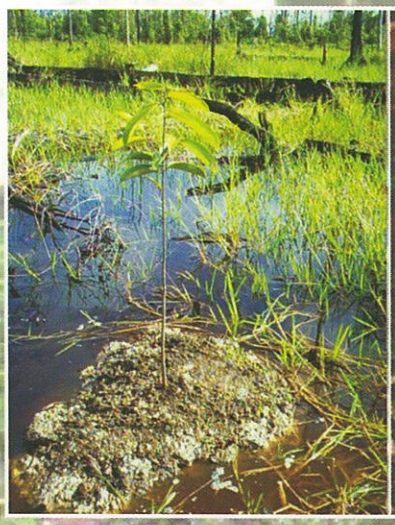
BARRIERS IN RAMIN PLANTATION ACTIVITIES

TECHNICAL REPORT NO. 04

ITTO PPD 87/03 REV. 2 (F)

IDENTIFICATION OF *GONYSTYLUS* SPP. (RAMIN) POTENCY, DISTRIBUTION, CONSERVATION AND PLANTATION BARRIER



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IDENTIFICATION OF GONYSTYLUS SPP (RAMIN) POTENCY, DISTRIBUTION, CONSERVATION AND PLANTATION BARRIER

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PREFACE

Ramin (*Gonystylus bancanus* (Miq) Kurz.) is one of the most important species growing in tropical peat swamp forest in Indonesia. Due to over eploitation, its population decreased sharply in last several years. To prevent further degradation of its population and habitats, ramin exploitation has been banned since 2001. The permit to harvest ramin is granted to one forest concession only who hold certificate of sustainable forest management from Indonesia Ecolabeling Institute. In response to this ban, plantation activities are widely promoted. However, there are several barriers in plantation of ramin. ITTO provides financial support to identify those potential barriers through ITTO PPD 87/03 Rev. 2(F). Survey to identify the barriers has been conducted in four provinces i.e Riau, Jambi, West Kalimantan and Central Kalimantan.

The results indicated that some barriers in ramin plantation include: (1) Uncertainty of forest area allocated for ramin, (2). Unavailability of appropriate silviculture technique, (3). Unavailability of seed sources, (4). Irregular Flowering and fruiting of ramin, (5). Short stability of seed, and (6). Lack of incentive to plant ramin at large scale

The above barriers are needed to be overcame in order to promote ramin plantation and rehabilitation success in both Sumatra and Kalimantan.

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Project Coordinator

ABSTRACT

Indonesia has the fourth largest peat forest in the world and the first largest tropical peat. One of the famous tree species in peat-land forests is ramin (*Gonystylus bancanus* (Miq) Kurz.). Because of an over exploitation, the ramin population have been decreasing sharply and the species tend to be nearly extinct. Since the year of 2001, logging and trading of ramin trees harvested from natural forest had been prohibited. The exception is given to the forest concessionaires which hold eco-label certificate. In addition, ramin is listed in Appendix II of the CITES in the year 2004. Conserving ramin and its habitat is needed in order to fulfill the wood demand by establishing ramin plantation in either production or conservation forest areas. Therefore, it is necessary to identified barriers in ramin plantation activities. The ITTO Pre-Project PPD 87/ 03 Rev.2 (F) (Identification of ramin plantation activities and plantation barriers) with the objective is to provide sufficient data on ramin plantation activities and plantation barriers was carried out from February to April 2005 by means of literature review and field survey. Direct observation including interview of resource persons was conducted in four provinces, where peat-swamp forests and ramin species existed, i.e. Riau, Jambi, West Kalimantan and Central Kalimantan. The barriers in establishing and developing ramin plantation consist of internal and external factors. There are three main barriers cause in achievement of sustainable peat-swamp forest management, namely uncertainty of forest area status, not well-mastered in silvicultural technique and in availability of feasibility study on socio-economic and environmental aspects. Several programs and activities have to be conducted to overcome the main barriers in ramin plantation activities.

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I. INTRODUCTION

1.1. Background

Industrial plantation forest (Hutan Tanaman Industri/ IPF) have been developed since 1985 in line with decreasing of wood supply from natural rain forest. The main purpose of IPF establishment was to guarantee supply of raw material of forest product industry such as construction wood, pulp, rayon and paper as well as luxury woods. The other purpose was to decrease deforestation of natural forest. However, supply of wood materials, which was hopefully fulfilled from the IPF was not realized since the wood production from the IPF was still low. Based on data from the Direktorat Bina Pengembangan Hutan Tanaman, Direktorat Jenderal Bina Produksi Kehutanan, production of wood from the IPF was only 3.5million m^3 per year. On the other hand, estimated supply of wood from the IPF started from the year of 2000 reached 90 million m^3/year, with assumption that wood's volume increment was 15 m^3/ha/year (Suseno, 2000). The low production of plantation forest, among others because of slowly progress of planting activities (the IPF areas up to the year 2001 was only 1.93 million hectares from 6.2 million hectares of planned area), less fertile of the plantation land, low quality of planting stock and un-appropriate species-site matching.

So far, establishment of IPF was only in dry land forest areas by planting dry land tree species. There is still less attention to peat-swamp forest as a habitat of peat-swamp tree species. Although, condition of the peat-swamp forest has been degrading and the potency has been declining to an apprehensive level.

