SECONDARY FORESTS IN SWIDDEN AGRICULTURE IN THE HIGHLANDS OF THAILAND

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SCHMIDT-VOGT, D. 2001. Secondary forests in swidden agriculture in the highlands of Thailand. Swidden farming is the main agent of conversion of primary forests to secondary forests in the highlands of mainland Southeast Asia, but there is a deterioration and decline of the practice with land use intensification. The population growth in northern Thailand has forced lowland farmers practising permanent wet rice cultivation to turn to short-rotation swidden in the foot-hill zone. Highland swidden agriculturists are adopting more intensive forms of swidden or are shifting to permanent farming. This change is supported by road construction and increased marketing opportunities for temperate crops grown in the highlands. The decline of swidden farming is causing a net degradation and decrease in fallow-related secondary forest cover, with consequent losses in the biodiversity and economic potential of these forests. There exists no policy or legal framework in Thailand that allows for the preservation and sustainable legal use of these forests. Major obstacles for the development of such a framework are the prevailing assessment of secondary vegetation as degraded scrub, and a highland development policy that does not encourage forest use by local communities. The introduction of community forestry legislation is still pending. There is a need to design land use systems that integrate fallow forest management with agricultural production.

Key words: Swidden agriculture - secondary forests - forest fallows - Thailand - Vietnam - Laos - mainland Southeast Asia

SCHMIDT-VOGT, D. 2001. Hutan sekunder dalam pertanian ladang di tanah tinggi Thailand. Pertanian ladang merupakan agen utama penukaran hutan primer kepada hutan sekunder di tanah tinggi Asia Tenggara, tetapi amalan tersebut berkurangan kerana wujudnya penggunaan tanah secara intensif. Pertumbuhan penduduk di utara Thailand memaksa petani-petani tanah pamah yang mengamalkan penuaian padi sawah bertukar kepada pertanian ladang kitaran pendek di zon kaki bukit. Para petani pertanian ladang tanah tinggi menggunakan kaedah pertanian ladang yang lebih intensif ataupun beralih kepada pertanian kekal. Pengalihan ini disokong pula dengan pembinaan jalan dan peningkatan peluang pemasaran bagi tanaman iklim sederhana di tanah tinggi. Kemerosotan pertanian ladang menyebabkan pendegradan bersih dan pengurangan litupan hutan sekunder yang berkaitan bekas ladang, dengan kehilangan secara langsung biodiversiti dan potensi ekonomi hutan ini. Tidak terdapat polisi atau rangka kerja undang-undang di Thailand yang membenarkan pemeliharaan dan pengekalan penggunaan hutan ini. Halangan utama perkembangan rangka kerja tersebut ialah penilaian tanaman sekunder sebagai semak samun usang, dan polisi pembangunan tanah tinggi yang tidak menggalakkan penggunaan hutan oleh penduduk tempatan. Undang-undang perhutanan penduduk masih belum dikemukakan. Terdapat keperluan bagi mewujudkan satu sistem penggunaan tanah yang menggabungkan pengurusan hutan tanah bekas ladang dengan pengeluaran pertanian.

Swidden farming and secondary forests in the highlands of mainland Southeast Asia

Most secondary forests in the mountainous parts of mainland Southeast Asia owe their origin to swidden farming. Secondary forests are defined here as "forests regenerating largely through natural processes after significant human disturbance of the original forest vegetation at a single point in time or over an extended period, and displaying a major difference in forest structure and/or canopy species composition with respect to nearby primary forests on similar sites" (Chokkalingam *et al.* 2000). Swidden farming, practised by minority groups referred to as hill tribes or hill people, was the dominant form of land use in mainland Southeast Asia until the 1960s. This is still the case in most of this region except maybe in northern Thailand. Occupants of the lowlands only recently began to encroach into the highlands to practice supplementary swidden cultivation, using short cultivation and fallow periods that result in a severely degraded version of secondary growth dominated by thorny species.

Swidden farming as practised by upland minorities is of two types. Rotational swidden farming applies short cultivation and long fallow periods, during which swidden fallow secondary forests establish rapidly over the course of several successional stages. Swidden fallow secondary forests are defined here as "forests regenerating largely through natural processes in woody fallows of swidden agriculture for the purposes of restoring the land for cultivation again" (Chokkalingam *et al.* 2000). Pioneer swidden farming has longer cultivation periods and an irregular fallow length, which is dominated by weeds and grasses for a long time before secondary forests regenerate. In some regions, these two types of swidden farming can be correlated to specific ethnic groups and altitudinal zones. Rotational swiddening is mainly practised at intermediate elevations between 600 and 1000 m by ethnic groups that are long-time residents in comparison to more recent immigrants, who practise pioneer swiddening at altitudes above 1000 m.

Until the 1960s, there was a strong correlation between secondary forest formation on the one hand and ethnographic pattern as well as ecological zonation on the other. This correlation persists in remote parts, especially in Laos and Myanmar. In Thailand and Vietnam, swidden farming has been influenced by modern economic development, population growth, and government intervention. The changing circumstances have altered swidden farming or replaced it altogether with other land use. This influences the cover, condition and the ecological and economic functions of secondary forests.

This paper focuses on northern Thailand because more research on swidden farming has been carried out here than in other countries of the region. In addition, modernisation has progressed further in northern Thailand, with traditional swidden farming persisting in isolated areas. It is, therefore, possible to present a more comprehensive picture of the interrelations between secondary forests and swidden farming in the different ecological, political and socio-economic conditions typical for mainland Southeast Asia. After a detailed treatment of the situation in northern Thailand, conditions in Laos and Vietnam are presented in two shorter sections.

