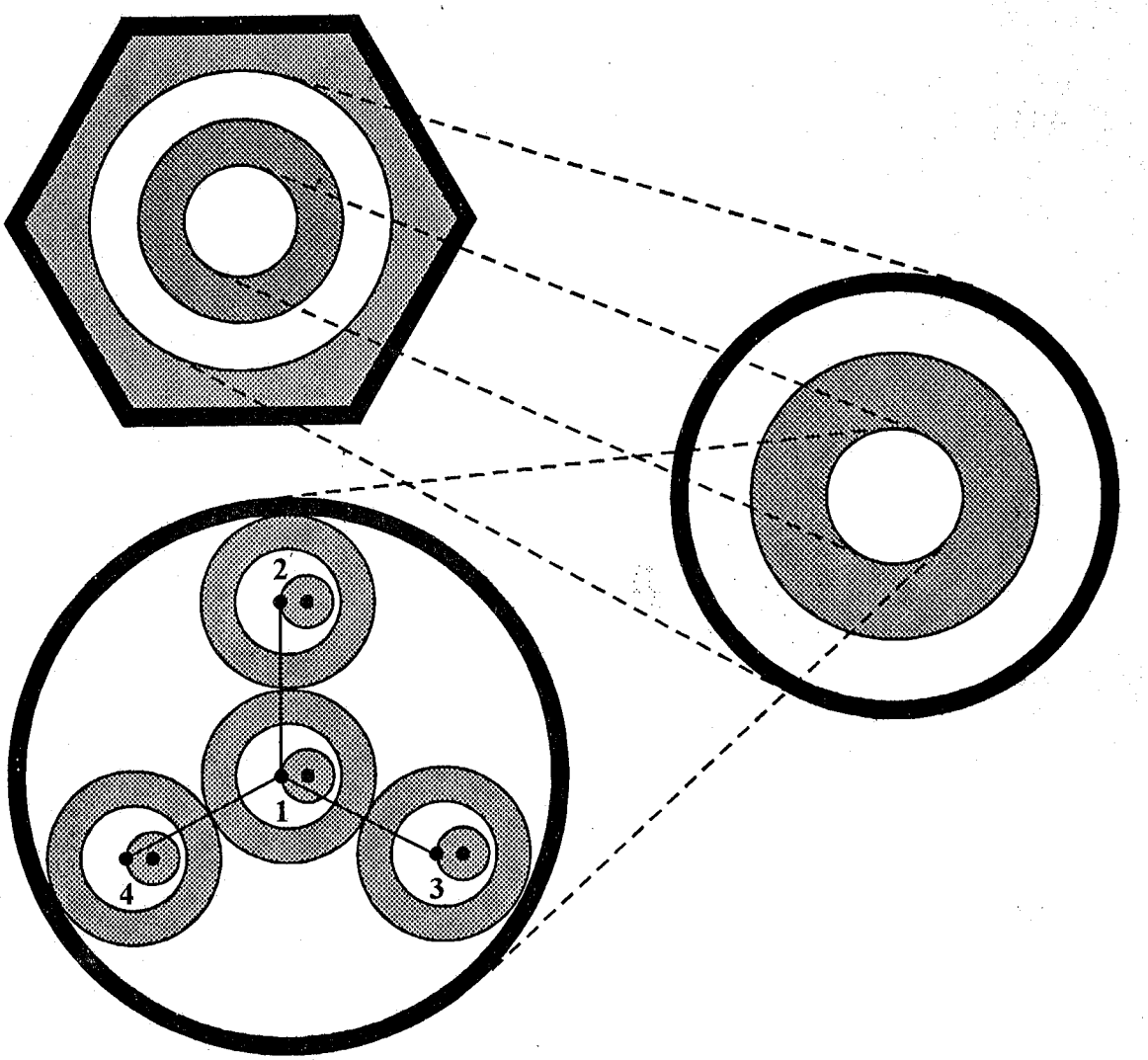

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CONTENTS

LIST OF ANNEXES

PROJECT IDENTIFICATION

a).Title	: Forest Health Monitoring to Monitor the Sustainability of Indonesian Tropical Rain Forest
b). Serial Number	: PD 16/95 Rev. 2 (F)
c). Executing Agency	: SEAMEO BIOTROP
d). Host Government	: Indonesia
e). Starting Date	: 1 January 1996
f). Actual Duration	: 5 Years
g). Actual Project Cost	: ITTO US $ 456,989.00
	GOI US $ 412,060.00

PART I : EXECUTIVE SUMMARY

1.1. BACKGROUND INFORMATION

1.1.1. Pre- Project Situation

Logging of Indonesian tropical rain forest is still going on following a method called the Indonesian Selective Cutting and Replanting System. In reality, most of the concession holders do not obey all the rules of this system. As a matter of fact, generally they embrace only the diameter limit regulation of the system excessively.

Sustainable yield management of the forest requires a large number of reliable information from various aspects. Good quality of data and information are imperative foundation in the process of decision-making effort. The output of this project is designed to provide a base line data in which data collection, analysis, and modeling across ecosystems are made possible, regardless of ownership.

In 1989, the Indonesian Government initiated the National Forest Inventory (NFI) Project, which was developed under the technical assistance of the FAO. The objectives of the NFI project were to provide information on the location and extent of the main forest types, to estimate the standing volumes and growth, and to assess the state and change of the forest in question. To fulfill its objectives, the NFI project covered several procedures namely Forest Resources Assessment (FRA), Forest Resources Monitoring (FRM), Digital Analysis System (DIAS), and Geographic Information Systems (GIS). To quantify the standing stock as forest changes overtime, the NFI applied the remote sensing techniques and the systematic field sampling method. The field samples were cluster plots consisting of 3 by 3-square plot arrangements (9 plots) and each plot measuring 100 m x 100 m. The distance between the adjacent plots is 500 meters. Of these, 8 at the edges and 1 at the center are treated as temporary and hidden permanent sample plots, respectively.

In so far as sustainable forest management is concerned, the NFI system did not include the biodiversity aspect and some other relevant indicators suggested by ITTO Guidelines. Theoretically, the indicators of a well-managed forest ecosystem must be equally defined in terms of environmental, economic and social attributes.

The FHM project, in contrast, developed basic tools so as to move towards the achievement of many objectives formulated in the ITTO Action Plan (1990), especially those related to Sustainable Forest Management.

In 1995, the USDA Forest Service and U.S. Environmental Protection Agency have initiated a multi-agency Forest Health Monitoring program. This program is known as the U.S. Forest Health Monitoring program (US-FHM). The focus of the program is to evaluate forest ecosystem conditions in terms of changes, trends, causal agents, and mechanisms, in order to assess the health of the U.S. forests.

Not long after the establishment of US-FHM, a similar program was proposed to complement the available data collected by the Indonesian National Forest Inventory (NFI). The system to be developed is hereafter referred to as the Indonesian Forest Health Monitoring system (INDO-FHM).

1.1.2. Specific Objectives and Outputs

The specific objectives of the INDO-FHM are:

(1). Evaluation of the significance of the selected indicators in relation to the question of assessment under the conditions existing in tropical rain forests. The outputs of this specific objective are (1) Technical Reports on selected indicators perceived as the most reliable means to assess the tropical rain forest conditions, and (2) Assemblage of applicable technology for detecting changes that may occur in forest vegetations.

(2). Establishment of the FHM plot system and related appropriate indicators within the existing Indonesian National Forest Inventory plots to address forest sustainability, including species biodiversity, and effort for the improvement of socio-economic conditions of the local communities. The outputs of this specific objective are (1) Technical Reports on INDO-FHM plot establishment in productive forests, both in natural and plantation forests, (2) Determination of any necessary modifications on the basic form of FHM plot design in order to accommodate the high species diversity found in the tropical forest ecosystems.

(3). Use of the FHM plots in tropical rain forests as demonstration site for future reference on the establishment of the FHM program in Southeast Asian Tropical Rain Forests. The outputs of this specific objective are (1) Training facilities for training of trainers for future establishment of the FHM program in Southeast Asian Tropical Rain Forests, (2) Report on the establishment of information management system for data exchange and reporting purposes.

(4). Technology transfer on linking remote sensing technique, including videography, to ground base of NFI plots, FHM plots, and Ecological Classification system. The outputs of this specific objective are (1) Report on the assessment of relationship between diverse remote sensing techniques (including videography) and ground base measurements, and (2) Report on early warning of changes in canopy condition of overstory trees.

(5). Technology transfer on the use of FHM methods and existing software for the analysis of productivity data collected from existing NFI plots. The output of this specific objective is Technical Reports on a system to establish a formula to estimate productivity based on stand population.

1.1.3. Project Strategy

In the process of developing the INDO-FHM Project, step-by-step strategies were adopted as follows:

(1). Scientists in forest biometrics and measurement, tree physiology and silviculture, entomologist, phytopathologist, taxonomist, ecologist, soil scientist, forest

economist and rural sociologist were invited to be actively involved in conducting the INDO-FHM research project.

(2). The US-FHM team of the USDA-Forest Service were invited to train and to support the Indonesian scientists in introducing the Forest Health Monitoring technology, in conducting a training course, and in providing the equipment and software as well.

(3). The Ministry of Forestry, Government of Indonesia, also supported the project in providing the equipment and counterpart budget, study site and field study arrangements.

(4). Forest concession holders (PT Asialog, PT Inhutani II, PT Sumpol and Perum Perhutani) were also actively involved in providing the facilities for plot establishment, indicator measurement, and field facilities. These plots were located in natural and plantation forests.

(5). FHM Plot establishment and indicator measurements were adopted from the Forest Health Monitoring: Field Method Guides (International-Indonesia), published by Environmental Protection Agency (EPA), USDA Forest Service, 1997.

(6). Off plots were established to measure the logging damage, minimum curve area and socio-economic indicators. To assess the indicator of damage caused by insects, INDO-FHM plots were established in plantation forest of *Paraserianthes falcataria* in Kediri, East Java.

(7). Data on growth, mortality, biodiversity, vegetation structure, crown condition, damage and soil indicators were collected periodically. Standardized data collection, management, and analysis procedures were made to produce INDO-FHM database. The US-FHM Team provided Portable Data Recorder software.

(8). Detection monitoring plots were established in South Kalimantan and Jambi and were overlaid with the National Forest Inventory plots to test the reproducibility of INDO-FHM plots. Remote sensing image was also used to relay the ground check data.

(9). Reports on different indicators were written in a series of Technical Reports (TR).

(10). A series of training courses were conducted to disseminate the FHM Technology as listed below:

- Introduction of FHM training course.
- Training-workshop for Indonesian scientists by the US FHM Team.
- Three training courses for the Indonesian Crew by the Indonesian Scientists.
- Two split training courses for the Southeast Asian Scientists by the Indonesian Scientists.

Reports on training courses were written in a series of Educational Reports (ER).

1.1.4. Project Plan and Planned Overall Cost

Initially, the project's planned duration was three (3) years. However, due to forest fire incidents and the political situation in Indonesia, the Committee has agreed to grant an extension of the project until December 2000, without additional funds, as stated in CRF (XXV)/12 Rev.1, page 7. The project's planned budget was US$ 456,989.00, which is the

contribution of ITTO and US $ 412,060.00, which is the contribution of the Government of Indonesia (GOI).

1.2. PROJECT ACHIEVEMENTS

1.2.1. Outputs Achieved

The outputs accomplished are listed below:

(1). Report on selected indicators of INDO-FHM and the corresponding data collected from INDO-FHM plots.

(2). Report on plot establishment.

(3). Report on INDO-FHM training program.

(4). Report on linking the remote sensing techniques to ground based NFI plots and FHM plots.

(5). Report on the use of INDO-FHM methods and existing software for the analysis of productivity data from existing NFI plots.

1.2.2. Specific Objectives Achieved

The achievement of each specific objective is accomplished as listed below:

(1.1). Technical report on selected indicators. The technical report was made available through the intensive evaluation on relevant criteria (productivity, biodiversity, site quality, crown condition, damage). The productivity criteria in terms of quantity merit was monitored through the measurement of growth, ingrowth, mortality and annual net-growth. The increment of annual diameter growth was found to be of little importance, and hence, it is suggested that diameter growth measurement should be monitored every five years.

Crown condition as one indicator of forest sustainability either in terms of productivity or vitality is a scientifically logical principle. To assess the parameters of crown width, crown length, life-crown ratio, crown dieback, crown density, and foliage transparency, especially in areas of high species diversity, together with multi-layers canopy and high tree density, some difficulties were encountered in the field. To cope with this problem, additional number of well-trained crew and time are therefore necessary. In addition, this problem can also be overcome through the application of spherical densiometer to measure the canopy density. The canopy density, moreover, may significantly affect the forest regeneration due to the variation of the intensity of solar radiation that can reach the forest floor. The next, life-crown ratio, considered as a good measure, can be used as a parameter reflecting the tree vigor. The observation of crown condition conducted every year was evidently insignificant to examine the substantial changes. Therefore, longer period of observation is strongly suggested in the case of natural forest.

The damage indicator is a powerful instrument and it is technically easy to confine valuable information on the vitality and productivity representing quality of the tropical forest trees within the main objective of the sustainable management of the natural tropical forest and plantation forest as well.

Soil indicator measurement is designed to capture information on the current status and projected trend of the physical and chemical nature of the forest soil and is considered as one important tool to justify forest sustainability based on the site quality point of view.

(1.2). Report on the technology to detect changes in forest vegetation. This activity was done through the field investigation in overlaying FHM–NFI plots established for the assessment of some selected indicators. Plots were established in Jambi and South Kalimantan.

(2.1). Report on the INDO-FHM plot establishment. INDO-FHM cluster plots were established in Pulau Laut (small island) and Jambi, Sumatra (big island). The INDO-FHM plot design was adopted from the US-FHM method. Some indicator measurements were necessarily adapted to the tropical rain forest conditions. Up to date, seven cluster plots were set up in Pulau Laut at different areas of forest functions (buffer zone, biodiversity conservation, dipterocarp plantation and seed production areas). Meanwhile, four cluster plots were established at a natural production forest and seed production area in Jambi. In addition to plot establishment in natural forest, four cluster plots were made in *Paraserianthes falcataria* plantation in East Java. Two overlaid NFI-FHM plots were made in South Kalimantan (main island) and one cluster plot in Jambi. Training plots were established in a seed production area in Jambi, in a buffer zone in Pulau Laut and in Gede-Pangrango National Park, West Java.

(2.2). Report on the modification of FHM vegetation quadrates to address tropical species diversity of trees. This was done through the establishment of Minimum Curve Area (MCA) plots in Jambi and Pulau Laut. The US-FHM plot design tested in the diverse tropical forest types in Pulau Laut, South Kalimantan, and Jambi, Sumatra, should be modified accordingly. In the plantation forest and in natural forest with low species diversity (consociation type), the plot design of US-FHM can be adopted as it is. In contrast, in the case of areas with high tree species diversity, adequate number of cluster plots should be considered.

(3.1). Report on the establishment of FHM training plots. Training plots were established in Jambi, Pulau Laut, and Gede-Pangrango National Park. This activity was initiated by site selection. Educational Reports were made for each training course, including the training program, resource persons and list of participants.

(3.2). Report on the establishment of information management system for information exchange purposes. The management information system of the INDO-FHM has been developed by making use of the MS Access 97 software, and called INDO-FHM D-Base. The collected data, either using tally sheets or Portable Data Recorder (PDR), were managed and analyzed to produce the valuable information for information exchange purposes. The data stored in the INDO-FHM D-Base could also be exported to MS Excel, SAS program or Minitab program for further statistical analysis.

(4.1). Report on the assessment of the relationship between remote sensing techniques and ground-based measurement.

(4.2). Report on the early warning of changes in terms of canopy condition of the overstory trees.

(5.1). Report on the system to produce population based estimates of productivity. This report deals with a system to establish formula based on stand population to estimate forest productivity.

1.2.3. Contribution to the Achievement of the Development Objective

The development objective of the project was directed on the technology transfer of Forest Health Monitoring method focusing on a wide array of its application aspects. This will enable the Indonesian Government to address many, if not all, of the current extent, status, changes and trends corresponding to important indicators reflecting the issues on the condition of the nation's forest ecosystems.

This assessment should represent an estimate that is good for both regional and national basis, within known statistical confidence. The project is also developed to be able to provide resource managers and the public with yearly statistical summaries and periodic interpretative assessment on the ecological status and trends.

It is also suggested that the Indonesian Government would be able to justify and address issues of labeling tropical timber and products as they are coming from sustainable forest by year 2000.

1.3. TARGET BENEFICIARIES INVOLVEMENT

The direct recipients of this project are the Ministry of Forestry and the Indonesian forestry community including universities. The outputs of INDO-FHM will enable the Indonesian government to develop appropriate policies referring to sustainable forest management and utilization of forest resources and enhance the development of forest industry for long-term benefit to society.

The detailed information on the biodiversity of plant species, the structure of plant communities, the suitability of habitat for wildlife, soil fertility and erosion, and other INDO-FHM indicators will facilitate the Indonesian government to address global concerns closely related to biodiversity, and sustainability characteristic of tropical forest ecosystems.

The INDO-FHM technique is launched in a very appropriate time for use in the tropical rain forest; for the meantime that the international forestry communities are still debating on long-term sustainability issues of world forests.

ITTO (1998) Criteria and Indicators for Sustainable Management of Natural Tropical Forests stated *Criterion 3 on Forest Ecosystem Health and Condition. This criterion relates to the condition of a country's forest and the healthy biological functioning of forest ecosystems. Forest condition and health can be affected by a variety of human actions and natural occurrences, from air pollution, fire, flooding and storms to insects and diseases.*

A forest ecosystem is healthy if it is productive, biologically and structurally diverse, large and not fragmented, balanced in size class distribution and resilient to natural and

prescribed stressors (Soekotjo, Pers.com). The perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time (The Dictionary of Forestry, 1998). In this regard, ITTO is perceived as one of the beneficiaries of INDO-FHM technology.

The INDO-FHM technology has been disseminated to various forest communities such as universities, research institutes, forest concession holders, CIFOR, Indonesian Ecolabelling Institute (LEI), scientists in Indonesia and Southeast Asian countries.

The mode of participation of the project beneficiaries are financial support (ITTO, MOFEC, BIOTROP, USDA Forest Service), and facilities (PT Inhutani II, PT Asialog, PT Sumpol, Perum Perhutani, D.G. of Forest Protection and Conservation), scientists (FORDA, Bogor Agricultural University, Gadjah Mada University, BIOTROP, USDA Forest Service). Perum Perhutani will use the INDO-FHM technology for pest and diseases monitoring, especially in the plantation forest. PT Asialog has used the INDO-FHM plots for reference plots.

BIOTROP is going to establish permanent INDO-FHM plots in Pasirmayang, Jambi, as field research station. SEAMEO BIOTROP has strong intention to organize the regular training course on FHM technology for stakeholders from Southeast Asian countries and other prospective Asian countries. Intensive Site Ecosystem Monitoring (ISEM) will be greatly facilitated by the INDO-FHM technology through the achievements obtained and precious experience gained during the project implementation.

1.4. LESSONS LEARNED

1.4.1. Development Lessons

a. Project design

The aspect of project design is important as it contributes to the success or failure in achieving the Development Objective. The INDO-FHM project is focused on the transfer of technology of Forest Health Monitoring and is designed to provide the resource managers and the public with yearly statistical summaries and periodic interpretative assessment on the ecological status, changes and trends.

To bring those development objectives into reality, a clear and workable methodology of INDO-FHM is a prerequisite. Professionals and dedicated resource persons also enhance the achievement of the goals. The institutional support provided by ITTO, USDA Forest Service, MOF, SEAMEO BIOTROP, the forest concession holders and other research institutes made the execution of the project possible.

The assessment of the relationship between diverse remote sensing techniques and ground-based measurements was partially achieved. Due to unavoidable circumstances, the videography technique was not successfully implemented. However, efforts have been made to produce the vegetation maps and ecological classification system. These maps were utilized to link the remote sensing techniques to ground based NFI and FHM plots. INDO-FHM will complement the Indonesian National Forest Inventory (NFI) program, which currently addressees the productivity and extent of the Indonesian forest ecosystem. This can be possibly

anticipated owing to the fact that the INDO-FHM concerns more on the ecosystem's health which naturally also covers the productivity aspects.

