

## From Shifting Cultivation to Forest Management through Agroforestry: Smallholder Damar Agroforests in West Lampung (Sumatra)

### Forest or Plantation

What immediately surprised the newcomer in Krui, capital city of the subdistrict Central Pesisir on the western coast of West Lampung district, is the importance of the forest cover in the surrounding landscape. The shallow plain occupied by well-managed irrigated rice fields is here directly followed by a beautiful high forest extending over the hills on thousands of hectares.

A closer look to the forest tree community reveals the dominance of a dipterocarp species called 'damar' (*Shorea javanica*), a resin producing tree with a fairly recognizable pattern of tapping holes extending to 4-5 m height on the trunk. With regard to that feature, and knowing the relatively high population density (about 80 persons/km<sup>2</sup>) as well as the extreme dominance of rural activities in the area, one may expect that this original forest cover is not of natural origin<sup>1</sup>.

This expectation is clearly confirmed by our studies (Mary & Michon, 1987; Michon, 1993; Torquebiau, 1984), which showed that all the forest cover surrounding Krui had been re-established by local farmers following the domestication of the damar tree some hundred years ago. As in other settlements in the area, in Pahlungan, an old village located 2 km from Krui, farmers perfectly know that the present forest cover is the result of damar and fruit tree plantations initiated by their grandparents at the end of last century, followed by their parents and now by themselves. They know that the driving force in planting damar trees, which resulted here in the original domestication of a local primary forest tree, was and is still the search for a stable source of cash income. Smallholders perfectly know the processes which resulted in the present forest cover, and they know its present benefits for their economic welfare.

### Damar Agroforest Benefits: Economy and Environment

The mature damar forest cover actually deserves the name of "agroforest": it is made up of an intimate mixture of various tree crops, managed day after day by smallholders. It is linked to the world of forestry through its structure and its ecological functions, but also through its management: natural regeneration processes in the mature agroforest are controlled by villagers and helped whenever necessary through enrichment planting, in such a way that there is no biological limitation to the duration of a fully productive mature damar agroforest. The agroforest is also linked to the world of agriculture through its productions, namely fruits, vegetables, and damar resin, which is here equivalent to rubber latex in rubber plantations.

In our inventories of the tree population in the mature damar agroforest of Pahlungan (trees over 20 cm DBH, 75 20x20 m plots), 39 tree species have been recorded, with a mean density of 245 trees/ha and a mean basal area of 33 m<sup>2</sup>/ha. These quite high figures, associated with a well-balanced diameter class distribution, add to the close structural resemblance between natural forests and mature damar agroforest managed by farmers (Wijayanto and de Foresta, unpublished report, 1992).

The tree species composition reveals three main components, each of them ensuring a different role for smallholders:

- Damar trees, with about 65 % of the tree community, are clearly dominant and represent the main source of regular cash income, through harvesting and sale of the damar "mata-kucing" resin, the main dipterocarp resin presently on the market.

- Fruit trees, with 20 to 25 % of the tree community, represent an additional but irregular source of cash income. During the season, it is not unusual to see two to three 6-ton trucks fully loaded with one of the major commercial fruits, durian (*Durio zibethinus*) or duku (*Lansium domesticum*), leaving Pahlungan for Bandar Lampung, the province capital city, or even for Jakarta. Here, as in many other places in Sumatra, the contribution of this fruit component to smallholder's economy has been increasing in recent years because of the growing importance of urban markets but also because of recent major improvements in the road network quality.

- The last component, 10 to 15 % of the tree community, is made up of wild trees which have been allowed by farmers to naturally establish and grow, either because they did not present adverse effects on planted trees, or because of interesting end uses (almost all the species concerned are known by villagers as valuable timber species). For smallholders this component mainly represents an inexhaustible source of products for household consumption (minor fruits, wild vegetables, medicinal plants, fuelwood, construction and furniture wood, bamboos and other materials).

Apart from its economic importance at household, village (in Pahlungan for instance, 70% of the annual income derives from the agroforest: Levang & Wiyono, unpublished report, 1993), subdistrict, district, province and state levels (foreign currency generation through damar resin exports), the extension of damar agroforests provides major benefits for the environment of the area because:

- Soil and water resources are protected with a natural forest cover, an especially important feature here as steep slopes prone to erosion and land-sliding dominate the landscape.

