

Field survey of agarwood cultivation at Phu Quoc Island in Vietnam

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Agarwood is one of most valuable minor forest products of tropical Southeast Asia forests. In Vietnam, considered as rich source of high quality product, agarwood is collected from heartwood of *Aquilaria crassna* (Thymelaeaceae). Continuing the survey of agarwood in Vietnam, it was carried out on plantations at Phu Quoc Island, and information about cultivation of agarwood was gathered from interview with local people. The results showed that cultivation of agarwood by islanders is increasing every year. Local plantations are based on seeds, seedlings and young *Aquilaria* trees, which grows together with other crops, for a future profit. The promotion and development of agarwood plantations would be an initiative to preserve natural *Aquilaria* trees, as well as supply the high demand for agarwood in world market.

Key words agarwood, tram, *Aquilaria crassna*, Vietnam.

Introduction

Agarwood (also known as aloeswood, eaglewood), jinko (沈香) in Japanese or tram huong in Vietnamese, literally means "incense from the wood that sinks", is a highly valuable resinous fragrant heartwood produced principally from tropical trees in the genus *Aquilaria* (Thymelaeaceae). Agarwood incense has been used for their fragrant properties for thousand years, mainly in Asia, in religious ceremonies by Buddhists. It is the main component in traditional Japanese incense ceremonies, called *kohdoh* (香道).¹⁾

Tropical Southeast Asian countries such as Cambodia, Indonesia, Malaysia and Vietnam are major countries of origin for agarwood, in which, Vietnamese tropical forest is considered to be a rich source of high quality agarwood.¹⁾ However, little is known about Vietnamese agarwood exploitation and production so far.^{2,3)}

Agarwood is a famous and valuable product in Vietnam. The production is restricted to the rare natural *Aquilaria crassna* trees, which is indigenous to the country.⁴⁾ It is now cultivated most in Phu Quoc Island and Khanh Hoa Province. In our research project on Vietnamese traditional medicine plants, we have conducted survey by interviewing local people dealing with agarwood and previously reported the status of agarwood exploitation and production in Vietnam mostly in Khanh Hoa Province. In continuing the project, this time we focus on the plantation of *Aquilaria* trees in Phu Quoc Island. Here, we would like to report our observations together with experience and knowledge of local people regarding the plantation of one of the most interesting tree of this tropical country.

Phu Quoc Island

Phu Quoc Island, literally means "Plentiful Country" in English, is located in South Vietnam, Kien Giang Province,

surrounded by the Gulf of Thailand and separated 120 km from Rach Gia city (Kien Giang province), 15 km from Cambodian border and 290 nautical miles (538 km) from Laem Chabang (Thailand). The island is 48 km in length, and 28 km across and has approximately 60,000 inhabitants. Phu Quoc has a monsoon sub-equatorial climate, with one rainy season (October) and eleven months of dry season (November to September). A total of 99 sandstone mountains rise from north to south of island, which height is below 700 meters (Figure 1A). Main products are black pepper and fish sauce.

Agarwood in Phu Quoc Island

According to the people we interviewed, Phu Quoc Island is famous for natural agarwood since ancient time due to its high quality. It is the reason that *Aquilaria* trees native to the island are always preferred for plantation not only by the islanders but also by people over the country.

In November 27th and 28th, 2004, we have visited four *Aquilaria* farms in Phu Quoc Island. In fact, the farmers cultivate other crops - black pepper, corn, fruits - together with agarwood trees, for a future high value after harvest. Indeed, according to farmers interviewed, native *Aquilaria* trees have been extensively exploited in the island forests. At the present time, only few trees remain, from which seeds are collected for plantation.

