Chapter 35

Fallow Management in the Borderlands of Southwest China

The Case of Cunninghamia lanceolata

Nicholas Menzies and Nicholas Tapp

Upland shifting cultivators such as the Hmong (referred to in Chinese as the *Miao*) and the Yao of southern China and northern Vietnam, Laos, and Thailand have frequently been criticized for their apparent disregard for, and destruction of, their forest environment. Shifting cultivation itself is often treated as a purely agrarian system, with no necessary or beneficial relationship with the forest. Yet since the early pioneering work of Conklin and Geertz in the Philippines and Indonesia, it has been generally realized that in comparison, for example, with wet rice monoculture, in ecological terms, the most distinctive positive characteristic of swidden agriculture is that it is integrated into and maintains the general structure of the pre-existing natural ecosystem into which it is projected, rather than creating and sustaining one organized along novel lines and displaying novel dynamics. (Geertz 1963)

Unprecedented political, social, and economic changes have transformed the upland economy in the region comprising the borderlands of Myanmar, southwest China, Laos, Vietnam, and northern Thailand, a region that is becoming known as Montane Mainland Southeast Asia (Rerkasem 1996). The widespread adoption of cultivated vegetable and fruit crops, often in internationally supported opium substitution programs, has transformed significant areas of shifting cultivation into permanently cultivated areas. These not only require large chemical inputs but also contribute to serious problems of lowland pollution and soil erosion. It is now widely recognized by scholars working in this field that shifting cultivation is seldom the sole cause of deforestation. Rather, the causes can be found in increasing pressure on

Editor's Note: A modified version of this chapter, "Miao Cultural Diversity and Care of the Environment", was published in *Links Between Cultures and Biodiversity*, edited by Xu Jianchu et al. (Yunnan Science and Technology Press, 2000).

Nicholas Menzies, Independent Researcher, 1203 Northwestern Drive, Claremont, CA 91711, USA; Nicholas Tapp, Department of Anthropology, Research School of Pacific and Asian Studies, H.C. Coombs Building, Australian National University, Canberra 0200, Australia.

land, water, and forest resources, and cultivation makes only a small contribution. In fact, in 1981, van der Meer estimated that only a very small proportion of the uplands and highlands was actually planted with swidden crops.

Shifting cultivation requires a low ratio of population to land, and a correspondingly large area of fallow, to be a viable and sustainable system. As Boserup showed in 1965, it is where the population-to-land ratio becomes unbalanced that shifting cultivation itself appears as an unsustainable system. In northern Thailand, for example, the main factor responsible for deforestation in the past has been population increase, particularly the upward movement of landless lowland Thai peasants, combined with large-scale logging and mining operations (Tapp 1986) of the type now threatening the forests of Myanmar and Cambodia. In 1984, Cooper attributed most of the deforestation in northern Thailand to the forestry industry, while there was strong evidence that poor road construction, rather than deforestation, had been the cause of much soil erosion (Talbott 1996).

For about 20 years, field research in northern Thailand has shown that systems of swidden cultivation practiced by a number of ethnic groups not only appear sustainable but have been in existence for several centuries (Kunstadter et al. 1978; Grandstaff 1980). This has led to the distinction between traditional or "integral" swidden cultivation and that practiced by people with less experience or a lesser understanding of the potential impacts of clearing and burning forest land. Field research in northern Thailand in 1981 and 1982 showed that, by contrast with newer, inexperienced swiddenists, the traditional cultivation practices of the Hmong were professional and respectful of the natural environment. For example, they cleared fire breaks before new swiddens were burned off, and left the stumps of large trees in the ground to fix the soil after the site had been cleared (Tapp 1989a). Although Hmong swiddening is invariably considered by governments as being among the principal causes of forest degradation, care for the environment is in fact part of the traditional way of life of the Hmong, and they recognize both the importance of fallow periods and the consequences when these are shortened.

Villages are carefully sited to be in harmony with the surrounding mountains and watercourses. They are surrounded by a belt of forest, and any alteration to the major contours or appearance of the landscape is seen as affecting the prospects of those who inhabit it. The Chinese system of geomancy, practiced by both the Hmong and the Yao, hinges upon the establishment of a basic relationship of equivalence and harmony between the community and its natural environment (Kandre 1991). At the time of this research, an entire Hmong village had to be relocated after a watercourse was built in the valley below it to supply a mining concession. The villagers believed that the "veins of the mountain" (*memtoj*), running from the peak to the village, had been "cut". The Hmong use elaborate physical imagery to describe the features of their landscape, portraying it as a living and dynamic entity. The fate of the living is seen as dependent on the way settlements are inserted into the natural ecosystem (Tapp 1988).

