

## Chapter 36

# Indigenous Fallow Management with *Melia azedarach* Linn. in Northern Vietnam

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Upland swidden agriculture constitutes a profound relationship between humans and nature. Countless ethnic groups in Europe, tropical Africa, the Americas, and the Asia-Pacific region have practiced it since the Neolithic era. Today, in tropical and subtropical zones, swidden agriculture still persists under a variety of names. It involves the clearing and burning of primary or secondary forest, dibbling and dropping seeds, and growing crops without fertilizer. Fields are planted with as many as five crops, over several years, before the soil loses its fertility and weed competition becomes too serious. Then the swidden is abandoned, the farmers move to a new plot, and the forest regenerates. The actual area of cultivation takes up only 15 to 20% of the cleared surface area (Cuc 1993).

Swidden agriculture has persisted primarily in tropical zones. It continues to be practiced where a fragile natural environment hinders the development of more intensive types of agriculture. Nearly 74% of Vietnam's national territory, an area covering 24.4 million hectares, can be described as "upland." Of this total, 20 million hectares has slopes greater than 15°. Nevertheless, 2.7 million hectares of this upland is classified as agricultural land and, according to one estimate, about 1.4 million hectares of it consists of currently cultivated swidden fields (NIAPP 1993). Another estimate says that the total area under shifting cultivation, including fallow areas, is about 3.5 million hectares (Sam 1994).

Many researchers have proven that a minimum standard of living for swidden cultivators can only be maintained when the population density is no more than five to ten people/km<sup>2</sup> of forest. According to Rambo (1997, 27) traditional systems of swidden agriculture in northern Vietnam are sustainable only if the population density is well under 40 persons/km<sup>2</sup>. Only when pressure on the land use is limited in this fashion can the forest still regenerate sufficiently to maintain the cycle.

The uplands of Vietnam are home to 24 million people, including almost all of the country's ethnic minorities. One 1989 estimate says that nearly 2,900,000 people, from more than 480,000 households, are engaged in shifting cultivation. What's more, 50 out of Vietnam's 54 ethnic groups practice shifting cultivation, and it is embedded in a diversity of

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traditions, customs, and cultures. For these reasons, upland areas are very prominent in any consideration of economic development and environmental protection.

Swidden cultivation can be both highly destructive to the forest and the cause of serious soil erosion. Policymakers currently view it as the single major cause of deforestation and soil erosion. This claim gains special stature in the face of an estimate by the former Ministry of Forestry that about 100,000 hectares of forest area is being lost annually in Vietnam, and about 50% of this is due to shifting cultivation. Swidden cultivation has, consequently, become the focal point of several government programs, most notably the Fixed Cultivation and Sedentarization Program. However, it is rarely recognized that there are many different types of shifting cultivation, with different scales of impact on the natural environment. A distinction can be made between migratory shifting agriculture, where whole villages move from one place to another, and sedentary shifting cultivation where only the swidden fields are rotated (Sam 1994). Apart from a few ethnic groups, most of the shifting cultivation practiced in northern Vietnam is of the sedentary variety. Swidden cultivation can also be divided into upland-based shifting cultivation and supplementary shifting cultivation (Khiem and van der Poel 1993).

Erosion rates on hilly lands in Vietnam are generally high, although there have been conflicting efforts to quantify soil losses. Some research has shown that under swidden cultivation, topsoil washes away within only two to three years (Toan 1994), whereas a study conducted by the Center for Natural Resources and Environmental Studies (CRES) in the midlands of northern Vietnam, found that soil loss under cassava monoculture amounted to between 147 and 245 tons/ha/yr, or between 0.9 and 2.1 cm of topsoil every year. This represented the loss of about 1 ton of humus, 50 kg of N, 50 kg of P, and 500 kg of K. However, the same study found that by intercropping cassava with *Tephrosia candida* or another legume species, soil loss was reduced to between 20 and 30 tons/ha/yr (Cuc 1995). Yet another case study, carried out in northwestern Vietnam by the Center for Agricultural Research and Ecological Studies (CARES), in conjunction with CRES and the East-West Center (EWC), showed that the amount of soil lost to erosion was not as great as previously suggested, even in monoculture swiddens with steep slopes of more than 45°. It found that soil loss varied from about 40 to 90 tons/ha/yr.

