CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

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DEVELOPING A NON-DETRIMENT FINDING METHODOLOGY FOR AGARWOOD-PRODUCING TAXA

Compiled by TRAFFIC, the wildlife trade monitoring network, for the CITES Secretariat

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SECTION 1 – INTRODUCTION

1.1 Background on Agarwood-producing taxa

Agarwood is a non-timber forest product valued for its aromatic, medicinal and cultural uses, and is also known as eaglewood, aloeswood, *gaharu* (Malay), *chen xiang* (Chinese), *jin-koh* (Japanese), *oudh* (Arabic) *mai kritsana* (Thai), and *tram huong* (Vietnamese) among many other vernacular and trade names (Barden *et al.* , 2000). Primarily sourced from two tree genera, *Aquilaria* and *Gyrinops*, agarwood's aromatic and medicinal properties derive from resinous deposits in the tree's heartwood that probably are produced as a response to wounding or infection – but this will not occur in every tree. Wild populations of agarwood trees are found in the lowland and montane tropical forests, with habitat varying for different species. Agarwood-producing taxa are distributed from north-east India eastwards through continental Southeast Asia and the Indo-Malesian bio-geographic realm as far east as Papua New Guinea, and north to the south-east provinces of China. There are 14 known range States (Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Papua New Guinea, Singapore, Thailand and Viet Nam[1]). All range States (excepting Singapore, which does not allow export of its native species) share a common characteristic of declining wild tree populations due to persistent over-harvesting and increasing habitat conversion (TRAFFIC Southeast Asia, 2004).

Concern over the effect of international trade led to the genus *Aquilaria* (along with one other agarwood-producing genus, *Gyrinops)* being listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which came into effect in 2005, 10 years after a single agarwood-producing species, *Aquilaria malaccensis*, was first listed in CITES Appendix II[2]. In general, a CITES Appendix II listing aims to ensure that the international trade is conducted legally and maintained within sustainable levels – it is not a trade ban.

Agarwood-producing taxa are linked to several genera in the family Thymelaeaceae, with the genus *Aquilaria* being the most important (Hou, 1960). However, not all species within these genera are known to produce agarwood. Furthermore, no standard biochemical parameters have been determined to define agarwood, with the make-up of the substance's various constituent compounds varying between different specimens from the same tree.

For agarwood-producing taxa listed in CITES Appendix II: *Aquilaria* spp. and *Gyrinops* spp, the provisions of CITES apply to all parts and derivatives under Annotation #1.

1.2 Requirements of the Convention for exports of Appendix II specimens

CITES requires that the export by range States of Appendix II species is not detrimental to the survival of that species in the wild. To ensure this, the CITES Scientific Authority (SA) of the State of export is required to make what is commonly referred to as a 'non-detriment finding' (NDF) prior to the issuance of any export permits by the CITES Management Authority (MA). The text of the Convention states that: "An export permit shall only be granted when the following conditions have been met: (a) a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species; …" (Article IV paragraph 2(a)). The CITES *Resolution Conf. 10.3* on the designation and role of the Scientific Authority recommends, *inter alia*, that NDFs and advice from the SA of the country of export be based on the scientific review of available information on the population status, distribution, population trend, harvest and other biological and ecological factors, as appropriate, and trade information relating to the species concerned (see Section 1.4 of this document for more detail on the relevance of *Resolution Conf. 10.3*).

The term 'export' for the purposes of CITES only applies to the trade of specimens originating in the country where harvest has taken place. 'Re-export' applies to the trade of specimens originating from a country other than the exporting country, in such instances specimens only require a Re-export Certificate. 'Country of origin' is defined as the country in which a specimen was taken from the wild or

[1] There is some uncertainty whether the Philippines is also a range State.

[2] The genus *Gonystylus*, better known for its Ramin timber but which also produces agarwood, has also been listed in Appendix II owing to concerns about the sustainability of the international trade in its timber.

artificially propagated. These definitions have been adapted from Resolution Conf. 12.3 (*Rev. CoP14*) on permits and certificates, Annex 2.

In practice, NDFs are often incorporated into an annual export quota system which can eliminate the need for a NDF to be conducted for each individual shipment of CITES specimens. This provides a basis for monitoring the trade and may facilitate the issuance of export permits (see *Resolution Conf. 14.7* on the management of nationally established export quotas).

The Convention also requires the CITES SA of the State of export to determine when to limit the granting of export permits for Appendix II species "in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs, and well above the level at which the species might become eligible for inclusion in Appendix I" (Article IV paragraph 3).

Although the primary responsibility for making NDFs rests with the CITES SA of the State of export, Article XIII vests authority with the CITES Secretariat to communicate with a Party when there are believed to be problems with implementation. Furthermore, the Conference of the Parties to CITES adopted *Resolution Conf. 12.8 (Rev. CoP13*) on the review of significant trade in specimens of Appendix II species that directs the Plants Committee to identify when Appendix II species are subject to unsustainable trade and recommend remedial actions through what is known as the "Review of Significant Trade". This can include, for example, the establishment of export quotas, development and implementation of management plans or, as a last resort, restrictions on exports for the species concerned[3].

1.3 Approaches to conducting NDFs for agarwood-producing taxa

Since a single agarwood-producing taxon, *Aquilaria malaccensis*, was first included in Appendix II in 1995, studies in agarwood range States, particularly Indonesia and more recently, Malaysia, have made efforts toward gathering information that would assist the formulation of NDFs for agarwood (Soehartono and Newton, 2000; Soehartono and Newton, 2001; Soehartono and Newton, 2002; Anon., 2003b; Walujo and Wiriadinata, 2006; FDPM, 2006). These efforts were made parallel to similar NDF initiatives for other CITES-listed tree species, particularly Big-leaf Mahogany (Oldfield and Newton, 2003; Magin, 2006; CoP14 Inf24) and Ramin (Anon., 2002; Anon., 2003a). However, these efforts have all been somewhat hampered by the fact that no standard methodology has been developed for making NDFs.

In a generic attempt to address the methodological gap, IUCN developed a *Checklist to assist in making Non-Detriment Findings for Appendix II exports* (Rosser and Haywood, 2002) ('the IUCN Checklist')[4]. This checklist approach is also known as a 'rapid vulnerability assessment' (RVA) (Wong *et al.*, 2001). Such a RVA helps to determine whether a species may be at risk from overexploitation. However, a RVA does not actually provide quantitative information to assist in determining harvest limits or export quotas, two mechanisms that have been used to maintain harvests and trade within sustainable levels by a number of CITES Parties.

The IUCN Checklist consists of two parts: 'Table 1' is an initial review at the national level on the types of harvest, the degree of control over the harvest, the segment of the population harvested, the level of total off-take (for domestic and international use), the reason for the harvest, and the end users of the harvest. There are also checks to distinguish between regulated and illegal or unmanaged harvesting. Concerns captured in Table 1 can then be dealt with in more detail in 'Table 2', which compiles information on management history and planning, harvest management, status of land on which harvesting takes place, capacity for monitoring the harvest, benefits and risks of harvest, and levels of strict protection (Rosser and Haywood, 2002). Scoring is done on a scale of 1-5, where 1 shows the lowest level of confidence for the category concerned.

