# INTERNATIONAL TROPICAL TIMBER ORGANIZATION

# I T T O

## PROJECT PROPOSAL

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| TITLE | PRODUCTION AND UTILIZATION TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT OF EAGLEWOOD (*gaharu*) IN INDONESIA |
| SERIAL NUMBER | PD 425/06 Rev.1 (I) |
| COMMITTEE | FOREST INDUSTRY |
| SUBMITTED BY | GOVERNMENT OF INDONESIA |
| ORIGINAL | ENGLISH |


**SUMMARY**

Eaglewood plays an important role in gaining foreign exchange and as a source of income for people living in around and inside the forest in Indonesia. However, at the mean time, its production has declined rapidly, due to lack of technology and limited dissemination of the inoculation technology. If no serious action to be taken, Eaglewood production would not be sustained. As a consequence, pressure on the natural forest will increase significantly.

This proposal is aimed at introducing inoculation technology to forest communities living in and around on the forest area. The inoculation technology will accelerate and promote Eaglewood productivity in the natural forest. Dissemination of the technology will be carried out by establishing sample plots in two places, i.e. West Kalimantan and a forestry research site in Banten province, covering a total area of 100 hectares. It is expected that artificial inoculums in large scale will improve communities' welfare and at the end reduce the pressure on the forest.

Activities of the project include cultivation technique, plantation trial plot, inoculum's production, artificial inducement and training for forest dweller. The most important benefits of the proposed project are increasing welfare of forest dwellers and local farmers, and boost foreign exchange earning that contributes to local and national income.


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| EXECUTING AGENCY | FORESTRY RESEARCH AND DEVELOPMENT AGENCY (FORDA)<br>MINISTRY OF FORESTRY OF THE REPUBLIC OF INDONESIA | |
| DURATION | 36 MONTHS | |
| APPROXIMATE STARTING DATE | UPON APPROVAL | |
| PROPOSED BUDGET AND OTHER FUNDING SOURCES | Source | Contribution in US$ |
| | **ITTO** | **499,975** |
| | Gov't of Indonesia (in kinds) | 119,250 |
| | **TOTAL** | **619,225** |

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## PART I. CONTEXT

### 1. Origin

Eaglewood or garro wood is one of the commodities of Non-Wood Forest Products (NWFPs) that plays an important role in gaining foreign exchange and as a source of income of people around and inside the forest. There are more than five genera that produce this resinous wood, covering Aquilaria, Wikstroemia, Enkleia, Aetoxylon, Gonystylus and Gyrinops (Sidiyasa. 1986; Whitmore and Tantra. 1989; Nusa Cendana University. 1996). Amongst these genera, Aquilaria and Gyrinops are known as the best plants to produce Eaglewood.

There are about six species that belong to genera Aquilaria covering *A. beccariana, A. cumingiana, A. filaria, A. hirta, A. malaccensis*, and *A. microcarpa* (Soehartono. 1997). *A. malaccensis,* one of the best species to produce resin wood, *is* grown restricted in Sumatra and Kalimantan. Other *Aquilaria* species are found in Irian Jaya, Kalimantan, Maluku, Sulawesi, Sumatra and West Nusa Tenggara, being distributed throughout natural forests (Soehartono and Mardiastuti. 1997; Wiriadinata. 1995). In Kalimantan, four species of *Aquilaria* are found scattered on ridges and slopes of well-drained land (Keller and Sidiyasa, 1994). These trees could also be found in Bukit Baka National Park; Gunung Palung National Park; Bintuang Karimun Reserve; Mandor Reserve; and Gunung Niut. The National Forestry Inventory (NFI) Database shows that *Aquilaria* species have adapted to various habitats in certain regions of West Kalimantan. Although widely distributed, the densities of Aquilaria stands are very low. The NFI Database gives approximate populations of *Aquilaria* species as 1.87/ha in Sumatra, 3.37/ha in Kalimantan and 4.33/ha in Irian Jaya (Soehartono and Mardiastuti. 1997). Moreover, surveys of Aquilaria have not been undertaken in all regions (Oetomo. 1995), so that population data are unavailable for *Aquilaria* spp., including for *A. malaccensis.*

Unlike other resinous products, Eaglewood is not tapped, but accumulates inside the tree and impregnates wood tissue to form aromatic nodules. It is produced only by tree infected with fungal pathogen that inducements resin formation.

Accounts of international trade in Eaglewood date back as early as the thirteenth century. India is one of the earliest sources of Eaglewood for foreign markets. Eaglewood is currently traded in large quantities. Over 700 tons of Eaglewood from *Aquilaria malaccensis* were reported in international trade in 1997, with exports from Indonesia and Malaysia taking the lead among approximately 20 reported countries of export/re-export. In the international trade, Eaglewood is in the form of wood, wood chips, powder, and `oil, although not identified in available trade data, almost certainly covering finished products such as perfumes, incense and medicines. Although overall trade volumes may appear small in 'timber trade' terms, they are not small in monetary terms. In international market, the best quality of Indonesian Eaglewood chip could reach around USD 4000-4400/kg; while Vietnamese Eaglewood could reaches USD 6000-13500/kg. The price of oil distilled from low Eaglewood quality is generally between five and ten thousand US dollars per kilograms, but can be significantly more for Eaglewood oil of exceptionally high quality (Barden. *et al.* 2000).

As mentioned previously that Eaglewood plays an important role as a source of income people around and inside the forest and in gaining foreign exchange. Up to 1998, Indonesia could export more than 300 tons per annum, but since 2000 from the export quota has been around 300 tones; it could only be fulfilled 15 %. The demand for Eaglewood currently far exceeds the available supply, which is naturally restricted owing to the nature of its formation. Eaglewood from *Aquilaria* trees, known to produce it, is only found in a small percentage. External signs of the presence of Eaglewood are not always obvious. As a result, *Aquilaria* trees are often cut down indiscriminately in the search for those containing Eaglewood. Moreover, the high value of Eaglewood products is also stimulating illegal harvest and trade in several countries. These have resulted in the fast depletion of eaglewood resources in tropical natural forests. Hence, other threats such as forest fires, forest conversion to plantations (including forest plantations), logging and land mining concessions also contribute to the demise of the resources. Declining in eaglewood supply finally leads to decrease in local people income. In National level, it also leads to the declining Indonesian export of this commodity, notably in 1999 from 313 ton to 175 ton in 2002.

Owing to Eaglewood plays important role in social welfare and foreign exchange earning as well as in reducing the tension to the forest, the Government pays attention to manage this commodity. In 1995, cooperation with UK tropical Forest Management program held a workshop. This meeting has identified (three) main problems and recommendations for the global Eaglewood developments. In the aspect of Eaglewood resources, the resource in natural tropical forest in Indonesia is being degraded due to over exploitation. Experts from various private sectors and growers in the country also considered great potential in the utilization of Eaglewood to enhance rural income through promoting plantation establishment and finding the cause of Eaglewood formation in trees. In 2001, government (Ministry of Forestry) held second meeting in this commodity with participated by various private and public sectors as well as NGO who concern on Eaglewood sustainability. This meeting came out with four recommendations. As follow up the first meeting, the development of Eaglewood plantation should be continued with paying attention on Eaglewood sustainability and the increase in local community's welfare. Further, Eaglewood quality should be developed to fulfill the requirement national and international market. In the last three years, Government (Ministry of Forestry) has initiated to document various publications and reports. Many Eaglewood experts from various institutions such as Indonesian Research Institute, FORDA, Universities, NGO, GTZ, ASGARIN, DG-LRSF, DG-Forest Utilization have invited to review and discuss main issues on Eaglewood resources, processing, marketing, etc. All these materials will provide important references of the main issues of Eaglewood in Indonesia to further develop project proposal.

FORDA through this proposal requests to ITTO support in improving living standard of local people living surrounding and inside the forest by promoting appropriate technology utilization for sustainable Eaglewood production. This purpose is in line with the government policy to increase the welfare of the people living surrounding and inside the forest. It is also correlated to the policy in utilizing natural resource in sustainable basis in which the participation of community in plantation and utilization will be encouraged and intensified to support more equal benefit among the eaglewood stakeholders. This project forms the first cooperation project in Eaglewood

development ever conducted between the government of Indonesia and international agency. Other institutions that involved in prior meetings will work together in this project.

## 2. Sectoral Policies

Basic Constitution of Indonesia, in Article 33 clause 3 of the 1945 Constitution (UUD 1945), states that land and water and the natural riches contained therein shall be controlled by the States and exploited to the greatest welfare of the people. This means that all resources are basic assets for the people's prosperity and should be exploited for the greatest benefit of the people. Further, in the basic Forestry Law no. 41/1999 article 26 states that the purpose of the forest utilization is to gain optimal usage for the welfare of the people in justice with keeping its sustainability. Further in article 68, it also mentions that people are obliged to participate in conserving and keeping forest areas from disturbance and destruction.

In Press release of Minister of Forestry No. S.662/II/PIK-1/2004 it mentions that Ministry of forestry in the five years to future has five targets of success in managing forest, i.e. (1) Combating illegal logging, (2) Rehabilitation and conservation of the forest resources, (3) Forest industrial revitalization, (4) Enhancement of the welfare of forest communities, and (5) Forest Land use Planning.

Three of these targets of success are related to this project that cover (2) Rehabilitation and conservation of the Forest resources, (3) Forest industrial revitalization, (4) Enhancement of the welfare of forest communities. Forest industrial revitalization means, as explained in Press release No. S.664/II/PIK-1/2004, that natural forest will be utilized wisely and carefully, and Non Wood Forest Products such as eaglewood will be developed its utilization in the future to increase the welfare of the people living surrounding and inside the forest; and in the same time to increase Indonesian forest exchange.

## 3. Programme and Operational Activities.

The Eaglewood development is aimed to support various development programs, covering Rehabilitation and Conservation of the Forest resources, forest industrial revitalization, Enhancement of the welfare of forest communities.

The use of Eaglewood is regulated via *Decree No. 8* of 1999 concerning the *Uses of Wild Flora and Animals. Aquilaria malaccensis* is one species included in the government's list of protected fauna and flora. Under the auspices of the Ministry of Forestry, the Directorate General of Forest Protection and Nature Conservation (PHKA) is Indonesia's CITES Management Authority. This institution, in consultation with Indonesian Science Institute (LIPI) as Scientific authority, establishes annual harvest quotas for *Aquilaria malaccensis* following the species' listing in CITES Appendix II. The harvest quota is distributed among Regional Forest Offices located in regions having the potential to produce *Eaglewood*, who in turn distribute the quota among registered *Eaglewood* traders throughout Indonesia.

There are several institutions that have experience in conducting Eaglewood research and development. Natural Forest Conservation and Forest Research and Development Center will lead to study the management of Eaglewood plantations through demonstration plots at West Kalimantan and West Java/Banten provinces. This is also intended, when the time comes, in preparing for Eaglewood production. Forest Products Research and Development Center will lead to study on sustainable harvesting and post harvesting including processing, utilization, diversification products, and chemical analysis of Eaglewood. There are suitable laboratories that afford to facilitate the project. ***Further, a stakeholder, called Lembaga Perberdayaan Masyarakat (Society Powering Institute), at onset of project will be involved in the project such as in assessing the signs of Eaglewood trees containing resinous material before artificial inducement. Some of the signs cover several ant-holes on the stands, many wounds along the stands and many leaves becoming yellows, dried bark, etc. The artificial inducement on such a tree will accelerate the occurrence of the Eaglewood and improve the quality. These experiences will give large contribution for the success of the proposed project in the Eaglewood development.***

## PART II. THE PROJECT

### 1. Project Objectives

#### 1.1. Development Objective

To promote and sustain Eaglewood production in both ***production natural forest and privately-owned lands*** to support Eaglewood-based industries toward Sustainable Forest Management and forest communities' welfare in Indonesia.

#### 1.2. Specific Objectives

**Specific Objective 1.** To introduce inoculation technology for increasing Eaglewood production.

**Specific Objective 2.** To disseminate the technology to communities living in and around the forest.

### 2. Project Justification

#### 2.1. Problems to be addressed

Nowadays, the export of eaglewood from Indonesia has declined rapidly due to Eaglewood resources which have been severely depleted. At the same time earnings of people around and inside the forest has also decreased. This is due to the declining of Eaglewood production from natural resources which further owing to the indiscriminate felling of infected and uninfected trees. Hence, several secondary threats those cover habitat degradation and loss resulting from forest fires, forest conversion to plantations (including forest plantations), logging and land mining concessions. In line with the above problems, two factors covering limitation on

inoculums technology of Eaglewood production and lack of dissemination on the technology are almost not implemented.

Declining in Eaglewood production from natural resources is due to lack of utilization technology on Eaglewood production as a result of limiting on inoculums production for artificial inducement, poor in inoculation engineering, and lack of selected pathogen.

In the field, natural inoculation to produce Eaglewood could not compete with the felling of both infected and uninfected trees, which is driven by continuing demand and large profits. In relation to this formation, it is believed to be stimulated by certain microorganism, most likely by fungi such as Aspergillus spp., Botryodyplodia spp., Pythium spp. (Santoso, 1996). There is a little effort so far in producing inoculums for artificial inducement, but this production and the experiment in stimulating Eaglewood formation is still in laboratory scale and very limited. FORDA has developed some inoculums and has also been applied in the field. Initial results indicated that artificial inducement is prospective to produce Eaglewood. Relating to this, the method to produce inoculums at laboratory scale for artificial inducement to produce Eaglewood has to be developed in a large scale. Further, a better technique to identify Eaglewood in trees, incorporated with a harvesting method will help to decrease in depleting Eaglewood resources in the forest.

