ITTO PD 425/06 Rev.1 (I)

Production and Utilization Technology for Sustainable Development of Eaglewood (*Gaharu*) in Indonesia

Ex-Post Evaluation Report

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Part 1 EXECUTIVE SUMMARY

1. Introduction

The Committee on Economic and Market Intelligence and the Committee on Forest Industry (CEM-CFI), decided during their Forty-Sixth Session (held in Yokohama, Japan in November 2012) that the project ITTO PD 425/06 Rev.1 (I) be subjected to an ex-post evaluation. The main objective of the evaluation is to determine if the project served its purpose, and draw recommendations for future action.

This ex-post evaluation report provides an in-depth diagnosis of the project, identifying its successful and unsuccessful outcomes, the reasons for the successes and failures, the sustainability of the project's outcomes, and their contribution towards the achievement of ITTA Objectives (1994 and 2006) and ITTO Strategic Action Plan 2008-2011. Lessons that can be used to improve similar projects in the future are also presented.

2. Evaluation scope, focus and approach

ITTO provided the following project documents and reports for review in preparation for the evaluation:

- Project Document
- Experts Panel's Appraisal
- Project Agreement
- Project Inception Report
- Yearly Plans of Operations
- Bi-Annual Progress Reports
- Minutes of the Project Steering Committee meetings
- Technical Reports
- Workshop Proceedings
- Financial Audit Reports
- Project Completion Report

The above documents were reviewed mainly in reference to the project's logical framework matrix, the effectiveness of technology transfer activities, and the project's overall contribution to the higher order objectives of ITTO. Interview guide questions were formulated for key staff, national experts, consultants, industry participants and forest farmers.

The ex-post evaluation was carried out on 3-10 June 2013 or twenty-five months after project completion. On the first day, an opening meeting was held in Bogor (West Java) with the Executing Agency's representatives, the project's key staff, national experts, and invited industry collaborators. During this meeting, the consultant briefed the participants on the purpose of the ex-post evaluation and how it will be conducted. The consultant requested the Project Coordinator to provide information on recent developments on the project outputs. The final destinations and schedule of field visits were agreed upon.

A small eaglewood and essential oil processing plant in Bogor was visited in the afternoon of 3 June 2013. The business owner and his client – an eaglewood trader based in Qatar, were interviewed. From 4-10 June 2013, interviews with forest farmers, regulators and researchers were conducted at the plantation sites and offices of collaborating organizations in Bogor, Banjarmasin (South Kalimantan) and Denpasar (Bali). A backyard eaglewood tea and wine production site and a university laboratory used for eaglewood research in Bali were also visited.

Finally, the consultant's findings and preliminary report were presented to the Executing Agency's representatives during the evaluation exit conference held in Denpasar on 10 June 2013.

3. Projects facts

ITTO PD 425/06 Rev.1 (I) titled "Production and Utilization Technology for Sustainable Development of Eaglewood (Gaharu) in Indonesia" aimed to promote sustainable production of eaglewood in production natural forests and privately owned lands in order to support the eaglewood-based industries toward sustainable forest management and forest communities' welfare in Indonesia.

This project is aligned with the following ITTA Objectives and ITTO Strategic Action Plans:

- ITTA 1994: Objectives c and f; and ITTO Action Plan 1998-2001 (Libreville Action Plan) and ITTO Action Plan 2002-2006 (Yokohama Action Plan); and
- ITTA 2006 and ITTO Action Plan 2008-2011.

The total approved budget for this project is USD 619,225 with ITTO contributing USD 499,975, and the Government of Indonesia's in kind contribution amounting to USD 119,250.

The specific objectives of this project were to (i) introduce the inoculation technology for increasing eaglewood production, and (ii) to disseminate the technology to communities living in and around the forest.

To attain these objectives, the project team delivered the following outputs:

- Identified eight tree species suitable for plantation establishment based on an assessment in at least 40 regencies where about 2 million trees are planted in farmer-owned lands. The species identified were *Aquilaria malaccensis, A. microcarpa, A. beccariana, A. hirta, A. cumingiana, A. filaria, A. crassna,* and *Gyrinops versteegii*. The *Aquilaria spp* were found suitable for cultivation in many soil types, especially in upland marginal soil. Eaglewood-producing trees found in the natural forests were reserved for seed production.
- Identified *Fusarium solani*, particularly sourced from Gorontalo and Jambi provinces, as the most effective pathogen in inducing eaglewood formation in susceptible trees. Inoculation of susceptible *Aquilaria and Gyrinops* tree species with this pathogen had 90-100% success rate. The chemical analysis of eaglewood produced revealed the presence of components highly sought by the perfumes and incense industries.
- Developed a laboratory-scale method of mass-producing the inoculum from *Fusarium solani*
- Prepared a standard operating procedure for inoculating trees starting from instrument preparation, inoculum dosage and method of application – including depth of drilling, vertical and horizontal distances between holes, recognizing physical characteristics of trees that indicate successful eaglewood formation, and determining which trees are ready for harvesting.
- Established two plots covering 72 hectares to demonstrate best practice plantation management to forest farmers in the provinces of Banten and South Kalimantan. Around 2,000 trees were inoculated in the provinces of Banten, South Kalimantan, West Kalimantan Barat, Bali, Lombok, East Nusa Tenggara, South Sulawesi, Maluku Provinces, and others.
- Conducted trainers training courses on the inoculation technology in Bogor; and later on, the trainers conducted training courses at the plantation sites for almost 1000 forest farmers – which is ten-fold the number targeted.
- Conducted three workshops focused on plantation management, proper use of the technology and standardization of inoculums.

4. Findings and lessons learned

4.1 Findings

The Executing Agency complied with all ITTO administrative, monitoring and technical reporting requirements. The Final Technical and Project Completion Reports were submitted to ITTO two months after the targeted completion date. Project acquittal occurred two months later - upon ITTO's approval of the project completion and final technical reports, the Executing Agency's plan for the disposal of project equipment purchased using ITTO funds, and the final audit report.

The project outputs described in Section 3 of this report are in accordance with the approved project document. The project team satisfactorily delivered the outputs within the planned timeframe, some exceeding targets. A few deviations from the planned activities and additional activities were noted. However, the minutes of PSC meetings revealed that these changes were aimed at improving project delivery, and did not require additional financial support from ITTO.

The Ministry of Forestry's ongoing national program on tree seedling production for forest communities has included in its priority species the gaharu-producing trees identified in this project, ensuring a sustainable supply for future plantations. As of May 2013, the project database showed that the number of planted eaglewood producing trees had increased to about 11.4 million trees from about 2.2 million in 2010. The database also shows that more than five thousand trees have been inoculated since the project exit in 2011.

Participants brought up the problem of insect infestation during this evaluation. For example, the owner of a private plantation reported that all trees in his seven-year old plantation were severely affected by the leaf-eating caterpillar *Heortia vitessoides* in 2010. At the project demonstration site in Banten, about 20 trees were also destroyed due to insect infestation. The Executing Agency and National Experts implemented mitigating measures but to a limited extent.