IUCN stressed that while the Checklist itself does not constitute a finding of non-detriment, its use should inform non-detriment finding methodologies. However, if the majority of factors are scored closer to 1, indicating a high degree of uncertainty, a Scientific Authority may conclude that insufficient information

[3] A review of significant trade was conducted for one Agarwood-producing species, *Aquilaria malaccensis*, in 2003, which resulted in recommendations being made to key range States, namely India, Indonesia and Malaysia with regard to implementation of Article IV of the Convention.

[4] This IUCN Checklist has been presented to the CoP as CITES Inf. 11.3 but has not been formally adopted.

exists on which to base a finding of non-detriment. In such a case it is recommended that most Parties should choose not to allow commercial trade until information quality is improved (Rosser and Haywood, 2002).

While a useful starting point, the generic IUCN Checklist has limitations in terms of its applicability to certain tree species and countries. The case of agarwood is very different from other CITES-listed tree species harvested for their timber – the fact that it is traded a non-timber forest product which is found irregularly in only 10-20% of agarwood trees makes the development of a NDF methodology even more challenging.

A national workshop held in Malaysia in March 2006 sought to assess the extent to which this generic checklist met the needs of making a non-detriment finding for *Aquilaria*; concerns were raised with the definition and clarity of checklist terms as applied to a national setting (Anon., 2006)[5].

Recognising the need for greater clarity in carrying out NDFs for agarwood-producing taxa, the Conference of the Parties to CITES (CoP) has recommended that a standard method for determining the population status of CITES-listed agarwood-producing taxa be developed to assist CITES SAs in carrying out NDFs: "Such a standard method could be used to verify populations across all agarwood-producing areas, and not allow only the setting of appropriate quotas but also allow the verification of species being harvested" (CITES Decision 12.70; CITES Decision 13.65(d)).

More generally, the CoP has decided to "develop guidelines for Parties to establish, implement, monitor and report national export quotas for CITES-listed taxa" (CITES Decision 13.66). In pursuit of these objectives, the CITES Secretariat contracted TRAFFIC Southeast Asia to develop a NDF methodology for agarwood-producing taxa. The first draft of such a methodology was prepared for discussion and further development by an international CITES Agarwood Experts Group Meeting involving government, scientific and industry representatives from key agarwood-trading countries held in Malaysia from 14-17 November 2006. Feedback from workshop participants has been incorporated into the present draft.

The term "not be detrimental to the survival of that species" is interpreted in the context of the full text of Article IV which notes the need to "maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs, and well above the level at which the species might become eligible for inclusion in Appendix I".

This wording can be broken down into a number of components: (1) the range of the species; (2) the abundance of the species consistent with its ecological role; (3) eligibility for inclusion in Appendix I. Further details on these components are found in the Biological Criteria for Appendix I which were adopted by the 13th meeting of the Conference of the Parties in 2004 (*Resolution Conf. 9.24 (Rev. CoP14*) on criteria for amendment of Appendices I and II, Annex 1). However, *Res. Conf. 9.24* does not actually specify criteria for the threshold levels at which species become eligible for inclusion in Appendix I.

1.4 Contextual and institutional references for CITES non-detriment findings

It is important to consider any NDF methodology in the context of the local governance framework (i.e. national or sub-national), including both legislation and institutional responsibility. This will include the framework for the management of species and habitats as well as the framework for the management of international trade. In terms of CITES implementation, the NDF is placed in the context of a wide range of responsibilities designated to the CITES MAs and SAs of each CITES Party.

Resolution Conf. 10.3 on Designation and Role of Scientific Authorities is a key reference in this regard, and illustrates the importance of having a functional and interactive relationship between SA and MA institutions. Several paragraphs of this Resolution are particularly important when considering the implementation of NDFs, including a), c), g), h), j) With reference to the fact that several agarwood-producing taxa have transboundary populations between range States, paragraphs d) and e) encourage co-operation and sharing of resources towards provision of the scientific ridings required under the

[5] See Annex 1 of this document for examples of outputs from using the IUCN Checklist for agarwood trade in Indonesia and Malaysia.

Convention. Paragraph m) of the same Resolution is relevant for the exports of cultivated agarwood products under the CITES definition of 'artificial propagation'.

Before the MA requests the SA to make NDFs for specimens of agarwood-producing taxa, it should determine that all applications for CITES permits to export these specimens are in order (*Resolution Conf. 12.3* (Rev. CoP14) on Permits and Certificates, Annex 2). In particular, the MA should ensure that the exporter has indicated the species, type, source and quantity of specimens on the standard permit specified in Article VI paragraph 2.

Prior to requesting advice from the SA, the MA should be satisfied that each specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora (Article IV paragraph 2(b)). NDFs and any quotas resulting from NDFs should not be used to legitimise illegal harvest of agarwood. Legality is generally considered to be a pre-requisite for sustainability and therefore the assessment of legality should be made prior to any NDF (for individual exports), or in conjunction with the issuance of export permits within the limits of any existing national quota. The first part of the IUCN Checklist ('Table 1') encourages the SA to make an initial review, at the national level, of the degree to which harvest is regulated (or legal).

The export of certain specimens of agarwood may not require advice from the SA. Examples include specimens that were artificially propagated (often referred to as cultivated agarwood) (with valid certificates of artificial propagation or proof of cultivation), pre-Convention specimens (with valid pre-Convention certificate) and non-commercial trade between scientists and scientific institutions. Agarwood seedlings may come under the category of plants that are artificially propagated in accordance with *Resolution Conf. 11.11 (Rev. CoP14)* on regulation of trade in plants, paragraph a. Agarwood from cultivated sources (home gardens, plantations) could come under the category of parts and derivatives of plants that were artificially propagated (CITES Source Code 'A'). Such specimens may be exported under the provisions of Article VII, paragraph 5, of the text of the Convention.

Finally, it is important that the SA does not consider its role complete once NDFs have been made. The Convention requires SAs to monitor the exports of specimens of Appendix II species. In this regard, it is important that, in the spirit of adaptive management, SAs work closely with the relevant Management Authorities, Customs and other relevant law enforcement agencies to assist with species identification and control of the chain of custody. The role of the SA should also be to advise on a practical permanent monitoring system to ensure levels of international trade (and by extension the harvest levels to supply those exports), do not become detrimental to the survival of the species in the wild.

1.5 How to use this document

Section 2 details a methodology for going through a NDF process with stakeholders towards assessing the impact of international trade levels on the status of agarwood-producing taxa. It suggests relevant categories of information, and the possible sources of such information, to assess the status of the harvest and trade relative to wild populations, identify knowledge gaps, and to examine any resulting trends or uncertainties in lieu of exhaustive field studies to enable CITES Authorities in relevant range States to evaluate the likelihood of detriment posed by current levels of trade.

Section 3 outlines technical specifications in the wider management context that encompass a resource assessment at more precise resolutions. Collection of such information would ensure that subsequent NDF assessments would benefit from an increasing degree of accuracy.

It also emphasises that the monitoring and verification systems that should be set up (or strengthened) in parallel to the NDF assessment process. Such systems will form the basis of an adaptive management system. Without a framework to pick up any iterative advances in quality and category of information, the management system will not be sensitive to change.

