ISBN 978-602-8964-02-9

SILVICULTURE, STUDY PLOTS, SEED PRODUCTION AND PROPAGATION OF RAMIN

An Executive Summary

ITTO-CITES Project on Assessing Silvicultural System on Ramin:
Review on the Current Practice and Re-vitalization of Existing
Permanent Sample Plots

Editors

Tajudin Edy Komar
Istomo
Siti Nurjanah

ITTO – CITES Project
in Cooperation with
Center for Forest and Nature Conservation
Research and Development
Ministry of Forestry

Bogor, 2010

Gonystylus bancanus
Documented by Evalin Sumbayak and team

SILVICULTURE, STUDY PLOTS, SEED PRODUCTION AND PROPAGATION OF RAMIN

An Executive Summary

ITTO-CITES project on assessing silvicultural system on ramin: review on the current practice and re-vitalization of existing permanent sample plots

Editors

Tajudin Edy Komar
Istomo
Siti Nurjanah

ITTO – CITES PROJECT
IN COOPERATION WITH
CENTER FOR FOREST AND NATURE CONSERVATION
RESEARCH AND DEVELOPMENT
MINISTRY OF FORESTRY

Bogor, 2010

Silviculture, Study Plots, Seed Production and Propagation of Ramin.

This work was made possible by a grant from ITTO under its collaborative program with CITES to build capacity for implementing timber listings. Donors to this collaborative program include the EU (primary donor), the USA, Japan, Norway, New Zealand and Switzerland

An Executive Summary of ITTO CITES Project on Assessing Silvicultural System on Ramin: Review on the Current Practice and Re-vitalization of Existing Permanent Sample Plots

ISBN 978-602-8964-02-9

Published by
Indonesia's Work Programme for 2008 ITTO CITES Project
Center for Forest and Nature Conservation Research and Development
Forestry Research and Development Agency, Ministry of Forestry, Indonesia
Jl. Gunung Batu No.5 Bogor-Indonesia
Phone : 62-251- 8633234
Fax : 62-251-8638111
E-mail : raminpd426@yahoo.co.id

Photo by the Team

Printed by
CV. Biografika, Bogor

PREFACE

Indonesia is rich with tropical forest tree species, and nearly over 400 species have been studied as having potential economic value and one of them come from Thymmeliaceae. From this family, ramin (*Gonystylus* spp.) has been becoming a commercial timber since late 1980's. One of the species, *Gonystylus bancanus* is a dominant species growing in peat swamp forests in Sumatra and Kalimantan.

This species, as other species, has been logged using a Silvicultural System adopted from Selective Cutting with diameter limit called Indonesian Selective Cutting. The system has practiced ever since with several modifications, especially in its diameter limit from above 50 and later above 40 cm with cutting cycle for 35 years. Later, the system was improved by adding the mandatory enrichment planting after logging operation for certain areas with insufficient potential natural regeneration, called Indonesian Selective Cutting and Enrichment Planting.

Under this project, a comprehensive review an evaluation on the system and its practice so far, including the existing study plots which are expected to be useful to observe population dynamic and potential growth of ramin and other species growing in PSF. Issues on potential seed production and alternative method for propagation were also addressed under this project.

It is expected that this executive summary will provide brief overview on each issues carried out under this project and detail for each activity could be further checked to the respective document.

Bogor, July 2010

Editors

ACKNOWLEDGEMENT

This executive summary is prepared (extracted) from the published technical reports and technical guidelines developed under the Activity Document 2: Assessing silvicultural system on ramin: review on the current practice and revitalization of existing permanent sample plots. The complete list of the technical reports and technical guidelines is shown in last page of this Summary. We would acknowledge the hardwork of Dr. Istomo and his team in conducting a comprehensive review of existing silviculture on ramin, preparing a revised draft to improve silvicultural system in PSF and ramin and took lead in the re-esblishment of observation plots in peat swamp forest in Sumatra and Kalimantan. To Dr. Hesti Lestari Tata, who led the team for reviewing and evaluating the existing permanent sample plot in Peat Swamp Forest is also acknowledged, and to Mr. Nurhasybi and Ms. Evalin S.S. Sumbayak on the technical guideline for monitoring flowering, fruiting and seed handling on ramin and technical guideline for vegetative propagation, respectively, are also acknowledged. We would thank to all people who have given their contributions until the completion of this Executive Summary.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PART I. INTRODUCTION

Based on the findings of previous ITTO project, Identification of *Gonystylus* spp. (Ramin) potency, distribution, conservation and plantation barrier (ITTO PPD 87/03 Rev.2 (F)), one of the causes for rapid decrease in ramin population is over-exploitation and ineffective implementation of rules and regulation related to the current silvicultural system, as well as a lack of supervision. Most of the species in peat swamp forests, including *Gonystylus bancanus* (ramin), are relatively slow growing. Current silvicultural system used is Selective Cutting with diameter limit of over 40 cm and rotation of 35 years.

In order to obtain a deep understanding on growth, yield and population dynamics of ramin and other species, long-term ecological studies are needed. The existing permanent sample plots for ramin and other species were established primarily for monitoring growth and yield, and may not be sufficient for observing population dynamics. After the termination of concession period, most of previously established permanent sample plots are not well managed and even abandoned due to poor accessibility.

Silvicultural system currently applied in peat swamp forest in Indonesia is Selective Cutting with Enrichment Planting. The system was the modification from Indonesian Selective Cutting which has been applied since 1980's. This system has been applied in forest types with some adjustments for peat swamp forest area, especially in the way logs are transported.

Scattered discussions on the appropriateness and effectiveness of this system to ensure sustainability of forest management and its associated resources have been conducted. However, the discussions have not been sufficient to make substantial revision to the system, especially in relation to the provision of reliable data and scientific information on growth and yield, as well as the stand dynamics in peat swamp forest. In this regard, the project was intended to conduct comprehensive review and evaluation, and to establish accessible, reliable and representative plots for long-term ecological study sites for ramin and other species growing naturally in peat swamp forests in Sumatra and Kalimantan.

The primary objective is to improve the silvicultural practice of ramin so as to ensure its sustainability for timber production through (i) the review and evaluation of current silvicultural system and its practice, and (ii) re-vitalization the existing permanent sample plots to obtain a better understanding on population dynamics, growth and yield of ramin and other species growing in peat swamp forests.

The expected outputs:

(i). Silvicultural system and practice are reviewed and evaluated,

(ii). Revision of silvicultural system in peat swamp forest, for ramin and other species in peat swamp forests (PSF),

(iii). A review of permanent sample plots for ramin and other species in PSF in Sumatra and Kalimantan,

(iv). Long term ecological study sites and other efforts to enhance the restoration of ramin,

(v). Technical guidelines for monitoring flowering-fruiting and seed handling and vegetative propagation technique.

Intended Situation

What will happen if no project intervention? The existing silvicultural system will be practised in peat swamp forest, the degraded ramin population and habitats will continue existing, the growing stock reduces over time, and revenue from forest industry using timber from PSF will also continue declining.

On the other hand, in-depth understanding on growth, yield and population dynamics of ramin and other species growing in peat swamp forests is still not updated due to the limitation of obtaining regular and reliable data from permanent sample plots. The existing permanent sample plots for ramin, as well as for other species, were established primarily for monitoring growth and yield, and hence, may not be sufficient for observing population dynamics. In addition, the plots are currently poorly accessible for regular monitoring. Therefore in this project, the existing permanent sample plots will be re-visited and evaluated, and newly designed plots will be established by considering, primarily, their accessibility and representativeness.