Other problems faced in handling Eaglewood products are poor in processing technology with no added value, and inappropriate grading standard of Eaglewood. On the processing techniques, the appropriate processing techniques that will open new opportunities to the industries to improve their product qualities and diversification have not been developed yet. Therefore, instead the form of raw material, technology to diversify raw material into further processed products that have high value need to be investigated. Further, the uncertainty of this grading system has been abused to reduce the bargaining position of Eaglewood dwellers, and to lead unfair trading and inequitable profit at farmer level. The Appropriate standard, which is acceptable and providing equitable profit sharing and well-accepted Eaglewood grading system, should be work out.

Limiting in the dissemination on a utilization of artificial inducement to the Eaglewood society is owing to lack of two aspects of knowledge that should be mastered, covering Eaglewood plantation and artificial inducement in the field, as well as promotion on Eaglewood production technology.

There is a little effort to cultivate *Aquilaria* which species has been initiated in several provinces and some traders have established plantations, e.g. in Riau (Sumatra), Lombok (NTB), West Kalimantan and West Java and East Kalimantan, amounted to 700 ha. This is still below from the amount of natural Eaglewood resources that have been depleted. More effort to promote this cultivation should be encouraged at large area, especially at natural habitat of this plant in forest. The cultivation technique of Eaglewood plantation required by Eaglewood farmers could be developed. In line with the production of inoculums in large scale, the demonstration of trial plot for artificial inducement in the field should be introduced to provide a picture for Eaglewood farmer in artificial Eaglewood production. To develop cultivation methods for

Eaglewood plant requires forestland provided by local government (West Kalimantan and West Java provinces). Local communities in these provinces area are able to adopt the knowledge and technology to establish Eaglewood plantation for producing resinous material that will provide additional income.

The failure in cultivation technique of Eaglewood plantation, artificial Eaglewood production, processing technology in almost areas of Eaglewood stands in Indonesia is caused by ignoring communities around and inside the forest who are not empowered through institutional building and the ignorance in production and processing. These should be overcome with involving all parties in Eaglewood activities.

As illustrated in Figure 1, the diagram of the project problem tree shows that the main problem to be solved is declining in Eaglewood production from Natural resources. These problems could be mentioned mainly as follows:

- The utilization related technology on Eaglewood production is not performed properly because:
  - There is a limitation of inoculums production for artificial inducement in the field
  - The identification of tree species that are susceptible does not conducted yet
  - Selection of pathogen is almost limited
  - Poor inoculation engineering

- Poor dissemination of the technology among forest dweller
  - Lack of local communities knowledge on Eaglewood plantation plots at the field
  - In availability of demonstration plot of Eaglewood plantation
  - Lack of an artificial inducement plot in some areas.
  - Insufficient of promotion on Eaglewood production technology to local communities

To address those problems, it is necessary to carried out several activities that will facilitate improvement as follows (Figure 2):

- Better inoculation engineering
- Mass production on selected pathogen for artificial inducement
- Documented data on existing of susceptible of natural and planted Eaglewood stands
- Appropriate product processing and grading system
- Establishment of demonstration plot for Eaglewood plantation
- Establishment artificial inducement trial plot in the field
- Improvement of local communities' knowledge and experience on Eaglewood production technologies

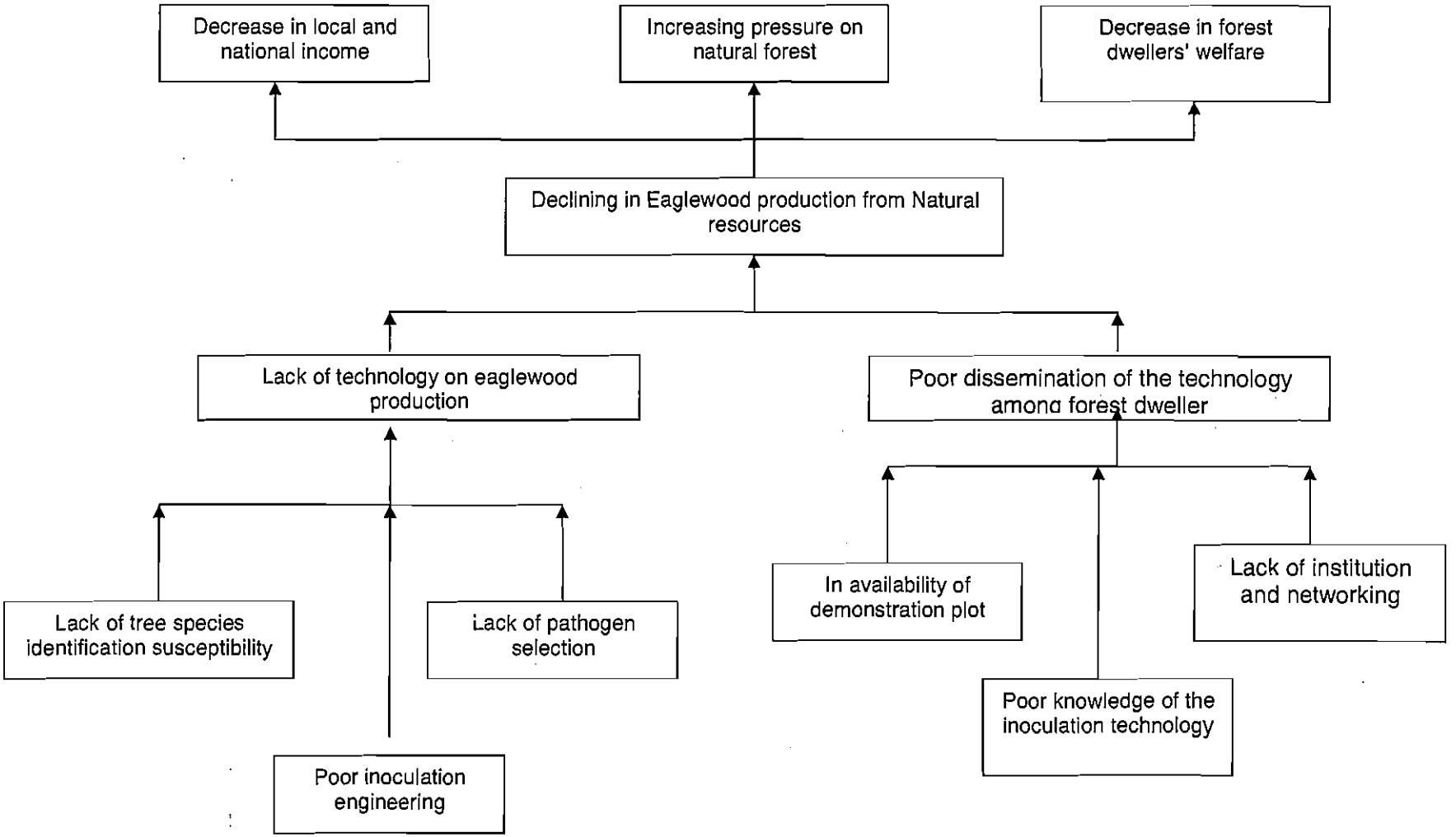



Figure 1. Diagram of the Project Problem Tree

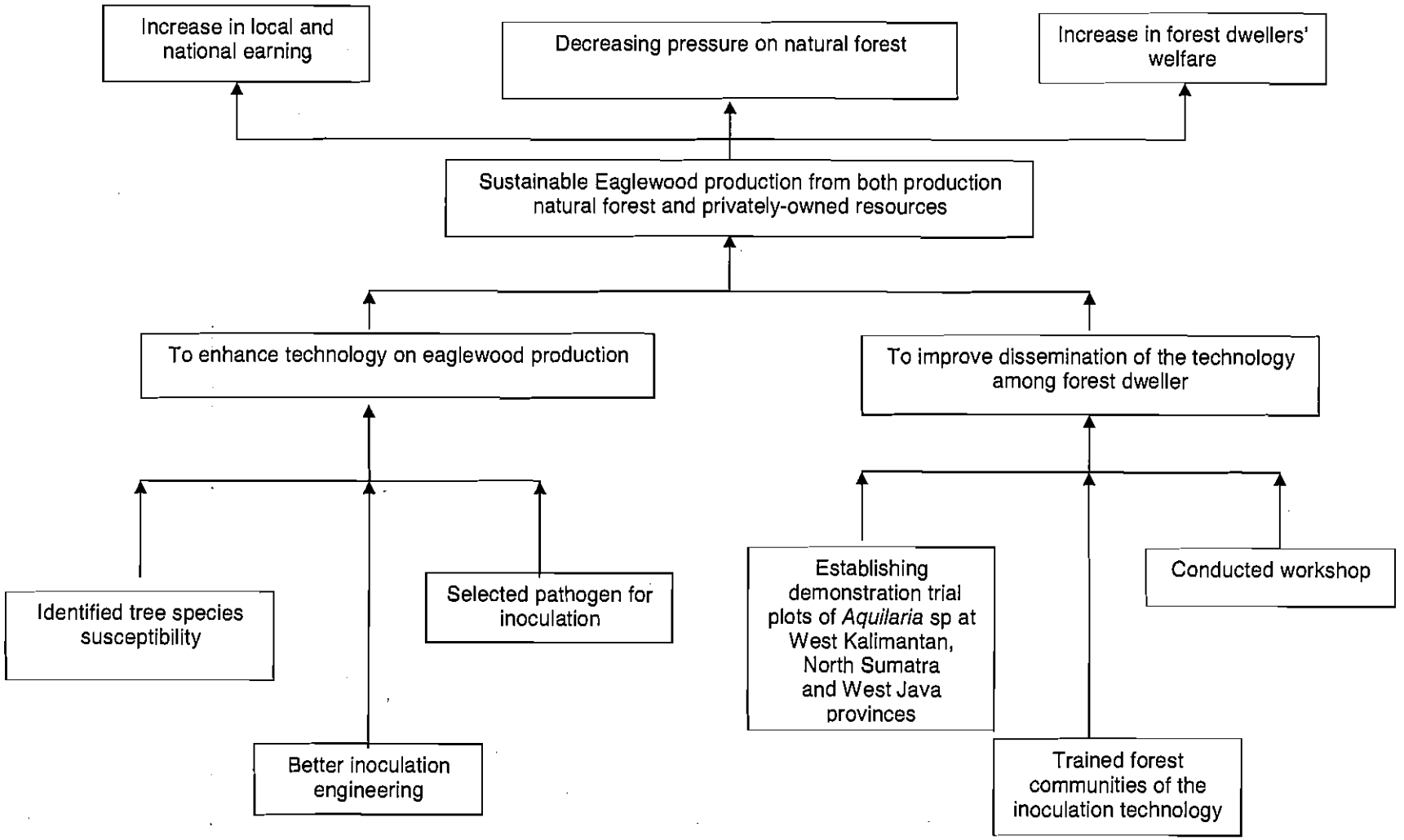



Figure 2. Diagram of the Project Development Objectives

## 2.2. Intended situation after project completion

This project could expectedly accelerate and maintain the sustainable Eaglewood production in Indonesia. Eaglewood resource is being sustained because

- Availability of inoculums in large quantity for artificial inducement.
- Well-acceptance of Eaglewood grading system for both raw and processed Eaglewood.
- Better processing and added value of raw Eaglewood products.
- The existing Eaglewood based industries became stronger and more competitive in international market due to stable supply of raw Eaglewood, improved qualities and available opportunities for promoting diversified Eaglewood products.
- Well-documented data on existing susceptible natural and planted Eaglewood stands.
- Growing interest of forest dwellers and local communities to maintain Eaglewood stands, and to expand their Eaglewood plantation both at their own land and at natural production forest.
- Growing interest of local governments, local communities or investor on intensive Eaglewood plantation at natural production forest.
- Increase in export earning and forest dwellers as well as local communities' incomes
- Awareness of forest dwellers and local communities to take apart in maintaining the forest as sources of their income.
- Availability of book entitled Eaglewood in Indonesia.
- Eaglewood production from both Eaglewood resources (natural production forest and local communities' land) becomes sustainable.

## 2.3. Project strategy

The project strategy to sustain Eaglewood production from natural resources in Indonesia is focused on utilization technology of Eaglewood production for industries and improving dissemination on utilization of artificial inducement in the field.

The first effort is then formulated into program and activities to be carried out to ensure the effectiveness of achievement of the objectives and targets, covering:

- Reviewing on existing susceptible natural and plantation Eaglewood stands through literature and field survey
- Identifying selected susceptible Eaglewood stands
- Selecting and developing several prospecting inoculums in large scale
- Evaluating and developing a better engineering technique for inoculations
- Implementing several prospecting inoculums for artificial inducement
- Evaluating Eaglewood product and stands
- Documenting data on Eaglewood potency and distribution in both natural forest and planted forest, if any. Through review activities on the available materials,
- Combined with the field surveys, more reliable figures on Eaglewood potency and distribution in Indonesia could be gathered.
- Evaluating basic properties of Eaglewood and improving processing technology and diversified Eaglewood products.

- Identifying both the preference of raw Eaglewood and Eaglewood products, including their types and qualities.

The second effort is to be carried out in ensuring the effectiveness of achievement of the objectives and targets as follows:

- Establishing demonstration plot for Eaglewood plantation, involving local communities and forest dweller.
- Assessing socialization result of Eaglewood production technology in several provinces.
- Conducting training for forest dwellers and local communities on cultivation and artificial inoculation techniques; Eaglewood processing and quality determination to increase their technical and management skills in sustainable Eaglewood production.
- Conducting national workshop on Eaglewood technology that expectedly will be participated by various parties who are concerned with Eaglewood. This workshop is useful to deliver project findings to a broad audience and simultaneously increase the national awareness on Eaglewood resources in Indonesia.
- Creating a book entitled Eaglewood in Indonesia.