It should be of no surprise, then, to find that for centuries in southern China, where the ancestors of the Hmong and Yao originated, and where their descendants still live, forms of upland dry and shifting cultivation have been successfully combined with the management of plantation forest, both for local use and for commercial sales. Members of ethnic minorities such as the Miao[1] and Yao have played a pivotal role in developing this system since very early times (Menzies 1994). This has particularly been the case in the cultivation of *Cunninghamia lanceolata* (see color plate 40).

Cunninghamia lanceolata

Regularly, but inaccurately, referred to as Chinese fir, *Cunninghamia lanceolata* is a species indigenous to the subtropical region of central and southern China and is an

[1] Tribespeople classified in China as Miao also include people from groups other than the Hmong.

important component of Chinese forest ecosystems. It is virtually unique among conifers in that it has an ability to vigorously regenerate through coppicing and is easily propagated through seed, coppice, or cuttings (Fung 1994). *Cunninghamia* can grow as high as 30 m, with a diameter at breast height of 2.5 to 3 m (Sheng 1996). It thrives across a wide latitudinal range, from 200 m above sea level in the eastern and northern regions, to between 2,000 and 3,000 m in western Sichuan and northeastern Yunnan, in the southwest of China (FAO 1982; Richardson 1990). It prefers a warm, moist environment with a mean annual temperature of 15 to 20°C and a mean annual rainfall between 800 and 2,000 mm. While requiring good drainage, it tolerates acid soils (Richardson 1990). Although it is now grown in large monoculture plantations under state guidance, ecologically it is probably not a monocultural species but one which occurs naturally in mixed deciduous and evergreen broad-leaved forests (Richardson 1966). However, as Chandler (1994a) points out, *Cunninghamia*, or *shamu* as it is known to the Chinese, is such a poor competitor in the early growth stages that it is rare to find natural stands in China today (Huo 1975).

Despite this handicap in natural growth, *Cunninghamia* is now the single most important industrial species planted in China, with the exception of bamboo. It covered at least 4.8 million hectares in 1992, and government policy was to reafforest a further 6 million ha by 2000. It makes up about 24% of the total industrial plantation resource in China and more than 50% in the southern region, as well as 39% of the area planted by 1992 under the World Bank–assisted national afforestation program (Hunter and Evans 1992).

Although *Cunninghamia* is used extensively as a plantation species, Chinese forestry authorities have been concerned for several decades by evidence of severe yield declines in second and third rotations. More recently this problem has been the subject of a research project in which one of the authors of this chapter participated and during which much of the contemporary data was collected.[2]

Social Values of Cunninghamia

Cunninghamia is an enormously valued and valuable local wood, and its usage interacts and intersects with the everyday life of local villagers. Traditionally, a copse of Chinese fir might be planted as a villager approached death, since the wood was the best available for coffins, or on the birth of a baby daughter for the dowry of dressers and chests which would be needed for her wedding. Light, strong, flexible, and durable, it has always been considered the best available material for the building of new houses and repair of old ones, for furniture and cabinet work, for pots and beakers, and for agricultural tools such as ploughs and hoes. Even though it burns badly and gives off little heat, *Cunninghamia* branches and tips are used as firewood in areas where better firewoods are scarce, in a mixture of approximately 30% with deciduous woods, pine, and grasses. Its bark is used for lining roofs, pigsties, and outhouses (Tapp 1996b).

Research in 1994 and 1995 on state forest farms in Jiangxi and Fujian showed that a household of three to five adults needed about two cubic meters of *Cunninghamia* timber every year, although this depended on a number of social variables such as house building or repairs, deaths, and out-marrying daughters. A new house largely built of wood needed about 20 m^3 of timber for four rooms of approximately 10 m^2 per room, although few houses these days are built entirely of wood. Four pieces of furniture were usually needed for the dowry for an out-marrying daughter and this averaged about 2 m^3 of timber. Coffins, on the other hand, required about 0.6 m^3 of timber, and, in just one county, there was an average of 6,000 deaths per year, and about half of the deceased were buried (Tapp 1996a).

