

**REPORT ON NDF OF AGARWOOD FOR SUSTAINABILITY
HARVEST IN INDONESIA**



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ABSTRACT

The Agarwood producing species consisting of 13 species belong to 2 genera *Aquilaria* and *Gyrinops* that distributed throughout Indonesia. Four species of genus *Aquilaria*, namely *A. malaccensis*, *A. hirta*, *A. beccariana* and *A. microcarpa* are known grow in western part of Indonesia only including Sumatra and Kalimantan and the other nine species of 2 genera namely *Aquilaria cumingiana*, *A. filaria*, *Gyrinops decipiens*, *G. caudate*, *G. ladermanii*, *G. moluccana*, *G. podocarpus*, *G. salicifolia*, and *G. versteegii* are distributed in eastern part on the country. For further management and harvesting control they have been grouped into two geographical distributions that are **Malaccensis** group for species that grow in western part and **Filaria** group for species from eastern part of the country.

The flowering season of both genera *Aquilaria* and *Gyrinops* is vary between March and February as well as May to October. The flowering and fruiting periods of Agarwood producing species in Sumatra occur between August to October, although some trees fruiting and flowering in May. Meanwhile in Kalimantan, flowering and fruiting periods of Agarwood producing species occur between January to May. The flowering and fruiting periods of *Gyrinops* from West Papua between August – September, while from Celebes July – August. The knowledge of flower biology and reproductive ecology of these species is still limited.

Habitat preference of Agarwood producing species ranged from primary non-inundated rain-forests at low and medium elevation to 800 m asl. Some species also recorded grow well in peat swamp habitat. As a minor component of forest community, the Agarwood producing species associated with different tree species. These species are distributed throughout Indonesia with the vast majority of species found on Kalimantan and Sumatra. Natural distribution's exception occurs on Java and Bali only. Genus of *Aquilaria* tends to grow in western part of Indonesia, while *Gyrinops* are distributed in east Indonesia including Lesser Sunda Islands. Two species of *Aquilaria filaria* and *A. cumingiana* reported grows at east Indonesia including Celebes, north Moluccas and West Papua.

The low natural regeneration has been noted for Agarwood producing species from the literatures as well as from direct field studies. The diameter only increased 1 cm a year in average for six years observation of tree stage. The natural regeneration rate under mature trees in the primary forest is low, being only 3 – 5 juvenile per mother tree. To get more accurate field data record on dynamics population and growing stock of the Agarwood producing species, permanent sample plots and regular monitoring activities are still needed for next future studies.

Key words: *ndf*, *agarwood*, *Indonesia*, *malaccensis* and *filaria*.

I. BACKGROUND

Agarwood or gaharu is the trade name of a resinous product from the infected trees in particular genus *Aquilaria* and *Gyrinops*. Gaharu is also produced from other genera such as *Aetoxylon*, *Claoxylon*, *Enclia*, *Gonystylus* and *Wikstroemia* belong to the same family of Thymelaeaceae. However, the quality of gaharu from these genera is not good and not so marketable. The infected tree produce a rich, dark, and aromatic resin within its heartwood that is usually called agarwood, aloes wood or oudh in international and gaharu in national market (Heyne, 1925). Santoso (1996) reported that the fungus infected the trees known from genus *Fusarium*, *Baryodiplodia* and *Pythium*. Rahayu et al. (1998) also reported that seven fungus infected trees had been isolated from various locations in Indonesia *Acremonium*, *Diplodia*, *Fusarium*, *Libertella*, *Scytalidium*, *Thielaviopsis*, and *Trichoderma* trees. The use of agarwood is in various ways such as for medicine (especially in China and India), perfumes and incenses (particularly in Japan, Middle East and Arabic countries) and for insect repellent (in many countries) as well as for preservative other products and accessories (Jalaludin 1977). The trend of increasing various uses of agar wood in international market, leads to increasing exploitation of this commodity. However, most of agarwood is still gathered from the natural population, as a traditional livelihood. Consequently the natural population of the species producing agarwood have been threatened due to the over exploitation (Soehartno, 2002).

There are six species of *Aquilaria* producing agarwood that grow naturally in Indonesia namely *A. beccariana*, *A. cumingiana*, *A. filaria*, *A. hirta*, *A. malaccensis* and *A. microcarpa*. The most valuable and highest quality of Agarwood in the country so far is from the species of *A. malaccensis*. Consequently, the most threatened of agarwood producing species in Indonesia is *A. malaccensis*. Due to the difficulties in identification of agarwood produced by species traded, Indonesia initially exported all agar wood under the name *A. malaccensis*. Since 1994 agarwood has been included in Appendix II CITES under species group of *Aquilaria* spp. with Annotation #1. To control the domestic trade system, Indonesia makes different permits for specimen sources. Agarwood from eastern part of Indonesia consists of Western Papua, Moluccas and Lesser Sunda Islands are traded under name *Filaria* group that included *A. filaria*, *A. cumingiana*, *Gyrinops versteegii*, *G. moluccana*, *G. podocarpus*, *G. decipiens*, *G. salicifolia*, *G. caudate*, and *G. ladermanii*, while agarwood from western part traded under name *Malaccensis* group. The

agarwood from Malaccensis group consists of *A. malaccensis*, *A. microcarpa*, *A. beccariana* and *A. hirta*. The geographical distribution of the two groups is not overlapping; therefore this distinguished transport permit is realized to control domestic trade and quota harvest as well.

This paper presents biological information and management status of agarwood producing species in relation to the non-detriment finding implementation of agarwood trade control in Indonesia as a warranty of sustainable management system.

II. BIOLOGICAL DATA

2.1. Scientific informations

It is well known that agarwood or gaharu is the trade name of a resinous product from the infected trees in particular genus *Aquilaria* and *Gyrinops*. In Indonesia gaharu is also produced from other genera such as *Claoxylon*, *Enkleia*, *Gonystylus* and *Wikstroemia* belong to the name family of Thymelaeaceae. However, the quality of agarwood from these genera is not good and not so marketable. There are six species of *Aquilaria* producing gaharu namely *A. beccariana*, *A. cumingiana*, *A. filaria*, *A. hirta*, *A. malaccensis* and *A. microcarpa*. and seven species of *Gyrinops* namely , *Gyrinops versteegii*, *G. moluccana*, *G. podocarpus*, *G. decipiens*, *G. salicifolia*, *G. caudate* and *G. ladermanii* *G. versteegii*, *G. moluccana* and *G. decipiens* are known grow naturally in Indonesia (Ding Hou, 1960). All of these species producing agarwood are categorized as threatened species according to the IUCN Red List due to over exploitation and habitat loss as well.

2.2. Common names:

Different vernacular names are used for each species producing agarwood according to the range areas where the plants occur since this product is related to the local people livelihood.

