ANNEX A Project

PROJECT PROPOSAL TO THE
Convention on International Trade in Endangered Species (CITES):
"Supporting sustainable management of endangered tree species"

Submitted by: FOREST RESEARCH INSTITUTE MALAYSIA (FRIM)
Endorsed by the Management Authority of: MALAYSIA

TITLE of Proposed Project:

Establishment of Arboreta and Strengthening Institutional Network for the Conservation of *Aquilaria malaccensis* in Peninsular Malaysia.

SUMMARY:

The genus *Aquilaria* has been listed in the Appendix II of CITES since 2004. Of the five species known in Peninsular Malaysia, *Aquilaria malaccensis* is the most sought after resulting in relentless harvesting pressures on its natural populations. Loss of trees caused by random harvesting has negatively impacted the genetic diversity in affected populations. The main objective of the proposal is to enhance conservation activities for *A. malaccensis* through establishment of institutional network and arboreta at selected areas. Guidance for this *ex situ* conservation effort is obtained from the 'Conservation Action Plan for the Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) in Peninsular Malaysia'. Through this project, it is anticipated that inter-governmental collaborations on research and conservation of *A. malaccensis* could be strengthened. Genetic conservation of *A. malaccensis* will be achieved with more systematically designed and well-managed arboreta. These repositories can act as seed provenances to reduce dependency on natural populations which subsequently contribute to healthier regeneration in the long term.

EXECUTING/IMPLEMENTING AGENCIES:

Ministry of Water, Land and Natural Resources, Malaysia (KATS) / Forest Research Institute Malaysia (FRIM).

COLLABORATING AGENCY: Forestry Department Peninsular Malaysia (FDPM).

DURATION (months): 24.

PROPOSED START DATE: January 2019.

PART I: CONTEXT

Origin/Background

The Forest Research Institute Malaysia (FRIM) had carried out three research studies on *Aquilaria malaccensis* Lam. to date. The first study was conducted between 2007 and 2008 entitled "*In vitro* Technology for Mass Propagation and Phytochemical Analysis of *Aquilaria malaccensis* and *Aquilaria hirta* (Endangered Gaharu Producing Species), Project No. MINT0000089" and funded by the Government of Malaysia (Ministry of Science, Technology and Innovation, Malaysia). The second project, entitled "Conservation studies and development of DNA microsatellite markers on *Aquilaria malaccensis* in Peninsular Malaysia" (Project No. 23172000000002; March 2011–November 2012), was also funded by the Government of Malaysia (Ministry of Natural Resources and Environment, Malaysia) for a sum of US$ 72,580. The third and most recent study (2013–2015) was funded under the Phase 2 of the ITTO-CITES Programme with the study entitled "Reproductive and genetic studies towards the conservation and management of *Aquilaria malaccensis* in Peninsular Malaysia" with a sum of US$ 141,570. An important output of the project was the 'Conservation Action Plan for the Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) in Peninsular Malaysia'.

In the Plan, six objectives were outlined over a span of five years. Some of the objectives are partially achieved, or are being worked towards, for instance, Objective 1 (Action 1.1.1 to identify five populations in each geographical regions - populations were identified), Objective 2 (Action 2.1.1 to conduct inventory of agarwood at state level - Fifth National Forest Inventory in Peninsular Malaysia, Action 2.1.2 to determine harvest quantity at state level - Fifth National Forest Inventory in Peninsular Malaysia, Action 2.1.3 to assess regularly harvest quota - export quota revised accordingly, Action 2.1.4 to analyse, assess and review harvest data - data shared among agencies), and Objective 5 (Action 5.1.2 to apply DNA profiling technologies for identification - technologies have been developed by FRIM, Action 5.1.3 to enhance enforcement capabilities, assets and manpower - numbers of successful raids over the years increased).

