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# 6 Economic aspects of integrated teak farming systems

Recent changes in policy and the institutional environment are influencing teak planting decisions and contributing to changes in land-use patterns in the uplands of Laos. Farming systems are in a period of transition, with governments, communities and individual smallholders seeking options that are economically attractive and sustainable over the long term.

## Stabilising agriculture

Increasing interest in planting teak in Laos (Figure 6.1) is being driven by government policy decisions coupled with environmental, social and economic factors. Since 2001 the Government of Lao PDR has pursued the protection of natural forest, discouraged shifting cultivation practices and established permanent subsistence areas. The protection of soil and water resources, especially in steep country, has also been an objective of both the national and provincial governments. In Luang Prabang province the governor has promoted the integration of forestry and agriculture within permanent subsistence areas in an effort to alleviate poverty and improve the livelihoods of smallholders in the province.

Agricultural land use in the uplands of Laos is going through a major transition from shifting agriculture to sedentary agriculture. The Government of Lao PDR plans to eradicate shifting cultivation by 2010. At the same time the government is decentralising power, conferring responsibility for meeting central government targets on provincial and district authorities (NAFRI 2004). Important policy targets include the stabilisation of shifting agriculture, eradication of opium cultivation, reduction in the number of village administration units, and improvement in land-use planning and land allocation. The National Growth and Poverty Eradication Strategy (NGRES) of the central government is aimed at increasing collaboration between agencies and provinces to ensure greater harmonisation of action plans to meet agreed targets.

**Figure 6.1** Newly planted teak

A workshop held in Luang Prabang in January 2004 revealed that rural communities practising shifting cultivation in the uplands have experienced a worsening of their livelihoods under these changes (NAFRI 2004). This was associated with the ineffectiveness of policy implementation, policy inconsistencies, inadequate extension services, underinvestment in market services and inadequate access to rural credit and development funds for farmers.

One of the critical changes for smallholders associated with the stabilisation of shifting cultivation is shortening of the fallow period. To maintain family livelihoods and land productivity, changed farming practices are likely to be introduced over the next decade. These may include:

- increased use of purchased inputs which embody technological advances
- the need for more technical knowledge associated with new crops and farming practices
- closer integration with the market economy
- labour management in more diverse production systems
- gaining access to and use of additional land resources.

The learning curve associated with these changes 'can be long and difficult' (Van Gabsberghe 2005, p. 53).

Food security remains the top priority for all farmers, ahead of cash crops and other alternative land uses such as trees. Because cash crops are subject to production and price risk, farmers will seek options that provide diversity and a buffer against variable returns. Other issues of importance, as production systems intensify, include:

- the need for more farm fencing
- better management of water resources
- complementary development of infrastructure to facilitate the transport of farm produce to markets
- fair prices for farmers.

## Profitable integration of teak into smallholder farming systems

Teak is a priority tree species for plantation expansion. Planting targets have been set by government and incentives provided to growers to establish plantations. Teak is preferred to other perennials because it grows quickly in the early years, is easy to manage and is fire tolerant. Most farmers from the three villages in Luang Prabang province who responded to our survey nominated the commercial attractiveness of teak as the primary reason for planting it. This is associated with farmers' perceptions that demand for teak is likely to continue to grow. Given their treatment of teak as a capital investment, they are also attracted by its relatively stable and high price compared to other tree species, and the ability to sell trees at any time during the year or at convenient times during the rotation.

Other factors that facilitate the integration of teak plantings into upland farming systems include (Hansen et al. 2005):

- the possibility of securing private land tenure
- government promotion and extension services
- the permanent settlement pattern adopted by most villages (despite practising shifting cultivation, village sites have tended to remain fixed)
- expansion of the road system which makes plantations possible in new regions (plantings tend to occur close to roads to facilitate harvesting and transport to processors or traders)
- land allocation schemes that provide additional land for perennial crops
- the depletion of wood from natural forests and the emergence of markets for younger teak wood
- promotion by private investors through financial support, supply of planting material and technical information for tree and land management.

### Constraints

In Chapter 2 it was noted that, despite its attractions, the benefits of teak plantings are limited by:

- poor management, especially insufficient pruning and delayed thinning of trees
- use of inferior genetic material because of the strong demand, limited supplies of improved seeds and associated high prices
- competition with agriculture for arable land, resulting in teak being planted on marginal land, as border plantings or in small plantations
- length of rotation and the difficulty for farmers to retain trees for 20–30 years.

Farmers surveyed for this study identified a number of additional constraints or difficulties that limit teak planting:

- poor infrastructure development
- unsympathetic land allocation policies
- inadequate market information systems
- limited investment in value-added processing
- conservative farmer attitudes and culture

- limited access to and use of government extension services
- farmers' scant knowledge of teak.

Efforts to successfully integrate teak into more sedentary land-use systems must tackle these limitations.

In this study some of these limitations are addressed. The options of pruned and thinned plantations are considered, as well as various intercropping alternatives including annual subsistence crops, cash crops and short-rotation perennials. Useful insights into the benefits of using improved genetic material and planting larger areas of trees per farm are also provided. While the length of rotation is a problem, especially for annual cash flow, the attractiveness of teak planting for timber production compared to annual cropping suggests that financing arrangements that support and sustain smallholders until plantation harvest would be of value to the community. Other limitations listed above are more difficult to address in this preliminary assessment but should be part of a more detailed study. Particular attitudes or perceptions of farmers that may need to change for teak to be successful include the use of modern technology, the use of borrowed funds, and treatment of teak trees as a capital investment. In this preliminary assessment of teak-based management systems we indicate how a change in attitude or approach by farmers can potentially improve their livelihood.

## Current smallholder farming systems

To enable valid comparisons with teak farming enterprises, budgets and cash flows are estimated for current land uses. Upland rice production with 1–3 years of cropping followed by up to 10 years of fallow is the traditional crop rotation system. This long-fallow system provides one baseline farming enterprise for our study of alternative land-use systems. However, in view of the government's wish to reduce and stabilise long-fallow shifting cultivation by 2010, a short-fallow cropping system, which is likely to be common in the future, is also included. This is a second baseline system for comparison with teak-based systems.

### Traditional long-fallow cropping systems

Upland rice is the principal crop grown within a shifting cultivation (swidden) system in the highlands of Laos. The slash-and-burn system is generally subsistence based, although most upland farmers do not produce sufficient rice to meet their annual household needs (Schiller et al. 2001; Shrestha et al. 2006).

Upland rice-based cropping is practised on a rotational basis. A single wet-season crop may be followed by a period of fallow in the range 2–10 years. A second and third rice crop may be planted, although yields decline rapidly depending on the soil conditions. Crops such as pineapples, maize and Job's tears often follow a rice crop as they are less prone to yield decline in subsequent years.

The benefits of traditional long-fallow cropping systems include partial restoration of soil fertility, reduction of soil erosion due to infrequent tillage, and little or no use of chemical pesticides and fertilisers (de Rouw 2005; Linquist et al. 2005).

### Short-fallow cropping systems

The traditional long-fallow cropping system is in decline in northern Laos. Increasing population pressure has reduced fallow periods for traditional upland rice production, but compensating changes in management practices have not been introduced. As a consequence rice yields have declined and the incidence of poverty among rural communities has increased (Linquist et al. 2005). The practice is unsustainable and is likely to be replaced by shorter rotation cropping systems embodying higher levels of technology and knowledge that will reverse the decline in soil fertility and productivity.

Saito et al. (2006) concluded that 'the long-term productivity of upland rice cannot be sustained with increased cropping intensity using the current management practices. Therefore, improved crop and resource management technologies are necessary for sustainable production'.

As the uplands are in a period of land use transition, it is appropriate to take a future perspective in this study and to include farming activities and practices which may develop over the next 10–20 years. In the future upland rice production is likely to be characterised by sustainable short-fallow systems incorporating shrubby legumes which can add nitrogen and other nutrients to the soil and reduce weed competition. Research by Linquist et al. (2005) has identified a number of promising fallow species including leucaena (*Leucaena leucocephala*), pigeon pea (*Cajanus cajan*), crotalaria (*Crotalaria anagyroides*) and paper mulberry (*Broussonetia papyrifera*). Paper mulberry

is not a legume like the others but is included because it is indigenous in northern Laos and has soil-improving properties. Linquist et al. (2005) found that farmers prefer paper mulberry and pigeon pea, especially the latter, because of the higher potential economic benefits. Research into fallow technologies to stabilise upland rice farming systems in West Africa found that legumes can suppress weeds and offer the potential to sustain rice yields under intensified cropping (West Africa Rice Development Association 1999).

In view of the attraction of paper mulberry, and given its potential as a companion crop for teak, a rice–paper mulberry rotation is selected as an alternative baseline farming system for comparative purposes.

### Rice–paper mulberry

After the rice is sown and established the paper mulberry can be planted and continues to grow after the rice has been harvested. Paper mulberry is harvested 18 months to 2 years after establishment. Harvesting continues until the next rice crop, at which stage the trees are cut down and the field prepared for the rice crop. Paper mulberry regenerates from roots, stems and seeds during the next rice growing season. However, survival is better for seedlings (80%) compared to root suckers (42%).

Paper mulberry is not intensively managed in existing systems, but as market prospects improve that is likely to change. Furthermore, labour requirements for paper mulberry complement those for rice, which adds to its attraction as a short-fallow rotation species. On the downside, however, paper mulberry fields have to be fenced as cows and buffalo like to graze it. Linquist et al. (2005) found that rice yields in the first year when paper mulberry was established were 1.83 t/ha, which is 14% above natural fallow rice yields (i.e. without a fallow crop). Rice yields decline in the second year as the paper mulberry growth increases.

## Teak farming systems

Teak has been cultivated in the Lao uplands for over 60 years. It is commonly grown in a taungya system (i.e. interplanted with agricultural crops) during the first 1–3 years. This makes weeding easier after establishment and is less demanding on labour resources than if teak and food crops were planted in separate plots (Hansen et al. 1997, p. 8). After the third year of production, intercropping ceases as shading by the young teak trees limits the production of the companion crops.

Various initial planting or stocking rates are used for commercial teak plantations. Where the aim is to produce large marketable logs in the shortest time, a spacing of 3 m × 3 m is typically used. However, where it is important to maintain sufficient light to support companion crops, a wider spacing is preferred. Government extension services advise farmers to use the 3 m × 3 m spacing, and almost 50% of the farmers surveyed for this study used this spacing. In the absence of attractive and proven combinations of crops and trees, many growers near Luang Prabang favour closer spacing including 2 m × 2 m and 2 m × 3 m. At these densities the teak trees soon capture the available light, nutrients and moisture on a site and limit aggressive understorey growth, reducing the frequency of weeding and simplifying future clearing should the land be converted to agricultural use. On the other hand, wider spacing offers the opportunity for intercropping with companion crops for a number of years but increases the risk of weed growth to the farmer, especially when the companion crops are harvested.

Once the teak is established the trees receive minimal attention, with the exception of removing diseased and dead trees. Few farmers prune the lower branches or forked trees and thinning is not practised until about year 15, when the larger and best-formed trees are selected for harvest.

In 1997 regulations were introduced restricting planting of teak on agricultural land with a slope of less than 12%. Extension services advise farmers to plant teak on marginal land, not on their good agricultural land.

Clearly there is much scope for improving the productivity and profitability of teak in northern Laos. However, any improvement is not simply a matter of technology but must also involve consideration of culture, family needs (food security), financial capacity and farmers' technical knowledge and skills.

Teak farming systems appraised in this study include:

- long-fallow rice–cash crop (e.g. pineapples, Job's tears or sesame)–teak with and without pruning and thinning
- rice–teak intercropped with paper mulberry with wide spacing, pruning and thinning.

## Thinning and pruning teak

Thinning is the deliberate reduction of the number of trees growing in a stand. There are many benefits associated with thinning. Reducing the number of trees in a stand potentially favours vigorous trees of good form by providing more space for crown and root development, enabling remaining trees to reach an optimum size sooner. Larger trees command better market prices. In addition, thinning may remove dead or diseased trees for reasons of stand hygiene (Evans and Turnbull 2004).

Thinning is a common practice in commercial teak plantations to maximise production of large, high-quality logs. Typically, in an intensively managed plantation with an initial spacing of 3 m × 3 m (equivalent to 1,100 trees/ha) and a rotation of 20 years, non-commercial thinning is scheduled at 4 years of age (to 500 stems/ha), followed by a commercial thinning at 14 years (to 125 trees/ha) before final harvest at 20 years. In a study conducted near Luang Prabang, Keonakhone (2005) found that thinning resulted in greater annual volume increment. Southitham (2001) found that diameter growth and 'commercial height' (log length) of teak were both increased by thinning.

Smallholder growers near Luang Prabang consider all planted trees to have some commercial worth. Consequently they manage their trees to generate cash flow as early as possible. They remove and sell larger trees from unthinned stands as soon as the trees reach a saleable size, normally at about 15 years of age. This practice ('thinning from above'), while responding to immediate household needs for income, significantly reduces the opportunity to produce high-value larger logs later in the rotation. In village discussions it was clear that the growers are not convinced of the long-term benefits of more conventional thinning 'from below'. Markets for small thinnings—below 15 cm dbh—do not exist and they see removal of such trees as a waste. Growers also reported an increase in epicormic shoots and side branches on the remaining trees after removal of trees for sale, which is consistent with observations by others (Krishnapillay 2000).

If teak is to be grown in association with companion crops, thinning can prolong the period during which these crops can be grown. However, if thinning is to be accepted by smallholders, there is a need to develop local markets for the small-diameter logs.

Pruning in commercial plantations of high-value tropical hardwoods is undertaken to improve stem and wood quality and to increase market value. Pruning removes branches from the stem while they are small to produce high-value knot-free timber. Pruning also provides an opportunity to manipulate the tree canopy to offer more light to companion crops. Initial spacing, thinning and pruning interact with each other in a complex manner to influence stand value.

Most teak trees observed near Luang Prabang demonstrated good apical dominance and form. The close initial spacing used by growers had limited the development of side branches, and pruning was not regarded as a high priority. In a study near Luang Prabang, however, Keonakhone (2005) reported that pruning had a positive effect on tree growth, although growers interviewed for this study were unaware of this information. Viquez and Perez (2005), working in Costa Rica, reached a similar conclusion.

There is compelling evidence that growth rates and market values for teak grown on smallholdings in northern Laos can be significantly increased through changes in management practices. Growers surveyed were unaware of the field trials which substantiate this assessment, and remained unconvinced that any change from existing practices would improve their household incomes and cash flows. A strong case can be made for establishing highly visible and accessible demonstration blocks and using participative action research to share outcomes with growers.

## Intercropping with teak

Species mixtures in agroforestry systems provide diversity and the prospect of income stability in case of market changes.

Teak planting is usually scheduled towards the end of a swidden cycle following agricultural crops such as upland rice, maize, pineapple, Job's tears and sesame; and occasionally cash crops such as peanuts and soybean grown on contract. Douangsavanh et al. (2003) reported on several local agroforestry practices in Luang Prabang province, including teak–upland rice and upland rice–teak–'mak kaen' (*Zanthoxylum* sp.) combinations. Typically, as reported in community interviews for this study, swidden crops are grown on a site for up to 5 years before weed competition and declining soil fertility prompt a change to a new site. At year 3, teak stumps or seedlings are planted and nurtured through the remainder of the swidden cycle, until they are well established and offer considerable competition to any other plants. Established teak trees

compete strongly for light and nutrients, effectively controlling weeds and woody regrowth, and allowing easy conversion should the site use revert to swidden.