The INDO-FHM techniques provide an easy tool to collect, monitor, analyze, and interpret such that the interpretative data will be available, and in turn, will be used as baseline information to draw relevant and conclusive recommendations.

b. Changes in inter-sectoral links which affected the project's success

The forest concession holders and MOF recognized that the INDO-FHM technology provides a promising tool in the process of creating baseline forest information and its relation to Sustainable Forest Management. The question raised during the execution of the project was, whether the implementation of INDO-FHM in managing forestry resources will then result to the certification of SFM to be granted by a certifying body.

In conjunction with human resources development in Southeast Asian countries, SEAMEO BIOTROP granted the second training course on INDO-FHM for young scientists.

c. Additional arrangements that could improve cooperation between relevant parties interested in the project

The additional arrangement made is a one-day workshop involving BIOTROP, CIFOR, and the Indonesian Ecolabelling Institute (LEI), to develop a common perception on SFM espoused by the institutions concerned on the issue. FHM technology, in fact, provides a practicable tool at the verifier level in the hierarchy of criteria and indicators of SFM.

Additional FHM plots in Kediri, East Java, were also established to monitor pest and disease problems in forest plantations.

An additional training course on FHM for the Indonesian crew and young scientists coming from Southeast Asian countries was also conducted and financed by MOF and SEDF (SEAMEO Educational Development Fund).

d. Factors affecting the project sustainability after completion

Sustainable forest management needs baseline forest information, a vehicle to arrive at conclusive recommendations. FHM, as one of the tools for sustainability assessment in the SFM, provides baseline forest information covering current issues on the status, changes and trends in forest conditions. This is true since sustainable forest management is a process in managing forestry resources requiring baseline information, so that the forest manager may act based on the goal to reach a rational decision for the sustainability of their forest resources.

The political will of MOF to implement the FHM technology is very crucial. Bearing in mind that forestry stakeholders are supposed to provide funding support. In fact, the INDO-FHM technology could be incorporated in the National Forest Inventory (NFI) program.

During the project execution, 102 foresters have been trained in various levels of management such as decision makers, scientists, field crew and other users. These included those coming from ten Regional Offices of the Forest Inventory and

Planning, representing North Sumatra, South Sumatra, South Kalimantan, East Kalimantan, South Sulawesi, Irian Jaya, and other Southeast Asian countries like Malaysia, Thailand, Myanmar, Vietnam, Cambodia, Lao PDR, and the Philippines. It is highly expected that they will be frontier stakeholders on the implementation of INDO-FHM technology in the region.

To secure their quality assurance, the trained crew should be involved continuously in the work of collecting and analyzing data of INDO-FHM related activities. The trained crew is a national asset for achieving the objective of SFM.

Institutional framework will affect very much the implementation of INDO-FHM technology on the ecosystem monitoring and information exchange.

The concerns of civil society to monitor and evaluate their forest resources will, therefore, maintain the implementation of FHM technology in the country. Besides, technically the INDO-FHM technology is rudimentary and easy to implement.

Professional crew who passed the quality assurance will guarantee the quality of data obtained.

The software of portable data recorder (PDR) is a very important program for data collection. The data can be stored in a floppy disc.

1.4.2. Operational Lessons

a. Project organization and management

The Project Steering Committee (PSC), as a governance body, monitors and evaluates the Project Executing Agency (PEA) on the execution of the project, examines whether the project is on track, and facilitates the PEA running the communication to ITTO Headquarters.

The chairman of the PSC is Dr. Untung Iskandar, Director of FORDA, formerly Director of the Bureau for International Cooperation and Investment, MOFEC. The members of PSC consist of ITTO representative (Dr. Efransyah), Dr. Kenneth W. Stolte (USDA-Forest Service), the representative of Agency for Forestry and Estate Crops Planning, Director of SEAMEO BIOTROP, and Chairman of PEA. The PSC meeting was conducted twice a year, while the PEA meeting was conducted every 2–3 months.

The PEA hired scientists bearing various scientific background, including forest mensuration and biometrics experts, sylviculturist, plant physiologist, soil scientist, ecologist, dendrologist, pest and diseases specialists, and computer scientists. Before getting involved in the INDO-FHM project, those nominated scientists were required to hold No Objection Letter (NOL) endorsed by the ITTO Headquarters through the Chairman of PSC.

PEA organized the scientists in carrying out field study, plot establishment, data collection and analysis, report writing, training and workshop, literature study, and publication.

In addition, PEA also arranged the technical assistance from the USDA Forest Service, MOF, and forest concession holders.

b. Project documentation

Project documentation consisted of:

(1). Administrative documents include Project Document, MOU, Work Plan, Minutes of Project Executing Agency and Project Steering Committee Meetings, and Correspondences.

(2). Technical Reports (TR), which include scientific papers prepared by the indicator leaders, in addition to workshop and seminar papers.

(3). Quarterly and Annual Reports are progress reports submitted to ITTO Headquarters and PSC, and designed for project monitoring purposes, including financial reports.

(4). Educational Reports are the reports on the implementation of training courses on the INDO-FHM.

(5). Completion Report is the final report, which comprehensively describes the overall project execution.

(6). Audit Report is the financial statement audited by a registered public accountant.

The Technical Reports, Quarterly and Annual Reports, Financial Audit Report and Completion Report adopted the format provided by ITTO Manual for Project Monitoring, Review and Evaluation (ITTO, 1999).

c. Monitoring and evaluation; quality of project planning

Project monitoring and evaluation were done through field visits and administrative evaluation, financial auditing, reporting and PSC meeting. Dr. E. Zemeka, ITTO representative, holding the right to check the plot establishment, data collection system, data analysis, and reliability and reproducibility of INDO-FHM technology in SFM, had the chance to conduct field visit to Pulau Laut, South Kalimantan.

The administrative monitoring and evaluation was conducted through PSC meetings to inspect the progress report *vis a vis* the Work Plan, and to scrutinize whether the project is still on the right track. If not, the PSC recommended to the ITTO Headquarters that the project be adjusted as necessary.

Consultations with the Assistant Project Manager of Reforestation and Forest Management, Dr. Efransjah, have also been conducted regularly.

The external auditor examined the financial records to evaluate whether or not the Project Executing Agency implemented the standard accounting procedures. The audit report was then submitted to the ITTO Headquarters and MOF as well.

The INDO-FHM project has five specific objectives, described in detail in the intensively reviewed and approved work plan by the PSC members. In principle, these specific objectives are comprehensively formulated to support the criteria and indicators of SFM issued by the ITTO.

Due to the economic crisis, however, the objective dealing with a comparative study among the diverse remote sensing techniques could not be achieved entirely, including videography. Because of this, the project executed only one remote sensing technique.

d. Definition of the roles and responsibilities of the institutions involved in the project implementation

The roles and responsibilities of the different institutions involved are as follows:

(1). ITTO provided the fund, monitored and evaluated the project execution.

(2). The Agency for Forestry and Estate Crops Planning of the Ministry of Forestry (MOF) provided the counterpart budget, facilities and equipment, and resource persons as well.

(3). The USDA-Forest Service provided the technical assistance for the development of INDO-FHM technology in a tropical country, including the funding for their scientists to visit Indonesia, equipment, and the software of portable data recorder (PDR). They trained the Indonesian scientists and crew. Consultations with US-FHM scientists were also provided.

(4). SEAMEO BIOTROP, as executing agency, was responsible for the project execution and also responsible to provide facilities, resource persons, and funds for the second training course on INDO-FHM for the Southeast Asian scientists.

(5). Forest concession holders (PT Inhutani II, PT Asia Log, Perum Perhutani, PT Sumpol, Directorate General Forest Protection and Conservation) provided field facilities, field crew and the guesthouse.

(6). Faculty of Forestry, Bogor Agricultural University; Faculty of Forestry, Gadjah Mada University; and FORDA, provided the experts on various field studies.

e. Actions taken to avoid variations between planned and actual implementation (schedule, costs, etc)

(1). Conducting the PSC, PEA and scientists meetings regularly.

(2). Sticking with the work plan to successfully achieve the project objectives.

(3). Keeping in constant touch with scientists (indicator leaders).

(4). Conducting data collection, analysis and report writing regularly.

(5). Consulting the Project Manager for Reforestation and Forest Management of the ITTO, together with the Chairman of PSC.

(6). Consulting with the Assistant Project Manager of Reforestation and Forest Management, ITTO, and the US-FHM team regularly.

(7). Sticking with the work plan while considering the cost effectiveness rationally.

f. Unforeseen internal factors that influenced the project implementation

(1). Delay in the release of the first fund installment.

(2). Failure to meet the MOF commitment to provide the videography equipment.

g. Unforeseen external factors that influenced the project implementation

(1). Political situation.

(2). Forest fire.

(3). Illegal logging, followed by forest encroachment.

1.5. RECOMMENDATIONS

1. Improve the relationship among institutions involved with respect to better execution of the INDO-FHM project. This can be achieved through continuous two-way communication among personnel coming from different offices.

2. Since INDO-FHM is a national program designed to determine the status, changes, and trends in indicators of forest condition on an annual basis, there should be a stronger commitment on the part of concession holders to provide the study areas in order that annual measurements are feasible and valid at any time.

3. Effort must be exerted under rigorous collaboration with MOF to increase the number of field staff from forest concession holders to be trained in the field of INDO-FHM. This will ensure their awareness to combat accelerated degradation of national forest so that the objectives of sustainable forest management can be achieved.

4. Continuous communication and cooperative activities between INDO-FHM project officers and forest concession holders must be in place not only during project execution.

5. Qualified and committed indicator leaders (scientists) must be available in the working system of the INDO-FHM project so that the evaluation of important issues can be anticipated in time.

6. The socio-economic indicator, an additional indicator endorsed by the PSC meeting to the original US FHM, by its very nature, deserves a longer period of time to be devoted for data collection and analysis, and therefore, a highly experienced scientist is a must.

7. Since scientists in the world question the future of plantation forest, it is suggested that the INDO-FHM method be implemented on the second rotation to assess the long-term sustainability of plantation forest. Moreover, intensive site ecosystem monitoring (ISEM) as the continuation of FHM project, is strongly suggested to be implemented in different ecological systems to monitor the forest sustainability in the management unit level. This effort is in line with Criterion 3 (Forest ecosystem health and condition) of ITTO Criteria and Indicators for Sustainable Management of Natural Tropical Forests (1999).

8. The INDO-FHM method covers sustainable resources related indicators, and for this reason, the indicator leader should be able to develop threshold factors for other significant indicators to be identified as more and more data will be available in the future. Hence, the INDO-FHM project should be extended for a longer period of time so that the threshold and trend prediction will be more accurate.

PART II : MAIN TEXT

2.1. PROJECT CONTENT

2.1.1. Project Description

The INDO-FHM project was focused on technology transfer from temperate forest to tropical rain forest to assess the extent of the status, changes, and trends in the indicators of the condition of forest ecosystem.

The project consisted of three major components to satisfy the adoption of FHM technology as a tool to assess the sustainable forest management in the country. The three major components are:

(1). Establishment of FHM demonstration plots to evaluate the significance of selected indicators through the establishment of FHM plot systems as initiation activity in the process of transfer of technology adopted from US FHM to INDO-FHM.

(2). Establishment of detection monitoring plots in which FHM plots were overlaid on the existing Indonesian National Forest Inventory plots in order to assess the forest sustainability, productivity and biodiversity.

(3). Establishment of training plots, in order to disseminate the FHM technology including the existing software to the Indonesian scientists and crew, and other Southeast Asian scientists as well.

Component 1: Establishment of FHM Demonstration Plots

The activities in the establishment of FHM demonstration plots can be broken down into the following:

(1). Evaluation of the selected indicators to provide an assessment of the conditions existing in tropical rain forest: growth, regeneration, mortality, stand structure, crown condition, damage due to logging, insects and diseases, composition, abundance, habitat suitability, biodiversity, and socio-economic aspects.

(2). Investigation of the relationship between the status, changes and trends of biodiversity and structure indicators with natural and induced stresses.

(3). Site selection for FHM plot establishment in Jambi (Sumatra), Pulau Laut and Kalimantan mainland (South Kalimantan), and Kediri (East Java).

(4). Modification of FHM vegetation quadrates to address tropical diversity.

(5). Evaluation of logging damage.

Component 2: Establishment of Detection Monitoring Plots

The activities covered are as follows :

(1). Field-testing of FHM plots and indicators to evaluate the effectiveness, logistics and reproducibility of combined NFI-FHM system.

(2). Comparison between remote sensing data and ground-based NFI – FHM plots.

(3). Completion of one full rotation of plots.

(4). Solution to sampling problems through another collection of data.

(5). Collection of data on crown damage due to logging.

(6). Collection and evaluation of plot level values for each element of heterogeneity and complexity of vegetation in logged-over and natural forest.

(7). Detection of changes.

Component 3: Establishment of Training Plots

The activities performed are as follows :

(1). Establishment of training plots in Jambi, Pulau Laut, and Gede Pangrango National Park.

(2). Initial training of Indonesian trainers and establishment of training plots.

(3). Training of Indonesian crew by Indonesian trainers.

(4). Training of Southeast Asian Scientists by Indonesian trainers.

(5). Standardization of data collection, management and analysis procedures.

(6). Production of FHM database.

(7). Improvement of information flow within and between INDO-FHM unit and their cooperator.

(8). Organization of seminar on FHM

(9). Consultation & training in US.

(10). Field data analysis, report writing and publication.

2.1.2. Development Objectives

The project focused on the technology transfer of Forest Health Monitoring. Its application will enable the Indonesian Government to address many, if not all, of the current issues on the extent, status, changes, and trends in indicators of the condition of the nation's forest ecosystem, on both regional and national basis, with known statistical confidence in the estimates.

The project was also directed to be able to provide yearly statistical summaries and periodic interpretative assessment on the ecological status and trends to resource managers and the public. As such, the Indonesian Government will be able to address the issue of labeling tropical timber and products as coming from sustainable forest by year 2002.

2.1.3. Specific Objectives

The specific objectives for INDO-FHM were:

(1). Evaluation of the ability of selected indicators to provide an assessment of conditions in tropical rain forests.

(2). Establishment of the FHM plot system, with appropriate indicators, within the existing Indonesian National Forest Inventory plots, to address forest sustainability, biodiversity, and improvement of socio-economic conditions of the local communities.

(3). Use of the FHM plots in the tropical rain forests as a demonstration plot for future establishment of the FHM program in Southeast Asian Tropical Rain Forests.

(4). Technology transfer on linking remote sensing technique, including videography, to ground-based NFI plots, FHM plots, and the Ecological Classification System.

(5). Technology transfer on the use of FHM methods and existing software for the analysis of productivity data collected from existing NFI plots.

2.1.4. Expected Output :

Specific Objective 1:

(1). Report on selected indicators as the most efficient way to assess tropical rain forest conditions

(2). Technology to detect changes in forest vegetations

Specific Objective 2:

(1). Report on FHM plot establishment in production forests, in both natural and plantation forests. Initial focus would be in Jambi province and Pulau Laut (South Kalimantan province)

(2). Determination of any modifications necessary in the basic FHM plot design to accommodate the high diversity found in tropical forest ecosystems

Specific Objective 3:

(1). Training facilities for future establishment of the FHM program in the Southeast Asian Tropical Rain Forest

(2). Report on the establishment of information management system for data exchange and reporting

Specific Objective 4:

(1). Report on the assessment of the relationship between diverse remote sensing techniques (including videography) and ground-based measurement

(2). Report on early warning of changes in canopy condition of overstory trees

Specific Objective 5:

(1). Report on the system to produce population based estimates of productivity.

2.1.5. Implementation Strategy

SEAMEO BIOTROP executed the project on INDO-FHM, in cooperation with the Agency for Forestry Planning, MOF and the USDA-Forest Service. During the project implementation, forest concession holders, research institutions and universities also supported the project.

The ITTO fund was channeled to a Special Account at the Bank of Indonesia in Bogor for further use to support the project activities. The counterpart budget from the GOI was managed by the Agency for Forestry Planning, MOF.

To coordinate the project execution, the chairman of the Project Executing Agency was appointed by the Director of SEAMEO BIOTROP, and endorsed by the Project Steering Committee to the ITTO.

2.1.6. Project Work Plan

The project agreement between SEAMEO BIOTROP and ITTO was signed on 15 September 1995 on the implementation of Project 16/95 Rev.2 (F): Forest Health Monitoring to Monitor the Sustainability of Indonesian Tropical Rain Forest.

The project work plan was discussed in a series of meetings and was approved by the Project Steering Committee members on 15 November 1995. The first budget installment was received on 1January 1996. Accordingly, the project execution began effective 1 January 1996.

The introductory training course of FHM was carried out on August 1995 with technical assistance from the US-FHM Team in Jambi, Sumatra. The project work plan can be broken down into three major components namely: establishment of FHM demonstration plots, establishment of detection monitoring plots, and establishment of training plots.

Component 1: Establishment of FHM Demonstration Plots

The activities in the establishment of FHM Demonstration Plots can be broken down into the following:

(1). Evaluation of the selected indicators to provide an assessment of the conditions existing in tropical rain forest: growth, regeneration, mortality, stand structure, crown condition, damage due to logging, insects and diseases, composition, abundance, habitat suitability, biodiversity, and socio-economic aspects.

(2). Investigation of the relationship between the status, changes and trends of biodiversity indicators with natural and human induced stresses.

(3). Site selection for FHM plot establishment in Jambi (Sumatra), Pulau Laut and Kalimantan mainland (South Kalimantan), and Kediri (East Java).

(4). Modification of FHM vegetation quadrates to address tropical diversity. Off-plot observation was established in Pulau Laut and Jambi.

(5). Evaluation of logging damage. Off-plot observation was established in Pulau Laut and Jambi.

Component 2: Establishment of Detection Monitoring Plots

The activities on the establishment of detection monitoring plots are enumerated below:

(1). Field-testing of FHM plots and indicators to evaluate the effectiveness, logistics and reproducibility of combined NFI-FHM system.

(2). Comparison between remote sensing data and ground-based NFI–FHM plots.

(3). Completion of one full rotation of plots.

(4). Solution to sampling problems through another collection of data.

(5). Collection of data on crown damage due to logging.

(6). Collection and evaluation plot level values for each element of heterogeneity and complexity of vegetation in logged-over and natural forest.

(7). Detection of changes. Detection monitoring plots were established in Kalimantan mainland (South Kalimantan) and Jambi. The FHM plots were overlaid on the permanent sampling plot of Indonesian National Forest Inventory.

Component 3: Establishment of Training Plots and Information Dissemination

Ten activities carried out under this component are as follows:

(1). Establishment of training plots in Jambi, Pulau Laut, and Gede Pangrango National Park.

(2). Initial training of Indonesian trainers and establishment of training plots.

(3). Training of Indonesian crew by Indonesian trainers.

(4). Training of Southeast Asian scientists by Indonesian trainers.

(5). Standardization of data collection, management and analysis procedures.

(6). Production of FHM database.

(7). Improvement of information flow within and between INDO-FHM unit and their cooperator.

(8). Organization of seminar on FHM

(9). Consultation and training in US.

(10). Field data analysis, report writing and publication.

2.1.7. Required Inputs

The project of INDO-FHM required financial support from ITTO and the Government of Indonesia (GOI) reflected as follows:

No.	Project Component	ITTO (US$)	GOI (US$)	Total (US$)
1.	BIOTROP Project Management	40,265	40,000	80,265
2.	Specific Objective 1.	132,000	0	132,000
3.	Specific Objective 2.	30,000	0	30,000
4.	Specific Objective 3.	104.200	86,362	190,562
5.	Specific Objective 4.	54,064	229,154	283,218
6.	Specific Objective 5	54.640	50,000	104,640
	Sub-Total	415,169	405,516	820,685
7.	ITTO Project Monitoring and Evaluation	41,820	0	41,820
	TOTAL	**456,989**	**405,516**	**862,505**

2.1.8. Project Rationale

Forest management has always been, and must be, value-driven. The adoption of ecosystem management philosophy adds non-traditional values, such as sustainability and biodiversity, and places new emphasis on human dimension including long-term incentives and benefits to the local forest dependent communities, and recognition of the rights of indigenous peoples.

The International Tropical Timber Organization (ITTO) Guidelines, based on the 1990 International Meeting, specify five groups of indicators for well-managed tropical ecosystems: resource security, continuity of timber production, conservation of flora and fauna, an acceptable level of environmental impact and socio-economic benefit.

The INDO-FHM will provide the necessary information to forest managers in the short term. INDO-FHM database currently developed for obtaining and analyzing the information of forest condition in the long term.

2.1.9. Relevant Background Information

Global concerns and societal values to the forest propel the forest stakeholders to understand their forest status, changes and trends, and to ensure the achievement of sustainable forest management objectives.

