Small scale teak plantations in Luang Prabang province, Lao PDR - Silviculture, ownership and market
Foreword
This minor field study (MFS) was carried out as part of the requirements and corresponds to 10 credits on C level. The Department of Silviculture at the Swedish University of Agriculture Sciences has planned the study in co-operation with the National Agriculture and Forestry Research Institute (NAFRI) in Lao PDR with the objective to describe the silviculture practise in teak plantations established by small-scale farmers. Besides biophysical aspects, tenure and market prospects both for plantations as well as for the wood have been discussed.

Acknowledgement
This study was funded by Sida (Swedish International Development Agency) as an MFS (Minor Field study). The MFS was hosted by the Lao-Swedish Upland Agriculture and Forestry Research Programme (LSUAFRP) which is a programme financed by Sida and run by the National Agriculture and Forestry Research Institute of Lao PDR (NAFRI) and Scandia consult Natura (SCC).

The MFS took in place in Lao PDR in August and September 2003 and was written in Sweden later that year.

We, Niklas Fogdestam and Helena Gålnder, would like to thank the following persons for their support and assistance during the time we have been working with this project:

Mr Houmchitsavath, our guide and interpreter during the field days in Pone Xay district.
Mr Olle Forshed, our mentor in professional as well as social life in Lao PDR.
Mr Robert Nygård, our manager and supporter in Sweden who encouraged us to study our data more thoroughly than we thought possible.
Mr Calle Mossberg, for great support and help in Lao PDR, both professionally and socially.
Mr Bounchan, for help with getting and performing the appointments in the villages.
Mr Thansamai, for taking us on a great field trip to Pho May Sack and generously sharing his knowledge in teak with us.
Mr John Raintree, for help with analyzing and understanding our data.
Mr Joust Foppes, for support and interesting questioning of our work and results.
Mr Songkham, for taking his time to teach us about the Lao teak market and showing us his industry.
Mr Peter Fogde, for sacrificing his time on us and explaining in Swedish what the tropical timber market really is about.
Mr Khampoui, for showing us forest research centre and helping us to design our field form and our questionnaires.
Mr Sianouvong, for explaining the legal framework of the Lao timber industry.
The students at the Namboo resort, for serving us the local delicacies and keeping us company at the resort.
The 12 villages and all the people living in them for taking their time to answer our questions.
Abstract
This Minor Field Study was done in the Pone Xay district the Luang Prabang province in the north of Lao PDR during August and September in 2003. The objective was to describe and analyse the current tenure system and the silvicultural practices of Teak plantations and to discuss its long-term potential to improve farmers’ livelihood. In 12 out 13 villages in the Pone Xay district the village headmen and a sample of the teak-owning families were interviewed and at least one of their teak plots was visited.

Our results showed differences in teak-owning among ethnic groups; 31 % Lao Loum, 17 % Lao Theung and 21 % Lao Seung, as well as among the wealthy, with 29 % of “surplus farmer” versus 19 % of in three sample villages. Out of the 195 families who owned teak, 23 families have sold the plantations which, when expressed in seedlings is 18 300, which equals 10 %. About half (52 %) of the interviewed farmers intended to continue with a second teak plantation after the current one, 21 % say that they won’t continue, and 27 % don’t know yet. A majority of the farmers answered that they have thinned (80 %) and pruned (62 %) in their plantations, however, none of the visited the plots had been pruned or thinned so far, i.e. in the scientific meaning of the words.

To analyse the entire market chain of teak outside the district and/or province, interviews with saw-mill owners, merchants, traders and government administrators were made on transport and labour costs as well as teak prices. The main finding is that prices offered by middlemen to farmers varied between 100 and 200 USD/m³, depending on size and quality. Assuming a teak value of 100 USD per cubic metre and a standing volume of approximately 10 000 m³ spread over 80 hectares in the Pone Xay district, it would be worth one million (1 000 000) US dollars.

Our assessment of the standing volume in the Pone Xay district shows that there is approximately 10 000 m³ divided on 80 hectares. If it would be sold today for 100 USD per m³ it would be worth 1 000 000 USD.

In order to improve teak production in the district we would like to recommend the farmers to:
1) Be careful when they select plant material and try to get the best there is.
2) Thin the trees on a regular basis and save the healthy and strong trees for further development.
3) Prune the trees with a straight and whole stem and aim for good and mature heartwood.

Keywords: tectona grandis; teak; lao PDR; forest plantations; land use
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1. INTRODUCTION

This study was carried out in Lao PDR in August and September 2003. The major part of the field study was made in the Luang Prabang Province but some parts took place in Xayaboury Province and in Vientiane community.

1.1 Objectives

The overall objective with this study was to describe and better understand the ownership and silvicultural practices for teak production in Luang Prabang province, which in the long run could help the farmers to manage their plantations for a better livelihood. The overall objective has been divided into four more specific objectives:

- Discuss merits and constraints of existing teak plantations and their establishment
- Describe the tenure system for teak plantations in Pone Xay district in Luang Prabang province
- Describe the plantation owners’ (farmers and others) silvicultural teak practices in Pone Xay district in Luang Prabang province
- Discuss the silviculture practices for different tenure categories (Compare the ownership with the silvicultural practices)
- Follow the teak tree from seed to end product and describe the involved steps, labour, costs and prices in a Market Channel Analysis (MCA).

1.2 Background

Lao PDR is one of the poorest countries in the world and most of the people support themselves by agriculture. In the northern uplands of Lao PDR the agricultural practices are dominated by shifting cultivation, which influence the vegetation in the landscape. The farmers cultivate upland rice on several small fields of a size of less than a hectare in a rotation system with short and long fallow periods. The fallow periods are essential to keep the fertility of the ecosystem at an acceptable level. During recent decades the length of fallow periods has decreased from around 20 years to 5 years or even less. Of course, there are many reasons for the decrease, but an increasing population pressure in some areas and an overall demand for better livelihood could be the main reasons. The yearly increase in population is 2.4 % according to the Swedish Department of foreign affairs (2002). The shorter fallow periods lead to a production degradation caused by increasing weed and loss of soil fertility (Roder, 2001). To deal with this problem of short fallow periods some solutions like agro-forestry systems, e.g. improved fallow periods, have been tested.

Another way of dealing with the loss of income that may affect farmers with degraded land, could be to plant cash crop or trees on the land. Teak (*Tectona grandis*) which is a native timber tree to Burma, Thailand, India and Lao PDR, has been promoted since the 1980s by the government of Lao PDR to be planted in the north of the country and especially in Luang Prabang province (Anon, 2001). Kolmert (2001) compared teak cultivation with upland rice cultivation and found that during a 25-year period teak could give around ten times higher income than ordinary rice production. Of course, this is in theory only since the farmer that chooses teak before rice on his land must have a secure source of rice during the time the teak need to reach harvesting age. According to Varmola (2002), teak is one of the most valuable and sought after hardwood species and demand will only increase in the future. However, in Lao PDR the farmers are not producing the good quality that the industry asks for.
1.2.1 Forest Policy
The government of Lao PDR (GOL) has recognised the agriculture and forestry sector as the backbone of the national economy, and to organise the protection and good maintenance of forests as well as to reforest is a major concern. The main goal with the country’s forest policy is to rationalise logging in order to protect the forest and the environment. In the middle of the 1990s the land and forest policy was implemented and the objectives with the policy were: “1) to promote crop production to replace shifting cultivation through allocation and titling of production land, and 2) to protect forests through classification and stabilisation of shifting cultivation” (Samontry, 2003). The policy consists of two main components. The first component is that the households get a contract of the allocation of degraded land for crop cultivation, tree planting or grazing. The contract is temporary for three years and if the households make use of the land they are entitled to titling. The second component, after the allocation of land, is that the village forest is classified into use, protection or other areas and an agreement on the rules governing each forest type is signed. One might wonder if it is possible to cultivate crops or plant trees on degraded land and to what extent this has been done since the policy was put into effect. However, these questions lie outside the scope of this study.

Before 1975 the need for teak plantations in Lao PDR was limited because of the large areas of natural forest that were still intact and that export opportunities were still limited (Houmchitsavath 2003). Development of the infrastructure increased, particularly in the northern parts of the country, between 1976 and 1988. Thereafter, it was easier to transport the timber and the number of plantations could increase. Another reason for expansion of teak plantations was that the GOL started to promote the planting of trees. The GOL have provided a legal framework for this purpose that includes the provision of degraded land for tree plantation through land and forest allocation and land leasing, assurance of ownership of planted trees, and provision of incentives such as land tax exemption and permission of log export. The GOL have also started to charge a reforestation fee on top of the log royalty in 2001. This fund has been used for the establishment of tree nurseries as well as for the distribution of seedlings to farmers.

1.2.2 LSUAFRP
The Lao-Swedish Upland Agriculture and Forestry Research Programme (LSUAFRP) hosted this Minor Field Study, which is a Sida-financed programme run by the National Agriculture and Forestry Research Institute of Lao PDR (NAFRI) and Scandiaconsult Natura (SCC). The programme’s overall objective is to reduce poverty in the uplands of Lao PDR. More specific objectives are, for example, to find out agricultural and forestry techniques acceptable to small farmers to improve their livelihood. For more information see the programme document (Anon, 2001). Pone Xay district is one of two target areas for the LSUAFRP.

1.3 Peoples Democratic Republic of Lao
1.3.1 General
Lao PDR is a landlocked country located in Southeast Asia. It shares borders with China in the north, Myanmar in the northwest, Thailand in the west, Cambodia in the south and Vietnam in the west (see fig 1). Lao PDR is located between latitudes 14° N and 23° N and longitudes 100° E and 108° E. The country has an area of 236 800 00 ha which is roughly half the size of Sweden. Vientiane is the capital of Lao PDR and it is located in the southwest, right by the border to Thailand.
Lao PDR has a tropical monsoon climate with a rainy season from May to October and a dry season for the rest of the year. During the rainy season about 80-85 % of the annual precipitation falls. The total amount of rain varies according to altitude and season, as does the temperature. The month just before the rainy season is the warmest month with an average temperature over 30°C, whereas December and January are the months with the lowest temperature, which can be low as 15°C.