Through the execution of this project, several information gaps could be filled. Overall expected situation after project completion is better management practices of peat swamp forests through improved silvicultural prescriptions, supervision and monitoring. In-depth understanding on the growth, yield and population dynamics of ramin and other species growing in peat swamp forests could be obtained through the establishment of well-designed and accessible study plots.

By obtaining accurate information on stand dynamic, growth rates, stem distribution and regeneration, a stronger scientific justification could be presented for formulating policy and decisions on determining diameter limits and assumptions used for choosing silvicultural system, as well as the rotation.

PART II. CURRENT POLICY

Ramin, especially *Gonystylus bancanus*, has been logged since last three decades. Current report indicates that its population in nature has decreased significantly due to various factors. In order to prevent further habitat degradation and population depletion, two policies were issued in 2001, logging moratorium and listing ramin into Appendix of CITES.

Logging moratorium for ramin has been imposed to all logging companies operating in peat swamp forests in Sumatra and Kalimantan. Under this policy, only certified company is allowed to harvest ramin. The requirement for certification is to ensure the Sustainable Forest Management (SFM) and conservation. Under this policy until currently, only PT. Diamond Raya Timber, located in Riau, Sumatra, is allowed to harvest ramin timber. This company is granted a permit to harvest ramin after granting a certificate of sustainable management by Indonesia Ecolabeling Institute (LEI) and chain of custody from Forest Stewardship Council (FSC). By imposing this policy, logging operation both legal and illegal logging decreased.

In the same year, ramin (*Gonystylus* spp.) listed into Appendix III of CITES, and up listed into Appendix II in October 2004 at COP 13, in Bangkok, Thailand and effective in 2005. Logging moratorium and listing of ramin into Appendix of CITES have been effective to reduce excessive logging and to combat illegal trade through trade control by the mandatory submission of export and import permits.

Silvicultural system to harvest ramin uses Indonesia Selective Cutting System with diameter limit to 50 cm dbh with cutting cycle of 35 years. Later this system was modified to Indonesia Selective Cutting with Enrichment planting (TPTI) using assumption that the growth rate of 1cu m per ha per year.

Under new Government regulation, the diameter limit reduces to $\geq$35 cm dbh which is only applicable after receiving approval from relevant Scientific Authority, FORDA and other relevant institutions. Since ramin is listed in Appendix of CITES, the harvest must also complies with CITES requirement. Some of the requirements are the provision of export-import permit, setting quota and Non-Detrimental Finding (NDF) assessment.

PART III. SILVICULTURAL SYSTEM AND ITS PRACTICE

Silvicultural system currently applied in peat swamp forests is selective cutting system, which cuts only commercial trees with certain diameter limit, and retain a number of core trees for the next cutting cycle. In the beginning, an Indonesian Selective Cutting (TPI) was applied in 1972. In 1989 the system changed to Indonesian Selective Cutting and Enrichment Planting (TPTI). In 1989, the cutting limit for ramin was ≥ 35 cm (if large ramin trees is not found) and non ramin commercial species was ≥ 50 cm with cutting cycle of 35 years, and in 1996 the diameter limit changed to ≥ 40 cm with cutting cycle of 40 years.

Silvicultural system for ramin (*Gonystylus bancanus*), as listed in the Appendix II of CITES was not specifically designed. The potency and production of ramin timber from peat swamp forests were decreasing. This is due to excessive logging resulted from over estimation of standing stock and illegal logging, insufficient core trees retained and poor regeneration success. Lack of replanting or enrichment planting of ramin has accumulated to depletion of population. Considering characteristic of ramin habitat is in waterlogged peat swamp forests, a system of harvesting and wood transportation should be environmentally and specifically designed.

In this review, current practice of laws, rules and regulations were compiled, interview and consultation with relevant stakeholders were also carried out. Data were also collected from field visit to the management unit of a forest concession holder (*Izin Usaha Pemanfaatan Hasil Hutan Kayu, IUPHHK*), PT. Diamond Raya Timber (DRT), Riau and ex-forest concession area of PT. Sanitra Sebangau Indah (SSI) in Central Kalimantan. Provincial and District Forest Services, Forest Production Management (BPK), MoF. Brief overview of the report is presented below.

3.1. A Review

The specific feature distinguishing peat swamp forest ecosystem from other forest ecosystems is the excess of water and the accumulation of organic materials. The tree species growing in this ecosystem is unique and mostly slow growing. One of the species is ramin (*G. bancanus*).

Several factors directly or either indirectly influence the sustainable management of peat swamp forests are:

1. The appropriateness of silvicultural system used, especially in its capacity to enable natural regeneration.
2. The certainty of land status, allocation and security, especially from possible converting to other uses, encroachment, fire, and illegal logging.
3. Strong policy concerning the rehabilitation of degraded forests provision of supporting fund for research, planting and salvation of endangered species.

In relation to sustainable utilization of peat swamp forests, tree species particularly ramin, there are several important silvicultural aspects need to be considered as follows:

1. Activities for ramin utilization should be conducted taking into account need to maintain the population balance vis-a-vis the other species within the peat swamp forests.
2. The determination of cutting quota (amount of allowable cut) for ramin and non ramin species should maintain the balance between potential timber to be logged and retained core trees. Therefore, there is a need to determine the minimum number of core trees for ramin and non ramin trees, which should be retained for the next cutting cyle.
3. There is a need to determine the proportion (percentage) of logged ramin trees compared to other commercial trees. The proportion in number between logged and unlogged (retained core trees) should also be accounted.
4. The basis for determination of cutting quota (amount of allowable cut) for ramin and non-ramin should accomodate the data of residual stand growth and ability of management unit to carry out enrichment planting or rehabilitation in open areas after logging operation. Therefore, tree growth measurement in permanent plots must be conducted to obtain valid growth data.

3.2. Proposed Improvement of Existing Silviculture System

Silvicultural system for sustainable utilization of natural forest in Indonesia had been regulated under Government Regulation (PP) No. 21 year 1970 and field guidance by Director General of Forestry Number 007/KPTB/DD/I/1972. It was improved later by Decree of Forestry Minister No. 485/Kpts-II/1989 and Decree of Director General of Forest Production Management No. 24/Kpts/IV-Set/96. In the latter, it was stipulated that diameter limit for cutting in peat swamp production forest was $\geq$40 cm, measured 20 cm above buttress with cutting cycle of 40 years and a number of core trees retained and maintained during the cutting cycle. The number of core trees

retained is at least 25 trees per hectare, with diameter ranges from 20 to 39 cm. The most recent regulation is Forestry Minister Regulation No. 11/Menhut-III/2009, issued February 2009. Under this newly issued regulation, the holder of Timber Utilization Permit for Wood Forest Product Unit (IUPHHK) is allowed to cut ramin with diameter limit of over 30 cm with cutting cycle of 40 years. Under this regulation, there is no specific silvicultural system applied for ramin and PSF, except that the cutting with that diameter limit should be based on prior assessment by relevant scientific authorities.