Elsewhere in Asia there are examples of successful intercropping high-value hardwoods with cash crops or woody perennials. Rubber, for example, has demonstrated a considerable capacity to accommodate intercropping. Rubber intercropping systems include rubber with food crops such as rice, maize, cassava and banana; and with cash crops such as tea, coffee, sugar cane, pineapple chilli and cardamom (Raintree 2005). Smallholder growers of rubber in Xishuangbanna, southern China, successfully practise a rubber–tea agroforestry combination which balances reliable income from tea against the attractive, but volatile, income from rubber. In a series of operations rubber plants are established with crops such as rice, maize or peanuts, which are followed by pineapples and then tea in year 4. Rubber is tapped from years 6 to 30, and tea harvested from years 7 to 30.

An important consideration in the choice of crops is the timing of essential operations and the demand for labour. Table 6.1 summarises the timing of operations in our study area and indicates competitive and complementary combinations.

During the course of this study it became clear that farmers grow teak as one stage in their use of agricultural land. None had considered combining cultivation of teak with companion crops on a long-term basis. In discussions growers revealed that they did not have the knowledge to change their practices either for teak or for possible companion crops to accommodate longer term interplanting and were unaware of any market imperatives to do so.

Another recurring concern revealed in community discussions was the uncertain nature of markets for cash crops which can be grown in association with teak. This concern is shared by donor-supported projects, which have identified market limitations as a major impediment to rural development in the uplands (e.g. the SADU Project—see Chapter 8).

Village growers are at a distinct disadvantage in the supply chain. Without adequate market information, firm contracts or any ability to undertake basic primary processing, they bear considerable risk when dealing with fluctuating prices in commodity markets for crops such as maize, sesame, pineapples and Job's tears. They are further disadvantaged when they are dealing in perishable products, being unable to effectively store or process them into higher value products.

Smallholders in Luang Prabang province are familiar with the vagaries of markets and the effect on the market price when supply exceeds demand. This has been the case with pineapples. Discussions with farmers at Ban Gok Gniew, a community which has enjoyed success at cultivating and marketing pineapples for 30 years, revealed their concern at the widespread promotion (with donor project support) of pineapples to many other villages in the area. They reported that this resulted in a substantial oversupply in the 2006 season and a collapse in prices to the lowest ever.

Changing market demand for Job's tears was reported to have caused hardship for some families at Ban Gok Gniew. During a time of high demand, farmers were approached by a company offering seed in return for exclusive access to the resulting crop. When the price for Job's tears collapsed, the company abandoned the farmers and most of the crop was left to rot, and it was too late in the season for farmers to plant alternative crops. The company was exposed to minimal risk (the cost of seed and some time) while the farmers risked their season's production and lost the opportunity for some extra income.

Because of the critical importance of markets and market information, a workshop entitled 'Market information systems for agriculture and forest products' was held in Luang Prabang in July 2005. Three broad categories of crops grown for commerce in Luang Prabang province were recognised (Phaphonsai 2005):

- long-term crops—timber (such as teak) and rubber trees
- mid-term products—livestock, fruits
- short-term crops—Job's tears, sesame seed, maize, paper mulberry, soybean, sticklac and cardamom.

The workshop identified some key issues to be resolved in marketing these products:

- Luang Prabang's central but remote location, which results in high transport costs
- insufficient development in human resources, needed to improve economic and social services
- lack of quality control and irregular supply of products.

A preliminary analysis by Inthongxay and Rattantray (2005) of the marketing chains for maize and other export products in neighbouring Sayabouli province revealed that the key issues facing growers dealing with such markets were:

- lack of transparency in price information, which may result in farmers not receiving a fair price for their produce

**Table 6.1** Seasonal agriculture calendar: main crops, cash crops and NTFPs[a] (based on Douangsavanh et al. 2003)

| Weather and crop | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **Weather** | | | | | | | | | | | | |
| Wet season | | | | | | | | | | | | |
| Cool season | | | | | | | | | | | | |
| Hot season | | | | | | | | | | | | |
| **Main annual crops** | | | | | | | | | | | | |
| Paddy rice | | | | Plough | Nursery | Transplant | Plant | Weed | Harvest | Harvest | Harvest | |
| Upland rice | | Slash | Burn | Weed, prepare | Plant | Plant | Weed | Weed | Harvest | Harvest | Harvest | |
| Job's tears | | Slash | Slash, burn | Burn, prepare | Prepare | Plant | Plant | Weed | Weed | Harvest | Harvest | |
| Sesame | | Slash | Slash, burn | Weed, prepare | Prepare | Plant | Weed | Weed | Weed | Harvest | Harvest | |
| Maize | | Slash | Slash, burn | Plant | Plant | Weed | Weed | Harvest | Harvest | | | |
| Vegetables | Harvest | Harvest | Plant | Plant | Weed | Harvest | Plant | Weed | Prepare | Plant | Weed | Harvest |
| **Cash crops** | | | | | | | | | | | | |
| Khaem | | | | | | | | | | | | |
| Posa | | | | | | | | | | | | |
| Pao pet | | | | | | | | | | | | |
| Cardamom | | | | | | | | | | | | |
| Bamboo | | | | | | | | | | | | |
| Tua mae (worms) | | | | | | | | | | | | |
| **NTFP planting** | | | | | | | | | | | | |
| Puak muak | | | | | | | | | | | | |
| Cardamom | | | | | | | | | | | | |
| Posa | | | | | | | | | | | | |
| Ginger | | | | | | | | | | | | |

[a] The basis for this classification is not entirely clear

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- storage losses, which further reduce farmers' profits
- lack of on-farm processing, which reduces farmers' ability to add value to products.

During group discussions at all three villages these three issues were raised many times, and were regarded as impediments to successful cultivation of cash crops. Any proposal to cultivate companion crops with teak must include consideration of the development of markets for these crops and the supply chain connecting growers and consumers.

One aspect of marketing not reported in the market information systems workshop, and an opportunity not considered by growers, was the potential to market swidden crops as 'organically grown produce'. Crops such as pineapples, sesame, Job's tears, maize and peanuts are all grown in swidden systems without the use of chemical fertilisers or pesticides. The large and expanding tourist industry in Luang Prabang may be receptive to marketing of organic produce, which presents an opportunity for local growers to exploit.

Possible companion crops for teak include known cash crops and plants that produce non-timber forest products. Most of the farmers interviewed had experience with commonly planted cash crops, and prospects for most of the cash crops were broadly understood. Agencies such as NAFRI have R&D and market support programs in place, but these services were not well-understood in the study villages. Details of crops commonly grown by upland farmers are presented in the following sections.

## Cash crop options for growing with teak

### Maize

Maize is the second most important crop in Laos after rice. It is cultivated primarily in swidden systems, and some 4,700 ha were harvested in Luang Prabang province during 2000, yielding over 10,000 t (Ministry of Agriculture and Forestry 2001). Some of this production is grown for commercial sale and export, with maize production for export to China beginning in the late 1990s in some parts of northern Laos. This expansion has affected the local farming and livelihood systems and also female labour, because women work until late at night husking the maize by hand. Informal reports demonstrate how vulnerable growers can be when participating in a contract maize production system. For example, seed grain was provided to growers at Ban Gok Gniew for 2,000 kip/kg and the husked grain was purchased by the trader for 500 kip/kg at the farm gate. Despite clear contractual agreements with the growers, the traders were reported to dishonour contracts if the market circumstances went against them. While this might reflect the reality of market forces, it demonstrates how vulnerable rural growers in northern Laos can be.

### Job's tears (adlay) (*Coix lacryma-jobi* subsp. *ma-yuen*)

In mainland South-East Asia, endemic edible varieties of Job's tears have traditionally been cultivated on a small scale for household consumption, although production is decreasing as this crop is replaced by rice and maize. The grains are eaten whole in soup, or ground into flour and eaten as porridge or cakes. Farmers in parts of Luang Prabang province have begun commercial farming of introduced improved varieties of Job's tears. Each plant bears a large number of ears which mature at different times and are hand-picked as they mature. Grain is exported to Japan, which has become dependent on imported supplies for its expanding health food market (Ochiai 2002). It is also processed into beer and sweets in Japan (Nakatsuji 2004). Grain is also exported to Thailand from where it is re-exported to Taiwan. There is great potential for value-added processing within Laos for export directly to Japan, Taiwan and emerging markets in North America and Europe (Douangsavanh et al. 2003, pp. 24–25).

The changing status of edible Job's tears, from a relic minor crop to a cash crop, has had local impacts. In Chomphet district (opposite Luang Prabang city on the other side of the Mekong River) cultivation of Job's tears has increased rapidly since 2001 and, in 2003, it was the most valuable sector in the district, yielding US$300,000 (Figure 6.2) (Boomsma 2004).

As a consequence of its increasing popularity and oversupply, the price of Job's tears was reported to have dropped to 1,000 kip/kg in 2002 before recovering to 2,800 kip/kg in 2003. The Chomphet study demonstrated the unpredictable nature of markets for cash crops. Although the production of Job's tears increased enormously, maize, peanuts and soy bean production also went up in 2002 but declined in 2003.

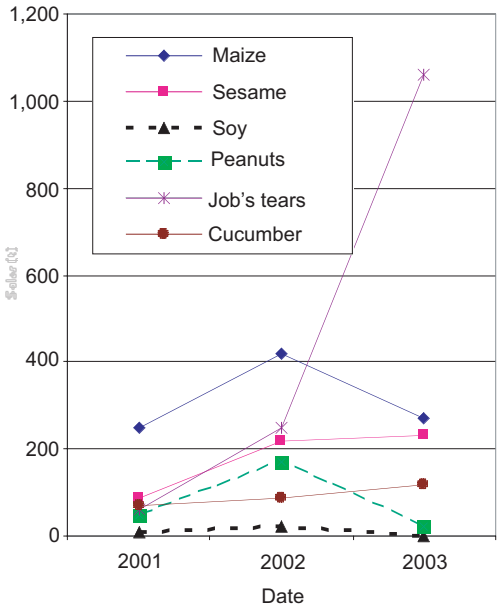


**Figure 6.2** Sales volume, Chompet district crops

### Sesame

Sesame is an ancient oilseed with unusually high oil content—around 50% of the seed weight, compared to 20% in the seed of soybeans. Sesame is a relatively high-value food crop, harvested for its whole seed which is used in baking, and for cooking oil which is extracted from the seed. Sesame is used widely in Lao cuisine.

Sesame (*Sesamum indicum*) is a broadleaf plant that grows to 1–1.5 m high and is adapted to areas with long growing seasons and well-drained soils. It is considered drought tolerant but needs moist soil to get established. It is not adapted to poorly drained soil and will not tolerate water-logged conditions. Soils close to a neutral pH of 7.0 are recommended.

In Chomphet district Boomsma (2004) showed that cultivation of sesame (along with Job's tears) had increased rapidly since 2001, as illustrated in Figure 6.2. In 2003 sesame was the second most valuable crop in the district, with production worth US$166,000. Its price grew strongly from 4,000 kip/kg in 2001 to 7,000 kip/kg in 2003.

### Pineapples

Ban Gok Gniew is a local leader in pineapple cultivation. It is believed that plants were introduced in Laos from Singapore in the late 1950s, and subsequently were cultivated in the village. The modest prosperity that the village has enjoyed over recent years has been largely due to the demand for pineapple. In 2006 the price collapsed due to oversupply. In 2005 farmers received 10,000 kip per fruit at the farm gate, but in 2006 the farm-gate price fell to 400 kip by mid year. Three years ago donor agencies, keen to help national government policies aimed at reducing poverty, began a program to widely distribute up to 100–200 free pineapple shoots per household. The resultant increased plantings have caused a glut in a small but important market.

## Potential for production of non-timber forest products in association with teak smallholdings

Non-timber forest products (NTFPs) play an important role in rural areas of Laos, where they serve a wide range of subsistence needs and provide opportunities for earning additional income. At the national level NTFPs provide about 2.5% of annual exports from Laos. Foppes and Ketphanh (2000) reported that NTFPs provide 50–55% of the cash income of rural villages, where 80% of the population lives. They estimated that the value of subsistence use of NTFPs would be equivalent to 20–30% of GNP. The reported export value of NTFPs was about US$6.3 million in 1993. Of the NTFPs exported, medicinal plants represented 70% of the total export value, followed by fibre products at 15%, resin 8%, edible products 6% and incense 2% (Vantomme et al. 2002). Most NTFPs are exported to China (especially medicinal plants), Vietnam and Thailand. Some products are exported to Japan and Europe as well.

From rural surveys villagers identified over 757 species of plants and 150 species of animals that are used. Many species have yet to be botanically identified, however, and frequently names used in reports are inconsistent (Vantomme et al. 2002). Most NTFPs are collected from the wild, and generally the resources have been exploited unsustainably. The process of domestication has begun for a few species such as *Amomum villosum* (cardamom), *Styrax tonkinensis* (benzoin), *Pentace burmanica* ('si siet' bark), *Thysanolaena maxima* (broom grass), rattan

(*Calamus* spp.), bitter bamboo shoots (*Indosasa sinica*) and tout tiang (*Boehmeria malabarica*—possibly *Debregeasia longifolia*, 'puak muak'). Currently cardamom, broom grass, rattan shoots, bamboo shoots and culms, and paper mulberry are collected from small-scale plantations, agroforests and home gardens (Foppes and Ketphanh 2000; Foppes et al. 2004; Vantomme et al. 2002).

Despite progress in domestication and modest market demand, some NTFPs may be incompatible for intercropping with high-value hardwoods. For example, although considerable progress has been made with some species of rattan, Ali and Barizan (2001) found that intercropping rattan with rubber and oil palm caused problems for both plants. The harvesting of rattan could damage the rubber, and rubber management could damage the rattan. Rattan is likely to present similar challenges when grown with teak if the trees are harvested tree-by-tree over a 10-year period. Edible shoots from rattans (*Daemonorops jenkinsiana* and *Calamus tenuis*) are a speciality in Luang Prabang cuisine. Evans (2001) reported an attractive market in South-East Asia and with Asian communities in France and the USA. It is unclear whether this specialist market would respond positively to additional supplies of edible shoots grown by interplanting among high-value hardwoods, or whether new supplies could compete with supplies from commercial planting reported elsewhere in Laos and northern Thailand (Evans 2002). Discussions with village producers of rattan shoots, 'nyot vway', near Luang Prabang revealed that harvesting was an unpleasant task due to the thorns, and that market prices were barely attractive. Given that these edible rattans prefer sites that receive regular flooding and full sunlight, it is unlikely that they would be an agronomic success with teak on well-drained slopes.

Foppes et al. (2004) identified 60 organisations working actively on NTFPs in Laos, more than 40 of which attended the NAFRI/SNV workshop entitled 'Networking non-timber forest products in Lao PDR' in 2004. Among the many issues identified at this meeting were that NTFPs were becoming rare, mainly through overexploitation, and that opportunities were being lost to Laos because of lack of market information, poor skills and few opportunities for primary processing. The value of effective marketing to increased profitability has been demonstrated in the case of bitter bamboo, 'mai khom' (*Indosasa sinica*), in northern Oudomxay province. The establishment of a sustainable harvesting system, a marketing group and clear sales guidelines fostered a sixfold increase in village income (Soydara and Ketphanh 2005).

