Tropical Forest Research

Traditional Village Forest Management

The Village Forest of Moxie, Southwest-China
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Eschborn 2000
Preface

In 1992 the conference of the United Nations for Environment and Development in Rio, which was attended by 178 states, proclaimed the Agenda 21. This contains a special chapter on forestry questions, which, together with the Forest Principles which were also agreed upon in Rio, form the basis for international cooperation in the conservation and sustainable management of forests. The declarations of Rio serve as the foundation of a process of national policy reform, with the aim of enhancing an environmentally sound and sustainable development in industrialised and developing countries.

The model of sustainable development rests on three main principles, on which all areas of policy should be oriented: economic efficiency, social justice and ecological sustainability. In the case of natural resources, this means that their global use must not endanger the development possibilities of future generations.

Forests of all climatic zones with their diverse functions represent one of the most important bases of human life. At the same time they contribute significantly to the global preservation of the biological diversity of life. Therefore, forest resources and forest areas need to be sustainably managed, preserved and developed. Only this can guarantee the production of forest products such as timber, fodder, food, medicine and fuel in the long-term and at the same time provide other important forest services like the protection against erosion, conservation of biotopes or the adsorption and fixation of the greenhouse gas CO₂ on a permanent and environmentally sound basis.

The project "Tropical Forest Research", carried out by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) on behalf of the Federal Ministry for Economic Cooperation and Development is intended to improve the scientific knowledge on the sustainable development of forests and thereby to contribute to the implementation of the Rio declarations within the framework of development cooperation.

Applied science research can contribute to a better understanding of the tropical forest ecosystems and their interaction with the economic and social dimensions of human development. At the same time, the project aims to encourage young researchers in applied German and local research which can be the basis for the development and dissemination of ecologically, economically and socially adapted forestry production systems.

This publication series by the "Tropical Forest Research" project aims to provide organisations and institutions involved in development cooperation and members of the public interested in environmental and development policy questions with an intelligible access to the results and recommendations of these studies.

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Abstract

This study describes the traditional forest management of the Dai people in Xishuangbanna, Yunnan Province, Southwest China with the aid of a case study in the village Moxie. It offers a comprehensive understanding of the traditional management and use of a village forest within the socio-cultural background of the Dai people.

The following underlying conditions in Xishuangbanna were considered important:

(a) The historical peculiarities of Xishuangbanna. This region was incorporated into Chinese territory at a relatively late date. Significant Chinese influence can be noted since 1949; (b) The multi-nationality of the province in which 14 minorities with their own language, culture and traditional land use systems are living; (c) The forest policy of China. The land reform of 1982-83, which undermined traditional tenure systems in China, had a significant impact on the original land use systems in Yunnan.

There is clear evidence of a changing pattern in the traditional systems. As cash-crop cultivation and the cultivation of traditionally unused land increases, the area under forest is decreasing. Relevant factors are: (a) population growth and the changing composition of ethnic groups, (b) changes in land ownership after the land reform of 1982, (c) the influence of government policies, (d) commercialisation and market orientation, and (e) indirect influences of the Cultural Revolution in China.

These factors have not yet had an effect in the case study site Moxie, which is characterised by still abundant natural resources. The low number of inhabitants (ca. 500) and the moderate demographic increase as well as traditional beliefs of the Dai have prevented major negative impacts on the
on the village land use system. Forest use, hunting, gathering and fishing all play an important role in the subsistence-oriented economy of the Dai. Local markets are still of little importance.

Dai people are Theravada-Buddhists, but still keep old animistic beliefs, which are the basis of the traditional man-forest-relationship. Spirit and tree worship encourage a conservationist attitude towards nature. The indigenous spirit beliefs are reflected in traditional ceremonies, where sacrifices are offered at holy hills, sacred groves and holy trees.

Tenure in forest land is vested in the hand of the community as a common property, everyone has the same rights in terms of access and use. The forest is divided into a used zone and a protected zone. The holy hills, sacred groves and the cemetery forest belong to the protected part, which covers 2% of the entire forest area. Strangler figs (*Ficus* spp.) are not felled in any part of the forest as they are believed to belong to the realm of the spirits.

The villagers divide the used part into a landscape forest and a watershed forest. The former mainly serves to enhance the beauty of the village, while the latter guarantees a sufficient water supply for the paddy fields and the village. The use of the forest is more or less unplanned and is carried out with simple tools. Because of this, the accessibility and transportation of wood are as important as the properties of the timber. Selective felling is carried out for construction timber and small clearings are made for fuelwood. This practice maintains the forested area and the main ecological functions of the village forest. Besides wood, the forest provides a wide range of non-timber products, e.g. bamboo, rattan, fruits and vegetables as well as medicinal plants.
The analysis of the floristic composition and the structure of the forests was undertaken in stratified plots of 0.25 ha each, differentiated according to the distance to the village. The *landscape forest*¹ (ca. 200 ha) is adjacent to the village, the *watershed forest* (ca. 400 ha) is located 3-7 km away. Additionally, the population of strangler figs (*Ficus* spp.) in one part of the landscape forest was studied.

Both landscape and watershed forest stands show a high species diversity. In the compartment > 10 cm DBH, 85 and 118 tree species respectively were found per 1.25 ha plot. The Fagaceae family dominates in the landscape forest, followed by the Moraceae and the Lauraceae families. In the watershed forest the Lauraceae dominate, followed by the Fagaceae and the Styracaceae. Both stands belong to the tropical evergreen montane rain forest. The frequent occurrence of subtropical plant families like Theaceae, Oleaceae, Juglandaceae and Elaeocarpaceae point to the location of the forest on the edge of the tropical zone.

In the compartment > 10 cm DBH, the landscape forest shows 424 trees/ha with a basal area of 26.1 m²/ha, compared with 614 trees/ha with a basal area of 29.0 m²/ha in the watershed forest. The landscape forest shows a distribution peak in the stronger DBH classes formed exclusively by *Ficus altissima*, a huge strangler fig. Strangler figs occupy almost 23 % of the total basal area in the landscape forest. In the watershed forest the basal area shows a typical staircase distribution. No specimens are found in the classes above 100 cm DBH. Strangler figs occupy only 2 % of the entire basal area.

¹ Literally translated from the Chinese term *fengjing lin* (*fengjing* means landscape and *lin* forest).
The volume of valuable timber species and species with good timber properties is much higher in the watershed forest than in the landscape forest, which has a higher proportion of fuelwood.

Natural regeneration (trees above 1.3 m height up to 10 cm DBH) in the two stands shows a higher floristic similarity than that of the tree species > 10 cm DBH. Young Lauraceae dominate in both stands. The percentage of valuable timber species is low in the landscape forest as well as in the watershed forest. Over-logging of valuable timber has a negative impact on the stocking of natural regeneration of valuable timber species. Different parameters, especially the standing volume of valuable timber species, indicate that the intensity of logging decreases as distance to the village increases.

Apart from village forest management sustaining forest cover, the cutting taboo on strangler figs evidently has positive effects on the ecosystem at village level. *Ficus* spp. in tropical ecosystems are keystone species sustaining frugivorous populations. Holy hills, sacred groves and holy trees cover only 2% of the village forest area, but are of great importance for the man-forest relationship.

The village forest is central to the land-use system. Other key elements are: rice paddy, home gardens, cultivation of *Cassia siamea* for fuelwood, cultivation of the medicinal plant *Amomum villosum* under forest shade, agricultural crops, hunting, fishing and gathering.

Out of all presented results conclusions for the conservation and development of village forests are drawn and recommendations are also made for forms of technical development co-operation.
I Introduction

This study analyses the forms of traditional village forest management as part of traditional land use systems in China and looks at the possibilities and problems involved in the community forestry practised there.

Xishuangbanna, a 20,000 km² large remote area in the South of the province Yunnan, in Southwest China, is inhabited by 14 ethnic minorities who all practice their own culture and speak their own language. The various differing land use systems which have been developed by these ethnic groups have formed the landscape of the area. One central element of all these systems is the village forest. A speciality in this region is that almost all villages have holy forests indicating the close spiritual relation between the people and their forest.2

Field research was conducted for the case study of the Dai-village Moxie and offers insights into the traditional use and management of the village forest within the socio-cultural values of the Dai.

Field research was conducted for the case study of the Dai-village Moxie and offered broad insights into the traditional use and management of the village forest within the socio-cultural values of the Dai.

The objectives of the study are:

• Description of the village conditions which are relevant for traditional forest management.

2 PEI 1985b
Traditional village forest management

- Description of the peculiarities of the village forests, which are based on religious beliefs.
- Analysis of the impact of socio-cultural factors on the management and use of the village forest.
- Analysis of the structure and floristic composition of the village forest and the possibilities of sustainable use.
- An overview of the whole land use system of the Dai and the relationship between the individual forms of land use.

The conclusions drawn at the end of the study concerning the significance of the village forests have the aim of supporting the conservation and sustainable development of the village forests within the research area. The consequences derived from these conclusions for future development cooperation were drawn on this basis.
II The setting in Xishuangbanna

1 Administrative structure and historical overview

The present day Chinese province Yunnan is divided into 15 prefectures, of which 8 are autonomous. The autonomous prefecture of the Dai nationality, Xishuangbanna, is composed of three counties, Menghai, Jinghong and Mengla. These are further divided into townships.

The connection between Yunnan and the original core area of China can be traced back to the 2nd century BC. A Chinese settlement was set up only later, however, after the Yuan-dynasty (1280 -1368) finally managed to incorporate Yunnan into the Chinese state, initially under Mongolian rule.

The antiquated feudal system was only dissolved after the Communists took power, who then set up a new administrative structure. In the year 1953, Xishuangbanna received the status of an "autonomous prefecture of the Dai-nationality".

2 Population and Minority status

At present, 28 of the 56 officially recognised ethnic minorities of China live in Yunnan province. 14 of these minorities, totalling 790,000 people, live in Xishuangbanna alone. Each minority has its own specific land use system. The most important ethnic groups in Xishuangbanna are the Dai, Hani and Aini, Yi, Yao, Lahu, Bulang and Jinuo. The Dai are the biggest group with 35% and are closely followed by immigrant Han-Chinese who make up ca. 29% of the population.

3 ANONYMUS 1990
Since the 1950s, autonomy has been granted to ethnic minorities along the lines of territory and nationality. Autonomy does not mean that these areas have the right to separate from the Peoples' Republic however, but that they benefit from certain special privileges under the administration of the higher organs. These include:

- the use of language and writing of the nationalities in these areas
- the officials in the administration are mainly recruited from the national minorities
- own laws and regulations can be set up
- own production plans can be drawn up (within the framework of the national state plan)
- the choice of an individual path of economic and cultural development (within the framework of the constitution)\(^4\)

These rights are rooted in the Autonomy Law of 1984. This tends to be so general in its formulations, however, that the content of the law is more intentional in character. The implementation of the law, especially in regard to the privileges listed above, meets with difficulties in Xishuangbanna as indeed in other autonomous areas.

3 Economic Geography

Yunnan is one of the poorest provinces in China, which is due to the infrastructure and transportation problems of this mountainous area. Although the Mekong flows through Xishuangbanna, and although the
The setting in Xishuangbanna

prefectural capital Jinghong is located on the river, until recently it has been one of the most isolated prefectures in Yunnan.

Fig. 1: Geographic Location of Xishuangbanna

The infrastructure of Xishuangbanna is still underdeveloped today, although the transportation lines are being expanded. These include the shipping traffic on the Mekong, the railway line between Kunming and Chiang Mai in Northern Thailand and the rebuilding of the old Burma Road between Kunming and Mandalay. There are also plans to connect the inland airport in Jinghong to the airport in Chiang Mai.

If the geographic position and the 4000 km long border of Yunnan used to be a big economic problem, in future the province and in particular Xishuangbanna prefecture could become an important economic area because of it. Historical and cultural relationships to both neighbouring countries Myanmar and Laos and also to Thailand and Vietnam already exist, and some
border traffic also takes place with Laos and Myanmar. The opening of the border to Thailand is due to take place in the near future.

Production in Xishuangbanna is almost entirely comprised of agricultural goods like tea, rice, sugarcane, cotton, rubber, peanuts as well as fruit and vegetables. The prefectural capital Jinghong is the only place which has wood and textile processing industries and sugar refineries and the production of agricultural machinery. Tourism is becoming more important. China's economic boom is also having an effect in Xishuangbanna.

4 Natural Geography

Xishuangbanna comprises 19.223 km² and is located within the Central Mountain Range of Mainland Southeast Asia. The topography is characterised by a very irregular relief with altitudes between 420 - 2400 m.

In Xishuangbanna, a typical monsoon climate prevails, in which two main air masses alternate during the year: between May and October the South-West-Monsoon delivers about 80% of yearly rainfall, whereas the dryer air of the Southern edges of the jet streams dominates the climate between November and April. Although rainfall is very seasonal, the dry season is not extreme in nature. According to ZHANG (1986), however, forest destruction and extensive cultivation of *Hevea brasiliensis* has led to local climatic changes in Xishuangbanna which has become warmer and dryer.

The climate is classified according to altitude into a Northern Tropical Climate below 800 m, a Southern Subtropical Climate between 800 and 1500 m, and a Tropical Rainforest Climate above 1500 m.

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5 ZHENG 1981
6 LIU et al. 1986
m and a Subtropical Climate between 1500 and 2000 m. The irregular relief creates local climatic specialities and exceptions to this classification.

LI & WALKER (1986) divide the vegetation of Yunnan into 13 formations, of which three are really relevant for Xishuangbanna. Local climatic differences are causing frequent changes in the three formations, sometimes they merge together resulting in a high species diversity. In a very small area, these forest formations bring together elements of lowland tropical forests and even deciduous species of more temperate zones.

5 Changing patterns in the traditional land use systems in Xishuangbanna

5.1 Overview

The traditional land use systems of the different ethnic groups in Xishuangbanna are manifold. Innovations and land use techniques which certain ethnic groups have brought with them from other regions have been adapted by neighbouring groups. The cultivation of Cassia siamea for fuelwood, for example, was introduced to Xishuangbanna by the Dai and copied by other minorities and by the Han-Chinese later on.