This document is presented in line with CITES Decision 14.143, directed to the Plants Committee and the Secretariat regarding Agarwood-producing taxa, which specifies that:

On the basis of the work on non-detriment findings for agarwood-producing species, that has been developed by TRAFFIC Southeast Asia and the Secretariat, the Plants Committee, in consultation with range States and the Secretariat, shall develop principles, criteria and indicators for the formulation of non-detriment findings for agarwood-producing species.

As such, the Plants Committee is invited to provide comments on this draft, and to consider how to further develop principles, criteria and indicators for the formulation of non-detriment findings for agarwood-producing taxa.

SECTION 2 – SOME STEP-WISE APPROACHES TO DECISION MAKING FOR NON-DETRIMENT FINDINGS

2.1 Define the scope of the assessment

Determine the current taxonomic status of the agarwood-producing species to be included in the assessment. Decide whether the assessment is addressing one or more species. Define the location subject to NDF assessment in terms of agarwood-producing species composition, geographic coverage as well as political and administrative limits[6]. If any previous NDFs have been made for the species, at the national level or any smaller geographic frame of reference within the national boundary, reference to these existing NDFs should be made when estimating values for scientific and management criteria (see step **2.3**).

2.2 Check for existing quotas

Check whether any existing harvest and / or trade quotas have been set, and whether they were determined by any previous NDF assessment for the species defined in step **2.1**. Determine whether these quotas are current and valid for the particular population of the species, taking into consideration any new information regarding the species.

2.3 Estimate values for fundamental scientific and management criteria

The IUCN document *Guidance for CITES Scientific Authorities: Checklist to assist in making non-detriment findings for Appendix II exports*, will provide a useful qualitative starting point for determining biological status, management history and planning, harvest management, status of land on which harvesting takes place, capacity for monitoring the harvest, benefits and risks of harvest, and levels of strict protection.

To assist with the accuracy of scoring the Checklist, and to assemble as much information about the status of the population being harvested, carry out a review of the existing literature[7]. In terms of quantitative information relevant to wild population status, the minimum, maximum and best estimates for the following factors will be relevant:

a) Total number of individuals (including seedlings, saplings, small trees, big trees)
b) Number of fruit-producing individuals
c) Level and pattern of recruitment
d) Number of sub-populations
e) Effective number of fruit-producing individuals in each sub-population
f) Level and pattern of exploitation, including for international trade
g) Area of natural distribution
h) Area of present occurrence
i) Quality of habitat
j) Integrity (fragmentation) of area of distribution

Further detail for structuring the resource assessment component of a NDF can be found in **Section 3.2** of this document.

[6] Article IV paragraph 2(a) requires the assessment of the conservation status of the species at a global level, at a subspecies level or at the level of geographically separate populations.

[7] This should include all relevant 'baseline data' derived from existing forest inventories, field-based assessments, botanical and ecological studies, and yield studies.

2.4 Conduct interview-based surveys with industry participants

Once the existing information and data have been reviewed, and key harvesting areas have been identified, the most important source of up-to-date information is likely to be from individuals and groups involved in harvesting and trading of agarwood. These industry participants, or stakeholders, may be located around the harvesting area, at intermediate points of consolidation and trade, at processing centres, or at points of warehousing and export. Field-based forestry officers, as well as those involved in issuing permits for harvest and/or trade, are also likely to be an important source of information, particularly if revenue is being collected from agarwood harvest and trade. Interview-based research could focus on the following information:

a) Numbers of industry participants and scale of industry (formal and informal) – including connection to international investment and demand, and how this relates to international trade dynamics.
b) Location of present harvesting areas – to determine where present supply is sourced from.
c) Extent of cultivated agarwood investment and whether any agarwood is being produced from cultivated sources.
d) Levels of trade – are these rising, declining or stable in both volume (quantity) and grade (quality)?
e) What understanding exists in terms of the existing institutional and regulatory system for agarwood harvest and trade (laws, permits, regulations)? Is it clear to trade participants which government agency has responsibility for monitoring the agarwood industry?
f) Annual value – national revenue from sale/export, how many stakeholders involved in earning an income [fewer participants may equal trade declining].

2.5 Examine additional factors that may assist with NDF assessment

Comprehensive information is unlikely to be available on population status, particularly at the national level, at the initial stages of carrying out a NDF. Therefore, in addition to analysing published data collected in step **2.3**, and interview-based information collected under step **2.4**, several other contextual indicators may assist in assessing the ability of the population to withstand the impact of harvest.

a) Are wild harvesting areas getting increasingly further away from urban trade centres?
b) Has volume of agarwood gathered per harvesting trip ('catch-per-unit-effort') decreased in terms of quantity (volume)?
c) Has quality (grades of agarwood) of agarwood declined?
d) Is the international market price rising?
e) Is any existing harvest quota from certain geographical areas being met? Are any trade (export) quotas fulfilled to the maximum level?
f) What size (diameter at breast height – dbh) trees are available for harvest in the wild?
g) Is harvested product coming from wild or cultivated sources? Can these be distinguished from each other?
h) Do any stockpiles of harvested (wood chips, pieces) or processed (e.g. oil, powder) agarwood products exist, and if so, how are these monitored or managed?
i) Are 'outsiders' involved in harvesting activities, including foreign nationals?
j) Are current harvesting areas inside or outside protected areas?
k) What evidence exists for illegal harvest and trade, and how does this compare to legal activities?
l) Are threats other than exploitation for trade (e.g. habitat conversion, fire) getting more severe?

2.6 Calculate the international trade threshold

Depending on the outputs from steps **2.3-2.5**, an estimate of the maximum quantity of agarwood which can be exported from a range State without detriment to the survival of remaining populations can be calculated. This export trade threshold should be based upon a level of harvest that does not exceed the ability of the species to regenerate.

An allowance for illegal harvest and trade should be deducted from the export trade threshold to incorporate an additional precautionary element.

The calculation will need to determine the conversion factor between the quantity (and the form or product type) of specimens entering international trade and the number of trees removed from the wild population in order to produce this quantity. Any domestic or national use of agarwood should also be taken into account.

For wood chips, this would need to address the number of live individual trees harvested per kg of wood chips in trade – or the number of kg of wood chips in trade per live individual tree lost[8].

For agarwood oil, this would need to address the volume (mass in kg) of agarwood chips used to produce resultant oil volume (litres), including an established metric for conversion. Once the volume/mass of wood (chips) is determined, that would also have to be calculated in terms of trees lost.

Based on these conversion factors, calculate the maximum quantity of agarwood (major products being wood chips and oil) that may enter international trade per year for the next five years before a species satisfies at least one of the Biological Criteria for inclusion in CITES Appendix I (A to C)[9]. Cultivated agarwood, however, and products derived from these controlled production systems, should be treated separately from wild-harvested agarwood, and production from cultivated systems should be differentiated to ensure it is not mixed or confused with wild harvested product (see **Section 3.1.3d)** of this document for more detail).

7. Determine management interventions

There are likely to be several 'unknowns' or information gaps in the NDF assessment, so incorporating precautionary approaches is recommended. Depending on the reliability of available information, several management interventions may be deemed necessary.