While NTFPs are important for generating cash for subsistence farmers in Laos, Bounthong et al. (2003) noted that NTFPs are most important for poorer rural households. Research conducted by the NGO Concern in the northern province of Bokeo found that, despite NTFPs being able to contribute to income generation, their potential is not being realised because unsustainable harvesting techniques are being used and market forces generally operate against these products and their producers. Foppes and Ketphanh (2000) noted a decline in traditional forest management practices which underpin sustained production of NTFPs. The reasons for this included rapid population growth, conversion of forests to agricultural land and insecurity over land tenure.

The agronomy for most NTFPs is unproven, with only a few approaching a level of domestication that could ensure reliability in cultivation by resource-poor farmers. The added complexity of growing NTFPs in association with plantations of high-value hardwoods limits the reliability of any technical inputs, based on existing information, which might be offered to farmers. Markets from the supply side are usually unreliable, poorly formed or dependent on opportunistic trade. It is unlikely that markets will be substantially improved without increased production (risking overexploitation) or some affirmative market intervention. In the absence of expanding and reliable markets, it is difficult to see how incomes derived from most NTFPs can be increased, and it could be argued that any ongoing reliance on NTFPs commits suppliers to a subsistence livelihood, a situation at odds with the Lao PDR Government's unequivocal commitment to poverty reduction.

There are a few NTFPs which have both proven agronomy and mature markets. Among these is paper mulberry, a plant with promising market potential that has been traditionally grown and harvested in northern Laos.

## Paper mulberry, *Broussonetia papyrifera* (posa-Lao)

Paper mulberry is a pioneer shrub or small tree commonly found in fallow after slash-and-burn cultivation. It is very versatile, with a wide distribution in the Pacific and Asia, including the northern Lao

provinces of Luang Prabang, Oudomxay, Phongsaly, Luang Namtha, Sayabouly and Bokeo, where it has been used for hundreds of years. A resurgence of interest in handmade paper using bast fibre of paper mulberry has resulted in expanded commercial cultivation in Thailand and Laos (POSAA 2001). Trends in production and yields for the districts of Kenthao and Paklay are presented in Table 6.2.

Paper mulberry can provide an income for rural communities and can be established either into upland crops (e.g. rice, maize or sesame) or by itself as described earlier in this chapter. The advantages of establishing it with upland crops include greater farmer acceptability and availability of income from the companion crops. In addition, yields of companion crops may not be reduced by paper mulberry (NAFRI 2004). Douangsavanh et al. (2003) report paper mulberry in existing indigenous agroforestry systems with upland rice, Job's tears and pineapple.

The agronomy of paper mulberry is well understood by growers. NAFRI advises that seedlings (raised in polybags), root suckers and root cuttings can be used as planting materials. Seedlings give the best survival and growth results, followed by root suckers. Root cuttings are not recommended because of low survival, but these could be planted first in polybags before outplanting in the field. Paper mulberry should be planted between late May and late June. Best survival is obtained when seedlings and root suckers are planted immediately after rain. The plants coppice readily after harvest.

Almost all paper mulberry grown in Laos is exported in an unprocessed state to Thailand, where it is processed for export to Japan and Korea. Demand is strong and estimated to be growing at the rate of 15–20% each year. About 18,000 t of bark are exported to Thailand from Laos each year, providing additional income to an estimated 20,000 households in northern Laos (NAFRI 2006).

Paper mulberry bark is collected and dried in Laos and then prepared for export to Thailand without grading or other value-adding. It enters Thailand worth US$0.86 million and leaves as processed paper and other finished products worth US$50 million. Given that Laos supplies 80% of the bark processed in Thailand, it should be possible for Lao traders to negotiate better prices and trade conditions, which would flow on to farmers and stimulate supply and improvements in quality control. To improve trade conditions, both the volume and quality of supplies from Laos must be improved. For example, Aubertin (2004) found that returns from paper mulberry production could be improved considerably through better grading and quality control, a sentiment strongly endorsed by Mohns (pers. comm. 2006).

Farmers in some areas are already moving to domesticate paper mulberry. Simple technologies such as boiling can extend the collecting season, reduce labour and improve the quality of the bark. Beyond such technical interventions, however, it is more important that traders of paper mulberry in Laos develop a common position for negotiation and maintain standards for quality (Phommasane 2006).

**Table 6.2** Areas and production of paper mulberry in northern Laos (Aubertin c. 2004)

| Location and attribute | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Kenthao district** | | | | | | | | | | | |
| Area (ha) | | | | 118 | 118 | 128 | 384 | 427 | | 203 | 300 |
| Production (t) | | | | 117 | 117 | 128 | 460 | 513 | | 243 | 360 |
| Yield (t/ha) | | | | 1 | 1 | 1 | 1.2 | 1.2 | | 1.2 | 1.2 |
| **Paklay district** | | | | | | | | | | | |
| Area (ha) | 10.35 | 40 | 124 | 244 | 357 | 360 | 240 | 300 | 450 | 450 | 600 |
| Production (t) | 7.24 | 31.5 | 85 | 95 | 324 | 324 | 312 | 390 | 585 | 585 | 780 |
| Yield (t/ha) | 0.7 | 0.82 | 0.68 | 0.66 | 0.9 | 0.9 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |

Source: Statistics of the Agricultural Departments of the Kenthao and Paklay districts. The shaded figures are surprisingly uniform, and may be affected by transcription error.

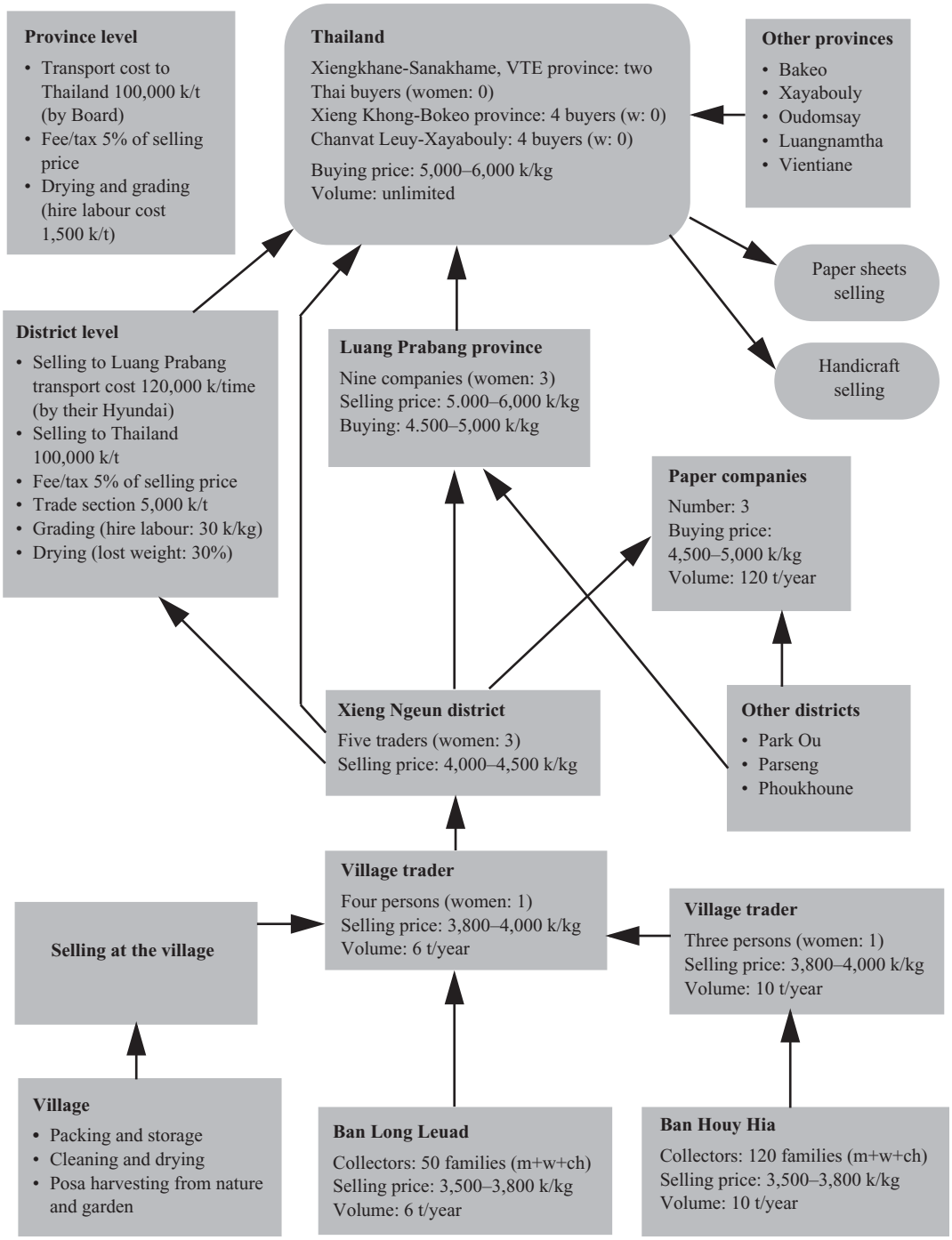


**Figure 6.3** Marketing channels for mulberry paper (posa): Long Leuad and Houay Hia villages, Xieng Ngeun district, Luang Prabang province (Mounlamai 2005). Ch = children; m = men; w = women; k = kip

A market information system is not available to growers, with villagers selling their paper mulberry in traditional ways in Luang Prabang province (Mounlamai 2005). Villagers did not know the exact price in the market and contracts were not available to growers. Buyers and sales were controlled by traders, and growers felt there was considerable insecurity associated with the paper mulberry market. The paper mulberry supply chain is shown in Figure 6.3.

A workshop on paper mulberry, held at Luang Prabang in May 2006, brought together growers, traders, government agencies and donor agencies. Among the priorities identified at the workshop was the need for better marketing and the development of value-adding opportunities in Laos, particularly in relation to bark grading and paper production. Establishment of grower groups, quality control and better links with traders were seen as specific areas for action.

Paper mulberry has been intercropped with teak for some time. Thaiutsa and Puangchit (2001) reported an intercropping system using paper mulberry and teak in Luang Prabang province which had been in existence for several decades. Farmers grew teak at a spacing of about 4 m × 4 m, with an irregular spacing of the intercrop. The farmers obtained an income during the first few years from paper mulberry, and then from teak trees thinned from ages of about 6–8 years depending on the site and vigour of the teak. In a series of intercropping experiments on nine sites in Thailand, Thaiutsa and Puangchit (2001) found that paper mulberry with teak planted at 4 m × 6 m gave better growth and yields than paper mulberry with either eucalypts or banana.

Paper mulberry is strongly demanding of light, and if it were to be grown as a companion to teak there would have to be compromises to traditional methods of cultivation of both crops. Thaiutsa and Puangchit (2001) recognised the light requirements of paper mulberry and recommended that, if it is managed as understorey, the overstorey intercrops should be thin-canopied or deciduous species such as teak. The technical feasibility of such as system would have to be demonstrated to smallholders to gain their acceptance.

One of the several attractions of paper mulberry as a companion crop is that the busy time of harvest does not clash with critical periods within the agricultural calendar (Douangsavanh et al. 2003). As noted earlier, this fact makes it an attractive option as a cash crop for intercropping with upland rice.

Midgley, S., Blyth, M., Mounlamai, K., Midgley, D. and Brown, A. 2007. Towards improving profitability of teak in integrated smallholder farming systems in northern Laos. ACIAR Technical Reports No. 64.

# 7 Assessing profitability of integrated teak farming systems for smallholders

This review of integrated teak cropping systems in northern Laos has identified a number of options suitable for smallholders. Due to increasing population pressure and the decision by government to eradicate shifting cultivation by 2010, land-use decisions made by farmers will be influenced increasingly by profitability. Sustaining productivity of the land under shorter rotations presents a new challenge for smallholders. Furthermore, as land-use intensity increases, so too does the demand for labour, especially for weeding which is critical to successful crop establishment and yield.

Alternative cropping systems need to be able to sustain profitability and productivity over the long term, and generate better returns for each additional labour input required than can be achieved in alternative employment, such as off-farm work. In this study we assess long-term returns to land and labour resources for a selection of alternative land-use systems available to smallholders in northern Laos.

The following cropping systems are assessed:

1. traditional long-fallow swidden including rice and a cash crop, maize
2. transitional short-fallow cash cropping system based on rice and paper mulberry
3. unmanaged teak, without pruning or thinning, within a medium-length fallow system based with rice and pineapples preceding teak
4. managed teak, with pruning and thinning, preceded by rice and pineapples
5. integrated teak cropping, with wide-spaced teak intercropped with cash crops of pigeon peas and paper mulberry, thinned and pruned.

Within each of these systems variations can be explored such as the use of purchased inputs (fertiliser and pesticides) for cash crops, the time for teak to reach a commercially harvestable volume, the availability of a market for young teak thinnings (less than 10 years old) and the length of fallow. The extent to which variations such as these can be explored depends on the availability of suitable data. The assessments made here are indicative of the relative returns from more intensive farming systems and the introduction of managed teak farming. Data used were drawn from many sources including the survey of village communities and smallholders undertaken for this report and the results of previous research. There were many gaps in the data required for this comparative assessment, necessitating a number of assumptions.

## Underlying assumptions

These assessments are based on gross margins for each of the cropping alternatives. A gross margin is the difference between the annual gross income from an enterprise or farming system and the variable costs incurred by the enterprise or system. Fixed costs such as the cost of land and capital equipment are not included as they are incurred irrespective of which enterprises are included in the farming system.

The assessments presented here are not dependent on the availability of labour or land on a typical farm. They are cropping enterprise gross margins, which are similar to operational budgets. Each gross margin is expressed on a per-hectare basis to facilitate comparison. From the perspective of an individual farmer whose plots may range from 0.1 to 1 ha, the estimated margins presented here may seem high. Selection of an optimal combination and sequence of crops by an individual smallholder must take into account the total and seasonal availability of family labour as well as the availability of land suitable for particular uses.

All input costs are expressed on a per-hectare basis in Lao kip. All returns are expressed in net present value (NPV) terms given that each of the farming systems appraised extends over many years. Most systems are estimated over a 20-year horizon.

Given the critical importance of labour to upland farming systems, returns are presented on a per-labour-day as well as per-hectare basis. Return to

labour is the wage rate that sets the NPV equal to zero. Where the returns to labour exceed the average daily wage rate, individuals with their own land are better off farming than working in off-farm activities. This is a useful primary indicator of profitability for smallholders.

All farm outputs are priced at their farm-gate values. This is to facilitate comparison between the systems. In most cases farmers retain their rice harvest and portions of cash crops for their own use. However, as land use intensifies, smallholders will change their land-use practices and patterns. This may include changing from growing rice to growing crops with higher returns.

## Discount rate

To compare expenses and income, which occur in different years over the period of each cropping system, it is necessary to express outputs in equivalent terms. A discount rate allows all amounts to be expressed in present value terms. A discount rate of 10% is assumed for determining the NPV of each cropping system. The sensitivity of the results can be explored using lower and higher discount rates.