The forest area in Xishuangbanna decreased from about 60% in the late 1950s to around 40% after the Cultural Revolution in 1969 to the current cover of ca. 28%. The area in the valleys used for paddy cultivation

7 ANONYMUS 1987
8 PEI 1985b
9 IUCN 1991, GUO 1993
10 IUCN 1991, GUO 1993
Traditional village forest management has hardly changed, as it is physically difficult to expand. However, paddy production has been steadily intensified and production per capita increased by 144% between 1949 and 1977, even though the population quadrupled.11 The area devoted to upland rice and to shifting cultivation, in contrast, expanded rapidly between 1972 and 1982, but has remained fairly stable since. Over 80,000 ha of rubber plantations with *Hevea brasiliensis* were established over this period of time (see table 1).

**Table 1: Changes in Land Use in Xishuangbanna between 1972 and 1992**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rice Paddy Area in ha</th>
<th>Upland Rice Area in ha</th>
<th>Shifting-Cultivation Area in ha</th>
<th><em>Hevea brasiliensis</em>-Plantations in ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>41400</td>
<td>49600</td>
<td>13200</td>
<td>10800</td>
</tr>
<tr>
<td>1982</td>
<td>43000</td>
<td>58100</td>
<td>46000</td>
<td>57700</td>
</tr>
<tr>
<td>1992</td>
<td>43300</td>
<td>60600</td>
<td>44200</td>
<td>92500</td>
</tr>
</tbody>
</table>

*Source: GUO 1993*

A tendency apart from the cultivation of *Hevea brasiliensis* is the recent focus on cash crops such as tea, coffee and fruit trees as well as medicinal plants (especially *Amomum villosum*).

Furthermore, one trend is for some ethnic groups to expand their indigenous cultivation methods to areas which were not traditionally used by them, e.g. highlander groups are now starting to cultivate in valleys and lowlanders are moving into higher areas. Other minorities which practised shifting

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11 ANONYMUS 1990
cultivation in the higher altitudes of Xishuangbanna have now become settled and have changed their traditional land use completely.

Negative impacts can be assumed by the rapid and unplanned changes of the factors which influence the land use systems, because the traditional concepts and land use systems cannot adapt to them and might even collapse, which would incur further negative effects.

5.2 Reasons for the changing land use systems

5.2.1 The influence of the Cultural Revolution

During the Cultural Revolution (1966-1969), a maximum food production was aimed at in order to increase the agricultural base of a projected industrial society. In Xishuangbanna, this lead to the increase of areas devoted to upland rice production at the expense of the forest.

At the high point of the Cultural Revolution, traditional and religious structures of authority were destroyed, thereby undermining those institutions which protected holy forests and trees. This led to the devastation of such areas.

Today the traditional customs have been revived in the cultural life of the minorities, and the remaining holy forests are strictly protected again.

5.2.2 Land tenure

Due to the large number of different ethnic groups and land use systems, Xishuangbanna has various forms of traditional land tenure. However, there are no clear property rights dividing the individual settlements.

12 BUNDESZENTRALE FÜR POLITISCHE BILDUNG 1990
The land reform carried out by the Communist Party of Mao Zedong between 1950 and 1953 nationalised all forest areas. Shortly afterwards, the forest areas were collectivised. In 1957, the "collective forest farms" were founded, which were envisaged as bases of production for industrial wood demand and which still exist today. From 1958 onwards, the state set up People's Communes, which managed the agricultural and forest lands collectively.¹³

In 1978, the ”System of Contracted Household Responsibility with Remuneration Related to Output” was introduced, replacing the People's Communes.¹⁴ Later, between 1982 and 1983 another land reform was implemented throughout China, in which the land was rented out to the villages. This land reform contained two regulations which arranged the ownership of agricultural and forest land.

Both regulations aimed to ensure that all agricultural land and most of the forest land was divided up between the individual households. It was assumed that 10-20 ha of forest should generally be enough for one household.¹⁵ In Xishuangbanna, this has been realised for agricultural land, afforestations and shifting cultivation land, but there is hardly any village forest that has been divided up between the individual households. These are still in communal ownership.

Apart from the positive effects of the land reform, which include an increase in agricultural production, a major disadvantage is that timber felling has increased threefold and that the forest area has decreased.¹⁶ This has also to
do with the fact that farmers, used to sudden 180 degree turns in Chinese politics, took advantage of the opportunity to fell trees. Where the forest has been divided up between households, it tends to be in worse condition than the communally owned forest.

The land reform had a further direct impact on changing land use patterns of certain highland groups in that it prohibited shifting cultivation, thereby forcing those peoples engaged in this form of agriculture to become sedentary. Indirectly the reform encouraged a more pronounced and flexible market orientation of the households which meant that cash crop production was intensified.

### 5.2.3 State policy

Of major significance for land use was the state sponsored support of *Hevea brasiliensis* cultivation. Because of an international trade blockade, China started to establish rubber plantations in 1953. After this proved to have negative effects on soil quality\(^{17}\) and on climatic conditions\(^{18}\) this support was shelved and no further state plantations were established. In the meantime, however, market prices for rubber have risen so dramatically that communal municipalities are now beginning to plant *Hevea* themselves. Interestingly, because of the lack of land, local farmers have developed systems in which they combine *Hevea brasiliensis* with tea, pineapple, mango, medicinal plants etc. The state farms are now starting to adopt these new methods.

Another intervention by the state is its migration policy. Up until 1982, Han-Chinese were repeatedly introduced into the region in the form of

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\(^{17}\) URUSHIBARA-YOSHINO 1986

\(^{18}\) ZHANG 1986
Traditional village forest management

independent units (road construction and co-ordination, forest farms, tea factories etc.) and this caused land scarcity and an intensification of resource use. Within the context of creating over 200,000 ha of "Nature Reserves" in Xishuangbanna, highland dwellers were relocated into the plains in order to keep them out of the core part of the protected areas.

5.2.4 Population growth and changing demographic structures

The major increase in the number of Han-Chinese was largely due to uncontrolled immigration during the Cultural Revolution (1963-69) (see table 2). Today they are the majority population in the towns. Lowland groups (99.8% Dai) and highland peoples (Hani, Yi, Yao, Jinuo etc.) both have a high rate of population growth, dating back to the Cultural Revolution, where birth control was frowned upon and the other extreme was encouraged. Only after 1973 did the old regulations become enforced again. Underrepresented minorities are now allowed to have three children, and most of the highland groups qualify. This is why the population of the highland ethnic groups is growing faster than the others. This also explains the increase in area devoted to upland rice and to shifting cultivation.
Table 2: Total population and ethnic composition in Xishuangbanna

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Population</th>
<th>Proportion of ethnic minorities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Proportion of Han-Chinese</td>
<td>Lowland groups (Dai)</td>
</tr>
<tr>
<td>1949</td>
<td>179.300</td>
<td>5.000 2.8 %</td>
<td>105.100 58.6 %</td>
</tr>
<tr>
<td>1956</td>
<td>250.645</td>
<td>17.905 7.1 %</td>
<td>131.796 52.6 %</td>
</tr>
<tr>
<td>1982</td>
<td>645.896</td>
<td>185.894 28.8 %</td>
<td>223.663 34.6 %</td>
</tr>
<tr>
<td>1992</td>
<td>790.460</td>
<td>201.850 25.5 %</td>
<td>270.900 34.3 %</td>
</tr>
</tbody>
</table>

Source: GUO (1993)

5.2.5 Commercialisation

The commercialisation of agriculture began in 1978 and is closely connected to the rehabilitation of Deng Xiaoping. Within agriculture, the land reform and the legalisation of the free market increased income per capita from 10 Yuan in 1978 to 51 Yuan in 1983\(^{19}\). The cultivation of cash crops increased. Increased income made more investment and specialisation within agriculture possible and this started to question the dominance of the subsistence economy. This has had far-reaching consequences for traditional land use systems.

\(^{19}\) RICHARDSON 1990
6 Forest Policy

6.1 Forest areas, land tenure and forms of management

According to the IUCN (1991), the percentage of forest cover in Xishuangbanna has fallen from 60% in the late 1950s to 32% in 1981. At the moment it is at about 28%.\(^{20}\) In Mengla county, forest cover stands at 47% (333,000 ha), which makes it the most wooded county. 82% of the area of Mengla county is state managed (113,000 ha Nature Reserves, 116,000 ha production forest, 44,000 ha forest farms) and 18% (60,000 ha) is under communal administration. The non-forest areas also include 78,000 ha bushland, including bamboo, 24,000 ha of degraded forest and 50,000 ha of *Hevea brasiliensis* plantations.

For 1982, a cutting volume of 40,000 m\(^3\) is planned for Xishuangbanna.\(^{21}\) This would imply a yearly harvest of only ca. 0.2 m\(^3\) per ha of production forest. Nevertheless, the forest is usually over-exploited. The reasons for this contradiction lie in uncontrolled fuelwood gathering, illegal timber theft and shifting cultivation.

Forest management in state forests usually means the harvest of timber with clear-cutting procedures. Afterwards the area is left for natural regeneration. Signs of an emerging management system are not forthcoming. Reforestation activities are rare. Between 1974 and 1982 a total of 18,000 ha wereas

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\(^{20}\) GUO 1993

\(^{21}\) ANONYMUS 1990
planted. Popular species are *Pinus khasya* var. *langbanniensis*, *Cassia siamea*, *Gmelina arborea*, *Paramichelia baillonii* and *Toona ciliata.*

The forest farms are forest product oriented companies. One forest farm usually consists of about 200-300 households and the forest area allocated to them by the state. The farmers tend to be immigrant Han-Chinese. In most cases this kind of management took the form of clear-cutting with subsequent reforestation, which usually failed. Usually because of the lack of forestry training, the areas were subsequently used for agricultural cultivation, mainly for tea. Today, the forest farms buy forest concessions in the village forests.

In contrast, the communal forest areas which are owned by the lowland minorities are usually managed by selective cutting systems which guarantees a permanent forest cover. The highland minorities mainly practice shifting cultivation, which is an area-oriented management system. Because of increasingly scarce land resources, it often leads to the loss of forest area.

### 6.2 Forest administration

The forestry offices in the townships are the smallest units of the forest administration. Apart from managing the state forests, they are also responsible for controlling and advising the village forests. They are subordinated to the county forestry bureaux, which have more professional staff and are therefore the most important units for forestry in China.

According to the Chinese Forestry Law of 1984, the state organs are also meant to supervise a sustained yield forest management in the village forests. This is impractical in the remoter areas. According to the law, the communal

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22 ANONYMUS 1990
municipalities need to apply for a license at the forestry office in order to harvest timber in their own forest. This does not usually take place, especially when timber is felled for subsistence needs.
III  The Dai village Moxie

1  Geographic location and historical peculiarities

The village Moxie is situated in the Mengla county, Shangyong township, about 40 km Southeast of the connecting road between Mengla to Muang Hay (Nam Tha province, Northern Laos), and about 20 km away from the border to Laos. With 76% forest cover, Shangyong township is the most forestry-dense in Mengla county.

Fig. 2: Location of the Dai village Moxie in Xishuangbanna
Traditional village forest management

Due to the close proximity of a salt spring, Moxie developed quite early on to become a small centre. It is the oldest village in the borough of Shangyong and is very traditional and established.

In 1949, Han-Chinese took over the management of the salt spring and set up a small salt factory. Today, about 300 Han-Chinese work and live here. This led to the loss of ca. 50 ha for Moxie.

Further land loss occurred in 1980 when a forest farm with 200 ha forest was established in the Northern perimeter of Moxie. Around 100 Han-Chinese live at the farm, and because of insufficient knowledge and the lack of forestry skills, have just about completely degraded the forest by today.
2 Agricultural and forestry use areas

The productive land of Moxie covers about 800 ha today, of which 600 ha are forest, 70 ha are paddy, 70 ha are other cultivated areas (tea, peanuts, corn, cotton and others), 20 ha are home gardens and fuelwood groves and 40 ha...
are for other uses. Shifting cultivation is not undertaken by the Dai from this village, but it does take place in other Dai villages in Xishuangbanna.

3 Socio-economic structures

In 1993, Moxie had 480 inhabitants (ca. 200 men, 160 women and 120 children). The village is made up of 91 households, in which on average 5.3 people live. Marriages usually take place between inhabitants of neighbouring villages. Mixed marriages between members of different ethnic groups only very rarely occur. The Dai, unlike the Han-Chinese, do not have preferences for male or female children. The man is the head of the household, but the woman usually administers the money. The Dai have to accept the Chinese birth control policy. The rural population is allowed to have 2 children per marriage. A moderate rate of population growth at around 1.2% per year can be derived from two sets of data: in 1982 there were 417 inhabitants, in 1993 480 inhabitants. Birth and death rates are not available.

The Dai practise a form of subsistence economy. They produce, with a few exceptions, nearly everything they need themselves.

A typical household has around 0.8 ha. of paddy, 0.1 ha home garden, 0.1 ha of fuelwood grove, 0.3 ha of tea plantation, 0.5 ha of other agricultural land (corn, peanuts etc.), 0.2 ha of land for medicinal plants in the forest, 4 water buffaloes, 2 pigs and 10 chickens. Water buffalo are used to plough the rice paddies but are also eaten. Chicken-, pig-, cattle- and sometimes duck-husbandry is widespread. In addition, every household gathers forest products in the entire village forest area.

23 Data for 1993
The agricultural field work is done by all the available labour force of the household. Forest work, hunting, fishing and house-building is done by the men, women do the gathering, weaving and cooking. All work is done with simple tools. Today, nearly every household owns a small tractor, which is also used for transport and carriage of heavy goods.

The individual households hardly deviate from the average described above. The income level is very well balanced and is around 700 Yuan per capita and annum.24

• *Agriculture*

Every household has rented its productive areas from the state, the rent is paid in kind and is 9 kg rice per 0,066 ha (1 mu), which is equivalent to about 4% -6% of the harvest. A small one-off fee of 1 Yuan (0,20 DM) per m² must also be paid for establishing a home garden. Some areas were established before 1982 and are still worked collectively.