[2] This project, managed jointly by the Overseas Development Administration and the Chinese Academy of Forestry, with assistance from the Institute of Sociology at Beijing University, was conducted from 1993 to 1996 on state forest farms in Jiangxi and Fujian Provinces. Tapp acted as a sociological consultant, through the Edinburgh Centre of Tropical Forestry at Edinburgh University.

The use of *Cunninghamia*, therefore, is vital to the local economy and to communities in the hilly to mountainous areas of southern China. Of course, carpenters commonly supplement *Cunninghamia* with pine and other woods, but none is so valued as the light, durable, and flexible *Cunninghamia* timber.

Commercial Value of Cunninghamia

Despite this social value to the local people, it is far outstripped by *Cunninghamia's* commercial value. This was very clear at the Jiangxi and Fujian project sites, where the main aspiration voiced by villagers was not to directly avail themselves of more timber, but to secure an increased share of the profits made by the state and collective plantations so they could purchase construction materials, as well as coal for household fuel (cf. Menzies 1991). As Chandler (1994a) points out, the primary motivation for intercropping *Cunninghamia* with edible, medicinal, economic, and oil-producing crops was never the dietary value of the agricultural crops. Rather, it was the opportunity to harvest the cash value of shamu timber. Chandler notes that in the 17th century, Chinese gazetteers reported double to tenfold returns on investments from crops of *Cunninghamia*. It was these commercial values that led farmers to perceive timber as a crop in its own right, rather than as a byproduct of clearing the land or as a secondary crop grown for household needs (Menzies 1988a, 95).

From the 16th century onward, commerce and industry grew rapidly in the Yangtze basin and the southern coastal region. The lowland cities clamored for timber, and the highland farmers increasingly found themselves able to provide it, usually through extensive river transport systems (Menzies 1994). In some areas, intercropping with *Cunninghamia* was used as a means to persuade traditional shifting cultivators to convert to more permanent settlements, and forestry became a viable alternative to establishing terraced ricefields (Menzies 1988a). From the late Ming dynasty, new settlers, who were known as "shed people," were often required, as tenants, to clear land and plant *Cunninghamia* and Masson pine. They could either use the land for grain or cash crops until the trees matured or receive a final share of the profits (Menzies 1996).

Cunninghamia provided cash, rather than a subsistence income, and could be used in times of special need to pay for medical emergencies, weddings, and funerals. This practice is similar to that in other countries where trees serve as a growing asset to be used at times of special need (Chambers and Leach 1987). The commercial importance of *Cunninghamia* can be gauged from the fact that, in the 16th century, a specific system of measurement and valuation was developed just for this species (Menzies 1996).

Historical Aspects of Cunninghamia *Management*

Cunninghamia has been maintained as a plantation species for more than a thousand years in the hilly to mountainous regions of southern China (Menzies 1994). Traditionally, it was regenerated through seedlings, coppice, or cuttings, and different parts of the country specialized in different propagation techniques. Sometimes it was maintained as a pure monoculture species, but more often it was cultivated in mixed plantations with perennial cash crops such as tea oil (*Camellia oleosa*), tung oil (*Aleurites* spp.), some annual staple crops such as wheat or millet, and sometimes with other timber species such as Masson pine (*Pinus massoniana*). Today, large *Cunninghamia* plantations are managed by state-run "forest farms," which are collective organizations attached to local townships and larger administrative villages. Since the reforms of Deng Xiaoping, tracts of these plantation forests have been leased to individual householders or groups of householders. In prerevolutionary China, by contrast, plantations of significant size were owned by

rich landlords who hired local or seasonal laborers to work on them, by temples, or by large landholding estates like the lineages common in the southeast of the country. Often there was a division of ownership between a distant owner, perhaps an urban surname association or a trading guild, who retained the subsoil rights, and farmers who leased the topsoil rights and owned the trees, and could mortgage or sell their rights. The farmers usually paid other agricultural workers to plant, harvest, and maintain the plantations and shared the profits with the subsoil owners as rent (Menzies 1988b). While larger plantations tended to be maintained in predominantly Han areas such as Fujian and Jiangxi, smallholder production was more common in the southwest and Hunan, particularly in ethnic minority areas. In more remote regions, poor farmers were also able to plant *Cunninghamia* on unclaimed mountain sites (Menzies 1988a). As early as the year 1173, a Song dynasty official, Fan Chengda, referred to ethnic minorities cultivating *Cunninghamia* in his diary of a journey in southern China:

> The tribespeople do not practice much agriculture. Most of them make a living planting *Cunninghamia*. *Cunninghamia* is something that grows easily so it may be harvested with little danger of exhausting [the supply]. (Fan Chengda 1173)