2.1.10 Project Location

The project location was established in Pulau Laut, South Kalimantan, to represent small island ecosystem and Jambi province, Sumatra, to represent big island ecosystem. The office of the Project Executing Agency was based in Bogor, West Java.

During the project execution, and in line with the project objectives, some other plots were also established in South Kalimantan (main island), Kediri, East Java, and Gede-Pangrango National Park, Bogor West Java. The new plot establishment was discussed during the Project Steering Committee meeting and in consultation with the Project Manager on Reforestation and Forest Management, ITTO, during his visit for monitoring and evaluation. The plot location can be classified as follows:

(1). Demonstration plots were located at Pulau Laut, South Kalimantan, (managed by PT Inhutani II) and Jambi, Sumatra, (managed by PT Asialog). The evaluation and selection of indicators used in INDO-FHM was done in these plots. The evaluation of damage indicator was carried out in the plantation of *Paraserianthes falcataria* at Kediri, East Java, (managed by Perum Perhutani).

(2). Detection monitoring plots were established in South Kalimantan main land (managed by PT Sumpol Timber) and Jambi, Sumatra (managed by PT Asialog).

(3). Training plots were established in PT Asialog, PT INHUTANI II, and Gede Pangrango National Park. During the training course on INDO-FHM for the Indonesian crew, field works were carried out in the protected area of Perum Perhutani in Kaliurang, Yogyakarta, in Tawangmangu, Central Java, and in Malang, East Java.

2.1.11. Previous Preparatory Activities

In March 1994, the United States Department of Agriculture Forest Service (USDA –FS), the Ministry of Forestry (MOF) formerly Ministry of Forestry and Estate Crops (MOFEC), SEAMEO Regional Center for Tropical Biology (SEAMEO-BIOTROP) and Center for International Forest Research (CIFOR) signed a Letter of Intent in which they agreed to study (1) Ecological Classification and Mapping, and (2) Ecosystem Vigor (Forest Health) in Indonesia. They also agreed to seek funding and support for the implementation of the studies.

Following up the Letter of Intent, Prof. Dr. Soekotjo, Director of SEAMEO BIOTROP and Dr. Burhanuddin Sarbini, staff of Ministry of Forestry, visited USA in August 1994 and were entertained by Dr. Kenneth W. Stolte of USDA-FS with whom they agreed to develop a project proposal on Forest Health Monitoring in Indonesia (INDO-FHM).

Following the above agreement, Prof. Dr. Soekotjo proposed the project to ITTO on Forest Health Monitoring to Monitor the Sustainability of Indonesia Tropical Rain Forest (INDO-FHM) through the Ministry of Forestry to obtain funding and the counterpart budget from MOF and USDA-FS.

The ITTO Council, in its 18th Session held in Accra, Ghana, on 10-18 May 1995, decided to approve and to support the funds for the project as Project PD16/95 Rev.2 (F).

2.1.12. The ITTO Context

The outputs of INDO-FHM project will be the fundamental tool for a sustainable forest management system, in compliance with all of the ITTO policies laid down in the ITTO Agreement, ITTO Criteria and Indicators for Sustainable Forest Management, and ITTO Action Plan and Priorities. The direct relationship to ITTO context can be listed with the following items.

(1). The specific objectives No. 1 and No. 2 are related to the specific objective of ITTO Agreement point 7c, d, f, and h.The indicator of well-managed forest ecosystems must be equally defined by environmental, economic, and social attributes. Environmental attributes include forest biodiversity, productivity, and ecosystem processes. Economic attributes include the proper evaluation of full range of forest products and services, and the reinvestment into the forest resources to maintain

ecological, social and economic function. Social attributes include long-term incentives and benefits to local forest dependent communities, and the recognition of the right of indigenous peoples.

(2). Objectives No: 3, No. 4, and No. 5 are related to the specific objective of ITTO Agreement point 7 a, which is, to provide an effective framework for cooperation and consultation on all relevant aspects of the tropical timber economy; point 7c which is, to help research and development which will improve forest management and wood use; and point 7h, to encourage national policies which aim at sustainable use and conservation of tropical forests and their genetic resources, and at maintaining the ecological balance in the region concerned.

(3). In compliance with ITTO Criteria, the project focused on technology transfer that will:

(a). Support the development of sustainable forest management system. As such, the project was related to Criteria a, b and c and Action Plan f and h of reforestation and forest management. Indirectly, it was also related to the establishment of demonstration area as a means for achieving consensus on the range of policy issues which would guide the overall strategy of sustainable development of tropical forests.

(b) Global concerns for biodiversity and sustainability of tropical ecosystems. In addition, the INDO-FHM system will provide an early warning on the regional decline in the forest ecosystem, and will link Indonesian forests to developing global forest monitoring systems. As such, the project output is in compliance with all of the ITTO Criteria (Criteria a, b, c, d, and e, Chapter 3, paragraph 19 of the ITTO Manual).

(4). Relationship to ITTO Action Plan and Priorities. Forest Health Monitoring is an ecological approach to monitor the condition and changes in forest ecosystems. As such, INDO-FHM is basic to many aspects of the objectives formulated in the ITTO Action Plan (1990). Priority ITTO objective to this project is to arrest the decline and degradation of tropical forest by incorporating sustainable forest management.

Since the use of the FHM plots in the tropical rain forest is a demonstration for future establishment of the FHM program in the Southeast Asian Tropical Rain Forest, the FHM project output is in relation to the ITTO Action Plan that concerns the promotion of cooperation between producer and consumer countries through networks.

2.2. PROJECT CONTEXT

2.2.1. National and Sectoral Development Objectives

Forest Health Monitoring is a cooperative, multi-disciplinary, multi-agency program with the mission to develop and implement a cooperative program to monitor, make assessment, and report on the long-term status, changes, and trends in the health of the nation's forest ecosystem.
The information obtained from INDO-FHM plots would enable the Ministry of Forestry to report annually on the conditions of forest ecosystem, with respect to forest attributes that are of national and international concern.

To accomplish the objectives of sustainable forest management, the empowerment of forestry stakeholders (forest managers, scientists, decision makers, NGO) both from Indonesia and Southeast Asian Countries are highly required.

Furthermore, INDO-FHM technology is complementary to the Indonesian National Forest Inventory system, especially on the productivity, biodiversity, forest vitality, and site quality aspects.

The data could be used in the management unit level, provincial level and national level planning for forest policy, and in the identification of areas that could be at risk from a variety of natural and human stressors.

2.2.2. Link Between the Relevant Sectors and Development Plan

INDO-FHM operates selected indicators of forest ecosystem conditions in order to detect early signal of changes in forest condition. The selected indicators are specially chosen to assess the productivity, biodiversity, site quality, forest vitality (crown condition and damage) and socio-economic merits.

A parallel endeavor will be required to foster the capacity of the various corresponding agencies of the Ministry of Forestry responsible on the forest management policy through an effort to empower human resource development of staff members at the professional level. This should be connected with proper action to enhance Indonesia's place in the international community with respect to the dialogue on sustainable forest management.

The project was a cooperative effort of the Ministry of Forestry, the ITTO, the USDA-FS, and SEAMEO-BIOTROP.

In line with the ITTO Objective 2000 (Ecolabelling), the involvement of the forest concession holders (PT Asialog, PT INHUTANI II, Perum Perhutani, PT Sumpol Timber) has contributed to the development of the Criteria and Indicators of Sustainable Forest Management.

In conjunction with human resources development, additional training courses on FHM for the Indonesian crew and for the Southeast Asian scientists have been successfully conducted under the support of MOF and SEAMEO. This support has proven the awareness of and support for sustainable forest management by the Southeast Asian Ministers of Education Organization and the Government of Indonesia.

2.3. PROJECT DESIGN AND ORGANIZATION

2.3.1. Adequacy of Identification Phase

The location of INDO-FHM cluster plots was in Pulau Laut to represent small island ecosystem and in Jambi, Sumatra, to represent big island ecosystem. It was presumed that small island has less stressor as compared to big island in nature. During the project execution, this presumption was proven to be incorrect due to the fact that the small island was more fragile than the big island, especially on the effect of human stressor to the forest sustainability which reflected the magnitude of socio-economic stressors.

Originally, the socio-economic indicator was not designed in the project proposal, but then the Project Steering Committee meeting decided to include this indicator to be investigated.

2.3.2. Conceptual Foundation

Realistically, the project rationale was sufficiently defined in the Project Document, while the perception of external influence was not adequately predicted during the project formulation. For instance, the unfortunate political situation in the country, forest fire, and forest encroachment, have caused the delay of the project execution and the cancellation of the US-FHM Team to participate in the training course for the Southeast Asian scientists.

The continuous change in exchange rate influenced the execution of the project activities, and this problem especially was experienced by the Government of Indonesia (MOF) to provide the counterpart budget accordingly.

2.3.3. Adequacy of Time and Other Resources for Project Formulation

Originally the project execution was scheduled to run from 1996-1998, but due to the political situation and forest fire, the project execution was approved to be extended by the CRF committee until 31 December 2000 without any additional funding.
Consequently, due to the unfavorable situation mentioned before, the US-FHM team could not participate in the training course for Southeast Asian scientists. As a result, the training course was rescheduled to be conducted the following year (1999).

In principle, there were no impediments during the project formulation.

2.3.3. Understanding and Appropriateness of the Roles and Responsibilities of the Institutions Involved in the Project Implementation

The roles and responsibilities of the institutions involved were carried out appropriately. However, due to the economic crisis, the videography technique was not carried out. Despite this, two additional training courses on INDO-FHM were successfully conducted following the additional funding from MOF and SEAMEO BIOTROP.

2.3.4. Beneficiary Involvement with the Project's Efforts and Actions

ITTO provided financial support, the Agency of Forestry Planning, the Ministry of Forestry (MOF) provided the counterpart budget, facilities and equipment, and resource persons. USDA-Forest Service provided the technical assistance for development of INDO-FHM technology in the tropical country. SEAMEO BIOTROP provided facilities, resource persons and additional funding for the training courses during the project execution. Forest concession holders provided field facilities, field crew and accommodation.

2.4. PROJECT IMPLEMENTATION

2.4.1. Critical Differences between Planned and Actual Project Implementation

2.4.1.1. On Costs

There are no critical differences between planned and actual project implementation with regard to the cost of the project from the ITTO funding.

The project was able to attract a part of the SEAMEO Education Development Fund (SEDF) to support participants to the training course on FHM from Southeast Asian countries.

The fund for financial audit was not previously planned, but then it was agreed by the ITTO Headquarters that the financial audit fee could be built in the project.

2.4.1.2. On Components

In principle, the activities of the INDO-FHM project were focused on the technology transfer with the following steps: testing of selected indicators in demonstration plots, reproducing the FHM technology in National Forest Inventory plot (detection monitoring plot) and conducting training course.

FHM indicators tested in INDO-FHM were adopted from the US-FHM Field Guide Method issued by the USDA Forest Service namely: growth, crown condition, damage, vegetation structure, and soil. A PSC meeting came up with the suggestion that the socio-economic indicator should be included and investigated.

All of these indicators were tested in the Demonstration Plots, Detection Monitoring Plots and Training Plots.

The activities related to the INDO-FHM plot establishment included the demonstration plots established in PT Asialog, Jambi, and PT Inhutani II, Pulau Laut in 1996; training plot established in Gunung Gede Pangrango National Park in 1999; and detection monitoring plot established in PT Sumpol, South Kalimantan in 1999. The field work of FHM training course for the Indonesian crew was conducted in Perum Perhutani Kaliurang in 1997, in Tawangmangu in 1998, and Malang in 1999, while field work for the Southeast Asian scientists was conducted in Gunung Gede-Pangrango National Park in 1999 and 2000 for future model of FHM plot to be established in other Southeast Asian countries.

Originally, the activity of FHM training course was designed for three separate training courses to be attended by 60 participants, but in the end the INDO-FHM project was able to conduct six training courses attended by total of 102 participants, which is 66 % higher than the target.

Detection monitoring plots were overlaid on the NFI plots to assess the reproducibility of the INDO-FHM technology. It was carried out in PT Sumpol, South Kalimantan.

Two one-day seminars were conducted at SEAMEO BIOTROP. The first one-day seminar was designed to draw comments and perceptions among the institutions

working on Criteria and Indicators for sustainable forest management (LEI, CIFOR and SEAMEO BIOTROP) as an additional achievement in the INDO-FHM project. The second one-day seminar was organized to evaluate the selected indicators used in the INDO-FHM technology.

2.4.1.3. On Schedules

Due to the political situation and the occurrence of forest fire, the INDO-FHM project was extended without any additional funding, from three years to five years (1996-2000).

2.4.1.4. On Outputs and Achievements

Overall, the objectives of the INDO-FHM project were achieved as indicated in the items described below.

(1). INDO-FHM cluster plots

The total number of INDO-FHM cluster plots is eleven cluster plots to assess the selected indicators, two detection monitoring plots, one permanent training plot, and three temporary training plots.

The selected indicators were growth, vegetation structure, crown condition, damage, and soil to support the criteria of productivity, biodiversity, forest vitality and site quality.

(2). Number of training participants

The training program of INDO-FHM consisted of introductory training, training for the scientists (indicator leaders), training for the Indonesian crew and training for the Southeast Asian scientists. The total number of training participants was 102 persons coming from various institutions in Indonesia and other Southeast Asian countries.

(3). Technical reports and educational reports

The technical reports consisted of a series of scientific reports concerning the indicators evaluation (status, changes and trends), while the educational report recorded the execution of training programs for various levels of the trainees. The total number of technical reports is 29 and seven educational reports.

(4). Workshop

INDO-FHM project was able to organize two workshops at SEAMEO BIOTROP.

(5). Field methods guide

Following the visit of the US-FHM team, the manual on Forest Health Monitoring Field Methods Guide (International - Indonesia) was modified and published by the US-FHM. Some indicator measurement codes were modified based on the tropical rain forest conditions. This manual is used for the training program of INDO-FHM for the Indonesian crew and scientists coming from Southeast Asian countries. The manual was also disseminated to several institutions.

(6). PDR, database

The Portable Data Recorder (PDR) program which is an electronic tally sheet was also established in INDO-FHM project after being authorized by the US-FHM team. The database of INDO-FHM is established at SEAMEO BIOTROP.

(7). Institutional building

During the project execution, the manual of Forest Health Monitoring Field Methods Guide (International - Indonesia) was distributed to institutions based in Indonesian and in Southeast Asian countries or International Institution, especially those working on forestry. Among them are Bogor Agricultural University, Gadjah Mada University, Bengkulu University, University Winaya Mukti, FORDA, MOF, LEI, CIFOR, WWF, Malaysia, Cambodia, Myanmar, Lao PDR, Thailand, the Philippines, Kerinci Sebelat Project.

The Faculty of Forestry, Bogor Agricultural University, also adopted the INDO-FHM technology in the subject of Forest Protection especially the method to monitor the health of the trees or stand.

Two undergraduate students conducted their research on Forest Health Monitoring.

2.4.2. Measures and Actions which Could Have Avoided These Differences

(1). Better knowledge on the stepwise planning on hierarchy of FHM in SFM.

(2). Better MOU with the partners

(3). Better project cooperation and execution with MOF.

(4). Better networking with the US-FHM team and other stakeholders.

2.4.3. Appropriateness of Assumptions Made

Assumptions made on project background, justification, objectives and expected output were appropriate. The assumptions in implementation were mostly correct, except for some items in the detection monitoring program due to lack of radar image and videography that should be overlaid in the National Forest Inventory plots.

2.4.4. Appropriateness of Identification of the Risks Involved

The political situation was an unforeseen problem that influenced the technical assistance from the US-FHM Team to participate in the Training Course for the Southeast Asian Scientists. It was delayed for one year, and finally, it was taken over by the Indonesian scientists.

Forest fire destroyed the cluster plots numbers 4, 5 and 6 in Pulau Laut, and followed by illegal logging after three-year measurements. While cluster plot numbers 1 and 7 in Pulau Laut were also destroyed by illegal logging in the fifth year of measurement.

2.4.5. Sustainability of Project after Completion as a Result of Project Implementation Conditions

The main product of Forest Health Monitoring, which is also the most important, is the information it provided on the forest condition. Sustainability of the project after completion can be divided into two different conditions and these are:

a. **Jambi.** PT Asialog is very much concerned about the sustainability of the FHM plots in their forest. This is an assurance to continue the data collection on the plots established in the area. PT Asialog uses the FHM plots for reference purposes in monitoring the forest production, site quality and especially, for species identification.

b. **Pulau Laut.** Unfortunately, FHM plots numbers 1, 7, 4, 5, and 6 were destroyed by illegal logging activities, but for plots numbers 1 and 7, there will be natural regeneration. Until the Year 2000, plots numbers 2 and 3 are still intact, and the data collection as reference plots can be continued.

c. **Bogor.** Training plots were also established in Gunung Gede-Pangrango National Park for the training courses conducted during the project. These plots will also be used for educational purposes either by BIOTROP or other interested institutions. FHM-Database at SEAMEO BIOTROP will be maintained and improved for the Development of FHM Technology.

2.4.6. Appropriateness of Project Inputs

Financial, personnel, material and management inputs to the project were appropriate, in quantity as well as in quality, except for the Radar and Videography.

2.5. PROJECT RESULTS

2.5.1. Situation Existing at Project Completion as Compared to the Pre-Project Situation

This project focused on the technology transfer on Forest Health Monitoring from the temperate forest to the tropical rain forest condition to monitor the sustainability of Indonesian tropical rain forest. The FHM technology assessed the current status, changes and trends in indicators of the forest ecosystem with known statistical confidence in the estimates. Some important changes after the project completion are as follows:

(1). Technology transfer of FHM by the US-FHM team was done in 1995 and 1996 for the Indonesian scientists as indicator leaders. The Indonesian scientists (13 person) trained the Indonesian field crew and scientists coming from different countries in Southeast Asia. The total number of trained field crew was 75 personnel, coming from Sumatra, Java, Kalimantan, Sulawesi, Ambon, Irian Jaya (Papua). The trained scientists coming from Southeast Asian countries are 14 scientists coming from Malaysia, Thailand, the Philippines, Myanmar, Cambodia, and Vietnam. It is expected that they will be core personnel in their respective home countries to develop and

implement the FHM technology to monitor the sustainability of their forest. Networking among the participating scientists was also established.

(2). FHM-Database was also made and established at SEAMEO BIOTROP and at the Agency for Forest Planning, Ministry of Forestry in Jakarta.

(3). Production, biodiversity, site quality and vitality indicators are important to assess the sustainability of tropical rain forest that were measured at verifier level. The detailed results of these indicators were presented in some Technical Reports (TR).

(4). FHM technology runs complementary to the National Forest Inventory technology, especially in assessing the biodiversity, site quality, vitality and forest production aspects.

(5). FHM technology has been adapted as one of the subjects on Forest Protection in the Faculty of Forestry of the Bogor Agricultural University. Some students conducted research on this topic for their thesis.

(6). PT Asialog uses the FHM plots as reference plots in measuring forest production, site quality and especially for species identification.

2.5.2. Extent of Achievement of the Project's Specific Objectives

The project's specific objectives were fully achieved, except for the one on detection monitoring using radar and videography technology.

2.5.3. Impact of the Project's Results on Sectoral Programs

The impact on Sectoral programs are as follows:

(1). **ITTO**. The criteria and indicators of SFM especially Criterion 3 (Forest Ecosystem Health and Condition) was tested up to the verifier level. Forest Health Monitoring: Field Methods Guide (International-Indonesia), issued by the USDA-Forest Service can be used for data collection with some modifications.

(2). **MOF**. Forest Health Monitoring runs complementary to the National Forest Inventory (NFI). The FHM cluster plot can be overlaid on the existing Permanent Sample Plot of NFI. Thirty field crew coming from the Regional Forest Inventory and Planning Offices and 24 from the Forest Inventory and Planning Headquarters were trained on FHM technology. They will play an important role in the accuracy of data collection in the field.

(3). **SEAMEO BIOTROP** will use the FHM Training Plots established in Gunung Gede-Pangrango National Park, Bogor, and PT Asialog, for the training course and research station on Forest Health Monitoring program for Southeast Asian countries. The FHM project attracted the SEAMEO member countries to provide additional training course, and it was done in Year 2000.

(4). FHM technology has been adopted as one of the subjects on Forest Protection in the Faculty of Forestry, Bogor Agricultural University. Some students conducted research on this topic for their thesis.

