



**Outreach Action Plan of the
Aquilaria malaccensis
Arboretum 2022–2031:
An Early Concept**

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GLOSSARY

karas- Local name for the tree species *Aquilaria malaccensis*. Occasionally, the term is also used to refer to other species from the same genus.

gaharu- The resin produced by *Aquilaria* species as a result of chemical interactions between the tree and foreign particles that entered the tree.

1.0 Introduction

The Outreach Action Plan of the *Aquilaria malaccensis* Arboretum 2022–2031: An Early Concept, was developed to enlighten various potential groups of users on the functions and benefits of the arboretum. This publication is an output from the project ‘Establishment of Arboreta and Strengthening Institutional Network for the Conservation of *Aquilaria malaccensis* in Peninsular Malaysia’, which was a project under the CITES Tree Species Programme funded by the European Union.

2.0 What is an arboretum?

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 plan 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 necessarily have to include all, nor is it necessarily to have a formal planting arrangement in it. Richmond (1971) regarded an arboretum as “an institution which develops and administers collections of trees and shrubs, arranged in aesthetic harmony with the surrounding landscape, and which conduct programmes based upon these collections for the purposes of public service, education, and research”.



The Pahang arboretum established in 2021. Photo: Siti Fariezza Khairi Thaw.



The Selangor arboretum established in 2022. Photo: Lau Kah Hoo.

3.0 What is the goal of the plan?

The goal of the plan is to provide user groups with adequate information on the functions and benefits of the arboretum. This is to ensure the users are informed and able to participate in the arboretum activities.

The goal aligns with the Conservation Action Plan For The Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) In Peninsular Malaysia 2016 (CAP) publication (Chua *et al.* 2016), which comprises six objectives with each specifying several actions outlining management and conservation measures. The specific actions are placed under two of the four relevant objectives of this Plan. These are in preparation to bring research and conservation into light, and to become a platform for knowledge sharing, plant material source, communication, education and public offerings.

3.1 OBJECTIVE 1: Develop messages for target user groups on the benefits of the arboretum

Several user groups have been identified who could benefit and/or take part in activities derived from the established arboretum:

- Researchers;
- Forest managers;
- Policy-makers;
- Plantation owners; and
- General public.



Stakeholders dialogue held in 2015 to gather feedback for the development of the Conservation Action Plan For The Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) In Peninsular Malaysia. Photo: Kevin Ng Kit Siong.

Each of the user groups has its own needs, and hence the messages will need to be properly defined and tailored to fit the needs and focus of each group. Also, as a means to deepen relationships among current user groups and establish new and diverse connections.

3.2 OBJECTIVE 2: Produce relevant publications for information dissemination

Publications such as semi-technical and general type articles are useful especially to the fifth user group (General public) who may not have an adequate background in biology. These include leaflets, brochures or any other promotional forms of media print. For the other four user groups (Researchers, Forest managers, Policy-makers, and Plantation owners), more technical write-ups are appropriate such as books, journal

articles and technical bulletins. Notwithstanding that, users of the arboretum can also publish their activities and share them with the community. In order to increase access and impact of such publications, suitable communication platforms and displays need to be available in public areas of FRIM and at the arboretum itself. Broadcasting the updates and other news such as research findings generated from the arboretum is an effective approach to widen the sphere of the audience.



Conservation Action Plan For The Threatened Agarwood Species *Aquilaria malaccensis* (Thymelaeaceae) In Peninsular Malaysia, and two more documents produced in 2016. Photo: Lau Kah Hoo.

3.3 OBJECTIVE 3: Organise get-togethers for user groups to discuss pertinent issues

Under Objective 3, four Actions outlined in Chua *et al.* (2016) were taken up to be further elaborate here (Table 1). The first is **Action 2.1.5:** Determine the period for the collection of planting

stocks; which aims to identify flowering and fruiting seasons of the *A. malaccensis* and subsequently the germination period in order to determine optimum seeds/seedlings collecting time. As more planting stocks are gathered, these materials could be distributed to interested parties under **Action 3.1.2:** Encourage local communities to designate trees in their villages/farms as gene banks. The Plan encourages the use of native agarwood species to be planted instead of introduced species. As more gene banks are established, either through new or existing farms or through home gardens, the species could be saved from the risk of extinction (Saikia & Khan 2012). Under **Action 6.1.8:** Strengthen networking between relevant state and federal agencies, including the sharing of data, is where formal discussions between government agencies could be initiated. This could be a platform where conservation issues for the species could be discussed, and if needed solution findings. Local communities could benefit from the arboretum through **Action 6.1.9:** Conduct Communication, Education and Public Awareness (CEPA) programmes particularly for local communities. This can be achieved through the organisation of various learning activities specifically for children, adults and educators. Programmes for volunteers or interns can be developed to meet specific objectives. Joint ventures and collaborations with community groups and other institutions are a good start. This can include both onsite (e.g. tree characters learning, phenology) and offsite (e.g. class teaching, virtual tour) arboretum programmes. Harum & Moestrup (2014) included, among others, the arboretum as a place for recreation, wildlife habitat, the city's green lung, and provides aesthetic value to the surrounding environment. Green area for therapeutic purposes has of late evolved into a popular trend and the benefit gained from 'forest bathing' is tremendous (Wen *et al.* 2019).