Of importance is Objective 4 that specifies the need to enhance research and development related to *in situ* and *ex situ* conservation and selection for superior

stocks. Action 4.1.2 of the Plan mentioned the need to designate and establish suitable areas in relevant states as agarwood arboretum to support gene banks. To achieve this particular objective, this project proposal is submitted to the CITES Tree Species Programme for consideration and funding. It is also imperative to note that the Plan involves many parties such as the Ministry of Water, Land and Natural Resources (KATS), the Ministry of Primary Industries (MPI), the Ministry of Finance (MoF), the Forestry Department Peninsular Malaysia (FDPM), the State Forestry Departments, the Department of Wildlife and National Parks Peninsular Malaysia (PERHILITAN), the Malaysian Timber Industry Board (MTIB), enforcement agencies at federal and state levels, and private and public landowners. As such, it is important to create a strong network to achieve each of the objectives.

The genus *Aquilaria* has been listed in CITES Appendix II since 2004. Of the five species known in Peninsular Malaysia, *A. malaccensis* is the most common species available and harvested, which subsequently create a threat to its natural populations. The understanding of its biological characteristics and population genetics has now enabled the undertaking of *ex situ* conservation efforts to complement *in situ* methods. Therefore, the project proposed the establishment of arboreta as a means of *ex situ* conservation.

An arboretum is an area set aside to grow and display different kinds of worthy ornamental trees, shrubs, vines and other plants. Arboretum has a scheduled maintenance and plants have proper record keeping and labels for reference (Wyman 1960). While it is possible to have as many plant species from each region, it does not neccessarily have to include all, nor is it neccesarily to have a formal planting arrangement in it. Richmond (1971) further defined, in general, an arboretum as “an institution which develops and administers collections of trees and shrubs, arranged in asthetic harmony with the surrounding landscape, and which conducts programme based upon these collections for the purposes of public service, education, and research”. Peninsular Malaysia has several established arboreta of mixed species but none of them displays *A. malaccensis* as the main crop. The establishment of agarwood arboreta through this project will be the first in the country.

PART II: THE PROJECT

1. Project Goal and Objectives

Project Goal:

Conservation of a threatened agarwood species, *Aquilaria malaccensis*, in Malaysia.

Project Objective:

To enhance conservation activities for *A. malaccensis* through establishment of institutional network and arboreta.

2. Justification

2.1 Problems to be addressed

Wild *A. malaccensis* trees have long been sought after for their resin and harvesting has negatively impacted the survival of populations. Although Chua *et al.* (2016) revealed high levels of genetic diversity at the population level, continued loss of adult trees eventually leads to the depletion of genetic diversity. The coefficient of population differentiation quantified using *F*-statistics showed that most of the total genetic diversity was partitioned within the population. This renders the need to conserve as many as possible natural populations that occur in the country, but this may be impractical in view of rising illegal harvesting trends. Although the government mitigates this through enforcement, it is clear that a more consolidated and carefully managed and monitored approach is required to conserve the germplasm. The establishment of arboreta complements the *in situ* measures that Malaysia is currently implementing.

Chua *et al.* (2016) reported that *A. malaccensis* is an obligate out-crosser and, in Peninsular Malaysia, about 92% of its genetic diversity is partitioned within the population. *A. malaccensis* populations are separated into two clusters, i.e., Cluster Kedah-Perak and Cluster Kelantan-Johor. Preserving genetic resources is required to (i) protect the potential adaptation of the species (Young & Boyle 2000; Krauss *et al.* 2002), (ii) preserve current genetic structure as reference materials for future comparison, and (iii) save populations that are threatened by anthropogenic activities (Eriksson & Ekberg 2001; Finkeldey & Hattemer 2007).

In Objective 4 of the ‘Conservation Action Plan for the Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) in Peninsular Malaysia’, Chua *et al.* (2016) outlined the need to enhance research and development in aspects related to *in situ* and *ex situ* conservation and the plantation sector, in particular,

the production of quality planting materials. One of the biggest problems faced in the plantation sector is the use of mixed and inferior quality planting materials. Lack of baseline data on the origin of planting stock jeopardizes breeding and propagation programmes and ultimately the viability of planting programmes. As mentioned in Chua *et al.* (2016), by preserving the genetic structure and its resources, the species has a higher chance to adapt to environmental changes and survive in the event of disaster. The importance of transfer of plant materials of *A. malaccensis* from various regions is emphasized in Lee *et al.* (2017). The established *Aquilaria* arboreta function as research and experimental plots for researchers. Forest managers and operators could promote them as seed sources to small planters as well as places to test different planting regimes. The arboreta are a reliable place for tree breeding programmes to be carried out as the origin of all individual trees are recorded.