Aquilaria malaccensis Lam.: kayu karas, gaharu (Indonesia), calabac, karas, kekaras, mengkaras (Dayak), galoop (Melayu), halim (Lampung), alim (Batak), kareh (Minang).

Aquilaria. microcarpa Baill: gaharu, karas (Indonesia.), mengkaras (Malay), hepang (Bangka), engkaras (Dayak).

Aquilaria beccariana Van Tiegh.: gaharu, merkaras, puti, gumbil.

Aquilaria hirta Ridley.: karas

Aquilaria filaria (Oken) Merrill :

Aquilaria cumingiana : giba-kolano Halmahera

Gyrinops versteegii (Gilg) Domke.: ketimunan (Lombok), ruhuwama (Sumba), seke (Flores).

Gyrinops decipiens Ding Hou: gaharu beringin

Gyrinops podocarpus (Gilg) Domke: kok koree (Asmat)

Gyrinops moluccana Boerl

Gyrinops ladermannii (Domke):

Gyrinops salicifolia (Ridl.):

2.3. Distribution

Phytogeographically, the genus of *Aquilaria* are distributed from India (Bengal and Assam) to New Guinea through Burma (Tenasserim), Indo-China (Cambodia, Annam, and CochinChina), China (Hongkong and Hainan), Malaysia, Singapore, the Philippines, and Indonesia as well. While *Gyrinops* spp. are distributed in Ceylon, Lesser Sunda Island, Celebes, Moluccas, and New Guinea.

In Indonesia, the range distribution of *Aquilaria malaccensis*, *A. beccariana*, *A. microcarpa* are in western part of the country such as Sumatra and Kalimantan; while *A. hirta* known only occur in eastern part of Sumatra and its adjacent small islands such as Bangka and Belitung (Ding Hou, 1960; Soehartono & Newton 2001). *A. filaria* and *A. cumingiana* are distributed in east Indonesia such as Celebes, Moluccas, Lesser Sunda Islands including NTB, NTT and West Papua. However, based on the herbarium collections at Herbarium Bogoriense, Botanical Division, Research Center for Biology-Indonesian Institute of Sciences, that one specimen of the last species has also been collected from Sampit, West Kalimantan. The *Gyrinops versteegii*, *G. moluccana*, *G. podocarpus*, *G. decipiens*, *G. salicifolia*, *G. caudata* and *G. ladermannii* are distributed in east Indonesia only (Ding Hou, 1960). Thus it is worthy to mention that the agarwood producing species are widespread through Indonesia. Based on export trade market there

are two groups of *Aquilaria* that separately distributed within Indonesia that are **Malaccensis** group including *A. malaccensis*, *A. beccariana* and *A. hirta* and **Filaria** group including *A. filaria*, *A. cumingiana*, *Gyrinops versteegii*, *G. moluccana*, *G. podocarpus*, *G. decipiens*, *G. salicifolia*, *G. caudate* and *G. ladermanii* (Figure 1). *Aquilaria malaccensis*, *A. beccariana* and *A. microcarpa* are identified grow in Sumatra and Kalimantan. In Kalimantan, it was recorded that the spatial distribution pattern of *Aquilaria* is clumped (Pribadi *et al.* 2006). A vegetation study of surrounding Dam in Batam Isl. recorded that they *A. hirta* and *A. malaccensis* occur as under storey with population about 5 individual per ha (Partomihardjo, 2004). Several field work from many different areas, reported that *A. malaccensis* and *A. beccariana* grow in the following areas: Muller Forest Protected Area, Central Kalimantan, Forest Research Station at Samboja, East Kalimantan, Giam Siak Sanctuary Reserve, Riau – Sumatra, Way Kambas National Park, Lampung-Sumatra as well as another conservation areas as mentioned by Zulkarnaen and Effendy (Soehartono and Mardiasuti 2002). Geographical distribution of genus *Aquilaria* and *Gyrinops* in Indonesia is given in (Annex 1). Based on spatial analysis map (overlying between herbarium collection, the latest grown check, and land cover map from 2005-2008) shown that estimation of the distribution of agarwood producing species in Indonesia still present. Because of the lack of information, estimate distribution agarwood producing species in eastern part of Indonesia is only few (Annex 2).

2.4. Biological characters

2.4.1. General Biology and Life History Characteristic

In general, the tree height of *Aquilaria* and *Gyrinops* can reach more than 40 m and 50 cm in diameter. Recent study reported that the largest individual of *A. malaccensis* is still recorded in Giam Siak, Sumatra with almost 1 m in diameter and 35 m high (Photograph 1). Both of these genera have been distinguished by the number of stamens. Ding Hou (1960) reported that *Aquilaria* has 10 stamens and *Gyrinops* has 5 stamens. Fruit of *A. cumingiana*, *A. malaccensis*, *A. microcarpa* and *Gyrinops versteegii* are obovoid or obovoid-oblong; fruit of *A. filaria* is ovoid with longitudinal

ditch in the middle of both valve; *A. beccariana* and *A. hirta* have elongate compress fruit.



Photograph 1. A mature tree of *Aquilaria malaccensis* with 98 cm in diameter grows naturally in the garden at Tasik Betung village, Riau – Sumatra. There is no seedling nor saplings appeared under this mature tree.

As a minor component of forest community, trees of Agarwood producing species have poor stocking seedlings revealed from natural regeneration. From demographic study of primary forest revealed no saplings stage was recorded within two permanent plots of primary forest at Betung Kerihun National Park, West Kalimantan (Suzuki *et al.* 2003), but data from Muller in central Kalimantan expeditions conducted by Bogor Botanic Garden reported that some seedlings and saplings have been found near mother tree. Paoli *et al.* (2001) reported that there are several seedling and sapling near adult tree, especially, in the distance 20 m.

Both *Aquilaria* and *Gyriops* have interesting dispersal modes. From their seeds which are tangle from the apex of the fruit valve, on filiform funicles, glossy dark colored and possessing tails or other aril like structure indicated for zoochorous dispersal mode (Ding Hou, 1960). However, no observation has as yet revealed more exacts data on its functioning. From its feature is no doubt to mention that for the far distant dispersal, seeds of these plants have been dispersed by birds. This phenomenon has shown by the natural population of *Aquilaria* within old traditional rubber plantations in Sumatra and Kalimantan as well. Several field studies informed

that most seedling (65%) of these species occurred within 5 m distance under the mother tree, indicating limited dispersal system.