## Labour requirements

It is assumed that all labour requirements are sourced from the farm family. Our survey of the three villages in Luang Prabang province indicated that each farm had an average of three workers available for farm work. After land, labour is the most critical input into upland farming systems in Laos. It is unlikely that farmers in Luang Prabang province will adopt farming systems that depend on hired labour. When labour demand exceeds supply for an individual farm family, it is common to exchange labour with other farm families and pay a rate that is below the market rate for farm labourers (Figure 7.1).

Family labour hours are not costed by smallholders in their operations. However, given the increasing demand for labour in the more intensive land-use systems that are expected to be implemented in the uplands over the next 5 years, it is appropriate for this analysis to cost labour at its opportunity cost. The opportunity cost of labour is the best return that can be achieved from alternative employment. From the survey of farmers conducted for this study the average price paid per day for hired labour was 12,600 kip. This rate is used in all assessments.

It is assumed that all farming activities are completed without the need for specialised mechanical equipment. Where practical, machines such as cultivators can be used for land preparation, which reduces the demand for labour. However, on steep slopes it is difficult to use machinery or bullocks for land preparation. Also, there is evidence that cultivators are not as effective in reducing weed growth after

**Figure 7.1** Teak is an increasingly significant crop on steep slopes. Seasonal tasks like planting are commonly undertaken cooperatively

the crop has been established, which increases the need for labour (de Rouw 2005).

The first stage in all the cropping systems assessed is clearing and preparing land following a period of fallow. This involves slashing and burning vegetation using family labour and hand tools. The duration of slashing operations varies with the volume of biomass to be cut, from 100 hours/ha for a herbaceous to bushy fallow (fallow period of 2–3 years) to 500 hours/ha for an older fallow of 10 years with trees (Van Gansberghe 2005). Machetes are most commonly used for cutting the vegetation although bigger trees may be cut with axes and occasionally saws. After allowing the slashed vegetation to dry in the sun for about 3–4 weeks, it is burned. A second burning may be required before larger debris is removed from the field. Clearing may require 50–250 hours depending on the volume of organic material to be reburnt or removed (Van Gansberghe 2005).

Following clearing, land may be tilled before sowing, although under shifting cultivation crops are generally sown directly into the cleared field without additional cultivation. Fields sown under short fallows or used for a second or third consecutive year are tilled and weeded using a small hoe. This is commonly done by women and can take about 100 hours/ha.

Sowing or planting the crop is an important family activity, and is accompanied by religious and social rituals. In the case of a newly cleared field, seeds are planted in holes made by a dibbling stick. For fields that have been tilled following a first- or second-year crop, seeds are broadcast. Sowing usually takes between 70 and 150 hours/ha according to experience (Van Gansberghe 2005).

Once a crop is established, weeding is the most critical activity. Weeding generally accounts for around 50% of total labour inputs of a cropping system (Seidenberg et al. 2003; Van Gansberghe 2005). Van Gansberghe reported that weeding may require 400–1000 hours/ha in 3-year fallow fields. It is widely believed that labour requirements for weeding under short fallows are higher than under long fallows because of greater weed growth, although scientific evidence is inconclusive (Seidenberg et al. 2003). Linquist et al. (2005) reported that farmers need to weed up to five times per year in fallows of 2 years or less compared with only twice in fallows of 10 years or more.

Within upland farming systems it is not common for farmers to use chemical fertilisers, herbicides or pesticides for a number of reasons, including capacity to pay, ready access to such inputs and knowledge on their effective use. While this situation may change over the next decade, it is assumed for this appraisal of alternative farming systems that purchased chemical inputs are not used.

Labour requirements for harvesting vary for each particular crop. In some farming systems it is necessary to erect fences around the crop to keep livestock out.

The labour requirements, in person days per hectare, for each of the farming systems appraised are presented in Table 7.1.

## Traditional long-fallow shifting cultivation system

This baseline cropping system represents the traditional swidden system, which is being phased out by the Lao PDR Government. The system is based on a 7-year fallow period, after which 3 years of crops are sown. In the first year after the land is cleared and prepared, rice is sown. This is followed by 2 years of maize, after which the land is rested for another 7 years. In the eighth year the cropping sequence recommences. Tables 7.1 and 7.2 present key inputs and outputs of the system. Data sources used for specifying this system include: Seidenberg et al. (2003); Siphandouang et al. (2002); Van Gansberghe (2005); and Chantavisay Keobounum and Sounthala Latsayavong (NAFRI), pers. comm., Vientiane (8 June 2006).

## Transitional short-fallow system

An alternative baseline cropping system is one that is compliant with the government's stabilisation plans for upland farming systems. This is a rice–paper mulberry system with 2 years of fallow. This short-rotation system may be practised by villages that have undergone land allocation which provides them with three discrete plots of land (Linquist et al. 2005). After the fallow land is cleared, a rice crop is sown in conjunction with paper mulberry. It is assumed that smallholders use selected traditional upland rice varieties that are suitable for short fallows and can yield 0.3–0.5 t/ha more than local check varieties.

The paper mulberry is maintained for 4 years, after which the land is fallowed for 2 years. The rotation repeats in year 7 for another 4 years and again in years 13 and 19 within a 20-year horizon. Linquist et

**Table 7.1** Labour requirements for upland farming systems (person days per hectare)

| System and operation | Year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Traditional long-fallow** | | | | | | | | | | | | | | | | | | | | |
| Land clearing | 56.3 | | | | | | | | | | 56.3 | | | | | | | | | |
| Cultivation | | 8 | | | | | | | | | | | | | | | | | | |
| Planting | 15 | 15 | 15 | | | | | | | | 15 | 15 | 15 | | | | | | | |
| Weeding | 40 | 55 | 55 | | | | | | | | 40 | 55 | 55 | | | | | | | |
| Fencing | 5 | | | | | | | | | | | | | | | | | | | |
| Harvesting | 0 | 25 | 25 | | | | | | | | 50 | 25 | 25 | | | | | | | |
| **Total** | **161.3** | **103** | **95** | | | | | | | | **161.3** | **103** | **95** | | | | | | | |
| **Transitional short-fallow** | | | | | | | | | | | | | | | | | | | | |
| Land clearing | 12.5 | | | | | | 12.5 | | | | | | 12.5 | | | | | | 12.5 | |
| Cultivation | 8 | 8 | 8 | | | | 8 | 8 | 8 | 8 | | | 8 | 8 | 8 | 8 | | | 8 | 8 |
| Planting | 10 | 2 | | | | | 10 | 2 | | | | | 10 | 2 | | | | | 10 | 2 |
| Weeding | 45 | 50 | 50 | 45 | | | 45 | 50 | 50 | 45 | | | 45 | 50 | 50 | 45 | | | 45 | 50 |
| Fencing | 6.25 | | | | | | 6.25 | | | | | | 6.25 | | | | | | 6.25 | |
| Harvesting | 25 | 92 | 92 | 67 | | | 25 | 92 | 92 | 67 | | | 25 | 92 | 92 | 67 | | | 25 | 92 |
| **Total** | **106.75** | **152** | **150** | **112** | | | **106.75** | **152** | **150** | **120** | | | **106.75** | **152** | **150** | **120** | | | **106.75** | **152** |
| **Unmanaged teak** | | | | | | | | | | | | | | | | | | | | |
| Land clearing | 56.3 | | | | | | 30 | | | | | | | | | | | | | |
| Cultivation | | 8 | | | | | | | | | | | | | | | | | | |
| Planting | 15 | 20 | | | | | | | | | | | | | | | | | | |
| Weeding | 40 | 50 | 45 | 35 | 35 | 30 | 25 | | | | | | | | | | | | | |
| Fencing | 10 | | | | | | | | | | | | | | | | | | | |
| Thinning and pruning | | | | | | | | | | | | | | | | | | | | |
| Harvesting | 25 | | 25 | 30 | 40 | 30 | 20 | | | | | | | | | | | | | 1 |
| **Total** | **146.3** | **78** | **70** | **65** | **75** | **60** | **75** | | | | | | | | | | | | | **1** |

Continued on next page

**Table 7.1** (cont'd) Labour requirements for upland farming systems (person days per hectare)

| System and operation | Year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Managed teak** | | | | | | | | | | | | | | | | | | | | |
| Land clearing | 56.3 | | | | | | 30 | | | | | | | | | | | | | |
| Cultivation | | 8 | | | | 2 | | | | | | | | | | | | | | |
| Planting | 15 | 20 | | | 15 | 25 | | | | | | | | | | | | | | |
| Weeding | 40 | 50 | 45 | 25 | 25 | | | | | | | | | | | | | | | |
| Fencing | 10 | | | | | | | | | | | | | | | | | | | |
| Thinning and pruning | | | | | | | | | | 6.9 | | | | | 4.5 | | | | | 1 |
| Harvesting | 25 | 25 | 30 | 40 | 30 | 20 | | | | | | | | | | | | | | |
| **Total** | **146.3** | **103** | **75** | **65** | **70** | **47** | **30** | | | **6.9** | | | | | **4.5** | | | | | **1** |
| **Integrated teak–paper mulberry with thinning** | | | | | | | | | | | | | | | | | | | | |
| Land clearing | 56.3 | | | | | | | 8.5 | | | | | | | | | | | | |
| Cultivation | 9 | 9 | 9 | | | | | 6 | | | | | | | | | | | | |
| Planting | 16 | 5.5 | 11 | | | | | 12.5 | 0.5 | | | | | | | | | | | |
| Weeding | 45 | 50 | 50 | 45 | 25 | 20 | 10 | 25 | 25 | 25 | 20 | 10 | | | | | | | | |
| Fencing | 10 | | | | | | | 2 | | | | | | | | | | | | |
| Thinning and pruning | | | | | | | | | | | | 1 | | | | | | | | |
| Harvesting | 43 | 18 | | 96 | 96 | 96 | 96 | 18 | 48 | 48 | 48 | 48 | | | | | | | | 1 |
| **Total** | **178.3** | **81.5** | **69** | **141** | **121** | **116** | **106** | **72** | **73.5** | **73** | **68** | **59** | | | | | | | | **1** |
| **Integrated teak–paper mulberry without thinning** | | | | | | | | | | | | | | | | | | | | |
| Land clearing | 56.3 | | | | | | | 8.5 | | | | | | | | | | | | |
| Cultivation | 9 | 9 | 9 | | | | | 6 | | | | | | | | | | | | |
| Planting | 16 | 5.5 | 11 | | | | | 12.5 | 0.5 | | | | | | | | | | | |
| Weeding | 45 | 50 | 50 | 45 | 25 | 20 | 10 | 25 | 25 | 25 | 20 | 10 | | | | | | | | |
| Fencing | 10 | | | | | | | 2 | | | | | | | | | | | | |
| Thinning and pruning | | | | | | | | | | | | | | | | | | | | |
| Harvesting | 43 | 18 | | 96 | 96 | 96 | 96 | 18 | 48 | 48 | 48 | 48 | | | | | | | | 1 |
| **Total** | **178.3** | **81.5** | **69** | **141** | **121** | **116** | **106** | **72** | **73.5** | **73** | **68** | **58** | | | | | | | | **1** |

al. (2005) describe a number of short-rotation cropping options such as rice–paper mulberry. These are aimed at improving rice production (self-sufficiency) and providing cash crops as a basis for diversification and to generate income that can be used to purchase rice. Sustainability is an important criterion. They found that farmers were attracted to paper mulberry because of its potential market returns. Other important criteria for short-rotation species include labour requirements, management ease and impact on rice yield. According to Aubertin (2004, p. 224) farmers appreciate paper mulberry 'because they accelerate the regeneration of soil fertility (thanks to their extensive carbon-fixing root system and their large leaves), along with their rapid growth, resulting in rapid canopy closure, which in turn reduces weeds'.

**Table 7.2** Traditional long-fallow system

| Key inputs and outputs | Quantity (kg/ha) | Value (kip/kg) |
|---|---|---|
| Rice seed | 65 | 3,500 |
| Rice yield | 1,700 | |
| Farm gate price for rice | | 1,900 |
| Maize seed | 36.8 | |
| Maize yield | 3,000 | |
| Farm gate price for maize | | 900 |
| Indicators of profitability | | |
| NPV (kip) | 5,426,975 | |
| Return to labour (kip) | 25,521 | |
| Discount rate | 10% | |

Linquist et al. (2005) reported that research is continuing on rice–paper mulberry systems in the areas of establishment of paper mulberry, bark yield, planting density, impact on rice yield and nutrient cycling. This production system has potential under more intensive land use, especially given the good market prospects for paper mulberry, smallholders' familiarity with the crop and the complementarity of labour demands of the rice–paper mulberry system.

A feature of paper mulberry compared to other cash crops is the high demand for labour for harvesting. It is high because the process of stripping the inner bark from the stems is labour intensive. Aubertin (2004, p. 226) estimated that the labour requirement amounts to 120 days for 1 ha supporting 5,000 plants at spacing of 1.5 m × 1.5 m. The system described here assumes that paper mulberry is planted with rice at the equivalent of 4 m × 4 m, which is a density of 625 plants/ha. At this rate and assuming 20% losses, the labour requirement for harvesting is set at 67 days/ha.

Another attraction of paper mulberry is that farmers can easily change to another crop and let the paper mulberry sprout again in the following year, depending on market conditions.

An important aspect of profitable paper mulberry production is the maintenance of quality from the field to the processor. Best prices are received for bark that is properly dried and free of mould and fungi. It should be clean and free of dirt and sticks when offered to traders. There is much scope to improve the quality control of paper bark harvesting, drying, storage, transport and processing within Laos. Aubertin (2004, p. 230) suggests that traders are not properly accounting for quality in the price they offer suppliers. Improvements in market information systems, product logistics and quality control along the supply chain would add significant value to the paper mulberry crop for growers, traders and processors.

Data sources used to specify this system include Aubertin (2004) and Linquist et al. (2005), in addition to those used for the traditional long-fallow system. Tables 7.1 and 7.3 present the key inputs and outputs of this transitional short-fallow cropping system.

**Table 7.3** Traditional short-fallow system

| Key inputs and outputs | Quantity (kg/ha) | Value (kip/kg) |
|---|---|---|
| Rice seed | 65 | 3,500 |
| Rice yield | 1,830 | |
| Farm-gate price for rice | | 1,900 |
| Paper mulberry plants (plants/ha) | 625 | 900 |
| Paper mulberry yield (dry bark) | 560 | |
| Farm-gate price for dry bark | | 3,000 |
| Indicators of profitability | | |
| NPV (kip) | 13,400,276 | |
| Return to labour (kip) | 28,421 | |
| Discount rate | 10% | |

## Unmanaged teak

This farming system describes the situation where smallholders plant teak after rice and a cash crop such as pineapples. In this system the teak trees are not thinned or pruned to enhance production. Trees are selected for harvest after year 15 on an as-needs basis rather than a commercial basis. As such, harvesting

rates are low compared to those typical of commercial operations and the best trees are selected first. It is assumed that at year 20 of the cycle, when the teak is 15 years old, 5% of the stock is harvested. For a 1 ha plot planted at 3 m × 3 m spacing and allowing for 20% loss over the 15 years, 44 trees are sold. In reality, the decision to sell trees depends on particular needs of the family, and so less than the equivalent of 44 trees/ha may be sold.

