



## Managed Forest Gardens in West Kalimantan, Indonesia

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West Kalimantan, the third largest Indonesian province on the island of Borneo, encompasses a total land area of almost 147,000 km<sup>2</sup>. Much of this land forms part of the Kapuas River watershed and lies directly on or very near to the equator (latitude 2°N to 3°S). The natural vegetation of the region is characterized by a variety of different forest types including mangroves, peat forest, freshwater swamp forest, heath forest, and lowland or hill mixed Dipterocarp forest. Some of these forests are reputed to be the oldest and most species-rich in all of Southeast Asia (1).

In spite of their extent and inherent diversity, very little is known about the forests of West Kalimantan relative to other areas of Borneo (e.g., East Kalimantan or the East Malaysian states of Sarawak and Sabah). The few floristic studies that have been conducted, however, suggest that the forests of this region are exceptionally rich in edible fruits, rattans, oil seeds, medicinal plants, resins, and other useful plant products. Leighton (2), for example, reports that the forests at Gunung Palung in the Ketapang district contain 21 species of wild mangosteen (*Garcinia* spp.), eight species of rambutan (*Nephelium* spp.), seven species of durian (*Durio* spp.), four species of mango (*Mangifera* spp.), and a host of lesser-known fruits such as rambai (*Baccaurea*; 23 species) and cempedak (*Artocarpus*; 13 species). Small tracts of forest may also exhibit a high abundance of useful plants. A 1.0 hectare plot of hill Dipterocarp forest inventoried in the Sambas district was found to contain three species of illipe nut (*Shorea* spp.), 25 species of edible fruits and nuts, 35 timber species, five species producing damar (oleo-resin) or other useful exudates, two species of rattan, three species whose leaves or bark are used medicinally, and one species used locally as a fish poison (3).

Much of the valuable germplasm growing in the forests of West Kalimantan is rapidly disappearing. Although reliable data on forest clearing are difficult to obtain, recent estimates suggest that almost 50% of the original forest land in this province has already been lost (1, 4); the destruction of lowland Dipterocarp forests and mangrove areas has been especially pronounced. Extensive logging, the establish-



ment of large-scale plantations of industrial crops, and the increasing agricultural demands of a growing rural population appear to be the major factors responsible for this alarming reduction in forest area.

Intensive timber extraction in West Kalimantan was initiated soon after the enactment of the Basic Forestry Law in 1967. By 1970, there were approximately 400,000 hectares of forest being logged (5). Currently, there are over 5.8 million hectares of timber concessions in this province; the total area of each concession averages about 92,000 hectares (6). Almost all of the local freshwater swamp and mangrove forests have been designated for logging (7). In many cases, the actual boundaries of these concessions are poorly defined and large tracts of forest reserved specifically for conservation or watershed protection are also logged. The Directorate of Forest Planning (8), for example, estimates that almost 800,000 hectares of forest concession in West Kalimantan are composed of lands that are actually designated as nature reserves, national parks, wildlife sanctuaries, or protection forests. Over the last 10 years, local concessionaires have logged an average of 1.4 million cubic meters of wood per year from the forests of this region, making it the third largest producer of sawlogs in Indonesia (9).

In theory, the Indonesian Selective Felling System (*Tebang Pilih Indonesia*, or TPI) was designed to provide a sustainable flow of wood products with minimal ecological impact on the concession areas being exploited (11). Only timber trees with a minimum diameter of 50 cm can be cut, and at least 25 merchantable trees per hectare must be left to grow until the next cutting cycle. The concessionaire is also required to mark the boundaries of the area, make inventories before and after harvest, conduct felling and skidding such that logging damage is kept to a minimum, replant logged-over stands deficient in regeneration, and submit periodic production reports to the Ministry of Forestry (11). A small, nonrefundable reforestation fee or *dana reboisasi* (approximately U.S. \$7.00 for every cubic meter of wood extracted) must also be paid to cover the costs of site rehabilitation.