2.4.2. Regeneration

Flowering season of agarwood producing species start at early of dry season and fruiting have occurred in the end of dry season (Ding Hou, 1960). Mulyaningsih and Yamada (2007) reported that in wild population; flowering and fruiting seasons of *Gyrinops caudate* at West Papua in August-September, while *G. decipiens* at Celebes in July-August. In West Sumatra, fruiting seasons of agarwood in April-Mei (Isnaini-personal communication). In natural population, *Aquilaria malaccensis* start to produce flower and seed at ≥ 20 cm diameter, or between 6 - 10 years after planting, are reported to produce thousands of seeds during one seasons fruiting periods. Semiadi and Wiriadinata (2008) reported that in Bengkulu at cultivation area *Aquilaria* spp. start to produce seed at 6.23 cm (STD 6.03) in diameter and the height 16.81 m (STD 1.74). Based on field survey carried out by the researcher of Indonesian Institute of Sciences, *A. beccariana* and *A. malaccensis* produce fruits since sapling stage at < 10 cm diameter. Paoli *et al.* (2001) recorded that in natural forest in Kalimantan, reproductive maturity start at approximately at 35 cm dbh. Since Soehartono and Newton, (2001a) said that the seed productions of *Aquilaria* will decline above dbh of approximately 40 cm. It was recorded that at least one thousand fruits were produced by a 10 cm in diameter individual of *A. malaccensis* planted in Bogor (Photograph 2 and 3). The number of fruit production increase accordingly with diameter growth, individual with 30 cm in diameter produce at least 3000 fruits (Partomihardjo personal communication). Seed production of *A. malaccensis* and *A. microcarpa* peaked at a dbh of approximately 40 and 50 cm respectively. At the optimum producing stage an individual tree are able to produce up to 19.000 seeds in a single season. Seed viability is about one week and germination take place between 15 – 60 days (Ng, 1992).

Recent study by Wahyuni (2008) shown that *A. microcarpa* has high potency to germinate. Fresh seed has high viability (92% in 17th days). Germination rates for

mature seeds will reach 95% to 100 % and that will show immediately within trays with high humidity environment. The growth of germinated



Photograph 2. Fruit of *A. malaccensis* of 8 years old after planting.



Photograph 3. Seedlings emerged under the mother tree

seeds rate of *Aquilaria* under the shading of mother tree in natural forest relative low due to allelopathy and other factors. Under nursery conditions, seeds of *Aquilaria* spp. germinated rapidly and a relatively high proportion of seed eventually germinated (>50%) (Soehartono and Newton, 2001a). The study of seeds storage and survival rate revealed that optimum germination and survival rate of *A. malaccensis* at four weeks both in room conditions and refrigerators (Table 1 & 2)

Table 1. Percentage of germination rate of *A. malaccensis* seeds after storage

Period of storage (week)	Air room condition (%)	Refrigerator (%)
Direct	82	-
2	69	69
4	77	69
6	56	61
8	48	24

Data sources : *Subiakto et al. (2009)*

Table 2. Percentage of survival seed (after six weeks plantation from storage test)

Period of storage (week)	Air room condition (%)	Refrigerator (%)
Direct	74	-
2	50	54
4	64	58
6	37	48
8	29	9

Data sources : *Subiakto et al. (2009)*

Patterns of seedling distribution indicate that a few seeds are distributed more than a few meters from mother's tree under the canopy shading, however light is an important factor at the early growth stage of this tree (Soehartono and Newton, 2001a). It was also reported by Paoli *et al.* (2001) that seedlings and saplings were significantly smaller near mature tree than away from that tree. Therefore, when the mature tree has been cut down, the seedling will grow better compared to that under the shading area. Study in Kalimantan by Paoli *et al.* (2001) shown there was no relation between size of mother trees and the abundance of seedlings. Further it has been mentioned that the mean seedlings density within 3-7 m of *Aquilaria* exceeded 2 individuals/m² and decreasing rapidly into <0.01 individuals/m² beyond 15 m.

2.4.3. Growth rate

There is no special study on growth rate of the agarwood producing species has been conducted for natural population. Six years diameter measurement of the 2 Ha permanent plots for forest dynamic studies in West Kalimantan, revealed that the annual growth rate for *A. malaccensis* is 0.5 cm/year (Figure 1). Diameter measurement of the planted *A. malaccensis* conducted in Bengkulu, Sumatra shown that the annual growth rate for the early stage is about 2 cm/year (Asgarin, 2004). A small plantation trial of *A. malaccensis* trees have been conducted both inside and outside the forest to obtain insight requirements of these trees in regards to soil, drainage and lights demands (Wulffraat, 2006). This study revealed that the growth rates of both height and diameter increment is fastest with the *Aquilaria* trees planted

in open areas. A mean tree height of 4.8 cm by the end of 2002 and 5.45 cm with 10.1 cm in diameter by November 2003. The mean growth rate of both height and diameter increment of *A. malaccensis* planted in five different sites has shown in Figure 2.

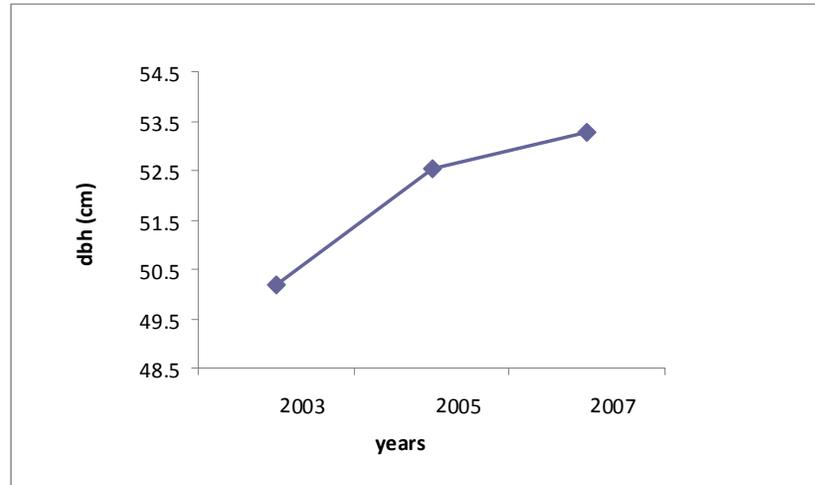


Figure 1. Growth rate curve of *A. malaccensis* from two ha permanent plots in West Kalimantan, Indonesia (After Suzuki *et. al.*, 2003).