General Provisions

1. Improvement of silvicultural system of peat swamp forest needs to consider the most recent condition of production forest in peat swamp forest. At present, there are at least four types of peat swamp forests, namely: (1) primary forest, (2) logged over forest in active IUPHHK, (3) ex-forest concession which naturally forms a mixed secondary forest, (4) ex-forest concession which naturally forms shrub land.
2. TPTI silvicultural system issued in 1989 with the improvement on several important aspects and uneven aged approach based forest management could be applied in primary forest or in logged over forest of active IUPHHK.
3. Rehabilitation system using strip planting and cutting to increase timber potential could be applied in peat swamp forests of ex-forest concession areas which naturally form a mixed secondary forest.
4. The number of core trees, the proportion of core trees, and the number of logged trees for each species group should be determined based on the basis of comprehensive and reliable inventory.
5. The number of core trees for logged species is at least 25 sound and evenly distributed trees per ha for commercial tree species. On the other hand, the number of ramin core trees is at least 3 trees per ha, whereas for meranti group is at least 10 trees, while the remaining are mixed forest species.
6. The number of trees allowed to be cut is at most 25 trees per ha which are distributed evenly. At least 30% of that number which are allowed to be cut should be retained as mother trees with intensity of cutting about 50% per diameter class and species group of the trees. Those, which are not logged, should be proportional for ramin, meranti group, and mixed forest species.
7. Diameter limit for cutting under current silvicultural system (P. No. 11/2009) is >30 cm, with cutting cycle of 40 years, and diameter limit for core trees ranges from 10 cm to 29 cm, with prior scientific assessment by designated institution (Research Institution as Scientific Authority).

8. Harvesting activity in peat swamp forests should utilize system which is environmentally friendly without neglecting the principles of efficiency and effectiveness. Use of heavy non-environmentally friendly equipments, such as *logfisher*, should be avoided.
9. Planting, replanting of poor regeneration areas, and weeding of plants in open area created by logging, such as ex-skidding road, ex-log yard and ex-rail road should be immediately carried out after logging operation.
10. Planting in the rehabilitation silvicultural system in unproductive areas must be conducted in strip planting with 3 m wide and 20 m away between strips and distance between plants within strip was 2.5 m. All trees and other vegetation in those strips are logged and cleared for planting of fast growing commercial species.
11. Residual stand and forest protection from land encroachment, illegal logging, construction of illegal canal, fire threat, and boundary maintenance should be conducted periodically.

3.3. Sequences of Logging Operation

1. To achieve desired condition under the existing silvicultural system, there is a sequence of activity and its respective schedule. Below is the proposed sequences for logging operation.

No.	Sequences of activity	Schedule of implementation
1.	Structuring of Working Area	Pe-2
2.	Pre-harvest inventory	Pe-1
3.	Opening of forest area	Pe-1/2 to -1
4.	Logging operation	Pe
5.	Tidying up of area (cleaning)	Pe *)
6.	Inventory of Residual Stand	Pe *)
7.	Procurement of planting materials	Pe-1
8.	Planting of open area	Pe *)
9.	First stage tending of plants	Pe+1/2 s/d Pe+1
11.	Advanced stage tending of plants	Pe + 2 and + 3
12.	Protection and safeguarding	Continuously
13.	Research and development	Continuously

Notes : Pe = harvesting year
*) = conducted directly after completion of logging

2. Sequences and schedule of activities to rehabilitate the non-productive area are as follows:

No.	Sequences of Activities	Schedule of implementation
1.	Structuring of working area and PWH	Pa-2
2.	Inventory of Residual Stand	Pa-2
3.	Logging and construction of strip planting	Pa-1
4.	Planting activities	Pa
5.	Procurement of planting materials	Pa-1
6.	Replanting of failure and tending of plants	Pa+1 up to +3
7.	Advanced tending of plants	Continuously
8.	Protection and safeguarding	Continuously
9.	Logging	In accordance with cutting cycle
10.	Research and development	Continuously

Notes : Pa = Planting; PWH = opening up of forest area.

3.4. Implementation, Arrangement and Supervision

To achieve the objectives of sustainable forest management, an effective and efficient implementing organizations are needed, which could organize forest utilization activities in accordance with the existing law, rules and regulation, and with the principles of sustainable forest management.

There are at least eight fields of expertises required to handle operational management. Those fields are administration and finance, human resources development, forest planning, silviculture, harvesting, community development, research and development, forest protection and safeguarding, and certification/ monitoring/evaluation. Good organization should be supported by proper budgeting and accounting.

Supervision should be conducted internally and externally. Internal control is conducted by *internal control system* (ICS) from management unit in routine and timley manner, and ICS organization should be separated from the implementing organization. External control is conducted by the holders of *management authority,* e.g. forestry agency and law enforcement agency.

Incentive system is given to the holder of Management Unit (MU) which performes well toward the sustainable forest management. On the contrary, the MU which exhibits poor performance and violates rules and regulations, should be sanctioned with heavy penalties (disincentive) in accordance with the level of violation.

3.5. Conclusion and Recommendations

Conclusion

There are at least four types of PSF based on status and condition of the forests, namely: (1) primary forest, (2) logged over forest in active concession company (IUPHHK), (3) ex-concession forest area which has been becoming a mixed secondary forest and (4) ex-concession forest area which has been forming a scrub-land.

Recommendations

1. Existing silvicultural system of Indonesian Selective Cutting and Enrichment Planting (TPTI) is still poorly practiced and therefore it is recommended that future implementation is fully supervised by responsible institution.
2. The replantation in ex-concession forest area of mixed secondary forest or scrubland needs to be carried out in strip cutting and replanting. Replanting of bared, ex-logging areas, such as ex-skid road, ex-log yard (log piling site) and ex-railroad need also be conducted immdediately after logging with existing tree species.
3. The improvement of this system for PSF should include determination of the number of core trees of logged species, proportion of core trees and logged trees of each species group, diameter limit for cutting, and cutting cycle which ensure sustainable harvest and conservation of species.
4. Several activities must be conducted periodically, such as tending of residual stand, safeguarding the area from land encroachment, illegal logging, illegal canal construction; fire threat; and the maintenance of the boundary lines in accordance with the sequence (schedule) of logging operation.

PART IV. OBSERVATION PLOTS IN PSF

Sustainable harvest is developed based on accurate information on growth and yield of forest stands. In order to obtain the accurate information, it requires scientific observation. The observation of forest stands in each forest types is carried out in representative observation plots. The observation plots, which commonly called as permanent sample plots (PSP) are established using certain design which could represent the stands and forest. From this PSP, it is expected that the accurate information could be obtained.

The information could include growth and yield, the change of quality and quantity of trees, ecology and existing biodiversity. The analysis of vegetation, forest dynamics, nutrient cycling, phenology, ethnobotany and wildlife habitat also be obtained from this PSP. In order to obtain those data and information, it requires consistent and long term observation. Therefore the establishment of PSP should consider various aspect including accessibilities.

4.1. Requirement for PSP Establishment

A guideline to establish and to carry out measurement in PSP for growth and yield (increment) monitoring in natural forest and peat swamp forest has been issued by Forestry Research and Development Agency (FORDA) in 1993, the obligation to establish PSP by each management units was issued, primarily for monitoring forest growth and stand increment. In this regulation includes measurement, provision of guidance, supervision and sanctions for violations. Current regulation related to the Work Plan of Utilization of Forest Product (RKUPHHK) for Natural Forest and Ecosystem Restoration, the obligation to manage PSP is not explicitly stated and not becoming a prerequisite and principal obligation by concession holders. Instead, the concession holders are obliged to implement new regulation to carry out a Comprehensive Periodic Forest Inventory (Inventarisasi Hutan Menyeluruh Berkala, IHMB) in their concession areas.

4.2. Existing PSP on *Gonystylus bancanus* in Sumatra and Kalimantan

According to the Directorate of Production Forest Utilization Plan (2007), currently the operating concession companies in various types of ecosystem are 317 units covering the total area of 28.9 million ha. Assuming each MU is managing PSP, the the number of series of PSP should be 317 PSP. From those PSP, only a few

concession companies are regularly collecting and monitoring growth and increment in their PSP. This is primaly based on new regulation that the PSP management is no longer an obligatory requirement in the submission of Annual Work Plan (Imanuddin and Wahjono, 2006)

In addition to the PSP, observation plot for similar and even broader purposes have also been established by various institutions. Some PSPs have been establslished in Malinau, East Kalimantan by CIFOR, STREK's in Berau District, East Kalimantan by Berau Forest Management Project, Murung Raya District, Central Kalimantan by Barito Ulu Project.