Mr. Thai Binh An, farmer in Duong To town (center of Phu Quoc Island), who started planting *Aquilaria* trees three years ago (Figure 1B). He has planted a total amount of 6000 trees, waiting for a valuable return after harvest and sell the seedlings (Figures 1C and 1D). When asked about experience in agarwood plantation, he said that all knowledge came from old men who worked as agarwood collector. He is expecting for collaboration with agricultural officers for technical support, but no technical assistance was available until now. He reported that every year in June

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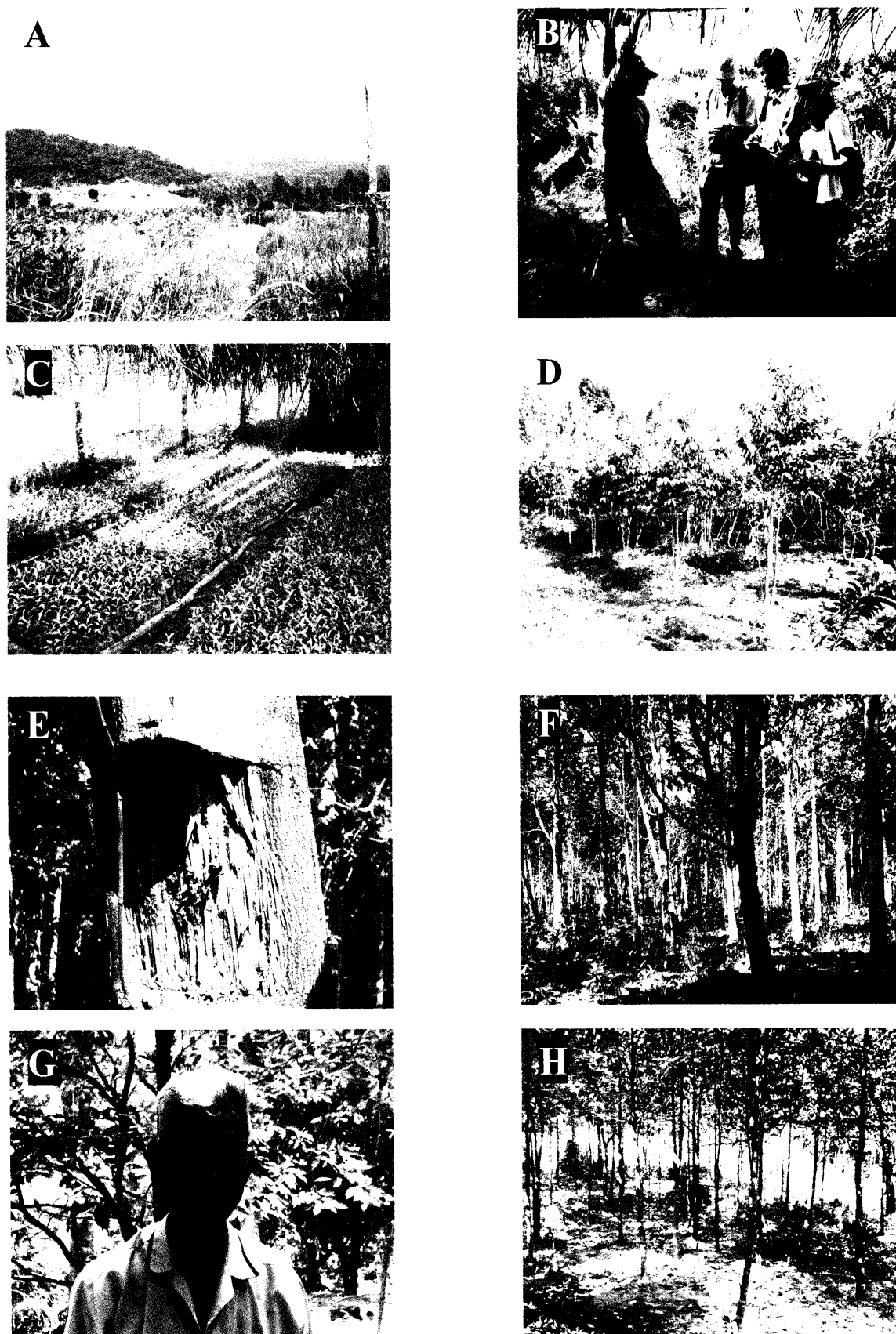


Fig. 1 (A) View of central mountain range and forests of Phu Quoc Island, from Duong To town. (B) Interview with Mr. Thai Binh An, farmer at plantation in Duong To town, Phu Quoc; (C) Cultivation of *Aquilaria* seedlings in Phu Quoc Island. (D) 3-years *Aquilaria* trees in a farm at Duong To town, Phu Quoc. (E). Agarwood tree trunk with a cut, collected for tests (Bai Thom town). (F) 10-years old *A. crassna* trees in a plantation, Bai Thom town. (G) Mr. Vo Van Tam, agarwood farmer in Bai Thom town. (H) Plantation of young agarwood trees in Bai Thom town.