Degradation of forest caused by uncontrolled logging, forest fire and forest conversion to other uses increases continuously. Deforestation rate in Indonesia in the period of 1985 to 1997 reached 1.7 million ha per year (FWI/GFW, 2001), whereas in 1999/2000, more than 2.3 million ha forest have been destroyed (Departement Kehutanan, 2003). Smoke haze that is produced by forest fire is one of the important negative effects of forest fire to the health of human being and environment. Forest fire, which is happens every year during dry season has caused environmental problem not only for Indonesia but also for neighbour countries. Forest fire will produce bigger smoke if it happens in peat forest. Indonesia has the fourth largest peat forest in the world and the first largest tropical peat. One famous tree species in the peat-land forest is ramin (*Gonystylus bancanus* (Miq.) Kurz.). In the year of 1983, Forestry Department estimated that the area of peat forest, which has potency of ramin was more than 13 million hectares. Therefore, Indonesia represents the biggest producer of ramin wood in the world and then is followed by Malaysia (Peninsular of Malaysia, Sabah and Serawak).

Ramin (*G. bancanus*) is a luxury tree species. High demand of this wood has lead to over exploitation that had been occurred during last two decades. Hence, the ramin population decreased sharply and the species tended to be nearly extinct. By comparison of two series of data (data in years of 1983 and 2002) about area of peat-swamp forest and ramin potency, it was estimated that the peat-swamp forest area decreased to be 53.6% and ramin potency declined to be 11.4 % of the initial potency (Bismark *et al*, 2005. in press).

In order to protect the population of ramin in nature, since the year of 2001 there had been a ban on ramin logging and trade (moratorium of ramin logging and trade) based on decree of Forestry Minister No. 127/Kpts-IV/2001, except for forest concession right holder which had got eco-label certificate could conduct logging by recommendation from Lembaga Ilmu Pengetahuan Indonesia (LIPI/Indonesian Institute of Science). Based on the CITES conference in Bangkok, Thailand 3 to 14 October 2004, the ramin wood was included into Appendix II of the CITES (Anonimous,

2004). This means that trading of ramin wood has to be controlled internationally and logging of ramin can be conducted on plantation forest or man made forest only. Consequently, ramin plantation has to be established and developed in large scales. Ramin plantations should be established either in production forest or in conservation forest areas. Plantation of ramin in production forest areas is mainly aimed to provide ramin woods, both for domestic and international consumers. Whereas, the purpose of ramin plantation in conservation areas is to conserve ramin population and it's habitat.

Establishment of ramin plantation requires comprehensive knowledge and skill especially on silviculture aspect by field manager and staff. Besides, plantation barriers that may be occurred should be identified. Further, programs and activities to study and to solve the identified barriers have to be constructed.

1.2. Objective

The objective of the ITTO Pre-Project PPD 87/03 Rev.2 (F) Identification of ramin plantation activities and plantation barriers, especially for activity 1.2.2 is to provide sufficient data on ramin plantation barriers.

1.3. Methods

Activities of the ITTO Pre-Project PPD 87/03 Rev.2 (F) Identifications of ramin plantation activities and plantation barriers were carried out from February to April 2005. There were two methods used, i.e. literature review and field survey. Literature review was conducted in National Library, Library of LIPI, Research Institutions, Universities, Province and District Forestry Services, State and Private Companies as well as non-government organizations. The review was focussed on constrains and problems in ramin plantation activities, including forest management and silviculture, properties and uses of wood and non-wood product of ramin.

Field survey was conducted by means of interview and direct observation. Method used to determine respondent institutions was purposive stratified sampling. There were three strata of respondent's institutions, i.e. government (as regulator and/or executor), company and non-government organizations (as executors). The government institutions were province/district forestry services where peat-swamp forest and ramin species existed, and other organizations that were involved in ramin plantation activities. There were 14 institutions of respondents: 10 governments, 3 companies and 1 non-government institution in four provinces, namely Riau, Jambi, West and Central Kalimantan. The total respondents were 18 persons. The direct observation was also carried out in those four provinces at several sites of ramin plantations.

The identified barriers were tabulated and classified as internal and external factors. Further, those data were analyzed by using a problem tree diagram to determine the main barriers in ramin plantation activities in Indonesia. Finally, programs and activities that should be conducted to study and to solve the barriers were constructed.

This report presents data and information on barriers that may be faced in establishing ramin plantation forest as well as programs and activities that should be conducted to study and to overcome the barriers.

II. LITERATURE REVIEW ON RAMIN PROPERTIES AND MANAGEMENT

2.1. Botanical Properties, Ecology and Growth Behavior

Review and current status of ramin plantation activities has been discussed in the technical report of activities 1.2.1. Ramin is the trade name of timber from a group of species, which belong to *Gonystylus* genus. Although it has 30 species, however, there are only 6 or 7 species, which are known as large trees. One of those species is Ramin (*G. bancanus*). Ramin is known and very popular both in terms of timber quality and value. A ramin tree is ecologically and morphologically easy to recognize in forests. The freshwater swamp or peat swamp forest habitat appears to be almost unique in the genus (Soerianegara and Lemmens, 1994).

The ecology of the most important species *G. bancanus* differs from the others. In a few heath forests on podzol, *G. bancanus* is often found in association with *Calophyllum* spp, *Dryobalanops* spp, *Kompasia malaccensis*, and *Shorea* spp with trunk diameter is usually less than 75 cm. *G. bancanus* prefers flat land without influence of tidal water and an acid, rather poorly drained soil (Soerianegara and Lemmens, 1994).

Appearance of ramin tree in the forest is very impressive and easy to be identified. The height of ramin trees are up to 42 m tall. The boles are cylindrical, straight, branchless for up to 21 m. The trunk diameter up to 60-120 cm, buttresses are thick if present. The bark surfaces are smooth to cracked, shallowly fissured or scaly, dull gray to red-brown or dark brown in color, occasionally with white patches. The inner bark is yellow, brown, pink or orange, laminated or fibrous, with glistening slightly irritating fibers on the cut surface. The twigs are striate, black or chocolate brown, pendulous (Soerianegara and Lemmens, 1995). Inner bark contains numerous fine, brittle fibers, which break off and irritate the skin (Anonymous ,1953).