Based on data from TSP/PSP re-enumerated between 1996 - 2002, ramin as a genus are found naturally from West Kalimantan, Central Kalimantan, South Kalimantan, to East Kalimantan of Borneo. While in Sumatra, ramin naturally distributes in Jambi, Riau, West Sumatra, to Lampung.

Since the number of concession companies currently operating in PSF has reduced into a few companies only, the current condition of previously established PSP is not completely known. Based on the land cover map extracted from Landsat imagery in the period between 2002 and 2003 (Forestry Planning Agency, 2005), the number of PSPs/TSPs in peat swamp production forest (including for ramin) is at least 14 series of PSP located in Kalimantan (Figure 1) and 3 series of PSP located in Sumatra (Figure 2). According to the map, natural population of ramin (*Gonystylus* spp.) in Kalimantan is found in PT. Kayu Mas, PT. Inhutani I, PT. Sumalindo Lestari Jaya, PT. Triwira Astra Bharat, PT. Arga Timber Indonesia, PT. ITCI, PT. BFI, PT. Wood Waja, PT. Inhutani III, PT. Aya Yayang Indonesia, PT. Pamukan Jaya, and PT. Natural Eka Unda. In Sumatra, ramin (*Gonystylus* spp.) populations are found in the area of PT. Rimba Karya Indah, PT. Niti Youth Concern, and PT. Mainstay Great Timber. Ramin from *G. bancanus* is naturally found in PSF of PT. Diamond Raya Timber of Riau and PT. Putra Duta Indah Wood of Jambi. There is no available document to confirm the number of PSP and its management for ramin including their data collection status.

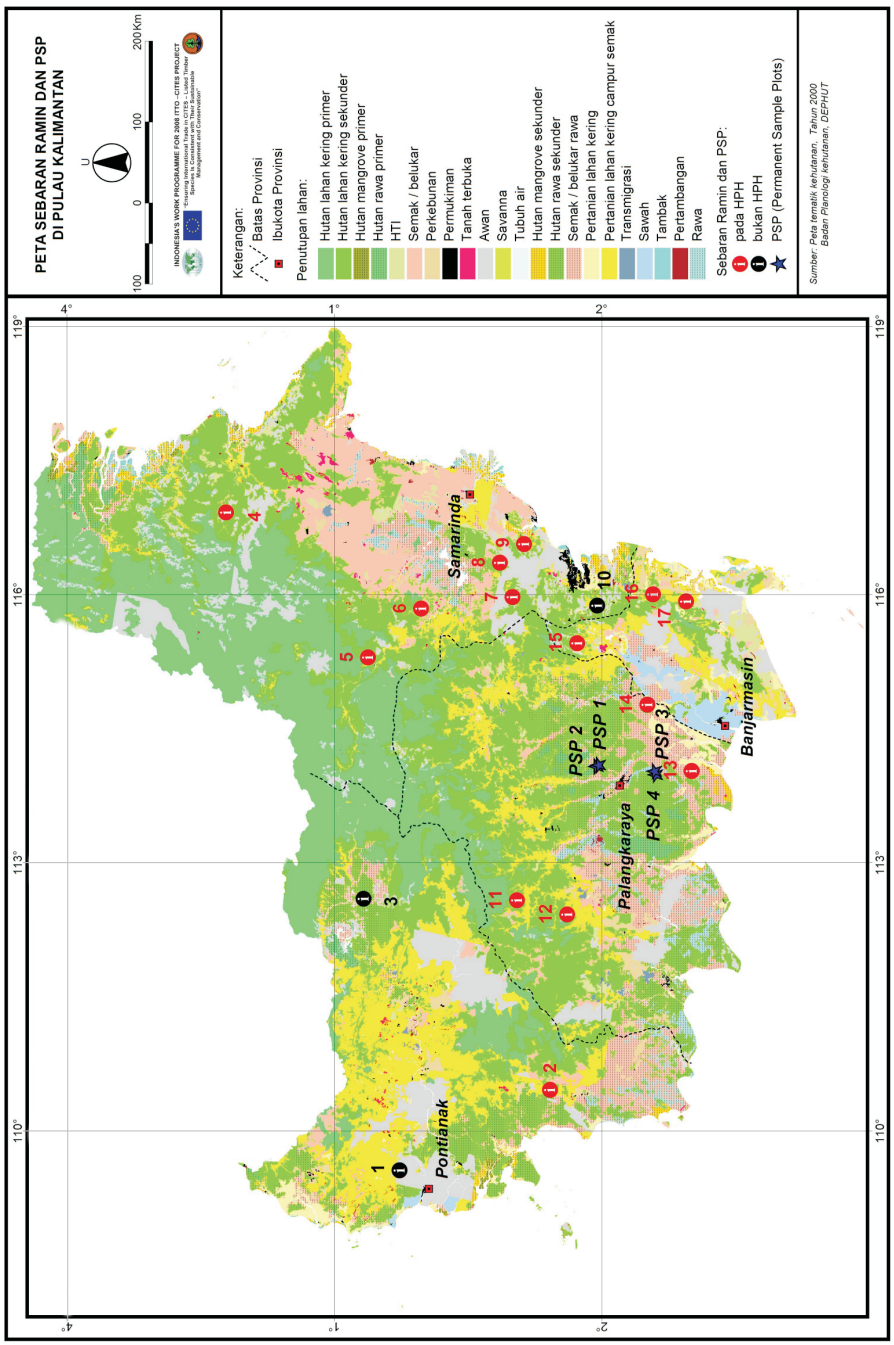

Figure 1. Ramin (*Gonystylus* spp.) distribution, concession holders and PSP established by project in Kalimantan (PSP 01-04)
Note: PSP = OP (Observation Plot).