Based on a review of the project document, the risk of insect infestation was not assessed during project planning. Although the extent of damage caused by insect infestation seems to have little effect on the delivery of outputs in this project, it is recommended that future projects purposely manage this risk. Uncontrolled insect infestation can be difficult to mitigate and can cause huge economic losses.

The effects of project outputs were assessed in relation to the project's intended situation. The following post project developments and specific observations best describe the outcomes twenty-five months after project completion.

- Training courses on tree inoculation and the project-developed inoculum are made available to forest farmers all over the country through field offices of the Ministry of Forestry, and other interested agencies.
- Indonesia's Intellectual Property Office granted a patent to an inventory for the project-developed inoculum on 11 August 2012. Farmers have reported 'imitation' inoculums being offered to them on more attractive terms than that provided by local providers.
- Local governments, government regulators, rural communities and investors, including agro-forestry landowners are increasingly becoming interested in eaglewood plantations.
- There is intensified interest in R&D on better eaglewood processing, value adding, and product development.
- The need for improved pricing and a more reliable gaharu grading system have become more apparent due to an increase in eaglewood supply and sales competition.

- Eaglewood plantations have been established in buffer zones of some protected areas (Tanjung Puting National Park, Central Kalimantan Province and Ujung Kulon National Park, Banten Province). The aim of this strategy is to provide accessible resources for the livelihood of the surrounding forest community, thereby relieving pressure on the National Park.

It is noteworthy that the Government of Indonesia has approved the Ten-Year Gaharu R&D Master Plan (2013-2023) prepared by the Executing Agency in 2012. Aside from more focused R&D studies on tree production, this Master Plan gives top priority to science and technology-based interventions that would enhance the capabilities of small and medium industries engaged in gaharu processing, value adding and product development.

Indonesia's Gaharu Forum, which was established by this project, continues to hold meetings primarily to disseminate information and exchange views on technical and trade issues. Recently, stakeholders sought government intervention to have the inclusion of eaglewood-producing tree species in CITES Appendix II re-assessed, and possibly removed. This entails a concerted effort among eaglewood producing countries to assess in a timely manner the impact of intensified plantation establishment and increased eaglewood production on trade and on the sustainability of eaglewood-producing trees in the wild.

4.2 Lesson learned

The following insights are worth considering in designing similar projects.

- Having a forum for communicating project objectives to the broader community, as well as gathering feedback, is critical to the project's success and the sustainability of its outcomes.
- In projects involving plantation establishment aimed at enhancing production and relieving pressure on trees in the wild, baseline data should be established at the start of project implementation. Monitoring the effects of project interventions is meaningless if baseline data is not available.
- Risk assessment is critical to project planning. The project logical framework matrix must accurately reflect the conditions outside the influence and control of the project sphere that pose risks to the project.
- Managing the risk of insect infestation is critical in projects involving plantation establishment.
- The risk of invasive pathogens must be assessed in projects involving 'new' pathogens for bio-induction methods

5 Conclusions and recommendations

5.1 Conclusions

This evaluation found that the Executing Agency satisfactorily completed all outputs within the 36-month duration as planned, and complied with all ITTO administrative, monitoring and technical reporting requirements. Adequate management and monitoring of activities were critical to the success of this project.

The PSC recommended additional activities and slight deviations that markedly improved project delivery. The changes implemented did not require additional ITTO financial support.

Although the problem of insect infestation seems to have little effect on the delivery of project outputs, it is recommended that future projects seriously assess this risk during project planning.

Several post project developments showed positive indications of sustained project outcomes in the longer term. As of May 2013, the project database showed that the number of planted eaglewood producing trees had increased to about 11.4 million trees from about 2.2 million in 2010. An additional five thousand trees have also been inoculated since the project exit in 2011. Eaglewood plantations have been

established in buffer zones of at least two national parks in order to provide resources for the livelihood of surrounding forest communities, whilst relieving pressure on the protected zones.

This project's successful outcomes, including the recent implementation of Indonesia's Ten-Year Gaharu R&D Master Plan (2013-2023), are providing impetus for Indonesia's Gaharu Forum's continued information dissemination and exchange, and more active stakeholder participation.

5.2 Recommendations

For the Executing Agency

- Recommend to the Ministry of Forestry the immediate preparation of a national management plan for eaglewood producing tree species in the wild and in plantations.
- Continue supporting the pro-active dissemination of project results and spearhead timely discussions among ITTO member countries on the formulation of a global strategy to assess the impact of intensified plantation establishment and increased eaglewood production on trade and the sustainability of eaglewood-producing trees in the wild.
- Put in place institutional mechanisms and guidelines to support the wider use of the patented inoculum formulation, and consider forging partnerships with private enterprises for more efficient and cost-effective commercial production, promotion and distribution of the inoculum.
- Recommend to the appropriate government body, monitoring and regulating the distribution of inoculums, including those that are produced in other countries. Inoculum end-users, especially farmers, must be made aware of the economic and environmental risks involved in using inoculums that have not been scientifically validated.
- Conduct training courses on the local gaharu visual grading system especially for farmers and traders, while conducting studies to improve this system
- Ensure that the gaps identified in this project are adequately addressed and in a timely manner. Some of the gaps are:
  - Measures to prevent and mitigate insect infestation in eaglewood-producing tree plantations
  - Assessment of the risks of introducing invasive pathogens through emerging inoculum formulations, including imported ones
  - Development of an improved gaharu grading system, including advance technology-based grading tools
  - End use optimization of gaharu resources

For ITTO

- Support information sharing among eaglewood-producing countries, and the immediate formulation of a global strategy to assess the impact of intensified plantation establishment and increased eaglewood production on trade and the sustainability of eaglewood-producing trees in the wild.
- In project appraisals, ensure that the project logical framework matrix accurately reflects conditions outside the influence and control of the project sphere that pose risks to the project.
- Strengthen the process of risk assessment during project planning by requiring proponents to indicate the likelihood (e.g. possible, probable, certain), consequences (e.g. minor, moderate, major, severe) and the proposed mitigating strategy for each identified risk factor.

Part 2 MAIN TEXT

1 Introduction

1.1 Background and rationale of the evaluation

The Committee on Economic and Market Intelligence and the Committee on Forest Industry (CEM-CFI), decided during their Forty-Sixth Session (Yokohama, Japan; November 2012) that the completed project ITTO PD 425/06 Rev.1 (I) be subjected to an ex-post evaluation. The main objective of the evaluation is to determine if the project served its purpose, and draw recommendations for future action.

The ex-post evaluation was carried out on 3-11 June 2013 or twenty-five months after project completion. This report provides an in-depth diagnosis of the project, presents its successful and unsuccessful outcomes, the reasons for successes and failures, the sustainability of its effects and contributions toward the achievement of ITTO's Objective 2000, and recommendations that can improve similar projects in the future.

