Glossary of Terms & Abbreviations

APB	Agriculture Promotion Bank
B	abbreviation for *Baan* – village
BAAC	Bank of Agriculture and Cooperatives (Thailand)
Baan	village
chao khwaeng	provincial governor
chao meuang	district chief
CPI	consumer price index
CSU	collection and sales unit of VRGA
DAFES	District Agriculture & Forestry Extension Service/DAFO/PAFO/MAF
DAFO	District Agriculture & Forestry Office/PAFO/MAF
DOF	Department of Forestry/MAF
DPCO	District Planning & Cooperation Office/CPC
GDP	gross domestic product
GIS	geographic information system
GOC	Government of China
GOL	Government of Lao PDR
GTZ	Gesellschaft für Technische Zusammenarbeit Gmb (German Organization for Technical Assistance & Cooperation)
HHs	households
HRD	human resources development
INRA	International Natural Rubber Agreement
IRSG	International Rubber Study Group
LA	land allocation
LNB	Lao National Bank
LNFC	Lao National Front for Construction
LNT	Luang Nam Tha
LRRS	Luang Nam Tha Research Station
LUP	land use planning
MAF	Ministry of Agriculture & Forestry
meuang	district
MIH	Ministry of Industry and Handicrafts

MOAC	Ministry of Agriculture and Cooperatives (Thailand)
MOC	Ministry of Commerce
MOU	Memorandum of Understanding
NAFES	National Agriculture & Forestry Extension Service/MAF (at Huay Nyang)
NAFRI	National Agriculture & Forestry Research Institute/MAF (at Dong Dok)
nai baan	village headman
NDF	non-deliverable forward, bank & customer agree on a later currency exchange rate
NGO	non-governmental organization
NR{*number*}	national road (major land communication arteries throughout the nation)
NR	natural rubber
NTFPs	non-timber forest products
OFTs	on-farm trials
ORRAF	Office of Rubber Replanting Aid Fund/MOAC (Thailand)
OSTs	on-station trials
PAFES	Provincial Agriculture & Forestry Extension Service/PAFO/MAF
PAFO	Provincial Agriculture & Forestry Office/MAF
PFM	project formulation mission of LSUDPAP
PLUP	participatory land use planning
POW	plan of work
PPA	participatory poverty assessment
PPCO	Provincial Planning & Cooperation Office/CPC
PRC	People's Republic of China
PSC	pioneering shifting cultivation
RD	rural development
RMDA	Lao-German Program Rural Development in Mountainous Areas of Northern Lao PDR
RRA	rapid rural appraisal (an extractive tool for outsiders to better plan monitor & evaluate)
RTG	Royal Thai Government
SSI	semi-structured interviews
SOE	state-owned-enterprise
songseum	extension (many times promotion)
souk ngieu	extension (many times promotion)
SR	synthetic rubber
SSPN	Sip Song Panna (Xishuangbanna in Chinese langage)
VDC	Village Development Committee
VRGA	Village Rubber Grower's Association
VRGAF	Village Rubber Grower's Association Fund

VRWF	village rubber welfare fund
WTO	World Trade Organization

Chapter 1
Introduction

Objectives and Scope of the Study

Goal: To study all relevant aspects of the cultivation of para rubber (*Hevea Brasiliensis*) as well as the production and marketing of latex in Luang Nam Tha.

Objectives:

1. Describe socio-economic (including marketing), technical and ecological aspects of the cultivation of *Hevea Brasiliensis*.
2. Analysis of cultivation for in order to make recommendations for technical viability, economic feasibility and ecological sustainability. This includes the evaluation of the suitable agro-climatic and geographic locations.
3. Analyze legal criteria of contract formulations between small farmers, Chinese companies and district agricultural authorities.
4. Analysis of technical aspects concerning agriculture and the development of concrete cultivation advise
5. Make recommendations concerning cultivation, technical support; eg, extension, training, and marketing.

The scope of the study was to query para rubber cultivators, merchants and traders, and key government officials in Luang Nam Tha concerning the cultivation, processing and sales of rubber in whatever form. Then obtain some lessons from China and Thailand concerning their experiences.

Comments on TOR

The TOR for this study did not ask for mapping of ecologically sensitive areas although it did request an "analysis of possible impacts on the ecologically sensitive mountainous areas". In subsequent conversations with the GTZ project leader for the Muang Sing/Na Lae project, he expressed a desire to have sensitive areas identified within a GIS map. The study team did not carry out this element of the verbal TOR for several reasons (given not in order of importance). First, we lacked the significant amount of time needed to put into this element particularly when weighted against the more pressing need of determining the current rubber situation in Luang Nam Tha province. Second, the GIS skills of the team member responsible for this input were rusty which would have slowed the process considerably. Third, the skill level of DAFO and GTZ staff was not capable of supporting the team member in this input. Fourth, the relevant databases needed to support this input are very disorganized and lack certain vital information. (Despite two previous GTZ training staff remain poorly trained and lack the proper skills needed to produce good GIS maps.) Fifth, given the available data only a gross scale map would have been produced. The study team member responsible for this area thinks that such gross scale would have been of little use.

We suggest that an additional GIS training program might build a project focused on demarcating areas that might be off-limits to rubber. The current criteria developed by the DAFO is a reasonable beginning, but it requires significant additional refinement. Additionally, the GIS map project should integrate the most recent attempts at PLUP and develop additional criteria regarding the quality of demarcated forest types. It would be logical that additional GIS layouts could indicate not only areas off-limits to rubber but areas poorly suited to rubber. The recently generated Vietnamese mapping project indicating areas suitable for rubber, only a hard copy was viewed, is a gross scale attempt that appears to be of little value.

Study

The study sponsored under the Lao-German Program Rural Development in Mountainous Areas of Northern Lao PDR (RDMA) in Meuang Sing. The field work was undertaken from October through December 2004 and the analysis and write-up was undertaken in January and February 2005. There were two field trips taken to northeast Thailand and one to Sip Song Panna in Yunnan, China. In addition one visit was made to the Rubber Research Institute of Thailand (RRIT) in Bangkok, discussion with a representative of a rubber company, discussions with Director of the Nong Khai Office of the Rubber Replanting and Aid Fund (ORRAF), and a seminar was attended on Rubber at the Faculty of Agriculture of Khon Kaen University.