## 2.4. Target beneficiaries

The project expectedly will provide both direct and indirect benefits to various parties. On rural communities, the beneficiaries of the project will be the forest dwellers and local farmers covering:

- Technological innovation and experience on Eaglewood intensive plantation trials will encourage forest dwellers and local farmers to establish Eaglewood plantation, both in natural production forest and their own land.
- The technological innovation on manufacturing inoculums in large scale and experience in artificial inducement in the field will help them to improve their product qualities
- The technological innovation on processing of Eaglewood with added value will help them to improve their product qualities and strengthen their competitiveness at national and international market. Improve Eaglewood qualities will have opportunity to gain more profits from the added value gaining process.
- Better practice on Eaglewood harvesting from natural stands by the forest dwellers as well as better perception from the farmers on Eaglewood resource will help to encourage community awareness and efforts to sustain Eaglewood resources as source of their income.
- Better bargaining position due to better grading system and improving livelihood of forest dwellers and farmers' welfare

On Eaglewood trader and industries, the beneficiaries of the project will cover:

- Eaglewood based industry will take advantage by the secured supply of raw Eaglewood and better qualities.
- Eaglewood traders could be indirectly benefited by the more stable supply of raw Eaglewood from the dwellers and local farmers.

On central and regional government levels, the beneficiaries of the project will cover:

- Forest dweller and gatherer will reduce their tension to natural forest resources, which help the conservation efforts of the natural forest.
- More reliable data on Eaglewood resources and so help them in the decision making process.

- Expansion on Eaglewood based products export activities will increase foreign exchanged and local earning

## 2.5. Technical and scientific aspects

As a member of the family Thymelaeaceae, Aquilaria is a medium-sized tree with average of 15–25 m in high. Some of them can grow up to 40 m in tall. Having a moderately straight stem, it can achieve a diameter (dbh) of up to 250 cm. ***In a plantation, 67 years old trees of* A malaccensis *reached 27 m in height with a diameter of 38 cm. Mature trees, about 80 years old may reach 25-30 m in height with its diameter at breast height of 55-79 cm. In India, trees reached nearly 5 m and a diameter of 30 cm after 8 years planting (Oyen and Dung. 1999). In West Kalimantan, it is found mature trees (>20 cm dbh) of* A. malaccensis *scarcely but widely distributed, ranging from 0.16 stems per ha in alluvial bench and lower montane forests to 0.32 stems per ha in lowland granite and sandstone forests. Scientists estimate stocking at 1.87 trees per ha in Sumatra, 3.37 trees per ha in Kalimantan, and 4.33 trees per ha in Irian Jaya.***

***Most Aquilaria species have smooth, thin, pale gray bark with dense, dark foliage of shiny elliptical to oblong leaves (7.5–12 cm long by 2.5–5.5 cm wide). Flowering and fruiting may start an age of 7-9 years where trees flower in March and bear fruit in June-July (in India). The small, pale blooms flowering in clusters on the short stalks of the leaf stems produce 3–5 cm long, bi-valved fruit capsules (Ding Hou. 1960 cited in Oyen and Dung. 1999). A shade-tolerant tree, Aquilaria is a tree of mature evergreen and semi-evergreen forest occurring at low to medium altitudes, generally up to 1000 m sea level, in primary and secondary forests mainly in plains but also hillsides and ridges.***

***Most Aquilaria regenerates freely under natural conditions as seedlings around the mother tree or sprouts from the stumps of harvested trees (Beniwal. 1989, Soehartono 1997, Oyen and Dung. 1999; Paoli. et al. 1994, Hasnida.* et al. *2001, Soehartono and Newton. 2002, Quan.* et al. *2003). In the plantation, after planting* A. malaccensis *requires regular weeding, up to 4 weeding in the first year, gradually decreasing to one weeding in the fifth year. Thinning to the final stand is done in the fifth year. In the age of 67 years in Malaysia the density of eaglewood stand decreased 31 per ha. In natural forest regeneration of A malaccensis seem adequate to maintain the density of tree (Oyen and Dung. 1999). A Figure 3 showed an example of the Eaglewood tree.***

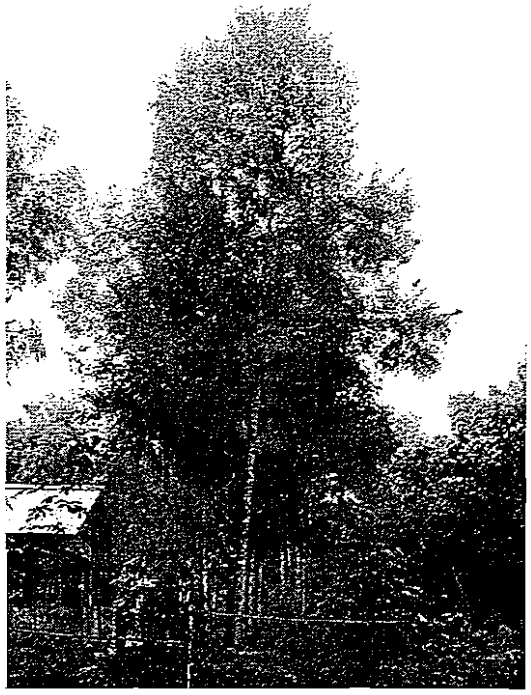


*Figure 3. An Eaglewood tree at privately-owned land*

In Natural forest, mother trees are becoming scarce in many areas because of over-exploitation although this condition may not lead to local extinction of the species, it may severely affect the availability of the product and, thus, the local Eaglewood economy. Several member of this family that grows in Indonesia could be seen in the following table 1.

***The occurrence of the tree itself does not guarantee the presence of the resin. Scientists estimate that only 10% of the Aquilaria trees in the forest may contain Eaglewood (gaharu) (Gibson 1977). Under natural conditions, the resin is more commonly found in trees of about 20 years or older, with trees more than 50 years old reportedly having the highest concentration (Sadgopol. 1959). According to Chakrabarty.*** et al. ***(1994), infected trees produce resin from the age of 20 years onwards, Sadgopal (1960, cited in Soehartono. 1997) suggesting that the best yields are obtained from trees aged 50 years and over. A "good" tree may yield several kilograms of the valuable dark, heavy resinous wood with the characteristic honey-like scent. The recent experiment of inoculation on natural Eaglewood trees such in Bangka-Belitung, Gorontalo, Langkat-North Sumatra, Barabai-South Kalimantan showed that one tree with six months after inoculation could produce 20 kg of Eaglewood with medium quality (kemedangan). It is also estimated that starting around 10 years old of Eaglewood tree could be induced in producing Eaglewood (Personal communication. August 2006). Examples of natural and artificial Eaglewood could be seen in Figure 4.***

***Figure 4. Natural Eaglewood (left-hand side) and artificial Eaglewood (right-hand side)***

Relating to this resinous formation in Eaglewood trees, it is believed to be stimulated by certain microorganism, most likely by fungi. The Eaglewood forms in response to wounding and subsequent fungal infection, and is found in many parts of the tree, according to some scientific sources in the bark and the roots as well as the heartwood (Jalaluddin. 1977). *Aquilaria* trees are naturally infected by a variety of fungi including: *Aspergillus* spp., *Botryodyplodia* spp., *Diplodia* spp., *Fusarium bulbiferum, F. laterium, F. oxysporum, F. solani, Penicillium* spp., and *Pythium* spp. (Santoso. 1996). The ecological interaction between the host tree and the wound and/or the fungi in order to produce Eaglewood is still poorly understood. Other factors such as the age of the tree, differences in the tree caused by seasonal variation, environmental variation and genetic variation of *Aquilaria* spp. may also play an important role in Eaglewood formation (Ng *et al.*, 1997). Further, the occurrence in the tree itself does not guarantee the presence of the Eaglewood.

Scientists estimate that only 10% of the *Aquilaria* trees in the forest may contain Eaglewood (Gibson. 1977). Under natural conditions, the Eaglewood is more commonly found in trees of about 20 years or older, particularly in trees more than 50 years old reportedly having the highest concentration in such Eaglewood (Sadgopol. 1959). A "good" tree may yield several kilograms of the valuable dark color, heavy resinous wood with the characteristic of honey-like scent. Distributed broadly through

Table 1. Some commercial Eaglewood stands in Indonesia

| No | Botanical name | Family | Location |
|---|---|---|---|
| 1. | *Aqualaria malacensis* | Thymeleaceae | Sumatra, Kalimantan |
| 2. | *A. hirta* | Thymeleaceae | Sumatra, Kalimantan |
| 3. | *A.filarial* | Thymeleaceae | Nusa Tenggara, Maluku, Irian Jaya |
| 4. | *A. microcarpa* | Thymeleaceae | Sumatra, Kalimantan |

| | | | |
|---|---|---|---|
| 5. | *A. agalloccha Roxb* | Thymeleaceae | Sumatra, Java, Kalimantan |
| 6. | *A. beccariana* | Thymeleaceae | Sumatra, Kalimantan |
| 7. | *A. secundana* | Thymeleaceae | Maluku, Irian Jaya |
| 8. | *A. moszkowskii* | Thymeleaceae | Sumatra |
| 9. | *A. tomentosa* | Thymeleaceae | Irian Jaya |
| 10. | *Aetoxylon sympethalum* | Thymeleaceae | Kalimantan, Irian Jaya, Maluku |
| 11. | *Enkleia malacensis* | Thymeleaceae | Irian Jaya, Maluku |
| 12. | *Wikstroemia polintha* | Thymeleaceae | Nusa Tenggara, Irian Jaya |
| 13. | *W. tenuriamis* | Thymeleaceae | Sumatera, Bangka, Kalimantan |
| 14. | *W. androsaemofilia* | Thymeleaceae | Kalimantan, NTT, Irian Jaya, Sulawesi |
| 15. | *Gonystylus bancanus* | Thymeleaceae | Bangka, Sumatra, Kalimantan |
| 16. | *G. macrophyllus* | Thymeleaceae | Kalimantan, Sumatra |
| 17. | *Grynops cumingiana* | Thymeleaceae | Nusa Tenggara, Irian Jaya |
| 18. | *G. rosbergii* | Thymeleaceae | Nusa Tenggara |
| 19. | *G. versteegii* | Thymeleaceae | Nusa Tenggara |
| 20. | *G. moluccana* | Thymeleaceae | Maluku, Halmahera |
| 21. | *G. decipiens* | Thymeleaceae | Central Sulawesi |
| 22. | *G. ledermanii* | Thymeleaceae | Irian Jaya |
| 23. | *G.salacifolia* | Thymeleaceae | Irian Jaya |
| 24. | *G.audate* | Thymeleaceae | Irian Jaya |
| 25. | *G. podocarpus* | Thymeleaceae | Irian Jaya |
| 26. | *Dalbergia falviflora* | Leguminoceae | Sumatra, Kalimantan |
| 27 | *Exccocaria agaloccha* | Euphorbiaceae | Java, Kalimantan, Sumatra |

Sidiyasa dan Suharti (1987); Sumarna (1998)); Anonimous ( 2004 )

Southeast Asia, the genus *Aquilaria* has been found from Bhutan and northeastern India across to southern China and then south as far as the island of New Guinea (Burkill 1966, Whitmore. 1972). Little detailed information exists, however, on its distribution, exploitation, or use in the southeastern edge of its range. In some of the earlier exploited areas, several species are thought to be extremely rare if not extinct in the wild, for example, in Bangladesh and Java (Chakrabarty. *et al.* 1994). Several fungi that naturally inflict infection on Eaglewood tree are found in Indonesia as presented in the table 2.

For many years, production of agar wood in good quality has depended solely on two or three species, *Aquilaria malaccensis, Gyrinops versteeghii*; whereas there are more than 10 agarwood species that can produce aromatic wood. Now beside *Aquilaria malaccensis,* almost all species that produce wood have been put in the APPENDIX II CITIES.

Table 2. Fungi associated with Eaglewood trees at several locations in Indonesia

| Location/Province | Fungi species | Literature |
|---|---|---|
| | *Diplodia* sp, *Pythium* sp and *Fusarium solani* | Sidiyasa *dalam* Afifi 1995 |
| Mataram, West Nusa Tenggara | *Fusarium lateritium, Papularia* sp, *Rhinocladiella* sp, dan *Rhizoctonia* sp | Parman. *et al*, 1996 |
| West Kalimantan | *Fusarium bulbigenum* dan *F. lateritium* | Santoso 1996 |
| Pekanbaru, Riau | *Acremonium, Diplodia* sp., *F. oxysporum, F. solani, Libertella* sp, *Scytalidium* sp, *Thielaviopsis parodoxa* dan *Trichoderma sp.* | Rahayu *et al.* 1998 |
| Lombok, West Nusa Tenggara | *Acremonium* | Rahayu et al. 1998 |
| Irian | *Acremonium* | Rahayu et al. 1998 |
| West Kalimantan | *Botryodiplodia, Pythium* sp. *F. oxysporum, F. bulbigenum, F. Lateritium* | Santoso. 1997 *dalam* Ngatiman *et al.* 2004 |
| Jambi, South Sumatra, South and East Kalimantan | *Fusarium* sp | Santoso. 1997 *dalam* Ngatiman *et al.* 2004 |

## 2.6. Economic aspects

In Indonesia, Eaglewood has been traded since the fifth centuries, and it continues until now. Trading in 1983-1987 is around 103 tones with the values of US $ 310,000. In the period of 1990-1999 average of the Eaglewood export is about 165 per annum with the value of US $ 2 million. In 2000 the Eaglewood export reached 446 tones with the value of US $ 2.2 million. In 2002, the quota of Eaglewood was about 300 tones, but the production only fulfilled 15 % of the quota.
Forest dwellers or local peoples search for and collect Eaglewood from forest. Their searching for harvest of Eaglewood may be either a temporary or permanent occupation, which depends on it for their income. They sell this product to local traders or middlemen, sometime through a credit system. Middlemen typically have links with 50-100 collectors and they can sell to any trader in any region or they may be dependent upon a single trader, who is often a family relative.