1.2 Project identification

Serial number:	PD 425/06 Rev. 1 (I)
Title:	Production and Utilization Technology for Sustainable Development of Eaglewood (Gaharu) in Indonesia
Host Government:	Republic of Indonesia
Executing Agency:	Forestry Research and Development Agency (FORDA) Ministry of Forestry, Republic of Indonesia

1.3 ITTO context of the project

This project is aligned with the following ITTA Objectives and ITTO Strategic Action Plans:

- ITTA 1994: Objectives c and f; and ITTO Action Plan 1998-2001 (Libreville Action Plan) and ITTO Action Plan 2002-2006 (Yokohama Action Plan); and
- ITTA 2006 and ITTO Action Plan 2008-2011.

These are outlined as follows:

ITTA 1994

Objective (c) - To contribute to the process of sustainable development; and

Objective (f) - To promote and support research and development with a view to improving forest management and efficiency of wood utilization as well as increasing the capacity to conserve and enhance other forest values in timber producing tropical forests;

Libreville Action Plan

Reforestation and Management

Goal 3: Enhance technical, financial and human capacities to manage the topical timber resource base

Action 1: Promote access to, and transfer of, technologies and encourage technical cooperation for sustainable forest management; forest restoration and reforestation;

Action 3: Design and conduct regional training events to enhance technical and human capabilities to manage the resource base.

The Yokohama Action Plan

Reforestation and Management

Goal 1: Support activities to secure the tropical timber resource base

Action 5: Assess opportunities for, and promote development of, non-timber forest products and forest services that can improve the economic attractiveness of maintaining the forest resource base.

Goal 2: Promote sustainable management of tropical forest resources

Action 5: Encourage members and assist them, where appropriate, to improve the productive capacity of natural forests, where appropriate, through intensified silvicultural practices, better utilization of lesser-used species, the promotion of non-timber forest products, guided natural regeneration, enrichment planting and reforestation.

ITTA 2006

Article 1, Objective (c) Contributing to sustainable development and to poverty alleviation;

Objective (q) - Promoting better understanding of the contribution of non-timber forest products and environmental services to the sustainable management of tropical forests with the aim of enhancing the capacity of members to develop strategies to strengthen such contributions in the context of sustainable forest management, and cooperating with relevant institutions and processes to this end.

ITTO Action Plan 2008-2011

Expected outcome 1: Increased production and further processing of tropical timber and other forest products from sustainably managed and legally harvested sources.

Actions by ITTO - Action I: Develop, publish and disseminate techniques and technologies on product development for the efficient and sustainable utilization of non-timber forest products

Possible actions by members - Action i: Undertake pilot and demonstration projects based on the use of non-timber forest products harvested in tropical timber-producing forests and support the widespread uptake of these in parallel with timber production

2 Evaluation scope, focus and approach

2.1 Purpose

This evaluation report provides an in-depth diagnosis of the project, identifying its successful and unsuccessful outcomes, the reasons for the successes and failures, the sustainability of the project's outcomes, and contribution towards the achievement of ITTA Objectives (1994 and 2006) and ITTO Strategic Action Plan 2008-2011, and to draw lessons that can be used to improve similar projects in the future.

2.2 Terms of reference

- Assess the project's design and contribution to the achievement of the project objectives.
- Assess the achievement of the project's outputs and specific objectives.
- Evaluate the impact and relevance of the project, detailing its impact on development and specific objectives as stated in the project documents.
- Determine the effectiveness of technology transfer to target groups if applicable.
- Assess the overall post-project situation for the projects, including the conditions of their intended direct or indirect beneficiaries.

- Define and assess unexpected effects and impacts, either harmful or beneficial, and present the reasons for their occurrences.
- Analyze and assess implementation efficiency, including the technical, financial and managerial aspects.
- Assess the overall sustainability of the project after completion, and include appropriate recommendations to safeguard the continuity of its positive impacts, and enhance utilization of the technologies (if applicable) and other results developed by the project.
- Taking into account the results of the evaluation, make an overall assessment of the projects' relative success or failure, to summarize the key lessons learnt; and identify any issues or problems that should be taken into account in designing and implementing similar projects in future.
- Assess the overall cost of the projects with original budget provisions, and their respective linkage with the overall results.
- Prepare the evaluation report in accordance with the references for the Project Evaluation Report, as contained in the ITTO Manual for Project Monitoring, Review and Evaluation, third edition and the ITTO Manual on Standard Operating Procedures 2009.
- Assess the project's contribution to the relevant ITTA objectives (1994 and 2006) and the relevant ITTO Action Plan.
- Prepare one or more articles for each project, for possible publication in the ITTO Tropical Forest Update (TFU), in consultation with the editor, containing an overview of the projects and summarizing the lessons learned from the evaluation work. Appropriate photographs should be provided.

Appendix A shows the timelines for this evaluation as agreed upon by ITTO and the Consultant.

2.3 Approach

ITTO provided the following project documents and reports for review in preparation for the evaluation:

- Project Document
- Experts Panel's Appraisal
- Project Agreement
- Project Inception Report
- Yearly Plans of Operations
- Bi-Annual Progress Reports
- Minutes of the Project Steering Committee meetings
- Technical Reports
- Workshop Proceedings
- Financial Audit Reports
- Project Completion Report

The above documents were reviewed mainly in reference to the project's logical framework matrix, the effectiveness of technology transfer activities, and the project's overall contribution to the higher order objectives of ITTO. Interview guide questions were formulated for key staff, national experts, consultants, industry participants and forest farmers.

The ex-post evaluation was carried out on 3-10 June 2013 or twenty-five months after project completion. On the first day, an opening meeting was held in Bogor with the Executing Agency's representatives, the project's key staff, national experts, and invited industry collaborators. During this meeting, the consultant briefed the participants on the purpose of the ex-post evaluation and how it will be conducted. The consultant requested the Project Coordinator to provide information on recent developments on the project outputs. The itinerary of the field visits was finalized (see Appendix B).

Appendix C is a list of people who participated in this evaluation, including those that were interviewed in the field visits.

A small eaglewood and essential oil processing plant in Bogor was visited in the afternoon of 3 June 2013. The business owner and his client – an eaglewood trader based in Qatar, were interviewed. From 4-10 June 2013, interviews were conducted with forest farmers, regulators and researchers at the plantation sites and offices of collaborating organizations in Bogor in West Java, Banjarmasin in South Kalimantan and Denpasar, Bali (see Appendix D). A backyard eaglewood tea and wine production site and a university laboratory used for eaglewood research in Bali were also visited.

Finally, the consultant's findings and preliminary report were presented during the evaluation exit conference held in Denpasar on 10 June 2013.

3 Project facts

3.1 Technical background and project intervention

Eaglewood, locally known as 'gaharu' in Indonesia, is the fragrant resin-rich heartwood formed when trees are infected by certain pathogens. Eaglewood producing trees belong to four genera, namely *Aquilaria*, *Gyrinops*, *Aetoxylon*, and *Gonystylus*. This non-wood forest product is an important raw material for perfumes, soaps, incense, and medicinal products. Eaglewood is also known by other trade names such as agar or agarwood, garro wood, kalambakin, kanankoh, jinkoh, oudh, and aloeswood.