The CARES-CRES-EWC study also found that the balance of N, P, and K was negative for all crops, even in the first years of cultivation. In almost all cases, and with the exception of K, the nutrients available from recycled materials could not cover the combined nutrient loss from soil erosion and the export of harvested products in the first two years of swidden rice production. This finding confirmed the rationale underlying the usual indigenous practice of cultivating swiddens for no more than three to four years (Vièn 1996).<sup>3</sup>

The gradual reduction of soil fertility in swidden fields corresponds to a cyclical transition in land use. This begins with the transition from natural forest to shifting cultivation. The yield of annual crops gradually declines within a swidden cycle. The longer land is under cultivation, the greater the fertility loss and, under these conditions, swidden cultivators choose drought resistant, traditional crops that produce low but reliable yields. However, when yields fall below a certain minimum threshold, the land is fallowed<sup>4</sup> and, if sufficient land is available, there is potential for forest succession. This is the way swidden farmers intend it, because forest succession is a viable basis for the recovery of lost soil fertility. However, because of population growth, in-migration, and the creation of forest reserves and wildlife habitats, which deny use of this land to swidden farmers, there is a growing scarcity of land and swidden farmers are forced to cultivate largely infertile former forest land on a more

<sup>3</sup> Another negative effect of swidden cultivation is that growing amounts of often acid sediments are deposited on downstream irrigated fields, leading to an increasing workload for those farmers.

<sup>4</sup> In addition to the loss of soil fertility, swidden plots are also abandoned because of increasing weed growth. Weeding requirements eventually exceed available labor.

permanent basis. Fallow periods are becoming shorter and the forest is not being given the opportunity to recover. Studies and observations suggest the following main scenarios regarding fallow successions.

- When a swidden field is cleared from forest, or where good quality forest remains in surrounding areas, regeneration after cultivation of crops is rapid, and soil fertility recovers relatively quickly, usually within seven years.
- On abandoned fields where bamboo dominates the fallow succession, the vegetation cover remains arrested and converts to trees only gradually, over long time periods. However, soil under bamboo forest is relatively fertile.
- In areas where the forest has been heavily degraded and low bushes are dominant, forest rehabilitation may take 15 to 20 years.
- In areas where there is no forest left, fallowed fields are dominated by grasses with low resource requirements. For example, *Imperata cylindrica* is dominant in northwest and central Vietnam. In these areas, forest rehabilitation is very difficult.

In summary, the principal factor contributing to the sustainability of swidden agriculture is the restoration of the forest and thus the recovery of soil fertility for the next cropping rotation.

### Fallow Management in Northern Vietnam

In most cases of shifting cultivation in northern Vietnam, the duration of the fallow is now similar to the duration of cultivation. Swiddenists have found many ways of maintaining the productivity of degraded soil in their fields, and approaches to fallow management encompass an astonishing diversity of practices. This section discusses findings from our research on different fallow management practices in northern Vietnam.

First, Figure 36-1 illustrates typical cropping cycles before 1986, compared to those of the present day. Before 1986, rice was grown in swiddens for two to three years, or occasionally four. This was followed by two years of cassava cultivation and then five to ten years of fallow. Currently, rice is grown for one or two years, or occasionally three, followed by one or two years of cassava and, finally, three or four years of fallow.

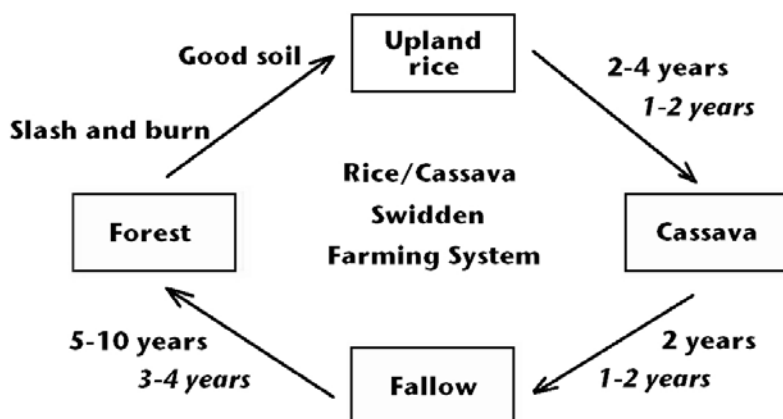


Figure 63-1. The Rice/Cassava Swidden Cycle, before 1986 and Present Day

Note: Data for the present swidden cycle are given in italics

Among the indigenous innovations aimed at improving the functions of the fallow, Dzao farmers in Moc Chau District, Son La province, have developed an interesting land classification system to restore the forest after the first crop of shifting cultivation. They have divided their fields according to their location, whether they are nearby the village, or distant, and their soil quality. The characteristics of the fields determine what will be planted, and how.