Swidden farming in northern Thailand

Santisuk (1988) concludes in his vegetation study of northern Thailand that "the development of vegetation in the northern highlands is largely the result of human pressures". These pressures resulted mainly from timber extraction and swidden farming. Swidden farming was practised by hill people and, more recently, also by lowland Thai farmers. As a result, secondary vegetation formations on swidden fallows have emerged as a major component of highland vegetation cover.

Ecological and phytogeographical background

Northern Thailand has a predominantly mountainous terrain. Mountain ranges are aligned north-south and have average elevations between 1200 and 2000 m. The northern highlands experience a monsoon climate with the characteristic alternation of rainy and dry seasons. The rainy season from May to September provides 85% of the average annual precipitation of 1203 mm. The average annual temperature of 25 to 26 °C does not vary significantly over the region, while the annual amplitude of 8 °C indicates a continental tropical climate with distinct seasonal thermal differences. Common soils are acrisols on slopes with an inclination of 20 ° to 40 °, cambisols on steeper slopes, and ferralsols on more gentle slopes or level terrain. Limestone areas feature chromic luvisols (Schmidt-Vogt 1999).

In 1998, northern Thailand had 7.3 million ha or 43.06% of the land area in forest, compared to the national average of 25.28% (RFD 1998). The 1000 m altitude marks a major dividing line between lowland forests and montane forests (Santisuk 1988). The lowland forests are composed of tropical species and include mixed deciduous forests, deciduous dipterocarp forests and seasonal rain forests. The montane forests are evergreen throughout and are composed of temperate species. Lower montane rain forest extends from 1000 m to 1800 m and is then replaced by upper montane or cloud forest.

Santisuk (1988) distinguished two types of montane secondary forest. Lower montane oak forest grows after swidden farming in lower montane rain forest. Lower montane pine-oak forest grows when repeated fires degrade such lower montane oak forest. There are no exact data as to the extent of primary and secondary forest types. The forest statistics of 1982 indicate that tropical evergreen forests comprise 2.6 million ha, or 29.14% of the forest cover of northern Thailand. This includes all evergreen montane forests and a fraction of seasonal rain forests. The larger portion of montane evergreen forests is secondary forest. In addition 84 600 ha or 0.96% of the land area is scrub forest (RFD 1998), which could be anything from early swidden fallow secondary vegetation to degraded woody vegetation on supplementary swiddening land or degraded vegetation not related to swiddening.

Historical and anthropological background

In northern Thailand, as in all other countries of mainland Southeast Asia, the lowlands were occupied by the ruling ethnic majority, in this case the northern Thai or the *Khon muang*. The highlands were dominated by the ethnic minorities. Immigrant peoples include long-established residents who settled in the lower and intermediate elevations from 700 to 1000 m between 200 and 800 years ago. Later arrivals entered northern Thailand around the end of the 19th century and occupied elevations above 1000 m. More recent migratory processes obscure this 'classic' distribution pattern.

The long-established resident groups are the *Lawa*, the *H'tin*, the *Khmu* and the *Karen*. The *Karen*, the largest ethnic group in northern Thailand, constitute almost 50% of its minority population. They live in a continuous area in the west, along the Thai-Burmese border. The *Lawa* is one of the smallest groups numbering 17 346 people in 1995 (Schliesinger 2000). They are the most ancient inhabitants of the northern highlands and mostly live in a cluster of villages near the town of Mae Sariang in the western part of northern Thailand. The *H'tin* and the *Khmu* live along the Thai-Laos border in the Nan province.

Later arrivals such as the *Lahu*, *Lisu* and *Akha* came through Burma and now live in the Chiang Mai, Chiang Rai and Mae Hong Son provinces. The *Hmong* and *Yao* came through Laos and are mainly concentrated in the Chiang Mai, Chiang Rai and Nan provinces.

The three categories of swidden farming distinguished in the section "Swidden farming and secondary forests in the highlands of mainland Southeast Asia" of this paper can be assigned to specific ethnic groups:

(1) The *Khon muang* in the foothills up to 600 m practise supplementary swiddening.
(2) The long-established highland minorities (*Lawa, H' tin, Khmu, Karen*) in the altitudes between 700 m and 1000 m practise rotational swiddening.
(3) The more-recently established highland minorities (*Hmong, Yao, Akha, Lahu, Lisu*) at altitudes above 1000 m practise pioneer swiddening.

Swidden land is traditionally regarded as common property. It is either claimed by individual households in consensus with competing users, or allocated to households by the village leaders. Irrigated land, on the other hand, is owned by individuals and may be transferred by payment or by exchange. The amount of swidden land each household holds varies. In the *Lawa* village of Ban Tun, treated in more detail later, optimal conditions for swiddening have prevailed until the present and each household cultivates 2.1 ha of swidden land annually. When fallow land is included, each household has access to 25 ha of swidden land.

Supplementary swiddening by the Khon muang

In the past, Thai farmers applied swiddening as a first step to convert forested land to irrigated fields when expanding wet-rice farming. When, in the 1950s, the reserves of irrigable land were exhausted in northern Thailand, the growing population turned to the foothills and upper terraces up to 600 m. Farmers make supplementary swiddens in already degraded scrub formations or in lowland forests, preferably in seasonal rain forest or mixed deciduous forest. They use deciduous dipterocarp forest only when other forest types are no longer available. Swiddens are cultivated for a period of one to two years, followed by two years of fallow. This intensive cultivation produces a severely degraded version of secondary growth of mainly thorny species (Bruneau 1972, Chapman 1978).