Ramin trees are reported not produce fruit every year (Supriyanto and Witjaksono, 1994) and the fruiting season is different among various locations (Alrasyid and Soerianegara, 1978). Flowering and fruiting of *G. bancanus* trees are at comparatively short but irregular intervals. In West Kalimantan the flowering time is August to October and in Central Kalimantan during April to May. Soediarto *et al* (1963) reported that ramin produce flowers in some regions during February to March and in the other regions in September to October. After 2 to 3 months of flowering season, fruiting season of ramin trees was coming. In West Kalimantan ramin trees were fruiting during October to December and the fruit will be mature from December to January (Alrasyid and Soerianegara, 1978). According to Soediarto *et al.* (1963) ramin trees produced fruit from May to June.

Ramin seeds have the characteristic of recalcitrant (Supriyanto and Witjaksono, 1994). Therefore, they must be planted as soon as possible after collecting. The germination vigor will reduce sharply when the seeds are stored for more than two weeks without treatments. Water content of the seeds should be maintained during its transportation from the forest by putting the seeds in a moist gunnysack under shading. Kartiko (1998) reported the seeds could be stored mixed with moist sawdust in a covered plastic bag in a room with temperature 18 to 20°C for two weeks to maintain the germination vigor higher than 80%. Actually, the germination vigor of the seeds can be kept higher than 80% for three months period of storage, but several of the seeds will germinate during those period. Hence, to avoid a bent stem, the storage bag should be substituted with an impermeable box. Figure 1 described a ramin tree, the twig, the flower and the fruit.

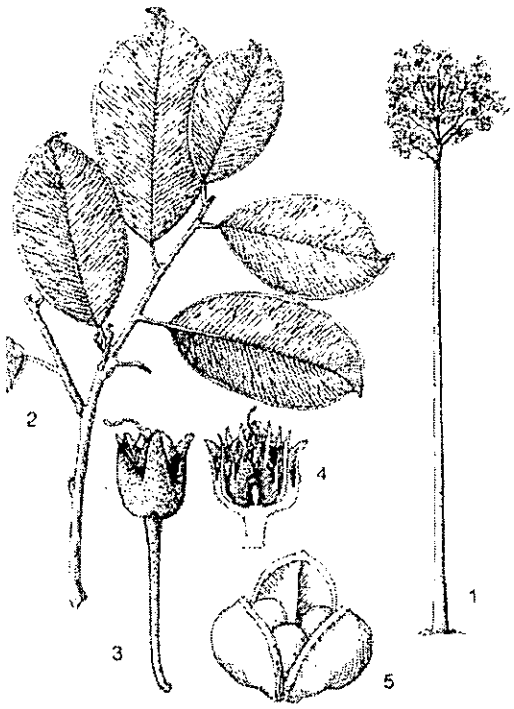


Figure 1. Description of *Gonystylus bancanus* (Miq.) Kurz. 1.tree habit; 2. sterile twig; 3, flower; 4, sectioned flower; 5, dehisced fruit.

Source: Soerianegara and Lemmens. 1994.

2.2. Forest Management and Silviculture

In Indonesia, ramin peat-swamp natural forest is managed through the Indonesian selective felling and planting system regulation (TPTI silvicultural system). Based on Decree of Directorate General of Forest Utilization number 564/Kpts/IV-BPHH/ 1989 and number 24/Kpts/IV-Set/96, limit diameter of tree cutting in peat-swamp forest was 40 cm and a cutting cycle was 40 years. At least 25 healthy trees per ha with the trunk diameter more than 20 cm should be left as core trees.

Access to the swamp forest, where ramin grows is often very difficult because of the spongy soil, stagnating water and the presence of fallen branches and trees. The trees are mostly harvested manually but chain saws are used for felling and cross cutting. Logs are hauled on wood sleds by man's power. Then the logs are transported to log yard by railway. During the logging activities, usually the felled tree destroy the seedlings or saplings of various species, including ramin. So selective cutting is not only reduce the number of old trees, but also young trees (seedlings and saplings).

As required by TPTI guideline, after logging, forest concessionaires (HPH) should do planting on felling areas or other open areas. However, the success was difficult to evaluate due to low accessibility of the area. The concessionaires normally carried out regular assessment of standing stocks before and after felling. However, the output is rarely verified by local government and never published as data and information validly.

Soerianegara and Lemmens (1994) suggested that in order to halt the over exploitation of ramin natural forest, the amount of harvested and

traded timber should be restricted. Logged over forest should be regenerated by means of enrichment planting, and large areas of swamp forest should be designated as protected reserves.

Soehartono and Mardiastuti (2002) reported that efforts to control international trade and to conserve ramin has been proposed at the beginning of 1992 in order to include ramin to Appendix II CITES. At that time, Indonesia and Malaysia successfully fought against the proposal, arguing that the population status of ramin was in no way threatened. On 11 April 2001, through the Minister of Forestry, Indonesia decide to impose a ban on any attempts to log ramin and trade the species for both domestic and export markets. Simultaneously, Indonesia transmitted a notification to the CITES Secretariat that Indonesia's ramin populations should be included in Appendix III (Ministerial Forestry Decree No. 127/Kpts-V/2001). At present, there is only one concessionaire, which is allowed to harvest ramin, and has received a certificate of sustainable harvest namely, PT. Diamond Raya Timber. In 2004, based on the CITES conference in Bangkok, Thailand, the ramin wood was included into Appendix II of the CITES (Anonymous, 2004).