In Moxie mainly rice is grown in the valleys, and this is combined with permanent crops like tea on the lower slopes.

• *Gathering, fishing and hunting*

Although they are sophisticated rice producers, the Dai have remained gatherers and they have a wide knowledge of plants at their disposal. A great number of plants which were gathered in the past are now cultivated in the home gardens.

Fishing, which includes lots of different techniques in rivers and in specially established ponds is quite important, hunting is less significant.

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24 Source: personal communication of the village cashier
Traditional village forest management

- **Crafts**

  Typical crafts practised by the Dai are weavings, basket and mat weaving, joinery and carpentry and brick baking. Nearly all households exercise these skills to fulfil their basic needs. Brick baking is an exception and there is a small kiln with permanent craftsmen at the edge of the village for their production.

- **Infrastructure**

  Because the village is near the road, transportation to Mengla town is relatively easy with public transport (bus), tractor or bicycle.

  There is one primary school in Moxie which teaches in Chinese language until the 4th grade. Further education can be obtained in Mengla town and Jinghong, but this is only rarely taken up, because family members who are old enough to work are needed for field work.

- **Markets**

  The biggest market for all products is Mengla town. Because of the fairly large distance of 40 km it is not visited frequently by the Dai from Moxie. It is sometimes used to sell spices, bamboo shoots, sugar cane, fruit and vegetables. Goods for more long-term consumption such as tools and household articles and clothes are bought there.

  Because of the proximity of the road, there is also a local market for tea. Nearby tea factories buy the product daily. Other markets include the salt factory and the forest farm, which are supplied with rice, meat, chicken and fish, as well as with fuelwood. The Dai can buy everyday goods like alcohol and cigarettes there.
4  Political, administrative and religious structures

Political power in the village is traditionally wielded by the village elders. On bequest of the central government, every village has to elect a village head, two deputies, a treasurer and a secretary. Today, the village head and his deputies represent the leadership of the village if political or economic questions need to be resolved. All spiritual, cultural and religious decisions are still made by the village elders. Typical for the Dai is their culture of debate, a broad consensus is sought after before any decision is made.

The religion of the Dai is Hinayana-Buddhism. Elements of older animistic religions have persevered at the same time and have fused with the Buddhist ones. Certain contradictory forms of animistic religion and Buddhism co-exist side by side.

5  The village in the mirror of geomancy

Geomancy is an old Chinese science which has existed since the 4th Century BC in order to harmonise humans and their buildings with different Earth energies. The right location and positioning of houses, roads, bridges and ditches etc. is seen to be important for happiness, health and wealth.\textsuperscript{25} The invention of the compass in China happened in connection with the development of geomancy.\textsuperscript{26}

Geomantic knowledge, which was decried as superstition in communist China has been forgotten by many today. However, lots of old geomantic practises are still evident in older settlements and in non-built-up areas in the way buildings and landscape elements are arranged. In Dai villages this can

\textsuperscript{25} NEEDHAM 1956
\textsuperscript{26} DIETSCH 1986
be seen in the regular way in which the environment of the village is arranged.

Fig. 4: Holy sites in and around the village

If a Dai village is founded, a suitable location for the cemetery must be found. It must be situated in a lower place than the village, symbolically beneath the level of the living. In contrast, holy forests are always on hills, because they belong to the world of the spirits and therefore need to be situated above the level of the living. The position of the houses, the location of the temple and the pagoda are also chosen along geomantic lines by the village elders. Practical considerations also play a role and they are combined with the aesthetic principles of geomancy.

Figure 4 shows the holy locations of Moxie village and its direct environment. The cemetery which is located beneath the village was not
moved as the village was relocated. The oval shape of the village is held together by four village gates.

6 Holy forests, sacred groves and sacred trees

6.1 Holy forests and sacred groves in Xishuangbanna

Holy forests and sacred groves are protected forests. The holy forest symbolises nature as the counterpart of the village. It is the representative of the one from which the villagers wrest their everyday necessities and has to be protected to sustain their living and well-fare. Whereas the origin of holy forests rests in animistic, pre-Buddhist beliefs, sacred groves are connected to Buddhism. The former are always natural forests, the latter are planted. Holy forests are usually much larger than the sacred groves. Sacred groves are nearly always located near temples and can also be characterised as temple forests.

Another protected forest is the cemetery forest of the Dai, which can also be found in the villages of most of the other minorities in Xishuangbanna. For the cemetery, the Dai invariably select a forest area separated from the holy forest and sacred groves.

An estimate made by this author puts the percentage of holy forests of the total 120,000 ha village forest area in Xishuangbanna at only 5-10%. This means are that today there are only 6,000 - 12,000 ha of holy forests in a pristine state. This estimate includes the holy forests of other minorities apart from the Dai.

27 Although every Dai village still has its own holy forest today, many are degraded and some are even reduced to only groups of trees.

27 This estimate includes the holy forests of other minorities apart from the Dai.
Even though this is a very rough estimate, it points to a drastic decrease in area of holy forests in Xishuangbanna. PEI (1985b) estimated that 50,000 ha of holy forests existed in the 1970s. It is possible, that many holy forests which were not in close proximity to a village were taken into state ownership after the land reform of 1982.

6.2 Holy forests, groves and trees in Moxie

All the different kinds of protected forests described above exist in Moxie. The holy forest is made up of three pieces of forest with a total area of ca. 6 ha. In addition there are sacred groves near the old temple and new temple (with 0.5 ha each) and round the pagoda (ca. 2 ha).

- The holy forest

No research was undertaken in this forest out of respect for the villagers who feared negative implications for the village. A walk through the forest gave the impression that the forest is a 20-year-old secondary forest with very old strangler figs, some of which are completely rotted. It seems as if the forest has been completely undisturbed for the last 20 years.

In the holy forest, every kind of use and hunting is forbidden, and women are not allowed to enter it. The most important element of the holy forest is the sacred tree, which stands on the middle at the top of the hill and which is usually a strangler fig. In Moxie's holy forest, this is a *Ficus altissima*, which was not planted but occurred there naturally. At the foot of the tree there is a small bamboo shrine which acts as a comfortable home for the spirits and in which small sacrifices are placed.
The holy forest is the place of collective cult rites of the village. During the traditional village festivities, animal sacrifices are offered at the tree which are thought to enhance the well-being of the whole village community.

- **Sacred trees**

In the remoter tribal areas of the Dai ethnic group the tree cult has survived. Forestry science has known for some time that in this area, *Ficus religiosa* and *Ficus benghalensis* are especially chosen as sacred trees. Almost every village in Xishuangbanna has sacred trees which are the location for performance of rituals and traditional sacrificing ceremonies. Here, too, a distinction can be made between sacred trees dating back to pre-Buddhist, animistic beliefs and those attributable to Buddhism. The former grow wild and are worshipped through collective rituals, whereas the latter are planted and are often worshipped in individual ritual acts.

*Ficus religiosa* is usually planted as a sacred tree for family cult activities. These can often be found near the village. Small sacrifices are regularly brought to these trees. The wild sacred trees are nearly all species from the Ficus genus. In Moxie, *F. altissima* is the dominant species.

In addition to the sacred trees which are the focus of regular sacrifices, all other large strangler figs are not felled (*Ficus altissima, F. benjamina, F. annulata, F. stricta* a. o.), as well as host trees which have been infested by young Ficus epiphytes. These trees are seen as representatives of the sacred tree and as a popular place for spirits, however, sacrifices are not made to them.

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28 BRANDIS 1897, BÜSGEN 1904, TROUP 1921
Sacred groves are influenced heavily by Buddhist thinking. They are usually located near temples. They are always planted groves which contain many allochthonous species (*Ficus religiosa*, *Dipterocarpus turbinatus*, *Dialium ovoides*). PEI (1991) compares the sacred groves of Xishuangbanna with botanical gardens, in which rare species of plants are protected *ex situ*.

• *The cemetery forest*

The cemetery forest is a separate piece of forest in which every use and other activity is forbidden. The cemetery of Dai villages is always separated from the holy forest.

### 6.3 Ecological significance

The ecological and obviously positive effects of holy forests are primarily their role in protecting floristic biodiversity in Xishuangbanna. LIU and XU (1989), in their research on five holy forests, found between 105 and 122 species of plants in the 0.15 ha survey plots. They emphasise the importance of holy forests as stepping stones for genetic exchange between biotopes. PEI (1985b) refers to their significance as a watershed for adjacent rice fields and as an element of a balanced, ecologically sustainable land use. In areas with little forest cover, holy forests are important islands of biodiversity. However, the positive effects of holy forests are primarily a spin-off effect of strictly religiously motivated behaviour.
IV The management of the village forest of Moxie

1 Site conditions

The whole 600 ha of village forest are located in the altitudes 750 - 1,150 m above sea level. Theoretically, this characterises it as monsoon forest. However, typical characteristics of this form of vegetation are lacking. In the dry season, leaf fall of the emergent trees in the canopy is less pronounced. The Moxie village forest is a transitional vegetation type between the montane moist evergreen forest and the moist deciduous forest (monsoon forest). Local site conditions are influencing the spectrum of species regardless of the altitude in the direction of one or the other type.

Because Moxie is higher up than Mengla town, it can be assumed that the annual mean temperature is between 20 °C (800 m) and 18 °C (1,200 m). Annual rainfall is at around 1,600 - 1,700 mm. Frost can occur above 1,100 m.

The soil conditions in the village forest have proven to be very homogenous. Using FAO classification, below 900 m Rhodic Ferralsol and above 900 m Ferralsol dominates. The two types differ mainly in the content of ferric oxide. The turnover of soil on the slope generates differences in soil depth, clay content and nutrient content. These decrease with increasing altitude. Most of the soil is characterised by a favourable soil texture. Water and nutrient content of the soil can be estimated with the help of indicator plants.
2 Regulations on forest use

The whole forest is owned by all villagers as a common property. The common ownership of the forest implies the same user rights for every individual. Strict and detailed use regulations have probably never developed by the villagers themselves because of the presumed abundance of resources. As long as subsistence needs are met, also state restrictions are nearly absent. A license needs to be collected from the forestry office before felling for house-building is allowed, but this is just a formal procedure. Clear-cutting and the conversion of forest area into other uses is not allowed, but this is more a principle of forest management rather than a restrictive law and is therefore more dependent on the acknowledgement of each individual. However, timber for the market can only be sold via the state forestry farms. The amount paid for there is well below market prices.

3 Management techniques

The managed part of the village forest comprises ca. 98% of the total area and is divided into its functions as landscape forest and watershed forest.

Whereas the main function of the landscape forest is to enhance the beauty of the village, the watershed forest is meant to supply the village with a sufficient and regular amount of drinking water and to irrigate the rice paddies.

The forest is still managed with simple tools like axe and saw, without any timber is limbed and barked in the forest and is then hauled with the aid of ropes and gravity to the nearest truck-suitable road. For this reason, felling is not just dependent on timber quality but also on the accessibility and transportability of the wood.
The management techniques employed by the Dai guarantee the sustainability of forest cover and the main ecological functions of the forest. However, negative effects on species composition and structure of the village forest can be discerned.

4 Forest products

4.1 Timber and fuelwood

The Dai have extensive indigenous knowledge concerning tree species and their wood properties. Research into the timber already used in construction showed that for constructions of the houses and the temple, only species with excellent quality and durable wood properties are used.

For timber, the following tree dimensions are required: for beams of 20 by 20 cm, trees with at least 30 cm DBH. Trees above 60cm DBH can be sawn into 4 beams of that dimension. For house construction, a length of 12 m per beam is ideal.

Whereas timber is harvested in a selective felling system, fuelwood is felled in small scale clearances of under 1 ha and sometimes in clear cutting. Preferred tree dimensions for fuelwood harvest are 20 up to 60 cm DBH, because the wood is cut by hand into 1 m long pieces and then split.

4.2 Non-timber forest products

4.2.1 Bamboo species and their uses

In Xishuangbanna over 60 species of bamboo are found from 17 different genera, of which 13 can be found in Moxie. Bamboo grows in the village forest as well as in the village and on agricultural land. With the exception of *Indosasa sinica*, *Pleioblastus* sp. and to some extent *Cephalostachyum*
pergracile all bamboo is cultivated. In the forest, it is restricted to borders close to settlements. The planting of bamboo establishes utilisation rights. Bamboo is used for many purposes, especially for auxiliary constructions for small stilt buildings, for verandas and for the bedroom flooring of the Dai houses, for weaving looms and for constructions for curing meat over the open fireplaces in the house. Carpets, baskets and other vessels, fish traps, chairs and tables are all made out of plaited bamboo. Cephalostachyum pergracile is used as a container for rice. Fireworks are made out of Schizostachyum funghonii for the water festival of the Dai and knitting needles are made out of Dendrocalamus hamiltonii. And last but not least, various kinds of bamboo are used to make chopsticks and others are used as offerings at the sacred trees.

4.2.2 Other non-timber products

The Dai collect a large number of non-timber products from the forest. These gathering activities are usually done whilst other jobs are being executed. Their economic significance within the subsistence society should not be underestimated. In this field, a whole range of indigenous knowledge and special technology for their use has been developed. Nearly all these products are gathered for household needs. A lot of the products which used to be collected in the forest are now grown in the home gardens. Some of the identified species and their uses are listed below, without claiming comprehensiveness. This ethno-botanical research was only done in Moxie. Those species which are now mainly grown in the home gardens are described in a later chapter and are not listed here, the same applies to medicinal plants. The Dai seem to use the latter only sporadically and it seems as if indigenous knowledge is being lost here.
The management of the village forest of Moxie

Pteridaceae: *Pteridium aquilium* var. *latiusculum* (L.): young shoots are used as a vegetable.

Saururaceae: *Saurura chinensis* (Lour.) Baill.: whole plant is used as a vegetable.