In practice, the concession system in West Kalimantan, as well as in other parts of Indonesia, is plagued by frequent abuses. As an illustration of this, the Director General of Forest Exploitation recently announced that less than 20% of the 522 concession holders in the country abide by the official regulations governing timber extraction (12). One major problem is that the concessions are usually granted for 20 years, while the TPI specifies a 35-year cutting cycle. Concession holders know that they have only one opportunity to log a particular tract of forest, and there is, therefore, a strong economic incentive to extract as much timber as possible during each harvest operation. Similarly, reforestation activities are frequently viewed as an unnecessary expense because the concessionaire will be unable to harvest the timber when it is mature. Excessive logging damage is also a chronic problem. Unless properly controlled, removing as few as 10 trees/hectare from mixed Dipterocarp forest can damage over 50% of the residual trees, denude up to 30% of the soil surface, and significantly increase the rate of run-off and erosion from the site (13). In spite of the original objective of sustained-yield management, the actual result of much of the logging currently occurring in West Kalimantan has been the degradation and progressive impoverishment of local forests.

The areal extent of both government-sponsored and small-holder plantations of estate crops in West Kalimantan has also increased dramatically in recent years. Official estimates (14) indicate that over 388,000 hectares of rubber and 43,000 hectares of oil palm have been established in this province. Coconut plantations occupy 80,000 hectares, most of these planted on the extensive peat soils found



near the estuary of the Kapuas River, and plantations of pepper, cloves, coffee, and assorted citrus contribute an additional 20,000 hectares. Given that many large-scale plantations have been established in areas formerly covered by species-rich forest, the increased production of industrial crops also results in a significant net loss of biodiversity.

The spread of swidden farming (also known as shifting cultivation or slash-and-burn) is frequently cited as the most important source of deforestation in Indonesia, and one recent study (15) estimates that over 2 million hectares of land in West Kalimantan are being farmed in this manner. It is difficult to assess the degree to which this practice is actually the cause of extensive forest degradation because only a small percentage of local swidden plots or *ladang* are created in undisturbed forest. The overwhelming majority of swidden fields are made in previously farmed sites or on lands that have been logged. A small percentage (approximately 170,000 hectares) occurs on lands that have been designated nature reserves or other protected forests, but this area is considerably smaller than the extent of logging concessions in conservation areas.

The rapid expansion of logging concessions and tree plantations has caused a notable reduction in the area available to local farmers for small-scale agriculture. In response to the pressure caused by this diminishing resource base, some swidden cultivators have moved into forested areas zoned for other purposes. This movement is facilitated by the construction of logging roads. Upon arrival at a suitable site, which is frequently logged-over forest, the valuable timber remaining may be felled and sold and the plot then cleared, burned, and planted. The common perception of swidden farming as a practice that necessarily leads to the invasion of Imperata grass and severe land degradation ignores the reality of traditional swidden systems in much of West Kalimantan. While Imperata has indeed become a problem in some areas, other zones have been used by swiddeners for centuries and yet remain relatively free of the noxious weed. Many of the indigenous farmers of inland West Kalimantan employ sophisticated techniques of forest management as part of their swidden cycle. Although frequently overlooked or ignored by government officials and policy makers, these management practices appear to make a significant contribution to the conservation of biodiversity in West Kalimantan.

## CASE STUDY: TRADITIONAL SYSTEMS OF FOREST MANAGEMENT

The dozens of indigenous tribal groups found in Kalimantan are known collectively as Dayaks. Each of these groups exhibits fundamental differences in language, customary law, artistic expression, housing architecture, and social organization (16). There is also considerable variation in the traditional pattern and intensity of resource use among groups. Descriptions of Dayak resource use have frequently mentioned the practice of collecting forest products and planting tree crops. Very few studies, however, have focused on local systems for managing forest vegetation (17). An unfortunate result of this oversight is that, in most circles, Dayaks are still perceived as highly mobile, aggressive groups of slash-and-burners who live at low population densities and are, at best, indifferent resource managers. While this stereotype may indeed be valid in some limited areas of Borneo, this is certainly not an accurate portrayal of most of the Dayak groups found in West Kalimantan. Results of ongoing studies in the Sanggau district suggest that Dayaks



in this region employ a multitude of techniques to both manage and conserve the limited areas of forest under their control.