Based on the results of data collection on current status of plantation activities indicated that ramin plantation on the field was very limited and the ramin plantations were still within research or planting trial scales. The problems were uncertainty of forest areas status due to forestland conversion or forestland occupation, low accessibility of the areas, ramin cutting cycle is very long, scarce of seed source, flood and fire. Nevertheless, based on several literature reviews and field survey, the propagation and producing of ramin planting stocks were not difficult, especially through shoot cutting. However, sources of seeds and wildlings for cutting were become problems due to mother trees or ramin seed stand was rare.

Political will of the governments, either central or local forestry agencies are needed to support and to achieve sustainable forest management especially in peat-swamp forest as habitat of ramin species.

2.3. Uses and Feature of Wood and Non-Wood Product of Ramin

The timber of ramin is highly prized and popular as a decorative cabinet timber. Generally, it is suitable for furniture, interior decoration such as wall paneling, light flooring, toys, turnery, broom handles and other non-impact handles, Venetian blind slats, dowels, rulers, picture frames and drawing boards. Ramin wood can be used for light constructions under cover such as door and window frames, mouldings, skirtings, ceilings, partitions, stair treads and counter tops (Martawijaya *et al*, 1986). Various other applications are planks, barrels, boxes and shipboards. Ramin is very suitable for veneer, plywood and blackboard manufacture and can be made into a satisfactory quality of particleboard (Soerianegara and Lemmens, 1994).

The resin impregnated pathological heartwood of several species is well known as 'gaharu' or 'kayu garu' and is used as incense oust like *Aquilaria* spp. The pounded fruits are sometimes used as a fish poison. A decoction of the roots of several species is administered after childbirth as a protective medicine (Soerianegara and Lemmens, 1994).

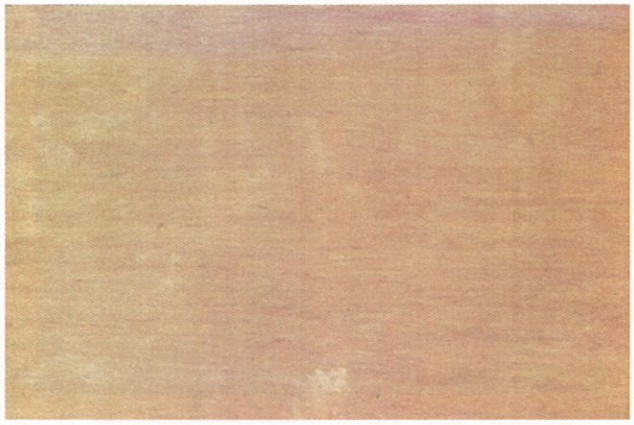
Soerianegara and Lemmens (1994) reported, good veneer can be produced from ramin wood at peeling angle of 92° 30' without pretreatment, but mild soaking in hot water renders peeling easier. Ramin wood is easy to work with hand tools as well as machines. It is easy to saw and plane in both green and dry condition. It can be easily worked into smooth mouldings. Turning gives quite good results, but boring produces rough surfaces. The wood can be stained and polished well, and glued with all types of glue. Ramin is prone to splitting when nailed, so pre-boring is recommended.

Ramin is a lightweight to moderately heavy hardwood. The heartwood is white to yellowish-white or yellow, sometimes weathering to straw-colored, and not distinctly demarcated from the 3-6 cm thick sapwood. The grain is straight or shallowly

Interlocked, texture moderately fine to moderately coarse and even. The wood surface is slightly lustrous and lacks a conspicuous figure. Ramin dries fast, but it is slightly susceptible to end splitting, cupping and warping. The use of an end coating can minimize end splitting (Soerianegara and Lemmens, 1994).

The wood is susceptible to blue stain and ambrosia beetle attack, but resistant to dry-wood termites and wood-rotting fungi is poor. Ramin is, however, easy to treat with preservatives. The inner bark contains numerous fine brittle fibres, which may cause skin and eye irritation, and wood dust has been reported to cause occupational asthma. Fresh wood has an unpleasant smell. In depots the logs are sprayed with preservatives. This is necessary, as they are very susceptible to blue stain and insect attack. In Sarawak a mixture Of benzene hexachloride, sodium pentachlorphenate, borax and water (5:1:2:10) is used for dipping, in West Kalimantan agrocide (1/3 kg/m^3), borax (1/3 kg/m^3) and sodium pentachlorphenyl (2 kg/ml) (Soerianegara and Lemmens, 1994). Figure 2 describes the ramin wood and the bark.

According to Soerianegara and Lemmens (1994), some timbers which are good substitutes for ramin, e.g. perupok (*Lophopetalum* spp.), which is particularly harvested in East Kalimantan. Rubberwood *(Hevea brasiliensis* (Willd. ex A.L. Juss.) Muell. Arg.) seems to be a promising substitute, as it can be planted easily, grows rapidly and has fairly similar wood properties. It was already planted on a large scale for the production of timber.



A

B

Figure 2. Ramin (*Gonystylus bancanus* (Miq.) Kurz.), A. the wood B. the bark.
Source : Martawijaya et al.,*1986*

III. RAMIN PLANTATION BARRIER BASED ON FIELD SURVEY

Attention, knowledge and skill about wetland, especially peat-swamp forest management are still lack up to now, while the area is a habitat of many commercial tree species as source of raw material of forest product industry. Peat-swamp area as a habitat of ramin tree species has specific characteristics, such as influenced by up and down of the tides, influenced by the depth of peat soil, as well as low fertility of the peat soil. Forest fire in peat-swamp area cause to decrease of the peat depth, then layer of hard and watertight mineral soil will be exposed (Bastoni and Sianturi, 2000). Consequently, roots of plants have difficulties to develop. Changing condition of ramin habitat ecosystem will affect in decreasing the capacity of ramin to regenerate.