Study Team

The core study team was composed of Mr David Bluhm, agroforestry specialist; Thao Somsouk Sannanikone, business law specialist; and Dr Charles Alton, agricultural and resource economist. All three have had considerable experience in the Lao PDR. Several GTZ staff and others assisted the team during the study.

Approach and Methods

Informal discussions were held with projects implemented by NAFRI, eg, the Lao-Swedish Upland Research Project, CIAT; and NGOS with interests in Luang Nam Tha, eg, ACF, Friends of the Upland Farmer.

Key provincial and district offices were contacted, eg, the Provincial & District Planning and Cooperation Offices (PPCOs & DPCOs), the Provincial & District Agriculture & Forestry Offices (PAFO & DAFOS), Provincial & District Information & Culture Office (PICOs, and the District Commerce Office (DCO).

Upon reviewing the existing data and para rubber tree cultivation situation in Luang Nam Tha, the team tried to determine where rubber was being cultivated in both Meuang Sing and Meuang Nam Tha. This was difficult to determine the area planted since both provincial and district statistics are not really kept update on newer crops. However, they did know the villages for the team to examine. In Meuang Nam Tha the obvious first choice was that of Baan Hat Nyao, a Hmong village, which is the first village in modern times to plant para rubber in 1994, and begin tapping in 2002. So we examined B Hat Nyao somewhat in depth both at the village level and sampled six households. From a list of four other villages which planted para rubber trees at the same time but discontinued because of frost kill losses in 1999. B Huay Dam, a Khmu village east of Luang Nam Tha provincial town, was one of the villages we which examined.

In Meuang Sing the only village to tap rubber thus far is B Lo Meu, a Akha village in Khet (sub-district) Meuang Mom. Tapping there began in 2004 with one household. Para rubber has been planted in other Akha villages in this sub-district, B Chaphoukeun, B Bouak Ya Sai Mai, B

Bouak Khou, and B Yang Leuang. Information was gathered mostly at village levels, with household level in B Lo Meu. Additionally, we interviewed in B Oudomsin, a Mien (Yao) village near the border crossing at Pang Thong.

For purposes of socio-economic and technical data collection, a variation of rapid rural appraisal (RRA) techniques were considered the most appropriate means of gathering information. RRA is a systematic means of quickly and cost effectively gathering and analyzing information. The heart of the RRA is the anthropologist's time tested semi-structured interview (SSI), which allows interviewers to guide informants through a series of question guidelines over a range of topics concerning their livelihoods systems. This is followed up by probing for explanations or details, which gives the interviewer the chance to redirect questions if the informant has drifted to far away from the original topic. In the case of Akha informants the Akha language was used, and with those of other ethnic groups the Lao language was sufficient to have dialogs and interview informants for this study.

Study Report

This study is basically a work in progress, which is not yet finished. Much of the study was like peeling an onion – progressively only working through several of the outer layers. It is not meant to be definitive but only a beginning. We are not rubber specialists *per se* – but development professionals with knowledge and experience in upland agricultural systems in the Lao PDR.

The organization of the report is according to how it was done. The first chapter is the introduction and the second includes the background of rubber in the world, region and in Lao PDR itself. The chapters three and four examine the lessons learned from para rubber tree cultivation in Thailand and China. The fifth chapter examine the experience of Baan Hat Nyao, the first rubber producing and tapping village in modern times. The environmental implications and technology of rubber tree cultivation are examined in the sixth chapter and chapter seven looks at the socio-economic implications. The eighth chapter concerns the financial analysis projections of rubber tree cultivation into the future. The ninth chapter examines legal concerns. The study's recommendations are in chapter ten.

Chapter 2
Background

Rubber is definitely one of the *hot commodities* in world commodity markets. Rubber consumption has increased at an average rate of 5.9 percent per year since 1900 to about 18.97 million tons in 2003,eg, 7.81m tons for natural rubber (NR) and 11.16m for tons synthetic rubber (SR). The superheated Chinese economy with an annual GDP growth rate of around 9.3 percent from 1990-2002, passing the United States as the world's number one consumer of rubber in 2002 it, at an estimated 3.45 tons (18.2%) of global consumption (Prachaya 2004). China is in the process of constructing 20,000 kilometers of new roads. So with the increased disposable income and the improvement of the transportation system, motorized vehicles and rubber tires will increase.

Burger and Smit (2004) in their rubber projection model project that world consumption will increase to 27.7 million tons in 2020. China's share of rubber consumption will increase to about 30 percent and thereafter remain constant. They mention that world rubber consumption has been steady at about 3 kilograms per person – until the recent Chinese phenomena where it has increased it to about 3.5 kg per person. In 2002 Chinese para rubber production met 35.7 percent of NR needs and about 15 percent of total rubber needs. China is the world's fifth largest producer of NR and third largest manufacture of SR. It is estimated that 11.5m tons of NR will be required in 2020 with China itself supplying about 4m tons (IRSG 2004). Thus, this will contribute to the increasing gaps between supply and demand. Some predict that India is also looming on the horizon to increase rubber consumption as its economy is taking off (personal communication Luckchai Kittipol, President, Thai Hua Rubber Company, Ltd).

In Asia many of the rubber producing countries are now preparing for continued strong demand for rubber in the region with China. Obviously, this is related to strong prices for natural rubber vis-a-vis those of the petroleum-based synthetic rubber. As can be seen in Figures 1 and 2 below prices of TSR20 in US cents per kilogram in Singapore have increased since late 2001 with a slight dip in early 2004. Burger and Smit (2004:74) project that NR rubber prices will increase until about 2010 at about $1.75 per kilogram and that the share of NR will stabilize at about 37 percent of total rubber consumption.