Figure 1. The location of Lao PDR.

1.3.2 Population

Lao PDR has a population of 5.4 million people and normally they are divided into three main ethnic groups, namely: Lao Loum, Lao Theung and Lao Seung. The three major groups can be further divided into 48 minority groups. According to Roder (undated) there is no need to distinguish between different ethnic groups in Lao PDR of today. “Past and recent observations on land use practices do not, however, lend support to the claim that there are distinct ethnic preferences for certain land use practices. When formulating future policies and implementing programs focusing on sustainable upland agriculture for the hilly areas of Laos, it would be more realistic to use economic stratification based on available options and opportunities rather than ethnic divisions.” However, in this study the traditional division into the three major ethnic groups have been used.

*Lao Loum (Lao of the lowlands)*

Almost half of the population in Luang Prabang province belong to the Lao Loum. Normally they live in the lowland (200 – 400 m above sea level) and are therefore called the Lowland people. Lowland farming and lowland paddy rice are their traditional methods of agriculture (Kolmert, 2001). But they also cultivate other lowland crops like mango and coconut (Roder, undated). The majority of the people who live in the cities are often Lao Loum. They often have the highest political positions and are, in general, the wealthiest people.
**Lao Theung (Lao of the mountain slopes)**

Mon-Khmer is a little group of Lao Theung and they seem to be the aboriginals of Lao PDR (Lonely Planet, 2002). 38% of the population in Luang Prabang province belong to Lao Theung. They live in the mid-altitude mountain slopes (300 m to 900 m) and use shifting cultivation systems. Upland rice is their main crop but they also cultivate crops like maize, Job’s tears, etc. Lao Theung is the poorest people in Lao PDR and often they work as labourers for Lao Sung and Lao Loum.

**Lao Seung (Lao of the mountain summits)**

During the last century Lao Seung immigrated from Myanmar, Tibet and Southern China to make their homes up in the mountains, above 1000 m (Lonely Planet, 2002). In Luang Prabang province about 15% of the population belong to Lao Seung. They live so isolated and remote that very little is known about their farming systems but normally they use Slash-and-burn for their maize and upland rice (Kolmert, 2001). Banana and papaya are important crops for the Lao Seung people because they can harvest them after a year, which suits their traditionally nomadic way of living (Roder, undated).

### 1.3.3 Luang Prabang Province

Luang Prabang province is located in the northern part of Lao PDR between latitudes 19° 15’ N and 21° 10’ N and longitudes 101° 57’ E and 103° 38’ E (Pradichit, 2002). It has an area of more than 2 million hectares, which makes it the second largest of the sixteen provinces in the country. Most of the land, about 85%, in the province is mountainous with the lowest point at 250 m a.s.l. and the highest point at 1600 m a.s.l. The province has a total of 967 villages today and is divided into eleven districts: Luang Prabang, Xien Nguene, Nane, Pak Ou, Nam Bak, Ngoy, Pak Xeng, Pone Xay, Chompet, Viengkham and Phou Khoune. Out of the total population of 412 000 in Luang Prabang province about 16 000 live in the city of Luang Prabang. Over 60% of the populations are still shifting cultivators (Pradichit, 2002). The area has received an average of 1379 mm of rain during the last 25 years, with a maximum of 1841 mm in 1981 and a minimum of 1035 mm in 1987. The mean temperature during the last 25 years has been 25.4 °C with a minimum of 3.5 °C in 1999 and a maximum of 41.4 °C in 1991. The normal rain season in Lao PDR is from June to October.

### 1.4 Teak (Tectona grandis)

#### 1.4.1 Introduction

Teak (*Tectona grandis* Linn. f.) is one of the most valuable tree species in the tropical regions of the world (Tanaka, 1998). Due to its popularity on the timber market a great many tropical countries have planted teak over time. The amount of plantations varies greatly between different countries. Lao PDR, which has large areas of natural teak forest, has only a relatively small amount of teak plantations as of today. For comparison, one can look at the following figures of teak plantations collected from various articles: 159 000 ha in Thailand (Varmola, 2002), 700 000 ha in Indonesia (Tanaka, 1998), Myanmar 139 000 ha (Varmola, 2002), Costa Rica 40 000 ha (Cordero, 2003) and Lao PDR 8000 ha (Thongthanh, 2001). According to Calle Mossberg (pers. comm. 2003) there where more than 10 000 ha of teak plantations in Lao PDR in 2003.
1.4.2 Morphology and phenology

Teak is believed to belong to the family Verbenaceae but recently scientists have started to question this with the help of modern DNA-technique. Probably teak will be placed in the family of Labiatae shortly (Teaknet, 2003). Teak has its natural distribution in limited regions of South and Southeast Asia (Tanaka et al., 1998). In Lao PDR the limited region consists of the northwestern part of the country along the northern border to Thailand. A teak plantation managed with the utmost care in Java has produced trees with a height of 45 m and a DBH of 111 cm at an age of 85. A teak tree normally has a well-developed tap root and is resistant to wind, but if it is planted so that the root does not develop in a normal way and the tree should not be planted in a windy environment (Thansamai, pers. comm. 2003).

Teak exists in at least two different phenotypes in Tirupati, India. The differences are in their leaf length/breadth ratio and are called broad-leaved (BL) and narrow-leaved (NL) phenotypes in an article by Rajendrudu, Naidu and Malikarjuna (1997).

According to a study performed in India made on three different localities (Priya & Baht, 1998) a mature tree shows the phenology phenomena displayed in Table 1 during a year.

<table>
<thead>
<tr>
<th>Month</th>
<th>Phenomena</th>
</tr>
</thead>
<tbody>
<tr>
<td>December-January</td>
<td>Leaf Fall</td>
</tr>
<tr>
<td>February</td>
<td>Leafless</td>
</tr>
<tr>
<td>March –April</td>
<td>Leaf emergence</td>
</tr>
<tr>
<td>May</td>
<td>Full foliage</td>
</tr>
<tr>
<td>June</td>
<td>Full foliage+flowering</td>
</tr>
<tr>
<td>July</td>
<td>Full foliage+flowering+fruit set</td>
</tr>
<tr>
<td>August-October</td>
<td>Full Foliage</td>
</tr>
<tr>
<td>November</td>
<td>Beginning of leaf fall</td>
</tr>
</tbody>
</table>

After checking this with staff at the Teak-station (Thansamai, pers. comm. 2003) it is safe to say that the trees follow, in all essentials, the same scheme in the Luang Prabang province. As one can see, the leafless months coincides with the dry season (see 1.2.1 and 1.2.3) in this region. The flowering occurs in July throughout August and the trees normally start flowering at the age of ten. However, in Lao PDR some trees flower and bear fruit already at the age of five but then the seeds often are of poor quality (Houmchitsavath, pers. comm., 2003). According to Kadambi (1972), teak in Uttar Pradesh, India can start to produce seeds as early as at the age of 4. However, by then the viability is only 4 percent. This should be compared with seeds from 23-year-old trees, which give a viability of 18 percent.
Figure 2. One year old teak plant in Luang Prabang province, approximately 1.3 m high

Figure 3. Three years old teak plantation, Ban Sopchia, Pone Xay district, approximately 5 m high
1.4.3 Site requirements

The minimum day/night temperature for teak seedlings is 21/16°C for growth and development and the optimum temperature seems to be 30/25°C. However, teak has proved to grow well in day temperatures ranging from 27 to 36°C and night temperatures ranging from 22 to 31°C. According to a trial into teak planting in north-eastern Thailand, teak grows well on well-drained porous soils with deep subsoil whereas soils with inadequate drainage are unsuitable. Teak requires slightly acidic to alkaline soils with a pH of 6.5 to 7.5 in order to grow well. Teak also requires a high base content especially with calcium, in order to be grow well naturally. Teak can be found on soils with different conditions than the ones described here but the above are mentioned as optimal conditions. In order to determine whether a site is good or bad for teak plantations, Tanaka claims one should consider the following factors: 1) Climate, 2) Edaphic factors such as geology, topography and soil, 3) Community levels such as light, soil moisture etc. In order to identify sites that fulfil the wishes for good teak growth in accordance with the stated three factors, one can use either of two methods. The first is a trial plantation, which of course is time consuming but normally gives an easily interpreted result. The second is the so-called plant indicator method where one uses for example Lagerstroemia calyciflora, Xylia dolabriformis or Bambuseae spp., all of which have similar site requirements as teak but much more rapid growth. (Tanaka et al., 1998).

1.4.4 Use of teak

In accordance with Mr. Thongthanh’s report from 2001, there are numerous products coming from teakwood. Among these floors, doors, indoor and outdoor furniture are some examples. In the town of Luang Prabang the local handicraft carpenters appreciate teak for it’s fine colour and smoothness as well as for its strength, which makes it easy to use for decorations (Mr. Bounekong, pers. comm.). In the small wood shops along the streets one can usually see elephant figures, signs and wall hangers made out of teak. Mr. Bounekong, who is a carpenter, also says that he can make furniture out of teak upon request but normally the locals prefer to have their furniture made out of rosewood (Dalbergia spp). In the villages we have visited teak is a much favoured wood for construction purposes. Natural teak has a very high density; one ton of teak logs equals 1.4158 m³ (Teaknet, 2003) that will give a density of 7.063 g/cm³ and, according to the Timber Trade Federation (TTF), teak from plantations has a density of 6.4 g/cm³.

1.4.5 Silviculture in general

Examples from Java, where a teak implementation programme has been used for over 100 years, show plantations planted with a density of 3300 seedlings/ha (Tanaka, 1998). These plantations are thinned about 11 times until the age of 60, which leaves between 100 and 150 trees per hectare. Final felling is conducted at an age of 80 and the average yield is about 170 m³ per hectare (Tanaka, 1998). Svenska TeakInvest AB has teak plantations in Panama and according to their website they thinned their plantations in years four and eight and do their final felling in year fifteen. In year four they thin 35 % and in year eight 53 %, the trees that are left for final felling have an average height of 25 m, diameter 35 cm in dbh and a volume of 0.625m³.