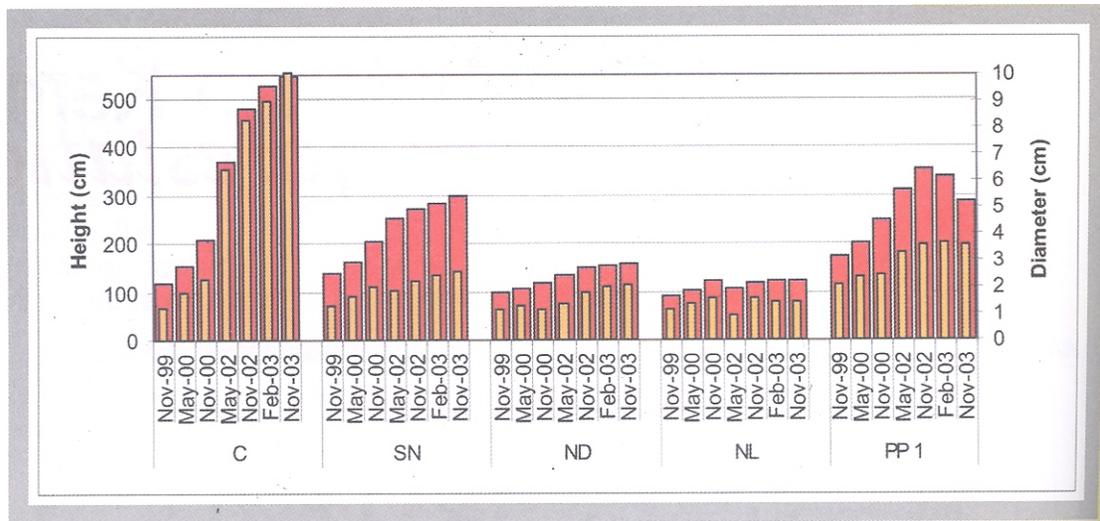


Figure 2. Mean height (outer column) and mean diameter (inner column) increment of *A. malaccensis* planted in five different sites (After Wulffraat, 2006)

2.4.4. Habitat types

In Indonesia Agarwood producing species could grows not only in primary forest but also in secondary forest. In Bengkulu (Sumatra) *Aquilaria* can be found naturally in

traditional rubber plantation (Semiadi dan Wiriadinata, 2008). Naturally, the distribution of *Aquilaria* is dispersed and relatively low density. It is typical feature of most tree species of low land rain forest of Indo-Malaya region (Whitemore, 1982, Richard, 1996). *Aquilaria* spp. common found in forest which has low and medium altitudes, some species occurring from 10 - 500 m, and often abundant in steep slopes (Ding Hou, 1960; Yamada, 1995). *Aquilaria* typically grows between altitudes of 0-850 m above sea level (asl.), in location with average daily temperature of 20-22°C (Wiriadinata, 1995). The recent study shown that in Kalimantan at burned secondary forest, *Aquilaria* grows at 45-130 m altitudes, daily temperature 26 – 33°C, humidity air 60 – 100%, slopes 0-50%, in ultisol and iseptisol with pH 6.4-7 and land humidity 10-75%. It grows rather abundant near the river bank. (Pribadi *et al.*, 2006).

Aquilaria species has adapted to live in various habitats, including podsolide soil, rocky, sandy, or calcareous, well-drained slopes and ridges and land near swamp (Wiriadinata, 1995). Keßler & Sidiyasa (1994) reported that *A. malaccensis* usually grows scattered on ridges and slope, on well drained soil, while *A. beccariana* tends to grow on the slope along the river bank and on inundated areas at swampy habitat (Partomihardjo personal communication). This species also grows well on the peat swamp forest areas. During field survey for bio-diversity assessment of peat swamp forest areas at Merang, South Sumatra, it was reported that some individuals of *A. beccariana* were flowering and fruiting although still 3 cm diameter (Partomihardjo, *et al.* 2008). Based on field observation *A. filaria* is also tend to grow along the inundated river bank areas particularly in Asmat and Mappi District, Papua (Asgarin 2007). *Gyrinops versteegii* which occurs scattered in Lombok island found in secondary forest, disturbed primary forest from lowland up to 900 m asl. Other *Gyrinops* species found in West Papua grows well in lowland primary forest.

2.4.5. Role of the species in its ecosystem

The roles of *Aquilaria* and *Gyrinops* in forest ecosystem are still not well known since most of these species were as minor component. In Sumatra the leaves of *A. malaccensis* are eaten by Rhinos. Seeds are eaten by birds while the woods are eaten by larva of beetles. As a minor component of the forest community, the present of

these species are always associated with other trees species and influence the biological process of the forest ecosystem.

2.5. Population

2.5.1. Global population size

The exact information and data of global population size in the natural habitat is uncertain because of Indonesia is a large archipelagic country. Limited information on population is available for Sumatra and Kalimantan only. The estimation of *A. malaccensis* is primarily based on the data from temporary field excursion carried out by scientist group and in combination with the national forest inventory (NFI), which is regularly conducted by the Directorate of Forestry Planning. The population of agarwood producing species in general is relatively low, since these species are known as minor component of forest community. Soehartono and Newton (2000) reported based on NFI database in Sumatra and Kalimantan that populations of *Aquilaria* spp. are ranging from 0.36 to 1.17 individuals ha⁻¹ under harvested areas. It was also mentioned that the density of those genus in Sumatra is lower than in Kalimantan. Suzuki *et al.* (2003) reported that within two ha permanent plots at Betung Kerihun National Park, West Kalimantan, it has been recorded at least 5 individuals of *A. malaccensis* with diameter ranging from 30.5 cm to 40.2 cm diameters. Wawo (2009) in his field survey noted that in Malino District, East Kalimantan the population of two species of *A. beccariana* and *A. malaccensis* trees (> 30 cm diameter) in average of 2 trees/ha and 1.5 trees/ha respectively. Based on the data population available, it has been estimated that the total growing stock of *Aquilaria* spp. in Sumatra and Kalimantan are ranging from 7753.3 to 551.6 trees (diameter > 10 cm) and 27989.5 to 2043.2 trees respectively. However, population data of *A. filaria* and *Gyrinops* spp. in natural habitat is still not known. Estimation of the population of agarwood production species in each location Indonesia at 2001-2003 presented in Annex 3.

2.5.2. Current global population trends

Within last decade, the population of agarwood is decreasing (Soehartono and Newton, 2000; Paoli *et.al* 2001). Great reduction of agarwood population is clearly seen from 1995, which was million m³ reduced to approximately one million m³ in 2002. This figure suggested by Soehartono & Mardiasuti (2002) based on the analyses data of from Directorate of Forestry Planning. Using other sources of data, it also indicated the drastic reduction in standing stock of agarwood of the natural population to only 5.6% or approximately 12 million m³ left compared with the earlier prediction of 1983. This was based on the assumption that natural forest degradation had amounted to 56% and allocated area for conservation 30%. The trader and collectors also confirm that, since then it has been very difficult to find agarwood in natural population. They believe that natural population of agarwood is decreasing due to the over exploitation. However, it must be considered that not all mature trees in natural forest produce agarwood resin. Local people will count individual of agarwood by mean of individual trees produce gaharu. Thus the healthy individuals that been left that potential as parent stocks for regeneration are may not been take into a count.