One of our study sites and the focus of this chapter lies approximately 25 kilometers north of the Kapuas River in the Balai subdistrict of Sanggau (Fig. 1). As of 1989, the population of this subdistrict was estimated at 21,206 inhabitants (18), most belonging to a previously undescribed Dayak group we have tentatively designated the Tara'n Dayak of Balai. The population density of this region is approximately 54 people per square kilometer, or more than twice the provincial average. The area is characterized by low hills of intermediate to steep topography, separated by several broad valleys and numerous small rivers and streams. The natural vegetation is hill Dipterocarp forest.

The study area of Tae, a village comprising five hamlets, extends over 1,600 hectares and supports about 88 people per square kilometer. Although mature forest is confined largely to steep hillsides and ridgetops unsuitable for cultivation, much of the area appears wooded. Patches of secondary vegetation of varying age testify to the continuing practice of swidden cultivation in the village. However, in the hamlet of Tae (one of the five hamlets that make up the village of the same name), as well as in other parts of the Balai subdistrict, land-extensive swidden cultivation is waning in favor of land-intensive wet-rice or sawah farming.



Figure 1.





Figure 2 (above). The hamlet of Tae surrounded by woodlands. What appear to be forests are actively managed forest gardens.

Figure 3 (right). A mature tembawang forest garden along a path between Tara'n Dayak hamlets.



In March 1990, for example, we found that only 19 of the 37 households in Tae hamlet farmed any swiddens at all; about half relied only on irrigated or rain-fed permanent fields for their rice crops, while the others employed various combinations of both sawah and ladang cultivation. As Tara'n Dayak farmers gradually decrease their dependence on swidden cultivation and extend and intensify their use of permanent fields, their need to clear wooded slopes diminishes. Tae hillsides are being increasingly transformed into forest gardens, managed forests, or agroforestry plots. These three principal vegetation types reflect distinct differences in the origin, management priorities, and rights of access and inheritance of each stand. In Indonesian they are known, respectively, as *tembawang*, *tanah ulat*, and *tanah usaha*.

## Tembawang Forest Gardens

The term *tembawang* refers specifically to former house sites, and many forest gardens in Tae started out as mixed plantings of fruit trees around longhouses, individual dwellings, or temporary farm huts. Tae residents report that on average they change the site of their village about every 20 years, often moving only a few hundred meters away. According to several informants, the reason for these frequent moves is that the fruit trees become too tall and start to shade the front yard, thereby eliminating the principal function of this multi-purpose area, i.e., drying rice in the sun. Rather than cut or prune the fruit trees, residents prefer to rebuild their houses elsewhere. After several centuries of residence in the Tae area, the Tara'n Dayak of Balai have created a landscape dotted with forest gardens. Contiguous areas of *tembawang* may be 10 hectares or more in size; the total area of forest gardens in Tae amounts to several hundred hectares.

Older *tembawang* contain not only planted species, but also a mixture of spontaneous vegetation that has grown up around the fruit trees. This vegetation is further enriched by the occasional planting of rubber, construction timbers, rattans, and medicinal plants. Tara'n Dayak informants cite the most casual of planting techniques as important in the formation of *tembawang*. For example, they report that many trees sprout from seeds discarded by people eating fruit as they walk through the garden. Selective wooding, particularly around durian and illipe



nut trees during harvest season to facilitate fruit collection, is an important management tool. During these weeding, the seedlings and saplings of especially valuable species will be spared while others are cut. In most tembawang, it is extremely difficult to distinguish between those trees that were intentionally planted and those that became established as volunteers and were later spared during weeding operations.