1.4.6 Silviculture in Lao PDR

According to Mr Thansamai, head of the teak station in Luang Prabang an optimal rotation of a teak plantation in Lao PDR should include the following steps: Plant the trees in June or July with a spacing of 2 x 2 meters, i.e. 2500 seedlings per hectare. Weed 2 times per year for the first three years until the trees can suppress the weeds on their own. When the canopy is
closed, about year 5 after planting, do the first thinning by taking out the weak trees so it equals around 40 % of the trees before thinning. One must pay attention to the canopy so that it doesn’t open too much. Trials with different pruning schemes were started in 2002 in Luang Prabang province by the Teak station. However, the data has not been analyzed or published yet. If the trees are to be pruned it can be done up to 60 % of the tree height. The trees can be harvested at an age of twenty but the quality will improve if you let them grow to 30-40 years old. After 40 years the heartwood is believed to rot but that is an observation not supported by any known research. The average age for teak harvest is 21 years in Luang Prabang province. Probably this is due to the fact that the minimum diameter required by the sawmills is 20 cm at breast height (Hansen et al., 1997). Since teak has very good coppicing ability the next generation will come by coppice and the original root system can support up to four teak generations by coppice before a completely new tree has to be planted.

The Second evaluation of an international series of teak provenance trials states that provenances from Thailand and Lao PDR are of good quality but especially provenances from Lao PDR are less productive than the average of the tested provenances. In this report, the quality traits include: survival rate, persistence, stem form, branch size, production and growth rate (Kjaer et al., 1995). There are some handbooks about teak management but not widely spread, at least not in English.

1.4.7 Pests and other problems
There are at least two different larvae attacking teak, one that eats leaves and one that eats the cambium. Neither seems to be lethal but both have an adverse impact on growth and quality. Rats as well as termites can attack the roots, thus decreasing the tree’s ability to get nutrients and water and eventually kill the tree. Also the wind and the frost can cause damage to the trees; the former in windy regions and especially in trees with poorly developed roots, the latter on young shoots at high altitudes where the temperature is low. If the shoots are harmed by frost it may cause the tree to bifurcate. The trees will be harmed by fire if the tree is thinner than 5 cm in DBH. If the tree is bigger it is very fire resistant and is not harmed by the extensive slash-and-burn period in the spring.
2 METHODS

2.1 Study site

The Pone Xay district is situated in the Luang Prabang province in the north of Lao PDR. The district has an area of approximately 180,000 hectares and a population of 24,400 people divided into 3,900 families. It contains 72 villages and its main way of transportation is a 30-kilometer long dirt road, completed in early 2003, that follows a west-east route along the Nam Pha river in the northwestern part of the district. The road is barely usable during the heavy rains in the rainy season. A small bus is trafficking the route Luang Prabang-Ponxai district town twice a day.

The Pone Xay district is a rural area with the Pone Xay district town, consisting of the two villages Pak Nga and Pong Ngam, as the most densely populated area. The district town is where the district office and other administrative offices on a district level are to be found. The district is dominated by shifting cultivators and is seemed to be one of the poorest in the country, partly because of its relative remoteness and difficult terrain. The people of Pone Xay live by subsistence agriculture with shifting cultivation as the dominant land use system complemented by small cash crop products like papaya, banana and pineapple. However, the government has been promoting different agroforestry systems in order to decrease the use of slash-and-burn practices. The main crops in this area, in order of importance are: Paddy field rice, upland rice, corn, Job’s tears and sesame. The most common domesticated animals, in no specific order, are: ducks, chickens, pigs, buffaloes, goats, cows and turkeys.

2.2 Sample

2.2.1 The villages

When interviewing Mr. Bounchan from the District Agricultural and Forestry Office (DAFO) he gave us the information that 13 of the villages in the Pone Xay district hold one or more teak-owning family. This information was according to his inventory (not yet published) of the farmers owning land in the district. All but one of the thirteen villages is situated along the main road mentioned above and we selected the twelve alongside the road for our study.

There were twelve villages used in our study, from west to east with these were:

Ban Huay Man, Ban Nam Boo, Ban Tap Pho Thai, Ban Tap Pho Nae, Ban Huay Maha, Ban Tha Kam, Ban Pak Vie, Ban Pak Ngam, Ban Pong Nga, Ban Huay Loong Theung, Ban Done Xay, Ban Sop Chia.

The five first villages are in a part of the study area for the programme (LSUAFRP) where we got information by Mr. John Raintree about the farmers and their wealth rank. The wealth rank is divided into five different levels: Surplus, Sufficient, Insufficient, Poor and Very Poor.

2.2.2 The interviews

In each village we wanted to meet and interview the village Headmen and at least one representative from each major ethnic group owning teak. From the headmen we wanted to know some general data about each village, see Headman Questionnaire appendix 1, and we wanted a list of all teak-owning families, stating name, ethnic group, number of planted seedlings and the year of planting. In combination with this we wanted them to help us draw a map of the approximate location of each and every teak plot. This was in order to estimate the distance to access-roads and to enable a follow-up in the future. A summary of the sketch
maps can viewed in appendix 6. From the farmers we wanted the answers to our questions in the Questionnaire Farmer, see appendix 2, and we wanted them to show us at least one of their plots so we could make some measurements and complement the semi-structured interview with specific questions related to the plantations. The field form is in appendix 3 and the definitions to the field form are in Table 2.

Table 2. Definitions for the field form used in a survey of teak plantations, August 2003, in Lao PDR

<table>
<thead>
<tr>
<th>Plot</th>
<th>If the farmer has more than one plot, our numbering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude</td>
<td>All the plots were situated at the same latitude, namely 20º North</td>
</tr>
<tr>
<td>Altitude</td>
<td>Meters above sea level, measured with a Barigo altimeter. Accuracy 25 meters</td>
</tr>
<tr>
<td>Aspect</td>
<td>The direction the major part of the plot is facing, Accuracy 45º</td>
</tr>
<tr>
<td>Slope</td>
<td>The average steepness of the plot measured with a Carl Leiss BL7 Altimeter. Accuracy 5 º</td>
</tr>
<tr>
<td>Area</td>
<td>The approximate area of the plot measured by foot. Accuracy 100 m²</td>
</tr>
<tr>
<td>Farmer</td>
<td>The name of the farmer.</td>
</tr>
<tr>
<td>Village</td>
<td>The name of the village.</td>
</tr>
<tr>
<td>Picture</td>
<td>If a picture has been taken its number is noted here.</td>
</tr>
<tr>
<td>Plant spacing</td>
<td>An average of five different spacing chosen subjectively.</td>
</tr>
<tr>
<td>Number of plants/ha</td>
<td>Calculated from area and plant spacing and controlled against the given number of seedlings.</td>
</tr>
<tr>
<td>Average diameter</td>
<td>An average of five different trees chosen subjectively and measured with a caliph meter.</td>
</tr>
<tr>
<td>Average height</td>
<td>One representative tree chosen and measured with a Carl Leiss BL7 Altimeter</td>
</tr>
<tr>
<td>Few/More/Many</td>
<td>The approximate amount of the specific heading. Few is less than 33%, More is between 33 and 66 % and Many is more than 66%</td>
</tr>
<tr>
<td>Weeding</td>
<td>The amount of weeds that are left, both on ground and on stems.</td>
</tr>
<tr>
<td>Grazing</td>
<td>If any animals are grazing in the plot the animal is noted.</td>
</tr>
<tr>
<td>Intercropping</td>
<td>If any crops are intercropped the specie is noted.</td>
</tr>
<tr>
<td>Thinning</td>
<td>If thinning has been performed an approximation of Few/more/Many is made.</td>
</tr>
<tr>
<td>Pruning</td>
<td>If it has been performed on a majority of the stems the height is noted.</td>
</tr>
<tr>
<td>Filling</td>
<td>If gaps between the stems have been filled up with seedlings.</td>
</tr>
<tr>
<td>Canopy</td>
<td>An approximation of the area of the ground that is shaded.</td>
</tr>
<tr>
<td>Coppice</td>
<td>If the standing trees have been shooting from the roots.</td>
</tr>
<tr>
<td>Shoots</td>
<td>If the standing trees have been shooting from the stems.</td>
</tr>
<tr>
<td>Root legs</td>
<td>If the root legs are visible above ground.</td>
</tr>
<tr>
<td>Damages</td>
<td>If any visible damage has sever the trees.</td>
</tr>
<tr>
<td>Type of damage</td>
<td>If possible the type of damage has been noted.</td>
</tr>
<tr>
<td>Irrigation</td>
<td>If any type of irrigation has been used.</td>
</tr>
<tr>
<td>Fertilization</td>
<td>If any type of fertilization has been used.</td>
</tr>
<tr>
<td>Distance to road</td>
<td>The distance to the road from the border of the plot closest to the road. Measured by foot, accuracy 10 m.</td>
</tr>
<tr>
<td>Future/History of the plot</td>
<td>The answer given in the farmer questionnaire.</td>
</tr>
<tr>
<td>Other information</td>
<td>Other information of any kind.</td>
</tr>
</tbody>
</table>
The three questionnaires have been designed solely for this study and they have all been carefully read and discussed with researchers at the National Agriculture and Forestry Research Institute (NAFRI) both in Vientiane and in Luang Prabang. The field form is unique for this study and it was tested before implementation on a small-scale farmer’s teak plot outside Vientiane. We also prepared ourselves by visiting Namxuang Forest Research Centre in order to see how the tree trials there were being performed.