Rotational swiddening by long-established highland minorities

Long-established highland minorities practise irrigated farming on terraces near watercourses and swiddening on the slopes above. Generally, a ratio of 1 ha of irrigated land to 2 ha of swidden land per household is possible under optimum conditions. Rice is grown on both swidden and irrigated fields, supplemented by additional crops including maize, sorghum, millet, chillies, beans, and cotton. The additional crops are grown in rice swiddens or in separate plots or house gardens. Agriculture mainly serves subsistence purposes. Swiddening consists of a rotational sequence of one to two years' cultivation, and 12 to 17 years' fallow. A low-intensity form of forest clearance aids the establishment of swidden fallow secondary forests. Stumps are left in the ground as sources of re-growth from coppice shoots and root suckers, while some trees preserved on the swiddens may act as a source of seeds. Swiddens are established in the transitional zone between lowland forest types and lower montane forest. Farmers who practise this type of farming are sedentary. They only occasionally move their villages and periodically rotate fields within boundaries that have remained unchanged for several generations (Grandstaff 1980).

Pioneer swiddening by more recent immigrants

The more recent immigrants pursue a variety of more intensive forms of swidden cultivation that are less easily defined compared to the former two types. The literature presents the *Hmong* farming system as typical for this form which obscures the heterogeneity within this group. The *Hmong* subsist on maize or, in villages at lower elevations, rice. Opium was the most important cash crop. Many *Hmong* villages cannot meet their subsistence needs and require income from cash crops to buy rice. They prefer to establish their swiddens in primary forests because of better yields and fewer weeds (Grandstaff 1980). Swiddens are cultivated usually for four or five years, or, on exceptionally good sites, for 10 to 15 years until either soil depletion or weed infestation render further farming unprofitable. Land at higher altitudes is usually cultivated continuously for longer periods than land at mid elevations. The moister and cooler climate allows for a longer cropping season, and soil fertility increases with an increase in soil organic matter at higher altitude (Hansen 1995).

Pioneer swiddening affects mostly lower montane forests, and only peripherally upper montane and lowland forests. Secondary growth after years of cultivation consists of a long period of weed and grass domination. Regeneration of secondary forests is slow but possible. When the primary forest has been transformed in an area, and primary forests are still available elsewhere, farmers move to new sites. In northern Thailand today, the scarcity of primary forests and the restrictive attitude of the Royal Forest Department force swiddeners to remain sedentary and either to engage in pioneer swiddening or to adopt permanent farming.

The impact of population growth and highland development on swidden farming

The population of northern Thailand totalled 11 million in 1993, of which 6% were ethnic minorities (Rerkasem & Rerkasem 1994). Populations of ethnic minorities have grown from 217 000 in 1960 (Young 1961) to 331 000 in 1973–1977 (Kunstadter 1983a) and 750 000 in 1993 (Rerkasem & Rerkasem 1994). Immigration from neighbouring countries and natural growth accounted for the minority population increase. The natural growth of all tribal groups is higher than that of the Thai people in the lowlands. Population pressure in the highlands is further exacerbated by Thai people migrating from the lowlands to the hills. Estimating the number of Thai farmers practising supplementary swidden cultivation in the foothill zone is difficult, but it is generally assumed that they have grown rapidly and now outnumber the swiddeners of other ethnic origins (Uhlig 1979). Based on the population estimates of the mid-1970s, Kunstadter (1983a) warned correctly that the highlands of northern Thailand would soon be overpopulated.

The Land Code of 1954 stipulates that all mountain land and land within 40 m of the foot of a mountain must not be damaged, destroyed or taken possession of. The hill tribes therefore have no legal rights to land in these mountains. They have been tolerated, but will not likely be granted land tenure in the future (Rerkasem & Rerkasem 1994). The government regards swidden farming as a harmful practice and actively engages in suppressing it. The national policy of highland development shifted in the 1970s from concern for national security because of communist insurgencies to the integration of hill-tribe people and the control of opium cultivation. Conservation became a new emphasis in the 1980s. The Highland Development Master Plans define economic and social development and are implemented by individual development projects. The Royal Forest Department controls all mountain areas and implements conservation measures. Conservation has been enforced through the establishment of national parks and wildlife reserves since 1972, the watershed classification of 1984, and the classification of water reserve land of 1993 as a basis for imposing land use restrictions (Rerkasem & Rerkasem 1994).

Since the 1960s, highland development has been a major cause of land use changes and roads were constructed into the mountains during the 1970s and 1980s. Road construction was a response to threats from communist insurgencies. Later roads were built to provide access to markets and social services to support the integration policy. Market access and the highland development projects led to the conversion of swidden cultivation to permanent farming with vegetables such as cabbage, tomatoes and potatoes; tree crops like lychees, pears and persimmons; and plantation crops like coffee and tea. Forestry plantations of pine, teak and *Eucalyptus* established by the Royal Forest Department are also in competition with swidden cultivation. Since the late 1960s, swidden farmers settled into "forest villages" to intercrop teak with rice and maize according to the taungya system.

Secondary forest in swidden farming

Research on swidden farming and secondary forests in northern Thailand

Loetsch (1958) was the first to investigate fallow re-growth, as part of an inventory of Thailand's teak resources. The study on mixed deciduous forests emphasised the behaviour of teak, while the study on evergreen montane forests emphasised forest hydrology. Nakano (1980) studied secondary vegetation on fallows in rotational swidden cultivation systems in a *Karen* village at 1000 m altitude near Mae Tho in the western part of northern Thailand. A similar research was also conducted in a nearby *Lawa* village (Kunstadter 1978, Kunstadter *et al.* 1978, Sabhasri 1978). More recently, Schmidt-Vogt (1995, 1998, 1999) compared one *Lawa* and one *Karen* village where traditional rotational swiddening was still practised, and one *Akha* village with more intensive swiddening. The cultural and historical background of rotational and pioneer swidden farming practices and their effect on the environment in northern Thailand was also studied (Grandstaff 1976, Mischung 1980, 1990).