2.5.4. Sustainability of the Project After Completion

There is a great chance that the completed project is sustainable due to the understanding of the project conceptualization by all relevant institutions and offices especially the MOF, ITTO, USDA-Forest Service and SEAMEO BIOTROP. The trained persons from the Southeast Asian countries are expected to be the core persons or indicator leaders in their respective home countries in implementing the FHM technology. They are willing to establish a networking on FHM in Southeast Asian countries.

2.5.5. Assumptions Made and Conditions Prevailing During Completion

Due to unforeseen political situation and field problems such as forest fire and illegal logging that occurred during the project implementation, which have caused tremendous delays, the project which was supposed to end December 1998, was extended to December 2000, without any additional funding. This was embodied in CRF XXV/12 Rev.1.

2.6. SYNTHESIS OF THE ANALYSIS

2.6.1. Specific Objective (s) Achieved

Realized
Specific objectives 1 and 2 were 100 % achieved, while specific objectives 3 and 4 were accomplished about 99 %.

Partly Realized
None.

Unrealized
None.

2.6.2. Outputs

Realized
Generally speaking, 99 % of the objectives were realized.

Partly Realized
None

Unrealized
None

2.6.3.Schedule

In Advance/on time:

(1). Introductory training and training plot establishment.

(2). Plot establishment.

(3). Training for scientists and field crew.

(4). Database management.

Delayed, not seriously:

(5). Training Course for Southeast Asian Scientists, due to unforeseen political situation.

(6). Detection monitoring due to forest fire.

Seriously Delayed
None

2.6.4. Actual Expenditure

Below planned
The total expenditure is 1 % below plan.

10 % above planned
None

> 20 % above planned
None

2.6.5.Potential for Replication

FHM technology has a significant potential for replication and implementation in different types of forest ecosystem. The Field Methods Guide, data processing, and trained persons are available.

2.6.6.Potential for Scaling-up

Not Potential
None

Modest potential
None

Significant potential

FHM technology has significant potential for scaling-up in different types of forest ecosystem and sylvicultural systems to provide the data on the current status, changes and trends due to the forest management, through the Intensive Site Ecosystem Monitoring (ISEM).

PART III : CONCLUSIONS AND RECOMMENDATIONS

3.1. DEVELOPMENT LESSONS

In general, the development lessons observed during the project execution are as follows:

(1). The transfer of technology was slightly affected by the fact that the political situation in the country was so unstable that the US FHM scientists were not able to conduct the third visit.

(2). The shortage of counter budget available brought about the cancellation of the photo radar and videography technique.

(3). Forest fire and illegal cutting incidents invaded some the FHM plots.

(4). The formulation of the Work Plan and its transformation to DIP budget system was tedious.

(5). The political will of the government of Indonesia will definitely ensure the adoption of the FHM technology on the assessment of sustainable forest management.

(6). Human resources development is highly important to transfer the FHM technology on the operational level.

(7). Awareness of societal values on the multi-functions of tropical rain forest ecosystem will strengthen the sustainable goal of the forest management.

(8). Indicators developed by the FHM project are complementary to the NFI (National Forest Inventory) to address the tropical forest issues of sustainability in terms of productivity, biodiversity, site quality and vitality.

(9). Since Indo-FHM concerns more the ecosystem's health, it is apparent that the FHM technology covers the criterion 3 (Forest ecosystem health and condition) of ITTO Criteria and Indicators for sustainable management of natural tropical forests.

(10). FHM technology provides baseline information covering current status, changes, and trends of forest condition such that the procedure can be employed in any sylvicultural system and forest function.

(11). The biophysics component has been covered on the procedure of FHM; however, the inclusion of socio-economic indicator is deemed necessary.

Some of the drawbacks mentioned above have caused the postponement of the project implementation from 1 January 1996 – 31 December 2000. The MOU was signed in 15 September 1995, and the first budget installment was 1 January 1996.

The lessons gained from the development phase are:

3.1.1.FHM method component

(1). The original FHM method was developed in the USA. Refinement of the method is necessary due to high biodiversity merit so that the implementation of such procedure on tropical rain forest is acceptable. For instance, the adequate cluster plots are needed, instead of enlarging the radius plot size.

(2). Translation project of the FHM course module into more readable format will enhance knowledge transfer to the forest stakeholders in each ITTO member country.

(3). The FHM technology provides a practicable tool at verifier level in the hierarchy of criteria and indicators of SFM.

(4). The Portable Data Recorder strengthens the data management and analysis in addition to tally sheet format.

3.1.2.Training component

(1). Transfer of the FHM technology was carried out systematically covering introductory training, indicator leader training, field crew training, and Southeast Asian scientists training. The training course for the Southeast Asian scientists is aimed at developing core personnel in their own respective country for future development of FHM technology to assess the sustainability of their forests.

(2). FHM training course designed for field crew of forest concession holders is imperative in order to ensure the implementation of FHM technology nation wide.

(3). Modification of PDR adapted to the Indonesian forest condition is still needed.

(4). The trained crew are national assets; however, the number and the distribution over the country should be significantly increased, and continuously involved.

3.1.3. Research component

(1). Selection and testing of indicators conducted in the demonstration plots were done prior to the implementation of those selected indicators in the detection monitoring programs, intensive site ecosystem monitoring.

(2). Relevant indicators proven to be applicable are production (net growth), site quality, biodiversity, and vitality through the measurement of related parameters.

(3). Based on this experience, it is suggested that the assessment period for measurement of certain indicators such as growth for instance, be carried out within five-year period in natural production forests.

(4). Applicability of the FHM technology is very important in monitoring the forest ecosystem condition.

(5). Research on various types of forest ecosystems is required.

3.2. OPERATIONAL LESSONS

In summary, the operational lessons derived from the project are as follows:

(1). The role of the Project Steering Committee as a governance body is crucial in the monitoring and evaluation of the project execution.

(2). The Project Executing Agency played an important role in organizing the implementation of the Work Plan successfully.

(3). Consultation with the ITTO Assistance Project Manager on Reforestation and Forest Management, to the US FHM team, and to the MOF were conducted regularly.

(4). The support provided by forest concession holders was helpful for the success of the project.

(5). Standardized data collection and management, data analysis, and report writing are vital to arrive at conclusive recommendations.

(6). Examination of financial statement and cash flow by involving registered external auditor turned out to be helpful for PEA to keep track of the project.

(7). The extension of the project duration gave a chance for the INDO-FHM team to gain more additional data to be incorporated on the preparation of the technical reports.

(8). The frequency of personnel turn-over in MOF which is in charge or related to the project have caused disruptions in the project's processes.

The lessons gained from the operational phase of important project components are the following:

3.2.1. FHM method component

(1). Some of the FHM plots established close to the accessible road in Pulau Laut had been illegally logged, and this has hampered the continuation of data collection on growth and damage.

(2). Forest damage that occurred on FHM plots in Pulau Laut as mentioned above, gave the research scientists a chance to analyze the weed vegetation that has invaded.

(3). The commitment of forest concession holders involved on the FHM project should be emphasized at the very beginning of the project to come up with a better understanding of the method and therefore resulting to better plots management.

(4). FHM method is applicable and workable to monitor the status, changes and trends in different types of tropical forest ecosystem.

3.2. 2. Training component.

(1). The FHM training for the Southeast Asian scientists were conducted successfully, but due to budget limitation, some candidates could not be accommodated.

(2). Most of the training participants were really interested in establishing FHM network in the Southeast Asian region.

(3). Using the available computers, the INDO-FHM Team was able to overcome the lack of PDR originally planned for the success of the training course.

(4). The FHM training plots located in Gede-Pangrango National Park, Bogor, are important to be maintained for future training programs.

(5). The trained scientists coming from the Region are important core persons to develop and implement FHM technology in their respective countries.

3.2.3. Research component

(1). FHM technology is applicable and workable for indicator selection of SFM in the verifier level, especially on production, biodiversity, site quality and vitality, that measure forest ecosystem health and condition (Criterion 3).

(2). Long-term data collection obtained from different forest ecosystems is very important to arrive at conclusive recommendations.

(3). Clear and workable methodology of INDO-FHM and dedicated resource persons are a prerequisite to bring the FHM technology into reality,

(4). Institutional support provided by the ITTO, USDA-Forest service, MOF, SEAMEO BIOTROP, forest concession holders, and other research institutes made the execution of the project successful.

(5). Assessment of the relationship between remote sensing technique and ground- based measurements was partly achieved.

(6). The videography technique was not implemented due to unavoidable circumstances.

3.3. RECOMMENDATIONS FOR FUTURE PROJECTS, REGARDING:

3.3.1. Identification

(1). The project should support the national as well as international commitment.

(2). The specific objective to be tackled should be relevant with Criterion 3 of the SFM as defined by ITTO.

(3). Selection and testing of relevant indicators should be addressed to the tropical rain forest conditions, including socio-economic benefits.

(4). Effective coordination and organization among the institutions involved must be improved.

(5). Institutional commitment to execute the project continuously is a must

3.3.2. Design

(1). Closer and more frequent deliberations in the formulation of cooperation between related institutions.

(2). Improved scope of thought in formulating alternative plans.

(3). Implementing agency and target beneficiaries should have a clear idea of what to do before the planning starts.

(4). Secure FHM cluster plots in order to ensure the quality of data collection.

(5). Cluster plots should be established systematically in different types of ecosystems.

3.3.3. Implementation

(1). To establish more FHM cluster plots in various ecosystems (Intensive Site Ecosystem Monitoring).

(2). To involve interested and prospective forest concession holders.

(3). To ensure the adoption of the FHM technology on the assessment of sustainable forest management, political-will of the GOI is needed.

3.3.4. Organization

(1). Continuous cooperative efforts between ITTO, MOF, US-FHM Team chairman of executing agency, scientists, forest concession holders, should always be made in the course of implementing project activities.

(2). Cooperation with other parallel projects must be maintained.

(3). Regular meetings among scientists, the Project Steering Committee, and Government Policy Makers are important for the execution of the project.

(4). FHM needs multi-discipline of sciences and approaches; therefore, synchronized program and schedule should be put into account properly.

(5). Indicator assessment should be carried out by the same trained persons, if possible, to minimize unexpected error. Therefore, the FHM team should master the Quality Assurance (QA) prior to field assessment.

3.3.5. Management

(1). The technical assistance from the US-FHM Team should not be affected by political situation.

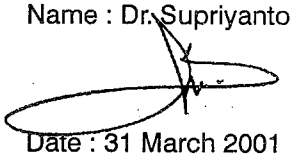
(2). Data collection in formatted tally sheet, FHM Database, data processing and analysis are very crucial for the success of formulation and interpretation of the goal of FHM to arrive at the conclusive results and findings.

Responsible for the Report

Name : Dr. Supriyanto

Position held;

Chairman



Date : 31 March 2001

ANNEX 1
TECHNICAL REPORTS ABSTRACTS

PLOT ESTABLISHMENT

Technical Report No. 1

Supriyanto
A. Ngaloken Gintings
Soekotjo

ABSTRACT

The criteria assessed in Forest Health Monitoring are productivity, biodiversity, vitality and site conditions. The indicators selected then should be suitable for assessing the above criteria either qualitatively or quantitavely. The selected indicators must be efficient in time, cost effective and easy to apply (to detect, to record and to interpret), precisely defined and measurable. Among the indicators selected in Forest Health Monitoring (FHM) are : tree growth and structure, crown condition, damage, biodiversity, and soil properties. Data recording and measurements on all indicators are taken in a permanent plot representing the forest community of the tropical rain forest condition. This reports discussed briefly the FHM plot design and the plot establishment procedure. Site-tree data, point-level area data, microplot-understory vegetation data, and microplot tree data are among the data collected from the FHM plots. The procedure of soil sampling and measurements are also discussed. General information related to the FHM plots established in PT. INHUTANI II, Pulau Laut, South Kalimantan; PT. Asialog, Jambi, Sumatera; and PT. Sumpol, South Kalimantan, has also been included. FHM plots were established in virgin forest, biodiversity conservation area, buffer zone, seed production area and plantation forest.

Key words: *Forest Health Monitoring, indicators, plots, data, soil.*

DATA COLLECTION, ANALYSIS AND MANAGEMENT

Technical Report No. 2

Erianto Indra Putra
Purnadjaya

ABSTRACT

FHM data have been collected using tally sheets or portable data recorder. Tally sheets were used for recording FHM field data from the first measurement in 1996 and re-measurements in 1997, 1998, 1999 and 2000, and they have been stored safely up to date. The data have also been managed in some reports done in 1996 and 1997. Starting October 1997, the FHM Database is used to manage all of FHM field data. Some rectification and updating on FHM Database are continuously done to improve its capability.

Key words: *Tally sheet, portable data recorder, FHM Database*

FOREST HEALTH MONITORING DATABASE (FHM D-Base®) 'USERS GUIDE'

Technical Report No. 3

Erianto Indra Putra
Supriyanto

ABSTRACT

FHM D-Base is the Forest Health Monitoring database management system that basically made up of the referential integrity among its tables. FHM D-Base provides more advantages to the users, containing several report forms and graphs as the output as well as the data entry forms. This guide gives the brief step-by-step instruction on how to operate the FHM D-Base properly, i.e. to open the FHM D-Base, to make the data entry and to get the data output such as in the reports or graphs.

Keywords: *FHM D-Base, instruction, data entry, forms, graphs*

VEGETATION STRUCTURE INDICATOR: 'PRESENT STATUS OF TREE SPECIES DIVERSITY'

Technical Report No. 4

Soekotjo
Uhaedi Sutisna

ABSTRACT

The tropical rain forest of Indonesia is widely acknowledged as the richest in terms of species and complex terrestrial ecosystem in the world. The Indonesian Forest Health Monitoring (INDO-FHM) project plans to track the regional status and trends of biodiversity in forests of Indonesia. The objective of this report is to characterize tree species diversity for the FHM sub-plots and annular-plots. Species richness, species evenness, species diversity and species equitability are measured by using well known formulas. The results showed that species richness, evenness, diversity and equitability depend on the sample size and community level. The formulas used meet the following criteria: (1) simple quantification, (2) low environmental impact, and (3) regional responsiveness.

Key words: *Tree species diversity, sample size, community level*

ASSESSMENT ON THE EFFECTS OF MECHANICAL LOGGING ON RESIDUAL STANDS (I : Logging Damage, Status Condition)

Technical Report No. 5

Soekotjo

ABSTRACT

Monitoring the effects of mechanical logging on residual stands was done on off plot of Forest Health Monitoring. The study area located at Compartment 7 of PT. INHUTANI II, Mekarpura, Pulau Laut, South Kalimantan. In this compartment, 12 quadratic plots of 50 m X 50 m were used to monitor the damaged. Among the data recorded of each tree in each sample plot are: number, position, species, and damage type, location and severity codes. The result shows that the damage types vary in each of sample plot with the total damage comprising 32% of total healthy residual trees. Most of the bark damage of meranti and keruing groups are located at lower bole followed by lower and upper bole, and root and lower bole at 75%, 9%, and 6%, repectively. Broken off is the most severe damage, and the least severe is broken branches. Regression equations of total damage

type (Y1), average severity of damage (Y2) and damage indices (Y3) on the amount of exportable trees extracted (X) are as Y1 = 87.13 – 13.02 X; Y2 = 2.59 + 0.78 X, and Y3 = 45.92 + 27.71 X, respectively.

Key words: *logging damage, damage type, location, severity, damage indices*

PRESENT STATUS OF CROWN INDICATORS

Technical Report No. 6

Simon Taka Nuhamara
Kasno

ABSTRACT

This report discusses the present status of crown condition of the trees assessed in the cluster plots of both study sites, Pulau Laut and Jambi. During this assessment, the data collected are related to the growth of the several important trees. However, further data are needed in order to explain how good is the crown condition selected as one of the forest health indicators, especially in relation to the tree growth.

Key words*: Crown indicator, forest health, Pulau Laut, Jambi*

INFORMATION FLOW

Technical Report No. 7

Supriyanto
Simon Taka Nuhamara
Ujang Susep Irawan

ABSTRACT

To provide information on how to organize and implement the several selected indicators in Forest Health Monitoring, an information flow was purposely constructed. This step by step procedures, coupled with the method for searching any missing subplot or plot center, have been provided to equip the field crew during assessment. It is hoped that this information flow could serve as a quick reference for those interested in finding the overall idea and techniques covered in Forest Health Monitoring.

Key words: *Information flow, forest health monitoring, sustainable forest management*

SOIL INDICATOR : PRESENT STATUS OF SITE QUALITY

Technical Report No. 8

A Ngaloken Gintings
Simon Taka Nuhamara

ABSTRACT

This report discusses the present status of the soil indicator at both plots sites, Pulau Laut, South Kalimantan, and Jambi, Sumatera. The physical and chemical properties of soil are presented covering both study areas. Some soil properties could be used as indicators for the growth of certain trees. From the soil point of view, erosion, nutrients,

compaction, toxic and carbon are among the parameters used in assessing the site index.

Key words: *soil indicator, forest health monitoring, Pulau Laut, Jambi*

CROWN INDICATORS : PRESENT STATUS OF CROWN STRUCTURE AND OVERSTORY DENSITY

Technical Report No. 9

Supriyanto
Kasno

ABSTRACT

The size and shape of a crown are considered as crown indicators. Among the measurable parameter of crown indicators are crown diameter, live crown ratio, crown density, crown dieback, foliage transparency, and canopy density. This report provides general information on each of the crown structure, parameters and its measurement procedures. The present status of trees crown structure, crown parameters, and canopy density on the FHM demonstration plot established in Jambi, Sumatera and Pulau Laut, Kalimantan were measured. The result showed that in higher crown density, caused lesser seedlings number. The method in assessing crown indicator is applicable in Indonesian Tropical Rain Forest.

Key words **:** *Crown diameter and shape, crown structure, canopy density*

SPHERICAL DENSIOMETER MANUAL

Technical Report No. 10

Supriyanto
Kasno

ABSTRACT

A special tool specifically developed for the FHM is the spherical densiometer. The spherical densiometer (SD) is a concave or convex mirror with definite focus position used to measure the estimation of density of a unit area (0.1 ha) of tree crowns. This manual provides the brief background on the development of SD and step-by-step instruction on how to use it. The procedures in calculating the canopy density as well as canopy opening are also briefly presented.

Key words: *Spherical Densiometer, canopy density, canopy opening*

PRESENT STATUS OF FOREST VITALITY

Technical Report No. 11

Simon Taka Nuhamara
Kasno

ABSTRACT

This report discusses the present status of the damage of trees encountered in several cluster-plots in Pulau Laut and Jambi. In this report, the tree level index and the plot level

index were drawn so as to examine the present status of the damage on trees in different clusters. To give an overview on the health status of the several trees, the mapped trees in each subplot or cluster are indicated.

***Key words**: Forest health, damage, vitality, plot level index, tree level index*

TREE SPECIES DIVERSITY ASSESSMENT: PRESENT STATUS AT JAMBI

Technical Report No. 12

Erianto Indra Putra
Soekotjo

ABSTRACT

Forest Health Monitoring to Monitor the Sustainability of Indonesian Tropical Rain Forest (INDO-FHM) plans to track down the status and trends of biodiversity in the forests of Indonesia, that one of them is in the species level. The objective of this report is to assess the tree species diversity of FHM Clusters 3 and 4 of Jambi. Species diversity formulas used are the species richness indices (Margalef Index and Simpson Index), the species evenness index (Pielou Index), and the species diversity indices (Shannon-Weiner Index and Simpson Index). The result shows that Forest Health Monitoring Cluster Design, consisting of four annular-plots and sub-plots, could be used to express the diversity assessment within its sampling design. The area of a cluster with an area of 0.4 ha having a high number of species gives the biggest value of species richness, abundance, equitability and diversity followed by the annular plots with an area of 0.1 ha and less number of species. The sub-plots with an area of 0.017 ha having the small number of species takes the last one. The high value of species diversity indices measured in Clusters 3 and 4 at Jambi indicates that both of these two clusters recently have the high species richness, abundance and diversity.

***Key words**: Tree species diversity, annular-plots, sub-plots,*

ASSESSMENT OF PRODUCTION INDICATOR IN FOREST HEALTH MONITORING TO MONITOR THE SUSTAINABILITY OF INDONESIAN TROPICAL RAIN FOREST

Technical Report No. 13

Supriyanto
Soekotjo
Agus Justianto

ABSTRACT

The health of a forest ecosystem may be determined by employing assessment procedure if they are productive, biologically and structurally diverse, large and not fragmented, balanced in size class distribution and resilient to the stressors. Continuity of timber production is one of indicators of a well-managed tropical forest ecosystem and must be maintained through better understanding of the dynamics, structure, mortality, in growth and up growth of trees. The net growth reflects the disturbance, stressors, growth and mortality in the forest ecosystem. The production indicator is relatively easy to measure and interprets high index stability.