During the time we did our interviews in Pone Xay district we lived in the so-called Namboo Resort, which is a small stone house with two rooms, one for men and one for women. Since you sleep on mattresses directly on the floor there is space for about ten persons in each room. There is an outdoor kitchen, a gigantic sink for showering and a hand-flushed toilet at the resort. The resort is in daily use by agricultural students performing studies for the LSUAFRP in the resort garden and the nearby villages. During our time in the villages we have had a 4-wheel jeep and an experienced driver constantly available, as well as our interpreter and guide, Mr Houmchitsasavath, Head Deputy Director of Northern Agriculture and Forestry Research Centre. The equipment we used was borrowed from the teak station in Luang Prabang where we have also had the constant support from the head and the former head of the Luang Prabang Teak Station, Mr. Thansamai and Mr. Thongsavanh.

The schedule for making an interview was as follows: First our guide helped us make an appointment with the Headman of the village in question. When meeting the Headman our guide introduced us and the aim of our study briefly before we started our short interview of the Headman about the village. Thereafter our guide and the Headman helped draw a sketch map of the teak plantations in the village, corresponding with a list of the known teak owners. The interview, the list of the owners and the sketch map generally took 1 to 2 hours to do. After surveying the list we selected the farmers we wanted to interview. Each farmer interview took about 40 minutes of just talking. The field visits varied greatly in terms of time consumption and physical effort. As a rule we did at least one village per day but sometimes we managed to make two. The twelve villages required nine whole days in the Pone Xay district.

2.3 Market Channel Analysis

In the semi-structured interview (appendix 2) to be undertaken with the village head man and individual farmers there was a chapter on the economy in teak management on all aspects from establishment to harvest, and where relevant, processing. In order to analyze the entire market chain outside the district and/or province of the teak produce and export interviews has also been made with saw-mill owners, merchants, traders and government administrators on all the involved steps, labour, costs and prices. Together with this, all existing sawmills in the district and easily accessible in the province were visited.

2.4 Assessment of standing volume in the Pone Xay district

After collecting our data on the estimated amount of teak in Pone Xay district, we wanted to estimate the volume today as well as that in the future. We also wanted to present the approximate value of these volumes. In order to do so, we used the following formulas and estimations:

Tree volume = diameter^2 x height x (Π / 4) x f (Thongthanh, 2001). Where f stands for form factor, which is dependent on the age of the tree.
3 RESULT

3.1 Study site

A total of 3876 families live in the Pone Xay district distributed among 72 villages. In each village there are, on average, 54 families with 6.3 individuals per family. The ethnic groups in the whole Luang Prabang province have the following proportions: 38.7 % belong to Lao Loum, 45.1 % to Lao Theung and 16.2 % to Lao Seung.

3.2 Sample

3.2.1 The Villages

In the twelve villages we visited there are 916 families of which 195 own at least one teak plot with at least 10 trees, corresponding to 21.3 %, according to data collected from the village headmen. All the teak-owning farmers (the sold plantations included) have planted about 181 000 seedlings on 241 different plots. An average plot has 753 seedlings and the average size is 0.33 ha. The average numbers of families owning teak in each village of the twelve selected villages are 17 families, ranging from 3 in Tha Kam to 65 in Pak Nga. The last village, Ban Huay Nga, are not counted but according to Mr. Bounchan from DAFO there are one or two families owning teak there (pers. comm., 2003). In the whole district 197 families own teak, which is roughly equal to 5 % (197 / 3876).

<table>
<thead>
<tr>
<th>Village</th>
<th>Lao Loum</th>
<th>Lao Theung</th>
<th>Lao Seung</th>
<th>Families</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huay man</td>
<td>2 %</td>
<td>77 %</td>
<td>21 %</td>
<td>48</td>
<td>305</td>
</tr>
<tr>
<td>Nam Boo</td>
<td>10 %</td>
<td>48 %</td>
<td>42 %</td>
<td>67</td>
<td>439</td>
</tr>
<tr>
<td>Tha Pho Thai</td>
<td>56 %</td>
<td>44 %</td>
<td>0 %</td>
<td>57</td>
<td>336</td>
</tr>
<tr>
<td>Tha Pho Nee</td>
<td>22 %</td>
<td>78 %</td>
<td>0 %</td>
<td>68</td>
<td>479</td>
</tr>
<tr>
<td>Huay Maha</td>
<td>2 %</td>
<td>33 %</td>
<td>66 %</td>
<td>123</td>
<td>827</td>
</tr>
<tr>
<td>Tha Kam</td>
<td>5 %</td>
<td>84 %</td>
<td>11 %</td>
<td>44</td>
<td>240</td>
</tr>
<tr>
<td>Pak Vii</td>
<td>40 %</td>
<td>7 %</td>
<td>53 %</td>
<td>55</td>
<td>377</td>
</tr>
<tr>
<td>Pak Ngam</td>
<td>433 %</td>
<td>38 %</td>
<td>105 %</td>
<td>121</td>
<td>806</td>
</tr>
<tr>
<td>Pong Ngam</td>
<td>10 %</td>
<td>72 %</td>
<td>18 %</td>
<td>100</td>
<td>575</td>
</tr>
<tr>
<td>Huay Loong Theung</td>
<td>7 %</td>
<td>93 %</td>
<td>0 %</td>
<td>89</td>
<td>503</td>
</tr>
<tr>
<td>Don Xay</td>
<td>0 %</td>
<td>100 %</td>
<td>0 %</td>
<td>74</td>
<td>450</td>
</tr>
<tr>
<td>Sop Chia</td>
<td>64 %</td>
<td>36 %</td>
<td>0 %</td>
<td>70</td>
<td>360</td>
</tr>
<tr>
<td>Total</td>
<td>25 %</td>
<td>53 %</td>
<td>21 %</td>
<td>916</td>
<td>5697</td>
</tr>
</tbody>
</table>

In the twelve villages we visited, the average number of families is 76.3 and the average population is 474.8. The average number of family members is 7.1 per family. The families in our study are divided into three ethnic groups. On average, 19.4 families belong to Lao Loum, 40.8 to Lao Theung and 16.1 to Lao Seung, which is equal to 25 %, 53 % and 21 %, respectively. 37 % of the people who own teak belong to Lao Loum, 42 % to Lao Theung and 21 % to Lao Sum (see Table 4). However, when calculating the percentage of teak-owning families within the different ethnic groups the figures are significantly different. 31 % of the Lao Loum own teak, 17 % of the Lao Theung and 21 % of the Lao Seung. Lao Loum own 46 % of all the planted seedlings, Lao Theung 31 % and Lao Seung 24 %.
Table 4. Number of families in the twelve villages in Pone Xay district in Luang Prabang province, owning teak plantations in each village divided into the three major ethnic groups

<table>
<thead>
<tr>
<th>Village</th>
<th>Lao Loum</th>
<th>Lao Theung</th>
<th>Lao Seung</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huay man</td>
<td>0 %</td>
<td>78 %</td>
<td>22 %</td>
<td>18</td>
</tr>
<tr>
<td>Nam Boo</td>
<td>14 %</td>
<td>14 %</td>
<td>71 %</td>
<td>14</td>
</tr>
<tr>
<td>Tha Pho Thai</td>
<td>100 %</td>
<td>0 %</td>
<td>0 %</td>
<td>13</td>
</tr>
<tr>
<td>Tha Pho Nee</td>
<td>21 %</td>
<td>79 %</td>
<td>0 %</td>
<td>14</td>
</tr>
<tr>
<td>Huay Maha</td>
<td>0 %</td>
<td>57 %</td>
<td>43 %</td>
<td>23</td>
</tr>
<tr>
<td>Tha Kam</td>
<td>0 %</td>
<td>67 %</td>
<td>33 %</td>
<td>3</td>
</tr>
<tr>
<td>Pak Vii</td>
<td>27 %</td>
<td>18 %</td>
<td>55 %</td>
<td>11</td>
</tr>
<tr>
<td>Pak Ngam</td>
<td>77 %</td>
<td>18 %</td>
<td>5 %</td>
<td>56</td>
</tr>
<tr>
<td>Pong Ngam</td>
<td>4 %</td>
<td>68 %</td>
<td>28 %</td>
<td>25</td>
</tr>
<tr>
<td>Huay Loong Theung</td>
<td>29 %</td>
<td>71 %</td>
<td>0 %</td>
<td>7</td>
</tr>
<tr>
<td>Don Xay</td>
<td>0 %</td>
<td>100 %</td>
<td>0 %</td>
<td>6</td>
</tr>
<tr>
<td>Sop Chia</td>
<td>100 %</td>
<td>0 %</td>
<td>0 %</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>37%</td>
<td>42%</td>
<td>21%</td>
<td>195</td>
</tr>
</tbody>
</table>

The data from the program (LSUAFRP) could be used for Ban Huay Man, Ban Tha Poo Nee and Ban Huay Maha. Together in these three villages there are 238 families and of them 55 families own teak. A major part of the total families are wealthy and also a major part of the teakowners. (see Figs. 4 and 5).

Twenty-three families of the 195 families who owned teak have sold the plantations, expressed in seedlings that is 18 300, which equals 10 %. One family sold half of their plantation and 2 families made a so-called 50/50 deal. A 50/50 deal is an expression used by the farmers for a special kind of deal between a farmer and an investor. The farmer supplies the land and the investor supplies the seedlings. After the land has been planted half of it belongs to the farmer and the other half belongs to the investor. Expressed in percent, this equals 12 % (22.5/195) of the families have planted and later sold their plantations and 1% (2/195) of the families have made a 50/50 deal. The majority of the plantations have been sold to other farmers or officials in the Pone Xay district. Four plantations have been sold to persons living in the city of Luang Prabang.
The first plantation was established in 1977 but most of the plantations in the Pone Xay district were established in 1996. Around 65,000 seedlings were planted that year, which is equal to 36% of all seedlings planted from 1977 to the present day (see Fig 6).