The ecology of secondary succession and secondary forests in rotational swiddening systems

Secondary forests are part of rotational systems, but can also develop on the intensively used fields of pioneer swiddeners. The composition of the original vegetation, site conditions, and land use techniques determine the development, structure and composition of these forests.

In rotational systems, the length of cultivation and fallow periods, and the swiddening techniques determine the development and structure of swidden fallow secondary forests. Most important is the length of the fallow period, which should be at least 10 years (Sabhasri 1978). Also crucial is the availability of stumps and roots left in the fields, from which coppice shoots and root suckers can develop. Rotational swiddeners also leave some large trees when clearing a swidden, referred to as "relict emergents". Ethnic groups differ in the number of relict emergents they leave on new fields. The *Lawa* practise a type of selective felling, which leaves trees with a diameter of more than 15 cm. They leave an average of 244 relict emergents per ha. The *Karen* do not seem to have a clear principle of selection and apparently fell large and small trees at random (Schmidt-Vogt 1999). Their swiddens contain only 20 to 40 relict emergents.

Secondary succession begins with the first weeds appearing after the swiddens have been cleared and burned and before the rice is planted. While the rice ripens, fields must be weeded several times. The last weeding occurs about one month before the harvest. By the time the rice is harvested, a 5 cm tall layer of weeds and re-sprouting woody plants cover 50 to 90% of the ground. One year later, the most successful weeds—among them exotic species such as *Chromolaena odorata*—dominate, and form a 2 m tall, almost impenetrable, tangle of vegetation. This stage persists for up to four years. By that time, woody plants re-sprouting from roots and tree stumps emerge and gradually suppress the weeds. Succession then proceeds through a scrub stage to a secondary forest stage.

In traditional rotational systems, swidden fallow secondary forests may reach a stand age of 15 to 17 years, and are structurally complex with trees of varying height and diameter. Three distinct tree layers characterise such swidden fallow secondary forest among the *Lawa*:

(1) Relict emergents with a height of over 10 m form the uppermost layer.
(2) Coppices of trees felled to make the last swidden with a height of 8 to 10 m form the main canopy.
(3) Seedlings and saplings with a height of 4 m or less grow under this canopy.

The large number of trees with a small diameter results in a high density (1600 to 2000 trees ha^{-1}) and a low basal area (28 m^2 ha^{-1}). Basal area, however, is highly variable because of the random occurrence of relict emergents with larger diameters.

Crown cover mostly exceeds 70%, but rarely approaches 90%. Even very dense stands have gaps in their canopies as a result of small crown sizes and patchy stem distribution. Many tree species in secondary forests form high and narrow crowns to exploit a high light regime (Boojh & Ramakrishnan 1982). Even the crowns of relict emergents are smaller than expected because they have been pruned during the clearing of swiddens to prevent shading of the rice crop. More important is the uneven distribution of trees. Dense clusters with overlapping crowns, a result of sprouting from stumps and rootstocks of former trees that were cleared, alternate with places that are almost treeless.

The most species-rich swidden fallow secondary forest stands contain more than 30 species per 500 m^2 in the tree layer alone. The most important species are *Schima wallichii* and *Eurya acuminata* (Theaceae), *Castanopsis armata, Lithocarpus elegans* and *Quercus* spp. (Fagaceae), *Aporusa wallichii, A. villosa* and *Glochidion sphaerogynum* (Euphorbiaceae), and *Styrax benzoides* (Styracaceae). The families Leguminosae, Lauraceae, Anacardiaceae, Ebenaceae, Rubiaceae, Myrsinaceae and Caprifoliaceae are represented by the highest number of species.

Forest stands show a rapid increase in wood volume with recruitment and growth of large numbers of new individuals. When undisturbed, forest development continues mainly through the maturation of coppicing trees and the filling in of canopy gaps by younger trees. Large numbers of seedlings of many species are present. Cheke *et al.* (1979) reported large amounts of viable seeds of secondary forest trees in the soil of forests above 1000 m, which must have accumulated over a period of several years.

Secondary succession and secondary forests in pioneer swiddening systems

The woody plants in early successional stages of rotational swiddening fallows are mainly the result of sprouting. In the seasonally dry tropics, trees are even more prone to reproduce through sprouting than in the wet tropics (Ewel 1980) because of the lower probability of seed regeneration due to a prolonged dry season. Rapid development of a woody fallow depends on the availability of stumps and rootstocks. In intensive swidden systems with long and intensive cultivation, the number of re-sprouting plants decline. Perennial herbs such as *Chromolaena odorata,* therefore, persist much longer in pioneer swidden fallows than in rotational swidden fallows. Distinctive elements of the fallow land of pioneer swiddeners are grasslands and bamboo groves. Intensive cultivation over several consecutive years and fire wipe out most other plants and promote grasses that survive fires through rhizomes. Grass cover retards but does not entirely suppress the development of secondary forests. Bamboo emerges in regenerating woody vegetation and soon overtops shrubs and trees. In some places, bamboo may become dominant and even suppress the regeneration of trees.

Secondary forests which develop on the fallow land of pioneer swiddeners are often low and with stunted trees. Their vertical structure is less complex than forests in rotational systems because farmers do not leave relict emergents on their swiddens. Older secondary forests, however, may show a conspicuous upper layer of scattered older coppices, and dense lower layers of younger trees. Density is below 1000 trees per ha and basal area has a low value of about 17 m^2 ha^{-1}. Forests are generally open with a crown cover below 50%, only rarely reaching 80%. Usually, one tree species dominates and there are around 10 tree species in 500 m^2 plots (Schmidt-Vogt 1999).