Many eaglewood-producing tree species are native to South and Southeast Asian countries, namely, Bhutan and India, Myanmar, Lao PDR, Cambodia, Vietnam, Thailand, Malaysia, the Philippines, Indonesia, and Papua New Guinea. In Indonesia, there are about 27 tree species in the natural forests of Sumatra, Kalimantan, and Papua that are known to produce eaglewood.

In the international market, superior quality eaglewood can cost from USD 7,000 - USD 10,000 per kg while oil extracted from eaglewood chips is sold at USD 18 per ml (or USD 18,000 per liter). In West Kalimantan, local traders are willing to buy at USD 2,500 per tree from plantations. Tree farmers sell oil extracted from eaglewood at USD 4.60 - USD 10 per ml (or USD 4,600 - USD 10,000 per liter). As such, management of plantations for eaglewood production is an attractive source of income for forest-dependent communities.

However, not all trees of species known to produce eaglewood actually produce eaglewood. One out of every ten eaglewood-producing trees in the wild contains eaglewood, and the only way for forest gatherers to find out is by cutting the trees down. Trade and scientific information in the 1990s showed that such indiscriminate harvesting practices in eaglewood producing countries resulted in over exploitation of the resource. If unabated, the extinction of some species was imminent.

In 1994, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) listed *Aquilaria malaccensis* Lamk. among the species that are not necessarily threatened with extinction but may become so unless controlled (CITES Appendix II). This signaled the increasing scarcity of the resource and as a consequence, eaglewood–producing trees fetched very high prices. To meet the huge demands of traders and businesses, harvesters cut down as many eaglewood trees within their reach–including those that did not contain harvestable eaglewood.

Hence, in 2004, the list was upgraded to 24 *Aquilaria* species and 7 *Gyrinops* species. To date, this list still holds and eaglewood producing countries are expected to regulate their eaglewood export based on the quota approved by the CITES Conference of Parties. Indonesia in particular has not come close to meeting its quota due to the scarce harvest.

To relieve pressure on eaglewood producing trees grown in the wild, the Indonesian government has embarked on the establishment of eaglewood-producing tree plantations. Establishing plantations alone does not translate to increased eaglewood harvest, as planted trees, just like trees in the wild, do not

necessarily produce eaglewood. They can, however, be induced to do so. This project's intervention is to improve currently used methods of inducing eaglewood formation in trees susceptible to infection by pathogens.

3.2 Development objective

This project aimed to promote sustainable production of eaglewood in production natural forests and privately owned lands in order to support the eaglewood-based industries toward sustainable forest management and forest communities' welfare in Indonesia.

3.3 Problem addressed

This project addressed the lack of a proven method to enhance eaglewood formation in trees known to be susceptible to pathological infection.

3.4 Objectives and outputs

The specific objectives of this project were to (i) introduce inoculation technology for increasing eaglewood production, and (ii) disseminate the technology to communities living in and around the forest.

To attain these objectives, the project team delivered the following outputs:

- Identified eight tree species suitable for plantation establishment based on an assessment in at least 40 regencies where about 2 million trees are planted in farmer-owned lands. The species identified were *Aquilaria malaccensis, A. microcarpa, A. beccariana, A. hirta, A. cumingiana, A. filaria, A. crassna,* and *Gyrinops versteegii*. The *Aquilaria spp* were found suitable for cultivation in many soil types, especially in upland marginal soil. Eaglewood-producing trees found in the natural forests were reserved for seed production.
- Identified *Fusarium solani*, particularly sourced from Gorontalo and Jambi provinces, as the most effective pathogen in inducing eaglewood formation in susceptible trees. Inoculation of susceptible *Aquilaria and Gyrinops* tree species with this pathogen had 90-100% success rate. The chemical analysis of eaglewood produced revealed the presence of components highly sought by the perfumes and incense industries.
- Developed a laboratory-scale method of mass-producing the inoculum from *Fusarium solani*
- Prepared a standard operating procedure for inoculating trees starting from instrument preparation, inoculum dosage and method of application – including depth of drilling, vertical and horizontal distances between holes, recognizing physical characteristics of trees that indicate successful eaglewood formation, and determining which trees are ready for harvesting.
- Established two plots covering 72 hectares to demonstrate best practice plantation management to forest farmers in the provinces of Banten and South Kalimantan. Around 2,000 trees were inoculated in the provinces of Banten, South Kalimantan, West Kalimantan Barat, Bali, Lombok, East Nusa Tenggara, South Sulawesi, Maluku Provinces, and others.
- Conducted trainers training courses on the inoculation technology in Bogor; and later on, the trainers conducted training courses at the plantation sites for almost 1000 forest farmers – which is ten-fold the number targeted.
- Conducted three workshops focused on plantation management, proper use of the innovation technology and standardization of inoculums.

3.5 Project rationale

In the last few decades, methods to enhance eaglewood formation in trees susceptible to fungal infection have been devised by researchers. Information on the efficacy of these methods for particular species is limited. Generally, the methods involve wounding trees to make them vulnerable to pathological infection. Previous studies found that puncturing the tree using blades or driving nails into the trunks can trigger

eaglewood formation, but not in all cases. In trees where eaglewood formed, the process was slow resulting in very low yield and inferior quality. More recent studies found that a more successful method is to directly introduce pathogens to the tree stems through inoculation after wounding trees by some mechanical means. In some trials using this method, inoculation caused the trees to die while in other cases inoculation triggered eaglewood formation but was not sustained.

3.6 Start date and project duration

This project was substantially completed in 36 months, i.e., commencing on 1 May 2008 and completed on 30 April 2011.

3.7 Budget

The ITTO financial support and Executing Agency counterpart are shown below.

Source	Approved, USD	Actual, USD
ITTO	499,975.00	433,300.75
Government of Indonesia	119,250.00	119,250.00
Total	619,225.00	552,550.75 *

*The remaining amount of USD 67,035 was allotted by ITTO for project monitoring and evaluation purposes.

4 Findings and lessons learned

4.1. Achievements

(i) Planned vs. Actual Outputs, and Achievement of Objectives

The project outputs described in Section 3.4 are in accordance with the approved project document. The project team satisfactorily achieved the outputs and the specific objectives within the planned timeframe, with some outputs exceeding targets.

A few deviations from the planned activities and additional activities were noted. However, the minutes of PSC meetings indicate that these changes were aimed at improving project delivery, and did not require additional financial support from ITTO. The activities are as follows.