Fan gave no indication of the silvicultural system used by the tribespeople, nor is it clear to which of the non-Han people in southern China he was referring. His account was, however, followed over the centuries and references to it can be found in a wide range of publications, including local histories, guidebooks to sacred mountains, briefing manuals for military expeditions, and travel accounts written by western authors from the 19th century onward (Menzies 1996, *574–578* and *626–630*). These accounts offer more detailed descriptions of a system of cultivation practiced by Han and minority ethnic groups, often associating it specifically with the Hmong/Miao, the Yao, the She, and the Dong. While details vary, the system involved land clearance, sometimes followed by burning. Farmers then planted *Cunninghamia*, usually using coppiced sprouts from older trees, and intercropped the plot with a wide variety of annual crops. After a few years, when annual crops could no longer survive under the shade of the trees, shade-tolerant cash crops might be grown until the forest cover prevented any further intercropping. Rotation periods varied over the centuries and, apparently, between ethnic groups, with rotations as short as 15 to 20 years and as long as 60 or even 90 years. After harvesting, the sequence began again with land clearance and intercropping.

The relative intensity with which *Cunninghamia* plantations were managed varied from region to region across China's vast landmass and a range of traditional techniques and systems were employed over the course of a millennium. Nevertheless, traditional management systems had certain common features that we can usefully consider here. Many of these traditional management practices persist in China today in smaller woodlots, in areas where local villagers have some measure of management control over plantations, or where cash investment is unavailable for more intensive methods of cultivation. Of particular interest to us is the system of agroforestry used in the cultivation of *Cunninghamia*, the extent of clear-felling involved, and the role of fire in the management system. These issues are of particular interest because the ethnic minorities who have been prominent in developing *Cunninghamia* cultivation are the same ethnic minorities that practice shifting cultivation. In many of the more traditional but more remote ethnic minority areas, land clearance may take the form of patch cutting rather than large-scale clear-felling, and burning may have been used only at limited points in the sequence of management activities. Clear-felling and extensive site burning are, by contrast, a marked feature of more modern systems of *Cunninghamia* plantation management.

Mixed Cultivation

Very often the practices of ethnic minorities have contrasted favorably, in an ecological sense, with their ethnic Han neighbors, who have settled and colonized southern China largely since the Song dynasty. For example, it was more common in the ethnic minority areas to see *Cunninghamia* in mixed plantations with *wenmu (Cryptomeria fortunei)* (Yu 1983; Wu 1984; Chandler 1994b). Chandler (1994a) contrasts the traditional practices of a She minority lineage (Miao-Yao language group) with two Han Chinese lineages in Fujian Province. One of the Han lineages had been settled in the area for more than 800 years, the other for a mere 225. The longest settled Han Chinese lineage, the Wu, imposed a maximum of three rotations of *Cunninghamia* on a single site before returning it to secondary forest for about 50 years. The more recently settled Han Chinese lineage showed no awareness even of the reasons for the period of fallow, and the minority She lineage practiced mixed cultivation and demonstrated a more ecologically informed understanding of the whole problem. They put it this way:

> The Wu people have that problem [the need to rotate shamu off the growing site] because they do not understand the soil. The soil is like a person. Turnips are good to eat and the Wu like to eat a lot of turnips. But if they eat only turnips, then very soon they become sick. Pork is also good to eat, but if we eat only pork, then very soon we also become sick. If we eat turnips and pork and rice and vegetables together we do not become sick, our health is good, and we are happy. The Wu soil is not happy. The Wu give it only shamu. They do not give it wenmu or *chumu* or *dumu* [both of the latter names refer to several genera of the Fagaceae] or other trees. Only shamu, and the soil becomes sick. Shamu buys a lot of money. The Wu want only money, so the Wu soil becomes sick. (Chandler 1994a)

The She minority lineage quoted here practiced a mixed cultivation of *Cunninghamia* with long rotations and no apparent yield decline. They saw no need for the fallow periods required by the neighboring Han lineage, whose rotations averaged only 35 years.

Integration with Agriculture

The traditional system of *Cunninghamia* management has been described as a remarkable instance of shifting cultivation in forestry (Hunter 1996) and has always been closely integrated with agricultural systems. Even in the state forest farms of Jiangxi and Fujian, villagers have planted medicinal plants, papaya, and gourds under the shade of young *Cunninghamia* trees in remote areas of the plantation (Tapp 1996b). Such intercropping has always been an integral feature of the system.