Many of these forest gardens are extremely rich in tree species. One 10 X 200 meter transect (0.2 ha) sampled in one tembawang contained 224 trees (>5.0 cm diameter at breast height (dbh)) or clumps of bamboo pertaining to 44 different species. Thirty of the species produce edible fruits or shoots. In addition to common market fruits such as durian, rambutan, langsat (*Lansium*) and mangosteen, the transect contained numerous examples of the semi-domesticated or wild relatives of these species. Sugar palms (*Arenga*), rubber trees (*Hevea*), illipe nuts (*Shorea* spp.), medicinal plants, and a variety of species useful for construction, e.g., bamboo and ironwood (*Eusideroxylon maagerii*), were also tallied. The Tara'n Dayak we interviewed in Tae claimed to have planted at least 74 species of fruit trees and they identified more than 100 different species of edible fruits in their managed forests. Although the claim is never directly made by Tae residents, it is difficult to avoid the conclusion that tembawang are consciously managed for diversity.

Many of the useful plant resources contained in these forest gardens are sold. Illipe nuts, an important source of edible oil and a major forest-product export in West Kalimantan, are routinely harvested from tembawang wherever available. Within the last 10 years, Tara'n Dayak villagers have also started marketing a large

quantity of durian fruits. During the height of durian season in 1991, more than 10,000 fruits were hauled to market (by motorcycle) from four of Tae's hamlets in a single day. Even at a minimal price of about 15 cents per fruit, the income earned by many families throughout the month-long season was substantial.



Figure 4. In the early morning a motorcycle is loaded with durians for sale in the market town of Batang Tarang.



Figure 5. Tara'n women carrying durians they have harvested in tembawang near Tae.

## Tanah Adat Forest Reserves

The second type of managed forest is termed tanah adat, or land preserved by traditional law. While these small areas of forest appear similar to tembawang, they were created in a totally different way. Tanah adat usually represents forest that was set aside many generations ago and has never been cleared. Tae hamlet has four such sites with a total area of about 12 to 13 hectares. Two of the tanah adat sites include village cemeteries.

Although traditional law prohibits the clearing of tanah adat, these



forest areas are heavily managed by the Tara'n Dayak of Balai. A variety of valuable species such as fruit trees and construction timbers are planted, while less useful trees that are interfering with useful species may be removed. The planting of durian trees to commemorate or assist the dead is a particularly common practice in the plots that serve as cemeteries. Forest composition is further enriched through periodic selective weeding at fruit harvest time. The results from a 20 X 100 meter transect sampled in tanah adat suggest that these areas are especially important as a communal source of timber for house construction. Among the 229 trees and 55 species recorded in the transect, 30 species were pointed out as valuable construction woods. Additional species of interest encountered in the forest reserve include illipe nut, rattan, sugar palm, bamboo, and a variety of different native fruits such as durian, langsung, rambai, and mentawa (*Artocarpus*). The fruits from the durian and illipe nut trees are collected and sold; most of the other plant resources found in tanah adat are destined for household use.

### Cyclic Tanah Usaha Plantings

The final category of managed vegetation in the village of Tae is referred to as tanah usaha or commercial plantings. These areas differ from the two previous types in that they are usually part of a cyclic agroforestry system wherein swidden plots planted to annual crops are gradually transformed into stands of trees. Such land management patterns have recently received considerable attention in the Latin American tropics (19). Similar cyclic shifts are apparently a common component of Bornean systems (20). The perennial crops planted by Tae swiddeners, usually rubber mixed with a varied assortment of fruit trees, are planted as the hill rice is ripening. After 30 years or so, when the rubber trees have passed their peak production and the demand for rice intensifies, these plots are cleared and burned to make ladang and the cycle is started again.