Currently, Malaysia does not have a network of institutions that maintains and manages *ex situ* collections of *A. malaccensis*. The need to enhance these field gene banks should be given priority since the species is being threatened by trade. A network of institutions will provide an excellent platform for various agencies to co-operate with a same aim, which is to contribute towards the sustainability of *A. malaccensis* in Peninsular Malaysia. Examples of roles in each agencies are further explained below. Results from the project will be used by Malaysia when preparing the Non-Detriment Finding (NDF) for the species.

2.2 Intended situation after Project completion

Genetic conservation of *A. malaccensis* will be better achieved with more systematically designed and well-managed arboreta. It is foreseen that the numbers of living *A. malaccensis* trees in the natural forest will decline in time. The establishment of arboreta is expected to lessen harvesting pressure on natural populations in the long term when sufficient research and development on trees that are able to provide planting materials which produce high quality agarwood yield become readily available. Hence, these repositories act as seed provenances to reduce dependency on natural populations and subsequently contribute to healthy regeneration in the long term.

Inter-governmental collaborations on the research and conservation of *A. malaccensis* is pivotal and is the first step in identifying different authorized sectors. In this regard, the FDPM and State Forestry Departments have jurisdiction over land matters and enforcement, whereas FRIM contributes research and development findings. The MTIB is expected to contribute to

aspects related to plantation and trade issues. This collaboration establishes a network of institutions to undertake research and management activitites with the aim to conserve and reduce the harvesting pressure faced by *A. malaccensis*.

2.3 Target beneficiaries

The main target beneficiary will be the FDPM and State Forestry Departments. Results from the project will be used to assist forest management and in species recovery programmes. The secondary beneficiaries would be KATS and MTIB. KATS is the lead Management Authority for CITES in Malaysia and MTIB is the Management Authority competent to grant permits for timber and timber products. The data and information collected from the proposed activities will be used in the preparation of an NDF.

2.4 Risks

A low availability of seedlings arising from the absence of reproductively matured trees and the lack of flowering events during the project duration is a considerable risk. It is crucial that adult trees are still thriving in the populations studied in the past project as seedlings have to be collected from these populations. To address the first risk, more sites need to be visited to increase chances of finding fruiting trees. For the second risk, it is imperative to first focus on fruiting trees from relatively safe populations.

3. Outputs

The expected outputs of the Project are as follows:

3.1 *Objective:* To enhance conservation activities for *A. malaccensis* through establishment of institutional network and arboreta.

Output 1: A network of institutions that is responsible for the conservation of *A. malaccensis.*
Output 2: Established arboreta of *A. malaccensis* in selected states.
Output 3: Dissemination and sharing of results.

4. Activities

4.1 *Output 1:* A network of institutions that is responsible for the conservation of *A. malaccensis.*

- *Activity 1.1* Identify potential institutions and management authorities.
- *Activity 1.2* Conduct meetings to designate and establish arboreta in Selangor and Perak as agarwood gene banks.
- *Activity 1.3* Strengthen networking between relevant states and federal agencies, including the sharing of data.

4.2 *Output 2:* Established arboreta of *A. malaccensis* in selected states.

- *Activity 2.1* Collect seedlings following an established guideline and raising and distributing seedlings to participating agencies.
- *Activity 2.2* Design planting layout according to sites requirements.
- *Activity* 2.3 Planting and monitoring work at two sites in Selangor and Perak.

4.3 *Output 3:* Dissemination and sharing of results.

- *Activity 3.1* Submit monthly progress report, biannual report with budget update and completion report.
- *Activity 3.2* Publish a semi-technical article.
- *Activity 3.3* Develop an outreach action plan.

5. Work Plan

The detail work plan of each Output is as follows and the timeline for the project is as presented in **Table 1**.

Output 1 focuses in developing a network of institutions to create a platform to discuss and solve issues related to conservation and sustainability of *A. malaccensis* in Malaysia. To start with, FRIM will call for a meeting of potential collaborators, i.e. FDPM and MTIB to discuss on the selection for arboreta location. It is further anticipated that these agencies will meet regularly to discuss matters pertaining to the establishment of these arboreta and other related issues. As the conservation action plan requires the involvement of many agencies, it is vitally important to strengthen the network through meetings and discussion.