The 1639 farming manual "Complete Treatise on Agricultural Administration" (*Nong Zheng Quan Shu*), by Xu Guangqi, advised a preliminary plowing of the land before planting *Cunninghamia*, then growing sesame with the young trees for a year or more, after which millet should be planted in the summer and wheat in the winter, as long as the location was suitable for such crops. In this way, it said, weeding and hoeing would not be necessary. It is believed that this system may have been the precursor of the *taungya* swidden system used by the British in Burma (Menzies 1994, 1996). The 17th century advice has since become the general practice. Annual crops planted during the early years of growth before canopy closure include wheat, millet, maize, sweet potato, cassava, and vegetables. Successional systems have also been used in which annual crops are followed by perennials such as tung oil and tea oil (Menzies 1994).[3]

In southwestern China, the related Miao, Yao, and She groups, as well as the Dong, have been particularly associated with the commercial production of timber.

[3] Tung oil trees were fully harvested in the fifth and sixth years and became old and feeble only as the canopy closed in the ninth to tenth year (Sheng 1996).

As noted earlier, tribal production of *Cunninghamia* is recorded from 1173, and the local history of Jianghua county in Hunan records commercial production of *Cunninghamia* from the early 17th century. The people of that county, which remains an autonomous Yao county to this day, cultivated *Cunninghamia* and rafted it down the Yangtze River for sale in the cities downstream. Income from the timber trade allowed the people of Jianghua to buy grain and other staple foods that were difficult to cultivate in their steep upland valleys (Menzies 1988a). Fortune (1939) described how the Yao of northwest Guangdong planted trees, conserved them, and cut and carried timber to the riverside for sale. Forestry occupied a crucial place in the agricultural life of the Yao and was a main source of income. In Yao-Ling Pai (Guangdong), which is now a protected forestry area (Tapp 1989b), *Cunninghamia* was traditionally cultivated for sale to wood merchants in Sanjiang (Fortune 1939).

In these montane regions, terraced irrigated ricefields are scarce and most land is devoted to the production of maize or buckwheat, sweet potato, and leafy green vegetables. Animal husbandry forms an important part of the local economy, and *Cunninghamia* has functioned as an important cash crop and source of security, either through laboring on local plantations or through direct revenues from commercial sales of timber to private wood merchants and government licensees. Forest cover in many areas was, therefore, maintained as a fruitful and integral part of the upland agricultural economy.

Intercropping has therefore long been a characteristic of these traditional *Cunninghamia* cultivation systems and has long been associated with minority groups such as the Hmong/Miao and Yao, who are practitioners of shifting and dry upland cultivation. In Guangdong Province, a system of *Cunninghamia* intercropped with cassava is described as having been originally devised by the Miao and subsequently adopted by the Han (Pendleton 1940, in Menzies 1994). Other traditional systems include intercropping for at least two to three years with maize, peanuts, or beans, or *Cunninghamia* grown together with tung oil for three to four years. Sweet potato, soybeans, mushrooms, and tea oil are also commonly intercropped. In parts of Fujian, a complex and lucrative medicinal fungus industry has grown up in the shade of the *Cunninghamia* trees (Tapp 1996b). Chandler (1994b) has shown how, in Fujian, agricultural intercropping with a wide variety of cereal, cash, medicinal, and oil-producing crops has formed a major part of the traditional management system centered around *Cunninghamia*. He argues that such intercropping in the initial stages of growth is an integral part of site preparation and tending to the young trees that contributes importantly to their establishment, growth, and survival.

Commercial production of *Cunninghamia* in mountainous areas, pioneered by upland ethnic minorities, was an integral part of a local economy in which upland dry agriculture, animal husbandry, hunting, and fishing were also important elements. The common practice of intercropping in *Cunninghamia* plantations gives good reason to propose that these farming systems should properly be seen as a form of shifting cultivation. They would appear to fit well with a category of upland farming common in Southeast Asia that Rambo (1996) has described as "composite swiddening agroecosystems."

Shelterwood and Declining Yields

One aspect of what is perceived as the traditional management system for *Cunninghamia* has been widely and intensively replicated on large areas of China's present state forest farms, and the World Bank has advised against it. It is preliminary burning and intensive site preparation before planting. The clear-felling practiced today is also seen as part of the traditional past.