- Additional activity on the preparation of a database on eaglewood producing trees in natural forests and plantations in private lands. This was not part of the original plan but the PSC found it necessary right from project commencement. Determining the project impact by monitoring plantations resulting from project interventions could have been meaningless without baseline information.
- Organized and held an additional workshop, i.e., the First National Gaharu Seminar attended by 135 participants in 2010, which focused on standardizing inoculums as suggested by the PSC. This is in addition to the two planned workshops i.e., one on plantation management attended by 140 participants in 2009, and another on the inoculation technology attended by 130 participants in 2011.
- Instead of travelling to Vietnam, project staff traveled to Taiwan and Saudi Arabia to assess the acceptability of eaglewood produced in inoculated plantations. The PSC recommended that the project would benefit more from visiting countries with more advanced eaglewood processing capabilities and/or established markets for high value products.
- The project had planned to hold farmers training courses in Bogor. Instead, a trainer's course on the inoculation technique was first held in Bogor, after which the trainers held training courses at various plantation sites in collaboration with government offices, private investors, and farmers groups. This resulted in more participants than targeted (1000 *vs.* 50 participants).

- Changes in the selection of project demonstration sites were noted. These were decided based on security from fires and illegal activities, as well as accessibility.

(ii) Risk assessment and risk management

Participants brought up the problem of insect infestation during this evaluation. For example, the owner of a private plantation reported that all trees in his seven-year old plantation were severely affected by the leaf-eating caterpillar *Heortia vitessoides* in 2010. In the project demonstration site in Banten, about 20 trees were destroyed due to infestation.

Project reports confirm that an outbreak of the leaf pest that destroyed almost all of gaharu trees in Bogor in May-September 2010. Outbreaks occurred during the transition from dry to wet and form wet to dry seasons. Project staff observed that *Gyrinops spp* are more resistant to infestation; however, *Aquilaria spp* produce better quality eaglewood.

The risk of insect infestation was not addressed during project planning. Although the damages due to insect infestation seem to have little effect on project delivery, insect infestation can be a serious problem in plantation establishment, and measures to prevent and/or mitigate this risk should have been deliberately put in place. The Executing Agency and national experts were able to mitigate the problem but to a limited extent.

It is worthwhile mentioning that during this evaluation, experimental setups on mitigating measures were observed within the Executing Agency's laboratories and experimental plantations. The mitigation measures being looked into include the application of a chemical spray, introducing predator ants, and instead of monocultures establishing mixed plantations such as with *Azadirachta indica*, and in the agricultural landscapes.

(iii) Effects of Project Outputs and Impact

The effects of project outputs were assessed in relation to the intended situation as stated in the project document. The following are concrete examples of project effects and outcomes that best describe the situation twenty-five months after project completion.

The project-developed inoculum and training course on tree inoculation are being made available to forest farmers all over the country, and other interested organizations.

- Indonesia's Intellectual Property Office granted a patent to an inventory for the project-developed inoculum on 11 August 2012. The most important benefit that can be derived from the patent is the protection of end users, especially the forest farmers, from 'imitation' products, especially those that do not serve the purpose. Imported inoculums are being offered to farmers in Indonesia and farmers have reported these to be less effective, if at all, than the locally developed inoculum. However, some uninformed farmers are lured into the products due to more attractive farmer's share (70% of proceeds at harvest) than what is offered by local providers (60%).
- The inoculum can be purchased at cost in 600 ml bottles having a shelf life of 3 months. On the average, one bottle of inoculum is sufficient for 3 trees.
- The inventor has introduced an improved inoculum dispenser, i.e., a more handy automatic syringe gun designed to dispense at an accuracy of 0.25 -0.5 ml, instead of the previously used plastic syringe's 1-2 ml accuracy. A further improvement being worked on is the use of glass ampules containing inoculum sufficient for one drill hole, instead of siphoning from 600 ml bottles and dispensing through a syringe gun.
- The Forest Research Institute in Lombok has set up a small laboratory for the purpose of developing inoculums from indigenous pathogens. The risk of unintentionally introducing invasive pathogens is a concern as this can cause immeasurable ecological damage that can be difficult and costly to mitigate.

Local governments, government regulators, rural communities and investors, including agro-forestry landowners/managers are increasingly becoming interested in eaglewood plantations.

- More plantations have been established and more trees have been inoculated using the project-developed inoculum. Based on the project database, there were about 2,218,949 eaglewood-producing trees in various plantations in 2010. This number has now increased to 11,395,000 trees where about 5000 more trees in (addition to those within the project duration) were inoculated. The eight eaglewood-producing species identified in this project plus *Aquilaria subintegra* – which was identified after the project completion, are now included in the Ministry of Forestry's national program on seedling production for forest communities.
- Eaglewood plantations have been established in buffer zones of some protected areas (Tanjung Puting National Park, Central Kalimantan Province and Ujung Kulon National Park, Banten Province). The aim of this strategy is to provide accessible resources for the livelihood of the surrounding forest communities, thereby relieving pressure on the National Parks.
- The Executing Agency continues to accommodate requests for training. Most requesting parties are willing to shoulder trainer's travel expenses. The participation women's civic groups and forest farmers' wives in courses on plantation establishment and the inoculation technique is noteworthy. On 5 June 2012, a woman civic leader, Mrs. Galuh Saly Muhidin, who collaborated with this project, was accorded national recognition (Kalpataru Regency Balangan) by the Ministry of Environment and the President of the Republic of Indonesia, particularly for her work in promoting eaglewood plantations all over Indonesia. For example, Mrs. Muhidin encouraged women in the village of Kasai, District of Batumandi to engage in plantation establishment and inoculation and convince their husbands to stop harvesting eaglewood in the wild.

There is increased interest in R&D on better processing, value adding, and product development.

- The owner of a small production plant in Bogor supplying mainly gaharu oil and other essential oils to perfumes and flavors businesses in Qatar, designs and fabricates his own processing equipment instead of purchasing imported ones.
- A gaharu research specialist set up his backyard production of gaharu tea and gaharu wine. He has obtained a Hazard Analysis Critical Control Point (HACCP) food safety certification for his product, and the required permit to sell his products to the public.
- The technology needs of small and medium enterprises, specifically in gaharu processing and value adding, are top priorities in the Ten-Year Gaharu R&D Plan. Two districts namely, Lamandau District in Central Kalimantan and Bangka Tengah in Banka Belitung Province, were designated to showcase best practice gaharu production and utilization technologies.

The need for improved pricing and better gaharu grading system has become more apparent due to increased production and sales competition.

- Regulating gaharu trade as per CITES mechanism has had the effect of pushing export prices up, hence some traders favor this mechanism. The 'surge' of plantation establishments triggered by the successful bio-induction method promoted by this project could lead to a substantial increase of eaglewood harvest in Indonesia in 2-3 years' time. The impact of increased raw material supply on trade, including the effects on local and export prices should be assessed in a timely manner.
- The industry's problems on pricing are also compounded by the lack of a foolproof quality-based eaglewood grading system. Currently, gaharu is graded visually and priced depending on the buyer's skill to visually recognize various gaharu grades, hence grading (and pricing) is subjective. Farmers are generally not trained on the visual grading system, and can end up on the losing end.