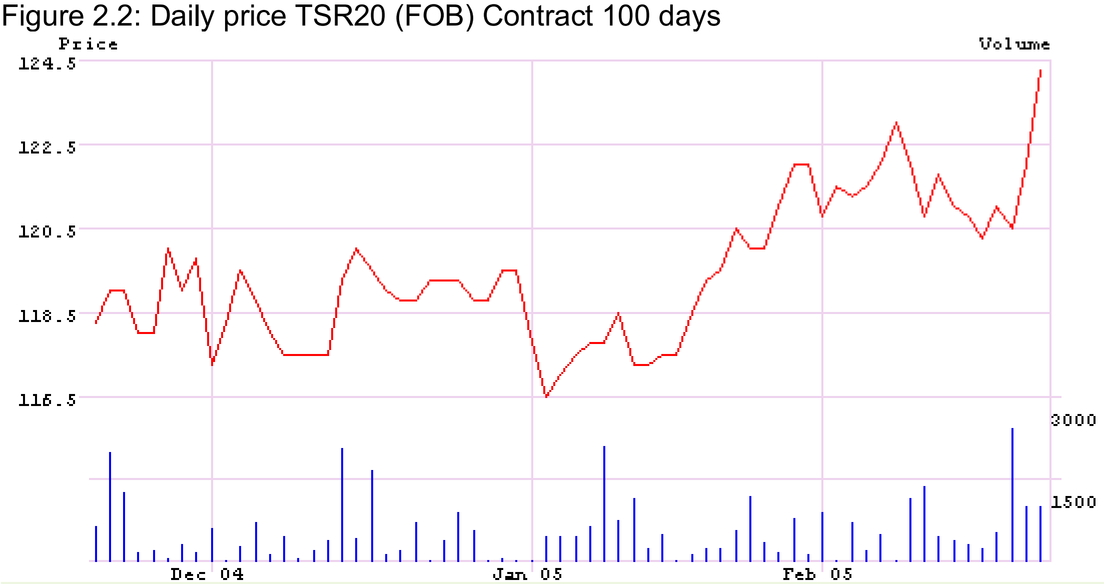
Figures 2.1 and 2.2 below show world rubber prices of TSR20 in recent years. One can see both the price trends and fluctuations since 2000. Basically the price trend since late 2001 has been rising steadily from a low point of US$ 0.45 per kilogram to a price of about US$ 1.24 per kilogram in late February 2005. Actually in late 2003 prices even reach US$ 1.46/kg.

From Figure 2.2 price volatility can be seen for the past 100 days even through the trend is favorable.

Figure 2.1: Daily price TSR20 (FOB)[1] Contract 2000 days

Source: Singapore Commodity Exchange in US cents/kg TSR20 (FOB) – 27th February 2005

Figure 2.2: Daily price TSR20 (FOB) Contract 100 days



Source: Singapore Commodity Exchange in US cents/kg TSR20 (FOB) – 27th February 2005

Within the southeast asian region Thailand, Malaysia, Indonesia, Sri Lanka, Philippines, Cambodia, Viet Nam, and China are all increasing their rubber tree planting and replanting to increase production to meet expected demand.

Thailand is going forward with a strong program of planting and replanting para rubber trees.

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[1] Specifications of TSR20 (FOB) contract: 20 metric tonnes (Single month) or 60 metric tonnes (Quarter) through the Singapore Commodity Market (SICOM).

For the period of 2003 - 2006 Thailand is increasing the area planted in the North by 48,000 hectares (300,000 rai) and in the Northeast by 64,000 hectares (700,000 rai).[2] In the South serious replanting is also being undertaken. Total area for 2020 in Thailand is projected by Burger and Smit (2004) to be about 2.4m hectares (15m rai) up from the approximately 1.9m hectares (12m rai) of the present.

In Malaysia rubber is no longer considered by the government as a sunset industry. While estates are on the decline (down to 13% in 2000), smallholders are on the increase. Currently 88 percent of rubber land is under smallholdings of about two hectares each. However there has been an overall decline in replanted rubber land to oil palm. Apparently Malaysia has as much 230 -300,000 hectares of mature trees that have not been tapped and are beginning to be tapped with higher prices. In addition Malaysia views rubber as one of the engines of future economic growth (Lim 2004).

Indonesia is expanding its production, however, about 80 percent of its production is consumed by its own tire industry (Suharto 2004). Apparently much of the residual is exported to China.

Viet Nam is expanding rubber production considerably in response to the China opportunities. At the end of 2003 the area in estates was 280,000 hectares out of a total of 450,000 hectares.[3] The planned targets para rubber area for 2005 are 500,000 hectares and 600,000 hectares by 2010. Apparently only about a maximum of 30,000 hectares of estates can be developed in the future and the rest of 70-120,000 hectares would be smallholder development (Le 2004).

In Cambodia there were 32,233.62 hectares under rubber. It is not certain how they have responded to current prices and increased demand in China.

Para rubber planting and rumors of planting are rampant in the Lao PDR. The situation with para rubber is changing so fast that the Ministry of Agriculture and Forestry (MAF) is not certain of even an estimate of the area planted. We will make an attempt to estimate from the plethora of newspaper articles on the subject over the past year (cf also **Appendix ??**). Chinese, Vietnamese, Thai investors and perhaps others are exploring investing in rubber production in the Lao PDR, and they are seeking land for concessions and other arrangements all over the country. A Vietnamese research institute and NAFRI have done some sort of a land suitability study in the south, focusing on rubber and cashew nuts (Table 1). They had identified suitable land for rubber tree cultivation in the five provinces. This seems to be a precursor or prerequisite for Vietnamese rubber companies to invest in Laos.

Table 1: Suitable land for para rubber tree cultivation (ha)

Savannakhet (SKT)	Saravan (SVN)	Sekong (SKG)	Attapeu (APU)	Champasak (CSK)
89,000	55,000	12,500	20,000	25,000

[2]Of course, these plantings will not come into production until 2009.

[3]The Viet Nam General Rubber Corporation (GERUCO), a state-owned enterprise, manages 220,000 hectares (~50% of the total area of the country).

The tentative list of investors below in Table 1 is an example of some of the response to high rubber prices and the perceived demand in China.