These may include, for example: preparation of a management plan; zoning of agarwood habitat into separate delimited areas for harvesting and conservation; population surveys of ecologically representative agarwood harvesting areas; setting size limits (tree dbh) for harvest; specifying product types allowed for export, designation of processing centres and points (ports) of export; and strengthening monitoring of any existing management systems applied to agarwood-producing taxa. A more detailed technical list is given in **Section 3** of this document, outlining elements which Parties may consider to incorporate into an adaptive management system.

However, given agarwood's nature as a high-value, predominantly open access resource, harvest and trade is likely to continue alongside any management interventions. Therefore annual limits to harvest and trade – in the form of quotas – may need to be set.

A national quota may be composed of several subordinate quotas relative to available habitat, harvesting locations, and political administrations. In the case of agarwood, the quota should specify to which species and product types it applies and in what volumes. The total national quota should be well below the quantity identified as a threshold in step **2.6** and should be tied to a calendar year (1 January to 31 December) [10]. The period after which a re-evaluation of a NDF for the species should be carried out should also be specified.

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[8] In the case of specimens of agarwood, the conversion factor will be a function of a number of variables including (1) the proportion of trees harvested which actually yield agarwood of the particular grade of the specimen; (2) the mortality rate of trees harvested; and (3) the conversion rate of processing activities, for example from trees to wood chips, and wood chips to agarwood oil (see **Annex 3** of this document for conversion rate examples). In 2006, Malaysia presented an explanation to the CITES Secretariat detailing the process of calculating a cautious harvest quota for *Aquilaria malaccensis* for the year 2007. This included considerations of a size limit for wild populations (trees above 30cm dbh), volume of potential annual harvest over a 50 year rotation, estimation of yield per tree for both wood and resinous deposits, while factoring the likelihood of agarwood formation at 10% of trees in the total wild population. Malaysia may wish to present the detail of this example to the Plants Committee for discussion with other range States.

[9] *Res. Conf. 9.24 (Annex I) (Rev. CoP14).*

[10] Ensure that the CITES Secretariat is informed of this annual export quota (in compliance with *Resolution Conf. 12.3 (Rev. CoP14)*, s VIII a).

8. Advise on whether proposed agarwood exports will be detrimental, or not, to the survival of the species

The Scientific Authority, having taken into account all available information, ultimately needs to advise the appropriate Management Authority whether the export of the proposed quantity of agarwood will or will not be detrimental to the survival of the species.

If information gleaned from steps **2.3-2.6** indicates a predominantly negative trend, i.e. towards detrimental impact on the survival of the species in the wild, then the management interventions under **step 2.7** may also consider the cessation of trade. This amounts to a (self-imposed) zero quota by the Party concerned, and will allow time for certain information gaps to be filled in order to consider whether managed wild harvest and export should resume. A comprehensive list of management criteria is outlined in **Section 3** of this document, which aims to present a list of options for CITES Authorities of range States to consider towards improving the sustainable management of wild agarwood populations.

SECTION 3 – SOME TECHNICAL SPECIFICATIONS TO INFORM ADAPTIVE MANAGMENT FOR AGARWOOD-PRODUCING TAXA (*Aquilaria/Gyrinops spp.*)[11]

3.1 – MANAGEMENT PRINCIPLES, METHODS AND INDICATORS

3.1.1 Management plans and principles

a) Establishment of management plans at national levels, accommodating State/province and smaller geographic units of management, will form the foundations of short, medium and long-term interventions towards a goal of legal and sustainable wild agarwood harvest and trade.

b) An adaptive management approach is essential, allowing for new information to be taken into account as it comes to hand and implementation of modifications as necessary. In addition to conducting a resource assessment (see **Section 3.2**) factors such as harvest area rotation, allowable dbh sizes, growth, regeneration, levels of legal and illegal harvest, levels of threat posed by logging and other land conversion of agarwood habitat, would need to be considered.

c) Management plans should incorporate considerations and needs of different production systems to acknowledge both populations in natural forests, as well as cultivated agarwood in plantations and home gardens, whether managed by private enterprise or local communities. Best-practice management guidelines and principles can be adapted for all agarwood production systems.

d) The outcomes of successful cultivated agarwood production systems (whether small-scale home gardens through to plantations with differing degrees of management inputs), such as those in place in Bangladesh, India, Lao PDR, Thailand and Viet Nam, should be studied. Where possible, information should be widely disseminated in order to enhance silvicultural knowledge of the species and allow for adaptation towards enhanced management of remaining wild populations.

e) In addition, any knowledge gleaned from the study of natural populations should be applied to *ex situ* cultivated agarwood production systems.

3.1.2 Factors that need to be considered for the sustainability of *in situ* agarwood populations

a) Harvest planning strategies:

- Define the type of harvest (destructive/non-destructive) to be undertaken according to age/size classes of agarwood tree populations and assessment of resin content in the tree;
- Depending on the type of harvest, to define the type of silviculture that will be implemented based on the distribution and proportion of seed-bearing mother trees, and harvestable agarwood-bearing trees.

[11] The structure of this section is adapted from a template developed by Mahogany range States regarding "Essential Elements for the Formulation of Non-Detriment Findings for Bigleaf Mahogany *Swietenia macrophylla*", presented to CITES CoP14 by Mexico as part of CoP14 Inf. 24, and presented again to the Plants Committee as Annex I of PC 17 Doc 16.1.2.

- Given the nature of wild agarwood populations as an 'open-access' resource, and the predominance of local harvesters, it is important to consider who will conduct harvest monitoring and verification measures (i.e. the local community, or an external government extension officer?).

b) *Harvesting Methods:* Based on the type of local/cultural approach to harvesting, and perceived economic viability, different harvesting methods may be carried out:

- Non-destructive:
    - Harvest of selected resin-bearing sections of tree, and/or stems where multiple stems exist or where coppicing has taken place, without killing the tree;
    - Harvest of whole trees, but leaving roots/stump for regeneration and coppicing (acknowledging uncertainty of future resin formation and fruit/seed production)[12].
- Destructive:
    - Harvest of whole tree, often including roots, which kills the organism.
    - If this is not properly managed, the felling of the tree may also kill surrounding wildlings and small trees.

c) *Regeneration:* Natural regeneration has been observed to be abundant when ecological conditions are optimal and mother trees are present in primary forest[13]. To sustain a viable population[14], it may be necessary to implement the following:

- Ensure retention and protection of seed trees, and recording their location to assist with monitoring;
- Ensure agarwood regeneration is considered in the management of an area, assuming multiple species are being harvested from that management area;
- Collection of viable seeds to establish nurseries to supply seedlings for enrichment planting;
- Establish the maximum distance between seed trees (taking into account requirements for successful pollination);
- Protection of agarwood trees to be retained for future harvests, based on likelihood of agarwood formation and oleoresin production (natural or induced);
- Enrichment of harvested areas through planting (e.g. can be implemented by local harvesters/traders as part of their licensing requirements).

d) *Conservation:* To protect the different species and their localised geographic populations found throughout each national agarwood range, and in order to ensure that the variety and diversity of the populations will be preserved, the following actions need to be considered:

- *In Situ*: Establishing strictly protected agarwood conservation stands in ecologically representative locations. This will ensure the maintenance of genetic variation, and aid with production of seeds and the establishment and monitoring of sample plots. Such zones could be linked to existing protected area systems.
- Coordinating an agarwood seed collection and management program, accurately documenting seed collection locations; and creating nurseries to supply seedlings from viable and carefully selected seed stock for enrichment planting in selected locations.