Relating to Eaglewood grade, its classifications vary slightly with locality and also from one middleman or collector to another. The government has never issued a standard grading classification that is acceptable to trading companies, collectors and alike. In East Kalimantan, 'super grade A' Eaglewood was quoted as selling for USD 450/kg. Meanwhile in West Nusa Tengara, the best grade of Eaglewood was quoted at approximately USD 540/kg. In 1999, in Jayapura, "super grade A' Eaglewood was for sale for approximately USD 385/kg.

In international market, during the period 1995 to 1997, Singapore reported the total re-export of approximately 581 tones of Indonesian Eaglewood to various countries, where the largest importer was Taiwan (229 tones). According to CITES annual report data, Taiwan was the largest end-consumer of *Aquilaria malaccensis* exported from Indonesia, i.e. 345 tones of Indonesian *A. malaccensis* was reported exported or re-exported to Taiwan. This is less than a third of Taiwan's total *Aquilaria* imports from Indonesia according to Taiwan's Customs statistics, which totaled approximately 1122 tones.

Looking at the benefit of Eaglewood trading in national and international markets, the investment cost of this project hence is very efficient that should be considered to the total benefits deriving from the increasing of rural community income and national earnings in Eaglewood activities. Moreover, the positive impacts may be delivered to natural forest conservation efforts.

The demonstration plots covering intensive Eaglewood plantation, artificial inducement and processing of this project will provide direct economic benefits to the rural communities and local government as well as the state owned company, which may be used for different purposes in further activities on the Eaglewood development efforts, such as training and permanent research sites.

## 2.7. Environmental aspects

This project concerns with the environmental aspect, in particular the sustainability of Eaglewood resources in Indonesia, ***either in the production natural forest or in privately-owned lands. The natural forest (protection forest) will become source of isolates (inoculants) and mother trees; while the production forest and the forest dwellers and local communities' land will be the target for plantation.*** The greater concern and interest in artificial inducement on Eaglewood stands in ***production natural forest and their lands*** with the development of inoculums production in large quantities followed by creating detection tools and sound harvesting method will significantly reduce the tension of over exploitation on Eaglewood stands in the natural forest. The improved income of the Eaglewood dwellers and local communities from their Eaglewood activities will increase their appreciation to the Eaglewood and forest resources that further greatly help to sustain the forest. Finally, the innovation of processing techniques could improve and diversify Eaglewood product qualities and prolong their life services, and hence improve the efficiency of raw material utilization.

***There is no impact in the environment because of the large scale in introducing pathogen. The pathogen will only influence the suitable Eaglewood trees, not other trees. If the pathogen does not find the suitable trees, it will not develop and finally it dies. During the inoculation activities, the pathogen will just be induced on the suitable Eaglewood trees. This activity will not much influence any living thing such as birds and other animals which are depended on the production natural forest and the privately-owned lands for their life. In the production natural forest, only Eaglewood trees will be harvested, while other trees required by birds or other animals still exist in the forest. In the privately-owned lands, at location the plantation will be arranged based on the difference of the age of Eaglewood trees. So, if the matured Eaglewood trees are harvested, other young Eaglewood trees required by birds or other animal fir their life still exist in the location.***

## 2.8. Social aspects

The selected demonstration plots for Eaglewood establishment and smallholder participation will be located at two regencies that are at West Kalimantan and Banten provinces. On these regencies will be occupied a total area of 100 ha for the project needs. The communities in these locations primarily live from activities in agriculture and farming, estate crops, etc.

Population growth is undoubtedly a demographic factor that has a considerable influence on forests. As the population grows, the availability of resources is increasingly reduced due to the growing demands on land for their live. Furthermore, the continuing of the use of traditional and unsustainable land-use systems practiced by a major part of the rural population deteriorates and reduces the resources degradation.

The social impact will be increasingly reflected in the communities, as they realize that forest resources are being sustainably managed and can generate income and employment in rural areas, which in turn help to minimize rural – urban migration and reduced the pressure exerted by the population on forest areas.

The results of the project, where its benefit take great concerns with local community and the development of Eaglewood through community participation are a likely direction for improvements. The project will also generate employment. Furthermore, the income generated from these management activities will improve the living standards of the rural communities and the project implementation is provided with a capacity for rapid expansion and replication.

**2.9. Risks**

There is a minor risk that may impede the successful implementation of the project. Low participation from the rural community and the local government may be encountered due to misunderstanding about the meaning and value of the project. This, however, can be solved by planning and working together with local chiefs and local government authorities in the field.

***There is no possibility of scientific failure in finding out effective pathogen and inoculation techniques. There are about 24 isolates that have been found in laboratory. All of these isolates can be used in artificial inducement. Hence, there are several inoculation techniques that have been tried in the field on several Eaglewood trees, and they are working properly. During this project it will be found out among the isolates and techniques which one the best to produce Eaglewood.***

## 3. Outputs

**Specific Objective 1.** To introduce inoculation technology for increasing Eaglewood production.

Output 1.1: Identified tree species susceptibility
Output 1.2: Better inoculation engineering
Output 1.3: Selected pathogen for inoculation

**Specific Objective 2.** To disseminate the technology to communities living in and around the forest.

Output 2.1: Two established demonstration trial plots of *Aquilaria* sp at West Kalimantan, and West Java provinces
Output 2.2: Trained forest communities of the inoculation technology
Output 2.3: Conducted workshop

## 4. Activities

Output 1.1: Identified tree species susceptibility
1.1.1. Reviewing on existing literature of Eaglewood species, potency, distribution and cultivation
1.1.2. Conducting field survey on Eaglewood natural and plantation areas.
1.1.3. Identifying selected susceptible Eaglewood stands

Output 1.2: Selected pathogen for inoculation
1.2.1. Selecting suitable inoculums
1.2.2. Developing several prospect inoculums in large scale
1.2.3. Implementing several prospecting inoculums for artificial inducement

Output 1.3: Better inoculation engineering technique
1.3.1. Evaluating basic properties of Eaglewood stands
1.3.2. Evaluating the existing inoculation engineering technique
1.3.3. Developing a better technique from the existing inoculation engineering technique
1.3.4. Characterizing and evaluating Eaglewood product
1.3.5. Visiting Eaglewood plantation and comparative study of inoculation technology in Vietnam

Output 2.1. Two established demonstration trial plots of *Aquilaria* sp at West Kalimantan, and West Java/Banten provinces
2.1.1. Establishing demonstration plots
2.1.2. Data collection and conducting financial analysis on Eaglewood plantation
2.1.3. Assessing socialization result of Eaglewood production technology

Output 2.2: Trained forest communities of the inoculation technology
2.7.1. Preparation of training, covering elaboration of training material, selection of participants.
2.7.2. Holding training on inoculation technology

Output 2.3: Conducted workshop
2.3.1. Preparation of workshop, instantly elaboration of workshop topics, inviting participants.
2.3.2. Holding workshop

## 5. Logical Framework Worksheets

| Project elements | Indicators | Means of verification | Important assumptions |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| **Development Objectives:**<br><br>To promote and sustain Eaglewood production in both ***production natural forest and privately-owned land*** to support Eaglewood-based industries toward Sustainable Forest Management and forest communities' welfare in Indonesia. | • Sustainable Eaglewood production from natural and privately-owned land<br>• Increase in local and national earning<br>• Decreasing pressure on natural forest | • Technical report<br>• Recommendation | • All stakeholders (government, local communities and traders) support the projects<br>• Government's willingness to conserve, manage and to utilize Eaglewood properly.<br>• Communities need and willingness to have alternative income from Eaglewood |

Continued

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **Specific Objective 1.**<br><br>To introduce inoculation technology for increasing Eaglewood production. | • Eaglewood production increased by 100 % in the five years | Recommendation and technical report | • Positive attitude toward implementation of Eaglewood stakeholders<br>• Full participation by local communities, and government officials to the projects<br>• Availability of reliable Eaglewood stands |
| Output 1.1<br>Identified tree species susceptibility | Availability of Information on four important Eaglewood species, included in Appendix 2 | Report on some important Eaglewood species, potency and distribution | • Availability of reliable Eaglewood stands for experiment<br>• Local community of Eaglewood owner willingness to cooperate in this project |
| Output 1.2. Selected pathogen for inoculation | Availability of applicable inoculants agent in the second quarter | • Report on the best pathogen for inoculation | • Availability of reliable Eaglewood data from respondents<br>• All stakeholders prefer to give all required information |
| Output 1.3. Better inoculation engineering | Availability of three selected inoculation engineering | • Report on inoculation technique | • Availability of reliable Eaglewood stands for experiment<br>• Availability of raw materials from various sources and qualities |
| **Specific Objective 2.**<br>To disseminate the technology to communities living in and around the forest. | • Improving knowledge and skill of local community on Eaglewood production | Recommendation and progress report | • Full participation by local communities, traders and government officials to the projects<br>• Positive responses of Eaglewood stake-holders on providing real information |
| Output 2.1.:<br>Two established demonstration trial plots of *Aquilaria* sp at West Kalimantan and West Java/Banten provinces | Two demonstration plots for plantation is established, covering 100 ha in total | • Report on implementation of demonstration trial plots in two locations<br>• Monitoring visits<br>• Report on cost analysis of establishing trial plots. | • Full participation local communities and local government officials to the trial port |
| Output 2.2 :<br>Trained forest communities of the inoculation technology | • A package of training module<br>• Two training conducted<br>• 25 participants trained | • Report on training | Full participation local communities, and government officials to the projects |
| 2.3: Conducted workshop | • Two workshop conducted<br>• 100 participants in total attended | Proceeding and Report on national workshop | Positive attitude from Eaglewood stakeholders |

## 6. Work Plan

| Output/Activity | Responsi-ble Party | Schedule of 3 years (in quarter) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **Specific Objective 1** | | | | | | | | | | | | | |
| **Output 1.1.** | | | | | | | | | | | | | |
| **Activity** 1.1.1. Reviewing on existing literature of Eaglewood species, potency, distribution and cultivation | FORDA | | | | | | | | | | | | |
| **Activity** 1.1.2. Conducting field survey on Eaglewood natural and plantation areas. | FORDA /Local representative | | | | | | | | | | | | |
| **Activity** 1.1.3. Identifying selected susceptible Eaglewood stands | FORDA | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Output 1.2** | | | | | | | | | | | | | |
| **Activity** 1.2.1. Selecting suitable inoculums | FORDA | | | | | | | | | | | | |
| **Activity** 1.2.2. Developing several prospect inoculums in large scale | FORDA | | | | | | | | | | | | |
| **Activity** 1.2.3. Implementing several prospecting inoculums for artificial inducement | FORDA /Local representative | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Output 1.3** | | | | | | | | | | | | | |
| **Activity** 1.3.1. Evaluating basic properties of Eaglewood stands | FORDA | | | | | | | | | | | | |
| **Activity** 1.3.2. Evaluating the existing inoculation engineering technique | FORDA /Local representative | | | | | | | | | | | | |
| **Activity** 1.3.3. Developing a better technique from inoculation engineering technique | FORDA/ | | | | | | | | | | | | |
| **Activity** 1.3.4. Characterizing and evaluating Eaglewood product | FORDA | | | | | | | | | | | | |
| **Activity 1.3.5.** To Visit Eaglewood processing and small scale plantation in Vietnam | FORDA | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Specific Objective 2** | FORDA | | | | | | | | | | | | |
| **Output 2.1** | | | | | | | | | | | | | |
| **Activity** 2.1.1. Establishing demonstration plots | FORDA/Local government | | | | | | | | | | | | |
| **Activity 2.1.2** Data collection and Conducting financial analysis on Eaglewood Plantation | FORDA/Local government | | | | | | | | | | | | |

Continued

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activity 2.1.3** To assess socialization results of Eaglewood production technology | FORDA/ Local government | | | | | | | | | | | | |
| **Output 2.2** | | | | | | | | | | | | | |
| **Activity** 2.2.1. Preparation of training, covering elaboration of training material, selection of participants | FORDA/Local government | | | | | | | | | | | | |
| **Activity** 2.2.2. Holding training on inoculation technology | FORDA/Local government | | | | | | | | | | | | |
| **Output 2.3** | | | | | | | | | | | | | |
| **Activity** 2.3.2. Preparation of workshop, instantly elaboration of workshop topics, inviting participants. | FORDA/Local government | | | | | | | | | | | | |
| **Activity** 2.3.2. Holding workshop | FORDA/Local government | | | | | | | | | | | | |