Table 1: Investors in rubber in Lao PDR

Location	Area (ha)	Amount	Investor	Comments
LNT	267	???		B Hat Nyao already tapping 267 ha planted 737 ha
LNT			Sino-Lao Co	
LNT	???	???	Chinese & others	planting of seedling nurseries in both Nam Tha & Sing districts
LPG	???	???	Chinese	signed with LPG province
CSK, SKG, SVN	10,000	$22m – 50 yrs	Viet Nam General Rubber Corporation	rubber factory – 18,000 tons/yr from Ho Chi Minh ?
LNT, OXY, BKO	1,000	¥30m	Chinese government & private sector	not yet signed also research station & seedling production facilties
CSK	10,000	VND 40m ($2.5m)	Quang Tri Rubber Co subsidiary of (VRC)	2,000 trees in 2005
CSK	10,000	$30m	VN-Laos Rubber Joint-Stock Company; 6 subsidiaries of VN Rubber Corp	2,000 ha this yr; 400 local laborers & 100 Vietnamese workers
Bachiang & Xaysomboun	10,000		???	rubber company from Ho Chi Minh
PSY, M Boun Neua (B Yo)	1,000	$900,000	Agr Dev Co	PPCO signed agreement w/ Tai Fong Agr Dev Co to plant 1,000 ha for 400 HHS in M Boun Neua (B Yo) $900,00
CSK , M Bachiang,	3,000		Agr Co of Dak Lak	also produce organic fertilizer in plant at km 46 in Pathoumphone; produce fertilizer for rubber
Vte P & BKY	16,000	Baht 20m ($500,000)	Thai Rubber Latex Group	survey in Vte P & BKY; 2,000 workers; also sent to factory in area (Beung Kan?)
OXY, M Namo	1,300	$1m in 2004	China Chien Fong (Mengla)	plans 6,300 ha 2004-8
SKT	11,000?	???	Thai Hua Rubber Company, Ltd	discussions with Governor of SKT
SVN, SKG, APU	???	???	Vietnamese company?	
SKT, SVN, SKG, APU, CSK			Vietnamese research institute in cooperation with NAFRI	survey of southern provinces for potential for rubber & cashew nut cultivation

Sources: Vientiane Times, Kaosaan Prasason Lao (KPL), Bangkok Post

KPL	3/3/05	Project to plant 10,000 ha of rubber in CSK province	VN-Laos Rubber Joint-Stock Company 2 Mar began proj to plant 10,000 ha of rubber trees; $30m from 6 subsidiaries of VN Rubber Corp; 6 yrs; 2,000 ha this yr; 400 local laborers & 100 Vietnamese workers

Chapter 3
Thailand Section

Para rubber has long been a strategic commodity in Thailand, where production has been historically concentrated in the South. At some point in the seventies it was thought that it would be a promising commercial tree crop in northeast Thailand, especially as an alternative to cassava production, and thus it trials and demonstrations were established in resettlement areas (*nikhom*) in Nong Khai, Udorn, Nakhorn Phanom, and Buriram and perhaps some other provinces. Then later as the *Isaan Khiao* (Greening of the Northeast) campaign of Prime Minister, Chatchai Choonavan and General Chaovalit program began to promote para rubber tree cultivation in 1983 in order to provide an livelihoods alternative for income generation. In this section we shall review the rubber situation in NE Thailand since it seems most relevant to Laos.[4]

Projects were designed and implemented to promote rubber production, such as the EU funded Pilot Project for Development of Rubber Tree Cultivation which established the present Nong Khai Rubber Research Center (then an Experiment Station) and Center for Extension & Development of Farmer's Livelihoods outside of Nong Song Hong close to Nong Khai town. Then there have been other government sponsored infrastructure and services, such as the Buriram Rubber Research Station, the facilities various on various land settlements, the many ORRAF offices throughout Isaan, etc.

It was determined that there were places in the region which had sufficient rainfall to cultivate para rubber trees. This coupled with the fact that until a few years ago in the southern rubber plantations up to 70 percent of the hired laborers were from Isaan who gained considerable skills over the years in rubber tree cultivation, harvesting, and rubber sheet processing. It is upon these acquired skills that laid the foundation for rubber tree cultivation and the present rapid expansion of the area planted under rubber.

By 2003 in the Northeast region there were 299,339 rai (47,894 ha) of rubber trees being tapped out of a total 725,023 rai (116,004 ha) planted. The total production in 2003 was 73,774 tons. Provincial yields ranged from 114.4 kg/rai (715 kg/ha) in Mahasarakham to 342.6 kg/rai (2,141 kg/ha) in Srisaket, and the regional average was 246.5 kg/rai (1,540.6 kg/ha), as opposed to the national average yield of 280 kg/rai (1,750 kg/ha). Nong Khai and Loei province has the greatest areas planted.

Because of current strong demand and subsequent high prices in the world marketplace, especially in nearby China, the Royal Thai Government (RTG) has a new program of increasing farm income in Northeast and Northern Thailand by expansion of the rubber tree cultivation area by one million rai, of which 700,000 rai (112,000 ha) is targeted for the NE and 300,000 rai (48,000 ha) for the North. It is targeted for the provinces of Nong Khai, Loei, Udorn and Nong Bua Lamphu to plant 400,000 rai (64,000 ha) in the five year period.

Livelihood Systems in Isaan

Up until the mid 1960s Isaan farmers were still basically subsistence-oriented – selling only rice

[4]Northern Thailand is still relatively new to rubber tree cultivation and there are few known results.

surpluses, a few fruits and vegetables and perhaps a little corn. Commercial agriculture in the region began with kenaf cultivation in the uplands. It was suited for the soils and climatic conditions in the undulating upper terraces of the agroecosystems. Many farmers cultivated kenaf and learned much about commercial production, including grading, but due to water shortages and pollution incurred in the retting, kenaf later began to be replaced by cassava for flour and export to the EU for the starch component of animal feed ration. This became widespread throughout the region by the late 1970s to the early 1990s. Also, in the 1980s investments were made in large sugar mills, thus encouraging sugar cane cultivation. Now it is our understanding that the northeast if the target area for sugarcane production. Of course, there was also cultivation of corn, fruits, Job's tears, macadamia nuts and other commodities.

While the region always did sell large animals to the emerging markets in Bangkok, livestock rearing as an economic enterprise got its jump start in the late 1960s with the improved roads to transport to Bangkok. By the mid 1970s commercial pig and broiler chickens became more important to some farmers. In the 1980s fish production in both farm ponds and village fish ponds became increasingly important to household nutrition and cash income.

Thus, when rubber began to become a viable opportunity Isaan farmers already had considerable experience in commercial agriculture. This more commercial-orientation coupled with the experience in rubber production of many workers in southern Thailand was very important for farm households to feel confident in their cultivation of rubber trees. In addition as marketing channels were established according to the southern experience and are somewhat assured of a marketing system.