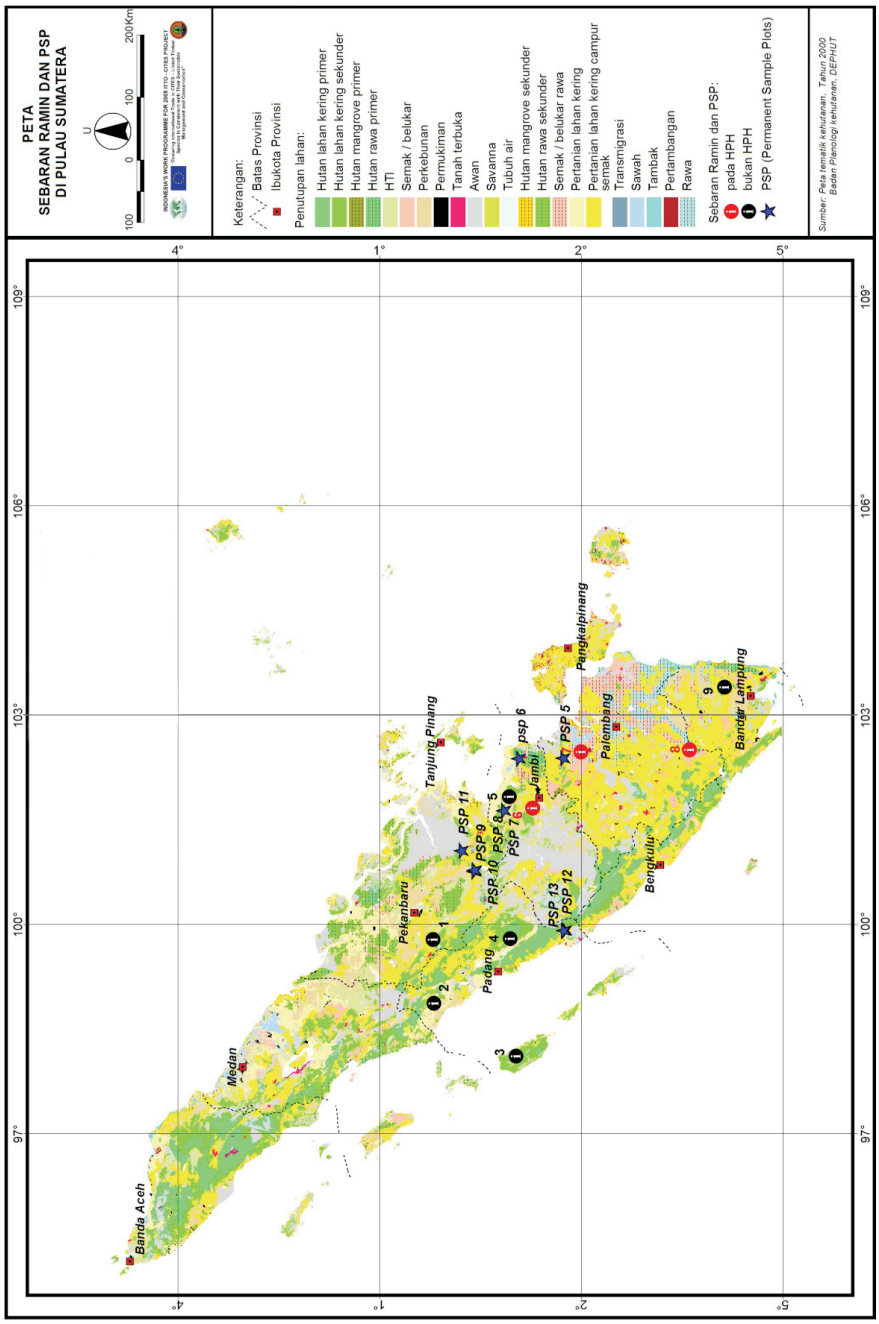

Figure 2. Distribution of Ramin as genus *Gonystylus* spp., concession companies and PSP established by project in Sumatra (PSP 05-13)
Note: PSP = OP (Observation Plot)

4.3. Institution Involved in PSP Management

Institutions involved in the management of PSP are described as follows:

- Management Unit of Concession company (HPH/IUPHHK).

  Obliged to establish, manage and secure the PSP in their respective area. Provide report of monitoring to the designated institutions. The Management Unit (MU) bears technical problems in planning, organizing and implementing PSP management. Most Management Units poorly implement the requirement related to PSP.

- Provincial District Forest Service, District Forest Service (Dinas Kehutanan, Dishut).

  Responsible for supervision of forest area in general including all activities carried out by company. Constrained by weak human resources and limited funding. There is still unclear authority between central government and local Forest Service.

- Directorate General of Forest Production Management (BPK).

  Plays role in analyzing and synthesizing the PSP data into sustainable forest management policy. BPK also faces problems in organization of PSP, supervision and control. Co-ordination with other stakeholders, such as MU, Forest Service and FORDA is required.

- Directorate General of Forest Planning (DG, Planologi).

  The use of collected data for management plan, such as to estimate annual production of timbers. DG, Planologi plays role in planning, implementation and oversight. The problem faced by DG, Planologi is the unavailability of human resources, budget and priority setting.

- Forestry Research and Development Agency (FORDA).

  Provide user friendly guideline for establishment PSP, receiving monitoring results and make analyses. The unavailability of budget allocation for collecting data. Relies on MU report .

- University and other institutions.

  University and Research institution involved in planning and data analysis of PUP. University as centre of excellence should contribute to the well management of PSP.

According to Imanuddin and Wahyono (2006) in Tata *et al.* (2010), some management unit of concession companies (IUPHHK) carry out PSP monitoring

and forward the data set to relevant agencies. This is especially after the enforcement under Forestry Minister Decree No. 237/95. The data set consist of growth measurement and increment monitoring. However, none of the report complies with the standard of working procedure and reporting. Since the year of 1999, reformation era, none of the concession companies (IUPHHK) submit reports of PUP measurement and monitoring to FORDA for further analyses. One of the reasons is that the monitoring of PSP is no longer a requirement for submitting annual coupe (Annual Working Plan).

The technical problem in monitoring PUP/PSP in peat swamp forest is poor accessibility to reach the PSP and mostly relies on the existence of railways. On the other hand, the railways for transportation facilities and infrastructure are removed to other working area after logging operation. This poor accessibility has contributed to the absence of measurement and monitoring of previously established plots. The existing guideline of PSP is still considered as too complicated which also contributes to the poor performance of overall PSP management.

Considering the above problems, the importance of PSP management is becoming an important prerequisite to obtain reliable and valid data for growth and yield and stand dynamic of PSF. In the establisment of PSP, various conditions of forest cover, peat thicknesses and forest functions need to be considered as in addition to the security of forest status from conversion, illegal logging, forest fires and encroachment.

4.4. Conclusions and Recommendations

Conclusions

1. PSP/TSP has an important role in providing biological-ecological data on forest stands, which is used to be the basis for determination of sustainable harvest. Therefore, the management of PSP is very important in forest management.

2. Current management of PSP faces several problem, range from poor implementation of rules and regulation, lack of supervision and limited skilled human resources.

3. Development, maintenance and measurement of PSP were hampered by unaccessibility of location, forest encroachment, forest fires and the uncertainty of forest status.

Recommendations

1. It is recommended that the enforcement of rules and regulations related to the establishment and management of PSP need to be consistently carried out.
2. Increasing awareness of concession holders on the importance of PSP development and management need to be conducted.
3. Strengthening the role of FORDA as a resource data base of PSP and data analyses.

PART V. LONG TERM ECOLOGICAL STUDY PLOTS FOR POPULATION DYNAMIC STUDY

In order to achieve sustainable utilization, the accurate data on the dynamics of forest stand, structure, growth and yield should have been available prior to harvesting. These types of data and information could be collected only from observation plots.

The objective of this activity is to construct and re-design observation plots (study sites, which is in some degree is similar to PSP) in PSF as in addition to the existing PSP for the observation of all tree species associated with ramin species, growth, stand/population dynamics and other biological-ecological aspects (biodiversity, biomass, carbon and nutrient cycle).

To ensure regular and consistent collection of data and information from these study plots, several aspects are considered in the selection of sites, such as the status and security from possible conversion to other uses, the accessibility by various modes of transportation, and representing the actual condition of PSF.

5.1. Method of Establishment

Locations of the newly established plots are in the ecosystem of peat swamp forests in Sumatra and Kalimantan and carried out from February to April 2010.

Technique used to construct the plot was followed the general guidelines by Alder and Synnott (1992) concerning *Permanent Sample Plot Techniques for Mixed Tropical Forest.* Using the guidelines, each plot was made in the size of 100 m x 100 m (1 ha). The shape of the plot is a square with the orientation of North – South and West - East. The plot is further divided into sub plots with the size of 20 m x 20 m. By then, each plot consists of 25 sub-plots. The sub-plots are numbered from 1 to 25.

In the construction and redesigning of the plot, baseline data and information were collected as follows:

1. The description of location in accordance with government administrative zones and forestry administration,
2. The coordinate of locations,
3. The accessibility of the area to reach the plot,
4. Peat thickness,

5. Type of vegetation cover,
6. Name of tree species,
7. Stem diameter at dbh for trees with diameter ≥ 10 cm,
8. Clear bole height,
9. Total height of the tree species.