3.1.3 Agarwood supply chain management

a) *Monitoring and verification:* this is probably the most critical element of a working adaptive management system to support NDF for agarwood-producing taxa, and includes elements of law enforcement further detailed in **Section 3.3**.

- Compliance monitoring referenced to existing regulatory system for managing agarwood harvest and trade (including taxa-specific management plans if they exist).
- Annual allowable cut (tree harvest volume) should be monitored in conjunction with product stockpiles (e.g. wood chips/pieces, powder, oil) and associated conversion ratios (particularly trees → wood chips; and wood chips → agarwood oil), and cross-referenced with levels of export trade in various agarwood product types.

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[12] In many cases, non-lethal (non-destructive) harvesting may not be economically viable.

[13] As agarwood-producing species are an upper-understory tree, the more light available will increase the speed of seedling growth (Anders Jensen, *in litt.* to TRAFFIC).

[14] For conservation stands, or seed sources, a viable population should include 30 fruiting and flowering trees at least 100m apart (Anders Jensen, *in litt.* to TRAFFIC).

- Where possible, establishment of permanent monitoring plots (in both harvested and non-harvested areas) is advisable in order to gain a detailed and long-term understanding of the impact of harvesting from agarwood habitats.
- Establishment of information databases and an expert group list-server is essential to support domestic and international information exchange on management of agarwood harvest and trade, including any associated scientific advances.

b) *Training/expertise and field data collection:*
- Define minimum training criteria and standards for harvesters.
- Devise an ongoing training programme for personnel (experts to train novice harvesters, whether local or outsiders) involved in harvesting activities to minimise destructive harvesting, and the selection of appropriate size and age classes of trees.
- Training programme for regulatory staff to ensure understanding of relevant range State regulations including harvesting criteria and indicators.
- In the course of population assessments and monitoring, drafting of geo-referenced maps of harvesting areas is recommended.

c) *Determining quotas for harvest and trade for wild-harvested agarwood:* Accurate quota establishment depends on adequate knowledge of wild populations. If quotas are established without knowledge of wild populations and levels of harvest (current and historical), and instead referenced only to domestic stockpiles and previous export volumes, it is impossible to assess the impact that exports will have on wild populations. The following steps should therefore be considered:
- Select an ecologically representative array of agarwood harvesting areas to determine minimum viable populations, to assist with calculation of the maximum volume (number of trees) subject to harvesting. This could also be paired with data on tree growth and regeneration/recruitment data to determine harvesting volumes, as well as considerations of any non-destructive harvesting.
- Harvest quotas will ideally be established with reference to a specific geographic area (including a defined collection area), to acknowledge variance in population structures, while also acknowledging any political management unit and associated regulatory procedures. This information can then be used as a baseline for establishing export quotas.
- As the current status of knowledge indicates 10-20% of trees in naturally occurring wild populations contain resinous agarwood deposits of commercial value, the number of harvested trees (including those with no agarwood deposits) should be referenced to volume of yield of resinous agarwood to reflect losses inherent from processing trees into agarwood chips[15].
- Export quotas should take into consideration the diversity of major products in trade and any associated conversion factors. In particular, the conversions of trees to wood chips, and wood chips to essential oil will both be critical considerations when setting annual thresholds/limits for exports[16].
- Quotas should be established one year in advance whenever possible in order to enable monitoring and verification.

d) Separating cultivated agarwood production from wild-harvested sources: Differentiation between wild and cultivated agarwood production systems and products in trade is necessary both for efficient management and monitoring of the agarwood supply chain, and a component of NDFs. This may involve:
- Registers of cultivated agarwood plantations and home gardens.
- Conducting NDFs for cultivated agarwood production referenced to outputs from these registered locations, whether wood chips, oil or finished products.

[15] In an intensively managed production system (e.g. cultivated plantations or home gardens), this may also enable information to be collected on the mix of quality/grades of agarwood harvested from age/size classes of trees.

[16] This should then be related back to harvest monitoring, and linked closely with the monitoring of agarwood industry members processing wood chips into oil.

- Upon application, verification of agarwood product source before issuance of CITES export permits with Source Code 'A', designating 'artificial propagation' or production from non-wild sources under controlled conditions[17].

3.2 – RESOURCE ASSESSMENT– to determine crucial baseline biological and ecological information

3.2.1Distribution

Determine range and distribution of agarwood-producing taxa at the national level. This is clearly dependent on agarwood-producing taxa being included at genus, if not species, level in national forest inventory specifications, or in production forest assessments of smaller geographic units. Some existing sources of information at the national level (which may be aggregated from smaller units of information such as State/province, or forest management area) are:

a) National forest inventories – which may give indications of agarwood-producing taxa at genus level;
b) Available satellite imagery – in the case of agarwood, this may only give indications of suitable habitat, but will not give more precise information for a typically widespread species which has clumped distribution;
c) Any existing mapping of production forest areas at sub-national (i.e. State or province) level, or smaller localised levels of forest management (including protected areas) where species composition has been assessed.
d) The most important source of information on agarwood presence/absence at the local level is likely to come from field-based forest rangers and individuals and/or groups involved in harvesting and trading of agarwood. These industry participants, or stakeholders, may be located around the harvesting area, at intermediate points of consolidation and trade, at processing centres, or at points of warehousing and export.
e) Over time, key harvesting areas can be identified and inventories can be conducted in an ecologically representative selection of agarwood habitat. Given the widespread but irregular (clumping) distribution, techniques such as distance sampling and adaptive cluster sampling may be most appropriate[18].
f) Reference set of herbarium specimens at national, regional and international herbaria and forestry research centres – useful only for determining some extent of natural (historical) distribution, and with understanding background ecological conditions

By analysing available information, some indication of the historical and current distribution of agarwood-producing taxa may be determined, and key areas identified for harvest management and conservation. Collated information may also allow for systematic comparison of current status to historical distribution of wild populations.

3.2.2 Population parameters

In order to assess populations of agarwood-producing taxa, regular monitoring of selected biological parameters and indicators of sustainable management must be carried out in representative harvesting areas within, for example, a monitoring interval of five years. Baseline figures are therefore essential to this process.

1. Monitoring parameters

a) Structure of agarwood populations:
- Diameter at breast height (dbh), based on an appropriate sampling method
- Height of trees, measured or estimated
- Density (# agarwood trees/ha; # agarwood trees/100 ha), by size classification
- Number of seed-bearing (mother) trees

[17] noting that the CITES definitions for 'artificial propagation' of agarwood or other non-timber forest products need examination with reference to *Res. Conf. 11.11 (Rev. CoP13)*.