Rubber in Livelihoods System

In northeast Thailand, many villagers have fully accepted rubber cultivation into their farming systems. However, they continue to undertake other activities such as, paddy rice, upland crop, fruit tree cultivation; livestock rearing and fish culture. Thus, they continue to spread the risks and maximize the opportunities. While agroforestry systems under rubber are not prevalent, they are important to livelihoods of some farmers.[5]

With high rubber prices in recent years many Isaan migrant laborers have returned to plant rubber trees themselves if they have sufficient funds, or they continue to work as hired labor in the region if they do not. Land under rubber is increasing due to government programs, a reasonably good marketing system, good communications (especially roads) and individual initiative. With high rubber prices, availability of RTG support programs of subsidized inputs and credit reduced farmer risk (cf in Institutions below), depressed prices of other perennial tree crops, and the familiarity of farmers with commercial production and marketing it is understandable why farmers are increasingly planting more rubber trees.

Yet, despite the RTG support, Isaan familiarity with rubber, and cash crop experience Isaan villagers accepted a perennial tree crop with no local markets, a product that required both an extremely long waiting period until harvest, a rather sophisticated level of post-harvest processing, uncertain and depressed prices, a total disruption of normal sleep patterns during

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[5]RRIT and other rubber organizations do not seem to actively promote any thing but rubber monoculture, however, some ORRAF officials did advocate it privately.

harvest, and a complete removal of land from production for three to four years. Thus, the motivation behind the acceptance of rubber into Isaan farming systems would be an interesting topic of research. Perhaps as Dove (Dove 1996,1998, 2002) notes for Indonesia the harvest of exudate NTFPs for sale created a historical precedence, but by the time rubber was planted in northeast Thailand most of the large *Shorea* spp. has been cut down.

At current rubber prices of Baht 46/kg rubber tree cultivation is very profitable since production costs are calculated at about Baht 22/kg for rubber sheets.

An example of prifitability is a farmer interviewed in B Na Duang, Loei province who provided us with the following information on his 18 rai (2.88 ha) of rubber trees. He estimated production for 2004 of about 7,677 kilograms for an average of 426.5 kg/rai (2,666 kg/ha), which compares quite favorably with the Loei provincial average of 224.4 kg/rai and the Isaan regional average of 246.5 kg/rai. At an average price of Baht 45 per unsmoked rubber sheets, he would obtain a gross cash income of Baht 345,465 from the sale of mixed grade sheets. This table does not include an estimated income for latex waste (*khii yang*) of about Baht 40,000 for a total gross revenue of Baht 385,465. This rubber production gives him a net income of about Baht 345,465 + Baht 40,000 (latex waste) - Baht 23,300 = Baht 362,165. This would amount to a net return to land of Baht 20,120 per rai ($503) or Baht 125,752/ha ($3,143.80).[6]

The total absence of any integrated rubber systems, eg, semi-complex agroforests or multistory cropping systems, suggests that the RTG research institutions have taken a narrow view of how rubber can fit into farming systems. There are two extension brochures discussing intercropping of ragam or rattan in rubber plantations, but the brochures offer little comment on returns from the integrated systems. In southern Thailand there are a number of villages that have complex home gardens/agroforests where rubber is a prime component of the system. In contrast, there is a plethora of informal literature about various integrated rubber systems in China.

The limiting factors for planting rubber in much of upper Isaan are: funds, good varieties, and land titles. Despite these limitations there is considerable interest in rubber tree cultivation expansion.

Institutional Factors

Because of the promising market opportunities and available government services gradually more farmers decided to plant rubber trees. These various government agencies have played an important role in promoting rubber production. First, of all the policy environment has been extremely favorable to rubber as a strategic commodity as mentioned at the outset of this section. Out of this flowed instruments to facilitate favorable private sector development, to design and implement government programs, and to provide services to farm households.

Rubber Research

Research on para rubber in Thailand is undertaken by the Rubber Research Institute of Thailand (RRIT) within the Department of Agriculture (DOA) on its various stations and centers throughout the country. There are two in the NE Thailand, the newly formed Nong Khai Rubber

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[6]This is calculated at an exchange rate of US$ = Baht 40.

Research Center (NRRC) in 1986 (2529) as an experiment station under the auspices of an EU project, and the Buriram Rubber Experiment Station. Both are still closely related to the larger Chachoengsao Rubber Research Center (CRRC) through many of its on-station experiments. RRIT's research objectives with generally recommended clones for each category are:

6. high yielding clones for latex: RRIT 251, BPM 24, RRIM 600;
7. high yielding clones for latex and wood/timber or latex timber clone (LTC): RRIC100, RRIC 101; and
8. high yielding clones for timber: CCS 50, BPM 1, AVRIS 2037.

Clones are recommended mostly based on soils (including slope) and climatic conditions[7]. RRIM 600 is still the most popular clone cultivated in Isaan. The most promising high yielding cold tolerant rubber clones are: Hiken1, BPM 24, and PB 235. PB 235 may be the best cold tolerant clone, but its heavy canopy makes it poorly suited to steep slopes (maybe due to root morphology). BPM 24 is the best for cold season latex production, lots of branching, needs higher soil moisture. Chinese clones have been tested: Hiken 1, Hiken 2, SCATC[8] 93/114, of which Hiken 1 seems the most promising as a cold tolerant clone. (For more information on various rubber clones see Appendix 2) They have also undertaken 17 years of germplasm testing Doi Tung in the North but these trials' results have not been released yet.

RRIT has zoned the areas in various parts of the country for rubber tree cultivation into three categories according to yield potentials depending upon climate, soils, and slopes: 1) L_1– >400 kg/rai, which is the best and is in areas suited for plantations in southern Thailand; 2) L_2– >250 kg/rai, and 3) L_3– <250 kg/rai. The latter two categories are relevant to Isaan and the north. The latter category L_3 is considered as marginal for rubber production.

Office of Rubber Replanting Aid Fund (ORRAF)

ORRAF is the agency within the RTG responsible for increasing rubber area and productivity, especially through replanting. ORRAF is a state-owned-enterprise (SOE) established in 1960 to assist small holders. It provides free or subsidized inputs and credit to smallholders. It began with services in the South and since has played a major role in the expansion of rubber tree cultivation in Isaan when in 1989 it opened its first offices with the Khon Kaen office and soon spread to all the provinces. From that time 1989 until 1997 it had program of assisting smallholders to cultivate rubber trees and undertake related activities. It assisted farm households with planting rubber trees up to 15 rai. ORRAF provided the following services: technical advice; free seedlings and fertilizer; credit of Baht 4,621.50 per rai (up to Baht 30,000 per household) over a seven year period for labor costs, including family labor, material inputs, especially weedicides; and other income generating activities.