Meanwhile research studies on the chemical composition of gaharu are now looking into identifying components associated with certain fragrances. The study by Lancaster and Espinoza[1] (2012), for example, found reproducible mass spectra that are useful for inferring the genus of suspected eaglewood samples and identified 17 ions that are useful for authenticating eaglewood. The gaharu industry can benefit from the experiences in other industries, such as the food and wine industries, where technology-enabled grading tools such as electronic noses (or e-noses) or electronic tasters (e-tongues) are used to detect patterns of specific chemical components of an odor or taste.

The Executing Agency is supporting continued dissemination of project results through local and international workshops and conferences, some of which are as follows:

- International Seminar on Forests and Medicinal Plants for Human Welfare held in Bogor Indonesia on 10-12 September 2013, organized by the Ministry of Forestry in collaboration with the National Working Group on Medicinal Plants.
- Paper titled "Development of artificial propagation to sustain Aquilaria and Gyrinops agarwood in Indonesia" was presented during the First International Scientific Symposium on Agarwood (ISSA 2013) held in Universiti Putra Malaysia, Selangor, Malaysia on 3-5 September 2013
- National Workshop on Sustainable Forest Management through CITES mechanism (agarwood and ramin) held in Bali, Indonesia on 28Oct -1 Nov 2012 (estimated participants)
- Workshop on the implementation of CITES for agarwood species held on 3-6 October 2011 in Kuwait City (estimated 100 participants)]
- Asian Regional Workshop on agarwood titled "Management of wild plantation source agarwood" held in Bangka Tengah, Indonesia on 22-24 November 2011 (estimated 160 participants)

(iv) Sustainability

The following post project developments contribute significantly to the sustainability of project effects and to the higher order objectives of ITTO:

The Government of Indonesia has approved the Ten-Year Gaharu R&D Master Plan (2013-2023) prepared by the Executing Agency.

In 2012, the executing agency spearheaded the preparation of a ten-year Gaharu R&D Master Plan. The Indonesian government has recently approved this plan and the executing agency has published it widely. The Master Plan builds on the successes of this project and serves as a guide to all government and private organizations, including universities engaged in agarwood R&D in Indonesia.

Information dissemination and exchange is continuing through Indonesia's Gaharu Forum

In 2010, the project and its collaborators organized Indonesia's Gaharu Forum (FGI) as a means of facilitating information exchange among stakeholders. For example, the FGI meeting held on 9May2013 in Medan was well attended by gaharu farmers, plant breeders, academics/researchers, and environmentalists. In this meeting, establishment of large-scale plantations was promoted as a means to revive the gaharu industry in Indonesia. The FGI Chairperson informed participants that 100,000 seedlings were recently provided to forest communities in the Aceh province, and provided information on seedling sources. Stakeholders sought government intervention in pro-actively working for the removal of the *Aquilaria spp* and *Gyrinops spp* from CITES Appendix II as they deem this favorable to the industry.

[1] Lancaster, C. and E. Espinoza. 2012. Evaluating agarwood products for 2-(2-phenylethyl)chromones using direct analysis in real time time-of-flight mass spectrometry. Wiley online library. http://onlinelibrary.wiley.com/doi/10.1002/rcm.6388/abstract.

4.2 Project formulation and implementation

(i) Stakeholder involvement during project formulation and planning

The problem addressed in this project was brought up in several national and regional workshops organized by the Ministry of Forestry. Gaharu experts from various institutions such as the Indonesian Research Institute, FORDA, Universities, NGOs, farmers and other private groups participated in these workshops. The executing agency conducted focused group discussions for the purpose of preparing this project's plan and streamlining the scope that can be reasonably addressed within a three-year period.

(ii) Project design and effectiveness

The project design was effective in implementing the project intervention within the 36-month duration. The GFI was a useful channel for communicating the project objectives and developments to the broader community, as well as gathering feedback.

Technology transfer through the project demonstration sites was significantly strengthened by the memorandum of agreement (MOA) forged with the farmers groups, and the Executing Agency's persistent efforts of keeping the farmers groups informed. The MOA clearly defined the roles and responsibilities of the executing agency–as the technology provider and the farmers groups as plantation management partners and technology and training beneficiaries. The Executing Agency highlighted the involvement of women in tree inoculations and the day-to-day management of plantations. Farmers remained committed in managing plantations throughout the project and even after project exit.

The project design did not address the risk of insect infestation; however, the outbreak that occurred within the project duration did not seem to affect the project delivery to an unmanageable extent.

The project exit strategy was critical in putting mechanisms in place to sustain the project effects in the longer term.

(iii) Efficiency and operational aspects

The Executing Agency and the ITTO Projects Manager adequately monitored the activities and evaluated the quality of accomplishments throughout the project. Bi-annual progress reports and minutes of PSC meetings provide sufficient documentation on decisions pertaining to additional activities and deviations from plans. These changes resulted in improved quality of outputs and overall project delivery.

The Final Audit report states that the project financial statements fairly presented the financial position the project. A total of USD 432,940.00 was transferred by ITTO to the executing agency. The remaining amount of USD 67,035 was allotted by ITTO for project monitoring and evaluation purposes.

The Executing Agency complied faithfully with all ITTO administrative, monitoring and technical reporting requirements. The Final Technical and Project Completion Reports were submitted two months after the targeted completion date. Project acquittal occurred two months later - upon ITTO's approval of the project completion and final technical reports, the Executing Agency's plan for the disposal of project equipment purchased using ITTO funds, and the final audit report.

(iv) Project appraisal process

Two critical recommendations made by the Experts Panel during the appraisal process were not addressed in the revised project document. The recommendations were:

Recommendation 6. Improve the risk assessment by considering the possibility of scientific failure (e.g. effective pathogen and inoculation techniques can not be found)

Recommendation 7. Justify the impact of large-scale introduction of pathogen.

The above mentioned recommendations underscore the importance of risk assessment in planning future projects. Identifying external factors (and preconditions for implementing the activities) that are beyond the influence of the project sphere are critical to the success of the project. Future project appraisals should pay more careful attention to project risk assessment and the assumptions indicated by proponents in the logical framework matrix.

4.3 Lesson learned

The following insights are worth considering in designing similar projects.

- Having a forum for communicating project objectives to the broader community, as well as gathering feedback, is critical to the project's success and the sustainability of its outcomes.
- In projects involving plantation establishment aimed at enhancing production and relieving pressure on trees in the wild, baseline data should be established at the start of project implementation. Monitoring the effects of project interventions is meaningless if baseline data is not available.
- Risk assessment is critical to project planning. The project logical framework matrix must accurately reflect the conditions outside the influence and control of the project sphere that pose risks to the project.
- Managing the risk of insect infestation is critical in projects involving plantation establishment.
- The risk of invasive pathogens must be assessed in projects involving 'new' pathogens for bio-induction methods

5 Conclusions and recommendations

5.1 Conclusions

This evaluation found that the Executing Agency satisfactorily completed all outputs within the 36-month duration as planned, and complied with all ITTO administrative, monitoring and technical reporting requirements. Adequate management and monitoring of activities were critical to the success of this project.