• An important part of the biodiversity usually associated to natural forest is conserved. Our inventories in damar agroforests show the preservation of hundreds of forest plants including rare epiphytes, herbs and shrubs (de Foresta, Michon & Molino, unpublished report, 1993), of at least 46 mammal species including 17 species protected by the Indonesian law (Sibuea & Herdimansyah, unpublished report, 1993), of at least 92 bird species (Thiollay, unpublished report, 1993) and of the whole soil mesofauna (Deharveng, unpublished report, 1993).

It should be emphasized that this last feature (forest biodiversity conservation) is quite unique among agricultural systems, and deserves special attention with regard to the global threats of species mass extinction in the humid tropics. Only a few agroforestry systems, which we grouped under the collective name "complex agroforestry systems"-association of a high number of components (trees as well as treeless, lianas, herbs), with a physiognomy and functioning close to those observed for natural ecosystems, either primary or secondary forests- are able to sustain both biodiversity conservation and farmers' economic needs. Another important Indonesian example of such systems is smallholder rubber agroforest (Gouyon, de Foresta, & Levang, 1993), which extends over two million ha and which at present should be considered as the most important reservoir of animal and plant forest species for Sumatra lowlands (de Foresta & Bompard, unpublished report, 1993).

### Establishment Process of Damar Agroforest

When regularly tapped, damar trees can yield resin for 30 to 50 years. However, after transplantation of damar seedlings, farmers have to wait some 15 to 20 years before the first tapping, when the tree reaches about 20 - 25 cm in diameter. This is a very long time span for smallholders, and it could represent a major economic handicap for the establishment of productive damar agroforest.

Smallholders have for long solved this major problem through the use of a well-adapted agroforestry technique, close to a classic "taungya"-like process of tree plantation (Michon & Jafarsidik, 1989). The main difference is here that farmers themselves, not the forestry services, own the trees and choose the species to be planted and managed. Damar and fruit tree seedlings are planted within young coffee or pepper or coffee/pepper stands established after rainfed rice cultivation on upland "ladang" fields<sup>2</sup>.

*Erythrina* or/and *Gliricidia* trees are also often planted in order to protect young plantations. The development of this crop mixture imitates a natural forest succession, with all its ecological benefits (soil protection, weed control, microclimate evolution in accordance with successive component needs): rainfed rice as the first grass phase, coffee/pepper as the pioneer tree phase, and damar/fruit trees associated with various wild trees as the mature phase.

For smallholders, this crop mixture is of tremendous importance as it makes up the basis of a succession of harvestable commercial products, thus reducing the unproductive time span of the plantation to some 5 to 10 years, during which the plantation is almost abandoned.

While the starting point of this original reforestation process is shifting cultivation, its end result is a definitive settling of the land use system, through the building of a permanent forest cover. Smallholder damar agroforestry system therefore represents a successful and original model of indigenous alternative to shifting cultivation.

### Damar Agroforests and Agroforestry: Future Improvement and Innovation

Damar agroforestry system, as most agricultural systems, are in constant evolution. New techniques have developed like damar nurseries instead of seedling collecting in natural forest; new species have been integrated in the establishment process such as *Gliricidia*, or in the mature agroforest such as cocoa. These innovations resulted in a constant improvement of

smallholders welfare through progressive adaptation of the damar agroforestry system.

Our research results may be used to suggest other innovations that could make the system more profitable and thus more attractive to smallholders, while preserving its environmental qualities.

The unproductive time span between plantation of damar seedlings and damar resin tapping could be further reduced through another choice of intercropped species. Cinnamon (*Cinnamomum burmanii*), rattan (*Calamus spp.*), as well as fruit trees like jengkol (*Archidendron pauciflorum*) and melinjo (*Gnetum gnemon*) for instance could begin to produce after coffee and pepper and provide important cash income until the establishment of damar tapping.

Improvement concerning the profitability of the mature agroforest could be obtained through the commercial valorization of the timber component. Villagers in the area have shown a tremendous practical know-how in silviculture and forest management; on the other side the timber potential in their agroforests is fairly high and the tree community structure is such that sustainable timber harvesting is feasible without disturbing the present functioning of the system. Timber from damar agroforest would make up an additional commercial resource, thus reducing economic risks linked to damar resin dependency and encouraging smallholders to innovate in adding valuable timber trees in the agroforest.

This innovation is already under way, with more and more local timber trees actively managed and some valuable timber species like sungkai (*Peronema canescens*) recently added into a few damar agroforest plots.