Data collected during this construction phase will become baseline or basic data for the plot and will be used as starting point to study the dynamics of forest stand structure or growth model. In addition, the obtained data could also be used to analyze other ecological objectives (importance value index, biodiversity index, biomass, and carbon content). To analyze stand structure dynamics and growth model, the increment data, in-growth, up-growth, mortality rate will be added at subsequent 2 - 3 measurements. As basic data in the analysis of forest stand structure, tree data with diameter of ≥ 10 cm were analyzed to determine the number of trees and tree volume based on diameter classes.

5.2. The Locations of Plots

There are 13 Observation Plots, which consist of 1 ha each were establsihed in Sumatra and Kalimantan. There were 9 Observation Plots in Sumatera, distributed in Jambi (4 Observation Plots) and Riau (5 Observation Plots). In addition, there are 4 Observation Plots in Central Kalimantan. Description of each plot is as follows:

1. **Berbak National Park, Jambi**
   a. Code of plot: OP 05 and OP 06
   b. Coordinates:
      OP 05: 01°63'34.4" dan 104°10'18.3"
      OP 06 : 01°16'31.8" dan 104°10'1"
   c. Forest condition: logged over forest (OP 05) and Secondary Forest (OP 06).

2. **Peat Protection Forest (HLG), District of Tanjung Jabung Barat, Province of Jambi**
   a. Code of plot: OP 07 and OP 08
   b. Coordinates:
      OP 07 and 08 : 01°00'53.1" 103°14'43.2"
   c. Forest condition: Logged over area (OP 07 and 08).

3. **Protection Area of PT. RAPP, Riau**
   3.1. Selempaya kiri and Selempaya kanan
      a. Code of plot: OP 09 and OP 10

b. Cordinates:
OP 09 : 00°29'41.6" 102°09'56.3"
OP 10 : 00°29'56.5" 102°11'17.7"
c. Forest condition: Logged over forest (OP 09 and 10)

3.2. Teluk Meranti (Meranti Estate)

a. Code of plot: OP 11
b. Coordinates: 00°15'59.7" 102°32'14.1"
c. Forest condition: Logged over forest area (OP 11).

4. PT. Diamond Raya Timber, Riau

a. Code of plot: OP 12 and OP 13
b. Coordinates:
OP 12**:** 02°05'34.7" 101°07'34.8"
OP 13: 02°04'22.4" 101°07'11.1"
c. Forest condition: the form of primary forest (OP12) and logged over forest of one year old (OP 13).

5. Lahai, Central Kalimantan

a. Code of plot: OP 01 and OP 02
b. Coordinates:
OP 01: 01°56'03.4" and 114°04'38.0"
OP 02: 01°57'29.6" and 114°05'39"
c. Forest condition: Forests which were relatively not yet disturbed (primer).

6. Sebangau National Park, Central Kalimantan

a. Code of plot: OP 03 and OP 04
b. Coordinates:
OP 03: 02°35'54.0" 113°59'08.1"
OP 04: 02°35'06.6" 114°01'25.4"
c. Forest condition : logged over forest (OP 03), and scrubland (OP 04).

Figure 3. Several photographs of Ramin taken in each observation plot. A. Lahai, Central Kalimantan; B. Sebangau National Park, Central Kalimantan; C. Berbak National Park, Jambi; D. PT. RAPP, Riau; E. Teluk Meranti (Meranti Estate); and F. PT. Diamond Raya Timber.

5.3. The Diversity of Biophysical Conditions in the Construction of Observation Plot.

In the construction of observation plot, the thickness of peat was also considered. Variation in peat thickness determines the composition and distribution of tree species. The observation plots were constructed in peat swamp forests at various peat thickness, starting from 2 meters to 7 meters.

The number of tree species and the number of tree species with diameter of ≥ 10 cm in each plot varies. The largest number of tree species was 52 (species) in OP 05 and the lowest number of species was 26 (species) in OP 12 with the average number of species as many as 37 species. The largest number of tree in each plot was 1043 individuals, and the lowest was 111 individuals of tree/ha. The number of species and the number of individuals does not always describe the condition of forest cover. Average number of individuals for the whole plots was as many as 587.8 trees per ha.

Ramin species recorded only in 10 plots. Out of 13 plots, there were 3 plots where ramin was not found, OP 4 in land cover type of old scrubland in Sebangau National Park, and OP 5 and OP 6 in Berbak National Park in land cover type of logged over

forest and old secondary logged over forests. In 10 plots where ramin was found, the number of ramin trees ranges from the lowest (1 tree/ha) to the largest (13 trees/ha).

5.4. Dominant Tree Species in Each Plot

Dominant tree species based on the value of importance value index (IVI) is highly variable. In primary forest in OP 01, OP 02 and OP 12, the dominant tree species respectively in each plot are jangkang (*Xylopia malayana*), bintangur (*Callophyllum pulcherrimum*) and balam (*Palaquium obovatum*). In logged over forest with varying intensity of logging, dominant species, among others, are terentang (*Campnosperma macrophylla)*, medang darah (*Litsea* sp.), ebony (*Diospyros* sp.*),* medang basah *(Litsea angulata*), and balam (*Palaquium obovatum)*. In the other land cover type of scrubland forest and secondary forest, the dominant species respectively are meranti (*Shorea* sp.) and mahang (*Macaranga maingayi)*

5.5. The Diversity of Tree Species

The value of species diversity (H') were categorized as high (the value of H' > 3) for OP 02, OP 05 and OP 11. The highest value of richness index (Index R) are in OP 02, OP 05 and OP 11, while E values are nearly similar, between 0.7-0.8. Those indexes are having high corelation with the number of species, the total number of individuals and the distribution of individuals in each species. The index values are not corelated with the condition of forest cover type, logged over forests or other secondary forests. The condition of land cover are highly related with the magnitude of tree dimension, either diameter or volume or biomass.

5.6. Stand Structure

In general, the number of ramin trees is greater for small diameter classes, and decreases with the increases of diameter classes, except in OP 01 and OP 11. In primary forests (OP 02 and OP 12) there were found ramin trees with diameter class of ≥ 40 cm. However, in logged over forest (OP 09 and OP 13) ramin trees with diameter ≥ 40 cm are still found. This phenomenon showed that ramin stand structure is not all in inverted J shape and the presence of ramin trees reflected the level of intensity of previous logging.

5.7. Tree Volume

Tree volume at diameter classes ≥ 10 cm ranges from 34.82 m^3/ha to 265.43 m^3/ha. The largest tree volume is found in OP 02, followed by OP 12, OP 01 and OP 11

which have the tree volume for diameter class ≥ 10 cm of more than 200 m^3/ha. For other OP, the tree volume is below 200 m^3/ha. This phenomenon showed that OP 02, OP 12 and OP 01 constitutes land cover type of primary forest. OP 11 which occurs in Teluk Meranti of PT. Riau Andalan Pulp and Paper (RAPP) still resembled primary forests. Meanwhile, OP 04, OP 06 and OP 07 are having the tree volume of <100 m^3/ha which was categorized as land cover type of old scrub land and secondary forest.

For 13 OP constructed, 3 OP of them with no ramin trees, namely OP 04, OP 05 and OP 06. Volume of ramin trees in the OP which were found to have ramin with diameter class ≥ 10 cm ranges from 0.46 m^3/ha in OP 08 (the lowest) and 6.17 m^3/ha (the highest) in OP 13. In general, the distribution of number of individuals of ramin trees on the basis of diameter classes, ramin trees with diameter class > 40 cm occur only in OP 02, OP 09, OP 12 and OP 13.