After clearing the fallow, rice is sown, followed by pineapples in year 2. These are maintained for 5 years, at which point they are shaded out by the teak trees that are planted as stumps in year 5. The teak is ready for harvest in year 20. Within this system there is no cash flow from the land occupied by teak from year 8 until year 20. This farming system depends on access to additional blocks of land to make it a viable option for smallholders, as it locks up land for many years without any returns. Alternatively, as Hansen et al. (2005) speculate, farmers could transfer ownership of the plantation to a private investor in return for an annuity. The feasibility of establishing and sustaining such financing schemes should be investigated.

The unmanaged teak system has been an attractive option for smallholders as a means of retaining access to land. Under the land allocation schemes, if land is not used for 3 years it can be reclaimed by the government for reallocation. By planting it with teak, farmers are assured of land-use rights. As Kolmert (2001) explains, under the land allocation policy that commenced in 1996 in Luang Prabang province, a family can be allocated up to four plots of land from 0.5 to 1.0 ha each for shifting cultivation, and they can also obtain 1 ha for planting perennial crops such as timber or fruit trees. Many farmers planted teak before the allocation occurred, which meant that they were allocated additional plots for cash crops and were allowed to keep their previously planted teak plots. For new settlers this option is not available.

The high short-term return from pineapples has made this option an attractive one in Luang Prabang province for established farmers. However, as recounted in Chapter 6, the increased interest in pineapples has oversupplied the market and prices have fallen to low levels. This is the nature of commodity markets. However, the prospects of supplying export markets, developing suitable infrastructure and marketing Lao pineapples as organically grown may help to buoy the price. Tables 7.1 and 7.4 present key input and output data and assumptions for the unmanaged teak system. Data sources used to specify this system include: Armitage (2004); Hansen et al. (1997, 2005); Kolmert (2001); Seidenberg et al. (2003); Van Gansberghe (2005); and Chantavisay Keobounum and Sounthala Latsayavong, NAFRI (pers. comm.), Vientiane (8 June 2006); Sianouvong Sawathvong, Director Forestry sector, Luang Prabang province, pers. comm. (June 2006).

**Table 7.4** Unmanaged teak

| Key inputs and outputs | Quantity (kg/ha) | Value (kip/kg) |
|---|---|---|
| Rice seed | 65 | 3,500 |
| Rice yield | 1,700 | |
| Farm-gate price for rice | | 1,900 |
| Teak stumps (no./ha) (kip/stump) planted in year 5 | 1,100 | 500 |
| Teak trees harvested at year 20 @ 15 years old); 80% loss | 44 (5%) | |
| Teak yield @ 15 years old ($m^3$/tree) | 0.157 | |
| Farm-gate price for teak (kip/tree) | | 100,019 |
| Pineapple shoots (no./ha) (kip/shoot) | 20,000 | 500 |
| Pineapple yield (fruits/ha) | 7,500–8,000 | |
| Farm-gate price for pineapples (kip/fruit) | 1,750 | |
| Indicators of profitability | | |
| NPV (kip) | 24,302,056 | |
| Return to labour (kip) | 71,355 | |
| Discount rate | 10% | |

### Teak prices

The price of teak varies with volume and quality. At the farm gate smallholders are quoted a price on a per-tree basis without any formal estimation of volume and only basic quality assessments. Traditionally, farmers sell one or two trees at a time when cash is required for a family need. In this situation farmers are price takers. The lack of a market information system makes it difficult for smallholders selling single trees to know what a fair price is. The farmers surveyed for this study quoted prices ranging from 60,000 to 200,000 kip for a tree with a circumference of 80 cm (≈ diameter 25 cm). A market information system would allow smallholders to plan their sales and improve returns. Over the longer term, access to market information may encourage teak growers to improve the management of their trees for volume and quality and help them to receive fair returns for their efforts.

To ensure consistency and realism in pricing for teak, we relied on data provided by Mr Sianouvong Sawathvong, Director of the Forestry Sector in Luang Prabang province. Using those data we estimated a relationship between tree volume and price, as presented in Figure 7.2. Teak prices used in this appraisal of alternative farming systems are based on this relationship.

## Managed teak

This farming system is similar to the unmanaged teak system but with the addition of thinning and pruning of the teak trees. The production system is the same as for unmanaged teak, with rice sown after a fallow, then 5 years of pineapples. The teak is planted at 1,100 trees/ha in year 5 using stumps. The first non-commercial thinning occurs at year 10 when the trees are 5 years old. The trees are removed using farm labour, thinning at a rate of 50%. There is no market for these thinnings, which may be left on the ground or used for construction poles or firewood. The commercial utilisation of young teak thinnings is likely to become more attractive as plantation areas expand. The existence of a market for thinnings will provide an incentive for farmers to thin and prune their stands. Options for utilisation of teak thinnings need to be investigated.

The first commercial thinning, again at the rate of 50%, occurs in year 15 when the trees are 10 years of age. While some farm labour is involved the task of removing logs and transporting them to the mill is undertaken by the buyer.

The benefits of thinning are reflected in increased volumes of timber and higher returns. As reported in Chapter 6, there has been some research on thinning and pruning of teak, although long-term assessments in Laos have not been conducted or reported. Evidence from other countries including Panama, Costa Rica and Nepal indicates the production benefits of pruning and thinning (e.g. Thapa and Gautam 2005; Viquez and Perez 2005; Zanin 2005).

The remaining trees are removed in year 20 when they are 15 years of age. The NPV of the managed system compared to the unmanaged system demonstrates the financial benefits of thinning. Also, thinning generates income in more years than unmanaged teak. The development of a market for

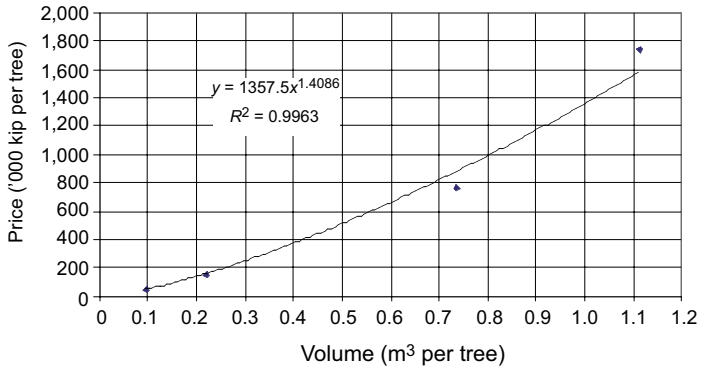


**Figure 7.2** Farm-gate price for teak trees

teak thinnings will make this option even more attractive to smallholders.

Tables 7.1 and 7.5 present key input and output data and assumptions for the managed teak system. Data sources used to specify this system are the same as those used for the unmanaged system.

## Integrated teak

This farming system attempts to capture the benefits of teak and generate more continuous cash flow for smallholders. The system is based on the intercropping of teak and paper mulberry. In the first year a rice crop is sown into the cleared fallow. As described by Linquist et al. (2005, p. 303), pigeon pea is planted a month of so after rice at a spacing of 1.25 m × 1.25 m, to minimise competition with the rice. The pigeon pea is a perennial legume and continues to grow after the rice is harvested. The pigeon pea is left in the field for 2 years and two crops are harvested. The pigeon pea has a positive effect of reducing nematode infestation and suppressing weeds. Teak stumps are planted in year 2 at a rate of 417/ha, equivalent to a spacing of 6 m × 4 m. This wide spacing is to accommodate the companion crop, paper mulberry, which is planted in year 3 in wide alleys between the teak rows. Paper mulberry is planted at a rate of 4,000 plants/ha. Replanting of teak and paper mulberry occurs in the year following sowing, based on assumed establishment rates of 85% for teak and 80% for paper mulberry.

Paper mulberry is cut from years 4 to 7, after which it is re-established to ensure bark quality. At this point farmers can decide to plant an alternative crop depending on relative returns and growing conditions. It is assumed that a second crop of paper mulberry is planted at 2,000 plants/ha and continued until year 12. At this point the teak trees are at 10 years of age and the companion crop is gradually removed.

Within this system it is assumed that the teak is thinned in year 12 when the trees are 10 years old. This is a commercial thinning with 50% of the stems removed. The remaining trees are harvested in year 20 when the trees are at 18 years of age. Table 7.6 presents the yield, price and return data.

**Table 7.5** Managed teak

| Key inputs and outputs | Quantity (kg/ha) | Value (kip/kg) |
|---|---|---|
| Rice seed | 65 | 3,500 |
| Rice yield | 1,700 | |
| Farm-gate price for rice | | 1,900 |
| Teak stumps (no./ha) (kip/stump) planted in year 5 | 1,100 | 500 |
| Teak trees thinned at year 10 (@ 5 years of age) | 550 (50%) | |
| Teak trees thinned at year 15 (@ 10 years of age) | 275 (50%) | |
| Teak trees harvested at year 20 (@ 15 years old) | 275 | |
| Teak yield at 10 years old ($m^3$/tree) | 0.1 | |
| Teak yield at 15 years old ($m^3$/tree) | 0.203 | |
| Farm-gate price for teak (kip/tree) @ 10 years old | | 52,983 |
| Farm-gate price for teak (kip/tree) @ 15 years old | | 143,641 |
| Pineapple shoots (no./ha) (kip/shoot) | 20,000 | 500 |
| Pineapple yield (fruits/ha) | 7,500–8,000 | |
| Farm-gate price for pineapples (kip/fruit) | 1,750 | |
| Indicators of profitability | | |
| NPV (kip) | 31,843,071 | |
| Return to labour (kip) | 91,340 | |
| Discount rate | 10% | |

An alternative integrated teak–paper mulberry system without the year 10 thinning was considered as well. The results for this alternative are presented in Table 7.7.

These production systems have not been proven in practice, but preliminary indications suggest that they would be valuable options for smallholders. One of the big advantages over alternatives is a longer period of cash flow, possibly up to year 12. Field trials of teak–paper mulberry intercropping systems would be a worthwhile undertaking to identify sustainable farming systems for smallholders in the uplands of Laos. These investigations would have to take into account the feasibility of such systems at the scale of a smallholding, among other factors involved in the transition of farmers to new farming systems.

Data sources used for the integrated teak–paper mulberry options include: Aubertin (2004); Chun Lai et al. (2005); Linquist et al. (2005); and Thaiutsa and Puangchit (2001).

## Comparing system profitability

Key indicators of the profitability of each system are presented in Table 7.8. The results indicate that all are profitable compared to off-farm work for individuals who possess land-use rights. All have positive NPVs and returns to labour. The indicators also reveal the positive financial impact of introducing shorter rotation cash crops and teak into upland farming systems.

While the traditional long-fallow system generates a NPV that is 40% of that of the short-rotation system, the returns to labour for the two systems do not differ greatly. The short-rotation system has the advantage of more years with positive cash flow. As the long-fallow system will be phased out by 2010, a more reliable base line for comparison is the short-rotation cropping system. Compared to this system, each of the teak-based systems generates higher returns to land and labour inputs. The highest returns are for the integrated teak-paper mulberry system without thinning, and the managed teak system,

**Table 7.6** Integrated teak and paper mulberry with thinning

| Key inputs and outputs | Quantity (kg/ha) | Value (kip/kg) |
|---|---|---|
| Rice seed | 65 | 3,500 |
| Rice yield | 1,700 | |
| Farm gate price for rice | | 1,900 |
| Teak stumps (no./ha) (kip/stump) planted in year 2 | 417 | 500 |
| Teak trees thinned at year 12 @ 10 years of age | 208 (50%) | |
| Teak trees harvested at year 20 @ 18 years old | 209 | |
| Teak yield @ 10 years old ($m^3$/tree) | 0.1 | |
| Teak yield @ 18 years old ($m^3$/tree) | 0.374 | |
| Farm-gate price for teak (kip/tree) @ 10 years old | | 52,983 |
| Farm-gate price for teak (kip/tree) @ 18 years old | | 339,693 |
| Paper mulberry plants (plants/ha) and kip/plant: | | |
| Year 3 | 4,000 | 200 |
| Year 8 | 2,000 | |
| Paper mulberry yield (dry bark) | 800 | |
| Farm-gate price for paper mulberry (dry bark) | | 3,000 |
| Pigeon pea seeds | 18 | 17,500 |
| Pigeon pea yield | 500 | |
| Farm-gate price for pigeon pea | | 2,800 |
| Indicators of profitability | | |
| NPV (kip) | 24,928,837 | |
| Return to labour (kip) | 46,384 | |
| Discount rate | 10% | |

which includes thinning and pruning. This indicates that adding various management inputs to teak production systems generates higher returns to land and labour inputs.

As mentioned earlier, the assumptions used in this analysis can be varied to test the robustness of the results and the impact of technical and other improvements. The teak systems described and analysed here are very different to traditional systems, requiring increased knowledge inputs as well as off-farm improvements in market information services, extension service delivery and investment in resource processing, especially for small-diameter teak thinnings.

Farmers of the Lao PDR uplands have not been as ready as farmers in other regions of the country to adopt new technologies (e.g. see Shrestha et al. 2006). Linquist et al. (2005, p. 4) suggest that adoption of new technologies and methods may be limited by the high level of diversity in the uplands in the following areas:

**Table 7.7** Integrated teak and paper mulberry without thinning

| Key inputs and outputs | Quantity (kg/ha) | Value (kip/kg) |
|---|---|---|
| Rice seed | 65 | 3,500 |
| Rice yield | 1,700 | |
| Farm-gate price for rice | | 1,900 |
| Teak stumps (no./ha) (kip/stump) planted in year 2 | 417 | 500 |
| Teak trees harvested in year 20 @ 18 years old | 417 | |
| Teak yield @ 18 years old ($m^3$/tree) | 0.374 | |
| Farm-gate price for teak (kip/tree) @ 18 years old | | 339,693 |
| Paper mulberry plants (plants/ha) and kip/plant: | | |
| Year 3 | 4,000 | 200 |
| Year 8 | 2,000 | |
| Paper mulberry yield (dry bark) | 800 | |
| Farm-gate price for paper mulberry (dry bark) | | 3,000 |
| Pigeon pea seeds | 18 | 17,500 |
| Pigeon pea yield | 500 | |
| Farm-gate price for pigeon pea | | 2,800 |
| Indicators of profitability | | |
| NPV (kip) | 39,712,038 | |
| Return to labour (kip) | 66,444 | |
| Discount rate | 10% | |

**Table 7.8** Profitability of alternative farming systems

| Farming system | NPV (kip/ha) | Return to labour kip/pd | Return to labour relative to wage rate[a] |
|---|---|---|---|
| Traditional long fallow | 5,426,975 | 25,521 | 2.03 |
| Transitional short fallow | 13,400,276 | 28,421 | 2.26 |
| Unmanaged teak | 24,302,056 | 71,355 | 5.66 |
| Managed teak | 31,843,071 | 91,340 | 7.25 |
| Integrated teak–paper mulberry, with thinning | 24,928,837 | 46,384 | 3.68 |
| Integrated teak–paper mulberry, without thinning | 39,712,038 | 66,444 | 5.27 |

[a] Wage rate for farm labour is 12,600 kip per day (pd)

- biophysical diversity—climate and soils
- socioeconomic diversity such as ethnic and cultural diversity and large differences in opportunities and constraints between individual households
- market diversity—particularly market opportunities and market access.

In view of the level of diversity, they advised that technology solutions and recommendations should be site specific. Furthermore, they argued in favour of participatory and adaptive research to ensure that researchers and farmers develop solutions that are suited to local conditions. Further research to improve the technical, social and economic attractiveness of more intensive teak-based farming systems should heed this advice.