Considering the specific ramin habitat, grow behavior and plantation management, plantation barrier can be classified into two major factors, i.e. internal and external factors. In the following part, constrains of ramin plantation will be discussed based on data and information collected from the field of four provinces where peat-swamp forest existed, namely Riau, Jambi, West Kalimantan and Central Kalimantan. Besides, reasons for planting and not planting of ramin trees are also discussed.

3.1. Internal Factors

Based on discussion and interview with several resource persons (experts) in the four provinces, among others are Forestry Service officials, Head of research institutes, researchers, forest concessionaires, as well as non government organizations, constrains faced in ramin plantation activities can be summarized into three aspects as follows:

1. Technical aspect
2. Ecological aspect
3. Aspect on transfer of knowledge and skill.

Detail of those internal constrains and stakeholders, who faced those constrains is presented in Appendix 1.

1. Technical aspect

The technical aspect comprises the following matters:

1. Silvicultural technique, starting from seed harvesting, seed treatments, propagation technique, nursery, seed transportation, planting technique, tending of plants until wood harvesting.
2. Techniques of land preparation to construct nursery infrastructure, inspection road, road for planting stocks and forest products transportation.

Scarce of seed stand as a source of seedlings was occurred in the most areas surveyed. As stated in Chapter I, decreasing of ramin potency up to 11.45% compared to the initial potency. This data in line with most information obtained from resource persons that mature trees of ramin that usually bear fruits and seeds were scarce. Actually, planting stock of ramin can be produced from wildling and shoot cutting. However, technology of the shoot cutting has not been understood yet, neither at province/district level staff nor at field level staff. Ramin trees do not bear fruit annually and wildlings with right size as a planting stock are not available over the time. The very low increment or very slow growth of ramin become a crucial barrier in developing ramin plantation. It needs a breaking technology to boost the ramin's growth. Ramin needs different light intensity during the stages of the growth. When ramin was young, it needs shade and gradually it needs full light after reaching adult stage. Planting technique is the other constrain in ramin plantation. On peat soils that usually flooded, ramin seedlings should be planted on piled soils.

The guideline of ramin plantation activities have been published by Soerianegara and Alrasjid (1976), but the information about ramin's growth in natural or in artificial environment is not complete. This is caused by the fact that demonstration plot for ramin planting trial has not been available in sufficient quantity and ages to support planting guidelines comprehensively.

Peat-land is the unique medium for ramin, in terms of physical or chemical aspects (soil fertility). Peat soil is dominated by water, the solid component is small in amount (with bulk density 0.1 - 0.2 g/cm^3). This condition cause the difficulties on supporting facilities construction, which are otherwise easily in the case of dry land, for instance construction of physical building inspection road, transportation road, etc. Based on experiences, silviculture activities on LOA depended very much on the existence of railroad. It will very difficult to conduct plant tending if the railroad has been dismantled. If the railroad is maintained, beside the need for expensive investment, it will need expensive maintenance, particularly for the use of sleeper that consumes small trees. Effort to construct limited amount of canal, probably could be conducted, but the danger of subsidence and over-drainage is always threatening. It should always be borne in mind that subsidence and over-drainage reduce the volume of peat and volume of water, as well as the soil fertility, because the nutrient that is produced from decomposition is accumulated in the peat liquid.

2. Ecological aspect

Ecological aspect comprises of interrelation between ramin's growth behavior and the site characteristics. As has been known, ramin grows specifically in peat-swamp forest. Tropical peat-soils that are originated from trees, occur in thick peat (up to 17 m deep). In such site, source of inundation water is only rainfall, and this is the reason why the tropical peat-land (commonly found in Indonesia) is categorized as poor in nutrient.

High fluctuation and long period of flood occurred in peat-swamp forest area is a crucial problem in Jambi Province, particularly in Berbak National Park. During dry season the peat soil become dry and inflammable, during rainy season surface of the peat soil is inundated and cause small ramin plants dead. Actually, this constrain can be solved by planting ramin seedling on a pile of soil, but this is costly. Canalization of peat-swamp area that was done in Riau and Central Kalimantan lead to susceptible peat soil on the forest fire. Further, the surface of the burnt peat soil will be decreased up to 50 cm at deep peat and up to 1 m at shallow peat (Bastoni and Sianturi, 2000). Then, layer of hard and watertight mineral soil will be exposed and roots of plants difficult to develop.

Based on the field observation, cutting ramin trees are rapidly and easily attacked by stem borer beetle (*Ambrosia beetle*) and need additional cost for spraying to protect the wood. Sometimes if insecticide, which is not environmentally friendly is used, then there will be a new problem arising.

3. Transfer of knowledge and skill

Ecology and silviculture of ramin as well as propagation and planting technologies have been understood comprehensively at the research institute. However, knowledge and skill on those subjects need to be transferred to the users by conducting specific trainings on ramin plantation covering planting stock propagation, planting and maintenance techniques. It includes skill in preparing and making the soil piles. Manual of ramin cultivation technique is crucial to be produced and disseminated.