The ecological value of secondary forests

Secondary forests are generally regarded as degraded vegetation. Forests can, however, only be judged degraded in comparison with primary forests or by assessing environmental services that they provide. Comparison with primary forests is difficult because remnant stands of original forests are often located on hilltops or ridges, sites that differ considerably from slopes preferred for farming.

These remnant stands have never been used for swiddening but were disturbed by selective felling and grazing and are no longer primary forests in the strict sense.

Secondary forests in rotational swiddening systems often have larger species diversity than mature stands, perhaps due in part to the large number of trees in a relatively small area. However, species of the lower montane zone have probably been replaced by species from lower elevations that thrive under conditions of frequent fires. Only counting species numbers is unsatisfactory to understand the floristic dynamics of secondary forests, but must suffice at present because of inadequate information concerning the autecology of the individual tree species. The fauna and its role in the ecology of secondary forests in northern Thailand is also largely unexplored.

Swidden farming is often blamed for problems of soil degradation in the uplands, and of water shortages and sedimentation in the lowlands. Studies on soil formation and the restoration of soil fertility indicate that a fallow period of 10 years permits the development of secondary forest and the recovery of nutrient levels to those existing prior to swiddening (Zinke *et al.* 1978). There is evidence, however, from studies in Chiang Rai province that denudation and sedimentation under swidden farming have been over-estimated (Forsyth 1996). Water shortages in the lowlands are rather a result of increased water use there (Alford 1992). Correlations between streamflow and sediment transport indicate that sediment derives from the river channels and not from the slopes above. A detailed investigation of the role of vegetation in surface flow and denudation processes, however, has not been done (Schmidt-Vogt 1998).

Socio-economic value and local knowledge of secondary forests

Anderson (1993) summarised the numerous studies on the ethnobotany of swidden farmers in northern Thailand. Kunstadter (1978) and Kunstadter *et al.* (1978) studied the ethnobotany of fallow vegetation and forests among the *Lawa* of north-western Thailand, while Schmidt-Vogt (1999) did so among the *Lawa*, *Karen* and *Akha*. The *Lawa* use a large number of plants for food, construction, fuel, medicine, animal food, clothes and decoration, and for ritual purposes. Kunstadter *et al.* (1978) found that 295 species were used for food, 119 for medicine, 44 for weaving and dyeing, and 27 for fuel. The majority of useful species were derived from swidden fallows. Kunstadter (1978) argues that the *Lawa*, through long fallow swiddening, have improved the availability of useful plants by maintaining a mosaic of microenvironments or successional stages which would not exist in the natural environment.

Table 1 lists tree species of swidden fallow secondary forests in the *Lawa* village of Ban Tun and their potential use by the villagers (Schmidt-Vogt 1999). Of 78 species, 49 are useful, most of them for two or three different purposes. The wood of Fagaceae, especially that of *Lithocarpus elegans*, is highly valued for construction purposes, although trees from old growth forests are often preferred to those from fallows because of their larger sizes. Wood from swidden fallow secondary forests is commonly used as firewood or tools, or for fences. *Quercus vestita* and *Q. kingiana*

Table 1 Ecological significance and uses of trees in swidden fallow secondary forests at Ban Tun

Species name	Ecological significance				Uses								
	Relative abundance (%)	Relative frequency (%)	Relative dominance (%)	Importance value	Con-struction	Fences	Fire wood	Tool	Food	Animal food	Medi-cinal	Cere monial	Decora-tive
Schima wallichii	4.36	2.53	14.59	21.48	x			x	x				
Castanopsis armata	5.54	3.16	10.32	19.02	x		x		x				
Lithocarpus elegans	4.16	3.16	7.61	14.92	x		x						
Shorea obtusa	3.17	1.26	6.89	11.32	x				x				
Aporusa wallichii	5.54	1.90	3.14	10.58					x	x			
Glochidion sphaerogynum	4.55	3.80	1.66	10.01	x	x							
Eurya acuminata	4.75	3.80	1.00	9.55	x	x							
Styrax benzoides	2.77	3.80	1.46	8.03	x	x	x						
Symplocos macrophylla	3.17	2.53	1.87	7.57		x							
Aporusa villosa	3.56	2.53	1.44	7.53	x	x			x				
Castanopsis diversifolia	2.18	1.26	3.79	7.23	x								
Eugenia albiflora	2.57	2.53	1.63	6.74					x		x		
Phyllanthus emblica	2.57	3.16	0.99	6.72					x		x		
Castanopsis tribuloides	1.19	1.90	2.56	5.65	x		x						
Anneslea fragrans	1.39	1.90	2.26	5.55		x	x		x				
Gluta obovata	2.57	1.90	0.88	5.35	x								x
Diospyros glandulosa	1.98	2.53	0.49	5.00		x			x				
Castanopsis sp.	0.99	1.26	2.47	4.72	x				x				
Dalbergia fusca	2.18	1.26	0.86	4.30	x			x					
Wendlandia tinctoria	1.58	1.90	0.65	4.13					x				
Tristania rufenscens	1.19	1.26	1.62	4.07	x			x					
Horsfieldia amygdalina	1.19	1.90	0.96	4.05									
Lithocarpus sp.	0.59	1.26	2.16	4.01	x		x						
Elaeocarpus floribundus	1.58	1.26	0.68	3.52	x	x			x	x	x		
Lithocarpus garrettianus	0.59	1.26	1.67	3.52									
Rapanea neriifolia	0.99	1.90	0.51	3.39			x		x				
Phoebe sp.	1.58	1.26	0.45	3.29	x								
Wendlandia sp.	1.39	1.26	0.57	3.22					x				
Olea salicifolia	0.99	1.90	0.29	3.18									
Callicarpa arborea	1.19	1.26	0.64	3.09					x			x	
Castanopsis indica	0.59	0.63	1.74	2.96									