2.6. Conservation Status

2.6.1. Global conservation status (according to IUCN Red List)

VU A1cd

2.6.2. National conservation status for Indonesia

Not listed than App. II CITES

2.6.3. Main threats within Indonesia

Unsustainable harvest, habitat loss/degradation (human included).

III. SPESIES MANAGEMENT IN INDONESIA

3.1 Management Measures

3.1.1 Management history

The genus had been traded from Indonesia for the years 1500's between trader from South Sumatra, West Kalimantan and China. It was mentioned by Heyne (1995) that

agarwood has been traded from Indonesia during 1918-1925 on 16.000 kg year⁻¹. After that, the trade of agarwood was rise up, until early in 1980s the traded then reemerged. Soehartono and Newton (2001b) mentioned that agarwood exported from Indonesia annually within period 1981-1996 years was an average 46.4 tones. Since *A. malaccensis* was included into Appendix II of CITES in 1994, the export permit of those regulated by Departments of International Trades had been taken by Directorate of PHPA, Department of Forestry. LIPI as Scientific Authority will serve data about species diversity of agarwood producing taxa and their distributions, potential status and PHKA as Management Authority will set up the annual quotas based on LIPI recommendation. There were many traders and agarwood exporters and it was very complicated by PHKA to distributed the quotas to such traders. To manage the quota system apply for *A. malaccensis* among traders, in 1995 there was established of APGKI (Asosiasi Pengusaha Ekportir Gubal dan Kemedangan Gaharu Indonesia, or Indonesian Gaharu Exporter Association), fall out in 1999 and reestablished with the new name “ASGARIN” (Asosiasi Pengusaha Ekpotir Gaharu Indonesia). This association helps the PHPA to coordinate the harvest and distributing quotas among the members, and help the Scientific Authority to get information and data about gaharu commodities e.q. stock files.

The national quota system for “*A. malaccensis*” was applied for *A. malaccensis* and also for other *Aquilaria* and *Gyrinops*.

The trend of quota set was actually decreasing (Table 3) except in 2009, the value considerable increased. This conditions lead to international concern. The considerable increased in 2009 caused by accumulated stockpile particularly in the entry ports of Jakarta and Surabaya. It is presumed that there may have been an international market instability of agarwood from Indonesia or because of the unpredictability of the exact demand for agarwood at the international level. Meanwhile, the collectors in the field were not directly aware of, nor affected by international market, resulting in the continued agarwood collection, regardless of the demands. Furthermore considerable increased in **Filaria** groups caused by the production of agarwood from mud that contain 78.5 % of water.

Table 3. Trend quota of Malaccensis groups and Filaria groups

Years	Harvest quota		Actual quota		Remarks
	Malaccensis groups	Filaria groups	Malaccensis groups	Filaria groups	
1996	300,000	-	299,986	-	All exports were regarded as <i>A. malaccensis</i>
1997	300,000	-	341,497	-	All exports were regarded as <i>A. malaccensis</i>
1998	150,000		124,313		
1999	300,000		74,616		
2000	225,000		52,194		
2001	75,000	125,000	72,426	125,000	Including <i>Gyrinops</i> spp.
2002	75,000	125,000	50,000	125,000	Including <i>Gyrinops</i> spp.
2003	50,000	125,000	49,585	125,000	Including <i>Gyrinops</i> spp.
2004	50,000	125,000	50,000	124,500	Including <i>Gyrinops</i> spp.
2005	50,000	125,000	49,919	125,000	Including <i>Gyrinops</i> spp.
2006	50,000	125,000	50,000	121,505	Including <i>Gyrinops</i> spp.
2007	35,000	65,000	35,000	65,000	Including <i>Gyrinops</i> spp.
2008	30,000	60,000	30,000	60,000	Including <i>Gyrinops</i> spp.
2009	173,250	455,000	29,520	128,327	Including <i>Gyrinops</i> spp.

Source: Cites-MA

3.1.2 Purpose of the management plan in place

The purpose of management in agarwood trade market is sustainable harvest with long term conservation. To achieve optimize harvest and minimum cost of sustainable harvest from wild habitats will be done by setting quotas and monitoring population. The law enforcement is also implemented by local forest authorities. To have export permits every exporter should have at least 2 ha plantation.

3.1.3 General elements of the management plan

In Indonesia, agarwood is treated as a non timber forest product (NTFP), although the producing species is categorize as tree. Consequently harvesting system of the producing species is not subjected to the regulation imposed in the Selective Cutting System (SCS) that applied for species of timber forest product. For example, there is no cutting cycle of 35 years and no minimum diameter limit of 40 cm or 50 cm.

To manage sustainable trade of agarwood, a standard procedure by setting national harvest quota was applied since **1995**, to control and monitor harvesting regimes, processing and trade activities. In 1995 the APGKI (Indonesian Gaharu Exporter Association) was established to manage the trade system more effective, but fall out in 1999. The association was re-established in 1999 with the name of ASGARIN (Indonesian Gaharu Association). The harvest quota is set up annually and distributed to the licensee exporters under the umbrella of agarwood association based on the potential of each province that proposed by BKSDA. National quota distributed to provinces where harvesting area located. BKSDA issues permits for collecting material based on allocated quota. From these issued documented permits, BKSDA monitor harvesting activities through regular inspection of the registered middle traders pass through exporter associations (ASGARIN). This inspection undertakes to ensure that total harvested materials would not exceed the permitted. Each BKSDA office then produces official records, and reports quota to the central office (PHKA) for annual national data compilation. The national quota system for *A. malaccensis* also applied for other *Aquilaria* and *Gyrinops* too.

3.1.4 Restoration or alleviation measures

Now days, local people in Sumatra, Lombok, Java, Kalimantan tend to planted *Aquilaria* in their own gardens as shading trees. As part of the regulation by ASGARIN and KKH, exporters are also obligated to have a cultivated area of any agarwood producing species at least 2 ha/ year/ export certificate. This regulation has been implemented since 2003 with the significant success of any planting started in 1995's. Some of the senior exporters had also planting the *A. malaccensis* since 1980 under personal initiative, particularly in Riau and Bengkulu Provinces, Sumatera; Mataram (Annex 4). As part of planting the species, majority of the exporters were also conducting a germinating trial to which the seedling were then distributed to the local people as part of the local reforestation activities (Photograph 4). In Indonesia, reforestation has been the annual activities by most of the local government, where from circa 2004 agarwood trees has been part of the species being distributed is still in low percentage (<15%). Research attempt has been conducted on inoculation,

tissue culture, planting, population in traditional rubber plantation (Umboh *et al.*, 2000; Isnaini, 2003; Isnaini *et al.*, 2004, Umboh *et al.*, 2004; Isnaini *et al.*, 2005; Astuti, 2005; Bayti, 2005; Triharyanto, 2005; Toruan *et al.*, 2007; Isnaini, 2007; Santoso, 2007; Silalahi, 2007; Azwin, 2007; Novriyanti, 2008).There are several farmers and exporters that successful in cultivated agarwood (Annex 4 & Photograph 5). Therefore, it can be mentioned here that even the natural population of these species in term of infected individuals producing agarwood tend to decrease, this individual will never extinct since the healthy individuals in the natural habitat left and plantation effort has been successfully extended.