These results are indicative of the financial potential of teak-based farming systems in northern Laos. Enterprise gross margins for alternative land uses were appraised and compared using basic economic indicators—NPV of returns to land and returns to labour. Individual smallholders' land-use decisions are subject to many conditions including the availability of suitable land, family labour, financial resources and knowledge. Furthermore, they must deal with the risks of weather, pest and diseases, and fluctuations in markets. For this study we have made assumptions about the availability and status or nature of several production factors. Variations in the fundamental factors of production should be explored more comprehensively through whole-farm modelling to assess the feasibility of alternative land uses. This would also need to take into account financial, social and other goals of smallholders.

Midgley, S., Blyth, M., Mounlamai, K., Midgley, D. and Brown, A. 2007. Towards improving profitability of teak in integrated smallholder farming systems in northern Laos. ACIAR Technical Reports No. 64.

# 8 Conclusions and opportunities for ACIAR to contribute

Teak has become an integral part of farming systems in parts of northern Laos. In Luang Prabang province there are over 10,000 ha of privately owned teak plantations in smallholdings varying in size from 0.1 to 1.0 ha. Because of promising long-term markets for teak wood and expanding road infrastructure, this resource is increasing and is now making a positive contribution to household incomes and to the regional economy. Expansion of plantations is entirely in accord with government objectives to reduce poverty and policies to increase the area of commodity crops, and is also in alignment with land allocation regulations and policies.

Teak is established as a stage in the management of swidden land. Towards the end of the cropping period for upland rice, maize, pineapples, sesame and other swidden crops, teak is planted in conjunction with these crops and benefits from the weeding and maintenance of the companion crop.

This study sought to assemble a foundation of information and to identify opportunities for smallholders to increase the profitability of their teak-based farming systems by improving cash flows through a 20-year teak rotation. Profitability of smallholdings could be improved in two ways:

- via improved management of the teak and, specifically, use of better genetic stock, shorter rotations, and timely thinning and pruning
- by extending the use of companion crops including non-timber forest products (NTFPs) in longer term agroforestry systems.

Challenges to these technical approaches are that growers are unconvinced of the benefits of thinning and pruning, while the concept of a more prolonged association between teak and other crops in agroforestry systems has not been considered. The study concurs with the conclusions of Roder et al. (1995) that resource-poor farmers generally cannot risk the long-term investments and credit associated with the cultivation of teak alone, and that modified systems combining cash crops or NTFPs with timber production will assist them to participate in lucrative teak production.

NTFPs play an important role in rural areas of Laos, where they serve a wide range of subsistence needs and provide opportunities for earning cash income. Some 60 organisations are working on NTFPs in Laos. The potential of NTFPs to contribute to income generation has not been capitalised upon because unsustainable harvesting techniques and inefficient markets generally operate against rural producers and collectors. The agronomy for most NTFPs is unproven, with only a few approaching a level of domestication that could confer reliability in cultivation by resource-poor farmers. The added complexity of growing an NTFP in association with plantations of high-value hardwoods limits the reliability of any technical package offered to farmers. In the absence of expanding and reliable markets, it is difficult to see how incomes derived from most NTFPs can be increased.

The study collated a great deal of information related to teak silviculture and its management and markets that has not been available to growers involved in teak-based farming systems.

The annual volume of teak being harvested from smallholdings in Luang Prabang province is expected to increase from the current 4,000 $m^3$/year to an estimated 18,000 $m^3$ in 2010 and 60,000 $m^3$ in 2020. The availability of a commercially significant volume of high-value plantation hardwood offers substantial opportunities for value-adding and processing in addition to the current activity.

Assessments of the profitability of a number of cropping systems in this study indicated that more intensive integrated cropping systems based on teak offer sustainable financial benefits for smallholders in the uplands of Laos. Further research is warranted on the technical, economic and social aspects of more-intensive production systems involving teak intercropped with food and fibre crops. On-farm pro-

ductivity improvements need to be complemented by improvements in the off-farm sector for food and fibre crops, including timber.

The most significant challenge identified by this study is effective engagement with markets for teak, companion crops and NTFPs. The requirement for such an improvement was strongly expressed by teak smallholders, government officials and donor supporters, and was seen as a fundamental requirement to the success of any research-driven interventions. The markets and market chains for potential companion cash crops and NTFPs were poorly understood by those interviewed, who regarded them as volatile and unreliable. Growers lacked adequate market information regarding both teak logs and their teak smallholdings, and were vulnerable to unscrupulous opportunism when selling either. Earlier studies, and farmer interviews associated with this study, clearly demonstrated that farmers were at a great disadvantage because of their lack of market information.

Most farmers in the region had agricultural experience with most of the cash crops considered as potential companion crops for teak. However, little information was available regarding cultural modifications that would have to be made if these crops are to be cultivated in the longer term with teak. There was also a lack of information for farmers considering basic primary processing of crops to buffer fluctuations in market prices.

Although considered gender neutral, the recent and continuing expansion of teak smallholdings will have a series of social impacts on communities. Apart from offering stable land use and increased and secure household incomes, teak plantings by roadsides will inevitably alienate some potential agricultural land. Incorporating teak into farming systems was an opportunity pursued by farmers who were well established in their villages; new arrivals at the villages who do not have access to traditional family lands do not enjoy the same opportunity.

Increasing the profitability of teak-based farming systems in a sustainable fashion will require a package of information, advice and services to the growers that includes (Figure 8.1):

- components on market information for both teak and companion crops
- identification of potential companion crops and their agronomy and capacity to grow with teak
- the social impacts of an expanding resource of privately owned teak smallholdings
- the technical issues surrounding the improved cultivation of teak itself.

## Opportunities for ACIAR

Within the framework of a package for delivery to teak smallholders involved in teak-based farming systems, a number of opportunities are available to

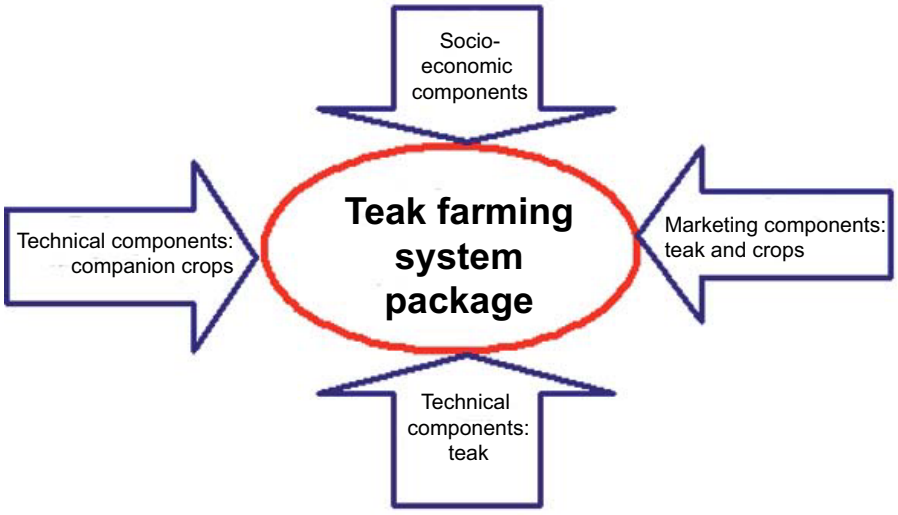


**Figure 8.1** Opportunities for ACIAR

ACIAR. A prerequisite will be a thorough understanding of the supply chains and market channels for both teak and potential companion crops. We suggest some association with the Smallscale Agro-enterprise Development for the Uplands (SADU) Project managed by the International Center for Tropical Agriculture (CIAT) and its partners at NAFRI. The approach of this project—to identify and evaluate market opportunities for agro-enterprise development through local stakeholder interest groups—engages farmers and offers market insights. The SADU approach starts in the villages and moves out along the market chain, focusing initial attention on products that are currently being produced and which have a stable or growing market demand. These products will be teak, cash crops or NTFPs. This approach provides assurance that there is a useful market for particular products (such as organic produce) and lays the framework for future market-orientated extension, which will establish closer links between growers, traders and processors. Such an activity will ensure that subsequent research is consistent with the overarching commitment of the Government of Lao PDR to alleviate poverty. As part of a program that seeks to offer improved market knowledge, ACIAR might encourage membership and participation in Teaknet, a regional network that has recently been reactivated through a commitment from the Kerala Forest Research Institute with modest ongoing support from FAO and APAFRI. An opportunity exists for the Lao PDR to become a fully participating member.

An Australian example of an industry-wide association which has involved growers, processors and retailers is the 'Blackwood Industry Group', which arose from an ACIAR project and is now sponsored by the Joint Venture Agroforestry Program.

With the knowledge of secure markets and within the context of a package available for teak smallholders, the following opportunities exist for collaboration in Laos.

## Market components

Important marketing issues include:

- understanding supply chains and opportunities for cash crops and NTFPs selected through the SADU approach of market-orientated agricultural development
- obtaining and disseminating information on prices and trends in markets for round and squared teak logs
- developing markets for small teak logs (thinnings). If thinning is to be promoted in any package of improved silvicultural practice, it is important that a market be fostered for the small logs resulting from these thinnings. Opportunities exist through the furniture sector and small piece sizes of kiln-dried lumber. The Research Institute for Wood Industries (RIWI) at the Chinese Academy of Forestry is well acquainted with the large Chinese markets for tropical plantation hardwoods (including teak) and with a number of low-cost, value-adding processing possibilities including rotary veneer. This veneer can be made on inexpensive, spindleless lathes from logs as small as 15 cm in diameter. The RIWI has indicated that it would be willing to provide access to its facilities and work with ACIAR in examining improved value-adding and market prospects for plantation-grown teak from Luang Prabang province.
- increasing market opportunity for the expanding volumes of teak from smallholdings. ACIAR might assist NAFRI to examine possibilities for certifying private teak smallholdings near Luang Prabang under a 'group certification' scheme. Plantation-grown, certified tropical hardwood is now gaining a premium (sometimes as high as 30%) in the discerning markets of North America and Europe, and furniture industries are keen to gain access to increased and sustainable supplies of wood which are certified. Australian Forestry Standard Limited could assist ACIAR and its Lao partners in this endeavour. In addition, the Tropical Forest Trust is well acquainted with certification issues in Laos and has indicated a willingness to share its smallholder experience with ACIAR and work towards certification of the teak smallholdings in Luang Prabang province. WWF has also indicated such willingness. This work would accurately quantify and characterise the resource of plantation teak as a basis for attracting commercial processing investment.
- developing simple methods to value teak smallholdings as the basis for sale or for loan agreements.

## Technical components: teak

The main technical issues for smallholders include:

- availability of quality germplasm and effective dissemination of improved germplasm: establishment of SPAs and CSOs

- adequate and publicly accessible demonstrations of the economic benefits of both thinning and pruning
- monitoring of insect pests and consideration of methods of control.

These technical issues have been identified and acknowledged by Lao professionals working in Luang Prabang province. ACIAR could offer research assistance through a series of technical support initiatives.

## Technical components: integrating companion food crops and NTFPs with teak

The economic and ecological implications of integrating teak in mixed farming systems need to be better understood. Most teak research has focused on the technical and economic aspects of growing the species alone in plantations. While this has provided important information relevant to smallholders, other areas such as the effects of teak on the yield of associated agricultural crops, as well as the effects of agricultural crops on teak productivity, need more research. Using reliable market information from the market-oriented approach suggested as a pre-project activity, likely companion crops and NTFPs could be selected and used in studies of their integration with teak in various conformations. Likely yields, agronomic inputs and changes in agronomy will need to be assessed.

The preliminary assessments conducted for this study indicated the potential of intercropping teak and paper mulberry. Further research into the technical and financial aspects of this intensive cropping system is needed, along with social investigations, to establish the most effective way to promote and implement this and similar teak-based systems. Participative action research has been shown by others to be most effective in the uplands. Scientists and farmers work together, planning, implementing, evaluating and revising candidate systems.

## Socioeconomic components

Important social issues include:

- organisation or coordination of growers into formal or informal groups to support local initiatives and provide market power when selling produce
- the impact of increasing areas of potential agricultural land being dedicated to teak
- ways through which new arrivals to villages near roads can benefit from teak cultivation.

## Networks

Many organisations and committed professionals are working with Lao communities and scientists in northern Laos. Much of this current work is relevant to the package which might be offered to teak smallholders. It makes good sense for ACIAR to establish strong networks to avoid duplication and achieve complementarity with current efforts. In exploring collaborative opportunities relating to teak-based farming systems in northern Laos, ACIAR has contributed to meetings such as the ‘Sustainable sloping lands and watershed management’ conference, held recently (12–15 December 2006) in Luang Prabang. The main purpose of the conference was to explore different strategies to promote environmental sustainability and enhance livelihoods of rural communities that inhabit upland areas.

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## Personal communications

Mohns = Bernard Mohns, GTZ, Houay Xai, Lao PDR

Savathvong = Savathvong, Sianouvong; Director, Luang Prabang Forestry Service (PAFO)

Siannouvong = Siannouvong Savathvong, Luang Prabang

Sinhotha = Phengdy Sinhotha, an innovative farmer who established and managed teak smallholdings in Ban Gok Gniew

Vongkhamheng = Vongkhamheng, K.; Director, Luang Prabang Provincial Agricultural and Forestry Extension Service (PAFES)

Midgley, S., Blyth, M., Mounlamai, K., Midgley, D. and Brown, A. 2007. Towards improving profitability of teak in integrated smallholder farming systems in northern Laos. ACIAR Technical Reports No. 64.

# 10 Appendixes

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# Appendix 1: ACIAR's project proposal

## FST/2005/180. Scoping study on teak and non-timber forest products as elements of agroforestry systems in Laos

### Terms of reference

***Background***

There are several thousand hectares of teak planted in Laos, and good prices are now being paid to farmers for trees of harvestable size. Productivity, however, is clearly affected by inadequate silviculture. Non-timber forest products (NTFPs) contribute a significant proportion of family income in many rural areas of Laos, and farmers are increasingly planting these species as an alternative to exploiting diminishing wild resources. Species involved include tree-form NTFPs such as paper mulberry and cinnamon.

As a component of its Lao forestry program portfolio, ACIAR is considering studies aimed at enhancing the productivity of agroforestry systems involving teak (or other high value species) and NTFPs. The intention is to develop silvicultural systems that optimise the economic productivity of both elements, and to develop and deploy improved cultivars of NTFPs. The scenario envisaged is that teak would be interplanted with tree-form NTFPs, conferring the form advantages from close spacing needed for teak. The NTFP component would subsequently be harvested, providing a significant economic return as well as releasing the teak through the equivalent of a thinning. Non tree form NTFPs could also be interplanted among the trees.

It is envisaged that, optimally designed and managed, these agroforestry systems could be low-input systems providing significant income streams, in both the short and long term, to rural Lao families.

In order to determine the potential value of such studies, and to more accurately identify potential constraints and economic benefits, ACIAR has decided to undertake a scoping study that will investigate the economic, social and other factors influencing the production and marketing of non-timber forest products and plantation teak in Laos. In particular, the scoping study will define the prospects for this type of agroforestry system, estimate potential economic benefits, and identify likely constraints and other factors to be considered.