***Key words**: Mortality, basal area, net growth*

ASSESSMENT OF PRODUCTION INDICATOR IN NFI – FHM AT SOUTH KALIMANTAN

Technical Report No. 14

Supriyanto

ABSTRACT

Field-testing of production indicator was conducted in PT Sumpol Forest Concession Holder, South Kalimantan and in PT Asialog, Jambi. FHM plots were overlaid on NFI plot system. Two NFI cluster plots, grid number 503209620 and 503209600 in South Kalimantan and one cluster plot grid number 483209760 in Jambi were selected. Vegetation maps of Meratus Mountain and it surrounding, South Kalimantan was made using satellite image, prior to the plot establishment for indicator testing. The diameter of all the trees with the diameter $\geq$ 10cm in the plot were measured for the basal area calculation. The results showed that the production indicator could be easily implemented in NFI plot system. The total basal area recorded in FHM plot system was higher than in NFI plot system. Reproducibility of production indicator in NFI plot system was good.

Key words : *NFI, basal area, indicator*

ASSESSMENT OF BIODIVERSITY INDICATOR IN FOREST HEALTH MONITORING FOR SUSTAINABLE FOREST MANAGEMENT: TREE SPECIES DIVERSITY

Technical Report No. 15

Erianto Indra Putra
Soekotjo
Uhaedi Sutisna

ABSTRACT

Most of our interactions with biological diversity occurred on the species level. Species embody the array of diversity from gene to population and provides a measure for the diversity of communities. Species can readily be identified and classified, and they can be counted. The objective of this study is to assess the biodiversity indicator in forest health monitoring for sustainable forest management. Tree species diversity (status, changes, and trends) was measured in FHM plot design. Species diversity formulas used to assess the diversity indicator are the species richness indices (Margalef Index and Simpson Index), the species evenness index (Pielou Index), and the species diversity indices (Shannon-Weiner Index and Simpson Index). The results showed that at the initial measurements, all of the cluster plots in Pulau Laut and Jambi have high species diversity. Changes and trends in tree species diversity show that when there is no disturbance, the value will be relatively constant. When there is forest disturbance, the value of species diversity decreases. The decreasing value of species diversity was found in Cluster plots 4, 5 and 6, due to forest fire and illegal cutting, while the values found in the other cluster plots remained constant.

Key words: *Tree species diversity, species richness, forest disturbance.*

ASSESSMENT OF BIODIVERSITY INDICATOR IN NFI–FHM PLOT SYSTEM AT SOUTH KALIMANTAN AND JAMBI PROVINCES

Technical Report No. 16

Supriyanto
Uhaedi Sutisna
Erianto Indra Putra
Soekotjo

ABSTRACT

Forest biodiversity have been identified as criterion of sustainability. In its own right, biodiversity is useful as a measure of forest health. National Forest Inventory (NFI) has been initiated in 1989, but it does not concern biodiversity that can reflect the condition of forest ecosystem. The objectives of NFI were to provide information on the location and extent of the main forest types, to estimate the standing volumes and growth, and to assess the status and change of the forest. Assessment of the biodiversity indicator in NFI plot system using FHM plot system was conducted in Jambi and South Kalimantan. FHM cluster plots were overlaid on Permanent Sampling Plot (PSP) of the NFI Plot system. The biodiversity indicator was assessed using the criteria of species richness (Margalef Index and Odum Index), species evenness (Pielou Index), and species diversity (Shannon-Weiner Index and Simpson Index). The objective of this study was to assess the biodiversity indicator used in FHM within NFI plot system. The results showed that the species names used in NFI plots were not identified correctly, FHM, therefore, adapted the names of the local species and then converted them to scientific names.

***Key words**: FHM, NFI , species diversity, species richness, species evenness, species name*

ASSESSMENT OF DAMAGE INDICATOR IN FOREST HEALTH MONITORING TO MONITOR THE SUSTAINABILITY OF INDONESIAN TROPICAL RAIN FOREST

Technical Report No. 17

Simon Taka Nuhamara
Kasno
Ujang Susep Irawan

ABSTRACT

The measure of damage indicator using the US-FHM technology has been tested in two ecologically different natural tropical rain forest ecosystems: one in PT. INHUTANI II, South Kalimantan, and the other in PT. Asialog, Jambi, Sumatra. Seven and four clusters, respectively, were established in Pulau Laut and Jambi in 1996. Assessment of the damage indicator was made from 1996 through 2000. It was found that the US-FHM technology is easily adopted for tropical rain forest condition in field data recording. The common damage types encountered in the two study areas are loss of apical dominance, broken branches, open wounds, and other decay indicators such fruiting body, conk and advanced decay. Two other damage types found during the study period both in Pulau Laut and Jambi have been suggested for inclusion in the 1999 INDO-FHM issue. These are stem damage due to termite attack, and stem disorder due to woody-vines, excluding cracks and seams and crown damage due to liana which have been included in the 1999 INDO-FHM mentioned. Three level indices have been established based on the severity threshold defined in the 1999 INDO-FHM. These are three-level index, i.e. species-wise

index, plot-level index and area-level index (Pulau Laut and Jambi, in this case). Since both of the study sites are of natural productive forest, it is clearly indicates an evidence for a tendency to develop serious heat-rot problem for the next cutting cycle to come. The information obtained will undoubtedly be of high significance for possible future reorientation of sustainable management of the tropical natural productive forest. It is believed that such a method will also be applicable to plantation forest. Furthermore, the data collected suggest that the residual stands in both study areas are getting worse and worse due to uncontrolled logging activities, coupled with its inherent ecological consequences. Therefore, this report is considered very timely for Indonesian forest condition to propose to authorized agencies to develop the next step of Forest Health Monitoring, the Intensive Site Ecosystem Monitoring (ISEM). Several related indicators seem to compliment each other. Therefore, adopting the method of field data recording for damage indicator as an instrument to assess other forest functions, such as protection forest, anticipative and creative analyses need to be developed wisely and accordingly.

***Key words**: Tropical rainforest, sustainable, forest health, forest damage*

STEM DAMAGE DUE TO LOGGING IN FOREST HEALTH MONITORING

Technical Report No. 18

Simon Taka Nuhamara
Kasno

ABSTRACT

Studies on the impact of the Indonesian Selective Cutting and Replanting System to the residual stand have been carried out in Block Number 751 at PT Asialog Concession Holder in the year of 2000. Damage location, type and severity were recorded as well as the direction and position of the cut trees. Nineteen economically important trees have been assessed. It was found that the cutting of 19 trees affected about 194 trees of economic value, as well as lesser-known species were damaged. The damage types identified were: open wound, broken bole or roots, lost or dead terminal, and broken or dead branches. These mechanical damages due to logging activities are really unavoidable, but efforts to minimize such kinds of damage are compulsory.

***Key words** : Logging, forest damage, dead terminal, broken bole*

ASSESSMENT OF THE CANOPY DENSITY INDICATOR USING THE SPHERICAL DENSIOMETER IN FOREST HEALTH MONITORING

Technical Report No. 19

Supriyanto
Kasno

ABSTRACT

The assessment of canopy density was measured using spherical densiometer, a handy instrument. The results showed that light intensity reaching the forest floor affect very much the forest regeneration and survival rate of seedlings and saplings. The light being blocked heavily from reaching the forest floor affects the natural pruning of seedlings, saplings, and pole stages. Canopy density is complementary to crown parameter, especially crown diameter.

***Key words:** Canopy density, spherical densiometer*

CROWN DAMAGE DUE TO LOGGING IN FOREST HEALTH MONITORING

Technical Report No. 20

Kasno
Supriyanto

ABSTRACT

An investigation on crown damage due to logging was carried out in PT. Asialog, Jambi Province, in 1999. The objectives of the investigation were to identify types of crown damage and to assess the severity of crown damage of the residual stand due to tree felling activities. Three rectangular plots of 10.000 m^2 were established in the logging area (block No. 751) of limited natural production forest. Data on identified trees that would be felled, tree diameter at breast height (dbh), crown size, number of main branches, expected direction of felling of each tree to be felled, and tree density (dbh 10 cm up) were recorded prior to the felling execution. After felling, data collection was made on the actual felling direction, number of trees killed and injured, and types and severity of crown damage due to felling activity. Crown damage classification developed by the USDA Forest Service was followed. The results showed that aside from killing some residual stands, felling activities may cause crown damages. Two types of crown damage were found: loss of apical dominance and broken branches. The deviation of felling direction from expected direction was varied from 0 – 111 with the average of 23; number of trees killed was varied from 2.6 – 9.9% with the average of 6.9%; number of injured trees varied from 4.4 to 15% with the average of 9.4%. The crown damage severity varied from 2-5 of the 0-9 severity classes. There was an indication that higher dbh and bigger crown size has caused more residual stand damage due to felling activities. The broken crown damage type is probably easy to recover, but the loss of apical dominance is believed to cause a lower quality of timber in the long run.

Key words: *Crown damage types, severity, felling activity*

TREND OF SOIL CHEMICAL PROPERTY CHANGES ON FOREST HEALTH MONITORING ACTIVITIES CONDUCTED IN SOUTH KALIMANTAN, JAMBI, AND EAST JAVA

Technical Report No. 21

Chairil Anwar Siregar
Supriyanto

ABSTRACT

Bearing physical, chemical and biological characteristics, the forest soils are typically stable and resilient bodies that are temporarily altered by natural driving forces like fire and flood. However, the effects of perturbations associated with intensive forest management on the soil physical, chemical, and biological properties and long term sustainability are relatively recent problems that have become a global issue. This study is aimed at examining the possible changes in soil chemical properties on selected study areas namely P.T. Sumpol, and P.T. INHUTANI II in South Kalimantan, P.T. Asialog in Jambi, and Perum Perhutani Unit II in Kediri, to monitor the forest health condition within a 4-year period. The decrease in soil organic matter should be viewed vis-à-vis the increase in tree growth indicated by an increase in basal area with time. Changes in soil reaction with time should be examined very carefully because the process may be induced by soil erosion, basic cations leached or absorbed by tree, and the presence of decomposed organic matters. Significant and high correlation between soil organic carbon and other soil chemical properties indicated that all soil chemical properties

examined to judge forest health are of the same importance. Examining the soil pH and soil organic matter changes with time in FHM activity should be related to the changes in basal area representing the tree growth in order to reach better understanding on the status of forest health.

Key words: *Soil fertility, forest health monitoring.*

SITE AND SPECIES SUITABILITY STUDY BASED ON FOREST HEALTH MONITORING ACTIVITIES CONDUCTED IN SOUTH KALIMANTAN, JAMBI, AND EAST JAVA

Technical Report No. 22

Chairil Anwar Siregar
Supriyanto

ABSTRACT

Soil is but one factor of a habitat, representing the region where a plant community naturally grows. Another significant factor that is inherent to habitat is the climate of a site, influencing a wide array of species grown in a given habitat. Hence, climate and soil are the two principal criteria that determine habitat suitability for a particular tree species. In this regard, site and species suitability has been an important forestry study ever since the development of tropical plantation forest was initiated two decades ago. Hence, the objective of this paper is to synthesize habitat suitability of forestry species by employing soil information collected from forest health monitoring activities. The forest health monitoring associated with the soil indicator study was carried out in four study sites namely: PT INHUTANI II in South Kalimantan, and PT Asialog in Jambi, lasting from 1996 to 1999; and PT Sumpol in South Kalimantan and Perum Perhutani Unit II in Kediri, lasting in 1999. A summary of the synthesis of species and habitat suitability is proposed. It covers 49 tree species mostly grown in tropical areas with altitude ranging from 0 to 3000 meters above sea level, receiving average annual rainfall varying from 500 to 5000 mm, and with soil reaction that is mostly acidic bearing generally low status of chemical fertility as in the case of typical tropical soils.

Key words: *Soil, habitat suitability, forest health monitoring, tropical species*

STAND STRUCTURE (STATUS, CHANGE, TRENDS)

Technical Report No. 23

Supriyanto
Ujang Susep Irawan
Erianto Indra Putra
I Wayan Susi Dharmawan

ABSTRACT

A natural forest ecosystem is health if the structure of the stand represents different classes of diameter (seedling, sapling, pole and tree stages). The changes of structure can be resulted from the diameter growth over the time. While the trend of stand structure depends on the stressors influencing the growth, either natural or human induced stressors. To study the stand structure, FHM cluster plots were established in different forest stand: natural forest, secondary forest (seed production areas) and plantation forests. The FHM cluster plot model followed the Forest Health Monitoring: Field Methods Guide (International – Indonesia) issued by EPA (1997). Data was collected for 5 years. The result showed that the diameter distribution in natural and logged-over forest follows the classical inverse-J distribution, while in plantation forest follows normal curve

distribution, over the period of measurement. The trees within the diameter 20 to 40 cm dominated the diameter growth of the stand either in Pulau Laut or in Jambi. The diameter growth of the trees higher than 40 cm in diameter was very slow. The ratio between saplings, poles and nucleus trees and mature trees was 238:12: 36: 12 in Pulau Laut, while in Jambi was 1501: 23: 68: 12, respectively. The number of mature trees (50 cm up) in Pulau Laut and Jambi shows the same trends (12 trees/ha). The trees within the diameter 20 – 29.9 cm dominated the mortality. The stand structure changes in seed production area were significantly affected by silvicultural treatment to stand (thinning). The number of seedling, sapling and pole decreased significantly, and finally tends to be dominated by the nucleus trees producing the seeds. The stand structure in Dipterocarps plantation (planted in 1976) is distributed from 15 – 45 cm and dominated by the diameter 25 – 30 cm. Seedling, sapling and pole from the regeneration was not found. There will be some seedlings when the trees start bearing the seeds.

Key words : *Stand structure, logged-over forest, sapling, pole, nucleus tree*

REGENERATION AND MORTALITY

Technical Report No. 24

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ABSTRACT

One group of criteria to be addressed in INDO-FHM is environmental criteria, which will address biodiversity composition, abundance, habitat suitability and ecosystem processes (growth, regeneration, mortality, stand structure) and productivity. Regeneration and mortality plays important role in the sustainable forest management, especially in uneven age natural forest. Regeneration and mortality were measured in INDO-FHM plots in Pulau Laut and Jambi. The ratio between saplings, poles and nucleus trees and mature trees was 238:12:36:12 in Pulau Laut, while in Jambi was 1501:23:68: 12, respectively. The number of mature trees (50 cm up) in Pulau Laut and Jambi shows the same trends (12 trees/ha). The trees within the diameter 20 – 29.9 cm dominated the mortality. The mortality rate in Pulau Laut was 35% - 63.7% (Saplings) 19.29% (poles), 8.21 % (trees). The mortality rate in Jambi was 0.9% - 2.8% (Sapling), 20.49% (poles) and 19.28 % (trees). The mortality rate due to fire was 100% (seedlings), 50% - 100% (saplings) 27.06% (poles), 37.18% (trees). The mortality of sapling, poles and trees in Dipterocarps plantation was not found during the period of measurement.

Key words : *Regeneration, mortality, natural forest, sustainable forest management.*

ASSESSMENT ON THE MODIFICATION OF FHM VEGETATION QUADRATES TO ADDRESS TROPICAL SPECIES DIVERSITY OF TREES

Technical Report No. 25

Uhaedi Sutisna
Erianto Indra Putra
Soekotjo
Djoko Marsono

ABSTRACT

Implementation of FHM technology should accommodate the difference in species diversity between tropical and temperate forests. Therefore, it is important to conduct

initial evaluation of FHM vegetation quadrates to address tropical species diversity of trees. The initial evaluation was conducted upon the establishment of minimum sample area plots in Jambi, Sumatera, and in Pulau Laut, South Kalimantan. Pulau Laut represents the small island ecosystem with limited species diversity, while Jambi, Sumatera, represents the big island ecosystem with high species diversity. The result showed that the minimal sample area (MSA) cannot be derived both in Jambi which only covered an area of 25.600 m^2 and in Pulau Laut with only an area of 6400 m^2. Referring to the experiment done by Ashton (1965), the extent of diversity in Jambi will require an MSA of at least four or five hectares. The MSA cannot be implemented at Pulau Laut since the community is dominated by one species (*Shorea polyandra*). Since the MSA cannot be used as a modification of FHM vegetation quadrates, the FHM cluster plot design cannot be modified to meet the tropical species diversity both in the high diversity forest (association type) and in forest with dominance of one species (consociation type). The implementation of FHM cluster plot design at plantation forest can be adopted as it is, since the biodiversity in this area is very limited. In contrast, in the case of areas with high tree species diversity (association type), additional number of the cluster plot should be considered. It means that 4-5 FHM cluster plots must be established for each association type to meet the high species diversity in the tropic.

***Key words**: Minimal sample area, species diversity, consociation type, association type*

A STUDY OF SOIL AND VEGETATION DOMINATED BY *Shorea polyandra* ON FOREST HEALTH MONITORING PLOTS IN PULAU LAUT

Technical Report No. 26

Chairil Anwar Siregar
Supriyanto

ABSTRACT

Shorea polyandra, one of the important merchantable trees, is being excessively logged either legally or illegally in Pulau Laut, South Kalimantan, these days. The work described in this paper was carried out with the objective of analyzing some important soil-related characteristics with reference to *S.polyandra* vegetation occurring at altitude ranging from lowland to upland forest through the implementation of forest health monitoring plots established in plantation forest, production forest, and protection forest in Pulau Laut. The trend of soil reaction was altered toward more acidic over time. The decrease in soil organic carbon and total nitrogen were also apparent. Soil pH and soil organic carbon decreased with the decrease in topographical position in most cases. The decrease in soil pH and soil organic carbon as well may also be due to changes in management regime of the study site in which cluster 2 vegetation was still covered by relatively dense *Shorea* trees, while the vegetation existing in cluster 1 was logged over area (logged in 1978), and cluster 3 was a 25-year old *Shorea polyandra* plantation. The difference in solum thickness, genetic part of the soil, among the three representatives of soil profile is obvious in which the solum thickness was least on high altitude and on steep slopes as it occurred in Cluster 2. It turned out to be thicker in lower altitude as it occurred in clusters 1 and 3 successively. In 1996, *Shorea polyandra* appeared to be dominant in Clusters 1, 2, 3, and 7, meanwhile *D. caudiferus* turned out to be relatively dominant in clusters 4, 5, and 6. In 2000, however, distribution of *S. polyandra* tremendously decreased and remained to be dominant in Clusters 1, 2, 3, and 7.

***Key words: Shorea polyandra,** soil organic carbon, logged over area.*

ASSESSMENT OF SOCIO-ECONOMIC AND CULTURAL INDICATORS OF FOREST HEALTH MONITORING

Technical Report No. 27

Bahruni
Dudung Darusman
Erianto Indra Putra
Djohan Setiawan

ABSTRACT

The indicators of well-managed forest ecosystem must be equally defined by the environmental, economic as well as social attributes. The objective of this study is to assess the socio-economic and cultural indicators in the Forest Health Monitoring program. A survey was conducted at four villages in Pulau Laut and one in Jambi. Data and information were collected in the form of verifiers or parameters using the survey and non-survey method (focused group discussion). This study showed that forest dwellers are generally dependent on the forest resources for their livelihood. They are aware that forest timber and non-timber products tend to be exhausted or even will be used up in the near future as a result of damages caused by forest fire and illegal cutting. Since most of the forest dwellers knew the FMU boundaries, less conflict occurred about the forest boundaries as found in Pulau Laut. The economic situation, however drives them to do illegal cutting and illegal log skidding, and transport the logs away. Moreover, the inability of the local community to face illegal loggers and the lack of a sense of belonging or collective interest between forest dwellers and FMU had implication on the unconditional effort to protect the forest. Another important aspect was the effort of both parties, FMU and the local community, to meet their mutual interest. The forest dwellers' well-being score in PT Asialog, Jambi, was higher than that in PT INHUTANI II, Pulau Laut i.e. 6.660 and 5.468, respectively. It was assumed that meetings between FMU and forest dwellers near the Asialog forest were more frequently conducted than in Pulau Laut. The lowest score in Pulau Laut was derived from the number of conflicts that occurred between FMU and the forest dwellers concerning the forest boundaries, and the illegal logging surrounding the FMU forest.