The PSC recommended additional activities and slight deviations that markedly improved project delivery. The changes implemented did not require additional ITTO financial support.

Although the problem of insect infestation seems to have little effect on the delivery of project outputs, it is recommended that future projects seriously assess this risk during project planning.

Several post project developments showed positive indications of sustained project outcomes in the longer term. As of May 2013, the project database showed that the number of planted eaglewood producing trees had increased to about 11.4 million trees from about 2.2 million in 2010. An additional five thousand trees have also been inoculated since the project exit in 2011.

This project's successful outcomes, including the recent implementation of Indonesia's Ten-Year Gaharu R&D Master Plan (2013-2023), are providing impetus for Indonesia's Gaharu Forum's continued information dissemination and exchange, and more active stakeholder participation.

5.2 Recommendations

For the Executing Agency

- Recommend to the Ministry of Forestry the immediate preparation of a national management plan for eaglewood producing tree species in the wild and in plantations.
- Continue to more pro-actively disseminate the results of this project and spearhead discussions among ITTO member countries on the formulation of a global strategy to assess the impact of intensified plantation establishment and increased eaglewood production on trade and the sustainability of eaglewood-producing trees in the wild.
- Put in place institutional mechanisms and guidelines to support the wider use of the patented inoculum formulation, and consider forging partnerships with private enterprises for more efficient and cost-effective commercial production, promotion and distribution.
- Recommend to the appropriate government body, monitoring and regulating the distribution of inoculums, including those that are produced in other countries. Inoculum end-users, especially farmers, must be made aware of the economic and environmental risks involved in using inoculums that have not been scientifically validated.
- Conduct training courses on the local gaharu visual grading system especially for farmers and traders, while conducting studies to improve this system.
- Ensure that the gaps identified in this project are adequately addressed and in a timely manner. Some of the gaps are:
  - Measures to prevent and mitigate insect infestation in eaglewood-producing tree plantations
  - Assessment of the risks of introducing invasive pathogens through emerging inoculum formulations, including imported ones
  - Development of an improved gaharu grading system, including advance technology-based grading tools
  - End use optimization of gaharu resources

For ITTO

- Support information sharing among eaglewood-producing countries, and the immediate formulation of a global strategy to assess the impact of intensified plantation establishment and increased eaglewood production on trade and the sustainability of eaglewood-producing trees in the wild.
- In project appraisals, ensure that the project logical framework matrix accurately reflects conditions outside the influence and control of the project sphere that pose risks to the project.
- Strengthen the process of risk assessment during project planning by requiring proponents to indicate the likelihood (e.g. possible, probable, certain), consequences (e.g. minor, moderate, major, severe) and the proposed mitigating strategy for each identified risk factor.

Annex Executing Agency's views

The Executing Agency

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- plan for a regional project aimed at sharing trade information and marketing system, and the immediate formulation of a collective strategy to assess the impacts of intensified plantation establishment, especially on controling pest and deseases, and increased eaglewood production on trade and the sustainability of eaglewood-producing trees in the wild;
- call for international support (ITTO) to formulate " incentive policy " for eaglewood from plantations and protection systems for illegal trade of eaglewood
- develop simple methodology applied by farmers for grading of agarwood and formulate a trainers course on gaharu grading specifically for farmers and traders;
- formulation of a national management plan for gaharu plantations;
- monitor and exchange information on the distribution of inoculums regionally with the view of preventing the adverse effects of invasive pathogen;
- forge partnerships for the commercial production and marketing of eaglewood , with a view to sustaining eaglewood production and increasing income for farmers .

Ir Adi Susmianto MSc

Director of Forest Conservation and
Rehabilitation Researh and Development Center
- Forest Research and Development Agency

Appendix A ITTO - Consultant agreed timelines

April 2013	Dispatch of the following documents supporting for the evaluation work: (i) Relevant ITTO Manuals (ii) Project documents (iii) Technical reports (iv) Project Audit Reports and (v) Project completion reports
June 2013	Meeting with the Executing Agency in Indonesia for briefing and comprehensive discussions and analysis of project implementation and results, as well as preparing the work programme for field visits. Discussions with relevant stakeholders involved in the projects works.
August 2013	Submission of draft evaluation report (Executive Summary) to ITTO, the Executing Agency and the governments of Indonesia for comments and suggestions
September 2013	Submission of the full final report including executive summary, and power point presentation to ITTO
October 2013	Submission of article(s) for possible publication in the TFU
25-30 Nov 2013	Presentation of the report during the 49th Session of the ITTO Council, and associate meetings of the Committees on Forest Industry and Economic Information and Market Intelligence

Appendix B Schedule of ex-post evaluation activities

Date	Activity
02 Jun 2013 (Sunday)	1830 Arrival of the Consultant in Jakarta, and travel by car to the Executing Agency's campus in Bogor
03 Jun 2013 (Monday)	0900 – 1300 Meeting of the Consultant with the Head of the Executing Agency, the Project Team, and other key stakeholders 1330 – Meeting with Ir Ramzi Salim, member of Gaharu Association Indonesia, and tour of his gaharu and essential oil production plant
04 Jun 2013 (Tuesday)	0600 Travel to Banjarmasin, South Kalimantan 1800 Meeting with Galuh Saly Muhidin, community leader for environment protection, promoting establishment of gaharu-producing tree plantations
05 June 2013 (Wednesday)	0730 Courtesy call at FORDA's Forestry Research Office in Banjarmasin and tour of nearby project demonstration plots 1000 Visit to the *Aquilaria spp* demonstration plots and private plantations, and interview with forest communities engaged in plantation, inoculation and extraction in Barabai, Kandangan as guided by Mr. Yani, agro forestry specialist
06 June 2013 (Thursday)	0600 Travel to Jakarta, onto Denpasar 1600 Meeting with Mr. Made Sukerata, member of Gaharu Association
07 June 2013 (Friday)	0830 Courtesy call to the local Forestry Office, Tabanan Regency 1000 Visit to Project Demonstration site followed by meeting with Mr. Made Sukerata, and 2 Gyrinops plantation owners and inoculum technology adoptors 1300 Visit to I Made Mega's research laboratory at Jurusan agroekoteknologi, Facultas Pertanian Universitas Udayana 1400 Visit to Souvenir Shop of Gaharu high-end products in Bali Mall
08 June 2013 (Saturday)	0830 Visit to eaglewood tea and wine backyard production site of Ir I Made Mega 1100 Visit to two *Gyrinops spp* plantations in Tabanan regency owned by Mr. Harisudana
09 June 2013 (Sunday)	Consultant's evaluation wrap-up and report writing day
10 June 2013 (Monday)	0800 Closing meeting of the Consultant with the Project Coordinator and key staff, and travel back to Jakarta
11 June 2013 (Tuesday)	Consultant's travel back to Perth, Western Australia