***The scoping study***

The contractor is thus required to provide a publishable report that includes the following:

1. An overview of the teak and NTFP sectors in Laos, including:
   - Market chains, trade patterns, potential demand
   - Influence of developments in neighbouring countries
   - Lao competitive advantages, with respect to both growing and processing
   - The potential for value-adding and industry development in these sectors
2. An analysis of factors that could influence the adoption of agroforestry systems using teak and NTFPs, for example:
   - Availability and tenure of suitable land
   - Social factors, e.g. community attitudes, gender
   - Government policy, priorities and programs
   - Financing requirements and limitations
   - Infrastructure limitations
   - Local capacity, e.g. in management, R&D, extension
3. An analysis of prospects for more productive teak and NTFP plantations in Laos, especially in agroforestry systems, in particular:
   - Potential to contribute to rural incomes, also more broadly through value-adding, and to GDP. Quantitative estimates should be provided.
   - Possible risks
   - Environmental impacts
4. A review of relevant activities of other agencies in Laos, including international donors, NGOs etc
5. A synthesis of researchable issues, their significance as impediments, and the extent to which these are issues of relevance also to Australian agencies, and to which Australian agencies have a comparative advantage to add value.

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# Appendix 2: Project questionnaires

## Questions for village chief, 'Ni Ban'

Village.....
Name of Ni Ban.....
Main ethnic group.....

1. How many families live in the village?
2. What is the total population?
3. What is the age and gender structure of the village?
   Males: Females:
4. Current birth rate (trend)
5. How many years has the village been here?
6. Highest level of education achieved by village youth:
   Primary Secondary College
7. What proportion of youth remains in the village and works on farms?
8. What access does the village have to government extension services—forestry, agriculture, agro-forestry?
9. What fruits are commonly consumed in the village?
10. Are there foreign-aided projects operating in the area?
    What are they about?
    Are you involved?
11. How many families in the village have teak plantations?
    Estimate the approximate area.
12. Do women and men take equal responsibility in planting and maintaining teak plantations? Are there any community concerns about teak plantations?
    If yes, what are they?
    What are the attractions/benefits and challenges for teak in your village?
13. Who makes the decision to sell?
    Is the decision likely to change?
14. How does the village gain access to new information about crops, and market prices for both companion crops and teak?
15. How is this information shared within the village?
16. Do you know of any research being done on teak/crop combinations or other land uses that might make teak more profitable?
17. How do people sell teak wood? By weight? By volume? By individual tree?
18. Who conducts measurement of the weight/volume?
19. Does the village sell trees to the same buyer or are there several buyers competing for the trees?
20. Are teak trees used for construction within the village?
    Do people plant the trees for their children's benefit?
21. What area of teak trees are owned by absentee landlords—city and foreign investors?
    Where do these plantings tend to occur?
22. Uses of teak plantings
    – to protect farmland and soil and water resources
    – demarcate boundaries
    – to provide living fences
    – to shelter more valuable crops
    – to provide windbreaks
    – for timber
    – for fuel wood
    – for poles.
23. Are trees planted on the best land or marginal land?
24. NTFPs—explore current and possible future activities

## Questions for farmers

Village.....
Name/ethnic group.....

### I. Household background

1. How large is your direct family?
   (a) Number and ages in the household
   (b) Gender and age of 'farmer'
   (c) Income earners
2. Is your family self-sufficient in rice?
   If not, how do you make up the shortfall?

3. How many family members work on the farm?
   (a) Do you only do one type of farming?
   (b) Part-time/full-time
4. What are your main sources of income?
   (a) Farm sources (%)
   (b) Off-farm sources (%)
   (c) Income from forest resources—each year?
5. What type of animals do you have and how many?

   Poultry
   Pigs
   Buffalos
   Cattle
   Goats
6. Do you have:

   (a) Car/motorbike/bicycle
   (b) Motor cultivator (age)
   (c) TV
   (d) Telephone Mobile
7. Do you plan to purchase any of the above in the next 3 to 5 years?
8. What type of land do you own / control?
   Estimate areas of each type? Note areas owned and areas rented

   Their own
   (a) Paddy
   (b) Swidden
   (c) Fish ponds
   (d) Where does most of your farm income come from?
9. Do you rent land from others?
   How much and for what purposes?
   Where is the land located?

## II. Teak trees

1. Do you have teak trees on your landholding?
2. Are you considering planting teak trees in the next 3 to 5 years?
3. Why was this block(s) chosen for teak planting?
   Commercial/income prospects?
   Soil, proximity to road, slope?
4. What was the land used for before planting teak?
5. When were the teak trees planted?
6. Did you plant the trees or did you obtain them in some other way?
7. How many times has teak been planted on this site?
8. How many trees were planted?
9. For the current tree crop, did you use seedlings or stumps?
10. Technical details—spacing, source of seedlings, cost of seedlings, month of planting, seedling survival rate (number surviving/number planted); labour inputs at planting (family and hired); hours to plant (number of trees planted and area planted)
11. Ground preparation—describe how land is prepared; how many hours work?
    Family labour only and/or hired labour?
12. Sources of advice
    Neighbour
    Other farmers
    Government extension service—forestry, agriculture etc.
13. What maintenance have you offered the teak trees?
    Weeding
    Fertiliser
    Pruning
    Thinning
14. With respect to Q 13—when was maintenance conducted and what inputs were used:

    Labour (family and hired—hours)
    Any purchased inputs—chemicals, fertilisers
    Rate of application (kg/ha)
    Frequency (how many times since planting)
    Type of fertiliser; price per kg
15. Any problems with pests and diseases?
    How are these treated?
16. Other risks—fire, drought, flood: likelihood and potential impact?
17. Do you plan to extend your teak plantings?
    If so, over how many years?

## lII. Ownership—Land and trees

1. Do you rent the land on which you have planted trees?
2. Do you own the trees?

## IV. Companion crops / interplanting

1. What crops have you tried in association with teak?
   Dryland rice
   Job's tears
   Sesame

Papaya
Sweet potato
Banana
Maize
Peanut
Pineapple
Other

2. Why have they been successful/unsuccessful?
   Comments on profitability and productivity.
   Highlight problems experienced.
   Are they problems beyond farmer control or can they be overcome (i.e. are solutions available)?
   If productivity problems could be overcome what crop would you prefer to plant in association with teak?
   Why?
   Seek details for gross margins.
3. What research is going on to address these limitations and improve agroforestry system productivity and profitability?
4. If you tried another crop, how long do you think it would take to be productive?
5. Where is the market to sell these type of crops?
6. How were the other crops marketed?
   Direct? Via middlemen? Farmer cooperatives?
   Unprocessed/semiprocessed; fresh/wet market or for processing?
7. Problems faced in market access—
   Keeping products fresh?
   Sufficient volumes?
   Distance to market?
   Infrastructure—roads, storage facilities?
   Transport services, taxes and regulations?
8. What other crops might be tried—
   Food (e.g. mushrooms)
   Fibre (e.g. posa)
   Fodder (e.g. legumes for domestic animals)
9. What new types of crop would be of interest to you?
10. Are you willing to participate in trial plantings of mixtures of teak and other crops in new designs?

## V. Economic prospects

1. Why plant teak? To protect farmland and soil and water resources; demarcate boundaries; provide living fences; to shelter more valuable crops; to provide windbreaks; timber; poles.
2. What are your expectations from the trees?
   At what age do you plan to harvest the trees?
   How will you sell them?
   Will you sell all your trees at the same time or will you stagger sales?
3. Would you be willing to sell the trees before harvest age if the offer was right?
   Have you received any such offer?
   How much were you offered per year?
   Did you accept or reject?
   Why?
4. Is it possible to borrow money against the expected future earnings from the trees?
   If yes, what organisations/businesses offer such credit?
5. Will you plant trees again after harvest of this rotation?
   If not, why not?
   What will you plant instead of trees?
   If yes, will you plant teak or another species? If another species, which one—rubber, posa, other
6. Who do you expect will buy the trees?
   For what purpose?
   Will they sell them to other people or process them?
7. What do you expect to receive when selling the trees—price?
8. Do you have any ideas of how teak planting could be made more profitable?
9. What expenses limit you to make a teak plantation?
   Are there high expenses associated with harvesting and transport?
10. Would you sell your land to a large commercial plantation company if an attractive offer was made to you?
    Yes—why?
    No—why?
11. Do you use hired labour?
    (a) If yes, for what purposes and how often?
    (b) What are the current labour wage rates per hour? Are they set or do they vary from village to village?
12. Land rental rates—per ha per month:
13. Land prices—per ha:

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# Appendix 3: People consulted during the field study

### Ministry of Agriculture and Forestry

Mr Xeme Samonty
Deputy Permanent Secretary

### National Agriculture and Forest Research Institute (NAFRI)

Dr Mounthathip Chanphengsay
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NAFRI

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Mr Peter Jones
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Mr Michael Victor
Acting CTA, SIDA
NAFRI

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Faculty of Forestry

### Forest industries, Vientiane

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Director, Burapha Group

Mr Thongthanh Southitham
Forest Industries Consultant

### Project staff, Vientiane

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Mr Souvanpheng Phommasang
NTFP Marketing Advisor, SNV

### Department of Forestry, Vientiane

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Senior Research Scientist
Department of Forestry

Mr Sousath Sayakoummane
Deputy Director
Planning and Cooperation Division
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Mr Khamphachanh Boungnakeo
Planning and Cooperation Division
Department of Forestry

### In Luang Prabang

Mr Kaysone Vongkhamheng
Head
Provincial Agricultural and Forestry Extension Service

Mr Sianouvong Savathvong
Forestry Director
Provincial Agriculture and Forestry Office

### Northern Agriculture and Forestry Research Centre (NAFReC)

Mr Homchitsavath Sodarak
Director, NAFReC

Mr Saysana Inthavong
Deputy Director, NAFReC

Mr Khamen Soubangxay
Head, Kengban Teak Improvement Centre

Mr Thongsavanh Keonakhone
Senior Research Scientist, NAFReC

Dr Paulo Pasicolan
Forest Research Advisor, NAFReC

Mr Martin Greijmans
NTFP Advisor, NAFReC

### Project staff, Luang Prabang

Mr Phousit Phoumavong
Acting Manager
Forest Management and Community Support Project (FORCOM)

Mr Phetsakhone Soulygnalath
Technical Officer
Forest Management and Community Support Project (FORCOM)

## Forest industries, Luang Prabang

Mr Bounthan
Director, Sawmill Km 4, Luang Prabang

Mr Thongsavi
Director, Sawmill Km 15, Luang Prabang

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# Appendix 4: Donor agencies and projects in the forestry sector of northern Laos

Several donor agencies, international organisations and NGOs support activities related to strengthening farming systems, tree planting and improving markets in the northern provinces of Laos. Among those identified are:

## Donor and international organisations

### Swedish International Development Cooperation Agency (SIDA)

The Government of Sweden has provided substantial technical assistance to the Government of Lao PDR in the natural resources sector since 1977. Until the mid 1980s the assistance focused on support to the Department of Forestry and two State Forest Enterprises. From 1985 assistance was expanded to include support for the establishment of a forestry training organisation including the Forestry Technician School at Mouang Mai. In the late 1980s the Lao–Swedish cooperation was further expanded to cover the stabilisation of shifting cultivation and nature conservation. During the first half of the 1990s the cooperation gradually changed to institution building and strengthening of the Department of Forestry at the centre and in selected provinces. SIDA also supports a number of initiatives being implemented by CGIAR centres and the Southeast Asian Network for Agroforestry Education (SEANAFE), which works with member institutions in Vietnam, the Lao PDR, Thailand, the Philippines and Indonesia. Phase 1 (2001–2005) and Phase II (2006–) of the Lao-Swedish Upland Agriculture and Forestry Research Project (LSUAFRP) work through NAFRI and aim (among other things) to develop productive upland technologies and land management recommendations that are acceptable to farmers for poverty alleviation and sustainable use of natural resources. SIDA is in the process of developing a new Upland Development and Poverty Alleviation Project (UDPAP) that will be closely linked with Phase II of LSUAFRP.

### Consultative Group on International Agricultural Research (CGIAR)

Several CGIAR centres have had a strong relationship with Laos since the establishment of NAFRI in 1999. This is best demonstrated through NAFRI's Integrated Upland Agricultural Research Project (IUARP), which involves IRRI, ICRAF, CIAT and IWMI, and receives support from ACIAR. The main aim of IUARP is to develop sustainable upland livelihood systems through an integrated and participatory research approach. The target area consists of seven villages in Pak Ou district, Luang Prabang province, in northern Laos, representing a range of ethnic, socioeconomic and market conditions.

### World Agroforestry Centre (ICRAF)

ICRAF operates the Agroforestry Support Project for Vietnam and the Lao PDR (ASP—V&L), which receives support from SIDA. The project enables ICRAF to progressively engage partner institutions and colleagues in Vietnam and Laos in collaborative activities related to agroforestry research and development, as well as to support further linkages and collaboration within the Montane Mainland Southeast Asia (MMSEA) ecoregion. Commencing in July 2001, the ASP—V&L activities built upon the foundation and informal network of partners established through the Vietnam Agroforestry Capacity-Building (VACB) project, which was supported by SIDA from May 1998 to June 2001.

ICRAF also participates in upland research in Laos via the ASB global partnership: Alternatives to Slash-and-Burn Consortium and the SLU/ICRAF/Rockefeller Foundation project on Sustainable Land Use Practices for the Uplands of Vietnam and Laos: Science and Local Knowledge for Food Security (LUSLOF).

### International Center for Tropical Agriculture (CIAT)

The Smallscale Agro-enterprise Development for the Uplands (SADU) Project works with NAFRI. Among the objectives of this project are to identify and evaluate market opportunities for agro-enterprise

development through local stakeholder interest groups, and to design and facilitate the implementation of agro-enterprise initiatives with supply chain participants.

### International Rice Research Institute (IRRI)

IRRI is conducting relevant work via the Lao–International Rice Research Institute (IRRI) upland component and the Integrated Upland Agricultural Research Project (IUARP).

### International Water Management Institute (IWMI)

IWMI coordinates the CGIAR Management of Soil Erosion Consortium (MSEC). This initiative uses an integrated, interdisciplinary, participatory and community-based approach to research that involves the land users and other stakeholders on a catchment scale. Six partner countries are directly involved in implementing the project. The coordination of the consortium is primarily supported by contributions from the governments of Japan, France, Norway, Australia, Thailand and the Philippines through CGIAR. Implementation of activities in these countries is funded through the ADB-supported project Catchment Approach to Managing Soil Erosion in Asia (ADB-RETA 5803) (IWMI 2006).

In Laos the consortium partner is the Soil Survey and Land Classification Center (SSLCC) and the benchmark watershed is Houay Pano in Luang Prabang province. The Institute of Research for Development (IRD) in France is a major collaborator in Laos. The other international partners in the consortium are:

- International Center for Research in Agroforestry (ICRAF), Indonesia
- International Crops Research Institute for the Semi-arid Tropics (ICRISAT), India
- Southeast Asia Regional Center for Graduate Study in Agriculture (SEARCA), the Philippines
- Asian Institute of Technology (AIT), Thailand.