[18] Areas assigned as *in situ* conservation stands for seed collection would be additionally useful for detailed tree inventories, and monitoring of seed trees. These conservation stands should be located across a representative range of ecological zones within each national jurisdiction.

b) Assessment of whether seed stock is being replenished (to determine recruitment potential)
c) Natural regeneration – estimate number of seedlings, saplings, small trees[19];
d) Growth rate (of standing trees at dbh) – as agarwood is an upper-understorey species, growth would vary depending on degree of canopy closure.
e) Indicative probability of agarwood formation in localised wild tree populations, based on information obtained from communities surrounding harvesting areas (depending on location).

2. Sustainable management indicators for viable agarwood tree populations

These indicators make it possible to identify the relative population dynamics to ensure that an equivalent population of agarwood trees is established for regeneration and maintenance purposes, so as to replace the trees that were destructively harvested:

a) Identification of seed-bearing (mother) trees, and monitoring of their mortality rate, within managed harvest areas. This would allow comparison with monitoring of mother trees in any protected / conservation zoned areas.
b) Regeneration rate / recruitment (natural or through enrichment planting), including considerations of seedling mortality.
c) Felling rate.
d) Retention rate of large trees (>50cm dbh).
e) Number of trees available for future harvest.
f) Ability of non-destructively harvested trees to allow agarwood formation.

3. Information gaps

In order to establish a basic silviculture for wild populations of agarwood-producing taxa, the following parameters need to be further understood by range State resource managers:

- reproductive biology, including pollination and dispersal mechanism;
- life history of all agarwood-producing taxa, including age at which agarwood formation and oleoresin production is most likely to occur;
- annual growth, regeneration;
- habitat and ecology (including soils, elevation, terrain, drainage, climate), including considerations of spatial distribution of agarwood trees in natural forest;
- phenology;
- agarwood formation process (and possible application of inducement technology to improve the speed and quality of resin formation[20]);
- minimum / maximum dbh appropriate for harvesting;
- agarwood content and quality in trees;
- techniques or tools on how to detect presence of resinous agarwood deposits in the tree without felling, including indigenous ethnobotanical knowledge;
- long-term morbidity associated with non-lethal harvest (and considerations of economic viability of non-lethal harvesting).

3.3 – MONITORING AND VERIFICATION TOOLS FOR CONSERVATION, HARVEST AND TRADE ACTIVITIES

It is necessary to support conservation and legal harvesting activities with monitoring and law enforcement in order to ensure compliance and reduce illicit activities driving illegal agarwood harvesting. These recommendations take note of outputs from the CITES Agarwood Experts Group meeting (Malaysia, 2006) and the 2nd International Agarwood Conference (Thailand, 2007):

a) Ensure clear definitions for aspects of the agarwood industry, particularly the parameters of 'cultivated agarwood' or plantation-sourced materials, a rapidly emerging component of future

[19] Strictly protected conservation stands would likely be managed specifically for recruitment, collection and planting elsewhere (whether in plantations or theoretically enrichment planting in wild population stands).

[20] Application of inducement technologies to wild agarwood populations should be examined under protocols agreed with the SA of the range State concerned.

supply that would need to be separated from, but informed by, wild harvest regulations. Other definitions that need to be established are agarwood powder/dust, wood chips, logs, wood pieces, oil, non-timber forest product, incense (as this refers to raw agarwood in some cultures) and even 'agarwood' itself (separate from the tree). A glossary of terms should be developed that considers cultural aspects of the agarwood industry and trade in order to allow better understanding between producers, traders and consumers, including government regulators.

b) Strengthen the chain of custody from forest (point-of-harvest) to point(s) of processing and/or export as a means of intensifying the control on legally and illegally harvested agarwood.

- Investigate options for an agarwood marking and traceability system to strengthen the chain of custody for product tracking, and to differentiate between cultivated and wild-sourced agarwood. This could also be extended to verify agarwood imports, right through to final sale of certain products (e.g. agarwood oil).

c) Establish a verification system for harvesting and supply chain management from production areas (at various levels e.g. national, State/province, or harvest site), carried out by the MA with the participation of the SA and any licensed harvest/trade participants, which may include:

- On-site (annual) inspection of harvesting areas to measure compliance with the approved harvest management protocols (acknowledging that these will vary between range States). under forest management plans, as well as monitoring systems utilizing available technology.
- Control systems for supply chain management from harvest area to point of processing, sale or export, in compliance with relevant regulations and procedures in each range State.

d) Under national management plans, establish national registers of industry participants in an effort to formalise the agarwood trade structure[21]. Such a register could also be referenced to licensing systems for harvesters, collectors, processors, vendors and exporters, depending on the regulations of each range State.

- Establish a register of cultivated agarwood plantations (including inventory of trees and stocks) at national levels, to enable better separation of production systems for cultivated agarwood and wild harvested agarwood.

SECTION 4 – CONCLUSIONS

This paper considers a range of options for carrying out a non-detriment finding (NDF) assessment for agarwood-producing species in compliance with the provisions of CITES. The text of CITES does not provide detailed guidance in regards to NDF, however the numerous decisions, resolutions and information papers of the CITES Conference of Parties does lay a foundation upon which the recommendations of this paper are built.

In practice, the lack of comprehensive information will inevitably render NDF assessments subject to a degree of uncertainty. Furthermore, there are numerous practical difficulties with the regulation of the agarwood trade that have been recognised and have yet to be resolved. Nevertheless, the practical implementation of NDF by the Scientific Authorities of the various Parties will begin to bring the trade in agarwood closer in line with the criteria of legality and sustainability.

However, the effectiveness of implementing a NDF rests on the fundamental assumption that range States have a functional and objective Scientific Authority (as defined by *Resolution Conf 10.3*), and an interactive relationship between the SA and MA focused on monitoring the legality and sustainability of Appendix II exports.

Through a process of continual improvement of the quality of data specific to agarwood-producing taxa, Parties can implement an adaptive management system that will aim to safeguard remaining wild populations.

[21] Note that this has been done in some range States already (e.g. India, Indonesia, Thailand), to different degrees.

SECTION 5 – RECOMMENDATIONS

In line with CITES Decision 14.143, it is recommended that the Plants Committee consider this draft and examine how to further develop principles, criteria and indicators for the formulation of non-detriment findings for agarwood-producing taxa.

It is recognised that for robust implementation of a NDF, prescriptive management interventions may be needed to support harvesting sustainability. For agarwood-producing taxa, meeting goals of promoting regeneration, agarwood product traceability, establishment and maintenance of conservation areas, monitoring systems, and law enforcement will require financial investment and technical support[22]. As such, the following considerations should be taken into account:

a) Range States should consider costing out activities required for sustainable management of agarwood harvest and trade in compliance with compatible NDF methodology, for the benefit of in-country value addition, related industry development (considering both wild harvest as well as cultivated production) as well as species management and conservation. Implementing management plans for agarwood will require additional financial investment.

b) If a National Management Plan is deemed appropriate, it may be necessary to evaluate the role that various institutions play in the oversight of agarwood harvest and trade in each range State, including monitoring and law enforcement. Clearly defined institutional responsibilities may improve the efficiency and transparent use of resources. One suggestion is to centralise administration of the agarwood industry to one government institution to streamline operations and ensure a clear 'rulebook' for industry participants.

c) Development (including funding) of any management plans for agarwood should be integrated into overall sustainable forest management strategies as they pertain to commercial tree species.

d) The cost of implementing sustainable harvest management plans may have an effect on the price competitiveness of agarwood sourced from legal and sustainable production systems (both wild-harvested and cultivated agarwood). This should be carefully considered as part of an ongoing dialogue between stakeholders in range and consumer States (both government and private sector).

e) By examining the supply/market chain for opportunities for cost and benefit sharing, practical co-operation could be facilitated between producers (including harvesters, collectors, processors), traders (import and export intermediaries), established agarwood industry members, and end users. For example, if end-use markets require particular qualities of wild-harvested or cultivated agarwood, private sector industry participants or end users may consider investment in supporting legal and sustainable production, harvest and export from range States.