Guttiferae: *Garcinia xanthochymus* Hook. f. ex T. Anders.: edible fruit

Caesalpiniaceae: *Bauhinia variagata* (L.): blossoms are used as a vegetable.

Mimosaceae: *Acacia intsia* (L.) var. *caesia* Wight et Arn.: young shoots are used as a vegetable.

Fagaceae: *Castanopsis hystrix* A. DC.: edible fruit

*Castanopsis indica* (Toxb.) DC.: edible fruit

*Castanopsis mekongensis* A. Camus.: edible fruit

Moraceae: *Ficus auriculata* Lour.: edible fruit, young leaves are used as a vegetable.

*Ficus callosa* Willd.: young leaves are used as a vegetable.

*Ficus glomerata* Roxb.: young leaves are used as a vegetable.

*Ficus lacor* Buch.-Ham.: young leaves are used as a vegetable.

*Ficus semicordata* Buch.-Ham. ex J. E. Sm.: edible fruit.

Burseraceae: *Canarium album* (L.): edible fruit

*C. strictum* Roxb.: edible fruit

Sapindaceae: *Nephelium chryseum* Bl.: edible fruit.

Anacardiaceae: *Dracontomelon macrocarpum* H. L. Li: edible nuts.

*Spondias pinnata* (L.): Fruit used for sauces

Juglandaceae: *Pterocarya tonkinensis* Dode: Leaves are used as fish poison, wood ashes are used to make gunpowder, fuelwood for religious ceremonies.

Rubiacsae: *Rubia cordifolia* (L.): red dye is made out of roots

Solanaceae: *Solanum nigrum* (L.): whole plant is used as a vegetable.

*S. verbascifolium* (L.): Leaves are used to clean pots and pans, bark is used to produce gunpowder.

Verbenaceae: *Gmelina arborea* (L.): Blossoms are used as a spice to sweeten rice.

Musaceae: *Musa* spp.: Branches are used as animal fodder, blossoms are used as a vegetable.

Zingiberaceae: *Alpinia galanga* (L.) Willd.: Fruit is used to make medicine.

Marantacaceae: *Phrynium capitatum* Willd.: Leaves are used to roll food in.

Palmae: *Calamus* spp.: Rattan for making furniture

Gramineae: *Imperata cylindrica* (L.) Beauv. var. *major* (Nees) C. E. Hubb.: is used to thatch roofs.
V Forestry science surveys

1 Location and characteristics of the individual sample plots

As this research was intended to supply qualitative parameters on individual tree species, it was not related to a specific area. Only one part of the village forest was systematically examined with regard to these individual tree species.

Firstly, a pre-stratification was undertaken in the landscape forest and in the watershed forest. This was done because it was assumed that these forests would be different in important aspects: the landscape forest lies in close proximity to the village, is used intensively and has a different floristic composition than the watershed forest, which is 3 - 7 km away from the village and is used less often. Literally translated, the villagers call the forest near the village landscape forest and call the more distant one water-storage forest. These terms were the origin of the names of the stratification between landscape forest and watershed forest.

These strata are understood as forest stands in the following and the corresponding terms are now used. In both strata, five 50 by 50 m large sample plots were established. Consequently, 1.25 ha area was profiled in both strata. Each sample plot was then divided up into concentric quadrates of different sizes:

- In compartment A (50 x 50 m = 2.500 m²) trees, palm trees and stumps with a DBH > 10 cm were recorded,

29 BRUN 1976
Traditional village forest management

- in compartment B (30 x 30 m = 900 m²) plants higher than 1.30 m < 10 cm DBH and
- in compartment C (10 x 10 m = 100 m²) plants between 0.30 - 1.30 m height.

In order to investigate the frequency of tree species, the sample units were divided into twenty five squares of 10 by 10 m.

All of the sample units were located on steep slopes. Since the landscape and the watershed forest are facing North in about three quarters of its area, all the sample plots were established on slopes inclined to Northern direction. No sample plots could be established in the holy forests and in the cemetery or in their proximity.

The recording of indicator plants in the ground flora showed better site conditions with regard to the water and nutrient balance in the watershed forest. In the landscape forests, first signs of soil degradation could be seen.

Fig. 5: Location of sample plots in the village forest.
Lf = Landscape forest, Wf = Watershed forest
2 Structure and floristic composition of the village forest

2.1 Species composition and classification of the tree stand > 10 cm breast-height diameter

2.1.1 Species area curve

Fig. 6: Species area curve in the landscape and watershed forests

Explanation: living trees > 10 cm dbh, sequence of sample plots: 1-2-3-4-5

The run of the curve is different in each stand. Optically, the minimum sample area is already reached in the landscape forest at 12,500 m², because the curve hardly rises after that. The total sample area of 12,500 m² can be seen as representative for the floristic composition. This is not necessarily the
case for the watershed forest. Even after the sample area reaches 10,000 m² the curve clearly carries on rising. Both stands show a high diversity of tree species.

2.1.2 Relative abundance, frequency, dominance and importance value index

The following parameter were calculated according to species for both stands:

− relative abundance = Stem number as a percentage of the total stem number

− dominance = Basal area in m² at 1.30 m height

− absolute frequency = the occurrence of a species in the subplots of the sample area in percent

− IVI = The sum of relative abundance, relative dominance and relative frequency

Amongst the ten dominant families, both stands include Fagaceae, Lauraceae, Moraceae, Euphorbiaceae, Myristicaceae, Guttiferae and Myrtaceae. In the landscape forest, Fagaceae are significantly more dominant than Moraceae and Lauraceae. In the watershed forest, Lauraceae beat the Fagaceae to first place but don't dominate the stand quite so conspicuously.

With regard to species, Castanopsis fleuryi and C. hystrix together with Ficus altissima dominate the landscape forest. These three species alone have an IVI of 125. Noteworthy is the high importance value of F. altissima, although this species is only represented by six specimens. These strangler figs are not
felled by the Dai. They can reach huge dimensions and nearly all of them are in the upper storey of the stand. Fourth place is taken by *Engelhardtia spicata*, a Juglandaceae, which, according to WHITMORE (1975) is a light demanding species with some pioneer characteristics, which often occur in forests disturbed by human interference. *Lauraceae* then follow at place five and eight with *Actinodaphne henryi* and *Phoebe minutiflora*.

In the watershed forest, a predominance of more than one species can be observed. A *Lauraceae, Litsea baviensis* has got the highest IVI. The next four species are, with the exception of *Syzygium yunnanensis*, characteristic for wet evergreen rain forests. *Barringtonia macrostachya*, a Lecythidaceae, is a specially protected species in China. It is followed by *Castanopsis hystrix* and *C. fleuryi* which take places six and eight. In between we find *Ficus langkokensis*, an undergrowth species characteristic for wet site conditions.

The species composition of the two stands shows the remarkable difference that the landscape forest is dominated by Fagaceae and the Moraceae *Ficus altissima*, and the watershed forest by *Litsea baviensis, Alniphyllum fortunei* and *Barringtonia macrostachya*. The fact that these three species typical for the watershed forest are not found in the landscape forest points to different site conditions. Human interference due to the character of forest management could also play a role. The inferior site conditions in the landscape forest could be a result of overexploitation.
2.1.3 *Species classification according to economic use potential, storey and light requirements*

In order to characterise the identified species with regard to their wood quality and use potential as well as their ecological properties the following criteria were used:

- **Use potential as economic tree species**

The classification was done according to the actual use of the tree species by the Dai and also according to literature.\(^{31}\)

- \(a\) = Qualitatively valuable and durable timber (construction timber, beams and planks)

- \(b\) = timber of good quality (board material)

- \(c\) = timber of low quality (fuelwood)

- \(d\) = timber of low or unknown quality (without possible uses or with an unknown use potential)

- **Storeys**

The classification was undertaken according to the tree heights measured in the sample plots. For the rarer species, this was a problem and was supplemented with height measurements outside the sample plots.

- **Emergents** (Em) = species in the upper storey with heights > 38 m

- **Upper storey** (Us) = species with maximum heights > 30 m

- **Middle storey** (Ms) = species with maximum heights between 20 and 30 m

- **Lower storey** (Ls) = species with maximum heights < 20 m

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\(^{31}\) YU et al. 1982, ACADEMIA SINICA 1984

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• **Light requirements**

All species were classified which showed a minimum abundance of eight specimens on the total sample area of 2.5 ha, and in addition those species with a lower abundance which had an IVI of > 2.0. They can be classified according to light requirements as follows:

– typical pioneer species (P)
– species with pioneer characteristics without the aggressiveness typical for pioneers (Pc)
– light demanding species (L)
– comparatively shade tolerant species (St)
– shade bearing species (S)

**Table 3: Species classification according to economic use potential (EUP), storey (S) and light requirements (LR)**

*Explanation:* N abs. = stem numbers of trees > 10 cm dbh, sample area 2.5 ha.

<table>
<thead>
<tr>
<th>Botanical species</th>
<th>Family</th>
<th>N abs.</th>
<th>EUP</th>
<th>S</th>
<th>LR</th>
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<td>b</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Alangium kurzii</td>
<td>Alangiaceae</td>
<td>10</td>
<td>d</td>
<td>Ms</td>
<td>L</td>
</tr>
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<td>Styracaceae</td>
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<td>Us</td>
<td>S</td>
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<td>Lauraceae</td>
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<td>b</td>
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<td>S</td>
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<td>Lauraceae</td>
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<td>S</td>
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<td>Ms</td>
<td>L</td>
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<td>Euphorbiaceae</td>
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<td>d</td>
<td>Ms</td>
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<td>Euphorbiaceae</td>
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<td>d</td>
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<td>Lecythidaceae</td>
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<td>?</td>
</tr>
<tr>
<td>Castanopsis calathiformis</td>
<td>Fagaceae</td>
<td>14</td>
<td>c</td>
<td>Ls</td>
<td>St</td>
</tr>
<tr>
<td>Castanopsis fleuryi</td>
<td>Fagaceae</td>
<td>141</td>
<td>c</td>
<td>Us</td>
<td>S</td>
</tr>
</tbody>
</table>

41
### Botanical species

<table>
<thead>
<tr>
<th>Botanical species</th>
<th>Family</th>
<th>N abs.</th>
<th>EUP</th>
<th>S</th>
<th>LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castanopsis hystrix</td>
<td>Fagaceae</td>
<td>73</td>
<td>b</td>
<td>Ms</td>
<td>St</td>
</tr>
<tr>
<td>Castanopsis indica</td>
<td>Fagaceae</td>
<td>10</td>
<td>a</td>
<td>Ms</td>
<td>St</td>
</tr>
<tr>
<td>Castanopsis mekongensis</td>
<td>Fagaceae</td>
<td>11</td>
<td>a</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Callicarpa arborea</td>
<td>Verbenaceae</td>
<td>9</td>
<td>b</td>
<td>Ms</td>
<td>?</td>
</tr>
<tr>
<td>Cylindrokelupha yunnanensis</td>
<td>Mimosaceae</td>
<td>8</td>
<td>d</td>
<td>Ms</td>
<td>?</td>
</tr>
<tr>
<td>Drymicarpus racemosus</td>
<td>Anacardiaceae</td>
<td>5</td>
<td>d</td>
<td>Us</td>
<td>?</td>
</tr>
<tr>
<td>Engelhardtia colebrookiana</td>
<td>Juglandaceae</td>
<td>7</td>
<td>d</td>
<td>Ls</td>
<td>S</td>
</tr>
<tr>
<td>Engelhardtia spicata</td>
<td>Juglandaceae</td>
<td>27</td>
<td>b</td>
<td>Us</td>
<td>Pc</td>
</tr>
<tr>
<td>Elaeocarpus austro-yunnanensis</td>
<td>Elaeocarpaceae</td>
<td>29</td>
<td>b</td>
<td>Us</td>
<td>Pc</td>
</tr>
<tr>
<td>Ficus altissima</td>
<td>Moraceae</td>
<td>8</td>
<td>d</td>
<td>Em</td>
<td>L</td>
</tr>
<tr>
<td>Ficus benjamina</td>
<td>Moraceae</td>
<td>4</td>
<td>d</td>
<td>Ls</td>
<td>L</td>
</tr>
<tr>
<td>Ficus langkakensis</td>
<td>Moraceae</td>
<td>34</td>
<td>d</td>
<td>Ls</td>
<td>S</td>
</tr>
<tr>
<td>Garcinia tetralata</td>
<td>Guttiferae</td>
<td>59</td>
<td>c</td>
<td>Ls</td>
<td>S</td>
</tr>
<tr>
<td>Garcinia xishuangbannaensis</td>
<td>Guttiferae</td>
<td>8</td>
<td>c</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Knema furfuracea</td>
<td>Myristicaceae</td>
<td>11</td>
<td>b</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Knema globulosa</td>
<td>Myristicaceae</td>
<td>30</td>
<td>c</td>
<td>Ls</td>
<td>S</td>
</tr>
<tr>
<td>Lithocarpus microspermus</td>
<td>Fagaceae</td>
<td>25</td>
<td>c</td>
<td>Ls</td>
<td>St</td>
</tr>
<tr>
<td>Litsea baviensis</td>
<td>Lauraceae</td>
<td>96</td>
<td>b</td>
<td>Ms</td>
<td>St</td>
</tr>
<tr>
<td>Machilus tenuipilus</td>
<td>Lauraceae</td>
<td>8</td>
<td>b</td>
<td>Us</td>
<td>?</td>
</tr>
<tr>
<td>Magnolia henryi</td>
<td>Magnoliaceae</td>
<td>5</td>
<td>d</td>
<td>Ls</td>
<td>S</td>
</tr>
<tr>
<td>Mangifera sylvestris</td>
<td>Anacardiaceae</td>
<td>7</td>
<td>b</td>
<td>Ms</td>
<td>?</td>
</tr>
<tr>
<td>Metadina trichotoma</td>
<td>Rubiaceae</td>
<td>18</td>
<td>a</td>
<td>Us</td>
<td>Pc</td>
</tr>
<tr>
<td>Myristica yunnanensis</td>
<td>Myristicaceae</td>
<td>12</td>
<td>d</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Phoebe minutiflora</td>
<td>Lauraceae</td>
<td>31</td>
<td>c</td>
<td>Ls</td>
<td>S</td>
</tr>
<tr>
<td>Phoebe puwenensis</td>
<td>Lauraceae</td>
<td>12</td>
<td>a</td>
<td>Us</td>
<td>Pc</td>
</tr>
<tr>
<td>Sacrosperma arboreum</td>
<td>Sapotaceae</td>
<td>15</td>
<td>c</td>
<td>Ms</td>
<td>?</td>
</tr>
<tr>
<td>Sapium baccatum</td>
<td>Euphorbiaceae</td>
<td>4</td>
<td>b</td>
<td>Em</td>
<td>Pc</td>
</tr>
<tr>
<td>Schima wallichii</td>
<td>Theaceae</td>
<td>4</td>
<td>a</td>
<td>Em</td>
<td>Pc</td>
</tr>
<tr>
<td>Semecarpus reticula</td>
<td>Anacardiaceae</td>
<td>5</td>
<td>d</td>
<td>Ms</td>
<td>?</td>
</tr>
<tr>
<td>Symplocos henryi</td>
<td>Symplacaceae</td>
<td>12</td>
<td>c</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Syzygium cumini</td>
<td>Myrtaceae</td>
<td>9</td>
<td>c</td>
<td>Ms</td>
<td>S</td>
</tr>
<tr>
<td>Syzygium yunnanensis</td>
<td>Myrtaceae</td>
<td>28</td>
<td>c</td>
<td>Us</td>
<td>S</td>
</tr>
<tr>
<td>Vitex quinata</td>
<td>Verbenaceae</td>
<td>4</td>
<td>a</td>
<td>Us</td>
<td>?</td>
</tr>
<tr>
<td><strong>Total: 45 species</strong></td>
<td></td>
<td>1031</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The species in table 3 with the highest stem number are *Castanopsis fleuryi* (141), *Litsea baviensis* (96), *Castanopsis hystrix* (73), *Alniphyllum fortunei* (60) and *Garcinia tetralata* (59). Because of its low durability *Castanopsis* 42
fleuryi can only be used as fuelwood, as is the case for *Garcinia tetralata* because of its small dimensions. The other three species have good wood properties and have been classified as b-timber. Provided that they have good bole forms and big dimensions, they can even substitute the a-timber. However, *Castanopsis hystrix* usually has unsuitable bole forms and *Litsea baviensis* is usually below 30 cm DBH. Only six valuable tree species are represented in the table. *Metadina trichotoma* with 18 individuals and *Phoebe puwenensis* with 12 individuals are quite frequent, these species show certain pioneer characteristics.