### German Technical Cooperation (GTZ)

GTZ is working on the following aspects of land use for rural development in mountainous areas of northern Laos:

- village-based land-use planning focusing on definition of permanent upland plots, definition of grazing areas, community forestry
- introduction of permanent upland plots—contour farming, hedgerows and cover crops, economic hedgerows ( paper mulberry), soybean cultivation
- livestock improvement, live fences, veterinary services
- inland fisheries
- small-scale irrigation—infrastructure development, rotational use of paddy lands (soy beans in the dry season)
- commercial aspects of small-scale forestry—use of bamboo
- value chains of agricultural products—decentralised manufacture of mulberry paper pulp, bamboo charcoal processing, soy bean processing.

### Japan International Cooperation Agency (JICA)

The JICA-supported Forest Management and Community Support Project (FORCOM) is based in Luang Prabang and has a target area of six northern provinces—Vientiane, Luang Prabang, Oudansay, Bokea, Luang Namtha, Houaphan and Sayaboury. This program of technical cooperation seeks to improve forest management and encourage production and income generation activities which contribute towards stabilisation of shifting cultivation and poverty reduction. The project promotes planting of teak and has established some village-level demonstration blocks.

### World Bank

The Sustainable Forestry and Rural Development Project (SUFORD) was launched in late 2003 with financial and technical assistance provided by the World Bank and the **Government of Finland**. The project aims to establish Production Forest Areas (PFA) all over the country and implement participatory sustainable forest management based on new GoL policy in eight priority PFAs located in four provinces in central and southern parts of Laos.

### European Union (EU)

The EU supports a number of initiatives in northern Laos, directly and via NGO partners. The Programme for Micro-Project Development through Local Communities is based in Luang Prabang (<www.microprojects-lao.org>). Among the project activities are marketing ecotourism and improvement in animal husbandry and upland farming techniques.

The Phongsaly Forest Conservation and Rural Development Project, based in the northern province of Phongsaly, promotes economic development interventions aimed at enhancing productivity from the sustainable management of natural resources. Among several project components are agroforestry and improved extension services, as well as participatory natural resource management planning, joint forest management and conservation strategies for Phou Den Dinh National Biodiversity Conservation Area.

### Food and Agriculture Organization of the United Nations (FAO)

The Marketing System Development for Non-Wood Forest Products in Lao PDR Project aims to contribute to the GoL development goals through development of NWFP marketing systems.

### Australian Centre for International Agricultural Research (ACIAR)

ACIAR is supporting a project aimed at enhanced processing of and manufacturing from Lao plantation timbers, especially teak and eucalypts. This is aimed at capturing more value from the teak plantations of northern Laos in particular. Work on the silviculture of teak interplanted with non-timber forest product tree species such as paper mulberry is also under consideration. ACIAR also supports a project on the domestication of Meliaceae species in South-East Asia, including Laos.

## Non-government organisations (NGOs)

Twenty-six NGOs are active in the agriculture, forestry and fisheries sectors in Laos, supporting some 53 projects (<http://www.directoryofngos.org>). A number of these encourage activities related to strengthening farming systems, tree planting and improving markets in the northern provinces.

### CARE International

Poverty Alleviation in Remote Upland Areas (PARUA)—supported by the Swiss Agency for Development and Cooperation (SDC), this project is based in Xayaboury province. The project goal is to sustainably increase livelihood security among poor ethnic groups in remote upland areas. Among the objectives is to improve the performance of agricultural livelihood systems by providing households with an expanded range of viable and sustainable agricultural production options.

Pak Lai Forest Conservation and Livelihood Development Project in Xayaboury province—Care International also supported this project, which sought to enhance the abilities of both villagers and government staff to manage and protect the forests of Pak Lai district, and to improve the livelihood of the communities there in a sustainable manner.

### Adventist Development and Relief Agency—Laos (ADRA Laos)

Sericulture Promotion and Integration for Community Empowerment Project (SPICE)—now complete, the SPICE project was based in Luang Namtha province and promoted mulberry tree cultivation and silkworm raising to provide an alternative and increased income source for 100 families. The goal of the project was to increase the income and food security of people in the target villages.

Subsequently, ADRA Laos has supported the Poverty Reduction through Land Tenure Consolidation, Participatory Natural Resources Management and Local Communities Skill Building Project, also based in Luang Namtha province. The purpose of the support is for nine typical poor rural ethnic minority communities to be socially prepared with secure land tenure and basic health and education, and able to manage their natural resources and respond to the opportunities and challenges brought about by improvements to Route 3.

ADRA Laos currently supports the Sustainable Agro-Forestry Systems for Livelihood Enhancement of Rural Poor Project in Luang Namtha province. The overall development objective is to bring about socially, economically, environmentally and ecologically sustainable rural poverty alleviation throughout the northern provinces of Laos. Project activities include on-farm activities to develop sustainable intensive interlinked agriculture and forestry land-use systems to enhance farm productivity, improve rural livelihoods and lay a foundation for secure land tenure certification.

### Concern Worldwide (CONCERN)

Community Livelihood Development Project (CLDP)—based in Bokeo province, the project

focuses on improving practices of land-use planning, land allocation and community resource management (e.g. NTFPs).

The Sisaket Sub-district Community Development Project is also based in Bokeo province along the Namtha River. This project marks the first phase of an integrated project which seeks to strengthen livelihood security and includes studies of NTFPs gathered from native forests.

### Cooporazione e Sviluppo Onlus (CESVI—Italy)

Food Security Project in Luang Prabang province—this project adopted an integrated approach with the objectives of increasing rice availability and upland households' cash income, and included activities related to the improvement of the productivity of upland farming systems.

### Deutsche Welthungerhilfe / German Agro Action (DWHH/GAA)

Community-Based Rural Development Project for Sustainable Food Security in Nga district—this project has support from the EU and is based in Oudomxay province. It aims to improve food supply, nutrition and health standards, and ensure that natural resources are used in an efficient and sustainable manner. It includes activities promoting the use of NTFPs.

Community-Based Rural Development Project for Conservation—this project was also based in Oudomxay province and is a continuation of the Community-Based Rural Development Project for Conservation of the Nam Beng/Nam Mau Watershed implemented by DWHH/GAA in 1999–2003. The project development goal is the efficient and sustainable use of the natural resources to improve food security and living conditions of the local population, and for conservation of the watershed function of the designated headwaters and provincial conservation areas. A major focus is on developing sustainable farming systems, including management of NTFPs.

Integrated Poverty Reduction Project Muang Mai—this project, based in Phongsaly province, aims to reduce poverty through agricultural and community development activities, and includes assistance to develop improved farming systems.

### Mennonite Central Committee (Laos) (MCC)

Integrated Agriculture Experimentation Project Borikhamxay Agriculture and Forestry College—based in Borikhamxay province, this project aims to provide improved agricultural production methods for villagers to ensure their food security and reduce poverty. It also includes the development of alternative models which can establish how much sloping land would typically be needed to support the needs of a Lao farm family to produce its own food and income needs using improved, integrated agricultural and forestry practices.

### Norwegian Church Aid (NCA)

Drug Demand Reduction and Poverty Alleviation for Ethnic Minorities—based in Luang Namtha province, this project seeks to improve food security through rural infrastructure, paddy land expansion and irrigation, livestock and management of NTFPs in a sustainable upland agriculture system.

### Netherlands Development Organisation (SNV)

Non-Timber Forest Products Advisory Programme—based in Luang Prabang province, this project operates via 'advisory programmes', with SNV advisers working alongside Lao organisations, but it does not fund them or implement their activities. SNV delivers advice on a range of topics within the NTFP sector, with a strong emphasis on networking and research. Two SNV advisers are based at the government's Forest Research Center (FRC), advising on the creation of a national NTFP network, development of micro-enterprises and support for forest users groups. One adviser is based at the Northern National Agriculture and Forestry Research Centre in Luang Prabang. In order to produce increased numbers of Lao specialists in this field, another adviser supports participatory curriculum development with the National University of Laos (<http://www.snv.org.la/ntfpindex.htm>).

# Appendix 5: Sources of information and cooperation

## International Union of Forest Research Organizations (IUFRO)

IUFRO has an active Working Group 5.06.02 – Utilization of Planted Teak (<http://www.iufro.org/science/divisions/division-5/50000/50600/50602/>), which has recognised that a priority for research is the use (properties and processing) of juvenile and/or sap wood available from thinning of teak plantations, and the establishment of grading/quality standards for improved market-value of small-dimension teak timber.

## Teaknet

With a commitment from the Kerala Forest Research Institute to host Teaknet, modest ongoing support from FAO and APAFRI, and a planned 2007 regional workshop (see below), it is expected that the Teaknet network and operations will be resumed. An opportunity exists for the Lao PDR to become a fully participating member.

## International Tropical Timber Organization (ITTO)

ITTO has a Committee on Economic Information and Market Intelligence and has supported a number of projects in the fields of economic information and market intelligence. It has provided the Kerala Forest Research Institute a grant to finance a regional workshop in 2007 to critically appraise the challenges for processing, marketing and trade of quality products of teak from plantations. All major Asian teak producer countries, viz. India, Indonesia, Malaysia, Myanmar and Thailand, are expected to participate, as well as the importing countries.

Midgley, S., Blyth, M., Mounlamai, K., Midgley, D. and Brown, A. 2007. Towards improving profitability of teak in integrated smallholder farming systems in northern Laos. ACIAR Technical Reports No. 64.

# Appendix 6: Regulation of the timber trade in Luang Prabang[1]

**LAO PEOPLE'S DEMOCRATIC REPUBLIC**

PEACE INDEPENDENCE DEMOCRACY UNITY PROSPERITY

The Governor of Luang Prabang Province

No……./PG.LP
Date

**DIRECTIVE FROM
THE GOVERNOR OF LUANG PRABANG
ON THE PROTECTION OF THE COMMERCIAL EXPLOITATION AND TRADE IN TIMBER**

- Whereas the Prime Minister's Decree on the Promotion of Timber Plantations for Commercial Purposes and on Environment Protection, Number 150/PM, dated 20/10/2003
- Whereas the Regulations on the Extension of Timber Plantations issued by the Ministry of Agriculture and Forestry, No. 196/MAF, dated 11/08/2000, and Guidelines on the Registration of Tree Plantations, No. 1849/MAF dated 07/10/1999
- Whereas the Guidelines on Financial Contribution from Timber and Non-Timber Products Sector, issued by the Ministry of Finance, No. 1059/MF dated 13/06/2003

In order to ensure that the protection of the commercial exploitation and trade in timber follow official guidelines and regulations, the Governor of Luang Prabang province has issued a directive on the protection of the commercial exploitation and trade in timber. The directive is as follows:

1. Encourage all commercial interests to participate in timber plantation business so as to increase timber plantations of all economic sectors. The principals of the commercial interests wishing to participate in this plantation business initiative must be the head of a business concern that has been approved by the Provincial Agriculture and Forestry Service, Provincial Finance Office and the Provincial Commerce Office. Only the principal who owns a registered timber trading business or is operating timber processing mills in Luang Prabang province will be approved as a party to participate in this initiative. Further, the principal concerned must not be a convicted criminal, must have some operating funds in a bank deposit, and must have a plan for either public or private timber plantations of no less than 5 ha per annum. These requirements will be taken as indications of the strength of the foundation of the principal's own business in the future and of the development of timber plantations and environment protection, as well as providing a contact office in Luang Prabang.
2. The interested parties must fully and correctly fulfil the following state obligations:
   - The principal of the commercial interest must undertake to pay all taxes on behalf of the growers on income derived from the sale of timer within the province of Luang Prabang. The amounts of taxes to be paid will be calculated and collected by the District Office of the Ministry of Agriculture and Forestry in which the plantation is located. The calculation will be based on the base price of a percentage of the unit price of sale of timber within the province, that is 800,000 kip/$m^3$ x 5% = 40,000 kip/$m^3$ of lumber.
   - [The principal of the commercial interest must undertake to] Pay all taxes on business turnover figures per consignment at the rate of 5% of the sale price in the Vientiane market. The calculation will be at the average of 1,200,000 kip/$m^3$ of the timber, with the Finance Office doing the calculation and collection of the taxes, totalling at 60,000 kip/$m^3$.
   - [The principal of the commercial interest must] Pay a withholding tax at the wholesale rate of 35% of the 10% commercial duties, to be calculated by the Finance Office; that is 120,000 kip/$m^3$ x 35% = 42,000 kip/$m^3$.
   - [The principal of the commercial interest must] Pay for all lodgements of documentation as required by law (Commercial Service 10,000 kip per set; Assets Control Office of the Finance

[1] This is an unofficial translation of the Lao original.

Service 10,000 kip; excise stamps 10,000 kip; registration based on the value at the last point of sale multiplied by 0.1%, that is 1,200 kip/$m^3$; documentation at the Customs Office 10,000 kip; Provincial Agriculture and Forestry Office for timber brand at the rate of 3,000 kip/$m^3$ of logs and 5,000 kip/$m^3$ of sawn wood; authority for transportation 10,000 kip; authorisation for exploitation approval 25,000 kip.

3. In the case where the principal of the business interest wants to export the timber overseas, they must fully comply with all tax and excise obligations in Luang Prabang. The calculation of the value of these obligations will be based on the average export price of the timber. That is, the average export price of timber of 12,000,000 kip/$m^3$ will translate to the following tax and excise obligations: (1) Excise on the growers 40,000 kip/$m^3$; (2) Excise on the wholesale business turnover 100,000 kip/$m^3$; Withholding Tax on profit 70,000 kip/$m^3$.

4. In the case where the timber is harvested from a private individual's own plantation, and the business principal has registered it as his own, the taxes will be calculated at the rate of 5% of the sale price at the destination sale point. That is, if the harvested timber is sold in Luang Prabang the tax will be 40,000 kip/$m^3$; if it is sold domestically in other provinces, the tax will be 60,000 kip/$m^3$; and if it is sold overseas, the tax will be 100,000 kip/$m^3$. The calculation and collection of these taxes will be carried out by the District Office of the Ministry of Agriculture and Forestry in which the plantation is located.

   [N.B. The collection of the income tax from the grower will be undertaken by the district level offices, and the collection of all other obligations will be done by the provincial level offices].

5. Procedures for approval of the harvest and transport of timber:
   - The business principal can buy timber from individuals per tree or per plantation. The bill of sale must specify the numbers of trees and quantity involved, the expected time of harvest from the original plantation as well as the full commercial price agreed between the two parties. Furthermore, the original plantation must have an authorisation for planting of timber or a registration as a timber plantation.
   - The business principal must carry out a survey of the trees to be harvested and have this survey approved by the District Office of the Ministry of Agriculture and Forestry in which the plantation is located before he can seek approval for commercial exploitation of the said timber.
   - After the harvest all the cut timber must be transported to an accessible location (called a 'secondary holding yard') so that the officials from the District Office of the Ministry of Agriculture and Forestry can inspect, measure and register all the timber.
   - The business principal must submit the timber registration form from the District Office of the Ministry of Agriculture and Forestry, together with receipts for the payments of all relevant duties and taxes, for approval by the Provincial Office of the Ministry of Agriculture and Forestry to obtain authorisation for the transport of the timber in question.

This directive is effective from the date of signature until being superseded by a further or new directive.

The Governor of Luang Prabang

**Distribution of copies**

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|---|---|
| Provincial Commerce Office | 1 copy |
| Provincial Finance Office | 1 copy |
| Provincial Agriculture and Forestry Office | 1 copy |
| All District Administrative Offices | 11 copies |
| Archive | 1 copy |