5.8. Biomass and Carbon Content

The highest values of volume, biomass and carbon occurred in OP 02, OP 12 and OP 1 which constitutes as primary forest, followed by OP 11, OP 10 and OP 03 which constitutes a logged over forest which have been recovered toward the condition of primary forest; while the lowest were OP 04, OP 06 and OP 07 which constitutes as old scrub land, secondary forest, and young logged over forest. For all species in each OP the total volume are 34.82 - 265.43 m^3/ha, the biomass are 33.63 - 285.00 ton/ha and carbon are 16.82 - 135.57 ton/ha.

5.9. Conclusion and Recommendations

Conclusion

Collection of biological and ecological data for determining sustainable harvest is still required for PSF in Indonesia. Thirteen (13) observation plots have been established for this purpose, consisting of 9 plots in Sumatra and 4 plots in Kalimantan, which represent most conditions of existing PSF. The plots were established primary based on representativeness and accessibility of the sites.

Recommendations

1. It is recommended that in order to achieve sustainable PSF management, biological-ecological data from the newly established observation plots be collected at least within the first 5 years and periodically afterward (every year at least for first 5 years, every 2-3 years afterward).

2. It is also recommended that a coordination team be formed consisting of representative management of observation plot, management authority (Forestry Ministry and Forestry Service Agency), Scientific Authority (Research and Development Agency, LIPI and Universities) and community groups for consistent monitoring.

3. In order to make usefule use of the data, it is recommended that the collected, compiled data are immediately reported and processed by designated research institution.

Reference

Alder, D. and T.J. Synnott. 1992. Permanent Sample Plot Techniques for Mixed Tropical Forest. Tropical Forestry Papers 25. Oxford Forestry Institute Department of Plant Sciences University of Oxford.

PART VI. FLOWERING – FRUITING AND SEED PRODUCTION

Earlier record indicated that the flowering and fruiting of ramin (*G. bancanus*) occurs every year. Recent records show irregular and interval flowering of ramin with peak flowering season takes place. The change in flowering behavior has been predicted to be influenced by the change of habitat and population structure which causes gradual decreases in flower, fruit and seed production.

Seed source inventory conducted in 2007 indicated that seed sources of ramin, such as seed stand, seed production areas have been very limited. Therefore, the overall seed production potency has decreased significantly and the seeds available for artificial regeneration has also become limited.

In order to ensure seed production, monitoring for flowering and fruiting in the remaining seed sources still need to be carried out. The monitoring is aimed to estimate the appropriate time for seed collection and production and to obtain information on flowering behavior as well as phenology. A technical guideline for monitoring of flowering-fruiting and seed production (Manual monitoring musim berbunga-berbuah dan produksi benih ramin) has been developed. The technical guideline (Indonesian) is downloadable from FORDA Web.

6.1. Phenology

According to previous record, ramin flowers and produces seeds every year. Since 2005, based on occasional monitoring in both Sumatra and Kalimantan, there was no mast flowering ever since. In 2007, there was a report that ramin produced a few flowers in a concession area of Putra Duta Indah Wood, Jambi, but not sufficent to produce seeds. Most of seeds were reported as attacked by seed predators.

Nearly similar pattern also reported by Ismail *et al.* (not dated) based on intensive observation of ramin in Pekan Forest Reserve, Pahang, Malaysia. Ismail *et al*. (not dated) also recorded the information regarding the interval flowering of ramin in this area.

Until today, there is no information regarding the first flowering event of ramin for individual tree. It is predicted that ramin with diameter over 30 cm dbh has been speculated to start flowering and fruiting. However, the flower and seed production is largely dependent on crown size, stand density and other environmental conditions.

The flowering season varies from one to other places. Recorded flowering-fruiting events based on various records are presented in Table 1.

Tabel 1. Recorded flowering-fruiting season

Locations	Recorded flowering/fruiting season/Seed collection	Sources of information
Riau, Sumatra	Fruiting: February	Istomo, 2005
Jambi dan South Sumatra	Flowering: September – October Fruiting: April - May	Bastoni, 2005
West Kalimantan	Flowering: February– March or September - October Fruiting: May – June and mature in April	Alrasyid, 2005
	Flowering: Agustus – December Fruiting: Oktober – December, and mature in December - January	Istomo, 2005
Central Kalimantan	Flowering: April - May Fruiting: June- Agustus	Istomo, 2005

Source: Komar, T.E. (2005).

6.2. Flower Stimulation

There is no information availlable regarding the result of flower stimulation trial on ramin. For other species, both broadleaf and conifer species, flower induction through various stress treatment, fertilizer and other treatment have been conducted. Flower production for some species has been successfully influenced by stimulation. For broadleaf species, treatment with paclobutrazol have been reported successful, especially for arboriculture species. Various hormones have been tried for conifer species. In relation to this possibility, it is recommended that the flower stimulation be conducted for ramin. Treatment other than chemical, could be used such as stress treatment, fertilizer treatment and thinning.

6.3. Seed Handling

Seed viability of ramin decreases very rapidly, especially if the handling from collection, processing and storage is not properly carried out. Research on seed storage of ramin is still limited, since seed production itself is still a problem. Based on physyical appearance and the difficulty in seeds storage, ramin seeds have been classified as recalcitrant seed, which is impossible to reduce moisture content and to extend storability.

There are several factors influencing the storability of ramin: seed condition at harvest, moisture content ,and storage methods. Sound and mature seeds collected at the appropriate time will have a good chance to produce high quality seedling. The collected seeds should be free from animal attack, having a suitable moisture contents will have chance to be stored with relatively high viability.

6.4. Seed Storage

If seed storage is unavoidable, storage condition below could be selected as follows, stored inside porous storage container, place in air conditioned room with temperature ranges from 18 to 20°C and humidity ranges from 50-60%.

6.5. Recommendations

1. It is necessary to annually monitor the flowering and fruiting of ramin to obtain information on the appropriate time for seed collection, flowering behavior and other aspects related to seed production by local institution.

2. It is also recommended to use the manual for seed handling for operational seed collection by field institution.

References

Ismail, P. *et al*. (not dated). Phenology of an Important Peat Swamp Forest Species: *Gonystylus bancanus*. Journal of Tropical Forest Science.

Komar, T.E. 2005. Konservasi dan Pembangunan Hutan Ramin di Indonesia Melalui Regulasi Perdagangan dan Pemacuan Alih Teknologi Konservasi, Penanaman, dan Teknik Silvikultur. Prosiding Semiloka Nasional. Pusat Penelitian dan Pengembangan Hutan dan Konservasi Alam dan ITTO PPD 87/03 Rev. 2(F). Bogor.

PART VII. VEGETATIVE PROPAGATION

Supra-annual flowering and fruiting season of ramin with limited seed production and relatively difficult seed handling (short storability), vegetative propagation is becoming one of the important alternatives for seedling propagation.

Propagation trial using stem-shoot cutting has been conducted for ramin. This technique has been successfully developed for ramin using full control of environmental conditions, temperature, light intensity and humidity.

Figure 4. Vegetative propagation trials; A. Stock plant; B. Cutting position; C. New shoot of ramin

Controlled environments are achieved through Fogging cooling nursery system (KOFFCO). Using this nursery, over 90% of the vegetative stem-shoots are successfully grow and produce roots within 11-12 weeks or nearly four months period. The temperature ranges to 30°C, humidity nearly over 95% of humidity inside the propagation chamber and light range from 10,000-14,000 lux. This environmnetal condition has been desribed in detail in the A technical guideline (manual) "Guideline for vegetative propagation techniques **(*Pedoman Pembuatan Stek Pucuk pada Ramin*)**. The manual, in Indonesian, could be downloaded from www.forda-mof.org/ramin or www.forda-mof.org. The brief outline of the propagation is shown in Figure 5.