## 7. BUDGET

### 7.1. OVERALL PROJECT BUDGET BY ACTIVITY

| Output & Activities | Project Personal | Sub Contracts | Duty Travel | Capital Items | Consumable items | Miscellanous | Quaterly Year | Grand Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Specific Objective 1.** To introduce inoculation technology for increasing Eaglewood production. | | | | | | | | |
| **Out Put 1.1.Identified tree species susceptibility** | | | | | | | | |
| **Activity.1.1.1.** Reviewing on existing literature of Eaglewood species, potency, distribution | 10,000(I) | - | 3,250 (I) | - | 2,000(I) | 1,000(I) | Q1Y1 | 16,250 (I) |
| | - | | - | - | - | - | | - |
| **Activity 1.1.2.** Conducting field survey on Eaglewood natural and plantation areas. | 9,000(I) | - | 3,500(I) | 3,000(I) | 1,500(I) | 2,000(I) | Q2-Q3 Y1 | 19,000(I) |
| | 1,500 (G) | | - | 7,000 (G) | - | - | | 8,500 (G) |
| **Activity1.1.3.** Identifying selected susceptible Eaglewood stands | 9,000(I) | - | 3,250(I) | 3,000(I) | 3,000(I) | 3,000(I) | Q3-Q4 Y1 | 21,250 (I) |
| | 1,500 (G) | - | - | 7,000 (G) | 2,000 (G) | 1,000 (G) | | 11,500 (G) |
| **Sub Total** | **28,000(I)** | - | **10,000(I)** | **6,000(I)** | **6,500(I)** | **6,000(I)** | - | **56,500 (I)** |
| | **3,000 (G)** | - | - | **14,000 (G)** | **2,000 (G)** | **1,000 (G)** | | **20,000 (G)** |
| **Out Put 1.2.Selected pathogen for inoculation** | | | | | | | | |
| **Activity.1.2.1.** Selecting suitable inoculums | 9,500 (I) | - | 3,000 (I) | - | 3,000 (I) | 2,000 (I) | Q1Y1 | 17,500 (I) |
| | 1000 (G) | | 0 | 7500 (G) | 0 | 0 | | 8,500 |
| **Activity.1.2.2.** Developing several prospect inoculums in large scale | 8,500 (I) | - | 4,200 (I) | 6,000 (I) | 2,500 (I) | 2,000 (I) | Q2-Q3 Y1 | 23,200 (I) |
| | 1000 (G) | | 0 | 0 | 0 | 0 | | 1,000 (G) |

Continued

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Activity 1.2.3.** Implementing several prospecting inoculums for artificial inducement | 9,000 (I) | - | 3,500 (I) | 3,000 (I) | 2,500 (I) | 1,250 (I) | Q5-Q6 Y2 | 19,250 (I) |
| | - | 2,000 (G) | - | 1,000 (G) | - | - | | 3,000 (G) |
| **Sub Total** | **27,000 (I)** | **-** | **10,700 (I)** | **9,000 (I)** | **8,000 (I)** | **5,250 (I)** | | **59,950 (I)** |
| | **2,000 (G)** | **2,000 (G)** | **-** | **8,500 (G)** | **-** | **-** | | **12,500 (G)** |
| **Out Put .1.3. Better inoculation engineering** | | | | | | | | |
| **Activity.1.3.1.** Evaluating basic properties of Eaglewood stands | 9,750 (I) | - | 3,360 (I) | 3,500 (I) | 1,500 (I) | 1,250 (I) | Q1-Q2 Y1 | 19,360 (I) |
| | 1,000 (G) | - | - | 9,000 (G) | 2,000 (G) | - | | 12,000 (G) |
| **Activity.1.3.2.** Evaluating the existing inoculation engineering technique | 11,000 (I) | - | 3,420 (I) | 4,500 (I) | 1,500 (I) | 1,450 (I) | Q3-Q4 Y1 | 21,870 (I) |
| | 750 (G) | - | - | - | - | - | | 750 (G) |
| **Activiry 1.3.3.** Developing a better technique from the existing inoculation engineering technique | 9,250 (I) | - | 3,160 (I) | 4,000 (I) | 3,000 (I) | 1,750 (I) | Q7Y2 | 21,160 (I) |
| | 1,750 (G) | - | - | 5,000 (G) | 400 (G) | - | | 7,150 (G) |
| **Activity 1.3.4.** Characterizing and evaluating Eaglewood product | 9,750 (I) | - | 3,300 (I) | 6,000 (I) | 3,000 (I) | 1,500 (I) | Q7-Q8 Y2 | 23,550 (I) |
| | 1,000 | - | - | - | - | - | | 1,000 (G) |
| **Activity 1.3.5.** To Visit eagle wood processing and small scale plantation in Vietnam | 9,500 (I) | - | 5,000 (I) | - | 2,000 (I) | 1,600 (I) | Q9-Q10 Y3 | 18,100 (I) |
| | - | - | - | - | - | - | | - |
| **Sub Total** | **49,250 (I)** | **-** | **18,240 (I)** | **18,000 (I)** | **11,000 (I)** | **7,550 (I)** | | **104,040 (I)** |
| | **4,500 (G)** | **-** | **-** | **14,000 (G)** | **2,400 (G)** | **-** | | **20,900 (G)** |
| Specific Objective 2. To disseminate the technology to communities living in and around the forest. | | | | | | | | |
| Out Put 2.1.Two established demonstration trial plots | | | | | | | | |
| **Activity.2.1.1.** Establishing demonstration plots | 10,000 (I) | 20,000 (I) | 4,500 (I) | 4,000 (I) | 1,100 (I) | 2,500 (I) | Q2-Q4 Y1 Q5-Q8 Y2 Q10-Q11 Y3 | 42,100 (I) |
| | 2,250 (G) | 15,000 (G) | - | 18,500 (G) | - | - | | 35,750 (G) |
| **Activity.2.1.2.** Data collection and conducting financial analysis on eaglewood Plantation | 10,000 (I) | 7,000 (I) | 4,600 (I) | 3,000 (I) | 2,250 (I) | 2,000 (I) | Q7-Q8 Y2- | 28,850 (I) |
| | 500 (G) | 0 | 0 | 0 | 0 | 0 | | 500 (G) |
| **Activity.2.1.3. Assessing** socialization results of eaglewood production technology | 10500 (I) | 0 | 9000 (I) | 4500 (I) | 2000 (I) | 5000 (I) | Q10 Y3 | 31,000 (I) |
| | - | - | - | - | - | - | | - |
| **Sub Total** | **30,500 (I)** | **27,000 (I)** | **18,100 (I)** | **11,500 (I)** | **5,350 (I)** | **9,500 (I)** | | **101,950 (I)** |
| | **2,750 (G)** | **15,000 (G)** | **-** | **18,500 (G)** | **-** | **-** | | **36,250 (G)** |
| **Out Put. 2.2.** Trained forest communities of the inoculation technology | | | | | | | | |
| **Activity.2.2.1.** Preparation of training | 9,250 (I) | - | 2,000 (I) | 4,500 (I) | 1,650 (I) | 2,180 (I) | Q7-Q8 Y2 | 19,580 (I) |
| | 2,000 (G) | 2,000 (G) | - | 4,000(G) | - | - | | 8,000 (G) |
| **Activity.2.2.2.**Holding training on inoculation technology | 9,500 (I) | 20,000 (I) | 5,000 (I) | 3,000 (I) | 1,500 (I) | 2,120 (I) | Q8 Y2 Q10 Y3 | 41,120 (I) |
| | 1,000 (G) | 4,000 (G) | - | 2,500 (G) | 300 (G) | 1,000 (G) | | *8,800* (G) |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| **Sub Total** | **18,750 (I)** | **20,000 (I)** | **7,000 (I)** | **7,500 (I)** | **3,150 (I)** | **4,300 (I)** | | **60,700 (I)** |
| | **3,000 (G)** | **6,000 (G)** | **-** | **6,500 (G)** | **300 (G)** | **1,000 (G)** | | **16,800 (G)** |
| **Output 2.3: Conducted workshop** | | | | | | | | |
| **Activity.2.3.1. Preparation of training** | 8,300 (I) | - | 2,000 (I) | - | 1,500 (I) | 2,000 (I) | Q3 Y1 Q10 Y3 | 13,800 (I) |
| | 1,000 (G) | - | - | 500 (G) | 500 (G) | 1,500 (G) | | 3,500 (G) |
| **Activity 2.3.2. Holding Workshop** | **9,000 (I)** | **15,000 (I)** | **4,500 (I)** | **3,000 (I)** | **2,000 (I)** | **2,500 (I)** | **Q1 Y1 Q11 Y3** | **36,000 (I)** |
| | **1,000 (G)** | **500 (G)** | **-** | **500 (G)** | **500 (G)** | **1,500 (G)** | | **4,000 (G)** |
| **Sub Total** | **17,300 (I)** | **15,000 (I)** | **6,500 (I)** | **3,000 (I)** | **3,500 (I)** | **4,500 (I)** | | **49,800 (I)** |
| | **2,000 (G)** | **4,500 (G)** | **-** | **3,000 (G)** | **800 (G)** | **2,500 (G)** | | **7,500 (G)** |
| **Sub Total ITTO** | **170,800** | **62,000** | **70,540** | **55,000** | **37,500** | **37,100** | | **432,940** |
| **SubTotal GOI** | **17,250** | **27,500** | | **64,500** | **5,500** | **4,500** | | **119,250** |
| ***GRAND TOTAL*** | **188,050** | **89,500** | **70,540** | **119,500** | **43,000** | **41,600** | | **552,190** |

## 7.2. YEARLY PROJECT BUDGET BY SOURCE-ITTO

| Budget Components \ Annual Disbursement | | Total | 2007.1-12 | 2008.1-12 | 2009.1-12 |
|---|---|---|---|---|---|
| 10 | Project Personal | 170,800 | 53,600 | 64,600 | 52,600 |
| 20 | Sub-Contract | 62,000 | 20,000 | 20,000 | 22,000 |
| 30 | Duty Travel | 70,540 | 22,520 | 22,500 | 20,160 |
| 40 | Capital Items | 55,000 | 43,350 | 11,650 | - |
| 50 | Consumables Items | 37,500 | 13,500 | 12,500 | 11,500 |
| 60 | Miscellaneous | 37,100 | 10,200 | 12,200 | 12,700 |
| | **Subtotal 1** | 432,940 | 162,320 | 144,300 | 118,960 |
| 70 | ITTO Monitor., Evaluat., and Administ. Cost | | | | |
| | 71. Monitoring and Review Cost (effective estimation) | **12,000** | | | |
| | 72. Evaluation Cost | **18,000** | | | |
| | **Subtotal 2** | **462,940** | | | |
| | 73. Program support cost (8 % of Subtotal 2) | ***37,035*** | | | |
| **ITTO TOTAL** | | ***499,975*** | | | |

## 7.3. YEARLY PROJECT BUDGET BY SOURCE-GOI

| Budget Components \ Annual Disbursement | | Total | 2007.1-12 | 2008.1-12 | 2009.1-12 |
|---|---|---|---|---|---|
| 10 | Project Personal | 17,250 | 6,000 | 6,000 | 5,250 |
| 20 | Sub-Contract | 27,500 | 9,500 | 9000 | 9000 |
| 30 | Duty Travel | - | - | - | - |
| 40 | Capital Items | 64,500 | 24,500 | 20,000 | 20,000 |
| 50 | Consumables Items | 5,500 | 2000 | 2000 | 1500 |
| 60 | Miscellaneous | 4,500 | 1500 | 1500 | 1500 |
| **Executing Agency Total** | | 119,250 | 43,500 | 38,500 | 37,250 |

## 7.4. CONSOLIDATED YEARLY PROJECT BUDGET

| NO | | BUDGET COMPONENT | UNIT COST (US $) | TOTAL (US $) | YEAR 1 (US $) | YEAR 2 (US $) | YEAR 3 (US $) |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 | 6 | 7 |
| 10 | **Personal Project** | | | | | | |
| | 11 | Fellowship &Training | | 12000 | | 12000 | |
| | 12 | Administration Staffs (Secretary, Accountant and Typist) for 12 months each year | 250/month | 31,000 | 11000 | 10000 | 10000 |
| | 13 | Other Labors (Technician and field labor) | 25/day | 34750 | 12250 | 11250 | 11250 |
| | 14 | Project Leader (for 27 months) | 900/month | 24300 | 8100 | 8100 | 8100 |
| | 15 | National consultant (3 persons for 5 months/persons) | 1,500/month | 27000 | 9000 | 9000 | 9000 |
| | 16 | National expert (Researcher) for 4 persons for 18 months/person | 750/month | 54,000 | 18,000 | 18,000 | 18,000 |
| | **19** | **Component Total** | | **170,800** | **53,600** | **64,650** | **52,600** |
| 20 | ***Sub Contract*** | | | | | | |
| | 21 | National conference (50 men, a day) | | 15,000 | 10,000 | | 5,000 |
| | 22 | Training Organization | | 20,000 | | 10,000 | 10,000 |
| | 23 | Establishing demonstration plot for plantation and artificial induce | | 27,000 | 10,000 | 10,000 | 7,000 |
| | **29** | **Component Total** | | **62,000** | **20,000** | **20,000** | **22,000** |
| 30 | ***Duty Travel*** | | | | | | |
| | 31 | DSA for surveying, including air ticket | 60/dim | 58,000 | 20,000 | 20,000 | 18,000 |
| | 32 | Local transport around Jakarta, Bogor, Bandung | | 7540 | 2520 | 2510 | 2510 |
| | 33 | International air ticket | | | | | 5000 |
| | **39** | **Component Total** | | **70,540** | **22,520** | **22,500** | **20,160** |
| 40 | ***Capital Items*** | | | | | | |
| | 41 | Machinery equipments | | 16,100 | 11000 | 5,100 | |
| | 42 | Vehicles | | 24,000 | 24,000 | - | |
| | 43 | Training and Conference Materials | | | | | |
| | | 43.1. PC destop 3 units | 1250/unit | 3750 | 2500 | 1250 | |
| | | 43.2. Laptop 2 units | ***2000/unit*** | 4000 | 2000 | 2000 | |
| | | 43.3. Printer 2 units | 500/unit | 1000 | 1000 | | |
| | | 43.4. Handycam I unit | 1500/unit | 1250 | 1250 | | |
| | | 43.5. Digital camera 3 units | ***800/unit*** | 2400 | 1600 | 800 | |