***Key words**: FMU, forest dwellers, forest resource, forest boundaries, criteria and indicators of sustainable forest management, forest dwellers' well-being score*

ASSESSMENT ON CROWN INDICATORS OF FOREST HEALTH MONITORING

Technical Report No. 28

Kasno
Supriyanto
Simon Taka Nuhamara
Erianto Indra Putra
I Wayan Susi Dharmawan

ABSTRACT

A study on the assessment on crown indicators for Forest Health Monitoring (FHM) as part of INDO-FHM project was carried out through two ways namely: by means of field work and training course implementations. This study was mainly aimed at testing crown as one of indicators of forest sustainability and applicability of the FHM method as applied to Indonesian tropical rain forest. The study has other objectives: to investigate the possible correlation of crown parameters to other groups of parameters, and to know the

status of crown conditions and possible changes as well as trends within three years assessment period in the study sites. It was proven that crown is one of important indicators of forest sustainability. Meanwhile, crown parameters such as crown diameter, live crown ratio, crown density, foliage transparency and crown dieback, may reflect forest health. In assessing forest stand dynamics and stand structure, crown parameters may be complementary to canopy parameters. In assessing forest tree vitality/vigor, crown parameters may be complementary to damage parameters. In assessing growth/productivity, crown size may be complementary to stem diameter/basal area. Crown parameter assessment as part of FHM method may be applicable on Indonesian tropical rain forest. Circular plot with radius 7.32 m, being used to assess crown conditions of a forest stand, is appropriate enough instead of larger plot.

***Key words**: Crown, indicator, parameter, health, vigor*

EARLY WARNING OF CHANGES IN CANOPY CONDITION OF OVERSTORY TREES

Technical Report No. 29

Kasno
Simon Taka Nuhamara
Supriyanto
Uhaedi Sutisna
I Wayan Susi Dharmawan

ABSTRACT

A study on the possible early warning of changes in canopy condition of overstory trees was carried out by overlaying INDO-FHM cluster plots on NFI cluster plots in the areas of PT. Sumpol Timber, South Kalimantan, and PT Asialog, Jambi. The objectives of this study were to evaluate the effectiveness of selected indicators, and to investigate the possible complementary of INDO-FHM method on NFI method in assessing the sustainability of Indonesian tropical rain forest. The results showed that the INDO-FHM method may provide significant contribution to NFI method in assessing the sustainability of Indonesian tropical rain forest. The inclusion of crown diameter as a crown indicator in the detection and monitoring program may indicate basal area, while the life crown ratio may indicate stand density. To obtain a sensitive image in the detection of early warning changes on canopy condition, the use of better technology, such as radar photography, is needed, and therefore is recommended.

***Key words**: Canopy, indicator, growth, crown*

ANNEX 2
LIST OF PARTICIPANTS OF FOREST HEALTH MONITORING TRAINING COURSES

No	Name	Address
1. Introductory Training of Forest Health Monitoring, Jambi 10-20 July 1995		
1	Prof. Dr. Soekotjo	SEAMEO-BIOTROP, Bogor
2	Dr. Setyono	Faculty of Forestry, Gadjah Mada University
3	Dr. Burhanuddin Sarbini	Directorate General of Forest Inventory and Land Use Planning, MOF
4	Dr. Supriyanto	SEAMEO BIOTROP
5	Mr. Transtoto Handadhari, MSc.	Directorate General of Forest Inventory and Land Use Planning, MOF
6	Mr. Agung Setyabudi, MSc.	Directorate General of Forest Inventory and Land Use Planning, MOF
7	Mr. S.Y. Chrystanto	Directorate General of Forest Inventory and Land Use Planning, MOF
2. Training Workshop on Forest Health Monitoring to Monitor the Sustainability of Indonesian Tropical Rain Forest, Bogor. 6-20 September 1996		
1	Prof. Dr. Soekotjo	SEAMEO-BIOTROP, Bogor
2	Dr. Setyono	Faculty of Forestry, Gadjah Mada University
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4	Prof. Dr. Dudung Darusman	Faculty of Forestry, Bogor Agricultural University
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7	Dr. Supriyanto	SEAMEO-BIOTROP, Bogor
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9	Dr. Ngaloken Gintings	Forest and Nature Conservation Research and Development Center, Bogor
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14	Mr. Teddi Setiadi	Directorate General of Forest Inventory and Land Use Planning, MOF

No	Name	Address
15	Mr. Winarto	Planing Bureau PT INHUTANI II Unit Pulau Laut, South Kalimantan
3. Training Course on Forest Health Monitoring for the Indonesian Crews, Yogyakarta, 14-25 July 1997		
1	Mr. Transtoto Handadari	Regional Forest Inventory and Planning Office Unit V, MOF, Banjarbaru, South Kalimantan
2	Mr. Masyhud	Directorate General of Forest Inventory and Land Use Planning, MOF
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7	Mr. Otong Sukmana	Directorate General of Forest Inventory and Land Use Planning, MOF
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14	Mr. Kholid	Regional Forest Inventory and Planning Office Unit V, MOF, Banjarbaru, South Kalimantan
15	Mr. Muzakir	Regional Forest Inventory and Planning Office Unit VI, MOF, Manado, North Sulawesi
16	Mr. Sahabuddin	Regional Forest Inventory and Planning Office Unit VII, MOF, Ujung Pandang, South Sulawesi
17	Mr. Herry Subanul Hoer	Regional Forest Inventory and Planning Office Unit VIII, MOF, Denpasar, Bali
18	Mr. Elpis Panggabean	Regional Forest Inventory and Planning Office Unit X, MOF, Jayapura, Irian Jaya
19	Mr. Winarto	PT INHUTANI II, Pulau Laut, South Kalimantan
20	Dr. Hariyanto Dwi Prabowo, MSc.	CIFOR, Bogor

No	Name	Address
21	Mr. Eko Warsito, MSc.	Faculty of Forestry, Gadjah Mada University
22	Mr. Amalyos	Directorate General of Forest Utilization, MOF, Jakarta
4. Training Course on Forest Health Monitoring Field Plot Survey Procedures, Bogor, 19-23 August 1998 and Tawangmangu, 24-28 August 1998		
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16.	Mr. Soni Tjahjadi, MM	Sub-Directorate of Technical Cooperation Directorate General of Forest Inventory and Land Use Planning, MOF, Manggala Wanabakti Bld., Jakarta
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5. Training Course on Forest Health Monitoring for the Southeast Asian Scientist, Bogor, 2 – 13 August 1999		
1	Mr. Herban Heryandana	Planning Agency for Forestry and Estate crops Manggala Wanabakti Bld. Jl. Jend. Gatot Subroto, Jakarta, Indonesia
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No	Name	Address
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6. Training Course on Forest Health Monitoring Techniques for the Indonesian Crews, Bogor, 6-9 August 1999 and Kediri, 10 – 15 August 1999		
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11	Mr. Irwan Hermawan, A. Md	Center for Forest Mapping, MOF, Jakarta
12	Mr. Bambang Catur Wahyudi	Perum Perhutani Forest State Company
13	Ms. Triastuti Nugraheni,SHut	Forest Planning, MOF, Jakarta
14	Mr. Herryman, BScF	Center for Forest Development, MOF, Jakarta
15	Mr. Zaenal	Center for Forest Resources, MOF, Jakarta
7. Training Course on Forest Health Monitoring : Criteria and Indicators for Tropical Rain Forest, Bogor, 2-13 August 2000		
1.	Mr. Seng Eang Samraing	Royal University of Agriculture Faculty of Forestry Sciences, Phnom Penh Cambodia
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ANNEX 3
ONE-DAY WORKSHOP LEI-BIOTROP-CIFOR
BOGOR, 3 MARCH 1999

1. Recommendations

One-day Workshop in the frame of developing collaboration among ITTO projects was carried out by SEAMEO BIOTROP, LEI (Indonesian Ecolabelling Institute), and CIFOR on 3 March 1999 at SEAMEO BIOTROP, Bogor. It was officially opened by Dr. Efransjah, the ITTO Representative. Keynote address was delivered by Dr. Untung Iskandar, Head of Bureau of International Cooperation and Investment, Ministry of Forestry.

The workshop was participated by 42 participants coming from different institutions i.e. Bureau for International Cooperation and Investments; Directorate General of Forest and Estate Crops Planning Agency, Ministry of Forestry; Indonesian Ecolabelling Institute (LEI); ITTO Representative; CIFOR; National Logistics Agency; Faculty of Forestry, Bogor Agricultural University; and BIOTROP.

The objective of the workshop were as follows :

1. To create a cooperative frame work among the project funded by the ITTO
2. To facilitate the information exchange on criteria and indicators studied by LEI, BIOTROP and CIFOR

The recommendations of the workshop are :

1. To adopt the criteria and indicators on FHM (Forest Health Monitoring) study proposed by BIOTROP team complementing to the study conducted by LEI and CIFOR toward sustainable forest management as determined by TTTO
2. To suggest the existence of networking among ITTO funded projects.

2. List of Participants

No.	Name	Institution
1	Dr. Efransjah	ITTO, Yokohama, Japan
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3	Dr. Benni Sormin	Bureau for International Cooperation and Investments, MOF, Jakarta
4	Mr. Prabianto, MSc.	Bureau for International Cooperation and Investments, MOF, Jakarta
5	Mr. Hardjono, M.Eng.	Bureau for International Cooperation and Investments, MOF, Jakarta

No.	Name	Institution
6	Mr. Yogi S. Halim	Bureau for International Cooperation and Investments, MOF, Jakarta
7	Mr. S. Y. Chrystanto	Directorate General of Forest Planology, MOF, Jakarta
8	Mr. Agus Justianto, MSc.	Technical Cooperation and Development, Directorate General of Forest Planology, MOF, Jakarta
9	Mr. Ishak Sumantri, MSc.	Directorate General of Forest Planology, MOF, Jakarta
10	Mr. Edi Suharno, MM	Technical Cooperation and Development, Directorate General of Forest Planology, MOF, Jakarta
11	Mr. Hudoyo	Directorate General of Forest Planology, MOF, Jakarta
12	Dr. Lini Wollenbergh	CIFOR, Bogor
13	Dr. Kuswata Kartawinata	CIFOR, Bogor
14	Mr. Ismayadi Samsoedin	CIFOR, Bogor
15	Dr. Douglas Sheil	CIFOR, Bogor
16	Dr. Plinio Sist	CIFOR, Bogor
17	Ms. Nining Liswanti	CIFOR, Bogor
18	Dr. Hariyatno D.	CIFOR, Bogor
19	Dr. Chairil Anwar Siregar	Forest Research Development and Nature Consevation Agency, Bogor
20	Mr. Uhaedi Sutisna	Forest Research Development and Nature Consevation Agency, Bogor
21	Mr. Machfudh	Forest Research Development and Nature Consevation Agency, Bogor
22	Mr. Daru Asycarya	Indonesian Ecolabelling Institute, Jakarta
23	Mr. M. Buce Saleh	Indonesian Ecolabelling Institute, Jakarta
24	Mr. Haryanto R. Putro	Indonesian Ecolabelling Institute, Jakarta
25	Mr. S.Taka Nuhamara, MS	Faculty of Forestry, Bogor Agricultural University, Bogor
26	Prof. Dr. Sitanala Arsyad	Director, SEAMEO BIOTROP, Bogor
27	Dr. Imelda C. Stuckle	Deputy Director for Program and Marketing, SEAMEO BIOTROP, Bogor
28	Dr. Supriyanto	SEAMEO BIOTROP, Bogor
29	Dr. Soekisman T.	SEAMEO BIOTROP, Bogor
30	Mr. Syukri M. Nur, MSi.	SEAMEO BIOTROP, Bogor
31	Mr. Widharto	SEAMEO BIOTROP, Bogor
32	Mr. Yahya Kartana	SEAMEO BIOTROP, Bogor
33	Mr. Kasno, MSc.	SEAMEO BIOTROP, Bogor
34	Mr. Syamsul A. Yani, MSi.	SEAMEO BIOTROP, Bogor
35	Mr. Sunjaya	SEAMEO BIOTROP, Bogor
36	Mr. Syaeful Ichwan	SEAMEO BIOTROP, Bogor
37	Mr. Djohan Setiawan	SEAMEO BIOTROP, Bogor
39	Mr. Erianto Indra P.	SEAMEO BIOTROP, Bogor
38	Mr. Ujang S. Irawan	SEAMEO BIOTROP, Bogor
40	Mr. I Wayan S. Dharmawan	SEAMEO BIOTROP, Bogor
41	Mr. Nurdin	Bogor Agricultural University
42	Mr. Agus Indiarto	National Logistics Agency, Jakarta

ANNEX 4
ONE-DAY SEMINAR ON FOREST HEALTH MONITORING
BOGOR, 8 MARCH 2000

1. Recommendations

The seminar was participated by 43 participants coming from different institutions i.e. Bureau for International Cooperation and Investments; Directorate General of Forest and Estate Crops Planning Agency, Ministry of Forestry; Forest Research Development and Nature Conservation Agencies, Ministry of Forestry; Regional Forest Inventory and Planning Offices, Ministry of Forestry; ITTO Representative; PT. INHUTANI I and PT. INHUTANI II Forest State Companies; CIFOR; MIT; Faculty of Forestry, Bogor Agricultural University; and BIOTROP.

The objective of the seminar were as follows:

1. To discuss the research results of Forest Health Monitoring to Monitor the Sustainability of Indonesian Tropical Rain Forest.
2. To disseminate the information on selected indicators used in Forest Health Monitoring to assess the forest sustainability.

The recommendations of the seminar are:

1. Forest Health Monitoring is accepted as a method for assessing forest ecosystem health with regard to the criteria and indicators of Sustainable Forest Management defined by ITTO.
2. FHM method is complementary to NFI method in assessing the sustainable forest management.
3. FHM and NFI programs should work synergitically in detection monitoring program.
4. To implement the FHM in a specific ecosystem or management unit, research on Intensive Site Ecosystem Monitoring (ISEM) should be made.

2. List of Participants

No.	Name	Institution
1	Dr. Efransjah	ITTO, Yokohama, Japan
2	Dr. Burhanuddin Sarbini	Directorate General of Forest Planology, MOF, Jakarta
3	Mr. Deka Mardiko, MSc.	Directorate General of Forest Planology, MOF, Jakarta
4	Mr. Agus Justianto, MSc.	Technical Cooperation and Development Directorate General of Forest Planology, MOF, Jakarta
5	Mr. Hudoyo, MM	Technical Cooperation and Development, Directorate General of Forest Planology, MOF, Jakarta

No.	Name	Institution
6	Mr. Edi Suharno, MM	Technical Cooperation and Development, Directorate General of Forest Planology, MOF, Jakarta
7	Mr. Moch. Firman Abada	Directorate General of Forest Planology, MOF, Jakarta
8	Mr. Iman Nuryanto, MSc.	Directorate of Social Forestry, Directorate General of Forest Planology, MOF, Jakarta MOFEC, Jakarta
9	Mr. Iman Santoso, MSc.	Directorate General of Forest Planology, MOF, Jakarta
10	Mr. Hardjono, M.Eng	Bureau for International Cooperation and Investments, MOF, Jakarta
11	Dr. Silver Hutabarat	Directorate General of Forest Utilization, MOF, Jakarta
12	Dr. Bambang Mardi R.	Directorate of Estate Crops, MOF
13	Mr. M. Asari, MSc.	Center for Planning, Bureau for International Cooperation and Investments, MOF, Jakarta
14	Mr. B. Benny H.	Regional Forest Inventory and Planning Office, Palangkaraya, South Kalimantan
15	Dr. Chairil Anwar Siregar	Forest Research Development and Nature Consevation Agency, Bogor
16	Mr. Uhaedi Sutisna	Forest Research Development and Nature Conservation Agency, Bogor
17	Mr. Judi	Forest Research Development and Nature Conservation Agency, Bogor
18	Mr. Omon Mulyana, MSc.	Forest Research Development and Nature Conservation Agency, Bogor
19	Prof. Dr. Sitanala Arsyad	Director, SEAMEO BIOTROP, Bogor
20	Dr. Imelda C. Stuckle	Deputy Director for Program and Marketing, SEAMEO BIOTROP, Bogor
21	Dr. Supriyanto	SEAMEO BIOTROP, Bogor
22	Prof. Dr. Irene M. Umboh	SEAMEO BIOTROP, Bogor
23	Mr. Kasno	SEAMEO BIOTROP, Bogor
24	Dr. Soekisman T.	SEAMEO BIOTROP, Bogor
25	Mr. Djohan Setiawan	SEAMEO BIOTROP, Bogor
26	Mr. Subiyantoro	SEAMEO BIOTROP, Bogor
27	Mr. Sunjaya	SEAMEO BIOTROP, Bogor
28	Mr. Syukri M. Noor, MSi	SEAMEO BIOTROP, Bogor
29	Mr. Erianto Indra P.	SEAMEO BIOTROP, Bogor
30	Mr. Ujang S. Irawan	SEAMEO BIOTROP, Bogor
31	Mr. I Wayan S. Dharmawan	SEAMEO BIOTROP, Bogor
32	Prof. Dr. Soekotjo	SEAMEO BIOTROP, Bogor
33	Mr. S. Taka Nuhamara, MS.	Faculty of Forestry, Bogor Agricultural University, Bogor
34	Dr. Ir. Irsyal Yasman	PT INHUTANI I, Forest State Company, Jakarta
35	Ms. Rosilawati	PT INHUTANI II, Forest State Company, Jakarta
36	Mr. Sunarno	PT INHUTANI II, Forest State Company, Jakarta
37	Ms. Eva Achmad	MIT Student, BIOTROP, Bogor
38	Mr. Didik Santoso	MIT Student, BIOTROP, Bogor
39	Mr. Janntorn Boonyanuphap	MIT Student, BIOTROP, Bogor
40	Mr. Tint Khaing	MIT Student, BIOTROP, Bogor
41	Mr. Markum	MIT Student, BIOTROP, Bogor
42	Ms. Ani Widyastuti	MIT Student, BIOTROP, Bogor
43	Mr. Ridwan	MIT Student, BIOTROP, Bogor

ANNEX 5
FHM TRAINING CURRICULUM

The summary of FHM training curriculum are as follows :

I. Introduction to Forest Health Monitoring

II. Criteria and Indicators of Sustainable Forest Management

III. FHM Methodology

3.1. Forest Mensuration
- Plot Establishment : Plot Identification ; Condition Classification ; Site-Tree Data ; Point Description ; Boundary Delineation
- Tree Stand Growth, in Growth, Mortality ; Forest Regeneration ; Stand Structure ; Site Productivity
- Microplot Understory Vegetation : Moss ; Lichens ; Ferns ; Herbs ; Shrubs ; Vines
- Microplot Tree Data : Seedlings ; Saplings
- Subplot and Annular Plot Tree Data
- Species Coding
- Offset Procedures

3.2. Crown Condition Classification
Crown Diameter Measurements ; Assessment on Live Crown Ratio, Crown Density, Crown Dieback, Foliage Transparency, Canopy density; Field Crew Organization

3.3. Damage and Catastrophic Mortality Assessment
Location of Damage; Type of Damage ; Severity of Damage

3.4. Vegetation structure
Plant Sample Collection, Preservation, Identification and Storage ; Quadrat Sample Area Establishment ; Vegetation Structure Measurements

3.5. Soil Measurement and Sampling
Soil Sampling Points ; Sample Collection ; Soil Organic Layer ; Soil Mineral Surface Layers ; Erosion Measurements ; Laboratory Analysis

3.6. Socio-economic and Cultural Aspects
Socio-economic and Cultural Indicators ; Data and Information Collection and Analyzes

IV. Database Management for FHM
Tally Sheet ; Portable Data Recorder ; FHM Database

V. Quality Assurance and Data Analysis

ANNEX 6
PHOTO COLLECTIONS AND PROJECT LOCATION MAP

PLATE 1 : Agreement Project PD 16/95 Rev. 2 (F) on Forest Health Monitoring

Agreement was signed by Prof. Dr. Soekotjo, former Director of SEAMEO BIOTROP (A, left) and Dr. B.C.Y. Freezailah , Executive Director of ITTO (A, middle) and was witnessed by Mr. Djamaludin Suryohadikusumo, the Minister of Forestry, the Republic of Indonesia (A, right) and Mr. Sumohadi, Director General of Forest Inventory and Land-use Planning (B, right).