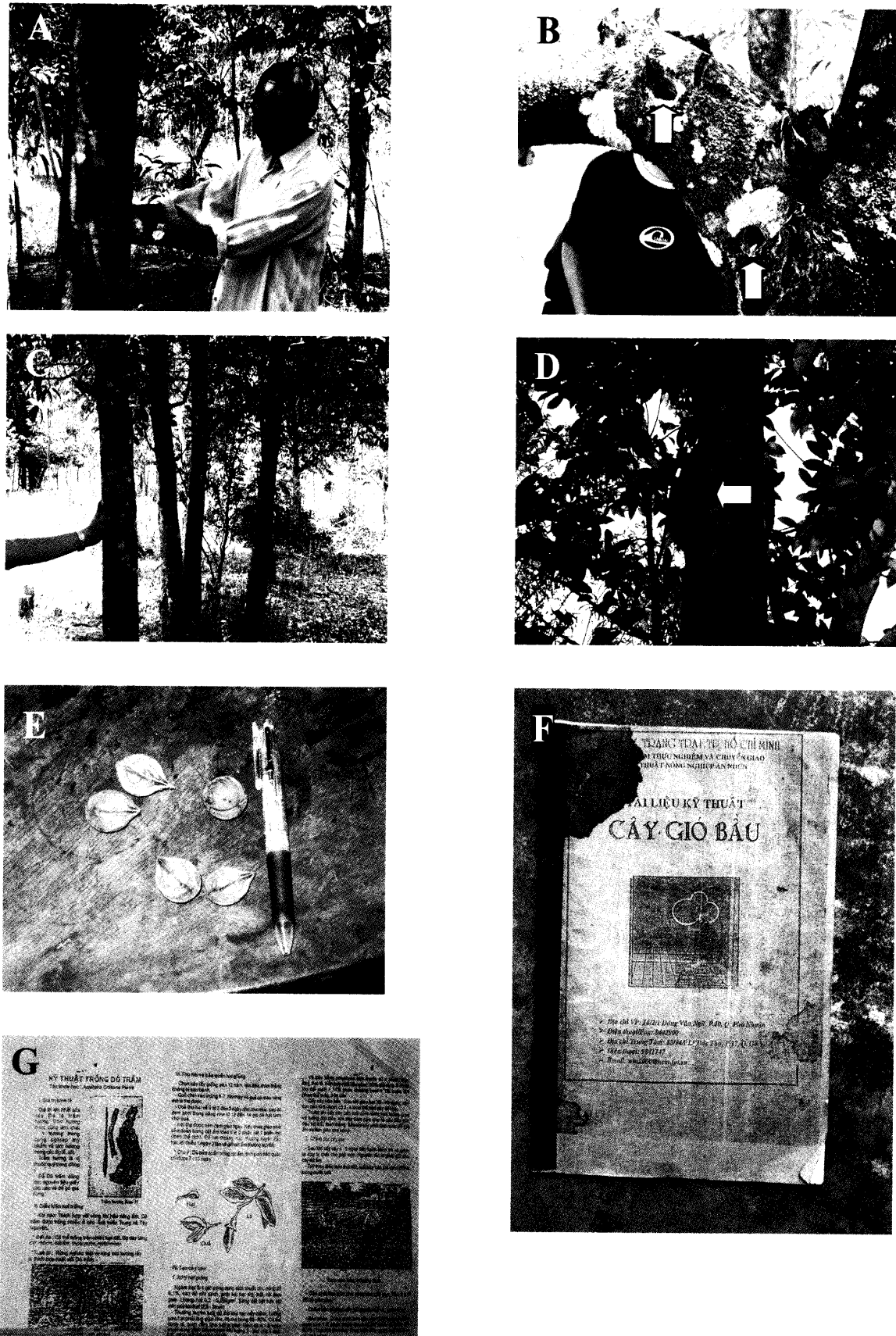


Fig. 2 (A) Mr. Nguyen Ngoc Toan, agarwood farmer at Cua Duong town, with an old *Aquilaria* tree. (B) A 9-years old *Aquilaria* tree, with two wounds (indicated by yellow arrows) - agarwood plantation, Cua Duong town. (C) Some young *Aquilaria* trees with fungi at Cua Duong farm. (D) Old agarwood tree infected by ants (nest indicated by arrow). (E) Agarwood fruit (pericarps) (F) and (G) Cover page and part of *Guideline for Agarwood Cultivation*.

and July he enters into the forest to collect seeds, although is not easy to find a living agarwood tree.

Hypotheses exists regarding agarwood formation. It is believed that agarwood is due to an immunological response of the host tree upon wound and/or infection (Figures 2B and 2D). It may be the result of pathological, wounding/pathological and/or pathological processes. To help the tree in producing agarwood, people also make wound on the trunk by slicing off the bark to expose the heartwood (Figure 1E). In the *Aquilaria* plantation field of Department of Forestry in Bai Thom town (on-route to An Thoi town, South Phu Quoc) we found a considerable number of experimental *Aquilaria* trees, most of the trees are 18-year old. The person in charge, Mr. Pham Ba Hien, reported that experiments have been conducted to test the possibility of agarwood production. The stems of the trees were injured with three to four knife-incisions along the stem. However, no conclusion was available at the time. In addition to the experimental trees, young trees and seedlings were also cultivated in this farm for commercial purpose, i.e. selling seeds and seedlings (Figure 1F).

The agarwood production have become a new economical option for many Phu Quoc islanders, as the case of Mr. Vo Van Tam, a 74-years farmer who started to plant 3000 *Aquilaria crassna* trees since 2001 (Figure 1G), as a future additional profit together with black pepper and fruits plantation. After a long time collecting seeds in forest for selling, he started to cultivate his own trees apart (Figure 1H).