Appendix C List of evaluation participants

<u>03 June 2013(Monday)</u>

Opening meeting at FORDA's R&D for Rehabilitation and Conservation Centre in Bogor

- Mr. Adi Susmianto, Director of the R&D Centre for Rehabilitation and Conservation (RDCRC), FORDA
- Dr. Ir. Maman Turjaman, Project Coordinator
- Dr. Ir. Erdy Santoso, Project National Expert
- Lukman Hakim, Office of the Deputy Director, Puskonser
- Uus Danu k, Section for Partnerships & Cooperation, Office of FORDA Secretary
- Ramzi Salim, Aromindo
- Mr Jamal Balfas, Centre for Forest Products Research, FORDA
- Mariana Takanjani, Puskonser
- Wawan Kurniawan, Centre for International Cooperation
- Asep Hidayat, Puskonser
- Lisna Etiyanti, Puskonser
- Luciasih Agustini, Puskonser
- Endro Subiandono, Puskonser
- Kuntadi, Puskonser
- Ari Wibowo, Centre for Policy & Climate Change
- Tukerin P, Center for Biology, LIPI
- Wahyu Catur, Puskonser
- Bugris Yafid, Puskonser
- Agus Tampubolon, Puskonser
- Sumarsdi, Puskonser
- Susantu, Puskonser
- Rochman, Puskonser
- Didik Purwito
- Dini Rukmana
- Iwan Ruswandi, Puskonser
- Ridwan, Puskonser
- Inadarawa, Puskonser

CV Aromindo, Bogor

- Ir. Ramzi Salim, Member of Gaharu Association of Indonesia
- Mr. Ibrahim Ali, Alattar Co, Doha Qatar, international trader of essential oils and gaharu products

<u>04 -05 June 2011 (Tuesday& Wednesday)</u>

Banjarmasin, South Kalimantan

Galuh Saly Muhidin, Nusantada Persada

Ir. Tjuk Sasmito Hadi, Head of FORDA's Forestry Research office in Banjarmasin

Ir. M Yani, Nando Agrobiz- gaharu and nursery plantation owner in Barabai

Mr. Nahnudin, gaharu head farmer group in Gumbil village

<u>6-7 Jun 2013 (Thursday and Friday)</u>

Tabanan Regency, Bali, Denpasar

Ir. Roemi Liestyawati, Head of Forestry Office, Tabanan Regency

Ir. Putu Budiasa, Chief of Forestry Extension Section, Tabanan Forestry Office

Mr. I Made Sukerata, Member of Gaharu Association of Indonesia

Mr. Guntoro – Community agriculture extension specialist

<u>08 June 2013 (Saturday)</u>

Universitas Udayana and Jagardatu village, Bali

Mr. I Made Mega, researcher and owner of tea and wine backyard production business

Ir. KS Harisudana, retired government worker now head of forest farmers/plantation owner

Mr. Nenghah Widi Antara, gaharu plantation owner

<u>10 June 2013 (Monday)</u>

Closing meeting at Hotel Ibis, Bali, Indonesia

- Dr. Maman Turjaman
- Dr. Erdy Santoso
- Mr. Lukman Hakim

Appendix D Observations & information gathered at plantations sites

Details of site visited	Observations during this evaluation	Other relevant information provided by on-site interviewees
1. Demonstration plot of *Aquilaria malaccensis* at FORDA's Forestry Research campus in Barabai, Banjarbagu, South Kalimantan	Plantation is well managed; natural regeneration is apparent.	Nursery has about 200 seedlings of Aquilaria spp being maintained in the area
2. Demonstration plot on private land planted to *Aquilaria malaccenis* in Gumbil Village, Barabai Regency, Banjarmasin (Nahnudin and Yani)	Trees aged 3, 4, 5 and 10 years old at 2 x 2m spacing, inter-planted with banana, cassava, and rubberwood. Trees generally healthy in appearance. All trees are inoculated. Sampled 2 trees and found positive agarwood formation. An insignificant number of trees show signs of insect infestation.	About 45 farmers are managing close to 500 hectares of land planted to *Aquilaria* trees in various sites in South Kalimantan, including about 2000 trees planted near the coalmine site in Banjarmasin. Four private nurseries of *Aquilaria malaccensis* are being maintained in the area. Each nursery has about 100 seedlings. Cost of one tree is IDR 7000.
3. Prioject Demonstration site planted to at least 100 trees of *Aquilaria crassna* in Mandala Village, Barabai Regency, Banjarmasin	Trees are 11 years old, average of 15 cm dbh, healthy in appearance, all inoculated (in 2011), and 2 trees sampled show visible agarwood production within the vicinity of inoculation	Provider of seedling and inoculum offering one of the following arrangements with the farmer-land owner: A. Provide seedling & inoculation after 5 years - 40/60 provider/farmer sharing of proceeds B. Farmer buys seedling at IDR 5,000 each and applies inoculum after 5 years - Agarwood harvest is bought by seedling provider from the farmer at IDR 50,000 per tree C. Farmer buys seedlings at IDR 7,000 The current cost of inoculum (project developed) from provider is IDR 250,000 for 600ml – good for 3 trees.
4. Private land planted to *Aquilaria malaccensis* trees inter-planted with papaya, cassava, banana, and fruit trees in Barabai regency in Layup Village, Barabai, South Kalimantan	Trees are 5 years old, average of 8 cm dbh, healthy in appearance, trees not yet ready for inoculation; one tree showed signs of insect infestation	Owner is an active agro-forestry community worker. He has established 4 nurseries of eaglewood producing trees in different locations, each having 100-200 seedlings.
5. Demonstration plot on private land planted to *Gyrinops* in Tabadan Regency, Bali, Denpasar	Plantation is well managed. Trees are healthy with no sign of insect infestation	Tabadan Regency Forestry Office provided 120 -600ml bottles of inoculum to gaharu producing tree farmers; 1 bottle is sufficient for 3 trees on the average; Ongoing research collaboration of one University and the Forestry Office on the use of gaharu oil as antiseptic; Numerous requests from farmers for gaharu tree plantation establishment and inoculation Low potency inoculum (imported) is being sold to farmers in the province on a 70/30 provider-farmer sharing

6. Demonstration plot on private land planted to *Gyrinops* spp in Jagardatu village, Tabanan Regency	Sloping land with berms formerly planted to rice, currently planted to 7 year old Gyrinops trees, which were inoculated in 2011; 15 cm average dbh; 2 x 2m spacing; inter-planted with cacao, banana, teak Newly planted *Gyrinops* trees in adjoining land downhill, inter-planted with *Anthocephalus cadamba* trees	Chairman of Gaharu Indonesia Association in Bali: about 100,000 trees planted by farmers in the surrounding villages *Gyrinops* tree inoculated in 2009 was sampled and found to have positive agarwood formation.

APPENDIX E

Executing Agency's Views

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