PLATE 2 : Initiator of INDO-FHM in Indonesia

Prof. Dr. Soekotjo was the initiator of INDO-FHM in Indonesia (A), and Dr. E. Zemeka, ITTO Representative, did field evaluation (B)

PLATE 3 : Project Management

Project Steering Committee meeting for monitoring and evaluation was chaired by Dr. Untung Iskandar (A). Seminar of research results on INDO-FHM (B) and Project Steering Committee meeting on presentation of Completion Report (C)

PLATE 4: Training Workshop for the Indonesian Scientists

Opening address by Mr Sumohadi, the Director General of Forest Inventory and Land use Planning (A), keynote address by Dr. L. Hunter, the ITTO representative (B), Training Workshop participants (C).

PLATE 5 : Field Training for the Indonesian Scientists by the US-FHM Team

Training on plot establishment by Dr. K. Stolte (A), training on crown indicator by Dr. M. Mielke (B), training on soil indicator by Prof. Dr. Palmer (C)

PLATE 6 : First Training Course on FHM for the Southeast Asian Scientists

Training participants (A,C), opening address by Mr. Roedjai Djakaria , the Director General of Forest Inventory and Land-use Planning (B, left), field work was conducted at Gede-Pangrango National Park (C), participants working in the field for canopy density measurement (D), species identification (E), and FHM data-base laboratory (F)

PLATE 7 : Training Course on FHM for the Indonesian Crew

Training participants (A), opening adrees by Mr. Imam Nuryanto, on behalf of the DG of Forest Inventory and Land-use Planning (B), welcome address by Dr. Imelda C. Stuckle, the Deputy Director for Program and Marketing SEAMEO BIOTROP (C), participants activity in the class instructed by Prof. Dr. Soekotjo (D), data processing (E) and micro plot establishment (E)

PLATE 8 : Second Training Course on FHM for the Southeast Asian Scientists

Training participants (A), reporting on INDO-FHM activities by Dr. Supriyanto, Chairman of INDO-FHM (B), welcome address by Prof Dr. Sitanala Arsyad, Director of SEAMEO BIOTROP (C), opening address by Dr. Burhanuddin Sarbini on behalf of the DG of Forest Inventory and Land-use Planning, MOF (D). Participant activity in the class instructed by Dr. C.A. Siregar (E) and plot establishment in Gede Pangrango National Park (F)

PLATE 9 : Plot Establishment

Briefing was given prior to data collection and measurement (A). Compassing the direction from the reference point (B), center plot 2 of cluster plot 1 (C) and establishment of plot boundary (D)

PLATE 10 : Forest Mensuration in Demonstration Plots

Tracing the hidden center plot (A), measuring the canopy density using the spherical densiometer (B) , measuring the DBH in the plantation forest (C) and in natural forest (D)

PLATE 11 : Research on Biodiversity Indicator

Micro plot establishment in natural forest (A), seedling of *Shorea polyandra* in Natural Forest at Pulau Laut (B), fern community (C), moss community (D). Micro plot design (E) and seedling counting (F) by the indicator leader, Mr. Uhaedi Sutisna.

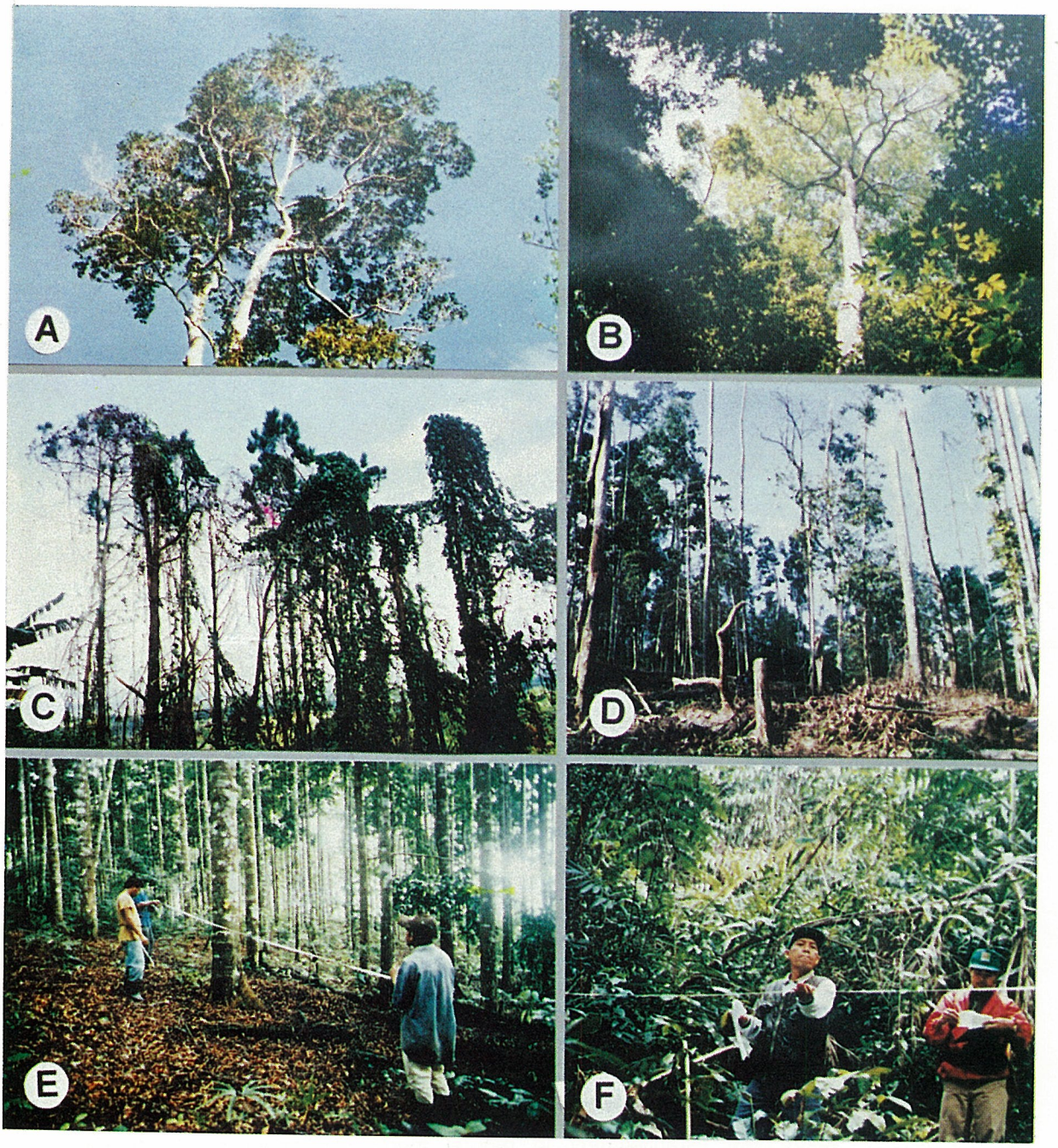


PLATE 12 : Research on Crown Indicator

Crown shape of mature tree (A) and young tree (B). Crown damage due to lianas (C) and due to logging (D). Crown diameter measurement in plantation forest (E) and in natural forest (F)

PLATE 13 : Research on Damage Indicator

Tree damage can be caused by galls (A), lianas (B), insects (C), conk (D), and human activities (E). Damage indicator leader, Mr. S.T. Nuhamara, taking note (F).

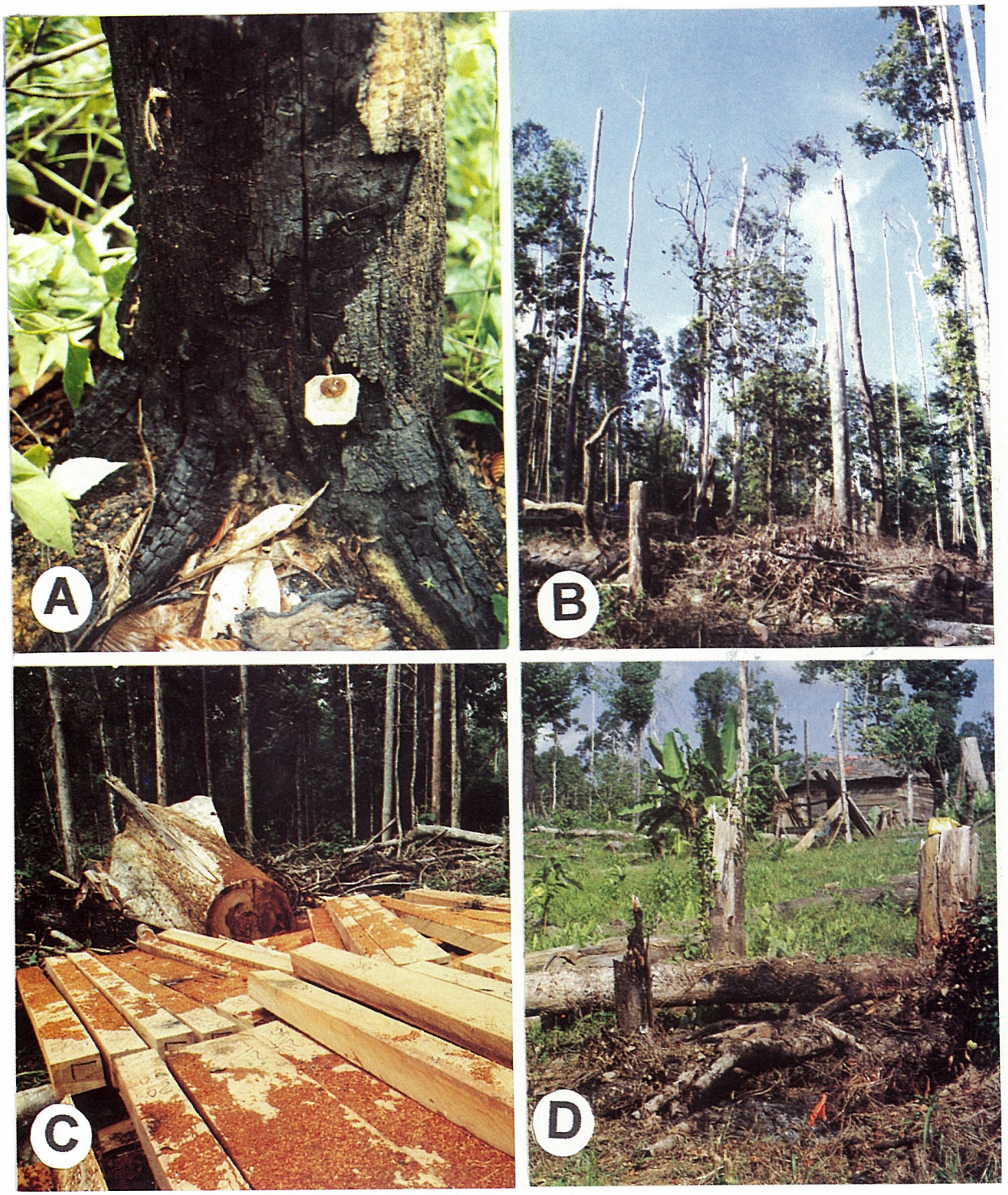


PLATE 14 : Cluster Plot Disturbances

INDO-FHM cluster plot number 4, 5, and 6 in Pulau Laut was destroyed by forest fire (A), illegal logging (B, C) and forest encroachment (D)

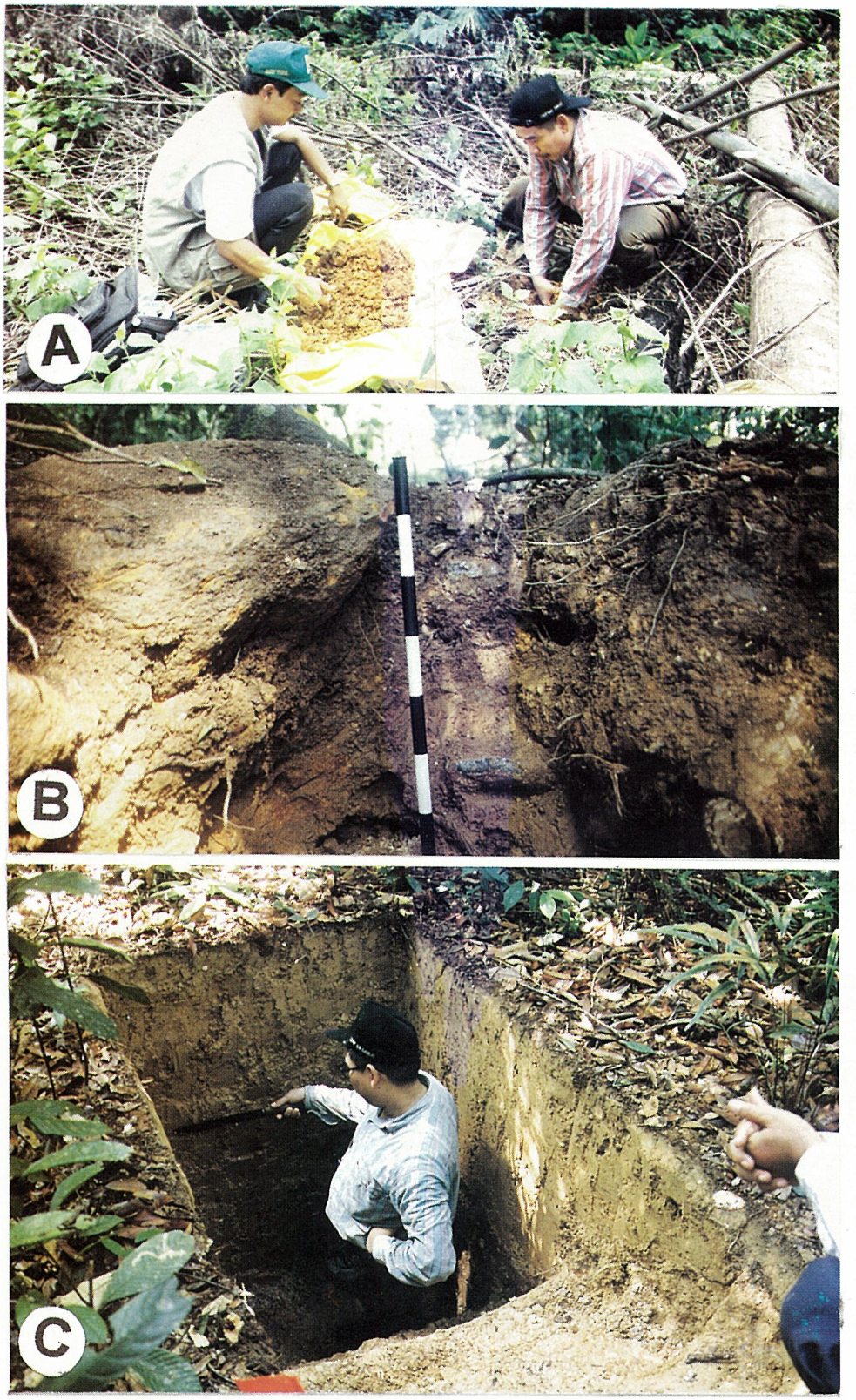


PLATE 15 : Research on Soil Indicator

Soil sampling collection in Jambi (A). Soil profile in Pulau Laut (B), and soil profile identification in Jambi by Dr. C.A. Siregar, Soil indicator leader (C)

PLATE 16 : Survey on Socio Economic Indicator

Survey to the forest manager (A), logger (B) and farmers (C) in Pulau Laut

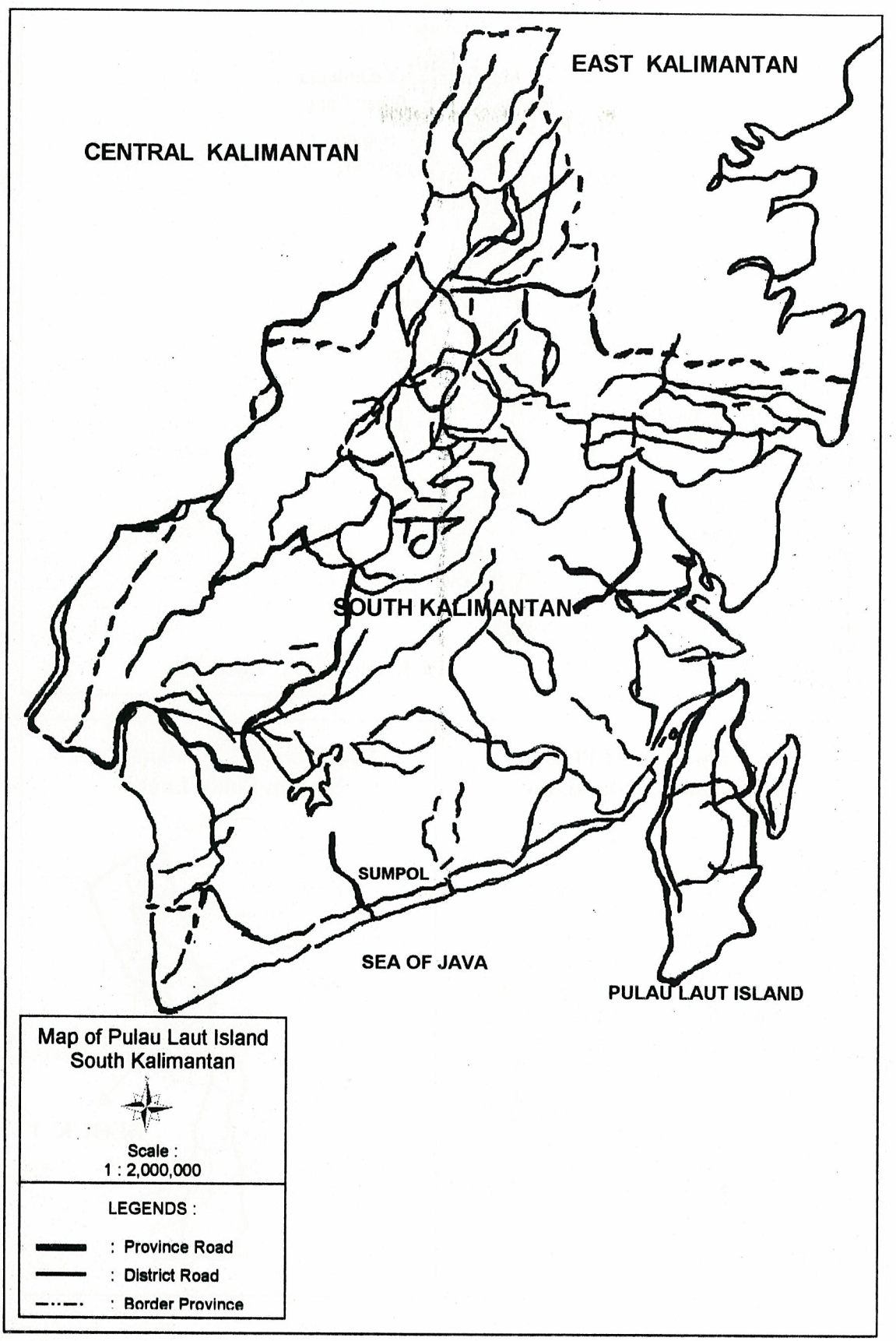
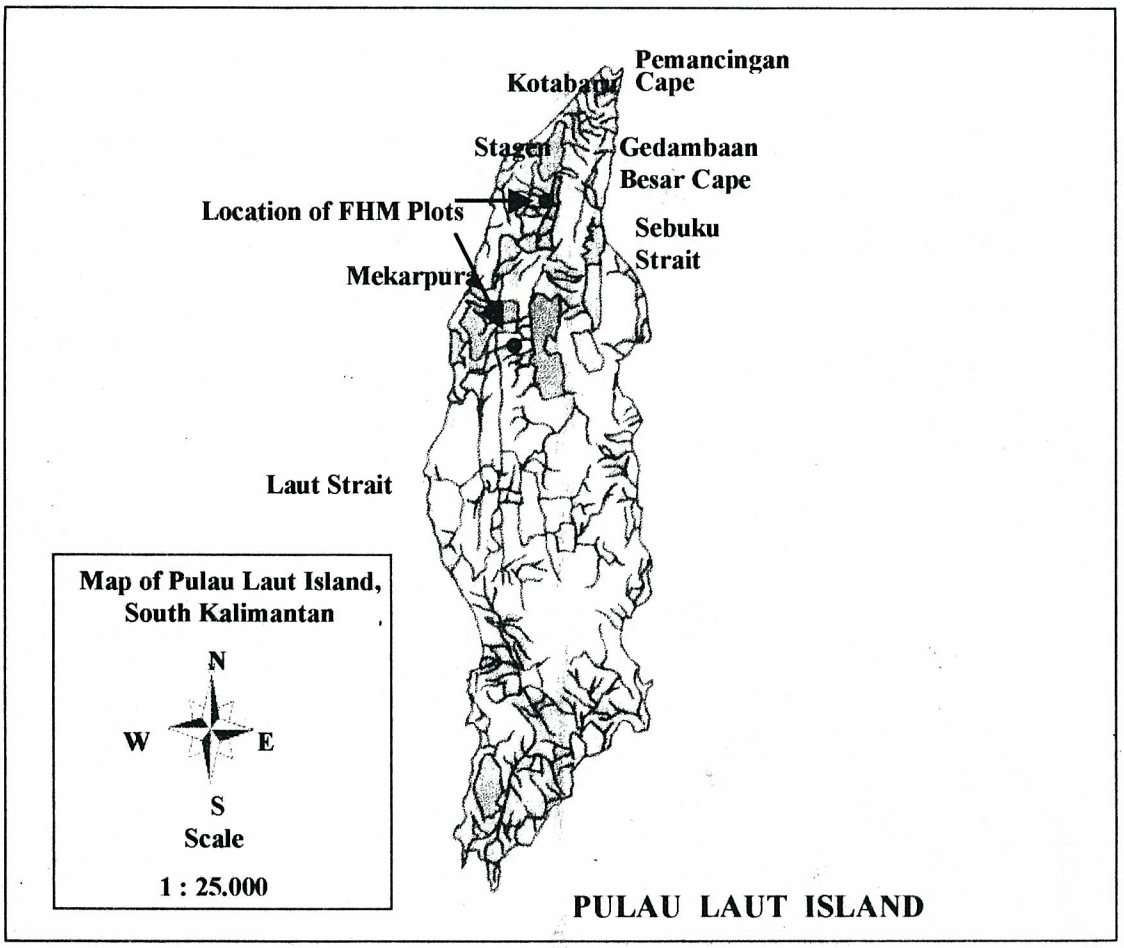