Continued

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| | | 43.6. Infocus 1 unit | 2500/unit | 2500 | | 2500 | |
| | **49** | **Component Total** | | **55,000** | **43,350** | **11,650** | |
| 50 | ***Consumable items*** | | | | | | |
| | 51 | Office supplies | | 9,000 | 3,000 | 3,000 | 3,000 |
| | 52 | Sample specimens | | 11,500 | 4,500 | 3,500 | 3,500 |
| | 53 | Chemical reagents, glassware, etc | | 9,000 | 3,000 | 3,000 | 3,000 |
| | 54 | Fuel and utilities | | 8,000 | 3,000 | 3,000 | 2,000 |
| | **59** | **Component Total** | | **37,500** | **13,500** | **12,500** | **11,720** |
| **60** | **Miscellaneous** | | | | | | |
| | 61 | Sundry | | 9000 | 3000 | 3000 | 3000 |
| | 62 | Auditing | 3500/year | 10500 | 3500 | 3500 | 3500 |
| | 63 | Technical report | | 11,000 | 4500 | 3500 | 3500 |
| | 64 | Meeting | | 6600 | 2200 | 2200 | 2200 |
| | **69** | **Component Total** | | ***37100*** | ***10200*** | ***12200*** | ***12700*** |
| | | **SUBTOTAL 1** | | **432,940** | **162,320** | **144,300** | **118,960** |
| **70** | **ITTO Monitoring, Evaluation and Administration** | | | | | | |
| | 71 | Monitoring and review costs | | 12000 | | | |
| | 72 | Evaluation costs | | 18000 | | | |
| | 73 | Program support Costs (8 %) | | ***37035*** | | | |
| | | **TOTAL BUDGET** | | ***499,975*** | | | |

## PART III. OPERATIONAL ARRANGEMENT.

### 1. Management structure

The Project will be coordinated by Forest Products Research and Development Center-FORDA as the Project Executing Agency, under supervision of the Project Steering Committee (PSC). The Steering Committee will be chaired by Secretary of FORDA. The Committee consists of representatives of the main involved institutions within this project and some invited experts. The role of the Committee is to guide the project, monitor its progress, approve annual operational plans, examine annual reports and propose adjustment to ITTO. Meanwhile, the Project Executing Agency will appoint the scientists to implement the project. The organizational chart of general management of the project is showed in Figure 5.

## 2. Monitoring, reporting and evaluation

### a. Project progress report

Annual progress reports will be prepared in accordance with the provisions of the ITTO Project Manual. These reports will contain information on project performance for each project activities and will be prepared at least 4 weeks before each monitoring mission. The documents will be submitted following the standard format for progress reports as established in the ITTO Manual for Project Formulation (ITTO. May 1999).

### b. Project completion report

The final project report will be submitted within three months after the completion of the project is. The Forest Products Technology Research and Development Center as the executing agency will take the responsibility of this reporting and will consult the Steering Committee before submission of the report.

### c. Project technical reports

Project technical reports will be submitted annually as part of the progress report. After the completion of the project or when relevant technical results have been achieved, the technical reports will be submitted separately. Report format will follow guidelines as provided in the ITTO Manual for Project Monitoring and Evaluation.

### d. Monitoring, review and steering committee's visit

The Steering Committee will meet at least twice a year to monitor the progress of project implementation. Strategic decisions could be taken by the committee during the meeting in order to fulfill the project objectives. ITTO representative's participation during the meeting is expected, at least within one of the meetings. The meetings are proposed to hold at the midterm of the annual project implementation and at least within 1 month before submitting the progress or final report.

### e. Evaluation

The project will be evaluated by the ITTO based on the submitted progress report. ITTO recommendation is expected to ensure that the project is implemented in accordance with the work plan and improve the approach on the following project implementation, whenever possible, that may assure to the achievement of the project objectives. This evaluation could be held at the same time with the steering committee meeting.

## 3. Future operation and maintenance

In general, the project consists of two main components. The first component would be a series of studies on Eaglewood, including the detecting method, harvesting, cultivating, post harvest handling and the industrial processing up to socio-economic, marketing and policy analysis. The second component is the establishment of Eaglewood plantation demonstration plots and small scale Eaglewood industry. Both project outputs will share significant contribution to the development efforts of Eaglewood in Indonesia. All scientific

materials resulted by this project will be useful source of information and will be maintained by the participated institutions.

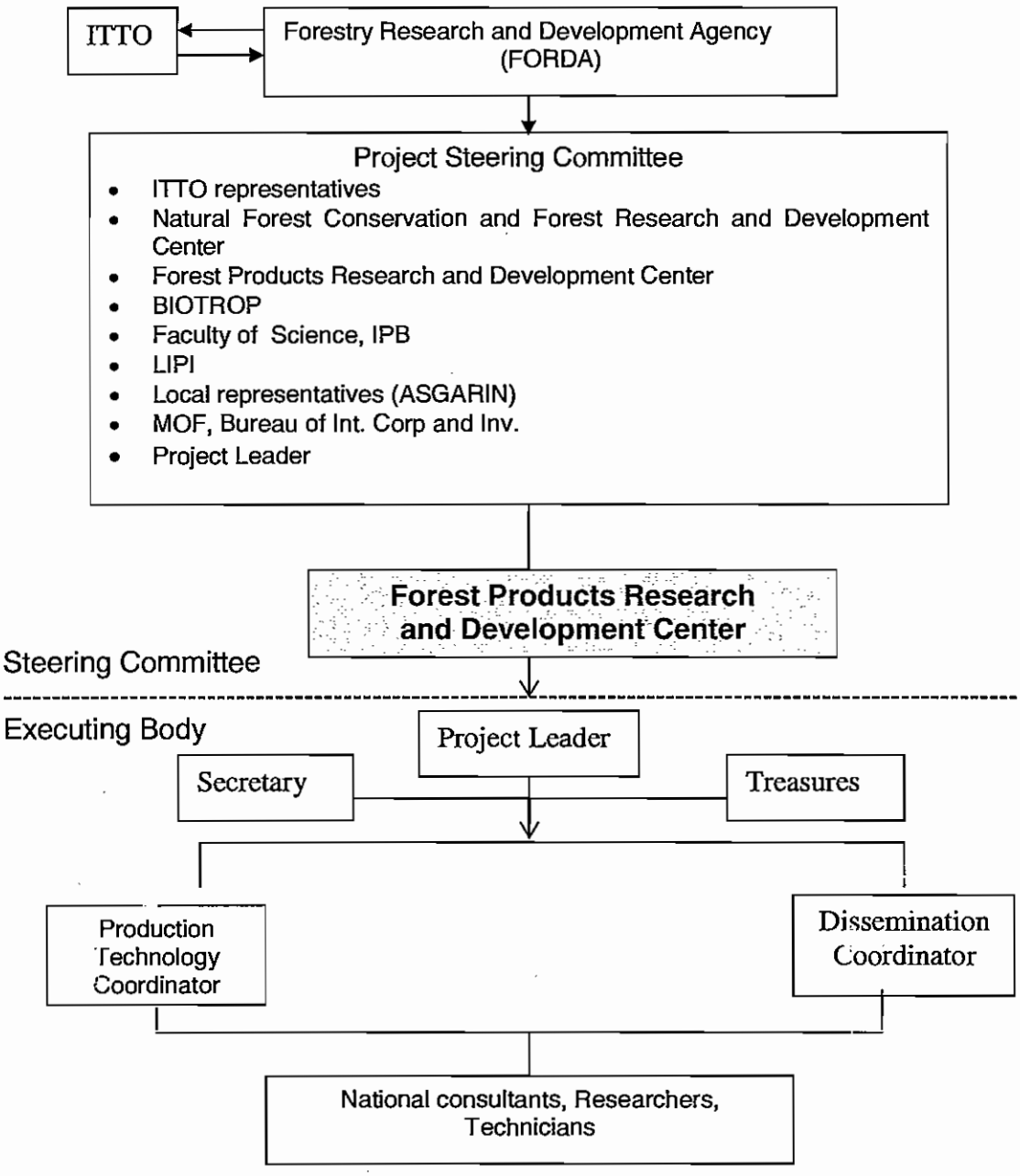



Figure 5. Organizational Chart of Project Implementation

FORDA, in particular will maintain the research results and use these as the basis for its future research activities. The FORDA and other institutions will disseminate the project results to potential communities and private companies for broader adoption. Forestry Regencies and Perum Perhutani (State-owned Forest enterprise) and will use the experience on Eaglewood plantation and further develop the model in their own programs.

The experimental plots will be kept and maintained for research and training purposes as well as a model for a profitable investment.

## PART IV : TROPICAL TIMBER FRAMEWORK

### 1. Compliance with the ITTA 1994 objectives

This project complies with the ITTO Objectives laid down in Article 1 of the 1994 ITTA (International Tropical Timber Agreement):

c. To contribute to the process of sustainable development;

e. To promote the expansion and diversification of international trade in tropical timber from sustainable sources;

f. To promote and support research and development with a view to improving management and efficiency of wood utilization as well as increasing the capacity to conserve and enhance other forest value timber producing tropical forest;

i. To promote increased and further processing of tropical from sustainable sources on producing member countries with a view industrialization and thereby increase their employment opportunities and export earning.

j. To encourage members to support and develop industrial tropical timber reforestation and forest management activities as well as degraded land, with due to regard for the interest of local communities dependent on forest resources.

### 2. Compliance with ITTO Action Plan

In the field of Forest Industry, ITTO aims to promote industrialization of producing countries and thereby increase their employment opportunities and export earning. This project relates to the ITTO Forest Industry Action Plans, especially in Goal 1: Promote increased and further processing of tropical timber from sustainable sources, and Goal 2: Improve industry's efficiency of processing and utilization of tropical timber from sustainable resources.

Goal 1. Promote increased and further processing of tropical timber from sustainable sources
Action 2. Study and promote policies and other measures to increase timber industry competitiveness.

Goal 2. Improve industry's efficiency of processing and utilization of tropical timber from sustainable resources
Action 1. Develop, publish and disseminate on increasing utilization efficiency and reduction of losses and waste throughout the production chain.

Action 2. Facilitate and encourage industrial demonstration projects addressing increased production and utilization efficiency, and the competitiveness of the tropical timber industry.

Action 4. Develop, publish and disseminate recommendation for increasing efficiency throughout the production chain through the utilization of residues and through recycling.

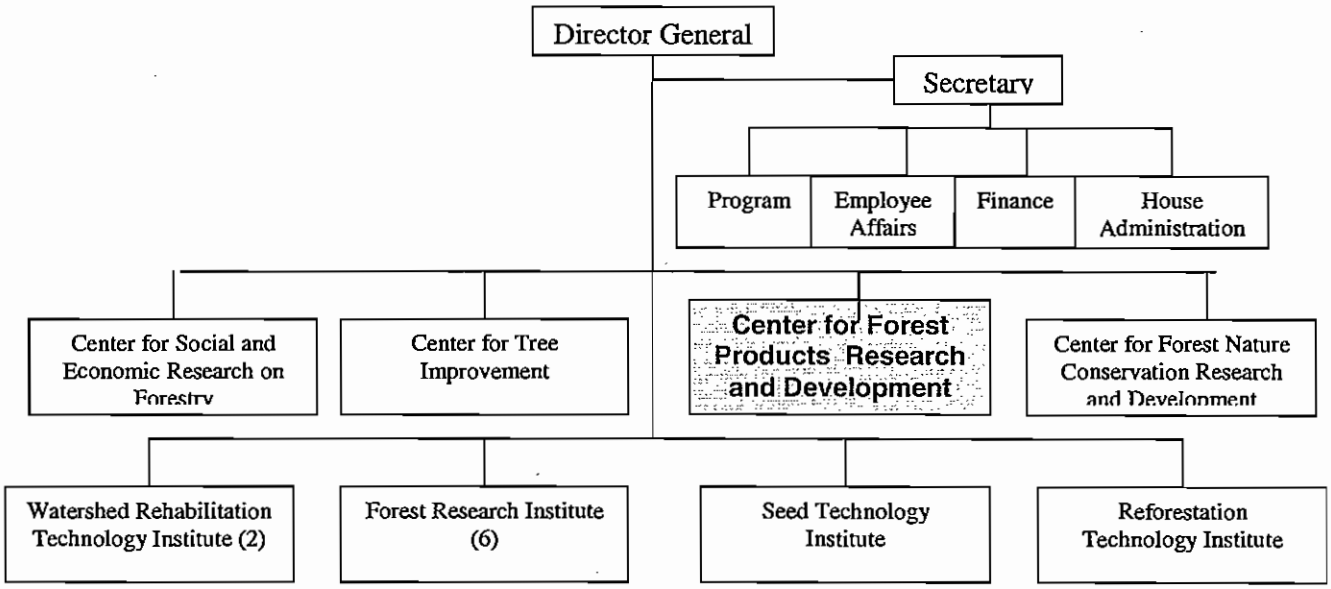
Action 5. To the extent possible given the Organization primary focus on timber, develop, publish and disseminate techniques and technologies on product development for the utilization efficiency of NTFP.