![Graph showing the number of teak seedlings planted per year in the Pone Xay district.](image)

**Figure 6. Number of teak seedlings planted per year in the Pone Xay district**

### 3.2.2 The Interviews

In each village we interviewed a sample of farmers according to a priority following a subjective order. After considering the list and the sketch map created by the headman, and after hearing about which farmers that were available at the time for our visit, we started by selecting one representative for each ethnic group. Preferably we picked the persons with the highest number of seedlings on their plots in order to be able to compare the differences in silviculture on the different plots. In some villages we interviewed more than three farmers if someone was easily available at the moment.

The Headmen provided us with a list of the known teak owners in each village. The lists contained information about the name of the farmer, the age of the plantation, the area or the number of seedlings in each plantation, and also the ethnic group of the farmer in question. Furthermore, the Headmen together with our interpreter and advisor Mr. Houmchitsavath Sodarak, have drawn a sketch map showing the approximate allocation of each and every plantation.

All in all, we interviewed 33 teak-owning households. The farmers we interviewed have, with few exceptions, also showed us one of their teak plots in the field. On the plots we performed a small survey of the status of the stand as well as of the silvicultural practices. Since the farmer in question accompanied us the interview continued in the field. The data collected are to be seen in our field form in appendix 3. Some plots were visited due too long distances in difficult terrain and some plots were visited even though no interview with the farmer was made. Both these examples are rare exceptions, though. Altogether we visited and collected data in 26 teak plots. The first part of the field form consists of data that were measured, whereas the second part is the result of our own approximations.
Of the interviewed farmers 84 % have either a plot with upland rice or paddy field rice, but only 61 % are self-sufficient in rice the whole year. The farmers also cultivate other kinds of crops, like sesame and corn, and the second most common crop is Job’s tears (67 %). Except for teak plots, the farmers own, on average, 2.8 plots of different kind of crops (see Table 5).

Table 5. Number of farmers owning plots of different types

<table>
<thead>
<tr>
<th>Plot</th>
<th>Number of farmers</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paddy field</td>
<td>13</td>
<td>39 %</td>
</tr>
<tr>
<td>Upland Rice</td>
<td>15</td>
<td>45 %</td>
</tr>
<tr>
<td>Corn</td>
<td>15</td>
<td>45 %</td>
</tr>
<tr>
<td>Sesame</td>
<td>13</td>
<td>39 %</td>
</tr>
<tr>
<td>Job’s tears</td>
<td>22</td>
<td>67 %</td>
</tr>
<tr>
<td>Paper Mulberry</td>
<td>8</td>
<td>24 %</td>
</tr>
<tr>
<td>Fruit garden</td>
<td>6</td>
<td>18 %</td>
</tr>
<tr>
<td>Fish pond</td>
<td>3</td>
<td>9 %</td>
</tr>
</tbody>
</table>

Each of the interviewed farmers had at least some sort of animal. However, 29 farmers owned a big animal, i.e. buffalo, cow, pig or goat. The average teak-owning farmer owned 1.1 buffalo, 2.1 cows, 2.9 goat, 1.8 pig, 35.6 chickens and 12.6 ducks (see Table 6).

Table 6. Number of the interviewed farmers who owned different kind of livestock

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Number of farmers</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo</td>
<td>9</td>
<td>1.1</td>
<td>0-9</td>
</tr>
<tr>
<td>Cow</td>
<td>14</td>
<td>2.1</td>
<td>0-19</td>
</tr>
<tr>
<td>Goat</td>
<td>8</td>
<td>2.9</td>
<td>0-40</td>
</tr>
<tr>
<td>Pig</td>
<td>16</td>
<td>1.8</td>
<td>0-12</td>
</tr>
<tr>
<td>Chicken</td>
<td>26</td>
<td>35.6</td>
<td>0-150</td>
</tr>
<tr>
<td>Duck</td>
<td>22</td>
<td>12.6</td>
<td>0-86</td>
</tr>
</tbody>
</table>

When asking the 33 teak-owning farmers about their average annual income the replies resulted in an average of 550 USD/year (one USD equals 10600 kip, September 2003) but one farmer in Ban Huay Man claimed that he had an yearly income of incredible 4 000 USD a year.

Figure 7. Average annual income among interviewed teak owners in each of the twelve villages.
When analyzing data from the 26 investigated teak plots we find that an average teak plantation has an age of 8 years, a height of 12 m and a diameter at breast height of 13.3 cm. The average area is 0.41 ha. The mean altitude is 631 m and the mean steepness is 14°. The average spacing is 2.09 m, which is equivalent to 2289 plants/ha. However, the most common spacing, the median, is 2 x 2 m.

Table 7. Silviculture data from 33 investigated teak plots in the Pone Xay district, Lao PDR

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>8 year</td>
<td>3-21 year</td>
</tr>
<tr>
<td>Area</td>
<td>0.41 m</td>
<td>0-2.6 m</td>
</tr>
<tr>
<td>Altitude</td>
<td>631.2 m</td>
<td>600-700 m</td>
</tr>
<tr>
<td>Slope</td>
<td>14°</td>
<td>0-40°</td>
</tr>
<tr>
<td>Spacing</td>
<td>2.09 m</td>
<td>0-2.6 m</td>
</tr>
<tr>
<td>Diameter</td>
<td>13.30 cm</td>
<td>5.8-27.7 cm</td>
</tr>
<tr>
<td>Height</td>
<td>12.42 m</td>
<td>6-21 m</td>
</tr>
</tbody>
</table>

When asking the farmers we found that 52 % of them are going to continue with a second teak plantation after the current one, 21 % says that they won’t continue and 27 % don’t know yet.

Of the interviewed farmers 79 % claim that they are going to use part of their plantation for house constructing within the family and 12 % claim that they won’t use it for own constructing. The remaining 9 % don’t know if they are going to use it or not.

When asked if they might be planning to sell some of their trees to someone else, 70 % answered yes while 21 % answered no. The remaining 9 % don’t know yet.

Eighty percent answered that they have thinned and 62 % that they have pruned in their plantations. However, when we visited the plots we discovered that none of the teak plots had been pruned or thinned, in the scientific meaning of the words, so far. This is also a fact for all the teak plantations visible from the road between Ban Huay Man and Ban Sop Chia. A vast majority has been intercropped the first two years with upland rice (Taungya system). Out of 61 plots, 58 had been weeded sometime and 28 plots were being weeded yearly after the fourth year.

Table 8. Number of farmers who have weeded the plot for the first four years

<table>
<thead>
<tr>
<th>No. of times</th>
<th>First Year</th>
<th>Second Year</th>
<th>Third Year</th>
<th>Fourth year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
<td>6</td>
<td>7</td>
<td>26</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>11</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>21</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>31</td>
<td>21</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>2.6</td>
<td>2.0</td>
<td>1.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Sixty-one percent of the farmers answered that they have had some kind of problem with their plantations. The most common problem (21 %) is an insect eating the cambium. The second biggest problem is wind breaking the top of the trees. Other kind of problem is defoliators, yellow leaves, vines, rats and erosion (see figure 8). In one of the plots we visited, a farmer had problems with frost but the farmer himself didn’t consider this to be a problem big enough to mention.
A majority of the interviewed farmers are managing their plantations in the way they have seen that “other people” manage them. When asked whether they have had access to advice from professionals a majority answered no. However, DAFO has informed and helped some people, as has the staff from the EU micro project.

3.3 Market Channel Analysis
The village head man gave us the names of the people who had bought teak plantations from the farmers. As of today, only one man had bought trees and he was not a farmer from the Pone Xay district. Therefore we have chosen to call him an investor. This investor passed away last year and therefore we interviewed his son, who inherited his father’s plantations, about the plantations. To follow the market chain we started by visiting a sawmill and by interviewing the owner in Luang Prabang. The sawmill owner’s daughter helps him to sell the logs to other companies in Vientiane, so she was also interviewed.
We also interviewed a carpenter in Luang Prabang city who makes hangers in teak for wall decorations and he also showed us his workshop. To see natural forest and to find out about the prices for natural teak we went to Sayaboury province, where we got an interview with the head of the DAFO in Pak Lai district. We also visited a natural teak forest, a managed and a non-managed teak stand together with a DAFO officer. In Vientiane we contacted Mr. Peter Fogde who owns an agro-forestry company (BAFCO) in Vientiane. We visited his sawmill and had a meeting with him in his office.

The market chain for teakwood has many actors and one of them is the middlemen. If we start the market channel analysis with the tree, the first step is to select the tree and the second is to cut it down. The farmer can either sell the teak tree to a middleman, a trader, other farmers or sell directly to a sawmill. If the farmer consumes it himself it is not considered to enter the market channel. The middlemen offer between 100 and 200 USD/m³ according to the people we interviewed.

After felling the trees the buyer decides into what lengths they should be cut, depending on the quality of the stem, the number of branches, etc. If the trees are to be transported by truck to a sawmill in Luang Prabang it will cost of 5 to 10 USD/m³. If the trees are sold within the village it will be sawn into planks in the forest (so-called pit sawing). This operation is usually performed by a two-man handsaw and it will take about one day’s work to transform one log into planks. In the Luang Prabang sawmill the logs are first made into square logs before they are sorted after quality and stored. After that, the square logs are either cut into planks or sold to the next processor, e.g. handicraft shops and carpenters in Luang Prabang town, or to other sawmills. The price per cubic meter of square logs varies greatly depending on quality, and it ranges from 200 to 1800 dollars. These other sawmills can either be domestic or in neighbouring countries such as China, Vietnam and Thailand. The transport cost by truck from Luang Prabang to Vientianne is around 31 USD/m³ (Burapha, 2002). For comparison, the price of an ordinary water buffalo in Pone Xay district is in the region of 1000 000 Kip or 100 USD (Houmchitsavath, pers. comm. 2003).

As mentioned previously most of the farmers in Pone Xay district have only young plantations and have only sold a few trees. A majority of the sold trees have been sold to other farmers around the village or have been used by the farmers themselves. The farmer selects the tree, cuts it, and by hand, makes a square log. A normal price for a cubic meter of teak in Luang Prabang province is between 100 USD up to 200 USD depending on the diameter. A cubic meter is not the common way to sell, instead they sell by tree, the price for a small tree (>20 cm in diameter) is 10 USD/tree. This can be compared with the mean annual income of a shifting cultivator household in Luang Prabang, which is about 500 USD (Hansen et al., 1997).