PLATE 17 A. Map of South Kalimantan



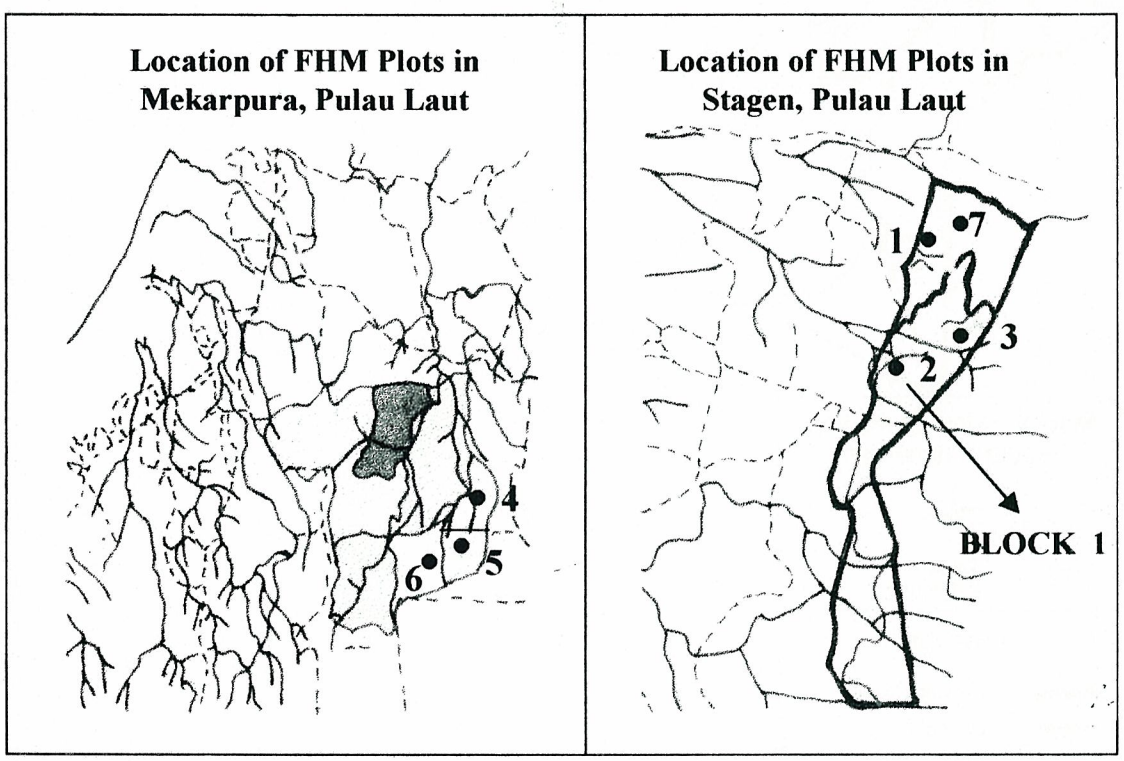


PLATE 17 B. Location of FHM Plots in Mekarpura and Stagen, Pulau Laut, South Kalimantan

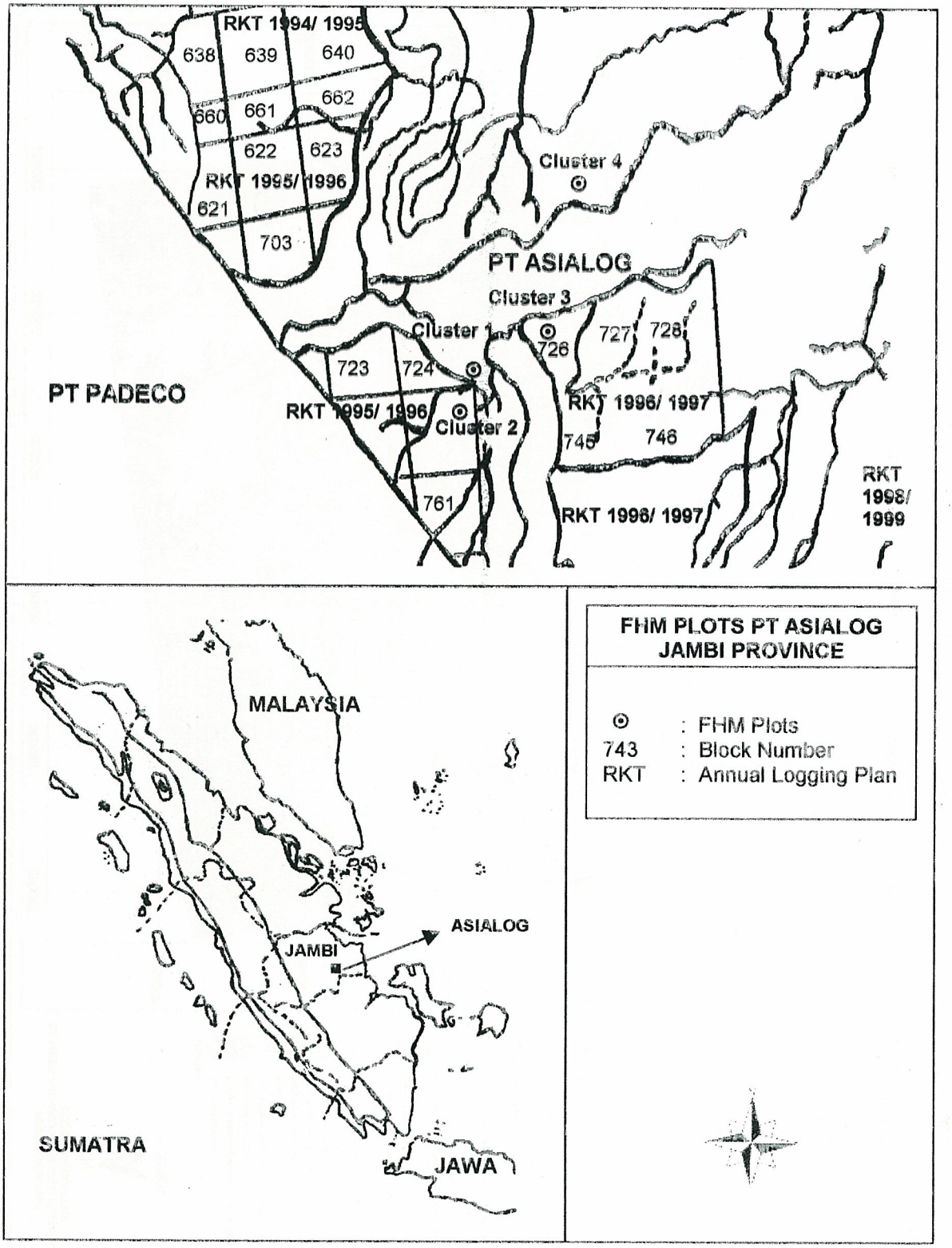


PLATE 18. FHM Plots Location in PT Asialog, Jambi Sumatra

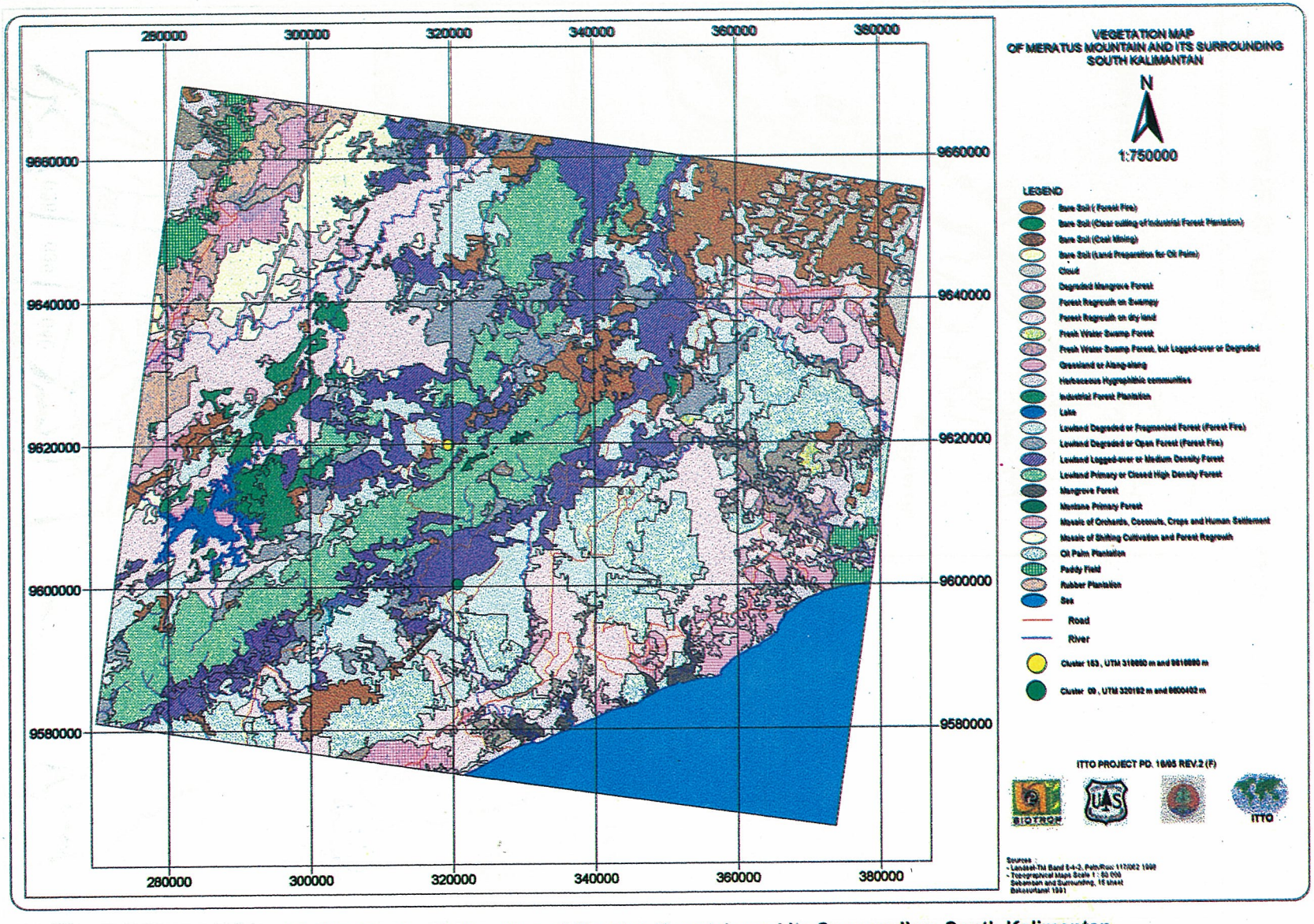


PLATE 19. Vegetation Map of Meratus Mountain and Its Surrounding, South Kalimantan

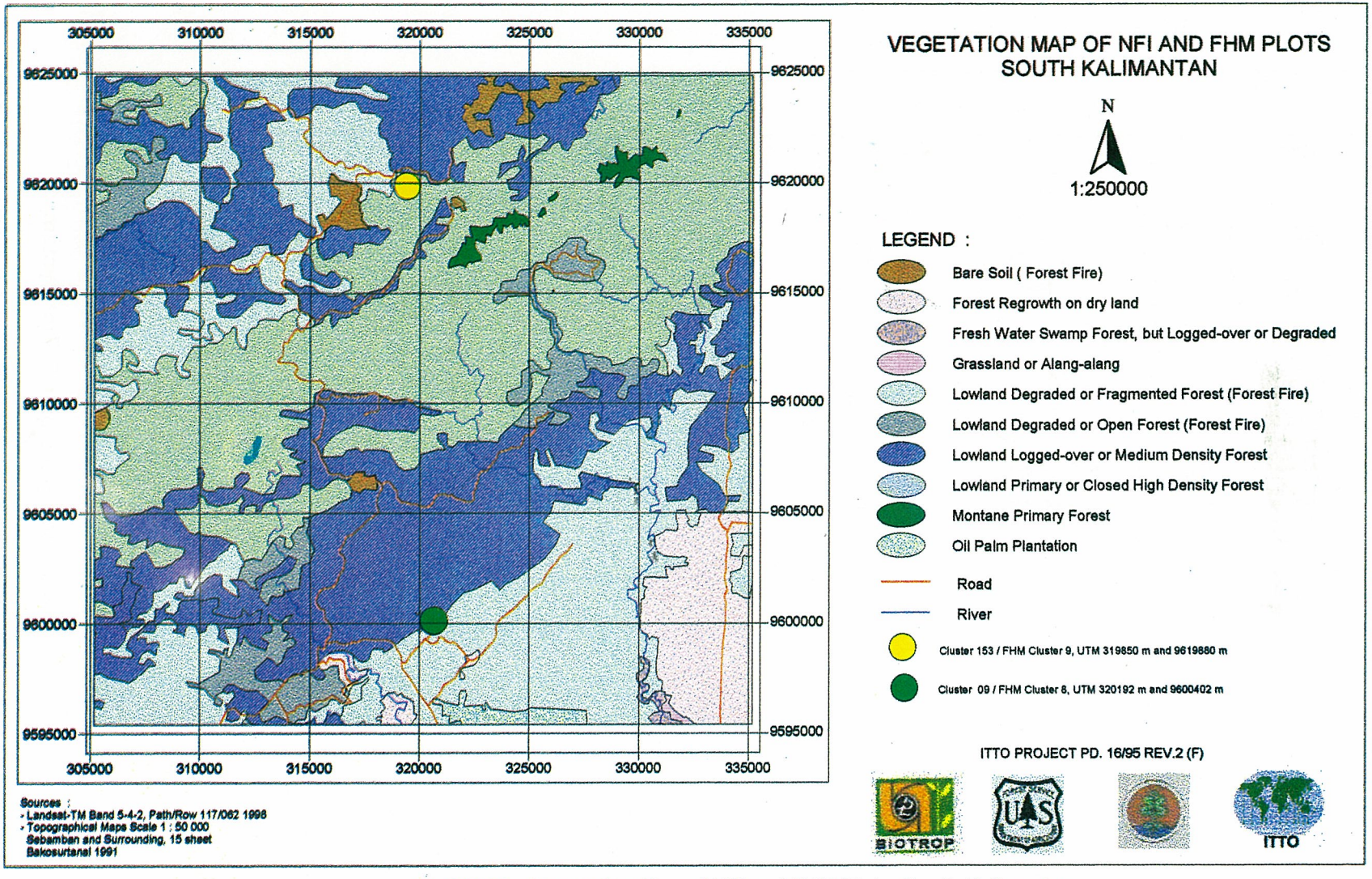


PLATE 20. Vegetation Map of NFI and FHM Plots, South Kalimantan

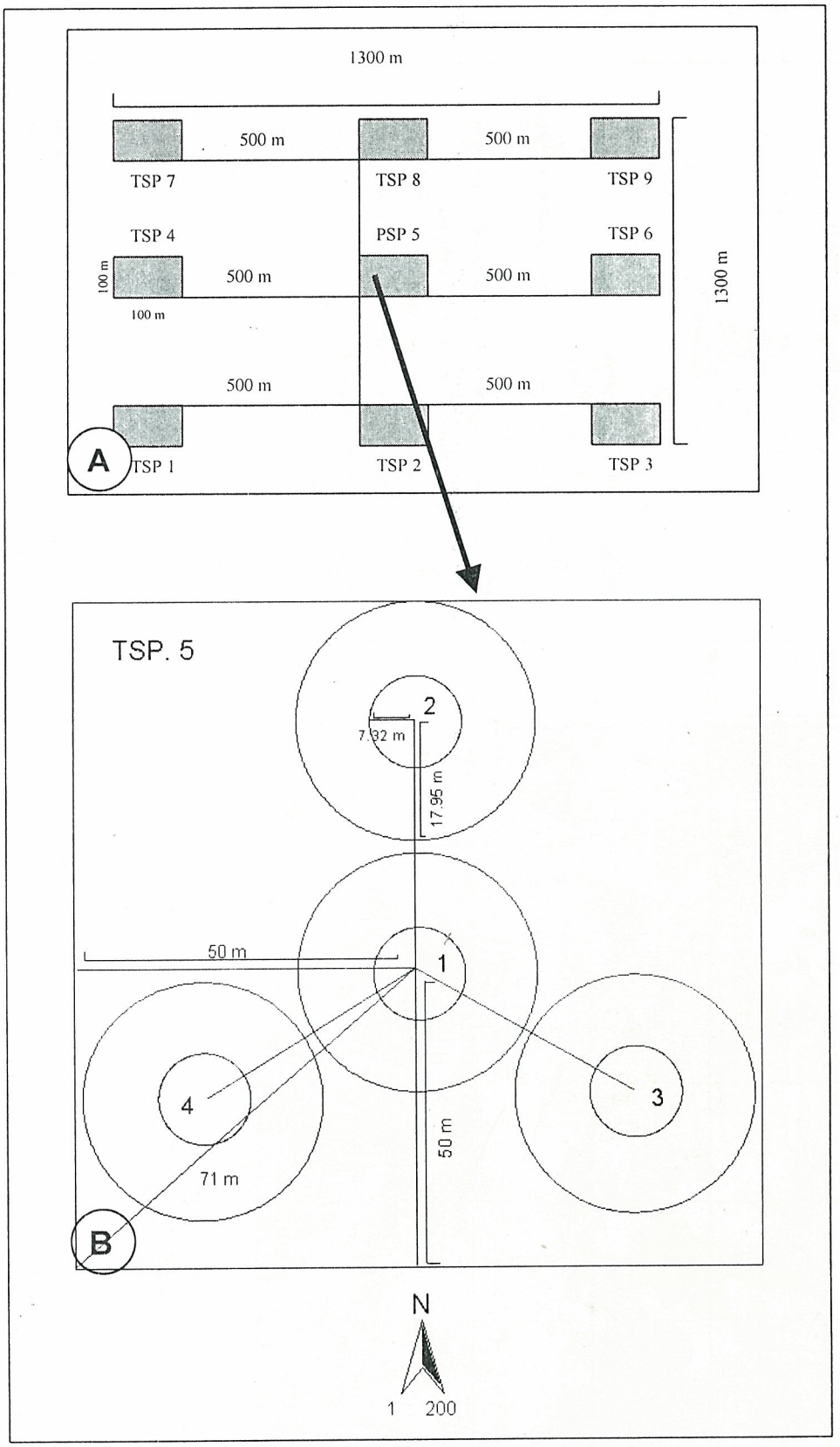


PLATE 21. Overlay FHM Cluster-plots on NFI Plot System

NFI Plot System (A): TSP: Temporary Sampling Plot, PSP: Permanent Sampling Plot. The overlay FHM Plot on NFI Permanent Sampling Plot (B)