While often described as relics of traditional practice that are difficult to change because of local custom and the lack of available labor, it must be remembered that in traditional systems, *Cunninghamia* was never cultivated in anything like the vast

areas common today. In addition, it was intercropped with a variety of medicinal, edible, or economic crops, or cultivated in mixed plantations with other species. In those areas where it was intensely cultivated as a monoculture, it was possible to allow long fallow periods in which the forest reverted to mixed pine, fir, and broadleaf forest. Certainly, both clear-felling and burning before planting were very generally practiced in the past, although on much smaller plots with wider spacing between the trees. As we have already remarked, burning may often have been carried out at limited points in the sequence of activities, and patch cutting was also a common practice, particularly in ethnic minority areas.

The Overseas Development Administration (ODA) research project, from which this chapter partly arises, investigated second rotation declining yields in *Cunninghamia* plantations. The key recommendations from this project singled out intensive site preparation, and particularly burning the site after clear-felling, as the most likely causes of yield decline. The project suggested a change in the silvicultural management of *Cunninghamia*, by leaving the slash unburned and planting seedlings through it, while also experimenting with shelterwood systems as an alternative to complete clear-felling. The shelterwood system would leave a small number of trees from the previous crop standing while seedlings grew in their shade. The elimination of clear-felling would also have made it easier to persuade villagers and forest managers not to burn before planting. In any event, while burning and other trials were conducted, it proved unfeasible to conduct a shelterwood experiment because Chinese silviculturalists, who classify *Cunninghamia* as a yang or sun-loving tree, were convinced that it would not tolerate shade,[4] nor would local villagers take kindly to the additional difficulties of planting among the slash.

The practice of burning the site before planting *Cunninghamia* may have originated with ethnic minorities such as the Miao and Yao. As traditional shifting cultivators, they usually cleared areas of forest in a similar way for their agricultural crops. In a sense, this contributed to the image of traditional *Cunninghamia* management as a system of shifting cultivation adapted for forestry. However, in many areas it seems that, beyond the initial clearing of forest, succeeding rotations were not clear–felled by the ethnic minorities. Here, again, their practices contrast favorably, in an ecological sense, with those of their Han neighbors.[5] In Jianghua county, southern Hunan Province, where traditional management practices are still followed, the Yao leave some trees standing after harvest to continue growing through a second rotation to produce larger sawn timber for house construction. In contrast, their Han neighbors in the same area clear-cut at the end of each rotation (Menzies 1994). Among the Yao, Dong, and Miao minorities on the Guangdong-Guangxi-Hunan border, five to six trees per mu ($1/15^{th}$ ha) are traditionally left to grow through to a second or even a third rotation, and shorter rotations are practiced under these stands. This system closely approximates the shelterwood system recommended by the ODA consultants.[6]

Referring, finally, to our previous example of the She minority lineage system of *Cunninghamia* management in Fujian: it was the She people, not the two Han Chinese lineages, who tended to open the canopy further by not replacing early mortality among the regenerating trees, and only the minority She who avoided clear-felling a site altogether if it had a significant proportion of young natural regeneration of *Cunninghamia*, wenmu (*Cryptomeria*), or useful broadleafs. The rotations of the She, too, were far longer than either of the two Han lineages. To obtain the large sawn timbers needed for house construction, they explained that a complete rotation should last about 95 years (Chandler 1994a).

---

4 For details of the Chinese classification of trees into yin and yang, see Menzies (1996, *610–612*).

5 While the Hmong and Yao have largely remained pioneer shifting cultivators in Southeast Asia until very recently, in many areas of China the transition toward more permanent forms of cultivation was accomplished several centuries ago.

6 Personal observations by Menzies during a field visit to Tongdao Dong Autonomous Prefecture, Hunan, June 1994.

Conclusions

If the soil allelopathy hypotheses preferred by some Chinese silviculturalists (Chou et al. 1987; Cheng 1992; Zhang 1993) prove to be the correct explanation for the declining yields in second or third rotations of monocultural *Cunninghamia* stands, then an initial burning and intensive preparation of the site may well prove to be beneficial. However, if the reasons prove to be an overpreparation of the site before planting, then almost certainly the less intensive practices of land-use management that seem to have characterized traditional ethnic minority *Cunninghamia* cultivation will form part of a solution to the problem.