Table 4 gives an overview of how many species in each forest fall into the different use potential categories. Most species in both stands belong to category *d*. These are species which have no use potential or an unknown one. Only 10 and 14 species respectively belong to category *a* (high quality timber). If the differences in the total number of species in the landscape forest and watershed forest are taken into account, then it can be said that the species are distributed in the use potential categories in similar proportions.
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Table 4: Number of tree species and relative dominance classified according to use potential

<table>
<thead>
<tr>
<th>Use potential</th>
<th>Number of tree species with dbh &gt; 10 cm</th>
<th>relative dominance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lf (1,25 ha)</td>
<td>Wf (1,25 ha)</td>
</tr>
<tr>
<td>a</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>b</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>c</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>d</td>
<td>36</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>118</td>
</tr>
</tbody>
</table>

A difference was found in the distribution of the corresponding basal areas. In the landscape forest, 1/3 of the total basal area belongs to categories \(a\) and \(b\) whereas in the watershed forest, this reaches 2/3.

This classification along the lines of economic use potential is now the basis for a group-specific analysis.

2.1.4 Diversity level and stand homogeneity of the surveyed stands

Following the JACCARD-Index, the floristic similarity between the two stands lies at 31.8\%, this coefficient points to a moderate species correspondence. The number of species shows a higher diversity for the watershed forest, which can be explained by the greater distance to the village and a correspondingly lower exploitation pressure. At the same time, the distinctive difference between the stands also reflects the fact that a certain species takes up a large proportion of the total number of individuals in the landscape forest.

The results show that both village forest stands have quite high levels of diversity.
2.2 **Basic data of the tree stand > 10 cm breast height diameter**

### 2.2.1 STEM NUMBERS AND BASAL AREA

There is a significant difference between the stem numbers in the landscape forest (424 trees) and the watershed forest (614 trees). It is impossible to say which stem numbers would be natural for each site. Dead but standing trees were hardly found in either stand.

The number of stumps is nearly twice as high (31) in the nearby landscape forest than in the watershed forest (16), although the basal area of the stumps (2.0m²/ha) is nearly identical. If the average diameter of the stumps are calculated, this gives us 28.4 cm for the landscape forest and 40.6 cm for the watershed forest. It can therefore be deduced that on average, larger boles are extracted from the watershed forest.

The total basal area in the watershed forest (31.1 m²/ha) is about 3.0 m² larger than in the landscape forest (28.2 m²/ha). The higher number of trees is not expressed properly by this figure. However, the average figures of the basal area, at slightly less than 30 m²/ha is normal.  

### 2.2.2 FREQUENCY DISTRIBUTION OF STEM NUMBERS AND BASAL AREA

The distribution of the stem numbers follows a typical pattern: nearly 2/3 of the stems fall into the first (10 - 20 cm) and about 1/5 into the second diameter class (20 - 30 cm). The stands differ significantly in the diameter classes 10 to 13 (100 - 140 cm). There are no trees of these classes in the watershed forest, whereas the landscape forest has five such specimens.

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32 see LAMPRECHT 1986
Fig. 7: Stem distribution per ha in the landscape (Lw) and watershed (Ww) forests

Fig. 8: Basal area distribution per ha in the landscape (Lw) and watershed (Ww) forests
The distribution of the basal area in the watershed forest shows a receding staircase distribution which is typical for tropical lowland rain forests. In the landscape forest, the declining trend is broken by irregular distribution peaks up to diameter class 9, after which it starts to rise again. This kind of distribution is characteristic for moist deciduous forests, in which single or groups of enormous emergent trees over 1 m DBH tower above the forest.

In the landscape forest, the total basal area for diameter classes above 9 is made up of the strangler fig *Ficus altissima*, which is regarded as holy by the Dai.

### 2.2.3 Stand volume according to use potential of tree species

The usable volume of the *c* tree species (to use as fuelwood) was estimated to be 90% of the total volume of these species. Category *c* supplies with 50% the biggest proportion of volume in the landscape forest. In contrast, about 60% of the total volume in the watershed forest is classified as category *b*. The proportion of high quality timber (category *a*), is with 16% significantly higher in the watershed forest compared to 5% in the landscape forest.

---

34 LAMPRECHT 1986
Table 5: Basic data on forest yield

<table>
<thead>
<tr>
<th>Basic data on forest yield</th>
<th>Landscape forest</th>
<th>Watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total volume per ha</td>
<td>291.21 m$^3$</td>
<td>334.11 m$^3$</td>
</tr>
<tr>
<td>harvestable volume per ha</td>
<td>142.77 m$^3$</td>
<td>219.67 m$^3$</td>
</tr>
<tr>
<td>harvestable volume to total volume</td>
<td>49 %</td>
<td>66 %</td>
</tr>
<tr>
<td>proportion of useful boles</td>
<td>80 %</td>
<td>76 %</td>
</tr>
<tr>
<td>proportion of harvestable volume to total volume of economic tree species</td>
<td>85 %</td>
<td>78 %</td>
</tr>
</tbody>
</table>

2.2.4 Distribution of harvestable standing volume according to diameter classes

The harvestable standing volume of the different quality levels is distributed unevenly along the different diameter classes (see table 6). The stock of quality tree species (a) in the landscape forest is spread between the lower DBH classes up to 60 cm, whereas in the watershed forest, the distribution peak is in the DBH classes 80 - 100 cm. The standing volume of good quality species (b) is fairly evenly distributed across all DBH classes up to 90 cm, with the exception of the DBH classes between 20 - 50 cm in the watershed forest, where significantly more standing volume can be found than in the

35 The calculation of the total volume ($V_{total}$) and the potentially harvestable volume ($V_{harvestable}$) is based on the volume of standing timber with bark. The total volume was calculated with the formula $V_{total} = \text{basal area} \times \text{height} \times \text{form factor} = 0.5). The harvestable volume of the high quality tree species and the quality tree species (a and b) was calculated with the formula: $V_{harvestable} = \text{HUBER’s basal area} \times \text{usable length}$. HUBER’s basal area is the basal area in the middle of the usable tree trunk. This formula is used in Germany to calculate the volume of felled timber (KRAMER & AKCA 1987). The use of this formula is more precise than using the formula: $V_{harvestable} = \text{basal area} \times \text{usable length} \times \text{form factor} (0.7)$. As the form factor is dependent on the usable length, the volume gets severely underestimated when the form factor 0.7 is used.
other classes. The standing volume of timber species with lower quality \((c)\) has a distribution peak in the landscape forest in the middle DBH classes between 40 - 60 cm, and in the watershed forest between 20 - 40 cm.

**Table 6:** Harvestable standing volume per ha in the landscape and watershed forests according to diameter classes and use potential

*Explanation: trees > 10 cm dbh*

<table>
<thead>
<tr>
<th>dbh class</th>
<th>Landscape forest</th>
<th>Watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Harvestable standing volume per ha in m²</td>
<td>Use potential</td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>10 - 20 cm</td>
<td>1,28</td>
<td>4,50</td>
</tr>
<tr>
<td>20 - 30 cm</td>
<td>1,32</td>
<td>7,62</td>
</tr>
<tr>
<td>30 - 40 cm</td>
<td>0,41</td>
<td>9,05</td>
</tr>
<tr>
<td>40 - 50 cm</td>
<td>1,14</td>
<td>10,77</td>
</tr>
<tr>
<td>50 - 60 cm</td>
<td>2,46</td>
<td>7,10</td>
</tr>
<tr>
<td>60 - 70 cm</td>
<td>0</td>
<td>4,75</td>
</tr>
<tr>
<td>70 - 80 cm</td>
<td>0</td>
<td>8,52</td>
</tr>
<tr>
<td>80 - 90 cm</td>
<td>0</td>
<td>7,59</td>
</tr>
<tr>
<td>90 – 100 cm</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>6,61</td>
<td>59,90</td>
</tr>
</tbody>
</table>

**2.2.5 Exploitation intensity of the village forest in relation to the distance from the village.**

With increasing distance from the village, the number of species in story A of the landscape forest grow from 26 to 51. This increase cannot be explained by differences in site quality but is rather dependent on the significant differences in stem numbers within story A. It follows that a higher rate of exploitation leads to the local reduction in the number of species.

An important parameter to characterise the intensity of exploitation is the standing volume of high quality timber. In the landscape forest, this is
extremely low in the four plots close to the village and only in the plot the furthest distance away from the village could a significant stock be found. The total volume of harvestable tree species is not correlated to the distance to the village, as a higher rate of exploitation favours the species *Castanopsis fleuryi* and *Castanopsis hystrix*, which sometime generate higher volumes in the proximity of the village, especially of fuelwood.

Compartment B also shows an increase in the number of species with greater distance to the village. In contrast, the stem number stays relatively homogenous.

The level of human interference in compartment B can be shown by the proportion of coppice shoots to stem numbers. This proportion increases with closer proximity to the village.

**Table 7: Parameters showing exploitation intensity in the landscape and watershed forest.**

*Sample area:* 1,25 ha per plot

<table>
<thead>
<tr>
<th></th>
<th>Landscape forest</th>
<th>Watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of species N/1,25 ha (comp. A)</td>
<td>85</td>
<td>118</td>
</tr>
<tr>
<td>Stem number N/1,25 ha (comp. A)</td>
<td>530</td>
<td>767</td>
</tr>
<tr>
<td>Stumps N/1,25 ha (comp. A)</td>
<td>39</td>
<td>20</td>
</tr>
<tr>
<td>Harvestable volume ((a+b+c)) in m²/1,25 ha (comp. A)</td>
<td>178,5</td>
<td>274,6</td>
</tr>
<tr>
<td>Standing volume of high quality timber ((a)) in m²/1,25 ha (omp. A)</td>
<td>8,3</td>
<td>43,8</td>
</tr>
<tr>
<td>Basal area of strangler figs in m² (comp. A)</td>
<td>7,6</td>
<td>0,6</td>
</tr>
<tr>
<td>Coppice shoots as % of stems (comp. B)</td>
<td>8,6</td>
<td>2,6</td>
</tr>
</tbody>
</table>

*Explanation:* comp. = compartment; A = living trees > 10 cm dbh, B = living trees > 1,3 m height up to 10 cm dbh; \(a, b\) and \(c\) = use potential.
Table 7 indicates a smaller number of species in the landscape forest compared to the watershed forest. This is mainly due to differences in the site conditions; for example, the landscape forest has an inferior nutrient and water supply. The extended duration of human exploitation of the nearby village forest which has been going on for around 250 years indicates that the inferior site conditions have human causes. In the direct proximity of the village, a reduction in the number of species has taken place.

The smaller amount of harvestable standing stock in the landscape forest is due to the lower stem numbers and the dominance of strangler figs. The latter basal area in the landscape forest is 7.6 m², which is 23% of the total. In the watershed area, this is only 0.6 m² or 2% of the total basal area.

The standing volume of high quality tree species is the most reliable indicator of exploitation intensity. This is significantly lower in the landscape forest than in the watershed forest. Unfortunately, there are no comparable studies in unused forests on similar sites.

2.3 Basic parameters and species composition of natural regeneration

Both the basic parameters of natural regeneration and the distribution of the absolute and relative regeneration abundance of species according to use potential show a general homogeneity of regeneration for compartment B of both stands and a basically even distribution in the different use categories (see tables 8 and 9). Regeneration numbers of category a are only 200 stems per ha and are therefore totally inadequate. Within a planned management of the village forest, therefore, enrichment plantings would be appropriate. However, this could only be decided after further surveys with the help of the "Diagnostic Sampling Surveys" method. In this context, the species classified
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in this study as high quality timber species should be included in the list of "commercial timber species". This list does not yet exist.