According to Mr. Sianouvong Savathong, head of the Luang Prabang PAFO, every time a farmer wants to cut down a tree, regardless if it is for sale or for private consumption, he has to notify DAFO or he will be fined.

According to The International Tropical Timber Organization (ITTO) the price for 1st quality teak was between 3180 and 3672 USD/m³ for planks of 1 x 8 inches x 8 feet, which roughly equals 2.5 cm x 20 cm x 240 cm. Teak logs over 50 cm in diameter had a price tag of 845 to 906 USD/m³ and logs of less than 50 cm in diameter cost 785 to 845 USD/m³ (ITTO, 2003).
When interviewing Mr. Songkham he told us about an Italian boat wharf that uses the teak heartwood for hull and decking and the sapwood for the boats luxury interior

4 DISCUSSION

4.1 Sample

4.1.1 The field visits
The visits that have been made for this study show that teak in the district grows fairly well but it is not managed properly.

One of the objectives was to compare the ownership with the silvicultural practices, and the overall impression is that there are no differences in how small-scale farmers, regardless of ethnic affiliation, are managing their plantations. However, large-scale farmers (see appendix 2) have a much higher awareness on how to manage plantations in order to obtain timber of good quality.

Another aim with the study was to determine to what extent the farmers plantations in the district have been sold to so-called investors. The study shows that surprisingly few plantations have been sold and only a few persons outside of the district.

A way of checking the validity of the figures given by the headmen is to look at the information from the 33 personally interviewed farmers. Our figures show that 13 % (4.3/33) of “our” farmers have sold their teak plantations and 3 % (1/33) have sold their land and their trees. An even better comparison is to see how many of the seedlings planted by the farmers in our sample that had been sold. Our data show that they have planted a total amount of 45360 trees, of which only 3550 had been sold. This equals 8 %. The figures from our sample correspond very well with figures from the whole population, and consequently we think they are realistic.

4.1.2 The interviews
The interviews show, among other things, that the farmers in Pone Xay district seldom get advice on how to manage their teak plantations. One may also question the quality of the advice that is given, since not one farmer interviewed has thinned his plantation. The farmers are fully occupied with their farming and everyday life and don’t have time to manage their plantations properly. Perhaps we will see entrepreneurs travelling around and performing tree management in the villages in the future. Anyhow, the farmers are in great need of professional advice if the plantations are to be well kept in the future.

From three of the villages we also got data about the farmer’s wealth rank. The reason why there are only three villages is that these three villages participate in another LSUAFRP-project. Figures 4 and 5 show that there are some differences in the wealth ranking between teak owners and the average farmer.

4.2 Market Channel Analysis
The market channel is complicated to describe in detail but an attempt has been made in this study and shows that the transports are many and difficult to perform. If teak is to be a valuable export goods the infrastructure has to be better than today.
4.3 Assessment of standing volume in the Pone Xay district

Assuming that all plantations have been planted with a spacing of 2.09 x 2.09 meters, which is the average from the plantations visited in this study, one hectare will have a density of 2289 trees. Altogether there are 180 000 planted seedlings in the district, and so the estimation is that there are almost 80 ha of teak plantations in Pone Xay district.

By using the average total volume per age class suggested by Thongthanh (2001) and applying this to the number of hectares in each class in our study we got a sum of 129 m$^3$/ ha. The total area of 80 ha times the 129 gives us a standing volume in the district of 10320 m$^3$ (129 x 80) and if it would be sold today for 100 USD per m$^3$ it would be worth 1 032 000 USD. However, when calculating the average standing volume on the 26 plots in our sample we found it to be no less than 160 m$^3$/ ha. If we use this as an average instead, the district has a total volume of 12 800 m$^3$ (160 x 80), which could be worth 1 280 000 USD today. By chance, the average age in our sample is 8 years whereas the average age of the 241 plots in the district is 7.6 years. One might wonder why our yield estimations are more than 30 m$^3$/ha greater than the ones in Mr. Thongthanh’s report. Perhaps this is because Mr. Thongthanh’s report states an average for the whole province, whereas our study only uses the data collected in the district. We have used the same formulas for volume but “our” trees are taller and have a greater circumference than the trees in Mr. Thongthanh’s report in the corresponding age group.

Our assessment is, in other words, that the present teak volume is between 10 000 and 13 000 cubic meters in Pone Xay district.

4.4 Recommendations

Our impression is that the teak plantations in Pone Xay district are not managed properly. The seedlings are of poor quality, the plantations are not thinned and the trees are not pruned. In order to achieve healthy plantations with trees of good quality we recommend the teak-owning farmers to:

1) Be careful when they select plant material and try to get the best there is.
2) Thin the trees on a regular basis and save the healthy and strong trees for further development.
3) Prune the trees with a straight and whole stem and aim for good and mature heartwood.

The natural teak from Lao PDR is of good quality (Kjaer et al., 1995) but as in all populations there are good and less good individuals. The distributors of seeds and seedlings should put an effort into finding good mother trees to take seeds from.

If we use the plantations on Java as an example, there should only be between 100 and 150 trees per hectare at the time for final felling. Additionally, the plantation should be thinned 11 times during a rotation of 80 years (Tanaka, 1998).

It is the heartwood that is the most valuable part of the teak tree (Fogde, pers. comm., 2003) and therefore one must try to make it develop early and mature nicely. This is an art that the teak owner should try to perform.

4.5 Suggestions for further studies
When working with this study many new questions that have arisen that were not within the scope of the study. Some of these questions are listed below as a suggestion for those who are interested in continuing and improving the work done so far.

1. To what extent does teak affect other crops and trees? Is it possible to produce teak at the same spot as crop?
2. Of what quality are the seeds and seedlings used in Lao PDR today? Are stumps a better alternative for successful regeneration?
3. Who is producing seedlings and stumps? And what techniques are being used?
4. What is the perfect way of managing a teak plantation in Lao PDR?
5. Are there any farmers associations in Lao PDR? Are they working with teak in any way?
6. If the plantations should be thinned properly is there a market for the thinned trees? What market could there be?
7. Why doesn’t every farmer plant at least some teak trees? If not in a regular plantation, why not along the borders of other plots?
8. In some years many plantations are established and very few in other years, why? What are the effective incitements?
9. Since teak is not edible it is interesting to know how much agricultural land is being used on behalf of teak? Can the farmers afford to put land aside for tree plantations?
10. We have discovered that there some problems with pests in the teak plantations. Is that a big problem in Lao PDR? Can something be done in a preventive purpose?
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Mr Thansamai 2003 Head of the teak station, Luang Prabang

Mr. Thongsavannh. 2003 Former head of the teak station, Luang Prabang

**Internet**

[www.teaknet.com](http://www.teaknet.com)
Appendix 1. Additional comments from the interviews with the farmers

Nam Boo A common procedure is that an investor gives a farmer, for example, 300 trees and then claims half of them at harvest. One farmer has sold one of two plots to an officer on the DAFO staff. He also thinks that a distance of 100 m is the maximum for a teak plantation to be away from the road it shall be profitable. Finally he claims that a tree with a diameter of 25 cm at breast height is worth 100 000 kip. In this village, Mr Bonlat is mentioned as a notorious teak buyer and investor.

Huay Man One of the farmer claims that about 20 trees per year are broken in half by the wind on his plots.

Tha Pho Thai One farmer claims that coppice shoot will grow considerably faster than a seedling. About 1.3 meters in a year, he says. All farmers in this village say that they would sell their teak trees any day if there is a buyer. They know that price increases with volume but in spite of this they are ready to sell. One farmer says that he would like to work more with management of the trees but he has got no time. One lady tells us that teak is good to use as burning wood but not many people trouble themselves by walking all the way to the plantation to collect the windfalls that are there. Another farmer in this village had sold two of four teak plots inherited from his grandfather. He has sold the trees but not the land they stand on. However, he has no idea about when he will get his land back so he can use it for other purposes. This fact didn’t seem to trouble him, though. It is the new owner, a trader not a farmer, who manages the teak trees today but according to this farmer the trader does nothing but looking at the trees once or twice a year. Not one of the three farmers has ever used or heard of anyone using irrigation for their teak.

Huay Maha In this village both Lao Loum and Laou Seung own teak but not one of the Lao Seung farmers were available due to work in their fields. A wife of a teak-owning farmer that we interviewed only spoke the Mong language so our questions went through two interpreters before they reached her. Apparently not all the people in this village were bilingual but many were. In this village, 6 plots have been sold to investors and Mr. Bounlath is one of them. The land does not seem to be sold but they don’t know when they will be able to use their land again.

Pak Vie In this village there were some plots within the village’s premises that were owned by other farmers in other villages. The simple explanations for this is that these people lived in Pak Vie previously but now have moved to other villages. One farmer says that he would like to buy more teak for his children in the future but no one in this village is willing to sell. He also hopes for 10 million Kip for the 38 trees at his plot. Another farmer says that it is too little profit for too much work when we asked him why he didn’t bother to prune his trees.

Tha Kam In this village a wife of a teak-owning farmer tells us that she has visited the example plots for teak management. That makes it two so far that we have heard of. However, both these persons say that they can’t afford to follow the advice given them. They neither have the time or the necessary tools.

Sop Chia Only five families have planted teak here and according to the village headman the reason is that no one is interested because the village is so remote. (The road goes through the river twice before reaching the village, so one is dependent upon 4-wheel drive and the water
level in the river). In this village, no trader has shown any interest so far but with the help of a
hand saw the villagers have produced timber for construction on their own. Not necessarily
timber from teak, but still. A woman tells us that her family would like to plant more teak but
they just have four plots of land and three of them are needed for food crops. The headman
also tells us that if they could get more seedlings to the village they would plant more teak
and one person in the village has planted 50 teak seedlings as late as year 2000. This can
serve as an example of the big interest in fairly small plantations in this village.