[22] This takes note of related discussions by Mahogany range States to recognise the need for cost effectiveness and streamlining institutional actions for NDF implementation, as detailed in CoP14 Inf. 24, and presented again to the Plants Committee as Annex I of PC 17 Doc 16.1.2.

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CITES Resolution Conf. 12.3 (Rev. CoP14) *Permits and certificates*
CITES Resolution Conf. 12.8 (Rev. CoP14) *Review of Significant Trade in specimens of Appendix-II species*
CITES Resolution Conf. 14.7 *Management of Nationally Established Export Quotas*
CITES Inf. 11.3 *Checklist to Assist in Making Non-Detriment Findings for Appendix II Exports*
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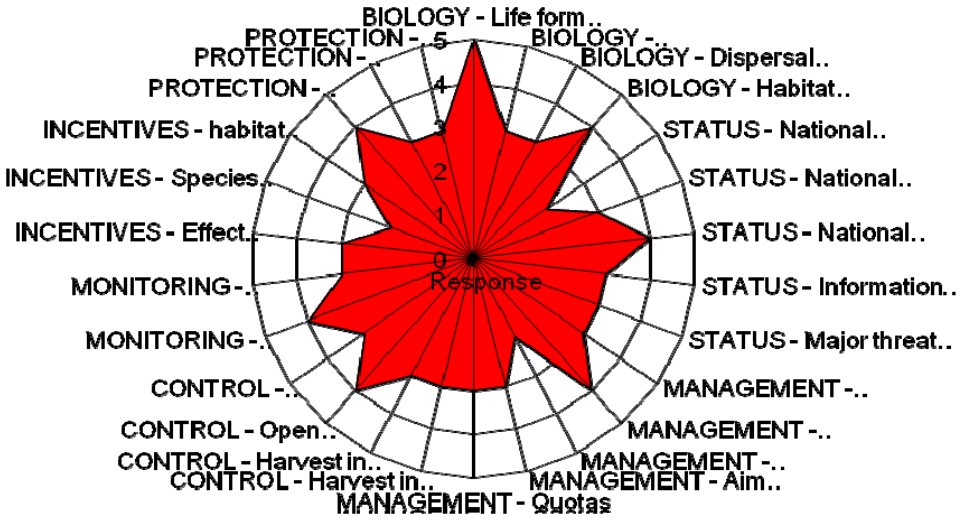
Annex 1

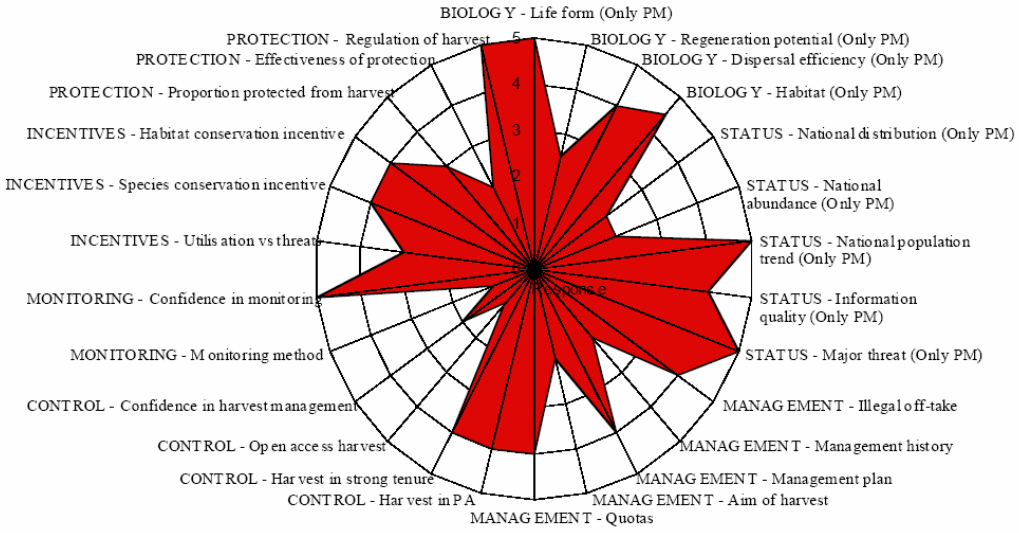
EXAMPLES OF IUCN CHECKLIST OUTPUTS FOR AGARWOOD

Figure 1 - Assessment of *Aquilaria malaccensis* in Indonesia (2003)
Plot of responses to questions to IUCN Checklist



Source: Samedi and Wiriadinata, *in litt.* to TRAFFIC Southeast Asia 2003.

Figure 2: Outcome of Working Groups, Malaysia National Workshop 2 March 2006 – Plot of responses to questions in related to agarwood-producing taxa



Note: Some of the attributed values here were referenced to a sub-national set of information (in this case Peninsular Malaysia) rather than a complete national overview.

Source: Anon. (2006a)

Annex 2

CONCEPTUAL MODELS OF RELEVANCE TO NON-DETRIMENT FINDINGS

Figure 3: Adaptive Management Model (Peters, 1994)