Rubber is the most important and common tree species planted in tanah usaha. Hevea seedlings were first acquired by Tara'n Dayak farmers in the late 1930s or early 1940s, and, as in many Bornean communities, this crop has provided an important income supplement to local farmers ever since (21). All of the households in Tae have substantial rubber gardens that produce a minimum of three kilograms of latex per day; carefully tended plots can yield a daily production of up to eight kilograms. It should be noted, however, that rubber is not the only commercial crop planted in tanah usaha, and many villagers have also incorporated cacao and other market fruits in their plots. Areas close to the village are often far more diverse in species, resembling tembawang in terms of the number and variety of fruit trees present. Those too far away to be conveniently harvested contain a smaller number of fruits.

### FOREST GARDENS AND THE CONSERVATION OF BIODIVERSITY

Recent literature related to the conservation of biodiversity in Indonesia cites the importance of local community involvement in development (22). This strategy represents a radical departure from the more traditional approach to forest conservation that relies heavily on patrolling, law enforcement, and the total exclusion of local communities from designated protection areas. The exact details of this community involvement have yet to be defined and surely will differ greatly



from region to region. There is general agreement, however, that the planning of conservation areas must begin to consider the activities and needs of local people, particularly boundary communities, in a participatory approach to the management and conservation of natural resources. Of particular interest is the development of appropriate management systems for these areas.

The traditional systems of forest management employed by the Tara'n Dayak of Balai would seem to be especially promising prototypes in this regard. Forest gardens are clearly less diverse than most "natural" forests (23), especially in larger animal fauna. They do, however, present significant advantages relative to more prevalent forms of land use practiced in West Kalimantan (e.g., selective logging or total forest conversion). These managed forests provide soil protection, maintain the hydrological functions of local watersheds, and offer habitat to certain, albeit limited, types of fauna. Based on the long history of this practice in Tae, forest gardens also appear to be operated on a sustained-yield basis. Perhaps their greatest importance, however, is that both *tembawang* and *tanah adat* are management systems that actually promote the *in situ* conservation of important cultivars and their wild relatives. The maintenance of genetic diversity is a cornerstone of Tara'n Dayak resource management. Instead of planting only one species of illipe nut, they plant nine. They plant commercial rambutan, yet they also favor the regeneration and growth of several wild species of *Nephelium*. Finally, the fact that managed forest gardens provide food and are an increasingly important source of both income and various subsistence products is a powerful incentive for local communities to protect and care for these areas.

In spite of these obvious ecological and economic benefits, the continued existence of the forest gardens in Tae and other Dayak communities in West Kalimantan is severely threatened. One reason for this is the inherent "invisibility" of these traditional management practices. None of the foresters or agronomists who staff provincial or regional government acknowledge that what Tae residents do should even be called forest management. *Tembawang* and *tanah adat* do not look managed. The plantings are not even-aged or evenly spaced and they appear haphazard. Spontaneous vegetation growth is not only tolerated but encouraged in these stands. Ecologically, this fostering of diversity is perhaps the most attractive feature of forest gardens. From political and economic standpoints, however, it represents tenuous middle ground. Forest gardens are viewed as far too managed for those interested in nature conservation, but not managed enough for those interested in crop production. They are dismissed by many as primitive and are easily encroached upon by development schemes for enhanced commercial production, especially monocultural plantations of oil palm or improved rubber. Given their diversity, the realization of the full commercial potential of managed forests would require the development of a wide range of processing and marketing facilities. The economic value of their genetic riches is also difficult to establish or compare to the worth of other enterprises, such as a palm oil plantation. As long as the management of diversity remains an issue of secondary importance in West Kalimantan, the traditional expertise of the Tara'n Dayak of Balai will probably continue to be overlooked and unappreciated.

Official recognition of the value of *tembawang* and other managed forests would not guarantee their continued prosperity, but would certainly lessen pressures for the substitution of monocultures in the name of "economic progress." Even more effective, however, might be programs for economically upgrading diverse stands with improved varieties of commercial species that do well under



such circumstances. The Tara'n Dayak of Balai are no different from other folk in desiring economic betterment of their region. They have eagerly adopted improvements in irrigation for rice and economically valuable species such as rubber. Agricultural advances that work within their systems of forest vegetation management would surely be embraced by these wise and innovative farmers.

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