Timber production as a new role of the agroforest (our present research programme) would be of particular interest in the present framework of natural forest resource exhaustion, and could represent an important example



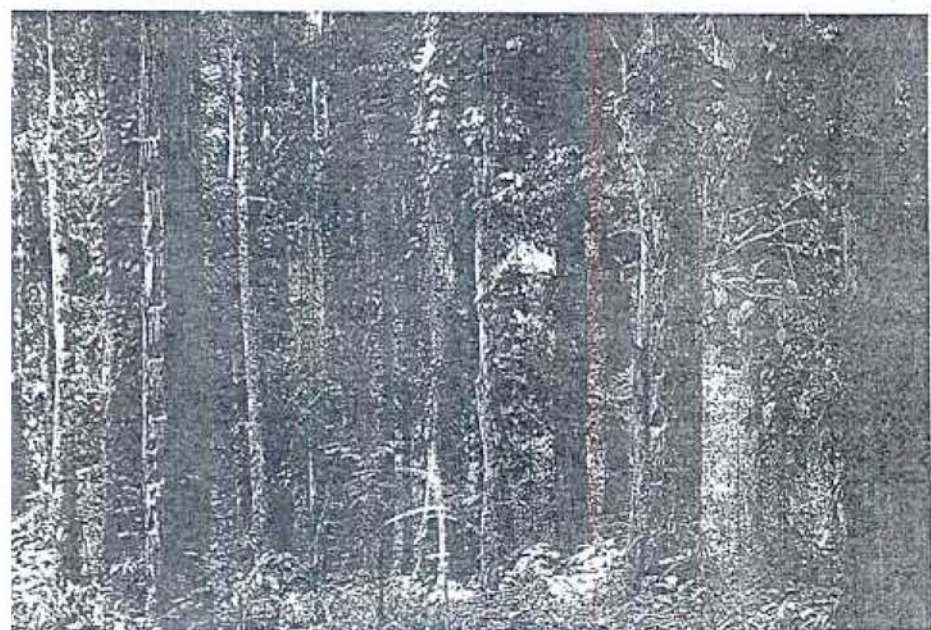
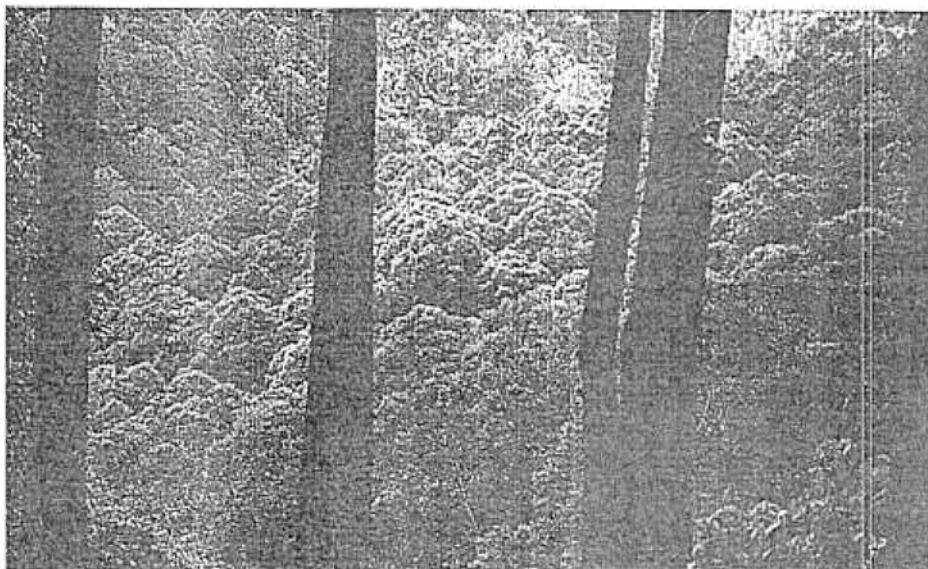
## Damar agroforests

### Krui area, Lampung Barat, Sumatra



A classic land-use pattern in Indonesia: irrigated ricefields on flatlands, village on the border, and agroforest on the hills.

The Damar agroforest, while expanding on large areas, consists of a mosaic of small (1ha) privately owned gardens, established after slashing and burning natural vegetation.