**Table 8: Basic parameters of regeneration in compartment B**

*Explanation:* living trees > 1,3 m height and < 10 cm dbh

<table>
<thead>
<tr>
<th></th>
<th>Landscape forest</th>
<th>Watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem number N/ha</td>
<td>3904</td>
<td>3556</td>
</tr>
<tr>
<td>Basal area m²/ha</td>
<td>2,60</td>
<td>2,62</td>
</tr>
<tr>
<td>Number of species per 0.45ha</td>
<td>121</td>
<td>143</td>
</tr>
</tbody>
</table>

**Table 9: Absolute and relative regeneration abundance of species in compartment B according to use potential**

*Explanation:* living trees > 1,3 m height and < 10 cm dbh ; Stem numbers per ha

<table>
<thead>
<tr>
<th>Use potential</th>
<th>Landscape forest</th>
<th>Watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N/ha</td>
<td>%</td>
</tr>
<tr>
<td>a</td>
<td>196</td>
<td>5</td>
</tr>
<tr>
<td>b</td>
<td>893</td>
<td>23</td>
</tr>
<tr>
<td>c</td>
<td>993</td>
<td>25</td>
</tr>
<tr>
<td>d</td>
<td>1822</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>3904</td>
<td>100</td>
</tr>
</tbody>
</table>

As in compartment B, the regeneration numbers of high quality timber species in compartment C are low, with only 400 or 460 individuals per ha respectively.

**2.4 Vertical constellation of flora**

According to LAMPRECHT (1986), species which occur in all three storeys can be referred to as vertically "consistent species". They make up 30 % of species in the landscape forest and 21 % of those in the watershed forest. The
proportion of "non-regenerative species" is about 10% in the landscape forest and 17% in the watershed forest. Species which are found in storeys A and B or in A and C, so called "partially regenerative species", account for around 15% of species in both stands (see table 10).

Table 10: Species distribution in the three storeys of the landscape and watershed forest.

*Sample area:* Compartment A 1.25 ha each, compartment B 0.45 ha each, Compartment C 0.05 ha each

<table>
<thead>
<tr>
<th>Sample area</th>
<th>Compartment A 1.25 ha each, compartment B 0.45 ha each, Compartment C 0.05 ha each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute and relative abundance of species according to compartment distribution</td>
<td></td>
</tr>
<tr>
<td>A+B+C</td>
<td>A only</td>
</tr>
<tr>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Lf</td>
<td>46</td>
</tr>
<tr>
<td>Wf</td>
<td>42</td>
</tr>
</tbody>
</table>

Tree species which only occur in compartment B, compartment C or only in B and C are "colonist species". In both stands, nearly half (or 45.8% and 42.2% respectively) the species fall into this category. However, these include lots of smaller tree species which never grow into dimensions above 10 cm DBH and which thereby distort the picture.

If only those colonising tree species which have a maximum height of above 15 m are considered, then their proportion of all species is reduced to 8% in the landscape forest and 4% in the watershed forest. The abundance per ha of these species, with exception of two, is low. Only the Meliaceae *Chisocheton siamensis* (for both stands) and the Juglandaceae *Engelhardtia roxburghiana* (for the landscape forest) can be expected to supply higher proportions of the trees > 10 cm DBH later on. Remarkably, the colonising tree species can be
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exclusively categorised as high and good quality timber species. These species are apparently non existent in the tree dimensions > 10 cm DBH because of over exploitation.

Another interesting point is how the tree species which can only be found in story A are distributed along the use potential classes (see table 11):

**Table 11: Number of species and abundance of trees which are only found in compartment A of the sample plots of the landscape forest and watershed forest**

*Sample plot compartment A 1,25 ha each;*

*Explanation: EUP = Economic use potential*

<table>
<thead>
<tr>
<th>EUP</th>
<th>Landscape forest</th>
<th>Watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of species</td>
<td>Abundance/1,25 ha</td>
</tr>
<tr>
<td>a</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>b</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>c</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>d</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>total</td>
<td>15</td>
<td>26</td>
</tr>
</tbody>
</table>

In the landscape forest, there are 15 tree species and in the watershed forest 33 tree species without regeneration in the sample plots. Their abundance is very low. In both stands, tree species without or with unknown use potential make up half of stem numbers. An interpretation is made difficult by not being able to consider the ecological aspects of these species as well as qualitative aspects such as exploitability and bole form.

In conclusion, the selective exploitation of certain high quality tree species eliminated them from the tree stock > 10 cm DBH. This human interference is superimposed by natural dynamics. The different ecological characteristics
and regeneration strategies of each tree species are also influencing the vertical floristic composition of both village forest stands.

2.5 Graphical description of stands with structural profiles

A typical profile of the nearby landscape forest shows a low number of stems. In the upper storey, the strangler fig *Ficus altissima* is dominant. The over-exploited middle storey is made up of *Castanopsis* spp. and *Actinodaphne henryi*. The lower storey is quite abundant in species, typical species are *Knema* spp., *Garcinia* spp. and *Baccaurea ramiflora*.

The typical profile of the more distant watershed forest shows a stand with a large number of stems and species. In the upper storey, *Symplocos* sp. and *Cinnamomum bejolghota* can be found. The middle storey, with its large number of stems, is largely made up of Myristicaceae, Lauraceae, Lecythidaceae and Styracaceae. Typical lower storey species are *Baccaurea ramiflora*, *Garcinia tetralata*, *Knema globularia* and *Symplocos cochinchinensis*.36

36 The profiles were plotted according to LAMPRECHT (1958). All trees > 10 cm dbh were registered within a 10 x 20 m strip. In a second strip of 2 x 50 m within the first one all trees > 5 cm dbh were registered. A registration of trees < 5 cm dbh was not undertaken as this would have overloaded the diagram. In addition to the parameters described in chapter V.1, the root collar co-ordinates, height to lowest branches and the crown circumference were also registered.
Fig. 9: Horizontal and vertical structural profile of the landscape forest
Explanations for Figure 9:

<table>
<thead>
<tr>
<th>No.</th>
<th>Tree species</th>
<th>dbh (cm)</th>
<th>height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ficus altissima</td>
<td>100</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>Engelhardtia serrata</td>
<td>23</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>Phoebe puwenensis (stump)</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Castanopsis fleuryi</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>Gomphandra tetrandra</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Actinodaphne henryi</td>
<td>35</td>
<td>21</td>
</tr>
<tr>
<td>7</td>
<td>Myristica yunnanensis</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Ficus altissima</td>
<td>140</td>
<td>42</td>
</tr>
<tr>
<td>9</td>
<td>Symplocos henryi</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>Dolichandrone stipulata</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>Dolichandrone stipulata</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>12</td>
<td>Alangium kurzii</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>13</td>
<td>Actinodaphne henryi</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
<td>Baccaurea ramiflora</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>15</td>
<td>Castanopsis hystrix</td>
<td>33</td>
<td>24</td>
</tr>
<tr>
<td>16</td>
<td>Elaeocarpus austro-yunnanensis</td>
<td>12</td>
<td>14</td>
</tr>
</tbody>
</table>

Trees > 5 cm dbh

<table>
<thead>
<tr>
<th></th>
<th>Tree species</th>
<th>dbh (cm)</th>
<th>height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Macaranga denticulata</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>b</td>
<td>Alangium kurzii</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>c</td>
<td>Knema furfuracea</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>d</td>
<td>Diospyrus atrotricha</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>e</td>
<td>Garcinia xishuangbannaensis</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>
Traditional village forest management

**Fig. 10**: Horizontal and vertical structural profile of the watershed forest
Explanations of Figure 10:

<table>
<thead>
<tr>
<th>Trees &gt; 10 cm dbh</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>17</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>21</td>
</tr>
<tr>
<td>22</td>
</tr>
<tr>
<td>23</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trees &gt; 5 cm dbh</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
</tr>
<tr>
<td>b</td>
</tr>
<tr>
<td>c</td>
</tr>
<tr>
<td>d</td>
</tr>
<tr>
<td>e</td>
</tr>
<tr>
<td>f</td>
</tr>
<tr>
<td>g</td>
</tr>
<tr>
<td>h</td>
</tr>
</tbody>
</table>
3 Strangler figs in Moxie village forest

3.1 Parameters of the strangler fig population and their host trees

The dominant role of strangler figs is reflected in the share of 23% of the basal area of the landscape forest. The family of Moraceae has the second highest IVI after the Fagaceae, *Ficus altissima* comes third in the ranking of individual species and *Ficus benjamina* 28th. The socio-cultural influences on the village forest find their highest expression in this dominance of strangler figs.

The following species of strangler figs and according numbers of specimen were found on a 25 ha sample plot of the landscape forest.

<table>
<thead>
<tr>
<th>Strangler figs in the upper storey:</th>
<th>Strangler figs in the lower storey:</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ficus altissima</em></td>
<td>54</td>
</tr>
<tr>
<td><em>Ficus sp.</em></td>
<td>11</td>
</tr>
<tr>
<td><em>Ficus benjamina</em></td>
<td>26</td>
</tr>
<tr>
<td><em>Ficus neriifolia</em></td>
<td>3</td>
</tr>
<tr>
<td><em>Ficus tinctoria</em> var. <em>gibbosa</em></td>
<td>2</td>
</tr>
<tr>
<td><em>Ficus annulata</em></td>
<td>1</td>
</tr>
<tr>
<td><em>Ficus stricta</em></td>
<td>1</td>
</tr>
<tr>
<td><em>Ficus vasculosa</em></td>
<td>1</td>
</tr>
</tbody>
</table>
The strangler figs of the upper storey develop into independently standing trees after their host tree dies, whereas the strangler figs in the lower storey cannot develop their own root system and remain dependent on a host tree. The diameters of *Ficus altissima* and *Ficus benjamina* are distributed evenly with a slight bell shaped concentration across all diameter classes. This supports the analysis that strangler figs are light demanding species and that these tree species have an ecological niche from which they can hardly be removed. Once they have established themselves, these species grow through all diameter classes and show low mortality and high competitiveness.

Of a total of 99 host trees, 43 (43.4%) were still alive. 56 had already died (56.6%), 52 of which had rotted to a large extent. *Ficus altissima* had already killed 68.5 % of its hosts, *Ficus benjamina* 53.8 %, in contrast to the lower storey species *Ficus* sp., which had only killed 9.1 % . With the increase in DBH of the strangler figs, more and more host trees die off. Above 90 cm diameter, there are no host trees left alive.

Most of the strangler figs are to be found on host trees in the medium DBH classes between 30 - 60 cm. About 30% of the host trees belong to the diameter class 10 -30 cm and about 25% of the host trees are in the class above 60 cm. These results are compared to the stem number distribution of all trees > 10 cm DBH in a 1.25 ha sample plot in the landscape forest. The comparison of both distributions points to the tentative conclusion that larger trees above 30 cm DBH are more likely to be infested by strangler figs. This interpretation also assumes that the figs strangle their host trees rather rapidly and do not tolerate their host trees growing into bigger dimensions.
Fig. 11: Relative abundance distribution of host trees for strangler figs and relative stem distribution in the landscape forest

Despite the small sample size, it is possible to say that certain species like Castanopsis hystrix, Aporusa yunnanensis and Schima wallichii are more likely to be infested by strangler figs and Castanopsis fleuryi disproportionately less. This can be explained by the micro-habitats specific tree species provide for the seed dispersing animals as well as for the germination of the seeds.
3.2 Factors supporting the spreading of strangler figs

The abundance of strangler figs in the landscape forest of Moxie lies at 11 specimens per ha (as counted in the five 0.25 ha sample plots) This is a very high figure compared to other surveys made in relatively undisturbed forests, which hardly found more than 3 specimen/ha.

In the landscape forest of Moxie, 8 different species of strangler figs co-exist on a relatively small area, which is a comparably high number, too. F. altissima and F. benjamina are more common species with an abundance of 5 and 3 specimens per ha respectively. Because of their diameter class distribution, both can be classified as light demanding species. This means that their abundance is encouraged by fellings which open up the stand.

Furthermore, other human induced factors and specific characteristics of host tree species can encourage the colonisation of epiphytes. The existence of strangler figs is also dependent on the supply of locations which are often visited by birds and small mammals which spread the fig seeds. In Moxie, these are pollards in the vicinity of settlements, stumps with coppice shoots and trees with caveats and holes and with extremely crooked bole forms. Three quarters of all host trees have defects and abnormalities which supply that kind of microhabitat and which thereby encourage infestation by strangler figs. One fifth of the effected trees were in site conditions which had been influenced by human activity.

The felling taboo for strangler figs also plays an important role. Significantly, this extends to those host trees which accommodate young epiphytes.
3.3 Ecological and technical consequences of the dominance of strangler figs

The special symbiosis of the strangler figs with their specific fructifiers, the fig gall-wasp means that fruits ripen throughout the year. This massive and constant fruit production is an important source of food for birds and small mammals, even for primates.

This means that positive ecological effects are created by the tradition of the Dai not to fell strangler figs. These need to be understood as positive side effects of a religious belief more than anything else. In addition, the strangler figs are significant for the permanence of forest cover. These specimens supply a forest scaffolding and minimum stock even when other tree species are heavily exploited, thereby guaranteeing forest regeneration and protection against soil erosion. The preservation of a multi-storey forest structure is also helped by this.