Extensive intercropping with agricultural and other crops, wider spacing, mixed plantations of *Cunninghamia* with other species, and above all, a far closer integration of industrial forestry with subsistence agrarian systems, are all part of traditional *Cunninghamia* management systems in China. Ethnic minorities, particularly the Yao, Miao/Hmong, Dong, and She, have been prominent in the development of these systems. They demonstrate a possible trajectory of evolution from swidden systems, in which land clearance for subsistence agriculture is the primary objective, to integrated "composite swiddening agroecosystems," in which crops, livestock, and trees all contribute in different ways to rural livelihoods. These management systems, developed by ethnic minority groups over several centuries or more, are important examples of "trees in agricultural landscapes," as agroforestry has recently come to be defined.[7] They also shed a new light on the historical image of the Yao and the Hmong in Southeast Asia as destructive slashers and burners. Clearly, their ancestors in China practiced a careful husbandry of the forest that rationally reduced the pressures of subsistence agriculture on forest resources.

References

Boserup, E. 1965. *The Conditions of Agricultural Growth*. London: George Allen and Unwin.

Chambers, R., and M. Leach. 1987. *Trees to Meet Contingencies: Savings and Security for the Rural Poor*, Social Forestry Network Paper 5a. London: Overseas Development Institute.

Chandler, P. 1994a. Shamu Jianzhong: A Traditionally Derived Understanding of Agroforest Sustainability in China. *Journal of Sustainable Forestry* I, 1–23.

———. 1994b. Adaptive Ecology of Traditionally Derived Agroforestry in China. *Human Ecology* 22: 415–442.

Chen, S., S Pei, and J. Xu. 1993. Indigenous Management of the Rattan Resources in the Forest Lands of Mountain Environment: The Hani Practice in the Mengsong Area of Yunnan, China. *Ethnobotany* 5, 93–99.

Cheng, H.H. 1992. A Conceptual Framework for Assessing Allelochemicals in Soil Environment. In: *Allelopathy: Basic and Applied Aspects*, edited by S. Rizvi and V. Rizvi. New York: Chapman and Hall.

Chou, Chang-hung, Hwang Shih-Ying, and Peng Ching-I. 1987. The Selective Allelopathic Interaction of a Pasture-Forest Intercropping in Taiwan. *Plant and Soil* 98, 31–41.

Cooper, R.G. 1984. *Resource Scarcity and the Hmong Response: Patterns of Settlement and Economy in Transition*. Singapore: Singapore University Press.

Fan, C. 1936 (ed.) *Can Luan Lu* (A Record of Carriages and Phoenixes). Shanghai: Cong Shu Jicheng Series.

Food and Agriculture Organization of the United Nations. 1982. *Forestry in China*. Rome: FAO.

Fortune, R.B. 1939. Introduction to Yao Culture. *Lingnan Science Journal* 18(3), 343–450.

Fung, L.E. 1994. A Literature Review of *Cunninghamia lanceolata*. *Commonwealth Forestry Review* 73(3), 172–192.

Geertz, C. 1963. *Agricultural Involution*. Berkeley, CA: University of California Press.

Grandstaff, T. B. 1980. *Shifting Cultivation in North Thailand*, Resources Systems Theory and Methodology Series. Tokyo: United Nations University.

Hunter, I.R., and J. Evans. 1992. Site Degradation in Chinese Plantations in the Eastern and Southern Monsoon Region of China. Report on a Visit to China for the Overseas Development Administration, November 20, 1992.

[7] This case can usefully be compared with the dongya system practiced by the Hani/Akha on the Myanmar border. See Pei (1985), Wang (1988), Yu (1994), and Chen et al. (1993) for comparative data on the Hani, Dai, Dulong and Nu.