	
<p>Photograph 4. Nursery of <i>A. malaccensis</i> in Sumatra</p>	<p>Photograph 5. Stand of <i>A. malaccensis</i> for 6 years old.</p>

3.2 Monitoring System

3.2.1 Methods used to monitor harvest

As the Management Authority, Directorate General of Forest Protection and Nature Conservation (PHKA) designated and implement regulations of CITES. The provincial representative of the Management Authority i.e. Forest Protection and Nature Conservation Regional Office (BKSDA) control and enforce harvest/ collection permits, and implement quota management and monitoring for CITES-listed species within their administrative jurisdictions. National quota distributed to provinces where harvesting area located. BKSDA issues permits for collecting material based on allocated quota. From these issued documented permits, BKSDA monitor harvesting activities through regular inspection of the registered middle

traders pass through exporter companies (ASGARIN). This inspection undertakes to ensure that total harvested materials would not exceed the permitted. Each BKSDA office then produces official records, and reports quota to the central office (PHKA) for annual national data compilation. Collectors may only by cutting down or chopping the trunks that has suspected contains agarwood oil. Professional collectors usually consist of local people who have mastering in identifying and will left the healthy tree that must not contain agarwood.

3.2.2 Confidence in the use of monitoring

This monitoring methods at provincial level as mentioned in point 2.2.1. believed to be the most effective since conservation units/regional offices (BKSDA) as institution responsible for the control of wildlife trade are located in almost at all provinces in Indonesia. However, monitoring harvest in the field is difficult because the registered middle traders are actually *middlemen* traders, who employ a number of free collectors and fixed collectors to collect material. These actors are truly hard to be monitored whether against the rule or not.

3.3 Legal Framework and Law Enforcement

With the listing of agarwood in CITES Appendix II, in terms of harvest, domestic transport and export is regulated by the Directorate General of Forest Protection and Nature Conservation (PHKA) as the CITES Management Authority. This follows Decree of the Minister of Forestry Number 447/Kpts-II/2003 concerning the Administration Directive of Harvest and Capture and Distribution of the Specimens of Wild Plant and Animals Species. The annual national quota is set under this Decree by the Director General of PHKA, and the Provincial Offices of the PHKA (i.e. the BKSDA) issues harvest permits, not exceed the amounts which have been allocated as the provincial quota. Permits for domestic transport are also issued by the provincial offices in accordance with the annual quota and with reference to harvest permits.

Middle traders and exporters must be licensed and registered at the Directorate General of Forest Protection and Nature Conservation (PHKA) in order to apply CITES export permits. Currently, 27 companies are registered as agarwood exporters which are directly

under the control of ASGARIN and the CITES Management Authority. All shipments are verified and checked by the provincial office of PHKA (BKSDA) and officers posted in the designated international ports.

Any violation to this regulation is sanctioned based on the provisions of the Government Regulation No. 8 of 1999 concerning Wild Animals and Plants Species Utilization, which is the implementation of the Act No. 5 of 1990 concerning Conservation of Biological Resources and Their Ecosystems. The Government Regulation No. 8 of 1999 provides penalties for smuggling/false declaration or trade that is not in accordance with the provision of the regulation and may be liable to imprisonment (in accordance with the Customs and Excise Law) and or fines of maximum IDR 250 million (about USD 27,000).

To curtail smuggling of agarwood and other species, the Government of Indonesia has provided training (in annual basis) on CITES and wildlife law enforcement for field officers and officials of Special Police and Civil Investigator of BKSDA, Customs, Quarantine and State Police. Coordination and cooperation between CITES Management Authority and the Customs and Quarantine are in the process of formalization in the forms of MOU.

IV. UTILIZATION AND TRADE FOR INDONESIA

4.1 Type Of Use (Origin) and Destinations (Purposes)

Agarwood is used for incense, perfume, traditional medicine, religious purposes and ornamentations. In Indonesia, local people used the fiber for rope, for necklace for the baby to protect him from the bad spirit and the incense for religious purpose. Recently, agarwood widely used as perfume, medicine and aromatherapy, good decorative. Incense can be descended from powder waste of agarwood (ash) as well as for cosmetics purposes as additional material. The product are traded in variety forms ranging from whole plants (seedling), logs, chips, flakes, oil, and powder waste (ash). Middle East is the main country destination for export agarwood follow by China, Taiwan, and Singapore.

4.2 Harvest

4.2.1 Harvesting regime

Harvest technique methods of collecting agarwood from infected tree conducted 2 ways. The first is felling the infected tree and cutting away uninfected wood, and the second is chopping the bark, trunk, or even the root which was suspected contains gaharu until nearest part of inner core of the wood and leaving the main part of the trunk for live. The first technique is commonly applied at Sumatra, Kalimantan, and East Indonesia. It's called servis (dayak Iban), punctut (dayak Punan), or pahat (dayak Kenyah). Meanwhile, in East Kalimantan commonly used the second technique (called tubuk) (Soehartono and Newton, 2001b). In second techniques, we don't necessary felling tree. The chopped agarwood from the field then will be sliced for commercial purposes. Collector's asses the infected status of tree by examined the color of inert trunks, sapwood, branch before cutting away or chopping. They will leave the tree no matter binger was, when there's no contain gaharu.

The early publications on gaharu harvest data clearly explained only those that have high quality of black gaharu as the main target for any extractive gaharu exploitation (Soehartono & Mardiasuti 1997). Threes that has been cut by the collector is only to those trees that has the "smell" and production of resin and will leave behind, no matter how big the tree is, when it is considered "empty" with resin or gaharu. This is true as well as for the area in Papua. However, starting in circa 2004 the kemendangan (grade II) has a high demand in market with substantial selling price. This has lead to slightly shifting on gaharu exploitation not solely to find the gubal (grade I) but also searching for the kemendangan in Indonesia.