Continued

Table 1 (continued)

Species name	Ecological significance: Relative abundance (%)	Relative frequency (%)	Relative dominance (%)	Importance value	Uses: Con-struction	Fences	Fire wood	Tool	Food	Animal food	Medi-cinal	Cere monial	Decora-tive
Turpinia pomifera	0.99	1.26	0.56	2.81									
Camellia oleifera	1.19	1.26	0.35	2.80					x				
Engelhardia spicata	1.19	0.63	0.94	2.76	x	x		x			x		
Dalbergia oliveri	1.39	0.63	0.69	2.71									
Macaranga denticulata	0.99	1.26	0.14	2.39					x				
Helicia nilagirica	0.59	1.26	0.50	2.35									
Quercus vestita	0.20	0.63	1.50	2.33	x		x						
Dillenia parviflora	0.79	1.26	0.25	2.30									
Eugenia angkae	0.79	1.26	0.19	2.24									
Helicia formosana	0.99	0.63	0.24	1.86	x								
Viburnum inopinatum	0.40	1.26	0.20	1.86							x		
Maesa montana	0.79	0.63	0.39	1.81	x				x				
Archidendron glomeriflorum	0.40	1.26	0.12	1.78									x
Engelhardia serrata	0.40	1.26	0.10	1.76				x	x				
Litsea sp.	0.20	1.26	0.22	1.68	x								
Symplocos racemosa	0.79	0.63	0.24	1.66									
Vaccinium sp.	0.59	0.63	0.41	1.63									
Pyrenaria garrettiana	0.59	0.63	0.29	1.51		x					x		
Dalbergia rimosa	0.59	0.63	0.25	1.47							x		
Maesa ramentacea	0.59	0.63	0.23	1.45									
Wendlandia paniculata	0.59	0.63	0.22	1.44									
Beilschmiedia sp.	0.59	0.63	0.20	1.42									
Rubiaceae	0.40	0.63	0.29	1.32									
Xantophyllum flavescens	0.40	0.63	0.22	1.25									
Phoebe lanceolata	0.40	0.63	0.09	1.12								x	
Ternstroemia gymnanthera	0.20	0.63	0.28	1.11									
Eugenia cumini	0.20	0.63	0.25	1.08									
Cinnamomum iners	0.40	0.63	0.04	1.07									

continued

Table 1 (continued)

Species name	Ecological significance: Relative abundance (%)	Relative frequency (%)	Relative dominance (%)	Importance value	Uses: Con-struction	Fences	Fire wood	Tool	Food	Animal food	Medi-cinal	Cere monial	Decora-tive
Semecarpus cochinchinensis	0.20	0.63	0.18	1.01									
Lauraceae	0.20	0.63	0.16	0.99									
Glochidion hongkongense	0.20	0.63	0.15	0.98									
Prismatomeris tetrandra	0.20	0.63	0.11	0.94					x				
Eugenia sp.	0.20	0.63	0.08	0.91					x				
Erythrina subumbrans	0.20	0.63	0.07	0.90					x		x		
Shorea roxburghii	0.20	0.63	0.07	0.90	x								
Viburnum cylindricum	0.20	0.63	0.06	0.89									
Debregeasia velutina	0.20	0.63	0.06	0.89			x						
Dalbergia stipulacea	0.20	0.63	0.04	0.87	x			x					x
Acacia megaladena	0.20	0.63	0.03	0.86				x					
Dillenia aurea	0.20	0.63	0.02	0.85									
Albizia odoratissima	0.20	0.63	0.02	0.85									
Glochidion assamicum	0.20	0.63	0.02	0.85									
Ilex umbellulata	0.20	0.63	0.02	0.85									
Lonicera ferruginea	0.20	0.63	0.02	0.85									
Rhus chinensis	0.20	0.63	0.02	0.85	x				x		x	x	x
Euonymus similis	0.20	0.63	0.01	0.84									
Alstonia glaucescens	0.20	0.63	-	-							x		
Unidentified	6.14	3.79	11.25	21.18									

from Schmidt-Vogt (1999)

yield fuelwood used during the rainy season because it provides a long-lasting fire. The wood of *Dalbergia stipulacea* and other leguminous species is valued for making tools, for instance for parts of the spinning apparatus. The bark of some trees is used to make strings (*Dalbergia fusca, Desmodium floribundum, Millettia pachycarpa, Spatholobus* spp., *Sterculia ornata, Thunbergia laurifolia*) and others for medicine (*Cinnamomum aromaticum*) and decoration (*Dalbergia stipulacea*). Fallow forests are an important source of fruits (e.g. *Elaeocarpus floribundus, Eugenia* spp., *Ficus* spp., *Litsea cubeba, Myrica esculenta, Oroxylum indicum, Phyllanthus emblica, Vaccinium sprengelii*) and edible leaves (e.g. *Cratoxylon cochinchinense, Engelhardia serrata, Maesa indica*).

Cultural and ritual significance of secondary forests

Secondary forests are of ritual significance especially in communities that practise rotational swiddening. Forest, as the domain where swiddening takes place, occupies a central position in the ceremonial life of the *Lawa*. Ceremonies involving animal sacrifices take place to obtain permission from the forest spirits to encroach into their domain before clearing a swidden, before rice planting, during the growing season, during harvest, after the harvest, and when the fields turn into fallows. These practices, however, are declining as a result of the influence of Christian missionaries, exposure to Thai culture, and the decline of the swiddening way of life (Kunstadter 1983b).