Action 7. Promote increased awareness and utilization of existing information on wood properties and end-use requirements.

This project also supports the actions 1, 3, and action 5 in Goal 2 of the ITTO Economic Information and Market Intelligence Action Plan Goals; and it also supports to the action 4 and action 5 in Goal 1 and to the action 2 in Goal 2 of the Reforestation and Forest Management Action Plan Goals.

## ANNEX A. PROFILE OF THE EXCUTING AGENCY

ORGANIZATION STRUCTURE




The Expertise of The Executing Agency

FORDA's mission is to find and to provide science and technology to support sustainable, diversified uses of forest for the benefit of people. In pursuit of the mission, FORDA's Research Priorities are:

1. Research and development to secure forest resources base
2. Development of harvesting technique and assessment of all type of quality products obtainable from forest including non timber forest products and service.
3. Research in environmental management and biodiversity assessment, genetic resources, forest health and water resources management.
4. Improving sylviculture techniques and forest management practices enhancing better socioeconomic conditions of forest dweller, and social welfare programs.
5. National forest policy research and assessment of forest practices including institutional aspects toward achieving Sustainable Forest Management.

FORDA's Personel

As of April 2000, FORDA has been supported by 2009 scientists, technicians and employees, of which 69 staffs hold Ph.D degree, 211 staffs hold master degrees and 641 B.S. degree holders, the remaining are graduated for either technical, senior or junior high schools. A total of research scientists and technician is around 323 persons, comprising 284 research scientists, 184 researcher candidates, 188 technicians and 139 technician candidates.

FORDA'S Cooperation

- Forest Tree Improvement Project, Phase II at Maluku 2002 – 2004

- Carbon Fixing Forest Management in Indonesia, (Jepang/JICA) in Jawa Barat, Kalimantan dan Sumatera, 2000 – 2005
- Sustainable Forest Management and Human Resource Development in Indonesia (ITTO PD 89/90 (F) (DITJEN PHKA, BADAN LITBANG, PUSDIKLAT) in Kalbar,Kaltim,Bogor (Jabar) 2002 – 2003
- Strategies for the Development of Sustainable Wood-Based Industries in Indonesia ITTO PD 85/01 Rev.2 (1)

Some FORDA's publications

- The growth and quality index of Eucalyptus deglupta Blume seedlings in various ambient temperature and shade levels
- Effect of forest plantation of some species of Shorea on soil fertility properties
- Hydrological Aspect of Eucalyptus
- Description of Four Tree Species for Private Woodland Development
- The Utilization of Forest Waste Through Vertical Mulch Technique for Soil and Water Conservation
- Wood Wasting in Natural Forest Harvesting in The Outer Java Island and Its Possible Solutions
- Prospect of Conservation Tillage Technology on Forest Plantation Development Using Agroforestry Pattern
- The Value and Benefit of Tengkawang Tree (Shorea spp.) Plantation in Kalimantan Island
- The Roles of Medicinal Plants on Plantation Forest Development
- Research Strategic Concept on Non-Wood Forest Product in Indonesia
- Approximation on Economic Valuation in the Resources of Conservation Area
- Forest Management in the Future : Based on Forestry Development Paradigm in the 21$^{th}$ Centur)
- Additional Programs and Cost Composition in Managing Natural Forest Using Indonesian Selective Cutting and Planting System
- Possibility of Debt for Nature Swap Implementation in Indonesia

The Infrastructure of The Executing Agency

Facilities available at FORDA are:
- Libraries;
- Laboratories facilities for forest products and non-timber forest products research;
- Dry and wet laboratories facilities for forest research;
- Herbarium;
- Office building for meeting, working rooms in Bogor, Jakarta and other cities;
- Experimental Forest in Bogor, Haurbentes and Samarinda

## ANNEX B. CURICULUM VITAE

**Personal Particulars 1.**

| | |
|---|---|
| Name in full | : Bambang Wiyono, (M.Sc., Ir.) |
| Present employment | : Forest Products Research and Development Center, Forestry Research and Development Agency |
| Research area | : Non Wood Forest Products |
| Email | : bambangw2004@yahoo.com; bambangw@forda.org |
| Place and date of birth | : Trenggalek, March 26, 1959 |
| Nationality | : Indonesian |
| Education | : 2006 Third Year of PhD Ronpaku Program, Ehime University Japan<br>1995 Master in Forestry Science at Dept. of Forestry, University of Canterbury, New Zealand<br>1985 Bachelor degree in Forest Products Technology at IPB, Bogor Indonesia |

**Seminar and Conference.**

a. Attending **Fourth International Sago Symposium**, 6-9 August 1990, Kuching, Serawak Malaysia.
b. Presenting a paper at **Seminar on Forest Plantation and Sustainable Forest Management,** Joint Working Group D (Forestry Research, Training and Extension), Bilateral Cooperation Indonesia-Malaysia. Palembang 26-27 August 1996.
c. Presenting posters at **XXI IUFRO World Congress** 7-12 August 2000 Kuala Lumpur, Malaysia.
d. Presenting a paper at **Symposium On Utilization Of Agricultural And Forestry Residues**, October 31 to November 3, 2001 Nanjing Forestry University Nanjing, Jiangsu, China.
e. Presenting a Recent Status of Sustainable Production of Rattan and Its Utilization in Indonesia at **Regional Conference on Sustainable Development of Rattan in Asia,** 21-23 January 2004, Manila-Philippines.
f. Attending Inception Meeting PD 334/05 Rev. 2(I): **Demonstration and Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN Member Countries.** 19 - 22 June 2006. ERDB Auditorium, UPLB Forestry Campus College, Laguna 4031 PHILIPPINES

**Work experience** :

a. Since October 1, 1985 to present, I have been working at the research group of Non Wood Forest Products Utilization and Processing at Forest Products Technology Research and Development Center, Forestry Research and Development Agency. Most research that I have carried out was utilization and processing oft natural products from forest, i.e. extracting or modifying natural resin and essential oil from forest, such as gum resin, rosin and turpentine, dammar, etc.
b. 1994 – 1998 as a Head of Non Wood Forest Product research group at Forest Products Technology Research and Development Center.
c. 1995-1997 a member of Joint Working Group D (Forestry Research, Training and Extension), Bilateral Cooperation Indonesia-Malaysia
d. 1995 to present as a research coordinator of Non Wood Forest Product utilization and processing

e. 2002 to present as a Head of Non Wood Forest Product research group at Forest Products Research and Development Center.

**Experience in ITTO Project**

a. As a coordinator for rattan Utilization on PD 108/01 Rev.3 (I) entitled "Development of Sustainable Rattan Production and Utilization Through Participation of Rattan Small Holders and Industry in Indonesia".
b. As a Contact person for Indonesia on PPD 51/02 Rev. 1(I) entitled "Application of Production and Utilization Technologies for Sustainable Development of Rattan in the ASEAN Member Countries".
c. As a Contact person for Indonesia on PD 334/05 Rev. 1(I) entitled "Demonstration and Application of Production and Utilization Technologies for Rattan Sustainable Development in the ASEAN Member Countries".

**Publication:**

It is about 60 publications that were published in Forest Product Bulletin, Forest Product Info, Proceeding, mainly in Non-wood Forest Products. Some of my publications are as follows:

a) Wiyono, B., N. Sumarliani, U. Kulsum and E. Kusmiyati. 2001. Quantification of several parameters on Indonesian national standard draft for garro wood (Aloe wood) quality. Forest Products Bulletin, 19 (3): 137-146.
b) Wiyono, B., E. Santosa, and I, Anggraeni. 1996. Determining on parameter requirement of garro quality. Forest Products Info, 3 (2): 29 – 36.
c) YI Mandang and B. Wiyono. 2002. Anatomy of Eaglewood (Aquilaria malaccensis) and several related species. Forest Products Research Bulletin, 20(2): 107-126.
d) Wiyono, B, P. Hastoeti and E. Kusmiyati. 2003. Effect of storage on the quality of the processed product of pine resin from West Sumatra. Forest Products Bulletin.
e) Wiyono, B.2002. Effect of acid concentration in maleic rosin processing on its yield and physico-chemical properties. Forest Products Bulletin, 20 (3): 207-215

**Personal Particulars 2.**

| | |
|---|---|
| Name in full | : Dr. Erdy Santoso |
| Present employment | : Forest & Nature Conservation Research & Development Center, Forest Research and Development Agency (FORDA) |
| Research Area | : Forest Pathology |
| E-mail | : erdi_s@forda.org |
| Place and Date of Birth | : Kediri, November 17, 1951 |
| Nationality | : Indonesian |
| Education | : Dr. in Forest Pathology IPB (1997). |

**Seminar and Conference.**

a. Study of pathology in forest plantation 1 march- 30 april 1997
b. Presentation a paper at BioThailand 2001: from research to market, 7-10 November 2001, Queen Sirkit National Convention Centre, Bangkok, Thailand
c. Short visit in Osaka Gaz Co. Ltd. For knowing Mycorrhizal Technology, August 1999.
d. Workshop about "Rust diseases in Eucalypts, 20-26 October 2004, FAO, Bangkok, Thailand

**Publication :**

It is about 50 publication that were published in FRDC Bulletin, Forest info and Prosiding mainly in Forest Development Publication are as follows :

a. Santoso, E. 1996. Agarwood formation with artificial inoculation. Prosiding in : Forest & Nature Conservation Research & Development Center (FNCRDC), Bogor.
b. Santoso, E., Irianto, R.S.B, Turjaman, M, Widyati, E., Sitepu, I. 2001. Effects of arbuscular mycorrhizal fungi (AMF) to plant growth of Khaya ivorensis in nursery. BioThailand 2001, Bangkok. Thailand.
c. Wiyono, B., Santoso, E. and Anggraeni, I. 1996. Determining on parameter requirement of garro quality. Forest product info, 3 (2) : 29-36.
d. Anggraeni, I. and Santoso, E. 2004. Identification and pathogenicity of root disease in the several of Acacia mangium . Forest Research Buletin

**Personal Particulars 3.**

| | |
|---|---|
| Name in full | : Yana Sumarna(Drs, MSi) |
| Present employment | : Forest Research and Development Center (FRDC)<br>Forest Research and Development Agency<br>(FORDA) |
| Research Area | : Non Wood Forest Products |
| Place and Date of Birth | : Ciamis, September 3, 1950. |
| Nationality | : Indonesian |
| Education | : Master in Forestry Sience at Dept. Forestry ,<br>Agriculture Institut of Bogor, Bogor. |

**Seminar and Conference.**

a. Presenting a Paper at Rattan Seminar in Kinabalu, Malaysia, IDRC Program, 20 – 27 September, 1989.
b. Workshop of the Agroforestry System, ICRAF program, September 3 – 23, 1985.

**Experience in ITTO Project.**

Research Assistance for rattan Cultivation PD 108/01 Rev.3(1) entitled " Development of Sustainable Rattan Production and Utilization Through Participation of Rattan Small Holder and Industry in Indonesia.

**Publication :**

It is about 34 publication that were published in FRDC Bulletin, Forest info and Prosiding mainly in Forest Development Publication are as follows :

- Sumarna, Y. 1984. Ecology of the Mangrove Forest in Riau and Jambi Province.
- Sumarna, Y and Y. Dali, 1989. Silviculture Techniques of Rattan Cultivation.
- Sumarna, Y. 1995. Inventory Techniques of Sagopalm and Rattan Plantation.
- Sumarna, Y. and Y. Heryaty, 2004 Silvicultur Techniques of Agarwood Plantation.
- Sumarna, Y. ; S. Kosasih S and N.Mindawati, 1998.Seeds handling and Propagation Techniques of agarwood plant of *Aquilaria malacensis* Lamk.
- Sumarna Y, and S. Kosasih, 1998.Silviculture Techniques of Shorea sp Plantation.
- Sumarna Y, 2002. Consevation and Cultivation Strategic of Medicine Plant.
- Sumarna Y and T. Setyawati, 2001. Biological and Ecological of the Mangrove Forest.

**Personal Particulars 4.**

| | |
|---|---|
| Name in full | : Maman Turjaman (DEA, Ir) |
| Present employment | : Forest & Nature Conservation Research & Development Center, Forest Research and Development Agency (FORDA) |
| Research Area | : Forest microbiolgy |
| E-mail | : turjaman@yahoo.com.sg or maman@forda.org |
| Place and Date of Birth | : Jakarta, August, 18,1965 |
| Nationality | : Indonesian |
| Education | : 2006 Final year of JSPS-Ronpaku Student (Doctor Thesis) in Yamagata University (Japan)<br>1995 DEA. Forest Soil Microbiology Laboratory-INRA; Faculty of Science; University of Nancy 1; France.<br>1989 Ir. (Forestry Engineer); Silviculture; Faculty of Forestry; Bogor Agricultural University, Bogor, Indonesia. |

**Seminar and Conference.**

a. Attending Third European Conference of mycorrhizal, August 1994 in Granada, Spain.
b. Attending in Second Asian Conference of mycorrhizal, Februarry 1991 in Bangkok, Thailand.
c. Attending in Workshop Biotechnology of JSPS Osaka University, November 2001, Penang, Malaysia.
d. Attending in International Conference Peat-Swamp Forest Rehabilitation of JSPS Osaka University, November 2002, Denpasar (Bali), Indonesia.
e. Attending in Workshop of Bioreforestation, Yogyakarta, Gajah Mada University, December 2003.