At Papua in 1994-1998 the exploitation of gaharu tree solely for the black gaharu harvest is the main focus and had in its peak number, particularly for Asmat and Mappi district. During that time only the black gaharu that was harvested and left behind for any remaining trunk known as kemendangan. When the kemendangan is known to have a price (1999-2003), local people than slight shifted its collection by re-visiting the old harvest area and start to collect the remaining trunk that is still un-degraded by soil and after due to its resin contents. This product is known as the main

collection in those areas. Searching the black gaharu is no longer as the priority since the vast availability of the trunk at the past harvest area. In 2004, new information came up for the gaharu expert, where in Asmat and Mappi district Papua, gaharu harvest is focus to kemendangan which were buried underneath the wet soil (mud) for years unspoiled due to its resin content (Photograph 5 and 6). BKSDA has reported that the production of gaharu from mud in 2007 (Tabel 4). Therefore for the time being the main trees of the gaharu is no longer under significant threat since the focus is no longer on cutting new tree. In the meantime the Yakohimo district has open up its area for gaharu exploitation to any exporters/traders, however due to its remote area no interest has been shown by any exporters to do so for the time being. It is believe that the population of gaharu trees in Papua is very vast if we want to study for its population. Report from the old exporters mentioned that in circa 1994-2003 each month number of black gaharu produced by the Papua area is no less than 2 ton, indicating the vast number availability of trees and production of black gaharu/tree.



Photograph 6. West Papua Agarwood production collected from decaying logs



Photograph 7. Finished product of Agarwood collected from decaying logs.



Photograph 8. Collecting Agarwood from decaying logs in West Papua by local people as a part of livelihood.

Tabel 4. Production of gaharu from wet soil (mud) at 2007 in Meurauke District Papua

Region	Estimated weight stored by local people (ton)
Kabupaten Asmat, Distrik Atsy	
Kampung Sagoni	±10
Kampung Bine	±10
Kampung Comoro	±15
Kampung Atsj	±5
Kampung Waganu	±15
Kampung Fos	±5
Kampung Bipim	50
Distrik Suator	
Kampung Jinak	±10
Kampung Waganu II	±15
Kabupaten Mappi, Distrik Eci	
Kampung Asgon	±10
Kampung Amagon	±15
Kampung Kanami	±25
TOTAL STOCK IN 2 WEEKS	±140

Field verification 2007 by Forestry District (BKSDA) Merauke

4.2.2 Harvest management control (quotas, seasons, permits, etc)

Following section 3.2.1, harvest is being control and monitored through designated quotas, registration and permits which implemented to the provincial level by the regional unit of management authority, the BKSDA.

Annual CITES quotas are set by the Directorate General of Forest Protection and Nature Conservation (PHKA) as the Management Authority based on the SA information. Due to an insufficient data of wild population at national scale, this quota system could be considered as an adaptive management response to start a harvest control mechanism. In the late-1990s, several attempts were made to derive species-specific quotas which matched approximately to the harvest in order to introduce more strictly controlled and managed harvests levels. Since the scientific information is limited, the quota is set under a very strict condition following a precautionary approach. This policy was chosen on the basis that should be done at precautionary levels without giving a zero quota which may trigger smuggling and illegal trade because of the persistent demand. The socio-economic and culture driver of the trade is an important consideration since gaharu has close related to the livelihood of local people.

Another consideration has been taken in 2005 for the quota setting process of all Indonesian species listed in Appendix II subject to export. The CITES Management Authority officers in each province proposing harvest levels appropriate to their field jurisdictions where harvesting takes place. These proposed harvesting level are then reviewed discussed further by the CITES Scientific Authority (the Indonesian Institute of Sciences/LIPI) and the Management Authority (the Directorate General of Forest Protection and Nature Conservation/PHKA). Various parameters, including environmental conditions, level of protection, level of enforcement and levels of illegal trade are determine the final annual quotas. In the process for setting the quotas, the CITES Scientific Authority inviting broad stakeholder such as expert from a wide range of disciplines, including scientists from other research organizations, universities and NGOs. Once initial quotas are set, LIPI submits this quota to PHKA that compiles the final quotas into an Annual Decree on the national totals for

allowable harvest and trade. In the final decree, the export quota is allocated approximately 90% of the harvest quota in order to accommodate domestic trade.

Following workshops in Indonesia focused on non-detriment finding methodologies in 2002, the Indonesian CITES Scientific Authority is now using the IUCN Guidelines (Rosser and Haywood, 2002) for assisting the non-detriment findings for Appendix-II exports. The quotas are based on non-detriment finding assessments as follows (Figure 3):

- In July-August every year, the BKSDA of each province provides to the Scientific Authority information or data on harvesting areas, total harvests of the previous year(s), and recommendations on likely harvest levels for the coming year. When available, the BKSDA also provides quantitative data on survey results on wild population abundance;
- In October every year, the CITES Scientific Authority organizes a workshop (consultation process) with all stakeholders, which include government agencies (research, management, trade, industry), universities, NGOs (local, national, international), and trade associations;
- Additional information is then fed into the deliberations from the workshop process, especially from individuals/originations undertaking field research, and helps to make appropriate adjustments to the quota amount that has been proposed;
- The CITES Scientific Authority may further consult with any other organization on relevant information, and there remains an 'open door' for any further unsolicited submissions to be made to the Scientific Authority;
- From the above process, LIPI as the Scientific Authority then provides recommendations on initial quota to the Management Authority, which then officially establish final Annual Quotas through a Decree of the Director General of Forest Protection and Nature Conservation;
- At this level, the Director General deliberates to receive additional information which may lead to the reduction of the quota prior to signing off on the annual checklist.