Another farmer, Mr. Nguyen Ngoc Toan, 70, farmer in Cua Duong town, possessing 20-year experience on agarwood, reported that the cultivation of agarwood trees have increased in the last four years. His farm has 600 trees with the age of 8- to 9-year old (Figure 2A) and more than 5000 trees planted one year ago (Figure 2B, 2C and 2D), which was the largest *Aquilaria* farm we had visited. In his farm, the tree produces fruits three years after plantation (Figure 2E). All fruits are collected and kept or sold to farmers and cooperatives. Due to high production, Mr. Nguyen Ngoc Toan is also selling seedlings to recover the expenses, otherwise all the *Aquilaria* trees seems to be a waste.

The price for one kilogram of the native seeds was 1,000,000 VND (US\$ 65.00). Total production of the island is about 100 kg of seeds per year, which is sold all over the country, even to Laos and Cambodia. The seed contains essential oils, and it is difficult to stock for long time (maximum one month). One kilogram of seeds contains approximately 6000 seeds.

To take the seeds, people collect the yellow fruits in June to July, which contains two seeds. The fruits are peeled off for immediate sowing, or kept in wet sand for 7 to 10 days. Before sowing, the seeds are soaked in 0.1 % KMnO₄ solution for 3 to 4 hours, then, washed with water. Processed seeds can be sown at 0.20 to 0.25 kg of seeds per m² in a shaded and watered nursery. 30 - 40 days after seeding, when the buds reach 6 - 8 cm, seedlings are transferred to polyethylene plots, filled with 85% of ground, 14% of cattle manure and 1% phosphate fertilizer, well shade and

watered.⁵⁾

After 6 to 12 months, seedlings with more than 40 cm in height, and 0.35 cm in diameter can be transplanted to ground with 2 m in distance between the trees. Best transplantation time is during the rain season (October). Fertilizer is provided at least once a year. Well growing trees should bear fruits after 4 - 5 years.⁵⁾