3.2. External Factors

Based on discussion and interview with similar resource persons (experts) in the four provinces, there are constrains in ramin plantation activities under external factors. These can be classified into three aspects and listed in Appendix 2. The three aspects are:

1. Social and culture
2. Economic and business
3. Policy

1. Social and culture aspects

Social and culture aspects become constrains to establish and develop ramin plantation since the local communities do not have habitual in cultivating timber trees. They prefer not to plant ramin trees since this species take long period without additional product. The community usually gather forest product, either wood or non-wood product. Participation of local community in timber trees cultivation with no additional products generally is low. It caused they are still have opportunity to get wood and other forest product from natural forest areas. They prefer to plant timber trees with additional products such as latex or fruits. Those additional products can be harvested routinely and be used as sources of family income (monthly or weekly income). Planting of ramin trees is not beneficial for them, even though some of them use pounded fruits of ramin for fish poison and decoction of the roots for protective medicine after childbirth. However, such utilizations have not reached a commercial scale yet.

In contrary, ramin bark contains brittle fiber, which break easily and is able to irritate human skin causing itchiness and swollen skin. Psychologically, this phenomenon makes people tend to avoid close contact with the trees, and even probably they are reluctant to plant it.

2. Economic and business aspects

There are several barriers in terms of economic and business aspects stated by resource persons in establishing and developing ramin plantation. The main barrier is the man made forest of ramin is not feasible. This is because of very long life cycle of ramin (more than 50 years) and very high cost, either for initial establishment or for maintenance and monitoring of the plantation. Peat-swamp forest as habitat of ramin has specific feature, and it needs special treatments in order to establish ramin plantation, such as construction of soil piles and railway tracks. The long period of nursery, usually around 12 months, will also increased the cost of ramin plantation. Long life cycle of ramin plantation affect to uncertainty of the insvestment, it related to government policy on the forest and timber management. For that reason, low motivation to invest capital in ramin plantation was occurred in Indonesia. Even though ramin wood is high value, but companies or common people are prefer to plant fast growing multipurpose tree species, such as tengkawang (*Shorea* sp.) or jelutung (*Dyera lowii*) that can produce fruits or latex as additional products. As an alternative, government interventions in form of subsidize or incentive is needed to establish ramin plantation forest or mix plantation forest between multipurpose tree species and ramin.

A study on economic aspect of ramin plantation is necessary to carry out, especially related to business feasibility. Demand of the market on ramin wood is high with very high price because it's superiority, particularly in terms of decorative aspect. Ramin is categorized as luxurious wood, in the next rank after ebony. Therefore, a large scale investment in ramin plantation with high risk of failure, is still debate.

3. Policy aspect

Inconsistency of government policy on forest area or forestland management is the main barrier to develop ramin plantation. Forest enterprises need guarantee on definite forest area status, especially for ramin plantation with very long time of life cycle. It required consistency on land or forest area status, timber and forest product management as well as international timber trade policy. Law enforcement on illegal logging and forest encroachment was the other constrains to establish and to keep ramin plantation forest saved until harvesting time.

According to staff and head of Forestry Service of Central and West Kalimantan Provinces, planting of ramin species was contra-productive, because it was not permitted to exploit the ramin trees. Ramin should be planted in conservation forest areas, not in production forest area. Other barrier to plant ramin species was national or local government were not give priority to plant ramin in National Movement of Forest and Land Rehabilitation (GERHAN).

Result of the stakeholders interviewed on why ramin species be planted and not be planted shows:

- Reasons for planting ramin species were: (1) as conservation effort, (2) to achieve sustainability of ramin forest, (3) to participate on rehabilitation of burnt peat-swamp forest area, (4) to rehabilitate unproductive and burnt peat-swamp forest area, (5) as a research activity, (6) the area was ramin's habitat, (7) ramin has a high economic value, (8) ramin is an endangered species and (9) ramin is a protected species.

- Reasons for not planting ramin species were: (1) there was no a government program for developing ramin plantation, (2) cultivation technique of ramin species is not be understood, (3) ramin species is not provide additional products or income, and (4) cutting cycle of ramin stand was very long.

IV. ANALYSIS AND DISCUSSION

Chapter II described management and silviculture of peat-swamp forest, properties and uses of wood and non-wood product of ramin. Chapter III discussed internal and external barriers in ramin plantation activities. In this Chapter, main barriers in establishing and developing ramin plantation will be analyzed by using a problem tree diagram. To study and to overcome those main barriers, programs and activities that should be conducted were also discussed.

Based on scales and plantation areas, barriers in establishing and developing ramin plantation as described in Chapter III can be differentiated into three categories:

1. Enrichment planting in natural forest, covering:
   - Silviculture techniques are not well-mastered yet
   - No monitoring and evaluation caused by very low accessibility of the area.
   - Lack of control by the government
   - Lack of law enforcement on TPTI implementation
   - Conflict of land use and threat of forest conversion for other uses.
   - High of deforestation rate and land degradation caused by fire

2. Plantation forest in a big scale, consisted of :
   - Conflict of land use and threat of forest conversion for other uses.
   - High of deforestation rate and land degradation caused by fire
   - A financial analysis (a feasibility study) is not available yet
   - Technologies to improve ramin habitat are not available yet
   - Insufficient law enforcement
   - Difficult to find seed sources and planting stocks in a big scale
   - No additional product of ramin species
   - Very low growth increment
   - A unique habitat of peat-swamp forest (peat soil and flooded)
   - Low accessibility of the peat-swamp forest area

3. Plantation activities at research scale, covering:
   - Limited research period or no continuous of the research
   - Limited volume or size of the research
   - Threat of forest conversion for other uses.
   - Limited seeds source (scarce of ramin mother trees and they do not produce fruits every year)
   - Low accessibility of the peat-swamp forest area
   - Very low growth increment
   - A unique habitat of peat-swamp forest (peat soil and flooded)
   - High risk for environmental impact due to peat land clearing or land preparation for establishment of plantation forest.
   - Fertility of peat soil is categorized as poor.