A field trip was organised to collect seedlings of *Aquilaria malaccensis* in 2019. Photo: Lau Kah Hoo.

3.4 OBJECTIVE 4: Plan and conduct research & development activities

Formal scientific research and development activities are included here. To achieve this objective, participation from other agencies, academic institutions and experts is highly anticipated and crucial. Under Objective 4, six Actions outlined in Chua *et al.* (2016) are seen to be potentially realized and achieved (Table 1). First is **Action 4.1.2**: Designate and establish suitable areas in relevant states as *karas* arboretum to support gene banks, which is well on track with the establishment of two arboreta, one each in the states of Pahang and Selangor, between the years 2021 and 2022. Nevertheless, more arboreta can be established in other states depending on sites and funds availability. The main objective of the arboretum is to

conserve the genetic diversity of *A. malaccensis* but as time goes by, more research can be conducted when the trees have been established. As the seedlings used in the arboretum originated from nine different populations, association studies and provenance trials can be carried out. At the molecular level, tree genomic study can be used to expand the genetic application such as identifying resistant and growth genes and verifying genetic contamination. Develop long-term tree improvement programmes under **Action 4.2.1**: Conduct selection and breeding programmes using the above gene banks to enhance the quality of planting materials is important in preparing agarwood as a commodity species in the future. Cost is an important element that needs to be factored in large-scale planting, and hence **Action 3.1.3**: Develop effective and cheap propagation techniques, including a protocol to record the origin of stocks, to increase availability of planting stocks, and **Action 3.1.4**: Develop appropriate agronomic practices at plantation/farm level help in paving a clear direction towards achieving a reduced long-term expenses goal. As such, the established arboreta will function as an experimental site to improve propagation techniques. A feature that could add value to the chain-of-custody is to develop a certification system. This falls under **Action 3.1.5**: Certify the quality of planting stocks through registration or certification mechanism. Important aspects to be incorporated are the origin of the seedlings, type of materials collected (seed or seedling) and date of collection. With all these in order, **Action 4.2.2**: Investigate the potential production of *gaharu* at plantation scale and related costs and benefits could be implemented to study the species' prospect as a commodity species.



An intern helped with segregating flowers collected from seed traps placed under mother trees of *Aquilaria malaccensis*. Photo: Lau Kah Hoo.

Table 1. Summary of Actions from Chua *et al.* (2016) as applied in the Plan.

Actions	Descriptions	Plan Objectives
2.1.5	Determine the period for the collection of planting stocks	3
3.1.2	Encourage local communities to designate trees in their villages/farms as gene banks	3
3.1.3	Develop effective and cheap propagation techniques, including a protocol to record the origin of stocks, to increase availability of planting stocks	4
3.1.4	Develop appropriate agronomic practices at plantation/farm level	4
3.1.5	Certify the quality of planting stocks through registration or certification mechanism	4

Actions	Descriptions	Plan Objectives
4.1.2	Designate and establish suitable areas in relevant states as <i>karas</i> arboretum to support gene banks	4
4.2.1	Conduct selection and breeding programmes using the above gene banks to enhance the quality of planting materials	4
4.2.2	Investigate the potential production of <i>gaharu</i> at plantation scale and related costs and benefits	4
6.1.8	Strengthen networking between relevant state and federal agencies, including the sharing of data	3
6.1.9	Conduct CEPA programmes particularly for local communities	3

4.0 Plan implementer

The successful implementation of the Plan can only be achieved through participation from various agencies and stakeholders. As the implementers could also be the users, the give and take concept is key to a sustainable and long-term plan. These groups of implementers and users are not subjected to only a specific objective, but interchangeably (Figure 1).