Conclusion

Phu Quoc Island has been famous for agarwood since ancient time. However, due to extensive exploitation, especially in recent decades, natural *Aquilaria* tree almost disappeared from the forests. A campaign, promoting *Aquilaria* tree plantation and artificial agarwood formation has been started in 2001. People started the plantation in their fields together with black pepper, the main crop of the islanders. The number of the trees has been increased year after year, but little or no agarwood has been produced. Hypotheses exist regarding agarwood formation, but until now no study has provided any conclusive evidence. That is the reason why no further technical support has been provided to the farmers. What the farmers are doing in Phu Quoc Island is just keeping the trees for collect seeds and to sell seedlings.

Several actions have been made in the last ten years to preserve the *Aquilaria* trees as well as the natural resources of agarwood. Vietnamese authorities have made an important action by promoting the cultivation of new *Aquilaria* trees in Phu Quoc Island and protecting wild trees.^{1,4)} The increasing number and area of the planted trees in private sections have proved the success of the policy. People have gained experience in the plantation procedure, which has been commercialized in the island.

It is widely recognized that the cultivation of *Aquilaria* trees has based greatly on the profit of the high value of agarwood. We also showed previously that artificial plantation of *Aquilaria* trees would be an initiative to reduce the pressure on the highly demanded natural resource and to conserve *Aquilaria* stocks. However, without an understanding of the mechanism of agarwood formation, the future of the *Aquilaria* farms in Phu Quoc is still uncertain.

Finally, the initiative to preserve *Aquilaria* and to produce artificial agarwood is remarkable, even with further challenges inherent to long-term development and highly demands of agarwood. Plantations of *Aquilaria* grow along the rich and splendorous Phu Quoc Island, as a bright for future expectations for best comprehension about agarwood and the insertion to nature.

Acknowledgements

This work was supported in part by a Grant-In-Aid for International Scientific Research (No. 16406002) from the Ministry of Education, Culture, Sports, Science and Technology, Japan.

References

- 1) Barden, A., Anak, N. A., Mulliken, T., Song, M.: Vietnam. In "Heart of the Matter: Agarwood Use and Trade and CITES Implementation for *Aquilaria malaccensis*." TRAFFIC International, Cambridge, UK, pp. 41-44, 2000 Online article at: <http://www.traffic.org/news/agarwood.pdf> (accessed in August, 2005).
- 2) Soehartono, T., Newton, A. C.: Conservation and sustainable use of tropical trees in the genus *Aquilaria* II. The impact of gaharu harvesting in Indonesia. *Biological Conservation*, **97**, 29-41, 2001.
- 3) Tran, Q.L., Tran, K.Q., Kouda, K., Nguyen, N. T., Maruyama, Y., Saiki, I., Kadota, S.: A survey on agarwood in Vietnam. *J. Trad. Med.*, **20**, 124-131, 2003.
- 4) Harris, T.: *Agarwood: Is It Endangered?* Online article at: <http://www.enfleurage.com/ac-agarwood-2.html>, (accessed in October, 2004).
- 5) Department of Agriculture, Science and Technology, "Guideline for Agarwood Cultivation", Hochiminh City, pp. 1-12, 2000 (Translated from Vietnamese).

Japanese abstract

沈香は、東南アジアの熱帯雨林での貴重かつ希少な産物である。良質な沈香の資源が豊富であると考えられているベトナムでは *Aquilaria crassna* (ジンチョウゲ科) の心材から採集される。ベトナムにおける沈香の調査で、今回、Phu Quoc (フーコック) 島でのプランテーションについて実現し、地元の人々に対する面談により栽培に関する情報が得られた。その結果、島民による沈香の栽培が毎年増加していることがわかった。各地のプランテーションは、種、苗木、あるいは若木から行われており、将来の利益のために他の作物とともに育てられている。プランテーションを振興および開発することは、野生の沈香原木の保存を率先することになり、また世界市場での高い需要に対応することになるであろうと思われる。

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