Analysis of all barriers described above by using a problem tree diagram lead to three main barriers, i.e. :

1. Uncertainty of forest area status and law enforcement.
2. Not well-mastered in silvicultural technique
3. Unavailability of feasibility study on socio-economic and environmental aspects.

Those three main barriers cause in achievement of sustainable peat-swamp forest management as presented in Figure 3.

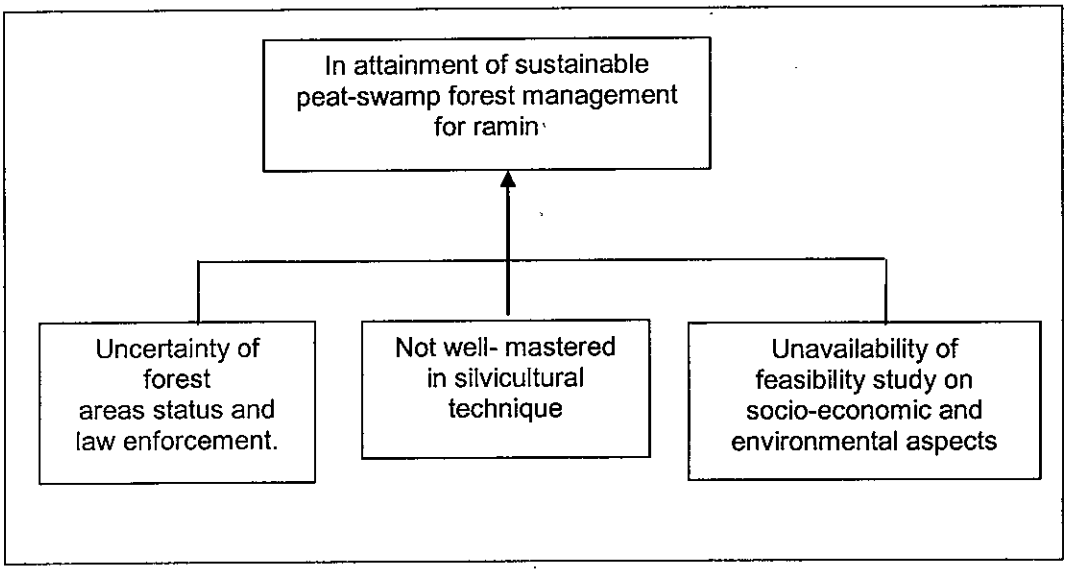


Figure 3. Three main barriers in ramin plantation activities cause in achievement of sustainable peat-swamp forest management

Grouping of barriers found in ramin planting in the field, into three main barriers, either enrichment planting in natural peat-swamp forest or plantation forest in a commercial scale, together with research and activities that should be done to overcome each main barrier, are listed in the following Table 1.

Table 1. Main barriers, barriers encountered and activities for overcoming ramin plantation barriers

Main barriers	Barriers encountered in the field.	Activities for overcoming the barriers.
Uncertainty of forest area status and law enforcement.	▪ Conflict of land use and threat of forest conversion for other uses. ▪ Lack of control by the government ▪ Lack of law enforcement on TPTI implementation ▪ High of deforestation rate and land degradation caused by fire ▪ Insufficient law enforcement	▪ Evaluate forestland use planning ▪ Study on social forestry and land tenure ▪ Enhance law enforcement and create a consistency government regulation in sustainable forest management ▪ Study on institutional arrangement among stakeholders involved (local/central government, local community and private sector) in ramin plantation activities
Not well-mastered in silvicultural technique	▪ Silviculture techniques are not well-mastered yet ▪ Technologies to improve ramin habitat are not available yet ▪ Difficult to find seed sources and planting stocks in a big scale ▪ Limited seeds source (scarce of ramin mother trees and they do not produce fruits every year) ▪ Very low growth increment ▪ A unique habitat of peat-swamp forest (peat soil and flooded) ▪ Fertility of peat soil is categorized as poor	▪ Conducting specific trainings to transfer the knowledge and skill on ramin plantation activities covering planting stock propagations, planting and maintenance techniques to the users ▪ Study on ramin propagation through tissue culture ▪ Establishment of hedge orchards as sources of shoot cuttings ▪ Determination and/or establishment of seed sources (seed stands and/or seed orchards) ▪ Study on growth and yield pattern of ramin ▪ Study on land preparation techniques in relation to peat water level and hydrological system in peat-swamp forest areas ▪ Study on site manipulation of ramin species and mechanism of nutrient availability ▪ Study on fertilization and mycorrhizal fungi inoculation
Unavailability of feasibility study on socio-economic and environmental aspects.	▪ Limited research period or no continuous of the research ▪ Limited volume or size of the research ▪ A financial analysis (a feasibility study) is not available yet ▪ No additional product of ramin species ▪ A unique habitat of peat-swamp forest (peat soil and flooded) ▪ High risk for environmental impact due to peat land clearing or land preparation for establishment of plantation forest	▪ Long term demonstration plot for ramin plantation is necessary with sufficient area size and distribution. ▪ Study a financial feasibility of establishment of ramin plantation forest ▪ Study plantation and management models of ramin and its impact on socio-economic condition of the surrounding community. ▪ Analysis environmental impact of establishment of ramin plantation forests, including carbon emission and sequestration

V. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

1. Barriers in ramin plantation activities consist of internal and external factors. Internal factor covers technical and ecological aspects as well as transfer of knowledge and skill on ramin cultivation and the ecosystem. External factor including social and culture, economic and business as well as policy aspects.
2. The barriers can be differentiated into three categories based on scales and areas of the plantation, i.e. enrichment planting in natural forest area, plantation forest in a commercial scale and plantation activities at a research scale.
4. Three main barriers, namely uncertainty of forest area status law enforcement, not well-mastered in silvicultural technique, as well as in availability of feasibility study on socio-economic and environmental cause in achievement of sustainable peat-swamp forest management.