On fields located not too distant from the hamlet, and independent of their soil quality, which is usually good, farmers intercrop upland rice with trees. At the same time as they plant their first rice crop, they plant *Móc* (*Caryota urens* L), a tree that provides fiber for making conical palm hats, or *Sa nhan* (*Amomum* spp.), a medicinal tree. While the farmers maintain their successive rice crops, they also attend to the interplanted tree seedlings, which need some care in the first three years. After the rice crops, the field is abandoned for five to eight years, at the end of which the trees are harvested and a new rice swidden begins.

On fields with poor soil quality, far away from the hamlet, the Dzao plant fruit trees, including *trâu* (*Aleurites montana*) or *sờ* (*Camellia oleifera*), before the field is abandoned for forest regeneration. *Aleurites* and *Camellia* are these days less popular than they were in the past because of unstable markets and their long period of immaturity before providing a harvest. Ethnic minority groups in Yen Bai province follow a similar practice to that of the Dzao of Moc Chau, but instead plant *Cinnamomum* or ginger as preferred fallow species (see color plate 47).

In the Ngoi Lao area, many plantations supply raw material to the Bai Bang Pulp and Paper Mill. Farmers plant *Styrax* and *Manglietia* with their first swidden crops of rice, cassava, or soybeans (see color plate 43). The intercropping increases the care provided to the tree seedlings in the first two to three years, through frequent weeding and protection, and improves soil productivity. After the agricultural cropping, the fields are fallowed and the trees dominate. At eight years of age, the height of the trees is about 22 m and they have a diameter at breast height (dbh) of 19 to 20 cm, which is more than the required felling limit. The trees planted in this system can be cut two years earlier than conventional plantation trees, which are usually harvested after ten years. However, in some cases this system reduces the productivity of the agricultural crops by 14 to 20%. The best combination is *Manglietia* trees with soybean in the first year and rice in the second year. The trees are planted at a density of 2,500 per ha and later thinned to a stand density of 1,600 per ha.

### Fallow Management using *Melia azedarach* Linn

Swidden cultivators from several ethnic groups in northern Vietnam, including Muong, Tày, Thái, Cao Lan, and Dzao, incorporate *Melia* into their farming systems as an improved fallow species (see Figure 63-2).

*Melia* is very popular throughout Vietnam. It is a fast growing and deep-rooted deciduous tree whose leaves are considered a good source of green manure for use in rice paddies. *Melia* charcoal is also used to make gunpowder for hunting. The timber can be harvested seven to ten years after planting, when the dbh of the trunks is about 20 to 30 cm. The trunks are submerged for some time under deep water and, if possible, covered with mud. They are then used as high quality construction timber. Branches cut during thinning or after harvesting are used as firewood.

There are several ways of introducing *Melia* into swidden fields so that it grows to dominate fallow vegetation after the cropping phase. Seeds can be sown directly, seedlings can be transplanted, or regeneration is simply left to nature.

#### *Selection and Treatment of Seeds*

*Melia* grows and matures rapidly and the trees flower and produce fruit after just four years. However, local people select seeds only from those trees that are between five and

eight years old, have a good shape, exhibit good growth, and have a dbh of more than 15 cm. When about two thirds of the fruits have ripened, they are picked to avoid plunder by birds. Usually, they are then sorted and only those with a diameter of more than 8 mm, and a length of more than 12 mm, are selected. They are covered for a few days, then the flesh is removed and they are washed and dried in the sun for five to six days. Then they are stored in a dry place. Some farmers adopt a different procedure and delay peeling and washing the fruit until just before sowing, or otherwise soak them in water.

Each “nut” contains up to six seeds, and has a hard shell, so they must be treated with heat or warm water to stimulate germination. In the case of treatment with heat, people dig a shallow hole; lay the nuts on the bottom, cover them with dry straw or grass, and then burn it. In the case of treatment with hot water, three parts of boiling water is mixed with two parts of cold water and the nuts are soaked in this for 24 hours. During this time, the water is changed twice, and the container is packed in rice husks or straw as insulation to keep the water warm. Then the nuts are placed in a bamboo basket, covered with a jute bag, and turned and watered two to three times per day. After two to three days, depending on the weather, the nut shells begin to crack.

### Sowing

After the shells crack, the nuts are promptly sown. Sowing is avoided if the nuts are already showing sprouts, because the sprouts can easily be broken and will not withstand dryness. Some farmers, usually those with enough labor, hoe the surface of the soil before sowing.