Hunter, I. 1996. Personal communication with the authors.
Huo, Y. 1975. The Effects on Soil Quality and Tree Growth of Burning, Site Preparation, and Intercropping with Shamu. *Guangdong Forest Science and Technology* 4, 7–10 (Chinese language).
Kandre, P. 1991. The Relevance of Ecology and/or Economy for the Study of Yao Religion. In: *The Yao of South China: Recent International Studies*. Paris: Pangu, Editions de l'A.F.E.Y.
Kunstadter, P., G. Chapman, and S. Sabharsi (eds.) 1978. *Farmers in the Forest*. Honolulu, HI: East-West Center, University Press of Hawaii.
Menzies, N. 1988a. Trees, Fields and People: The Forests of China from the Seventeenth to the Nineteenth Centuries Ph.D. thesis. University of California, Berkeley.
———. 1988b. Customary Law and Tree Tenure in China: Whose Trees? In *Proprietary Dimensions of Forestry*, edited by Louise and John Bruce. Boulder: Westview Press.
———. 1991. Rights of Access to Upland Forest Resources in Southwest China. *Journal of World Forest Resources Management* 6, 1–20.
———. 1994. *Forest and Land Management in Imperial China*. London: St. Martins Press.
———. 1996. The History of Forestry in China. In *Science and Civilization in China* Vol 6 Pt.III, edited by Joseph Needham. Cambridge: Cambridge University Press.
Pei S. 1985. Some Effects of the Dai Peoples' Cultural Beliefs and Practices upon the Plant Environment of Xishuangbanna, Yunnan Province, Southwest China. In *Cultural Values and Human Ecology in Southeast Asia*, edited by Karl Hutterer, A. Terry Rambo, and George Lovelace. Ann Arbor: University of Michigan.
Pendleton, R. 1940. Forestry in Kwangtung Province, Southern China. *Lingnan Science Journal* 16(3), 473–495.
Rerkasem, B. (ed.) 1996. *Montane Mainland Southeast Asia in Transition*. International symposium November 12–16, 1995, Chiang Mai, Thailand. Chiang Mai: Chiang Mai University Press.
Rambo, A. T. 1996. The Composite Swiddening Agroecosystem of the Tày Ethnic Minority of the Northwestern Mountains of Vietnam. In *Montane Mainland Southeast Asia in Transition*, edited by Benjavan Rerkasem. Chiang Mai, Thailand: Chiang Mai University Press.
Richardson, S.D. 1966. *Forestry in Communist China*. Baltimore: Johns Hopkins University Press.
———. 1990. *Forests and Forestry in China: Changing Patterns of Resource Development*. Washington, DC: Island Press.
Sheng, W. 1996. A Review on Management of Chinese Fir Plantations. Paper presented to the final workshop of the CAF-ODA Cooperative Project to Correct Yield Declines in Successive Rotations of Chinese Fir, March 25–30, 1996, Chinese Academy of Forestry, Beijing.
Talbott, K. 1996. Roads, People and Natural Resources: Towards a Regional Policy Framework for Transport Infrastructure in Montane Mainland Southeast Asia. In *Montane Mainland Southeast Asia in Transition*, edited by Benjavan Rerkasem. Chiang Mai, Thailand: Chiang Mai University Press.
Tapp, N. 1986. *The Hmong of Thailand*. London: The Anti-Slavery Society and Cultural Survival.
———. 1988. Geomancy and Development: The Case of the White Hmong of North Thailand. *Ethnos* 53, 3–4.
———. 1989a. *Sovereignty and Rebellion: The White Hmong of Northern Thailand*. Singapore: Oxford University Press.
———. 1989b: Reflections on Fieldwork among the Yao. In *Ethnicity and Ethnic Groups in China*, edited by Chien Chiao and Nicholas Tapp. Hong Kong: New Asia Press.
———. 1996a. Social Aspects of Chinese Fir Plantation in China. Paper presented to the final workshop of the CAF-ODA Cooperative Project to Correct Yield Declines of Successive Rotations of Chinese Fir, March 25–30, 1996, Chinese Academy of Forestry, Beijing.
———. 1996b. Social Aspects of Chinese Fir Plantations in China. *Commonwealth Forestry Review* 75(4), 302–308.
van der Meer, C.L. 1981. Rural Development in Northern Thailand: An Interpretation and Analysis. Ph.D. thesis. University of Groningen.
Wang, N. 1988. Preservation and Development of Minority Cultures in Southwest China: A Study on Ethnoecology. Paper presented at the 12th International Congress of Anthropological and Ethnological Sciences, July 24–31, 1988, Zagreb.
Zhang, Q. 1993. Potential Role of Allelopathy in the Soil and Decomposing Roots of Chinese Fir Replant Woodland. *Plant and Soil* 151, 205–210.
Yu, X. 1994. Protected Areas, Traditional Natural Resource Management Systems and Indigenous Women: Case Study in Xishuangbanna, P.R. China. Paper presented at the MacArthur Grantees Meetings/ICIMOD Seminar on Indigenous Knowledge Systems and Biodiversity Management, April 13–15, 1994, Katmandu, Nepal.
———. 1983. *Shamu*. Fuzhou: Fujian Science and Technology Press (Chinese language).
Wu, Z. (ed.). 1984. *Shamu*. Beijing: Forestry Press (Chinese language).