**Don Xay** In this village, 6 people own teak today and one has sold his trees. One of the
interviewed farmers wants to sell his trees, but not the land, within the next 3-4 years (at an
age of 12) because he needs money for digging a fishpond. Also in this village the headman
believes that the number of teak plots will increase in the near future, the interest is great
among the farmers.

**Huay Long Theung** This village moved to its current location next to the road because they
wanted to develop. It is difficult to develop by yourself in an remote area in the mountains.
After the sketch map had been drawn in this village we discovered a fully visible plantation
that was not on it. It had been forgotten but contained no less than 300 trees! A lady in this
village told us that her family had become interested in teak after hearing about its pros from
DAFO officials. She also told us that 5 workers are needed for 2 x 2 hours to weed a small
plantation of 200 trees. But her experience told her that if you don’t weed (take away vines)
the trees would be attacked and injured by ring-barking insects. She thinks that 4 trees with a
diameter of 25 cm can be sold for 1 million Kip. Another lady confirmed the first lady’s
observation about weeding and ring-barking insects. She also told us that it takes 6 workers 8
hours to weed a plot of 600 trees.

**Pak Nga** In this village, we were told about a man who bought two trees with a diameter of
35 cm each for 50 000 Kip per tree. There, we asked whether the teak farmers had someone to
ask for advice if needed. The answer was that they could get advice from The DAFO but the
officers there didn’t have very much experience of teak according to the farmers. One farmer
we interviewed had planted 1000 trees but today only 100 of them were still standing. Starting
in 1999 they had died off little by little and the reason was landslides and “the yellow leaf”
disease. Another farmer told us that he thinks that the price for a teak seedling today is 1000
Kip.

**Pong Ngam** According to the village headman, half the population in this village is poor in
the respect that they live life day-by-day in small houses. They can’t see into the future
because their main concern is to get food for the next day. One farmer we interviewed said
that he would like to get advice on how to manage teak but he hadn’t got it so far and he
didn’t know how to get it. Another farmer claimed that he had been pruning his trees to a
height of four meters after discussing the issue with DAFO personnel. However, when we
visited his plot the trees didn’t look very pruned at all. He said that he had pruned the year
before using a stick to break off the branches. The headman confirmed the price of 1000 Kip
for one teak seedling.
Appendix 2. Interviews made for the Market Channel Analysis

Sawmill and plantation owner Mr Songkham Manivong

Name of the company? Naluang Sawmill
Where do you live?
In Luang Prabang
How much land/trees do you own? Where?
Approximately 20 ha in the Luang Prabang Province, all within a maximum distance of 100 km from Luang Prabang town.
What is your business idea?
To provide customers all over the world with teak products; logs, sawn timber and furniture. The main product is square logs of teak but other tropical hardwood species, e.g. eagle wood and rosewood, may well be a future product for him. Eagle wood, with a rotation time of just 8 years might well be a coming product for him.
Do you have any competition in your area of business? Who?
There are 6 independent and privately owned sawmills in the area of Luang Prabang town.
How many of them who handle teak is unknown to Mr Songkham, but he believes that he is the only one with an emphasis in teak.
How did you get the land and the trees?
Land: He has bought all his plantations, land and trees, when they already were planted. As an example, he bought 2 hectares of teak plantation in 1990 for 3000 USD (at the rate of today).
Trees: When buying trees directly from small-scale farmers, Mr. Songkham goes out into the forest, personally, to decide which trees to buy and at what price. He also decides into what lengths the tree is to be cut.
How do you take care of the trees/land?
Mr. Songkham is aware of how a teak plantation is to be managed in order to produce high quality wood after his experience of working with the EU micro project. He has a clear idea of how and when the trees should be pruned or thinned. However, the 2 ha plantation mentioned above, which is very close to his saw-mill, is left to mature in a natural way, i.e. without management. If a teak plantation should be properly managed it ought to be thinned every 8 years with a start when the trees are between 5 and 10 years. Each thinning should result in a reduction in numbers of 40 %. The branches should be pruned when they are very small otherwise the stumps will rot and damage the timber.
How old are the trees?
None of the trees in his plantations is younger than 30 years. The one of 2 ha mentioned above is 45 years old today (2003).
When will you be harvesting?
The trees should be at least 50 cm in DBH and most of the trees reach that when they are around 30 years old.
What are you going to do with the land after harvesting?
He will continue with teak plantations forever and since he uses selective harvesting the forests will continue to grow naturally.
Why did you buy teak plantation?
He wanted to improve his personal wealth and was inspired to invest in teak while he was working for the EU micro project in 1994.
What are you going to do with the trees?
Harvest and sell them to best price. Some will be used for personal house constructing for himself and his family.

Where do you get your timber? How is the goods transported?
Some is harvested in his own plantations but since he is in need for more he also buys a great deal from small-scale farmers in the area. The round wood is transported by truck from the plantation to his mill.

Who stores the product and how?
He stores the round wood and the square logs at his sawmill.

Economy
How much do you pay for wood/other products?
For a tree with a DBH of 50 cm he pays 100 USD, which roughly equals 200 USD/m³. For small trees the price is no more than half of that, i.e. 100 USD/m³.

Who buys the teak?
During the past he has sold teak to Vietnamese-, Chinese- and Thai companies as well as to a small Italian boat wharf and to an Australian company. He would like to sell more to foreign countries but both the transports and the terms of payment are a problem He has tried a strategy where he gets a buyer in Europe for a Thai businessman that Mr Songkham sells logs to, but so far this strategy is not firmly established.

At what price are they sold?
The price is directly dependent on the quality of the wood but when selling a mix of sapwood and heartwood the minimum price is 350 USD/m³. For high quality heartwood square logs he can get as much as 1800 USD/m³. He claims that he has to pay higher taxes and charges since the Lao authorities are aware of the fact that he sells his products to Europe and Australia.

How are the goods transported?
The trees are harvested manually, either by handsaw or chain saw and then cut into 1.5, 2.0 or 3.0 meter pieces. These pieces are transported manually, sometimes with the help of elephants, to the road where a truck takes them to the mill.

How big volume do you handle by month/year?
The volume differs between 2000 and 5000 m³ per year and the Naluang sawmill (his own) cuts approximately 4 m³ of round wood into square logs per day. The remaining 500 to 3500 m³ are cut at other sawmills momentarily hired by Mr Songkham He has to pay 25 USD/m³ when outsourcing the cutting.

Other information
Apparently there is a market even for the sapwood from the teak. One is the small scale construction in the villages but also for furniture. According to Mr. Songkham the Italian wharf mentioned above uses sapwood for the interior and heartwood for the deck and hull of the boats.

The price of the local market is too low for Mr. Songkham, therefore he doesn’t sell timber to local construction companies. But the local people can collect junk wood for free from the sawmill.
Investor and plantation owner Mr. Vansai, son of Mr. Bonlat

Where do you live?
He lives in Ban Tat Loung in Luang Prabang town. He lives in a house made of teak although it is not teak from their plantations.

How much land/trees do you own? Where?
He owns approximately 200,000 trees in the Luang Prabang province. But just a few of these are to be found in the Pon Xay district. (200,000 trees probably equals 80 ha if planted with a density of 2500 trees/ha, 2 x 2 m spacing)

What is your business idea?
The idea of his father was to promote personal wealth as well as getting construction material for himself and his family.

How did you get the land/trees?
He owns both the land and the trees. He inherited most of it from his father. When he buys teak he often cuts a deal with the farmer. The deal states that he pays for all the seedlings if he later will get half of the farmer’s land. Sometimes he also buys the land directly.

How do you take care of the trees/land?
When hiring labour in the villages he pays the labourers 200 Kip (approximately 0.02 USD August 2003) in one ha of 2500 trees it is 500,000 Kip or 50 USD) per year to manage the trees. Normally the seedlings are planted with a spacing of 2 x 2 meters, sometimes 3 x 3 m, and they are seldom pruned and never thinned.

How old are the trees?
His father started to buy land for teak in 1994 and since he has planted all land “by himself” the oldest trees are now around 9 years old.

When will you be harvesting?
He will probably harvest when the trees have a DBH of 40 cm which will occur around the age of 20.

What are you going to do with the land after harvesting?
Wait for the coppice to produce a new generation.

Why did you buy teak plantation?
See above.

What are you going to do with the trees?
Some of the trees will be used for house construction within the family but most of them will be sold.

Economy
How much do you pay for wood/other products?
He pays around 1000 Kip per seedling today.

Who buys the teak?
He hasn’t sold any yet and doesn’t know.
The Head of DAFO in Sayabory district

**General**
77 villages with a total population of 60,000 people
In this district there are over 1000 ha of Natural Teak Forests and 40 ha of teak plantations belonging to governmental agencies (DAFO). According to the head of the DAFO these 40 ha are to be preserved for environmental reasons. How many hectares the small-scale farmers have planted they don’t know. Every year the whole province gets 8000 m³ of timber to take out from the forest of the government; this district gets 4000 m³. The money from the timber is used to develop the district, with infrastructure and such (4000*200 =800,000 USD).

**Silviculture**
Most of the plantations are from year 1990. The normal planting space in this area is 3x3 m and they are harvesting when the trees are about 20-30 cm in diameter, but the minimum age is 8-9 years. DAFO believes that the first thinning should be performed around the age of 7 and the second one at the age of 15. (How large the thinning should be is unknown but probably the canopy should be closed but not compact.) But it is a problem that the trees are very small in the top and the hardwood is not developed. In some areas in the district they have clear-cut when the trees are 15 years old, but the most common practise is selective cutting. When they are harvesting natural forest he think the trees are about 50-60 years old, but he is not sure. He has seen no evidence of heart rot in the trees when they reach the age of 40 (which is a common belief among farmers in the Ponxai district). However, there seems to be some sort of insect that attacks and eat the juvenile wood, making a hole in the bole of the tree.