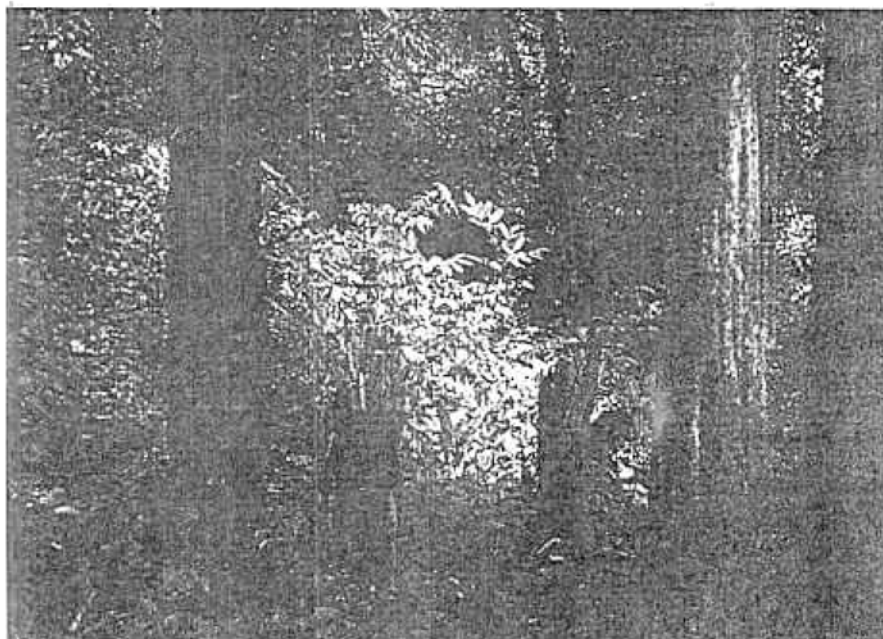
The forest-like structure of the agroforest, which allows the conservation of a large part of the natural forest biodiversity, often hampers its recognition as a profitable and productive land-use system.





Damar resin harvesting, the beginning of a long trading chain which leads to paint and varnish industries as far as Germany or Japan, provides smallholders with a regular income, equivalent to a salary.

Fruit harvesting in the agroforest, provides an important food complement. The so abundant Durian and Duku, which are exported to be sold in Jakarta, also procure important seasonal income to villagers.



The agroforest replaces the natural forest in many ways: for the villagers, it is nowadays an inexhaustible source of products which were previously harvested in the natural forest, like vegetables, fruits, medicinal plants, timber, and fuelwood.

of potential smallholder contribution to regional and national timber production (de Foresta & Michon, 1992).

Acknowledging the achievements of the damar agroforestry system with regards to local and regional economy as well as to environment, one would very logically be tempted to expand the system to other areas (de Foresta & Michon, 1993).

Although the damar system itself could be replicated *per se*, any attempt to replicate it on large areas should first consider the economic implications on the damar resin trade, as it is suspected that the damar market cannot be extended *ad infinitum*. A sudden afflux of damar resin could well have detrimental effect on the market price, which in turn could reduce the economic interest of the system, and encourage drastic changes in the management of century old damar agroforests.

Damar agroforestry system may also be considered as a model, far from conventional agroforestry models like "alley cropping" or "simple tree/crop associations". This could be of great help in designing new agroforestry systems for shifting cultivation areas or for rehabilitation of degraded land. With this perspective in mind and all other factors being favorable (secure land tenure, correct infrastructure network, presence of potential traders), the main lessons learned from damar agroforests are the importance of the association of tree species with various economic roles (regular cash income, seasonal cash income, household consumption) in the mature phase, the importance of a correct pattern of crops succession in order to reduce the unproductive time span before agroforest maturity, and the importance of land tenure as well as tree ownership and species choice, which should be left to smallholders even if outsiders can play an important role in providing advice and materials (seedlings, fertilizers). Associated with community control over radical transformations, the ownership of trees by farmers may be considered as the best incentive to increase the farmer's responsibility for agroforest management:

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<sup>1</sup> For about ten years, our team (French scientists under the French Ministry of Foreign Affairs and then under ORSTOM, the French Research Institute for Development through Cooperation, associated to LIPI, the Indonesian Institute of Science, and then to SEAMEO-BIOTROP, the Regional Center for Tropical Biology) undertook research aimed at solving this apparent contradiction between the existence of a large forest cover associated with important rural settlements in Krui area. Up to now, 43 scientific publications and reports have been produced covering a wide range of subjects linked to what we now call damar agroforests. The present paper is an attempt to summarize our main results with regards to the potential of damar agroforest as an original agroforestry model.

<sup>2</sup> This establishment process can still be observed in recently settled areas, in the northern and southern parts of the district along the coast.

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