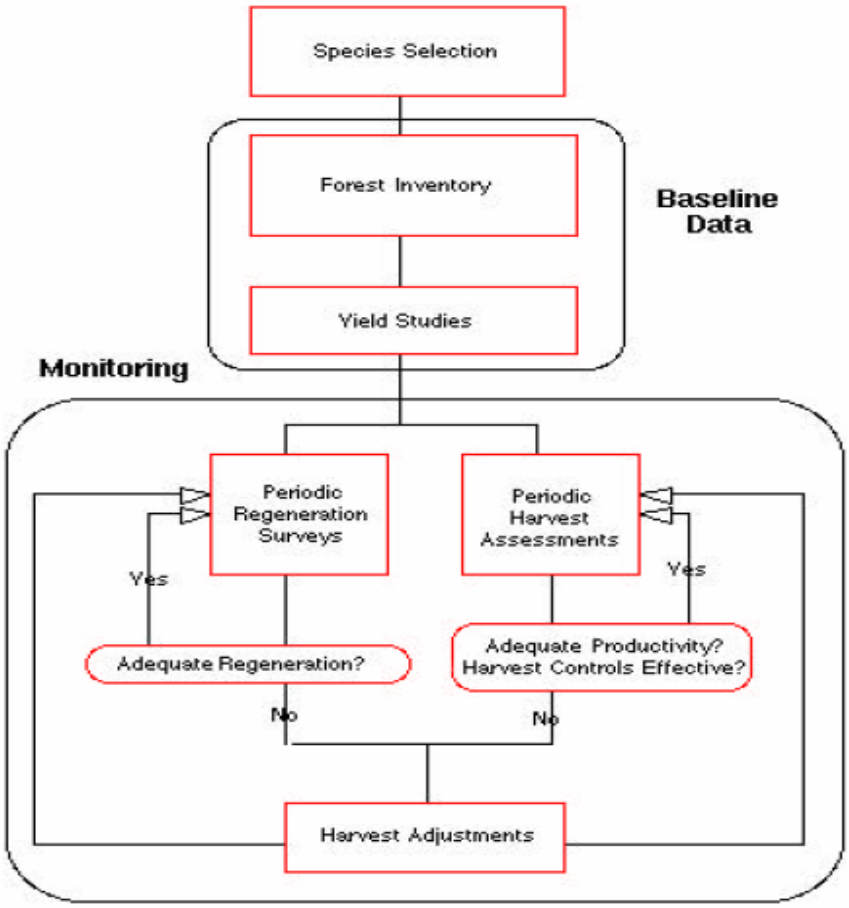
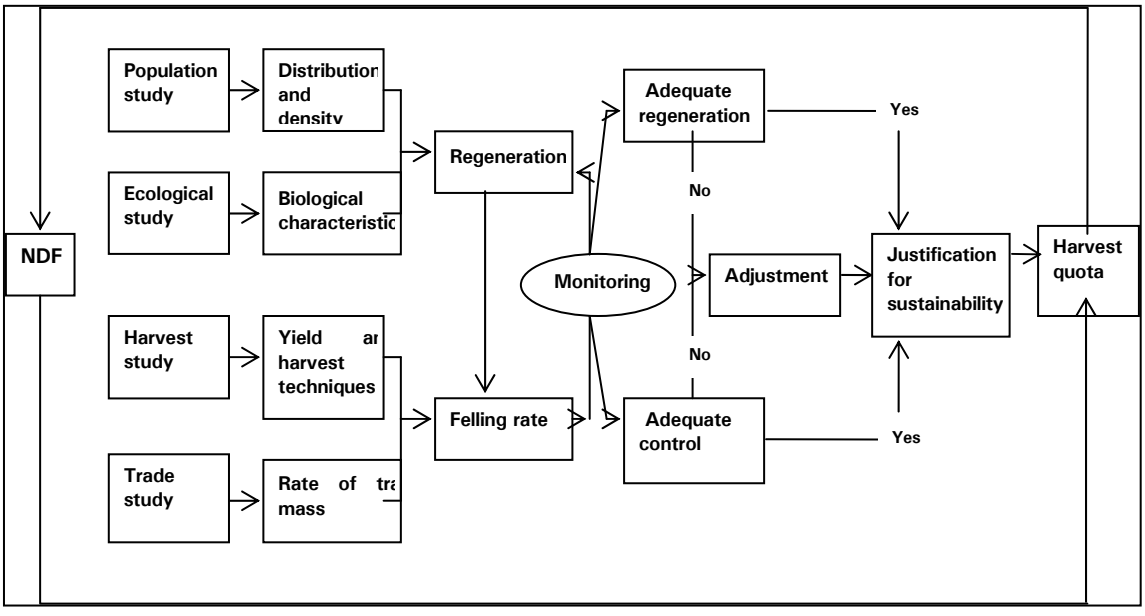


Figure 4: Schematic for assessing sustainability of harvest quota and making a NDF for agarwood (T.Soehartono *in litt. to TRAFFIC Southeast Asia,* 2006)



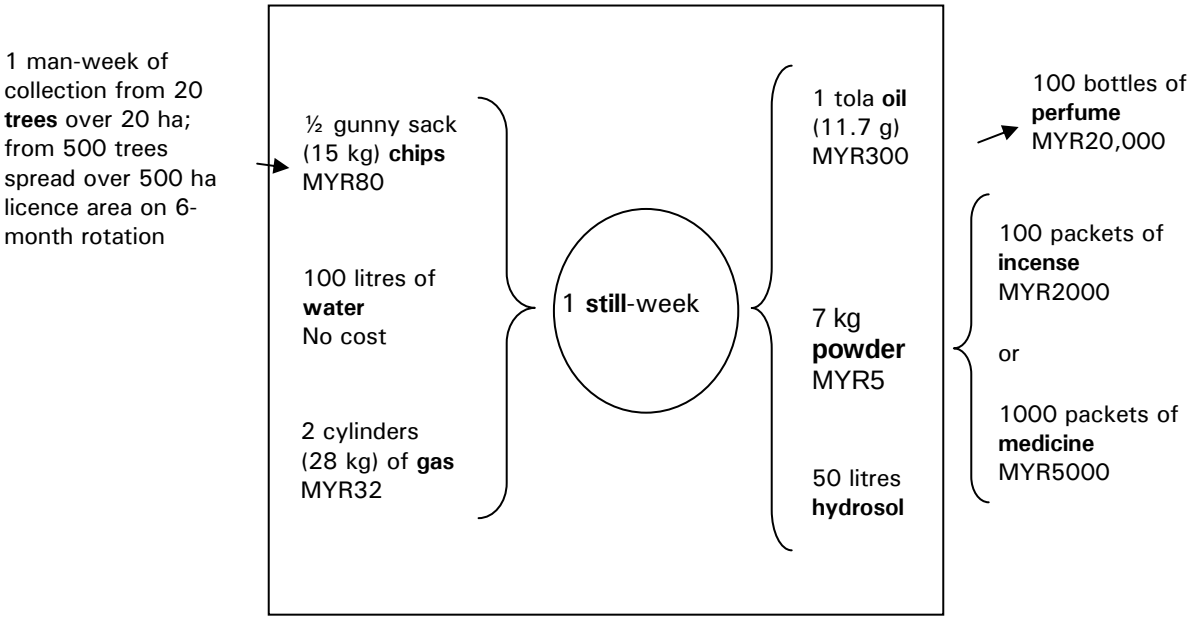
Annex 3

EXAMPLES OF CONVERSION RATES FROM TREES TO FINISHED PRODUCTS

1) Field work carried out by TRAFFIC in **Malaysia** has found that the yield from *gaharu* (agarwood) distilleries was in the order of 0.1%, i.e. roughly 1 kg of wood chips yielded 1 g of oil. However, distillation was considered a profitable enterprise as MYR1 (USD0.26) of chips could be converted into MYR3 (USD0.79) of oil (**Figure 1**).

Figure 1

Schematic diagram of the economics of *gaharu* distillation in Malaysia



MYR – Ringgit Malaysia (MYR3.8 = USD1 at 2005 rates)
Source: TRAFFIC research, Kelantan, Malaysia 2005.

2) In the United Arab Emirates, a benchmark conversion level has been set following the calculation:

To derive 6 *toulas*[23] of pure agarwood oil, 10 kg of wood is required. Therefore, to produce 1 litre of pure agarwood oil, approximately 143 kg of agarwood are used (Source: TRAFFIC research, 2006).

[23] A *toula* is a traditional unit of measurement in the markets of the Middle East (and India), approximately equal to 11.6 millilitres. Therefore, there is approximately 86 *toula* in 1 litre.