From Depleted Forest Resource to Profitable Agroforest Component

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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EX ANTE IMPACTS OF *Aquilaria spp* (*THYMELAEACEAE*) BIOTECHNOLOGY

BACKGROUND

For the past 2000 years (at least) international trade in gaharu ('agarwood' or 'eagle-wood') derived form the natural forests of Southeast Asia has been a major source of income for people living in the forest edge.

The gaharu is the source of aromatic oil used in the Middle East. Gaharu is formed inside the stem of medium-sized trees of a number of genera in response to wounding and fungal infection, often at the points where branches break of. Many trees are, after felling, found not to have any appreciable oil content, so the search for and harvest of gaharu is surrounded by mystique and ritual.

In fact there are several species and genera of trees that can produce gaharu. CITES (the Convention on the International Trade in Endangered Species of Wild Flora and Fauna) has enlisted the aromatics producing tree species *Aquilaria malaccensis* (in November 1994) and *Gyrinops spp.* and *Gonystylus spp* (in October 2004) on the CITES Appendix II list in response to the threat of over-harvesting. Indonesia has an allowable quotum for export but has, in recent years, not been able to reach this amount due to increasing scarcity of the 'non timber forest product'.
The trees as such are not difficult to propagate and grow, but the formation of the value-giving resin remained a matter of chance – until recently. A relatively simple form of biotechnology has been developed for wounding the trees with a mechanical drill and injecting a concoction of fungi into these holes. Although the gaharu formed is not yet of the highest quality and the matching of fungi * tree species (ecotype) * location is still under testing. The economic prospects of producing a product with a price of 100's of $ per kg (in stead of per m^3 as is the price of wood) is mind blowing.

Aquilaria trees are shade tolerant and can grow well as part of an agroforestry mixed canopy system. However, the new biotechnology is likely to saturate the market and lead to a crash in prices.

***Gyrinops versteegii* in agroforestry systems in West Nusa Tenggara.**

Aquilaria plantation growing under other rainforest tree species in Vietnam.

Aquilaria plantation in Thailand.

Aquilaria trees in Bhutan

RESEACRH QUESTIONS

Can we predict when this will occur?

1. What the new price level will be?
2. What this will mean for forest-dependent people who currently derive income from will gaharu?
3. What this will mean for forest conservation?
4. How the existing CITES regulation will influence these changes?

We decided to start with a literature and market review to answer these questions.

***Gyrinops versteegii* nurseries**

***Gyrinops versteegii* tree after 2 years innoculated**

Photo Credit : Robert A Blanchette
http://forestpathology.coafes.umn.edu/agarwood.htm

Cross section of *Aquilaria* sp. stem after inoculation Cultivated agarwood produced in a plantation grown tree using new techniques

Photo Credit : Robert A Blanchette
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A longitudinal section cut from an experimental tree showing the column of agarwood that formed inside the tree.

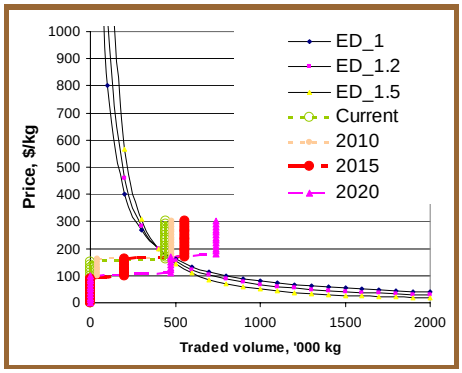
Gaharu from natural forest

Gaharu oils

EX ANTE IMPACT APPRAISAL OF NEW GAHARU TECHNOLOGY

Production systems Assumptions

	Natural forest	Agroforest + Aquilaria	Aquilaria plantation
Fraction of trees infected	0.1	0.40	0.40
Harvestable agarwood content fraction kg/kg	0.1	0.10	0.10
Sustainable harvest cycle (years)	50	35.00	12.00
Area in Indonesia, M ha	30	3.00	0.00
Search & travel time, days/ha	6	0.50	0.50
Management time, days/ harvestable tree (10 cm dbh)	0	8.00	12.00
Harvest time days/tree (for tree of 10 cm dbh)	1.5	1.00	1.00
Fraction in Quality I	0.1	0.00	0.00
Fraction in Quality II	0.4	0.20	0.20
Fraction in Quality III	0.5	0.80	0.80
Number of trees/ha, 10 ch dbh	0.447	60.00	240.00
Number of trees/ha, 20 cm dbh	0.05	20.00	150.00
Number of trees/ha, 30 cm dbh	0.0029	0.00	10.00
Number of trees/ha, 40 cm dbh	0.001	0.00	0.00
Indicators			
Harvestable & extractable oil, g/ha	**3.7**	**747.6**	**5458.3**
days of work per ha per cycle	**6.8**	**785.1**	**5773.0**
g oil day of work	**0.542**	**0.952**	**0.945**
$ per day of work at current prices	**2.5**	**4.0**	**3.9**
kg oil per habitat in Indonesia	**2205.2**	**64077.9**	**1819.4**



SUMMARY RESULTS

Under assumptions about the effectiveness of the biotechnology in turning Aquilaria trees into agarwood (Gaharu), the growthrates of the trees under plantation conditions and as understory in rubber agroforest and the potential available productipn area, we predict that domesticated production will have higher returns to labor (more g of oil produced per day of work) and that, if collection of NTFP and labour in agroforests or on plantations is paid for at the same wage rate, domesticated production will 'undercut' collection from the wild between 2010 and 2015.
At current, relatively low, effectiveness of the gaharu infection technique, the price will shift relatively little as labour cost remains the determining element.
The assumptions, on which these projections are based, however, are uncertain. A literature survey and solicitation of 'expert opinion' needs to provide a firmer basis for them.