The predicament of secondary forests in swidden cultivation

The impact of demographic and socio-economic change on secondary forests

The policies and developments described in the section "Swidden farming in northern Thailand" have reduced the number of swidden farmers. Also, the correlation between the type of swidden cultivation and ethnic affiliation, common before the 1960s, is weakening. Cultivation systems today respond to the constraints and opportunities posed by modern development rather than conforming to tradition. Rotational and pioneer swidden cultivation systems are both rapidly disappearing and farmers now use one- or two-year fallow rotations. Most of the contemporary swidden cultivation is a degraded form of rotational swiddening (Rerkasem & Rerkasem 1994).

Consequently, the secondary forest cover is diminishing. Where swidden cultivation is adapted to the scarcity of land with shorter fallows, more degraded types of secondary vegetation such as weed communities, grasslands and bamboo groves replace secondary forests. More profound changes result in the replacement of swidden fallow secondary forests with permanent fields, tree crop plantations, forest plantations and conservation areas.

The future potential of secondary forests

The shift from a subsistence-based economy to a commercial economy may open up new economic potential for secondary forests. Sabhasri (1978) proposed, based on surveys of swidden fallow secondary vegetation among the *Lawa*, that swidden farming could be transformed into forest management for the production of firewood. The major obstacles for such a development at that time were unresolved land tenure and the lack of infrastructure for transporting the firewood. Land tenure among minority groups is still a contested issue, but the transport situation has improved significantly, creating better opportunities for marketing forest products today than were possible 20 years ago.

The sale of firewood is only one possibility for commercialising forest products. The secondary forests of the *Lawa* village of Ban Tun contain many tree species suitable for commercial use. *Styrax benzoides* produces an aromatic resin that can be sold in markets (Table 1). In Laos, *Styrax tonkinensis* is cultivated for this purpose in agroforestry systems. Future research could identify useful species and investigate their market value with the aid of indigenous knowledge, and help design land use systems that incorporate the commercial use of secondary forests. Some possibilities are:

(1) Convert swidden farming into agroforestry systems similar in structure to the swidden fields of the *Lawa* with relict emergents.
(2) Supplement swidden farming with the management of fallow forests.
(3) Combine swidden farming with forest management following the taungya principle.

Swidden farming and secondary forests in Laos

In Laos, despite a rapid rate of deforestation, forest cover is still higher than in Thailand. The map of Laos, published in the Conservation Atlas of Tropical Forests: Asia and the Pacific (Collins *et al.* 1991) indicates 6.8 million ha of closed forest and 5.7 million ha of degraded forest, or 29% and 25% of the land area respectively. The northern provinces have less forest coverage as compared to the rest of the country. The total area of closed forest is estimated to have decreased by about 10% from 1981 to 1990. Degraded forest is not further specified and it is therefore not possible to assess the extent of secondary forest due to swidden farming.

Similarly, the exact area of swidden farming and associated fallow is not known. Aerial photographs from 1981–1982 and 1988–1989 suggest the area used for swidden cultivation in 1989 with an average fallow period of eight years to be 4.8 million ha, or 20.5% of the national land area (Chazee 1994). The same aerial photographs also indicate a 73% increase in the area under swiddens from 352 500 ha to 610 700 ha, and a 5.7% increase in the area under fallow from 4.0 million ha to 4.2 million ha. This indicates an increase in the importance of swidden cultivation with a trend towards reduced fallow periods.

Swidden farming plays a larger role in Laos compared to Thailand, as it is practised all over the uplands, especially in the northern and eastern provinces. It is the main farming system of 90% of all farmers in Laos (Souvanthong 1995). The population of Laos can be divided into 68 ethnolinguistic groups, commonly grouped into three categories similar to the classification in Thailand:

(1) The *Lao Lum*: people of the lowlands; 56% of the population.
(2) The *Lao Theung*: people of the middle altitudes; 34%.
(3) The *Lao Sung*: people of the higher altitudes; 10%.

Swidden farming practices are also grouped according to these categories:

(1) The *Lao Lum*, like the *Khon muang* in Thailand, used to practise wet rice cultivation but in recent years have been moving uphill and adopting shifting cultivation.
(2) The *Lao Theung* practise rotational shifting cultivation with fallow periods between 5 and 15 years. In the south of Laos, this system is considered sustainable. In the north, which has higher population densities, fallow periods produce grassland and bamboo, rather than secondary forests.
(3) The *Lao Sung* practise pioneer swiddening, resulting in grasslands and bamboo groves, especially in the north of Laos.

Swidden farming practices are still largely determined by ethnic group, much more so than in northern Thailand. Population growth, development and national policy are, however, changing this. Population increase has caused uphill migration of the *Lao Lum* in order to practise supplementary swidden farming and migration of the *Lao Theung* from the densely populated northern provinces to the south. There has been little change in the agricultural practices of the *Lao Sung*.

Government policy has prioritised the termination of swidden farming since 1976. In the late 1970s and early 1980s, more than 10 000 families of swidden farmers were resettled into areas of permanent cultivation. Currently, less drastic measures are being implemented to reduce swidden cultivation. It is now permitted where viable alternatives cannot be found, especially in the case of rotational swiddening in areas of degraded forestland and only for subsistence production. Pioneer swiddening is still not allowed.