For timber utilisation, there are disadvantages however, in that the growing exploitable stock cannot be used. Encouragement of the strangler figs which are not useful for timber or fuelwood leads to a reduction in annual increment and volume of exploitable timber. This creates a conflict with the sustainable production of timber. However, the underlying conservationist attitude of the Dai towards the forest should be seen as more valuable than this problem.
4 The potential of sustainable village forest management in Moxie

4.1 Wood supply and wood demand

In order to calculate the harvestable wood volume in the village forest, it is necessary to classify the standing volume, which was calculated with the general formula,\textsuperscript{37} according to economic maturity classes. The specific needs and the timber harvesting and processing methods of the Dai have been taken into account. This gives us the following classification:

<table>
<thead>
<tr>
<th>Class</th>
<th>Economic maturity class</th>
<th>Use potential $a$ and $b$</th>
<th>Use potential $c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>“still growing”</td>
<td>10 - 29 cm dbh</td>
<td>10 - 19 cm dbh</td>
</tr>
<tr>
<td>II</td>
<td>“partly harvestable”</td>
<td>30 - 59 cm dbh</td>
<td>ab 60 cm dbh</td>
</tr>
<tr>
<td>III</td>
<td>“harvestable”</td>
<td>ab 60 cm dbh</td>
<td>20 - 59 cm dbh</td>
</tr>
</tbody>
</table>

Table 12 shows the harvestable standing volume per ha according to economic maturity classes and use potential of the tree species. Volume is given in m$^3$ of harvested wood without bark. For this reason, a subtraction of 10% for bark and 10% for harvest loss is calculated. In both stands, the standing volume is greatest in the class "harvestable". It should be reminded that the class "harvestable" is only made up of timber of $a$ and $b$ quality and of diameter classes of 60 cm and above. The percentage of harvestable boles above 60 cm DBH in total standing volume is 27% in the landscape forest and 33% in the watershed forest. In the landscape forest, there is no high quality timber above 60 cm DBH which is harvestable.

\textsuperscript{37} compare Table 6, p.41
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Table 12: Harvestable standing volume per ha in m³ harvested timber under bark in the landscape and watershed forests

*Explanations:* classified according to economic maturity classes and use potentials *a*, *b* and *c*

<table>
<thead>
<tr>
<th></th>
<th><em>V</em>_{harvestable} in the landscape forest</th>
<th></th>
<th><em>V</em>_{harvestable} in the watershed forest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in m³/ha</td>
<td>in m³/ha</td>
<td></td>
</tr>
<tr>
<td></td>
<td>growing partly harvestable harvestable</td>
<td>growing partly harvestable harvestable</td>
<td></td>
</tr>
<tr>
<td><em>a</em></td>
<td>2,1 3,2 0,0</td>
<td>3,0 9,6 15,4</td>
<td></td>
</tr>
<tr>
<td><em>b</em></td>
<td>9,7 21,5 16,7</td>
<td>27,8 44,9 31,3</td>
<td></td>
</tr>
<tr>
<td><em>c</em></td>
<td>7,6 9,4 44,0</td>
<td>6,0 7,6 29,7</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>19,4 34,7 60,7</td>
<td>36,8 62,1 76,4</td>
<td></td>
</tr>
</tbody>
</table>

The standing volume of harvestable timber in the village forest can now be calculated on the basis on the results shown in Table 12. The 600 ha of village forest are divided into (basis for the calculation of Table 13):

- Watershed forest: 400 ha, of which 100 ha are degraded; calculation basis: 300 ha.
- Landscape forest: 200 ha, of which 100 ha are degraded; calculation basis: 100 ha.
Table 13: Harvestable standing volume in harvested timber under bark in the village forest of Moxie

Explanations: classified according to economic maturity classes and use potentials a, b and c

<table>
<thead>
<tr>
<th></th>
<th>still growing [m³]</th>
<th>partly harvestable [m³]</th>
<th>harvestable [m³]</th>
<th>sum [m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>1.110</td>
<td>3.200</td>
<td>4.620</td>
<td>8.930</td>
</tr>
<tr>
<td>b</td>
<td>9.310</td>
<td>15.620</td>
<td>11.060</td>
<td>35.990</td>
</tr>
<tr>
<td>c</td>
<td>2.560</td>
<td>3.220</td>
<td>13.310</td>
<td>19.090</td>
</tr>
<tr>
<td>total</td>
<td>12.980</td>
<td>22.040</td>
<td>28.990</td>
<td>64.010</td>
</tr>
</tbody>
</table>

The annual increment in the village forest is derived with the help of Chinese information concerning the various species38 and under consideration of the species composition and number of harvestable boles in the village forest and is estimated at 5.8 m³/ha/year of harvestable timber in the watershed forest and 3.4 m³/ha/year harvestable timber in the landscape forest.

Table 14 shows the current total increment of harvestable timber in the village forest. For comparison, it specifies harvested timber without bark. The calculation is based on the assumption that the increment is distributed in the same proportions as the standing volume in the three use potential classes.

The same table shows the annual demand for wood in Moxie. This calculation is an estimate which is based on questionnaires, observations, measurements of buildings in Moxie and the inspection of village accounting, which should guarantee sufficient precision.

38 ANONYMUS 1986
Table 14: Annual increment of harvestable wood in the village forest and annual demand in m³ harvested wood under bark

<table>
<thead>
<tr>
<th>Use potential</th>
<th>Increment in m³/year</th>
<th>Demand in m³/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>233</td>
<td>100</td>
</tr>
<tr>
<td>b</td>
<td>935</td>
<td>301</td>
</tr>
<tr>
<td>c</td>
<td>496</td>
<td>860</td>
</tr>
<tr>
<td>total</td>
<td>1664</td>
<td>1261</td>
</tr>
</tbody>
</table>

Total demand does not exceed total increment in the village forest. In the case of the supply of high quality timber (a), it must be remembered that in this classification, the bole quality was not examined. Not all boles are characterised by straightness, fullness of bole volume and absence of flaws. The demand for fuelwood (c-wood) is greater than increment and has to be satisfied with b-wood, which happens in practice anyway.

Among the construction timber species of excellent quality (a), there is only one pioneer tree species, *Duabanga grandifolia*, *Metadina trichotoma*, *Phoebe puwenensis* and *Schima wallichii* all show some affinity towards sites which have been disturbed by human use and show satisfactory regeneration under such conditions. They have a certain pioneer character. The seed supply of *Schima wallichii* is often quite low due to the absence of seed trees. All the other tree species are characteristic species for relatively undisturbed forests. This means that the sustainable management of these high quality tree species generates problems which cannot be solved by the current practice of management in the village forest.

Among the group of tree species which have been classified as construction wood of good quality (b), *Betula alnoides*, *Altingia excelsa*, *Castanopsis hystrix*, *Alniphyllum fortunei*, *Litsea baviensis*, *Nephelium chryseum* and *Sapium baccatum*, because of their relatively good timber qualities, can be
used as a substitute for the high quality timber species, as long as they have acceptable bole forms. This means that a sustainable management of the village forest of Moxie could supply a sufficient amount of high-quality construction timber.

4.2 Requirements on a sustained management

4.2.1 Permanence of forest cover

The forests of the Dai have been managed for decades in a way that secured the permanence of forest cover, so the fulfilment of this requirement seems realistic in the future. However, the increasing commercialisation, in particular the cultivation of cash crops like tea and *Hevea brasiliensis* imposes a threat to degraded forest areas to transform them into other than forestry uses.

4.2.2 Sustained yield production

The comparison between wood demand and increment showed that this requirement can basically be fulfilled in future. However the calculations are based on the precondition that firstly a balanced selection system is applied and a constant annual increment given, and secondly that the whole forest is managed evenly, i.e. that the annual sustained cut is distributed over the whole area. These preconditions are not given as of now. In practice, the more accessible areas are overexploited and that the increment becomes less until the area is taken out of production. This has already happened on 100 ha (50%) of the landscape forest and 100 ha (25%) of the watershed forest. On the contrary, in non accessible areas, increment cannot be harvested to the possible extent.
4.2.3 Sustained yield of high quality timber

This requirement cannot be met, because this would require a silvicultural management of the stands. The special needs of the high quality timber species mean that, given the current forest management, a reduction of these species is taking place. The fulfilment of this requirement should be aimed for, however, because otherwise timber exploitation would increase in volume given the shorter durability of the alternative species.

The sustained yield production of timber will crucially be dependent on whether the whole of the village forest will be included in wood harvesting and if it will be possible to restart production on the degraded areas.

The inclusion of the whole of the village forest in utilisation would meet with technical difficulties. The insufficient forest road system and the archaic timber harvest and transport techniques are problems which cannot be solved in the near future. The reintegration of the degraded areas could be achieved by reforestation with fast growing tree species like Cassia siamea which can be used for fuelwood. Some households in Moxie already grow Cassia siamea; but production is only at about 40 m³ per year so far, and this amount was left out of the calculations above.
4.3 Changes in everyday life

Changes in the everyday life of the Dai can have serious effects on the sustainability of village forest management. In the past, such changes were usually passed on by the Han-Chinese to other minorities. Examples of this are the use of gas for cooking and the shift to using stone for house-building.

In these cases, the forest could theoretically recover and chances for sustainable management could increase; on the other hand, a portion of Dai culture could be lost and in their wake, traditions and ancient forest conservation practices. Furthermore, the interest in protecting the forest for its wood could decline, as agricultural products attain much higher prices than timber.
Further forms of land use in Moxie

1 Home gardens

Home gardens are a typical element in the traditional land use systems of the ethnic minorities in Southwest China. This agroforestry system is a characteristic element in the sustainable land use of the Dai minority.

In Moxie, every household has a 20 - 2,000 m² sized home garden, whereby the gardens get bigger from the village centre outwards to the periphery. Apart from bamboo and fruit trees, vegetables, spices, medicinal plants and fodder as well as ornamental plants are cultivated. Among them, lots of species used to be gathered in the forest. Because the village moved location in 1969, the gardens are still young. They encompass 82 different plant species, showing high diversity. Located at the edge of the tropical zone, the gardens show adaptations to the periodic dry season, which can last up to 5 months. Distinct characteristics in connection with the water buffalo breeding practised by the Dai are also interesting. Each of the various small plots of the home garden is surrounded by thorny and drought resistant hedges or bamboo fences. Only chickens are an integral part of the home garden. Single storey gardens are dominant. In the dry season, no annual plants are to be found except those which are watered from the verandas of the stilt houses. In spring, young leaves and shoots of the trees complement the diet of the Dai. A speciality are hanging vegetable beds or ones on stilts which can be reached from the veranda and which are used to grow herbs for the kitchen. Fertiliser plays a negligible role. Animal manure from the pig sties in the garden is only used to a small extent. Droppings from free range chickens spread fertiliser around the system in an uncoordinated way.
The home gardens in Moxie supply to 90% everyday needs of the family, only a small amount of cash crops are grown.

Figure 12 shows a compound made up of 5 home gardens at the edge of the village Moxie. This is a typical example for home gardens with a high number and diversity of species in lots of Dai villages in Xishuangbanna.
Further forms of land use

Fig. 12: Sketch of an extended home garden complex at the edge of the village Moxie
2 Cassia siamea-cultivation for fuelwood production

Cassia siamea was introduced over 400 years ago to Xishuangbanna and since then has been coppiced by the Dai for fuelwood production.\textsuperscript{39} Most of the stands are found within a 1 km radius of the village.

Cassia siamea produces an excellent fuelwood with 4600 kcal/kg dry wood. NAS (1980) and NAIR (1993) both state the annual increment to be 15 m\textsuperscript{3} per year and ha. SAINT-PIERRE (1991) calculates hectare production to be 10.5 m\textsuperscript{3}/year for the first cut and 16.3 m\textsuperscript{3}/year for 50-year-old stands.

With demand lying at 1.0 - 1.5 m\textsuperscript{3} per year and person and about 5 m\textsuperscript{3} per year and household in Xishuangbanna, a stand area of 1 mu (1/15 ha) per person or 5 mu (1/3 ha) per household is enough to satisfy demand sustainably.

In Moxie, the total area cultivated for Cassia siamea is about 10 ha. The average per household is only 0.1 ha. Only 8 - 10 households can meet their fuelwood demand exclusively by their fuelwood plantations. Some families are now starting to cultivate Cassia siamea or to expand their plots.

Cassia siamea can also supply good and durable construction wood. After about 20 years, the trunks have reached corresponding dimensions so that they can be deployed for posts of the Dai houses.

In Xishuangbanna a total of about 7000 ha are stocked with Cassia siamea,\textsuperscript{40} which can supply about 15% of the demand for fuelwood in the rural area. Additional afforestations are being encouraged by the state and are being

\textsuperscript{39} PEI 1985b
\textsuperscript{40} ANONYMUS 1990
Further forms of land use

supported with 10% of the investment sum, which still leaves agricultural cash crops financially more attractive for farmers.

High production on small areas, easy and straightforward cultivation, harvest and transport mean that *Cassia siamea* could be a real alternative in order to reduce the exploitation of natural forests. The forestry inventory undertaken in context of the 1992 land reform shows a clear correlation, with villages which meet their fuelwood demand with *Cassia siamea*-plantations having relatively few degraded forest areas.

### 3 Cultivation of *Amomum villosum* in the forest

*Amomum villosum* Lour., Zingiberaceae, is a medicinal plant which was imported from Guangdong (Kanton). The fruit is used to produce medicines against stomach ache, flatulence, loss of appetite, nausea and vomiting, enteritis and dysentery.\(^\text{41}\)

To cultivate the plant, all undergrowth up to a DBH of ca 15 cm is removed. *Amomum villosum* thrives the best under 70% shade and in humid conditions. The species grows as a dense layer of about 2 m in height, attention or fertiliser are not required.\(^\text{42}\)

Production varies between 30 - 150 kg/ha/a, but harvesting is not possible every year. Prices vary considerably depending on the market. In good years, an income of 500 - 600 Yuan can be made. In comparison, the annual income in Moxie is about 700 Yuan per head. Nearly every household in Moxie has on average a small area of 0.2 ha under cultivation, giving a total of about 20 ha.
Traditional village forest management

The botanical institute in Menglun, Xishuangbanna, encourages the cultivation particularly for village forests. XU (1991) and SAINT-PIERRE (1991) both honour *Amomum villosum* cultivation as a way to protect natural forest and at the same time to provide farmers with additional income. On the other hand, it is problematic that the forest structure is influenced in quite a massive way and that regeneration is completely stopped during the cultivation period. For this reason, it should not be cultivated at the same place for longer than 10 years.