Output 2 focuses on collecting, raising and planting of seedlings. Firstly, FRIM will organize field trips to selected populations for phenological observation. Seedlings or seeds will be collected following an established guideline as presented in **Annex 2**

and labelled according to the mothers' tree (conducted by FRIM). Seedlings will be raised (or seeds will be germinated) until they are ready for out-planting (conducted by FRIM). Seedlings to be distributed will be hardened (in polybags) on/near planting sites for several weeks prior to the actual planting (conducted by FRIM and FDPM). Seedlings to be planted according to specific design layouts at the two sites in Selangor and Perak amounting to five hectares will be provided by FDPM. Preparation of planting beds and seedlings planting will be carried out by sub-contractors hired by FDPM. Planting layouts are however to be designed by FRIM.

Output 3 focuses on results dissemination and sharing. Monthly progress report and biannual report with budget update will be submitted as required. At the end of the project, a completion report will be submitted. An outreach action plan to disseminate the project results to relevant stakeholders will be developed and will be implemented when additional funds are available. It is envisaged that the same planting layout could be duplicated in developing additional tree arboreta in Peninsular Malaysia, e.g. INSTUN and Taman Tugu projects as a showcase to stakeholders, and a model to interested plantation owners. One semi-technical article is also planned for publication.

The project will be executed by a designated Project Team Leader, Mr. Lau Kah Hoo, from FRIM whose main responsibilities are to plan, execute activities and oversee the whole project implementation; prepare and submit Monthly Progress Report, Biannual Progress Report and Project Completion Report; and attend relevent meetings.

.

.

Table 1. Work Plan

OUTPUTS/ACTIVITIES	RESPONSIBLE PARTY	SCHEDULE (in months)																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Output 1: **A network of institutions that is responsible for the conservation of *A. malaccensis.***																									
Activity 1.1 Identify potential institutions and management authorities.	FRIM																								
Activity 1.2 Conduct meetings to designate and establish arboreta in Selangor and Perak as agarwood gene banks.	FRIM																								
Activity 1.3	FRIM																								

OUTPUTS/ACTIVITIES	RESPONSIBLE PARTY	SCHEDULE (in months)																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Strengthen networking between relevant states and federal agencies, including the sharing of data.																									
<u>Output 2:</u> **Established arboreta of *A. malaccensis* in selected states.**																									
Activity 2.1 Collect seedlings following an established guideline and raising and distributing seedlings to participating agencies.	FRIM																								
Activity 2.2 Design planting layout according to sites requirements.	FRIM																								

OUTPUTS/ACTIVITIES	RESPONSIBLE PARTY	SCHEDULE (in months)																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Activity 2.3 Planting and monitoring work at two sites in Selangor and Perak.	FRIM, FDPM																								
<u>Output 3:</u> **Dissemination and sharing of results.**																									
Activity 3.1 Submit monthly progress report,biannual report with budget update and completion report.	FRIM																								
Activity 3.2 Publish a semi-technical article.	FRIM																								

OUTPUTS/ACTIVITIES	RESPONSIBLE PARTY	SCHEDULE (in months)																						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Activity 3.3 Develop an outreach action plan.	FRIM																								

7. Sustainability of Outputs after Project Completion

The established arboreta will serve as repositories and research plots for *A. malaccensis* in Peninsular Malaysia and are expected to be managed by FRIM and state forestry departments. Continuous research activities through government in-kind and external funds are expected to sustain the management and maintenance of the arboreta. It is also foreseen that the size and number of arboretum could be expanded when more funds are available.

The safety of these established arboreta will be ensured to maintain the tree collections. Proper gates and fences will be installed within the perimeter of the arboreta. Presence of monitoring teams will further improve security issues.

Matured trees in these arboreta will act as providers of seeds and other forms of planting stock for the plantation industry. This approach is expected to reduce collection pressures and impacts on natural forest regeneration. Established and enhanced arboretum could be used as teaching and display areas to forestry students and researchers alike.