Now with the new program initiated in 2004 ORRAF provides: technical advice on cultivation; seedlings for free from 6-8 rai per household; farmer group formation; loans of up to Baht 150,000 per group for seven years, which are used for income generating activities for cash intercrops in the first three years, and livestock, fish, handicrafts and other activities in later

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[7]We suspect that there may also be some criteria of disease tolerance.

[8]SCATC – South China Academy of Tropical Crops

years in the livelihoods system but not necessarily under rubber. These loans are for groups of five and greater and come with an annual interest rate of 3 percent for a two year period. These activities can be expanded if are successful.

ORRAF is also involved in other activities which smallholder rubber farmers undertake, such as, fish ponds, livestock, crops, and handicrafts in order to reduce the risk of these farmers while waiting to tap the rubber trees. They assist these households in with extension information on these and provide some credit funds. They also assist households in a village iwth community organization required in cultivating rubber trees. There are the beginning of the formation of some rubber cooperatives.

Bank of Agriculture and Cooperatives

Most of the credit for rubber tree cultivation has come from the Bank of Agriculture and Cooperatives (BAAC). They also had a program of lending to individual farm households of up to Baht 4,600 per rai. Most of these funds again went to labor, fertilizer, and other materials. Now with the RTG's new program for expanding rubber cultivation by one million rai in for 2004 - 2006 it offers credit to groups rather than individuals but at the previous rate of up to Baht 4,600 per rai. Depending upon their circumstances and business plans groups could probably borrow funds of up to 100 rai to plant rubber trees. ORRAF overseas the technical dimensions of the loan for BAAC.

Private Sector

To date that we are aware of there are two major companies with rubber processing factories in NE Thailand, eg, Thai Hua Rubber Company Ltd, which as a factory in Nonghaan district in Udorn Thani province; and Thai Rubber Latex Company Ltd in Beungkaan district, Nong Khai province.[9] There are a number of agents and representatives of these companies (and perhaps other companies with factories elsewhere) throughout the northeast. They are involved in a seemingly highly competitive bidding process for farmers' rubber. It seems as though farmers have some idea of the prices in order to intelligently bargain.

Environmental Problems

In examining rubber production in the mountainous Loei province, which is analgous to northern Laos, there seems only to be a problem of soil erosion in the early years of establishment. Farmers probably are not cutting down forest in sensitive watersheds since most of the significant quality forest cover in Loei has long since been cut. Farmers have established rubber on slopes in excess of the limits suggested by RRIT, but they do dig meter wide bench terraces. However, they determine contour lines by eye. With the exception of Loei most of northeast Thailand has gentle topography so rubber planting on excessive slopes would not be a concern elsewhere.

We are not aware of issues concerning farm level processing of rubber sheets, waste disposal, and water usage and the resultant effects on watersheds. Given northeast Thailand's dry nature

[9]Both of these companies have studying the potentials for rubber production in Laos. Thai Rubber Latex is interested in Bolikhamxay and Vientiane province, and Thai Hua is interested in Savannakhet.

(low precipitation and generally rapid infiltration) it is possible that processing effluent could have relatively greater consequences than in an area of greater precipitation. Thai rubber officials said that there were no pollution problems from rubber. We note elsewhere in this study that the Thai Hua Rubber Factory uses large amounts of fuelwood for the smoking procedure in processing SSR. They buy their fuelwood locally, and there seems to be no shortage of suppliers.

Chapter 4
China Section

The first rubber trees in China were established in 1906 in Hainan Island. Guangxi (Guangxia 1997) states that rubber was also planted in Yunnan in 1907 by Malaysian Chinese, but almost all of the trees died. Hainan has remained the center of rubber cultivation in China, and its rubber plantations are far more productive than the rubber plantations in Yunnan due to a more favorable climate. In 1974 Hainan Island accounted for 90% of China's rubber production with Yunnan producing 10%. With heavy state support and guaranteed prices in the early 1980's Yunnan's share of rubber output rose to 30% by the mid 1990s.

The Chinese began to establish rubber in Sip Song Panna (Xishuangbanna)[10], Yunnan Province from the late 1940s to the early 1950s. Several authors note (Jianchu et al 2003, Guangxia 1997) that the national government established rubber to meet state demand but also in response to international trade sanctions (Jianchu et. al. 2003). From the 1950's through the 70's rubber plantations were the exclusive domain of state-run collectives, and, as such, came under the directives of the centrally planned economy. The labor used to establish the plantation came from Han Chinese resettled into Yunnan by the central government (Jianchu et. al 2003), and presumably all inputs used to establish rubber plantations came from the state. The same author notes that state policy also intended to push rubber up to the border regions as a method of national defense.

The late 1970's saw an initial increase in rubber planting when collective farmers converted significant areas of fallow forest into rubber. The end of the collective period in 1978 and an incremental series of moves towards land reform caused a larger increase in rubber planting from the early 1980's until the mid 90's. Between 1978 and 1983 the Chinese government implemented the Household Responsibility System in which forest continued to be under state control and agricultural land was divided contractually among villagers. In Yunnan farmers received 1 *mu* of paddy and 21 *mu* of sloping land (15 *mu* to 1 hectare).

The *liangshanyidi* program started by the Yunnan government in 1983 attempted to limit swidden agricultural through land titling and demarcation (Jianchu *et al* 2003). The *liangshanyidi* program moved forest management from the state to individual households who were contracted to regenerate forest resources. This program appears to resemble other social forestry programs with village contract reforestation elements common to some Asian countries in the 1980's. In China, the result was a massive increase in land planted to monocrop rubber and consequent loss of forest resources.