**Publication :**

It is about 40 publication that were published in FRDC Bulletin, Forest info and Prosiding mainly in Forest Development Publication are as follows :

Turjaman M., Tamai Y., Segah H., Limin S.H., Cha, J. Y., Osaki M., Tawaraya K. 2005 Inoculation with the ectomycorrhizal fungi *Pisolithus arhizus* and *Scleroderma* sp. improve the early growth of *Shorea pinanga* nursery seedlings. New Forests. .Accepted in August 2004. *In Press*.

Turjaman M., Tawaraya K., Tamai Y.Sitepu I.R., Santoso E., Osaki M. 2003. Response improvement of *Ploiarium alternifolium* and *Calophyllum hosei* to arbuscular mycorrhizal fungi *Glomus clarum* dan *Glomus aggregatum*. Workshops of BIOREFOR, Jogjakarta, 14-17 Desember 2003, Faculty of Forestry, Gajah Mada University.

Tawaraya, K., Takaya, Y., Turjaman, M., Tuah, S.J., Limin, S.H., Tamai, Y., Cha, J.Y., Wagatsuma, T., Osaki, M. 2003. Arbuscular mycorrhizal colonization of tree species grown in peat swamp forests of Central Kalimantan, Indonesia. Forest Ecology and Management 6258 : 1-6.

Turjaman M., Irianto R.S.B.I., Sitepu I.R., Widyati E., Santoso E. 2003. Mass production of ectomycorrhizal in encapsulated alginat beads for inoculating of seedlings planting stocks in nursery. Proceeding of rehabilitation and conservation of forest resources. ISBN :979-3145-09-9. Bogor. 9-24 pp.

## ANNEX C. TERMS OF REFERENCE

1. **Project Coordinator**
   *Qualification and experiences*
   a. Having background in forestry at least 10 years experiences
   b. Having a good in English, both speaking and writing
   c. Has been involved in the ITTO project preparation

   *Responsibilities*
   a. Preparing annual action plan
   b. Preparing coordination within several parties
   c. Implementing the project based on Steering Committee direction and annual action plan
   d. Coordinating national consultants, experts (researchers), team works and project staffs in the Project implementation
   e. Taking care on daily project activities
   f. Monitoring and evaluating the project activities progress
   g. Organizing and coordinating workshops and training

2. **National Consultant for Cultivation System**
   *Qualification and Experience*
   a. MS in silviculture or forestry
   b. Minimum 5 years experience in silviculture project
   c. Having a good in English, both speaking and writing

   *Responsibilities*
   a. Designing planting activities in the field
   b. Organizing planting activities
   c. Organizing maintenance of plantation
   d. Preparing technical report and guidelines at the end of each mission including finding and recommendations and submit it to the project coordinator

3. **National consultant for inoculums production**
   *Qualification and Experience*
   a. PhD in biochemistry
   b. At least 5 years experience in biochemistry in related
   c. Both oral and written communication in English.

   *Responsibilities*
   a. Designing equipment for mass production of inoculums for artificial inducement
   b. Establishing and managing in producing artificial inoculums in large scale
   c. Reviewing artificial inducements and related topics based on existing literature consultations and field visits.
   d. Preparing and Implementing artificial inoculation in the field
   e. Monitoring and evaluating on the successful of inoculating in the field
   f. Preparing technical report at the end of each mission including finding and recommendations and submit it to the project coordinator

4. **National consultant for Eaglewood products and grading system**
   *Qualification and experiences*
   a. Master in NWFP processing
   b. Minimum 5 years experience in utilization of Eaglewood product and grading system
   c. Having a good in English, both speaking and writing

   *Responsibilities*
   a. Reviewing utilization of Eaglewood product and grading based on existing literature consultations and field visits.

b. Analyzing product preference of Eaglewood
c. Reviewing Eaglewood utilization on existing literature and field visits.
d. Reviewing the existing commercial grading system in national or international market and propose possible new grading system to be introduced in the country.
e. With coordinator to prepare technical report at the end of each mission including finding and recommendations and submit it to the project coordinator.

## ANNEX D: Bibliography


1. Santosa, E. 1996. Pembentukan gubal gaharu dengan cara inokulasi. Diskusi Hasil Penelitian dalam menunjang Pemanfaatan Hutan Lestari. Cisarua 11-12 Maret 1996.
2. Whitemore, T.C. and I.G.M. Tantra. 1989. Tree Flora of Indonesia. Check list for Sumatra. Forest Research and Develepment Center.
3. Universitas Nusa Cendana. 1996. Prospek pengusahaan gaharu di NTT: Syudi potensi dan managemen eksploitasi. Laporan Hasil Penelitian. Kerjasama Balitbang Kehutanan dengan Universitas Nusa Cendana
4. Soehartono, T. (1997). Overview of trade in gaharu in Indonesia. In: Report of the Third Regional Workshop of the Conservation and Sustainable Management of Trees, Hanoi, Vietnam. WCMC IUCN/SSC. Pp. 27-33.
5. Soehartono, T . & Mardiastuti, A., 1997. The current trade in gaharu in West Kalimantan. Biodiversitas Indonesia 1: 1-10.
6. Wiriadinata, H. (1995). Gaharu (*Aquilaria* spp.) Pengembangan dan Pemanfaatan yang Berkelanjutan. In Lokakarya Pengusahaan Hasil Hutan Non Kayu (Rotan, Gaharu, dan Tanaman Obat). Departemen Kehutanan. Indonesia-UK Tropical Forest Management Programme. Surabaya, 31 July-1 August
7. Keller, P. and Sidiyasa, K. (1994). Trees of Balikpapan-Samarinda Area, East Kalimantan, Indonesia: A Manual of 280 Selected Species. The Tropenbos Foundation, Wageningen
8. Oetomo, H. (1995). Tinjauan terhadap pemasaran komoditi gaharu Indonesia di perdagangan Internatsional. In:Lokakarya Pengusahaan Hasil Hutan Non Kayu (Rotan, Gaharu, dan Tanaman Obat). Departemen Kehutanan. Indonesia-UK Tropical Forest Management Programme. Surabaya, 31 July-1 August 1995.
9. Barden, A., Awang Anak, N., Mulliken, T., and Song, M. (2000). Heart of the Matter: Agarwood Use and Trade, and CITES implementation for *Aquilaria malaccensis.* TRAFFIC International.
10. Ministry of Forestry (DG of LRSF). 2001. Pengembangan Tanaman gaharu. Proseding Lokakarya. Jakarta, September 2001.
11. Press release of Minister of Forestry No. S.662/II/PIK-1/2004. Five targets of success in managing forest in the five years to future in Ministry of forestry.
12. Beniwal, B.S. 1989.Sylvical characteristic of *Aquilaria agalocha*. Indian forester 115: 17-21.
13. Oyen, L.P.A. and Ng. X. Dung. 1999. Essential-oil plants. Plant Resources of South-East Asia. PROSEA, Bogor-Indonesia.
14. Paoli, G.D., D.R. Peart, M. Leigton, and I. Samsoedin. 2001. An ecological and economic assessment on the NTFP gaharu wood in gunung palung national park, West Kalimantn, Indonesia. Conservation Biology 15 (6): 1721-1732.
15. Hasnida, H. N., M.Y. Aziah, M. Salbiah, Z. Fadhilah, i. Haliza, and H. J. M. Azmy. 2001. Multiplication of shoots from *in vitro* germinated seedlings of Eurycoma longifolia and Aquilaria malaccensis. Pages 269–276 in Tropical Forestry research in the new millennium: meeting the challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1–3 October 2001, Kuala Lumpur, Malaysia.
16. Quan Le Tran, Qui Kim Tran, K. Kouda, N. T. Nguyen, Y. Maruyama, I. Saiki, and S. Kadota. 2003. A survey on agarwood in Vietnam. *Journal of Traditional Medicine* 20(3):124–131.
17. Sadgopol, D. 1959. Experimental studies on the development of essential oils and their components in aromatic plants. *La France et Sa Parfums* 3: 62–71.

18. Soehartono, T., and A. C. Newton. 2002. The *gaharu* trade in Indonesia: is it sustainable? *Economic Botany* 56(3):271–284.
19. Jalaludin, M. 1977. A useful pathogenic condition of wood. Economic botany 31: 222-224.
20. Gibson, I. A. S. 1977. The role of fungi in the origin of oleoresin deposits of agaru in the wood of *Aquilaria agallocha* Roxb. *Bano Biggyan Patrika* **6**:16–26.
21. Ng, L.T., Chang, Y.S. and Kadir, A.A. (1997). A review on agar (gaharu) producing Aquilariaspecies. Journal of Tropical Forest Products 2(2): 272-285.
22. Burkill, I. (1966). A Dictionary of Economic Products of the Malay Peninsula, I. Government of Malaysia and Singapore. The Ministry of Agricultural and Cooperatives, Kuala Lumpur.
23. Chakrabarty, K., Kumar, A. and Menon, V. (1994). Trade in Agarwood. TRAFFIC India and WWF-India, New Delhi. 51pp.
24. Afifi (1995). Proses pengolahan pohon gaharu sampai siap diperdagangkan dan tata cara pembudidayaannya, serta proese gaharu pembentukan gubal. In:Lokakarya Pengusahaan Hasil Hutan Non Kayu (Rotan, Gaharu, dan Tanaman Obat). Departemen Kehutanan. Indonesia-UK Tropical Forest Management Programme. Surabaya, 31 July-1 August.
25. Sidiyasa, K. dan M. Suharti. 1987. Jenis-jenis tumbuhan penghasil gaharu. Makalah Utama Diskusi pemanfaatan kayu kurang dikenal. Puslitbang Hutan dan KA, Bogor.
26. Parman, T., Mulyaningsih, M.Y.A. Rachman. 1996. Studi etiologi gubal gaharu pada pohon ketimunan (A.filaria). Makalah temu pakar gaharu. Kanwil Dephut NTB, 11-12 April 1996.
27. Whitmore, T. C. 1972. Thymelaeaceae. Pages 383–391 *in* T. C. Whitmore, editor. *Tree flora of Malaya, Vol. 2.* Malayan Forest Records No. 26, Forest Research Institute, Kepong, Malaysia.
28. Sumarna, Y. 1998. Teknik budidaya gaharu. Penerbit Swadaya, Jakarta.
29. Anonimous. 2004. Strategi generik pengembangan komoditas gaharu. Biro KLN dan Investasi, Sekretariat Jendral Departemen Kehutanan, Jakarta.
30. Rahayu, G., Isnaini, Y., Situmorang, J. dan Umboh, M.I.J. 1998. Cendawan yang berasosiasi dengan gaharu (Aquilaria malaccensis) dari Indonesia. Prosedng pertemuan ilmiah tahunan Perhimpunan mikrobiologi Indonesia. Universitas Lampung, 14-15 Desember 1998. Bandar Lampung: PERMI Cabang Lampung.
31. Ngatiman, S.A. Siran dan Armansah. 2004. Teknik penyumtikan untuk pembentukan gaharu. BP2K Samarinda.

**ANNEX E: Summary of modification of the proposal as recommended by the Thirty second Expert Panel**

| No. | Recommendation | Modification |
|---|---|---|
| 1. | More clearly define the characteristics and biology of Eaglewood; | The characteristics and biology of Eaglewood has been added in the technical and scientific aspect **at page 14-15.** |
| 2. | Clarify whether the focus of Eaglewood production will be from "natural forests" noted in the development objective or "plantations". Relationship of Eaglewood production to natural forests needs better explanation; | The focus of Eaglewood production will be both natural forest (protection forest and production forest) and privately-owned lands. **See at page 7.** Eaglewood stands found in the protection natural forest will be used as source of isolates (pathogen) and as mother trees; while in the production natural forest and in the privately-owned lands will be used as Eaglewood production. By introducing the Eaglewood production technology and dissemination of this technology among forest dwellers, they are expected to implement this technology on Eaglewood stands in the production natural forest to replace the conventional means in Eaglewood collection, which usually damage the stands. In the same time, it is expected that they will expand their plantation both in privately-owned lands and in the production natural forest, and implement the technology. By applying this technology to both resources (privately-owned lands and in the production natural forest), the Eaglewood sustainable production will be achieved. |
| 3. | Provide a bibliography to match in-text citations; | Bibliography has been added as **an Annex D** |
| 4. | Make provisions for some stakeholder involvement at onset of project (Traditional Ecological Knowledge (TEK) assessment, etc.); | The involving of the stakeholder, called Lembaga Perberdayaan Masyarakat (Society Powering Institute) that has many experiences (TEK) at onset of project has been added as **at page 7.** |
| 5. | Provide more specific information about silvicutural aspects of Eaglewood focusing on production times for eaglewood and life-cycle of *Aqualaria* spp; | Information on silvicutural aspects of Eaglewood focusing on production times for eaglewood and life-cycle of *Aqualaria* spp has been added in the technical and scientific aspect **at page 15-16.** |
| 6. | Improve the risk | The risk assessment has been improved as |

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| | assessment by considering the possibility of scientific failure (e.g., effective pathogen and inoculation techniques cannot be found); | can be seen in the risk **at page 21** |
| 7. | Discuss environmental impacts from large-scale introduction of pathogen; | Environmental impacts from large-scale introduction of pathogen has been discussed as **at page 20** |
| 8. | Justify the unit costs for laptops and digital camera; | The unit cost for laptop and digital camera have been modified as can be seen **at page 28.** |
| 9. | Adjust the ITTO's Programme Support Costs to 8% of the ITTO total contribution; and | It has been adjusted as **at page 29.** |
| 10. | Provide an Annex which shows the recommendations of the 32nd Expert Panel and the respective modifications in a tabular form | The annex for the recommendation and respective modification was written in a tabular form as **in Annex E** |