It is anticipated that institutions in the network will meet and discuss relevant matters pertaining to conservation of *A. malaccensis* at the regular meetings organized by KATS, e.g. *Mesyuarat Jawatankuasa Kebangsaan* CITES Malaysia (Meeting of the National CITES Committee). The network will also serve as a platform where these institutions can exchange research and management data.

PART III: OPERATIONAL ARRANGEMENTS

1. Management Structure

The Executing Agency (EA) of the Project is the Ministry of Water, Land and Natural Resources (KATS) while the Implementing Agency is the Forest Research Institute Malaysia (FRIM). The implementation and operational activities will be executed as presented in the Work Plan.

2. Monitoring, Reporting and Evaluation

Project Progress Reports

Monthly Progress Report will be prepared based on the achievement of the activities/outputs as described in the Work Plan and will be prepared and submitted to the CITES Secretariat through the Regional Coordinator for Asia.

Biannual Progress Report including both project's activity and financial situation will be prepared and submitted to the CITES Secretariat through the Regional Coordinator for Asia.

Project Completion Report

Within two months of the project's completion, a Project Completion Report comprising a Technical Report and a Financial Report highlighting, among others, the project's expenditures and balance will be prepared and submitted to the CITES Secretariat through the Regional Coordinator for Asia.

Annex 2

Guideline to Collect Seedlings in Peninsular Malaysia: Excerpt from the Conservation Action Plan for the Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) in Peninsular Malaysia (Chua *et al.* 2016)

The Conservation Action Plan for the Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) in Peninsular Malaysia draws upon the results from past projects as well as stakeholders' dialogue. The guideline is as follows:

1. *Aquilaria malaccensis* populations in Peninsular Malaysia are divided into two genetic clusters, i.e. the Kedah-Perak and Kelantan-Johor regions.
2. Preserving the genetic structure and its resources increase the species chance to adapt to environmental changes and survive in the event of disaster.
3. Transfer of collected plant materials from a population in the Kedah-Perak region should be restricted to locations within that region.
4. Planting of *A. malaccensis* seedlings from the region of Kedah-Perak in the region of Kelantan-Johor should be avoided and vice versa.
5. The two geographical regions should be considered independently for the selection of mother trees for seed colection.
6. As the species is an outcrosser and about 91.9% of its genetic diversity is partitioned within the population, a minimum of 25 mother trees per region should be used to establish a field gene bank.

List of References

Chua, L.S.L., Lee, S.L., Lau, K.H., Nurul-Farhanah, Z., Tnah, L.H., Lee, C.T., Ng, C.H. & Ng, K.K.S. 2016. *Conservation action plan for the threatened agarwood species* Aquilaria malaccensis *(Thymelaeaceae) in Peninsular Malaysia*. Forest Research Institute Malaysia, Kepong, p74.

Eriksson, G. & Ekberg, I. 2001. *An introduction to forest genetics*. SLU Repro, Uppsala.

Finkeldey, R. & Hattemer, H.H. 2007. *Tropical forest genetics*. Heidelberg: Springer-Verlag, p315.

Krauss, S.L., Dixon, B. & Dixon, K.W. 2002. Rapid genetic decline in a translocated population of the endangered plant *Grevillea scapigera*. *Conservation Biology* 16: 986-994.

Lee, C.T., Tnah, L.H., Ng, K.K.S., Nurul-Farhanah, Z., Ng, C.H., Lau, K.H., Tani, N., Kobayashi, M.J., Diway, B., Khoo, E. & Lee, S.L. 2017. Plant Material Transfer Guidelines for Tropical Forest Species. FRIM Research Pamphlet No. 137

Richmond, G.B. 1971. General comments on arboretum organization, financing, and administration. Arboretum and Botanical Garden Bulletin Vol 5 No. 3.

Wyman, D. 1960. How to establish an arboretum or botanical garden. *Arnoldia* Vol 20 Numbers 11-12.

Young, A.G. & Boyle, T.J. 2000. Forest fragmentation. In: Young, A., Boshier, D. & Boyle, T (eds.) *Forest conservation genetics*. *Principles and practice*. Pp. 123-134. CSIRO, Collingwood and CABI, Oxford.