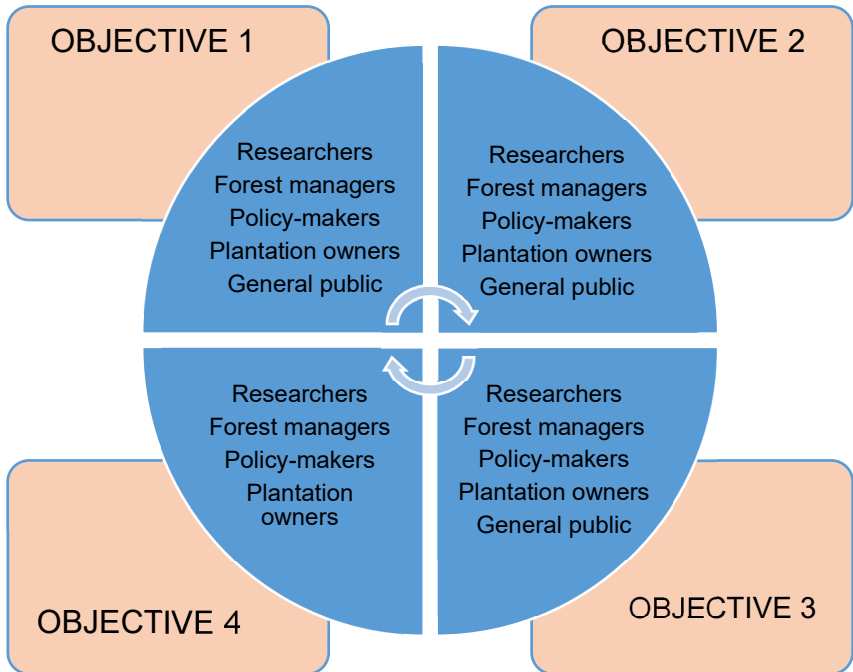


Figure 1. The implementers and users of the plan work in a cycle and are not restricted to only one objective.

Researchers: Forest Research Institute Malaysia (FRIM), universities, Non-Governmental Organisations (NGOs)
Forest managers: Forestry Department of Peninsular Malaysia (FDPM), state forestry departments
Policy-makers: Malaysian Timber Industry Board (MTIB), various ministries
Plantation owners: Government or private plantation owners
Public: Individuals or companies

5.0 Financial sustainability

To ensure the sustainability of the arboretum it is paramount to know its huge benefits. New funding opportunities need to be continuously explored to sustain the arboretum, either from foreign or local funding agencies. New research grants have to be assessed periodically to secure adequate funding to conduct various research activities. While larger grants are needed for research and development, it is also important to establish appropriate smaller funding plans for infrastructure improvements as well as for ongoing repair and maintenance expenses.

6.0 Pests control and biodiversity monitoring

The best approach for controlling pests is through Integrated Pest Management (IPM). The idea of IPM in this context includes controlling pests mechanically and naturally, without the use of pesticides. As such, we promote the principle of working with the Mother's Nature web of life to control pest outbreaks. The use of fertilizers is also not encouraged, as the ultimate objective of the arboretum is to test the tree's performance from different regions. Invasiveness from surrounding plants is monitored to prevent outbreaks through monthly inspections. Being an outcrossing species, the presence of pollinators is a critical part of the *A. malaccensis* reproductive cycle. As such, the site's faunal composition is a key resource and visceral component of a healthy arboretum. Nevertheless, small mammals such as squirrels and macaques have been recorded in natural forests to have disturbed the flowering and fruiting process.



Squirrel from the species *Callosciurus prevostii* has been recorded to prey on *Aquilaria malaccensis* fruits. Photo Lau Kah Hoo.

7.0 Outreach Action Plan

The proposed objectives, activities and timeline in the Outreach Action Plan are given in Table 2. The proposed timeline is from 2022 until 2031 over a duration of 10 years taking into consideration the estimated growth rate of the newly planted *A. malaccensis* seedlings to reach maturity in their fifth year (Chua *et al.* 2016; Lok & Yahya 2016). Although expected to go beyond 2025, the plan is in line with the National Policy on Biological Diversity 2016–2025 Target 1 of Goal 1: By 2025, more Malaysians are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably; Target 2 of Goal 1: By 2025, the contributions of indigenous peoples and local communities, civil society and the private sector to the conservation and sustainable utilization of biodiversity have increased significantly; and Target 9 of Goal 3: By 2025, the extinction of known threatened species has been prevented and their conservation status has been improved and sustained. The plan itself is dynamic in nature and the activities, timelines and their implementation are to be reviewed over time.

Table 2. Proposed objectives, activities and timelines in the plan.

		Timeline									
Objective	Activity	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Objective 1											
Develop messages for target user groups on the benefits of the arboretum	Identify user groups who can benefit from the arboretum										
	Define specific messages for each user group										
Objective 2											
Produce relevant publications for information dissemination	Publish technical publication										
	Publish journal publication										

		Timeline									
Objective	Activity	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Objective 3											
Organise get-togethers for user groups to discuss pertinent issues	Phenology monitoring for planting stocks collection										
	Pests control and biodiversity monitoring										
	Distribute planting stocks to interested individuals for gene banks start-up										

		Timeline									
Objective	Activity	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Objective 4											
Plan and conduct research & development activities	Establish <i>karas</i> arboretum to support gene banks										
	Conduct selection and breeding programmes										
	Develop effective, cheap and reliable propagation technique										
	Develop advanced agronomic methods at plantation level										

		Timeline									
Objective	Activity	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	Develop a registration or certification system for planting materials										
	Conduct studies on the potential of <i>karas</i> as a commodity species										

8.0 Conclusion

It is envisioned that the arboreta could offer substantial benefits to the identified user groups in years to come, be it leisurely or scientifically. Participation, involvement and utilisation from stakeholders for activities derived from the arboreta are important to ensure the arboreta could unveil their fullest potential. With that, it is of FRIM's vision that these arboreta continue to be sustained at their current locations to ensure an undisrupted programme planning according to the proposed plan.

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