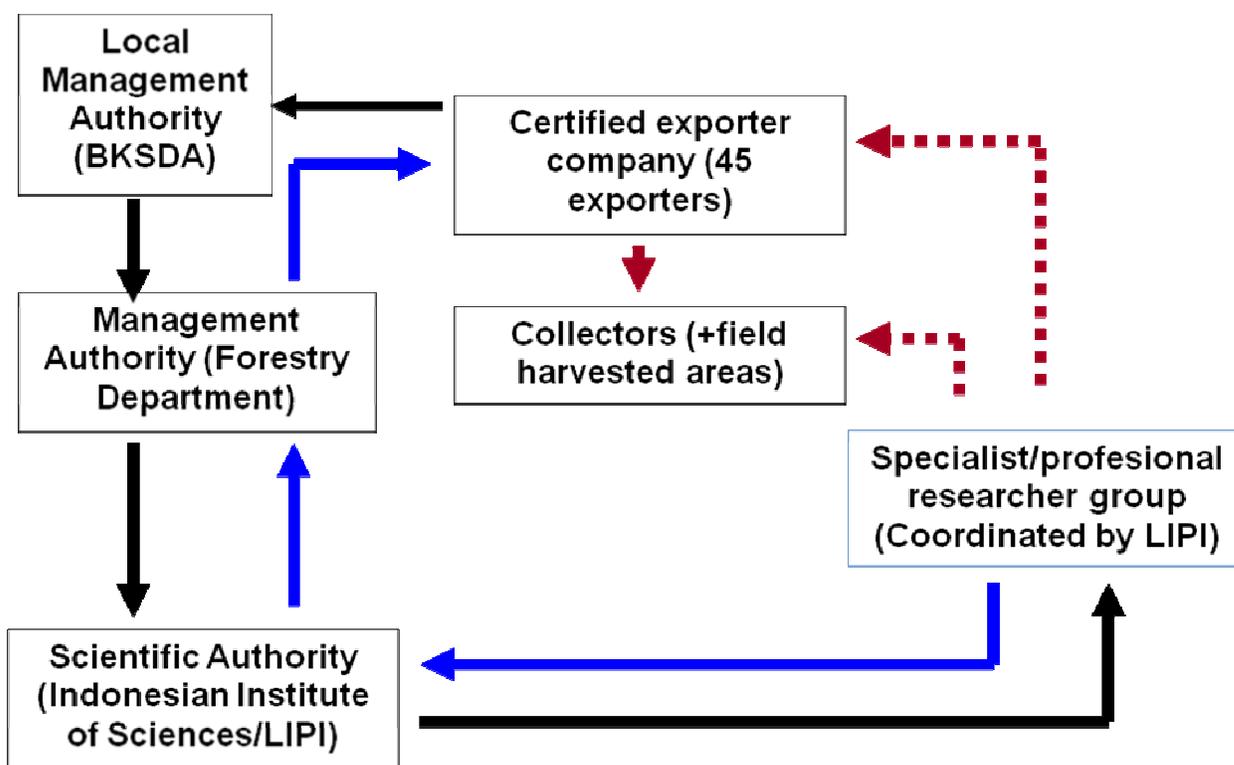


Figure 3. Procedure for determining quota of Agarwood based on Non Detriment Finding.

4.3 Legal and Illegal Trade Levels

Illegal trade was reported at 2005-2008 where the materials being collected from various places (Table 5).

Table 5. List of illegal trade in Indonesia

No.	Cases study	Location	Volume	Year
1.	to accommodate stolen gaharu in Ujung Kulon	BKSDA Ujung Kulon	2 bags	2005
2.	Kaimana Police arrest KM Putra Wakatobi which carried away gaharu and has no legal transport permits	BBKSDA PAPUA BARAT	106.156 Kg	2008
3.	owning wood without legal document	DINAS KEHUTANAN KAB. LOMBOK BARAT	24 trunks	2006
4.	Stolen of gaharu	BTN WAY KAMBAS	2 kg	2007

II. Non Detriment Finding Procedures (NDFs)

1. Is the methodology used based on the IUCN Checklist for NDFs?

Yes it is. The NDF study on agarwood producing species systematically followed IUCN Checklist of NDFs (Rosser, 2008). In the basis of the web chart is following Rosser and Heywood (2002). The following information gathering and research priorities were identified (Figure 5).

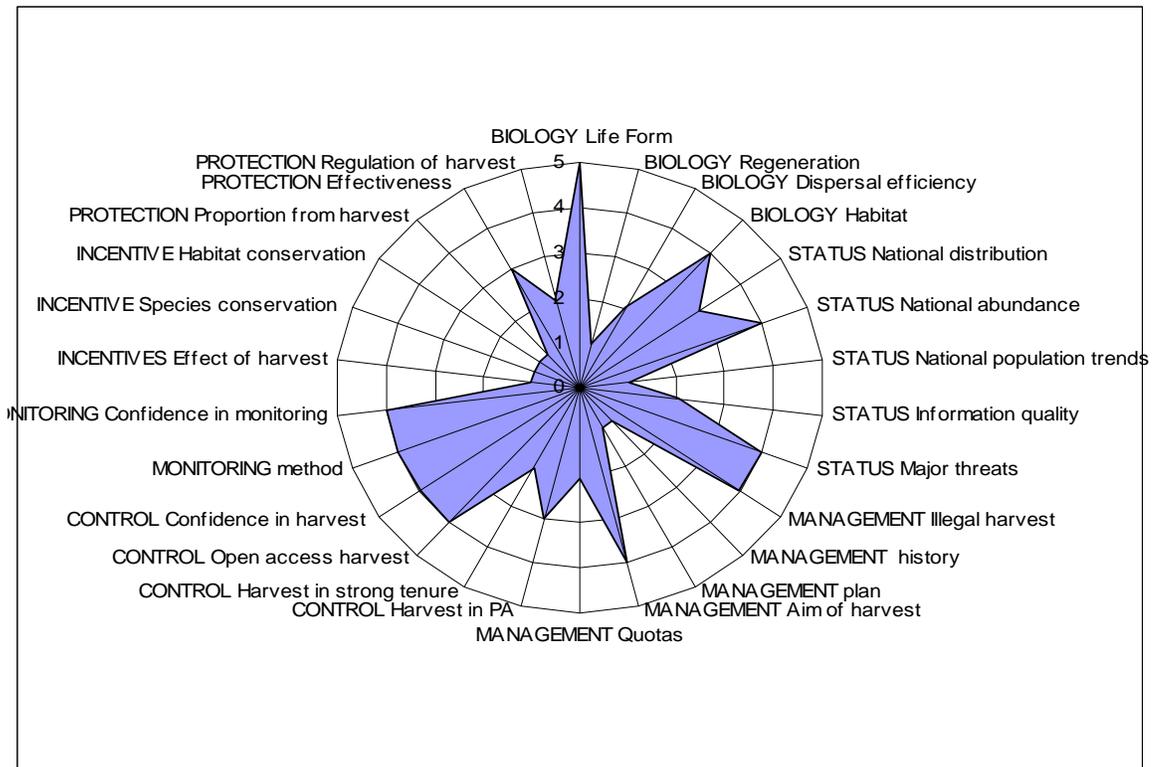


Figure 5. Spider web chart of agarwood Indonesia

2. Criteria, Parameters and/or Indicators Used. Biological Characteristics of The Species, Regulation of Harvest and Trade Statistic

Criteria, parameters, and indicators that used are:

- Distribution, biological characteristic such as population size, regeneration, growth rate, habitat types, role in ecosystem from research and data survey
- Information from regulation harvest from harvest methods and its level
- Trade statistic were source from level of export realization

3. Main Source of Data, Including Field Evaluation or Sampling Methodologies and Analysis Used

Data were gathered through research, field surveys, herbarium specimens, and reports plus interviews to the local people.

4. Evaluation of Data Quantity and Quality for the Assessment

5. Main Problems, Challenges or Difficulties Found on The Elaboration of NDF

-Very little recent information about population of agarwood especially about *filaria* and *Gyrinops*. Indonesia is an archipelago with huge cover area and require a lot of asses, monitor, and complete data for CITES interest.

-Current procedure needed to control harvesting

6. Recommendations

Surveys number must be increased in order to comply with the number of possible harvest locations. Surveys number increases also to fulfill a reliable inventorying standing stock and to extract complete biological information. Sufficient data will support a better management implementation.

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