**Prices**
DAFO sells seedlings to villages for about 350 kip/seedling and the village sells it to a farmer for about 500 kip/seedling. The extra money, 150 Kip/seedling, can be used by the village for development within the village. DAFO collects the seeds from the natural forests, but not from any specific mother tree.

The price for one cubic meter is presently 200 USD, it is the most expensive wood right now in this district. According to Mr. Thansamai the *Afzelia Xylocarpa* was the most valuable species previously. But usually the price is between 700,000 – 1,000,000 kip/m³ (70-100 USD/m³) when roundwood is sold to local sawmills.

They don’t know how much the trader and sawmill get when they sell flat timber.

**Other information**
Illegal harvesting of the natural forest is a common problem, because the farmers are very poor and need timber for building their houses.

Last year they started with demonstrations plots for thinning and pruning to show the farmers how they should do their tree management. However, the project is one-year-old and no one can tell how it is working out yet. The head of the DAFO had not heard any talk about eco-labelling or environmental certification.
Local carpenter in Luang Prabang

General
The carpenter buys his teak wood from Mr Songkham. Every year he buys around 30 planks and he pays 36 USD for 30 planks with a size of 2 m long, 1.5 cm thick and with a width of 15-16 cm. That is roughly equal to 270 USD for a cubic meter. He uses the wood to make hangers, which he sells, to tourists for around 10 USD. He can also make furniture, wood elephants and signs.

He uses teak for his hangers and signs because the tourists like teak. It’s a luxury wood for tourists and, of course, also for him. But he thinks teak is only on the third place of all the luxury wood. When asked about his list for wood preferences this was his answer:

1. Dalbergia spp.
2. Afzelia Xylocarpa, Pterocarpus
3. Tectona Grandis

Sawmill and plantation owner in Vientiane Mr. Peter Fogde

General data
Mr. Peter Fogde started his first company in Lao PDR in 1989 and has been active in the country since then. Today he has 3.5 companies within the Vientiane area. He has a consultant company, a sawmill, a dairy processing milk and youghurt and he is a part owner in a resort, Ban Pako, outside Vientiane.

The greatest problems concerning business in Lao PDR are to find risk funding and qualified labour. According to Mr. Peter Fogde neither exists in the country today. The banking system is not working very well, which means that it is next to impossible to get short-term loans and to get paid.

Burapha Group
The Burapha Group, which is Mr. Peter Fogde’s Forest Company, is mostly sawing eucalyptus, of which the company owns about 800 hectares, and is part owner in an additional 400 hectares. The eucalyptus is, among other things, used for DVD-racks and outdoor furniture for IKEA. The Burapha Group are also sawing and processing acacia and teak. Some of the raw material comes from the group’s own plantations, but as much as 80 % is being bought from private farmers. The Burapha Group never buys the timber unseen but performs an inspection before they negotiate about the price and terms of deliverance.

According to Mr. Peter Fogde teak is not a very profitable business in Lao PDR today. It is too expensive by far and to many middlemen expect to much in profit. As an example, the Burapha Group has produced and tried to sell teak floors. They bought the raw material for 8000 USD/m³ but they only got 1000 USD/m³ for the floor itself. And that was before the labour costs were added. Fortunately, the affair was not a total failure due to the fact that the leftovers from the production could be sold. However, the company made no money on the experiment.
The eucalyptus plantations
Eucalyptus grows well in Lao PDR and it produces beautiful timber and is easy to work with. In the plantations belonging to the Burapha Group the average yield is 20-25 m³/ha/year but Eucalyptus may well grow 29 m³/ha/year on the best sites. These plantations all come from cuttings and not from seeds, which give a considerably lower yield. Mr. Peter Fogde claims that it is possible to increase the yield to over 30 m³/ha/year if some effort is put into selection of mother trees and management of plantations.

Production of teak
When teak logs are sawn into square-logs the normal output volume will be 70 % but if the aim is to get clean heartwood the output volume will be no more than 15 to 30 %. When the teak has been sawn into square logs it will be dried to 8 % moisture and then packed in plastic film. However, due to the high humidity in the tropics the wood will re-moisture to 11-12 %. Teak is very resistant to humidity and temperature changes and will not be negatively affected by the dry air in Sweden, according to Mr. Peter Fogde.

According to Mr. Peter Fogde there are no known uses for the sapwood of teak and therefore it is practically useless.

The only customer the Burapha Group has at present that is interested in teak products is a hotel on the Maldives that buys floors. They allow up to 30 % sapwood in the floors, which makes business with some profit possible.

Prices and costs
The price for teak logs varies between 160 and 220 USD per log depending on quality and size. For logs with heartwood of more than 50 cm in diameter the price can increase to 275-300 USD per log. After the logs have been transformed into square logs the price will increase slightly to 10 000-14 000 Baht (238-333 USD) per m³. The greatest part of the export goes to Thailand and Vietnam.

Teak from plantations in Indonesia has a price of 86 USD/ m³ for logs with a diameter between 16 and 19 cm. Logs with a diameter of more than 30 cm have a price of between 160 and 360 USD/m³. These prices cam be compared with the prices for eucalyptus and acacia, respectively. The former costs 25 USD/m³ and the later costs between 25 and 30 USD/m³. The end products, e.g. DVD-racks, benches and dish-racks, bring a price of 600 to 1600 USD/m³.

Forest management
Private forest owners in Lao PDR are not managing their trees in a way that they can expect good prices. The quality is just not good enough. They must thin in order to increase the circumference of the trees and to obtain higher quality. If they are to achieve the best quality, the so-called A-grade teak log, they must also pay attention to pruning. This will produce logs that are suitable for furniture and indoor decorations.
**Environmental certification**
The Burapha Group is not certified simply because it is not worth it. Today, the buyers are not willing to pay more for certified products. It will cost at least 50000 USD to be certified in accordance with the FSC-system and there are no customers who make such demands, and none would be willing to pay for it. IKEA, on the other hand, make demands on how the logs are acquired and on how the manufacturing is being performed. IKEA also requires an annual report, describing the origin of the wood and, according to Mr. Peter Fogde, IKEA only buys wood from plantations, not natural forests, in tropical countries.

**Forest owners union**
Together with other actors from the forest business, Mr. Peter Fogde are working with the starting up of a union for private forest owners in Lao PDR. The union will be called Lao Plantation Owners Programme and it will politically independent. Its aim will be to help the plantation owners to get the right prices for their products, as well as to give them technical assistance for their forest management. Mr. Peter Fogde is vice president of the union, which has had its first meeting but is not fully official yet.

**About Sida and Sweden’s possibility to perform forestry aid in developing countries**
Mr. Peter Fogde thinks it is within the field of plantations that Swedish know-how really could make an important and valuable effort. In Sweden we don’t know much about the management of natural forests but research and development about plantations is a field where we are among the best in the world. We could easily aid Lao PDR in this field and in a relatively short time help the country to develop.
Appendix 3. The field form
Small scale teak plantations in the northern uplands of Lao PDR, Ponxai district - ownership and silvicultural practices

<table>
<thead>
<tr>
<th>Plot</th>
<th>Latitude</th>
<th>Altitude</th>
<th>Aspect</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>Farmer</td>
<td>Village</td>
<td>Picture</td>
<td></td>
</tr>
</tbody>
</table>

| Plant spacing |  |
| Number of plants/ha |  |
| Average diameter |  |
| Average height |  |

| Weeding | Grazing | Intercropping | Thinning | Pruning |
| Filling | Few | More | Many | |

| Canopy | Coppice | Shoots | Root legs | Damage |
| Type of damage |  |

| Irrigation |  |
| Fertilisation |  |

| Distance to road |  |
| Future/History of the plot |  |
| Other information |  |
Appendix 4. The farmers questionnaire
Small scale teak plantations in the northern uplands of Lao PDR
- Ownership and silvicultural practices

<table>
<thead>
<tr>
<th>Name/People</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Village</td>
<td></td>
</tr>
</tbody>
</table>

Family life
1. What people does your family belong to?
2. How many family members are you?
3. Is your family self sufficient in rice? If not, where do you get the rest?
4. What are your main sources of income? How many and what type of animals do you have?
5. What is your family’s yearly income?
6. How much land do you own? How is it used? How long a fallow period do you use?

Silviculture
7. What was the land used for prior to the teak plantation?
8. When did you plant? And how many trees did you plant?
9. What is the reason for you to plant teak?
10. Why did you choose the specific plot for planting teak? Soil, slope, distance to roads et c, advice?
11. Where did you get your plants? Did you have any options on how to get plants?
12. Have you intercropped your teak plantation with other crops? Grazing? Why / why not?
13. Have you been weeding? Why / why not?
14. Have you or are you planning to prune? Why / why not?
15. Have you or are you planning to thin? Why / why not? Can you use the stems for something?
16. Have you had any problems with the plantation during the rotation, e.g. damage? If so, what have you done?
17. Did you get any advice on how to perform silviculture? Can you get advices from someone?

Ownership
18. How did you get the plot for teak?
19. Who owns the teak trees?
20. Who owns the land? If someone else why did you sell it?
21. Have you made any arrangements about selling of the trees?

Economy
22. What are you going to do with your trees?
23. Have you taken any loans or made any other arrangements, e.g. borrowed, for the plantation?
24. Will you continue to grow teak after this rotation? Are you happy with your teak trees?
25. Who buys the teak and when and to whom is it sold?
26. What will it be worth if you sell it?
Appendix 5. Village Head man questionnaire
Small scale teak plantations in the northern uplands of Lao PDR
Ownership and silvicultural practices

Name of the Head of the village:

Name of the village:

1. How many families live in the village? How many people?

2. How many years has the village been here?

3. Where was the village located before?

4. How long is the village going to stay here?

5. How many families have teak plantations? Name?

6. What are your main concerns? Now/in the future?

7. Do you think your life is going to change in the future? What has changed?

8. What people does the village belong to?
Appendix 6 Map of teak plantations in Pone Xay district