4 Agricultural production systems

4.1 Rice cultivation

The Dai only cultivate paddy rice. Although two or three crops of rice would be possible in Xishuangbanna, in Moxie, as in most other Dai villages, rice is only grown once a year. The reasons for this are the high labour intensity necessary with little use of machinery and the fact that one harvest per year is sufficient for meeting subsistence needs. The cultivation period is from the end of May to the beginning of October during the rainy season. The terracing of the fields enables a technically easy river-fed irrigation. During the dry season, fields near rivers continue to be irrigated in order to cultivate vegetables and water melons.

Since the land reform of 1982, the agricultural land has been distributed among the households. Each household farms about 0.7 - 0.8 ha paddy.
Further forms of land use

The average yearly rice harvest in Xishuangbanna is 3.2 t/ha. Top harvests with two crops a year can reach 5.6 t/ha. In Moxie, the farmers state that their yield is 2.2 - 3.4 t/ha/a. Rent payment in kind is 135 kg of rice per ha and year, which is equal to 4 - 6% of the harvest. Traditional rice varieties, like the glutinous ("sticky") rice, only yield 800 kg per ha, but are still cultivated because of their popularity. Market prices for the traditional varieties are three to four times as high as for the high yield varieties. At all traditional festivites of the Dai, only the glutinous rice is consumed.

4.2 Tea cultivation

In the region of Mengla, tea of a high quality, the large leafed *Camellia sinensis* var. *assamica* can be grown. Some minorities, for example the Jinuo, grow this type in the forest. Today, most tea is cultivated as a monoculture and not as an element of agro-forestry systems.

Tea has developed into a stable cash crop. Demand is rising steadily. The income for small farmers is at around 7500 Yuan per ha and year. In Moxie, every household cultivates around 0.3 ha of tea. The income generated from tea can contribute around 2/3 to the annual cash income of a household. The expansion of tea cultivation has led to the loss of forest in Moxie as well, especially on Northeastern to Northwestern slopes. As a perennial crop, tea cultivation can replace shifting cultivation however, and encourage highland peoples to become sedentary.

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43 ANONYMUS 1990
44 SAINT-PIERRE 1991
5 Hunting, fishing and gathering

Hunting plays a secondary role for the sustenance of the Dai. This has apparently always been the case, as no specific hunting culture or special hunting techniques have developed. Individuals occasionally go hunting with muzzleloaders.

In contrast, fishing plays an important part to ensure food security. The Dai fish in rivers and artificial ponds. In addition, the home gardens also have little fish ponds. Today, most fishing is done with nets. Traditionally, the Dai used bamboo fish-traps which were placed in the rivers. Occasionally, leaves of the Juglandaceae, *Pterocarya tonkinensis* are used as fish poison. They are placed in backwater parts of rivers. After a few minutes, the dead or numbed fish can be gathered up.

Gathering also contributes significantly to food supply and is an integral part of Dai culture. Lots of the most popular collected products are now grown in the home gardens.
VII Consequences for the conservation and development of the village forests

1 The Significance of the village forests

1.1 The Significance of the village forest in Moxie

The case study in Moxie attests to the significance of the village forest as the main resource of life for its inhabitants in many different ways. The use of timber and fuelwood plays the most important role in this subsistence economy. The collection of non-timber forest products and to a lesser extent fishing and hunting are important for food security. Gathering medicinal plants has become less important, although the cultivation of shade bearing medicinal plants like *Amomum villosum* for the market is increasing. As a watershed area for the paddy fields in the valley, the forest guarantees a steady supply of water for irrigated rice cultivation. The forest is also important for the positive effects it has on the landscape and village scenery, which is highly regarded by the villagers.

The forest in itself, especially the holy forests, the sacred trees and sacred groves, are part of the cultural identity of the villagers. An important side-effect of this religiously motivated protection of forest areas and certain tree species are positive effects on the carrying capacity of the village eco-system.

1.2 The significance of the village forests in Xishuangbanna and scenarios of their future development

In addition to the local importance of the village forest in the case study, the village forests in the region of Xishuangbanna have an altogether stabilising
Traditional village forest management

effect on the whole region, especially on the water and climatic balance. Their even distribution makes them into islands of biodiversity in the midst of a landscape in which the natural forest has been increasingly cleared and replaced by monocultures. Furthermore, abundant spots of holy forests and trees provide local gene pools across the region.

Table 15 shows a scenario of how the village forests in Xishuangbanna could develop in the future. The likely development in the near future is shown in the first section. It is based on the assumptions that on the one hand the region will continue to develop economically and that therefore a further market orientation will take place without subsistence economy dying out and on the other hand that the rural population will continue to uphold their ethnic identity and traditions. Section 2 tries to envisage the effects of other developments on the village forests. In all scenarios, the village forests are threatened by over-exploitation and consequently with the extinction of species and forest degradation. The area under forest will probably decrease. The scenarios show points of reference for what a planned development cooperation should consider and where its potential and limits lie.
### Table 15: Scenario of the development of the village forests of Xishuangbanna under specified conditions

<table>
<thead>
<tr>
<th>Current condition</th>
<th>Forests near village (Landscape forests)</th>
<th>Forests in village neighbourhood (Watershed forest)</th>
<th>Holy forests</th>
<th>Degraded forest areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• relatively few species and little standing stock</td>
<td>• relatively high number of species and extensive standing stock</td>
<td>• young secondary forests which recover after one-off interference</td>
<td>• bushland with isolated trees and lots of bamboo</td>
</tr>
<tr>
<td></td>
<td>• consistently over-exploited</td>
<td>• accessible areas are over-exploited</td>
<td>• high number of species</td>
<td>partly areas with <em>Chromolaena odorata</em></td>
</tr>
<tr>
<td></td>
<td>• lots of strangler figs</td>
<td>• high quality tree species endangered</td>
<td>• loss of area for cash crop cultivation</td>
<td>islands of strangler figs</td>
</tr>
<tr>
<td></td>
<td>• high quality tree species have vanished</td>
<td></td>
<td></td>
<td>rarely able to recover by itself</td>
</tr>
<tr>
<td></td>
<td>• Transformation of species spectrum has taken place</td>
<td></td>
<td></td>
<td>some conversion into agricultural land</td>
</tr>
</tbody>
</table>

1. Development given the current status quo

<table>
<thead>
<tr>
<th></th>
<th>Forest area remains</th>
<th>Over-exploitation for fuelwood</th>
<th>forest area remains</th>
<th>slow but total conversion into fields for cash crops with some fuelwood plantations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>forest condition worsens</td>
<td>Disappearance of certain valuable tree species</td>
<td>increase in area unlikely</td>
<td>conservation of small ficus islands</td>
</tr>
<tr>
<td></td>
<td>development towards impoverished forests which can hardly supply timber</td>
<td>further loss of areas on the lower slopes due to cash crop cultivation</td>
<td>condition improves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>as in 1.</td>
<td>ecological value increases</td>
<td>no effect</td>
<td>rapid conversion into agricultural land likely</td>
</tr>
</tbody>
</table>

2. Development under certain conditions

<table>
<thead>
<tr>
<th>a) Religious restrictions disappear</th>
<th>• tendency towards degradation into bushland with bamboo</th>
<th>• degradation</th>
<th>• ficus islands disappear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Strangler figs disappear, thereby loss of structure and ecological value</td>
<td>• disappearance through conversion</td>
<td>• otherwise as in 1.</td>
</tr>
<tr>
<td>b) Commercialisation; increased market orientation and in part dependence; abandonment of subsistence economy</td>
<td>development as in 1.</td>
<td>• effect on area and intensity of cash crop cultivation</td>
<td>• no effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• further loss of area is likely</td>
<td>development as in 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rapid conversion into agricultural land likely</td>
</tr>
</tbody>
</table>
### Traditional village forest management

<table>
<thead>
<tr>
<th></th>
<th>Forests near village (Landscape forests)</th>
<th>Forests in village neighbourhood (Watershed forest)</th>
<th>Holy forests</th>
<th>Degraded forest areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>c) Modernisation ; replacement of fuelwood by gas, stone construction of houses</td>
<td>Area remains the same, condition remains the same</td>
<td>no over-exploitation no loss of species loss of area depends on supply of alternative land and on the ecological consciousness and its implementation</td>
<td>• no effect • development as in 1.</td>
<td>conversion is total</td>
</tr>
<tr>
<td>d) improvements in rail and road transport</td>
<td>hardly any change, as in 1.</td>
<td>• Over-exploitation due to timber sales • no loss of area given sustainable management • possible distribution of forest to households</td>
<td>• no effect • development as in 1.</td>
<td>increased cultivation of marketable products for trans-regional markets</td>
</tr>
</tbody>
</table>

#### 1.3 Trans-regional observations

China is an example of successful endeavours in the field of community forestry.\(^{45}\) Self-help management and participation of people are not a guarantee for a sustainable resource management, however. In particular, artificially formed communities, such as the forest farms in China, or immigrant groups of people without a social structure, indigenous knowledge and relationship to the land are, without the necessary technical help and training, unable to preserve the forest in their responsibility.

Traditional village communities offer more favourable prospects. Intact social and cultural village communities are most likely to be found in areas inhabited by e ethnic minorities. The relationship between humans and forests and trees is rooted in the diverse traditional land use systems, which are themselves closely connected to the socio-cultural practices of the relevant minority. These are not necessarily sustainable within a changing environment, but they provide the opportunity to achieve this goal. Projects

\(^{45}\) FAO 1982
Consequences for the conservation and development of the village forests

needs to be implemented which incorporate the socio-cultural value system of the local population into a approach of sustainable resources management.

2 Consequences for Development Co-operation

2.1 The Problem

As shown in this case study, there are village forests in Xishuangbanna which are able to supply all the village's demand for wood and non-timber products whilst at the same time fulfilling its ecological functions. In spite of a conservationist attitude towards the forest, which has found its highest expression in religiously protected holy forest areas, however, a regulated management system has not been developed up to today. The consequence is that an ineffective and unplanned exploitation is deteriorating the condition of the forest and that degradation of the forest and its subsequent conversion into agricultural areas could lead to a further reduction of the forest area in Xishuangbanna.

Over the last 50 years, demographic and migratory growth and a shift in the ethnical composition of the population, increasing scarcity of resources, conflicts between traditional and state imposed land tenure, state policy and distinct political developments (Cultural Revolution) have been responsible for the halving of the forest percentage in Xishuangbanna, which is equal to the loss of 600,000 ha of forest area.

The current situation is characterised by a strong commercialisation and modernisation of agricultural areas. Seemingly in contradiction to this, but understandable as a counter-reaction to the Cultural Revolution, is the simultaneous revival of old traditions and a reorientation towards the ethnic identity of the rural population.
The scenario developed in Table 15 predicts a further reduction of the forest areas in the land use systems. This poses a challenge to development cooperation if village forests are to be preserved as an integral element of a sustainable land use in combination with state forest areas and natural reserve areas.

2.2 Possible solutions

The results of this case study and the insights gained into the socio-cultural value system of the Dai minority can contribute to the design of projects in development cooperation. The guiding principle is that the local population needs to be integrated into the project concept and in particular, that the project should enable the villagers to use and manage their resources in a way which corresponds to their economic requirements and socio-cultural values.

The Xishuangbanna region offers good prerequisites for projects in the field of community forestry. In the following paragraphs, these positive conditions will be outlined and subsequently, a conception of how a project could be developed will be offered.

- Positive prerequisites in Xishuangbanna

The clear land tenure situation enables a long-term conception. Due to state policy, population growth is moderate and migratory growth can be assumed low for the future.

In rural areas, the target groups are mostly autochthonous village communities of ethnic minorities, which are usually inhabited by members of the same minority. These communities are characterised by an intact social structure. Each village acts as an independent cultural and economic unit.
Furthermore, local communities can be assessed as open-minded and – since food security is given – innovative and willing to take risks.

The land use systems are to the most part traditional and are influenced by indigenous knowledge. Subsistence economy is still dominant today, but markets exist on which rural development can be based.

An ecological understanding of the importance of the forest for the water balance and an aesthetic feeling towards the forest can be assumed as given with the Dai.

With a further relaxation of the situation and further opening of the neighbouring countries Laos and Myanmar, it might even be possible to connect development cooperation projects on a trans-regional scale.

- Course of action

The factors mentioned above show that important underlying conditions have already been fulfilled. For the project conception, mechanisms for a equitable distribution of user rights to the forest need to be developed. The author's opinion is that the allocation of forest to individual households, as planned by the state, should not take place, as experience shows that this leads to an increase in felling activities in the respective forests.

The implementation of the project should start with the minorities, whose basic needs with regard to the forest and in particular their socio-cultural value system are known. Simultaneously, the specific problems and distinctive situation of the other participating groups should be analysed and integrated into the subsequent planning. It should be remembered that a minority does not act as a collective, but rather that each village sees itself as a cultural and economic unit and that therefore different solutions for different villages of the same ethnic minority could be appropriate.
Participatory evaluation and planning methods should be used in order to facilitate the implementation later on.

The perception of village forest as the most important life resource should be reinforced in the interest of its owners. The tendency for a reorientation towards old traditions should be used to reanimate the formerly existing conservationist attitude towards nature. In addition, training and education can enhance the ecological understanding and awareness of the population. For this educational work, mainly counterparts from the respective minorities should be employed. However, only the long-term presence of committed experts and a continuity of the extension work can guarantee success.

Apart from building on traditional values, economic incentives for local people will be crucial. Agro-forestry systems and - in particular for young people - small projects in the primary and secondary sector could be supported: e.g. fish breeding in ponds, small animal husbandry, combined cultivation of marketable fruit and vegetables, local processing (tea a. o.), simple rural industries. Starting points for this already exist in private initiatives of certain households and village communities. The relatively low level of success so far as been mainly due to transport and marketing problems.

As for forest management, the training and financial support of local foresters from the respective villages is a foremost task. Only in this way can a sustainable, planned and controllable forestry be developed.
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