**Figure 63-2. *Melia azedarach* Linn**

Note: 1: leaves; 2: flowers; 3: fruit. Source: Vu Van Me 1993, 29-30

If sowing is to be done under dry weather conditions, or directly into swidden fields, the heat method is usually used or the nuts are immersed in warm water and sown without further treatment. They can be expected to germinate within 15 days.

Muong swidden farmers in Hoa Binh and Thanh Hoa provinces clear the forest and sow *Melia* nuts before burning the site. The fire stimulates germination. (See color plate 42 for a comparable system in the Philippines, based on *Paraserianthes falcataria*). Later, they sow rice. The rice and *Melia*, thinned to a density of between 1,000 and 1,500 trees per ha, are tended regularly. After three rice crops, the soil productivity declines, but by then the *Melia* is well established and forms a secondary forest, often mixed with bamboo. After eight to ten years, the *Melia* and bamboo are harvested, after which the second rotation of food crops starts. During the fallow period, people have been able to harvest bamboo shoots.

In some areas, a similar taungya system is used in which *Dendrocalamus membranaceus* is interplanted with rice and corn. Then, when arable cropping is no longer possible, the *Dendrocalamus* is allowed to dominate the fallow vegetation.

### ***Seedling Cultivation***

Some farmers establish nursery gardens to raise *Melia* seedlings before transplanting them into swidden fields. The nursery beds are about 1 to 1.2 m wide, and are raised about 15 to 20 cm. The seeds are sown in rows, or holes, or are simply broadcast across the bed. If sown in holes, the distance between holes is about 40 cm, the holes are 2 to 3 cm deep, and one nut is placed into each hole. About 1 kg of nuts covers 10m<sup>2</sup>. After sowing, the nuts are covered with a thin layer of soil and straw, and are watered every day. When the seedlings reach a height of 1 to 2 cm, the straw is removed. Because each nut contains several seeds, they germinate to form a clump. When the seedlings reach 10 cm in height, they are thinned and only one or two are retained from each clump. They are weeded about once every two weeks. When the seedlings reach a height of 20 to 30 cm they are thinned again, this time retaining only the best seedling from each former clump. After five to six months, the seedlings are 40 to 50 cm high and are beginning to develop branches. The branches are pruned to improve their shape and produce a straight trunk. After about one year, when the seedlings are more than 2 m high and have a dbh of 2 to 3 cm, they are ready for transplantation into the field.

### ***Transplanting***

The transplanting season is in the spring, when the seedlings are just ready to bud, or just after buds begin to show. The *Melia* seedlings are bare-root transplanted into the swidden fields. If the main root is too long, it can be pruned, usually to about 25 to 30 cm long. The seedlings are transplanted into holes of about 40 x 40 x 40 cm, leaving a distance of about 2 m between holes, which corresponds to a density of about 2,500 to 3,000 trees/ha. If labor is in short supply, farmers may simply open the soil surface to plant the seedlings. If they are not all planted at once, the seedling roots may be placed in mud and kept for up to one week.

### ***Tending and Thinning***

In the fourth and fifth lunar months, farmers prune some branches and leaves from the *Melia* trees to prevent them being blown over in the frequent typhoons and whirlwinds at that time of year. The leaves are used as green manure in paddy fields. Although *Melia* thins itself, farmers still prune branches during the winter and spring for the first two years, usually leaving only three branches on each tree. The branches are cut close and parallel to the main trunk, but care is taken to avoid damaging the bark and risking possible fungal infection. At the same time, poorly performing trees are weeded out, while still maintaining a harvest density of 1,000 to 1,500 trees/ha.

### ***Intercropping with Yam (Dioscorea esculenta) or Rattan (Calamus tetradactylus)***

About one year after planting, when the *Melia* trees are 4 to 6 m high, with a dbh of 5 to 6 cm, farmers plant *Dioscorea* next to the *Melia*, at a distance of about 40 to 50 cm. The tubers are cut into pieces, and the pieces are either placed in lime water or their cut surfaces are covered in ash and allowed to dry before planting. Two to three pieces of *Dioscorea* are planted around each *Melia* tree, which then provides support for the climbing *Dioscorea*. However, it is prevented from climbing up into the *Melia* branches. The *Dioscorea* can be harvested nine to ten months after planting, and yields 2 to 4 kg of tubers per hole.