5.2. Recommendations

Several programs and activities should be conducted to overcome the main barriers in ramin plantation activities, depending on main barriers encountered, namely:

1. For the main barrier of "uncertainty of forest area status and law enforcement" activities that should be conducted are as follows:
   a. Evaluate forest land use planning
   b. Study on social forestry and land tenure
   c. Enhance law enforcement and create a consistency government regulation in sustainable forest management
   d. Study on institutional arrangement among stakeholders involved (local/ central government, local community and private sector) in ramin plantation activities
2. For the main barrier of "not well-mastered in silvicultural technique" activities that should be conducted are as follows:
   a. Conducting specific trainings to transfer the knowledge and skill on ramin plantation activities
   b. Study on ramin propagation through tissue culture and establishment of hedge orchards as sources of shoot cuttings
   c. Determination and/or establishment of seed sources (seed stands and/or seed orchards)
   d. Study on growth and yield pattern of ramin
   e. Study on land preparation techniques in relation to peat water level and hydrological system in peat-swamp forest areas
   f. Study on site manipulation of ramin species and mechanism of nutrient availability and study on fertilization and mycorrhizal fungi inoculation
3. For the main barrier of "unavailability of feasibility study on socio-economic and environmental aspects" activities that should be conducted are as follows :
   a. Long term demonstration plot for ramin plantation is necessary with sufficient area size and distribution..
   b. Study a financial feasibility of establishment of ramin plantation forest
   c. Study plantation and management models of ramin and its impact on socio-economic condition of the surrounding community.
   d. Analysis environmental impact of establishment of ramin plantation forests, including carbon emission and sequestration

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APPENDICES

Appendix 1. Internal constrains in ramin plantation activities

No	Constrain	Faced by		
		Government	Company	University
A	**Technical**			
1	Development of canalization	Forestry Training Institute, Riau	-	-
2	Seedling preparation and planting technique (on flooded area)	▪ Forestry Services of Jambi Province ▪ Forestry Services of Tanjung Jabung District, Jambi ▪ Forestry Services of Central Kalimantan	PT. Inhutani II	-
3	Scarce of seed sources or seed stands	▪ Forestry Services of Jambi Province ▪ Forestry Services of Central Kalimantan ▪ Forestry Services of Tanjung Jabung District, Jambi	PT Inhutani II	▪ Research Institute of Untan, West Kalimantan ▪ CIMTROP, Central Kalimantan
4	Survival rate and increment are very low	-	PT. PIW	▪ Research Institute of Untan ▪ CIMTROP, Central Kalimantan
5.	Low accessibility of the area	-	Wetland International Indonesia Project	-
6	Low human resources	-	Wetland International Indonesia Project	-
B.	**Ecological**			
1	Fluctuation of the tide up to 2 m (flooded)	Berbak National Park Institute	Wetland International Indonesia Project	
2	Forest fire	▪ BP2HT-IBT ▪ Berbak National Park Institute	-	CIMTROP, Central Kalimantan
C.	**Tranfer of knowledge and skill**			
1	Need a training on technical aspect	-	▪ PT DRT (Riau) ▪ PT PIW (Jambi)	CIMTROP, Central Kalimantan
2	Need a manual of ramin cultivation	Forestry Service of Jambi	-	-
3	Shoot cutting technology has not understood yet	Forestry Service of Jambi	-	-

Appendix 2. External constrains in ramin plantation activities

No	Constrain	Faced by		
		Government	Company	University
A. Social and Culture				
1	The community has no culture in cultivating ramin trees	▪ Forestry Service of Riau Province ▪ Berbak National Park		
2	No additional product beside the wood	▪ Forestry Service of Riau and Central Kalimantan Provinces ▪ Forestry Service of Tanjung Jabung District, Jambi Province	PT. PIW	
3	Social culture of local community is not supporting			Research Institute of Untan
B. Economic and Business				
1	Unfeasible business (life cycle of ramin more than 50 years)	▪ Forestry Service of Riau Province ▪ Forestry Service of Jambi Province	▪ PT. PIW ▪ PT DRT	
2	High cost (especially in making soil piles)		Wetland International Indonesia Project	
3	Need government intervention (subsidize)	Forestry Service of Riau Province		
4	Low benefit and no budget available	Forestry Service of West Kalimantan Province		
5	Low motivation to invest in ramin plantation (not attractive)	Forestry Service of Central Kalimantan Province		
C. Policy				
1	RTRW (regional spatial planning) has not fixed yet	Forestry Service of Riau Province		
2	Law enforcement is weakness		▪ PT. Inhutani II ▪ PT DRT	
3	Inconsistent policy on forest area (uncertainty of forest area status)	Forestry Service of West Kalimantan Province	▪ PT PIW ▪ PT DRT ▪ PT. Inhutani II	Research Institute of Untan
4	Forest encroachment (occupied by the community)	Forestry Training Institute of Riau		
5	Illegal logging	▪ Forestry Training Institute of Riau ▪ BP2HT-IBT		
6	Plantation area should be in protected forest	Forest Service of Jambi, West Kalimantan and Central Kalimantan Provinces	PT PIW	
7	Need a regulation to incorpo-rate ramin as IPF component	Forest Service of Jambi Province		
8	Local government more			CIMTROP,