Several authors (Guangxia *et al* 1997, Jianchu *et al* 2003) attribute this rapid and large scale expansion of rubber to several factors. First, the above mentioned moves towards privatization of agricultural and forest resources gave villagers the land base on which to plant rubber. Second, the Chinese government protected domestic rubber prices in the period creating strong production incentives. Third, new clonal selections helped boost rubber production. Fourth, privatization of land resources caused an increase in agricultural production and a consequent

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[10] Sip Song Panna is the *Tai* name for what is known in Chinese as Xishuangbanna Prefecture in the southern part of Yunnan province of the People's Republic of China (PRC). We shall refer to this *Tai* name since this what all Lao people refer to it as. It has only been relatively recently as Xishuangbanna with the spread of ethnic Han influence.

increase in household income. Farmers looked for further investments to enhance agricultural productivity, and, thus, many farmers turned to rubber.
During the course of the team study tour to China, we were told by one collective official (it is not clear to what extent government run collectives have been in transitioned to become farmer led cooperatives so for the purposes of this report we retain the use of the word collective) that collective members seeking to increase their income have signed contracts with private land owners to do rubber sharecropping arrangements. The collective members have greater skills in the various elements of rubber production so they are able to establish and manage more productive rubber plantations. In addition, the village chief of Ban Hat Nyao told the team that most Hmong in China do not own their own land or have very meager land parcels. Furthermore, property in China, according to him, are indivisible, i.e. one can never sell one's land. To get around this barrier various forms of leasing and sharecropping predominate in Sip Song Panna. This may be one factor driving the use of similar sharecropping models in Luang Nam Tha Province.

The team study tour through Sip Song Panna via Meuang La, Meuang Nun, Jinghong (Xieng Hung), and Meng Hai (Meuang Hai) revealed a remarkable landscape of uplands to about 700 to 900 meters totally dominated by rubber. There were some agricultural mosaics or different upland crops, mostly tea orchards and young rubber, in the uplands from the Boten border crossing to Muang La, but thereafter only rubber was visible. On the road from Jinghong to Meng Hai only monocrop rubber was present to approximately between 700 and 900 meters above sea level (masl). Above that elevation tea was the only crop on the mountain slopes. The rubber visible from the road in Sip Song Panna was found on slopes estimated to be as steep as 35^0. Widespread erosion, including severe gullying and slumps, was omnipresent particularly on the road to Meng Hai. The river draining the watershed going to Meng Hai and emptying into the Mekong (Lancang in China) had huge piles of sand along the banks; people were manning pumps throwing streams of sand on to the piles. Cheo (Cheo 2000) also notes that this is a significant problem in Sip Song Panna with widespread ramifications. Osborne (Osborne 2004) states that the high siltation levels in the Liangshi dam are attributable to high levels of soil erosion in the Mekong watershed due to poor agricultural practices. Although in the area of the dam rubber is probably not grown, the problems in the upper watershed are illustrative of what is happening in the lower watershed. It was quite clear that the monocrop agricultural system of rubber had severely affected the long term ecological sustainability of the area.

The literature supports the above field observations. In the Mangelong area (Jianchu et. al. 2003) Forest cover declined from 36 to 24%; bush/grass fallow area went from 26 to 14%, and rubber plantation area increased from 8 to 27% between 1965 and 1992. During that period the land area had a net loss of dense forest of 1,261 ha, net gain of sparse forest of 102 ha, and a net loss of bush/grass fallow of 1,271 ha At the same time, land planted to rubber increased by 2,044 ha That net gain of rubber came primarily from dense forest (816 ha), bush/grass fallow (747 ha), and sparse forest (364 ha) (cf Table 1 below). The number of rubber patches (ie, scattered rubber plantations) decreased by 38%, but the size of the patches increased by 50%. These changes reflect the increase of monoculture rubber.

Table 1: Transition matrices of land-cover classes in Menglong between 1965 and 1992 (from aerial photographs) (from Jianchu *et al* 2003).

1992 1965	Dense Forest (ha)	Sparse Forest (ha)	Bush Grass land (ha)	Rubber (ha)	Swidden (ha)	Paddy (ha)	Other	Total Loss (ha)
Dense Forest (ha)	_	861	393	816	138	79	30	2317
Sparse Forest (ha)	389	_	364	364	29	67	22	1235
Bush Grass land (ha)	616	416	_	747	143	154	26	2102
Rubber (ha)	16	13	7	_	15	102	20	173

1992 1965	Dense Forest (ha)	Sparse Forest (ha)	Bush Grass land (ha)	Rubber (ha)	Swidden (ha)	Paddy (ha)	Other	Total Loss (ha)
Swidden (ha)	20	28	55	88	_	50	14	255
Paddy (ha)	11	15	9	190	53	_	49	327
Other	4	4	3	12	4	50	_	77
Total Gain (ha)	1056	1337	831	2217	382	502	161	0

1992 1965	Dense Forest (ha)	Sparse Forest (ha)	Bush Grass land (ha)	Rubber (ha)	Swidden (ha)	Paddy (ha)	Other	Total Loss (ha)
Net gain/Loss	(-1261)	102	(-1271)	2044	127	175	84	_

Cheo and Xu (Cheo 2004, Xu 1997) cite a Chinese study that showed soil erosion rates 43 times greater under monocrop rubber plantations when compared to native forest. The same study says that swidden systems have a rate 20 times greater than monocrop rubber though no data are given as to the methodology employed.

There are more than 200 factories processing various types of rubber in Yunnan Province (Guangxia *et al* 1997). Cheo breaks down rubber processing facilities into 6 main centers, 39 smaller centers, and 413 work units (Cheo 2000); the latter category may include local latex collection facilities. Officials in Mengla told the study team that there are 18 factories in the county. The first factories in Yunnan were constructed in the late 1950's. Several authors express their concerns about both the level of pollution from the factories and their energy use. They note that processing rubber requires significant energy inputs, and that factories consume large amounts of firewood. The study team learned that a Mengla factory uses 90 kilos of coal to dry one ton of rubber, but we did not find out the amount of firewood utilized in the factory to smoke the rubber sheets. We failed to make a similar inquiry at the Thai Hua factory in Udorn Thani though we observed a massive pile of firewood.

We have no information on the environmental impact on water resources by rubber factories, particularly small scale factories such as the ones in Sip Song Panna. Factory officials in Mengla told us that they use 20 tons of water to produce one ton of dry latex. They had a series of settling ponds with water hyacinth. They use this aquatic plant to clean the water of the environmental contaminants produced in dry latex production. After passing through the settling ponds for an unspecified period they release it back to a nearby stream. The officials said that villagers had not complained about water contamination.