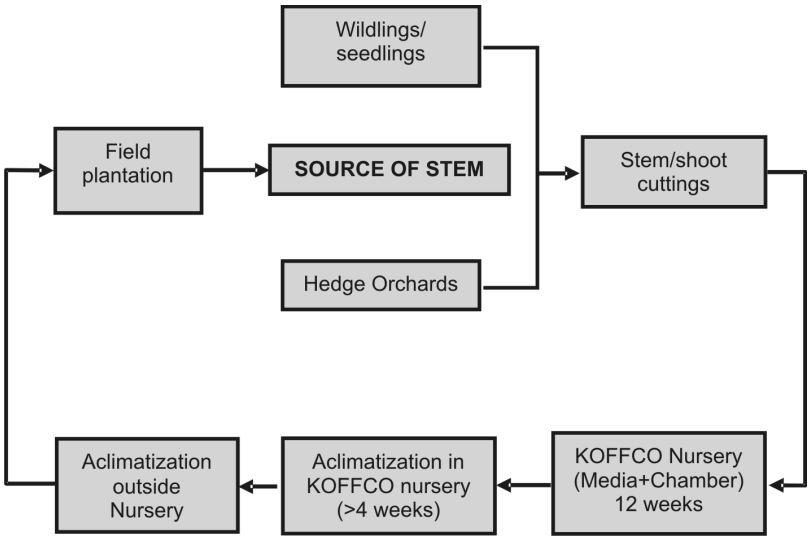

Figure 5. Flow chart for production of vegetatively propagated seedlings (up to 12 months before field planting).

7.1. Recommendations

1. It is necessary to continuously produce planting materials for ramin for ensuring continuous plantation activitiy both in Sumatra and Kalimantan using both seeds and vegetative cuttings.
2. It is also recommended to use the manual for vegetative propagation. Based on the implementation, consider whether there is a need for futher impvement of the manual.
3. In order to test the appropriateness of the manual, and necessary for future adjustment, it is recommeded that the munual is followed and tested

7.2. Strategic Plan

In order to continuosly produce ramin planting materials from stem cuttings, it is recommended that stock plants as sources of cuttings established in as many places as possible. This is since harvesting (cutting) cycle of cutting after previous cutting is executed nearly 12 months. The source of cuttings could be any stage of tree development, however, until recently the cuttings are cut from seedlings, not yet from mature species. Approximately 10,000 stock plants will be available to be used for vegetative propagation in Central Kalimantan. Assuming 80% of the stems are rooted and grow 8,000 planting materials will be available per year and at least 10 ha per year of PSF could be rehabilitated using indegenous species of ramin.

PART VIII. OVERALL CONCLUSIONS AND RECOMMENDATIONS

8.1. Conclusions

1. Existing peat swamp forests in Indonesia could be divided into four condition of forests, namely (1) primary forest, (2) logged over forest of in currently active concession companies (IUPHHK), (3) ex-concession forest area which has been becoming a mixed secondary forest and (4) ex-concession forest area which has been forming a scrub-land.

2. The existing silvicultural system have not been fully implemented in PSF causing some degradation and unproductive areas of PSF.

3. The existing PSP/TSP have not been fully utilized for monitoring biological and ecological data of PSF including for growth rate, yield and population dynamics.

4. Current management of PSP faces several challenge, range from the poor implementation of rules and regulation, lack of supervision and limited skilled human resources.

5. Development, maintenance and measurement of PSP in PSF were hampered by severe field conditions, such as encroachment, forest fires and the uncertainty of forest status.

6. There are 13 observation plots established for collecting biological-ecological data required for determining sustainable harvest of ramin and other species in PSF. Nine observation plots are located in Sumatra and 4 observation plot are located in Kalimantan.

7. Current records indicate that ramin flower and produce seeds irregularly and even considers as supra-annual which directly influenced by habitat condition and microclimate change.

8. The newly developed technology for provision of planting materials for ramin has been available using stem/shoot cutting in KOFFCO Nursery System.

8.2. Recommendations

1. In order to achieve sustainable management of PSF, it is recommended the revised draft of silvicultural system be implemented, supervised and if necessary to be further improved.

2. The existing rules and regulation, procedures and guideline related to silvicultural system (i.e P. No. 11, 2009 and its proposed improvement) need to be consistently implemented.

3. The existing PSP/TSP and newly established observation plots which consists of 13 Observation Plots need to be regularly monitored to obtain sufficient scientific data for determining sustainable harvest of ramin and other species in PSF.

4. In order to obtain information on flowering behaviour, seed production on ramin regular monitoring and intesive studies on phenology and ontogeny need to be carried out.

5. In order to sufficiently provide planting materials for ramin, stem (shoot) vegetative propagation technology should be applied as an important alternative way for seedling propagation.

LIST OF PUBLICATIONS

1. The Evaluation of the Silvicultural System in Peat Swamp Forest Area in Indonesia (*Evaluasi Sistem Silvikultur Hutan Rawa Gambut di Indonesia*) - **Published** for general distribution.

2. Draft Revision Silvicultural System in Peat Swamp Forest Area (Draft Revisi Sistem Silvikultur di Hutan Rawa Gambut) – **published for internal distribution.**

3. Review and Evaluation of Permanent Sample Plot of Peat Swamp Forest) (Tinjauan dan Evaluasi Petak Ukur Permanen di Hutan Rawa Gambut) – **Technical Report, Published for internal distribution.**

4. Design and Establishment of Ecological Observation Plot and Population Dynamic of Ramin and other species in Peat Swamp Forest in Sumatra and Kalimantan; Book 1: Main report (Desain dan Pembuatan Plot Pengamatan Ekologi dan Dinamika Populasi Ramin dan Jenis-jenis lain pada Hutan Rawa Gambut di Sumatra dan Kalimantan; Buku I: Laporan Utama) – **Technical Report, published for internal distribution.**

5. Design and Establishment of Ecological Observation Plot and Population Dynamic of Ramin and other species in Peat Swamp Forest in Sumatra and Kalimantan; Book II: Data base Phase I (Desain dan Pembuatan Plot Pengamatan Ekologi dan Dinamika Populasi Ramin dan Jenis-jenis lain pada Hutan Rawa Gambut di Sumatra dan Kalimantan; Buku II: Data base Hasil Pengukuran Tahap I) – **Technical Report, published for internal distribution.**

6. Technical guideline for monitoring flowering of ramin (*Gonystylus bancanus*) (Manual Monitoring Musim berbunga – Berbuah dan Produksi Benih Ramin (*Gonystylus bancanus*)) – **Published for general distribution.**

7. Technical guideline for vegetative propagation on ramin (*Gonystylus bancanus*) (Pedoman teknis pembuatan stek pucuk ramin (*Gonystylus bancanus*) – **Published for general distribution.**


STAKEHOLDER CONSUL ON SILVICULTURAL SYSTEM
AND SUSTAINABLE MANAGEMENT ON RAMIN
Bogor, 22 July 2009


A SHORT TRAINING WORKSHOP
ON THE MANUAL FOR MONITORING FLOWERING


PT DIAMOND RAYA TIMBER
LOKASI PERSEMAIAN
UNIT 1 LUAS 1Ha
JENIS
RAMIN, SUNTAI,
MERANTI DAN
KOMERSIL LAIN

ISBN 978-602-8964-02-9