Dzao farmers in Yen Bai province grow rattan with *Melia*, so that the *Melia* trunks provide support for the rattan in a similar fashion to their support for *Dioscorea* in the system described above. The price of rattan, when sold in the village, has recently been about 1,200 Vietnamese Dong (VND)/ball (a ball is 5 to 6 meters long), or 1,800 VND/kg. Because of a lack of labor and unstable prices, farmers often limit their interplanting of rattan and *Melia* to rows around fields, forming barriers to prevent buffalo encroachment. The farmers can earn about 10 million VND (1997U.S.\$860) after five to eight years, when the rattan is sold.

Intercropping with *Dioscorea* or rattan depends on the availability of family labor. People generally prefer to grow yams, for the simple reason that it is a food crop. However, most swidden farmers cultivate only *Melia*.

At the harvest density described above, the volume of *Melia* wood reaches 130 to 150 m<sup>3</sup>/ha after seven to eight years. The current price of *Melia* wood is 250,000 VND/m<sup>3</sup>, so farmers can earn at least 25,000,000 VND/ha (1997U.S.\$2,143), equivalent to a rice harvest of 1.9 tons/year. If we assume that farmers harvest only half the potential volume, they still obtain an annual income equal to 1 ton of rice from swidden agriculture on the same area, and this does not include the value of the green manure applied to paddy fields or incomes derived from yams or rattan.

### ***Natural Regeneration***

In some areas, people neither sow *Melia* nor raise seedlings, but simply rely on natural regeneration after they abandon the swidden field. Because *Melia* seeds can survive in the soil for up to six or seven years, they germinate spontaneously when swidden fields are fallowed. Tay communities in Da Bac district of Hoa Binh province employ this method to establish tree fallows that are dominated by *Melia*, but which develop into mixed gardens (Rambo 1995).

## **Conclusions and Recommendations**

Swiddening is almost universally denigrated by the Vietnamese Government, and by many lowland people, as being wasteful and harmful to forests. Yet, in reality, swidden agriculture includes many complex variations, and generalization is inappropriate. There are many reasons for the persistence of shifting cultivation: some are cultural, because minority groups have a history of swiddening. Others are more practical, such as the very limited areas of paddy fields available to mountain people, their limited knowledge of wet rice cultivation, and their lack of access to higher yielding rice varieties.

The fundamental requirement of sustainable shifting cultivation is the maintenance of soil fertility. Where land is scarce, the fallow period is reduced and soil fertility declines, leading to soil degradation. Increasing population density is seen as one factor precipitating the slide from sustainability to degradation. However, in a district level study in Song Da watershed using all available records, no relationship could be traced between population density and the occurrence of shifting cultivation

(Khiem and van der Poel 1993). The same researchers also reported another interesting feature: the percentages of forest cover were not directly related to the occurrence of shifting cultivation. These figures confirm that shifting cultivation is not solely responsible for deforestation.

A total ban on shifting cultivation is now official government policy in Vietnam, but, as is obvious, it is not always enforced, and solutions for the sustainable development of agriculture on sloping lands are urgently needed. Therefore, rather than support enforcement of the ban, it might be more useful to consider alternatives. Transforming swidden practices into perennial-based farming systems appears to be a promising solution, but it is not easily achieved in a short time. Some authors have also argued that agricultural development in the uplands needs to take existing swidden systems as a starting point and apply modern agricultural science to improve their productivity.

Since the crucial issue is the shortening of fallow periods, improved management and enrichment of the fallow offers a solution to these problems. This calls for the application of indigenous knowledge in tandem with advanced techniques and sciences. There are many management practices, both indigenous and advanced, that may be suitable. For example, agroforestry models with nitrogen-fixing and multipurpose tree species hold strong promise.

As illustrated by this case study, research is needed to identify suitable ways to improve fallow husbandry using indigenous variations of fallow management. One option to be encouraged is intercropping *Melia* with legume species, providing the dual function of producing wood and improving soil fertility. However, there are some areas where *Melia* does not grow successfully. According to our research, it thrives in areas with fresh weather and humid soils derived from limestone or basal stone. If these conditions are not present, *Melia* does not develop as well.

The system of fallow management using *Melia* has been developed by ethnic minority farmers who, over many generations, have developed knowledge of *Melia* husbandry under difficult conditions. Their practices, which are successful in many communities, are a wise strategy in resource management.

We have not yet had the chance to conduct more detailed studies of the many systems discussed in this chapter, but those in which *Melia* is the preferred fallow species warrant clearer understanding. They appear promising for wider application. This observation offers an interesting research focus for the future.

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