The new forest legislation of 1993 aimed to achieve the sustainable management of forests and watersheds. This legislation is part of a National Rural Development Programme approved in 1998 (Chazee 1999). The new legislation addresses land allocation and tenure issues. In rural areas, land tenure was formerly established through informal agreements between families or through village chiefs. Under the new legislation, the state allocates land to each family. Where swidden farming is the most suitable form of land use, families may use unlimited areas of land. Degraded forestland may be allocated to families by family forest management contracts for permanent agriculture, forestry and livestock production, or for rotational swiddening if permanent cultivation is not feasible. If the terms of the contract are fulfilled for three years, the family receives a certificate of permanent tenure. Degraded forests may also be subject to a forestation business contract, designed to promote commercial plantations (Souvanthong 1995).

Swidden farming and secondary forests in Vietnam

According to 1993 data, forest cover 9.1 million ha or 28% of the total land area in Vietnam. Vietnam has 54 ethnic minority groups and 50 of them practise swidden cultivation. According to 1989 data, 2.9 m people in 482 512 households are engaged in swidden cultivation on about 3.5 million ha of land.

The *Hmong* people living in high altitudes practise pioneer swiddening, while the other ethnic groups practise rotational swiddening. These are the main types in Vietnam. Increased population pressures, forest planting and forest rehabilitation in the 1990s have reduced the land available for swidden cultivation and people have moved to new areas. In these new areas, there has been a trend towards pioneer swiddening. The total area under swidden cultivation is still increasing, especially that under pioneer swiddening. In the northwest region, forest cover decreased from 20.9% to 10.6% between 1965 and 1985. Deforestation caused by swidden cultivation, it is believed, represents about 30% of the total deforested area. In the central highlands, the forest cover is over 60% because of the prevalence of rotational swiddening.

Formerly, land tenure was regulated by mutual consent. Since 1959 in the north and 1976 in the south, cultivated land belonged to cooperatives and forestland was under the management of state forest enterprises. Since 1988, the state has allocated land to long-term users for the cultivation of annual crops. Forested land can be allocated to households for forest protection or for agroforestry. Bare land is allocated for forest planting or also for agroforestry. There are regulations on the use of forested land for swidden cultivation.

In the mountainous areas, population growth is high, and there is insufficient land to practise rotational swiddening. The fallow period is therefore shortened. Much of this population growth is caused by migration from the lowlands to the uplands and central highlands.

The government has been implementing a programme to end swidden cultivation since 1968. Land is allocated to people in the mountains to work on forests and forest planting in combination with permanent cultivation and sedentarisation. People in the mountains now have better opportunities to develop industrial forest plantations, cash crops and fruit trees because of the development of the private sector since the reorganisation of the national economy. Apart from participating in forest planting and forest rehabilitation, the general trend of the ethnic minorities is to grow fruit trees. The planting of cinnamon by the *Dao* and other ethnic groups is economically very successful.

Alternatives to shifting cultivation include the expansion of wet rice cultivation and forest plantations using species like *Mangletia glauca, Styrax tonkinensis,* *Cinnamomum cassia, Pinus merkusii, Illicium verum, Acacia mangium, Cunninghamia sinensis, Pinus khesiya, Eucalyptus* spp., *Acacia auriculiformis, Tectona grandis, Dipterocarpus alatus, Anisoptera cochinchinensis, Canarium* spp., *Talaunna gioi* and *Cassia sianea.* A number of forest products find an export outlet now that the Chinese market has opened up—*Cunninghamia sinensis* wood, *Aleurites montana* fruit *and Illicium verum* flowers. Commercial plantations include rubber, coffee, mulberry, tea and cashew (Sam 1994).

Conclusion

The highlands of mainland Southeast Asia experience competition between swidden farming, permanent cultivation, forestry and conservation. The pressure, however, is on the swiddeners, who are being encouraged, and sometimes forced, to move away or to change their land use. Population pressure is leading to the reduction of fallow periods and the intensification of swidden farming. Improved access to lowland markets and land use restrictions imposed by the governments induce farmers to adopt permanent cultivation. These developments are more pronounced in Thailand than in Vietnam or in Laos and lead to a reduction in the cover of swidden fallow secondary forests.

Authorities in Thailand and in the other countries of mainland Southeast Asia do not yet recognise that secondary forests can be valuable as a plant cover and an economic resource. Government officials rate secondary vegetation as degraded scrub land and attempt to eliminate swidden farming because it is supposedly the chief cause of vegetation change and other environmental problems. Studies of secondary forests in swidden cultivation in Thailand, however, show that fallow vegetation ought to be regarded as an asset. This applies in particular to secondary forests created by rotational swiddening systems, which are ecologically valuable mainly because of their complexity in terms of species composition and stand structure. They are also an economically valuable resource within traditional subsistence economies because of the nutrients they hold and because of the large number of timber and non-timber forest products. Swidden fallow secondary forests should be conserved for ecological reasons, but also rendered economically useful under the conditions of a cash economy, which is rapidly evolving in the highlands of northern Thailand.

The existing dense network of roads that can be used for transporting forest products to market in both uplands and lowlands can enhance the economic value of swidden fallow secondary forests. However, the current development policies and legal framework for the uplands of northern Thailand impose major limitations. Swidden cultivation is formally illegal and can be carried out only because it is tolerated. The utilisation and management of fallow forests requires a legal basis. This could be provided by the new community forestry legislation, which has been debated for years and may eventually be passed. Security of land rights may induce swidden farmers to engage in fallow forest management, as implemented successfully in Laos. Additionally, management systems for the use of fallow forests must be devised, which take into account that farmers are likely to change land use in order to increase their cash income. Indigenous knowledge of tree species is an important basis for devising fallow forest management systems, but must be supplemented by studies into the market potential of swidden fallow secondary forest products.

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