A conclusive evaluation of rubber planting in Sip Song Panna is not possible given the limited information available to the team. However, a number of researchers question the economic returns, long term sustainability of rubber, and opportunity cost of growing rubber in Yunnan. Guangxi (Guangxi et. al.1997), in an otherwise positive outlook on the affect of rubber on shifting cultivation in Yunnan, acknowledges that other countries in the region have a comparative production advantage in rubber. They say that the continued success of the rubber system is contingent upon fair prices and an adequate energy supply for processing. In addition, they stress the development of cold tolerant varieties for better production in Yunnan. They argue that rubber has brought significant economic benefits to farmers, especially small farmers, in Yunnan. (We should note that they argue that rubber is a type of fallow system and as such an indigenous adaptation to upland systems. This argument is absurd; rubber, in China, is a monocropped plantation tree. By definition it is not a fallow.)

Writing at a time of declining rubber prices in 1999 and 2000, Cheo (Cheo 2000) questions both the economic viability and the ecological sustainability of rubber in Yunnan. He contends that with the increasing production of synthetic rubber (SR), declining prices for rubber (at the time of writing), and the formation of International Natural Rubber Agreement (INRA) resulting in stockpiles of natural rubber (NR) that rubber in Yunnan, China has high opportunity costs. It may be surviving only due to state targets, fertilizer programs, and seedling promotion. (Since Cheo's paper the rise in oil prices has probably affected SR prices. We were also told that the state does not support rubber farmers directly, but collective officials in Jinghong told us that interest and principal payments from collectives are now turned over to fund small private rubber holders.) He further states that higher quality and cheaper NR can be imported from abroad and bypassing local factories. Additionally, he states that the environmental toll that vast monocropped rubber has taken on the environment is very high. Modeling the agricultural productivity of Hainan and Yunnan he finds that the latter may be experiencing flat to diminishing returns in spite of rubber growth. This, he suggests, may be due to erosion and climatic difficulties.

The International Rubber Study Group (IRSG 2003) contends that the future for rubber in China is good. They do not distinguish between production areas in China, but they note that the Chinese rubber business has benefitted from import tariffs as high as 30%. China joined the WTO in late 2001, and this may have implications for Chinese price supports for rubber.

The study team found that of 76,667 ha of rubber planted in Mengla County (from 1960-2004) about 50 percent is done by smallholders and 50% by collectives. The average productivity of smallholders is 1,200-1,350 kg/ha and that on collectives is 1,950 kg/ha The collectives have a higher productivity, according to collective officials, due to more technical advice, better clones, more progressive management of collectives, and more recent smallholder plantings resulting in rubber trees that are lower on the yield curve. Not only does a significant yield difference exist between the two sectors, but one must remember that state collectives received total state support. As above, some of that capital is turned over through loans to private farmers. For Laos we note that the Chinese history with rubber is not a good example given its growth within a state controlled economy and continued recycling of working capital generated by collectives.

Finally, Jianchu (Jianchu *et al* 2003) makes three important observations. First, marketing of large scale cash crops (eg, rubber) is controlled by the state and sometimes by large state enterprises. Second, large state farms or enterprises control rubber processing and marketing in Sip Song Panna so small farmers are often forced to shoulder the market risk of low prices. Third, rubber plantations in Sip Song Panna have eroded customary boundaries and resource management institutions as well as the capacity of farmers to manage ecologically diverse landscapes and to participate in market networks.

An understanding of the rubber situation in Yunnan is vital as it has direct bearing on how the rubber system is driven in Laos. Every factor related to rubber from technical advice, labor, seed supply, bud wood, equipment and other inputs, and, most importantly, rubber markets comes from or is found in China. In addition, both small and large scale rubber contracts are the result of Chinese businesses seeking lucrative opportunities in Laos. Therefore, though the Chinese market will continue to drive demand for rubber, Laos will need to closely follow the production of rubber in China and assess trends in rubber production systems. It may be that Laos is seen by the Chinese as a strategic, albeit small, producer of rubber with abundant land resources, cheap labor, and a more favorable climate. Yet the Lao productive capacity pales in comparison to Thailand or Viet Nam, and technically Laos has yet to reach even the most elementary level of knowledge about rubber. As a result, Laos will remain dependent on Chinese input and knowledge unless the country broadens it strategic technical vision vis a vis rubber to include Thailand. (This may already be happening in southern Laos with projects initiated by Vietnamese and Thai investors. The degree of Thai or Vietnamese government support for technical capacity building in rubber in the projects is not known.)

Chapter 5
Baan Hat Nyao: First Rubber Village

This is a documentation of the cultivation of para rubber trees (*Hevea brasiliensis*), the initial production of rubber tub lumps, and their subsequent sale. Data collection in this village was undertaken as a part of a para rubber study in Luang Nam Tha province from October through December 2004. It is a brief account of the socio-economic and technical dimensions.

It is significant in that Baan Hat Nyao is the nation's first village in modern times to plant para rubber trees and to tap them to harvest the rubber latex.

Background

Baan Hat Nyao is a small village at the edge of the provincial town in Luang Nam Tha province, ie, Nam Tha district[11]. Presently there are 91 households in the village with a total of 156 families. The total village population is 874 people of which slightly over half are females (cf Table 1). As far as the socio-economic categorization of the village goes, about 44 percent of the village households are considered as well-off[12], almost a quarter are less well-off, and about a third were mid-level.

Table 5.1: Village Demographics[13]

			Total	Well-off	Mid-Level	Less Well-off
HHs	Fam	Female	Popl	HHs	HHs	HHs
91	156	450	874	40	30	21

Its population is mostly White Hmong (*Mon Tleu*). Their descent patterns are patrilineal with inheritance patterns passing through the sons remaining in the father's household, and residence is patrilocal or neolocal[14] nearby to the parental home (LeBar, Hickey and Musgrave 1964:75). They have exogamous patrilineal clans with proscribed behaviors for clan members, and where children are members of their father's clan. It is not sure how many clans are in the village.

History

The village was established in 1975, the year of the founding of the Lao PDR. Most of the early

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[11]The location of the village is N 21° 01.223' and E 101° 24.790' at an elevation of 653 meters above sea level (masl).

[12]This makes this village unusual to have such a number of well-off households.

[13]Household classification criteria by the villagers themselves based on rice self-sufficiency, labor availability, livestock, permanency of house, etc. By their definition those in poverty would actually be the lower part of "less well off" HHs, those who are *destitute.* This would constitute some families with basically little available labor such as a widow with small children, an elderly couple or person living alone, someone who was chronically sick or addicted to opium, etc. There are only two or three households of this type in the village.

[14]Where new wives move into the homes of their father-in-law and later establish new homes in the father-in-law's locality.

families came from Pak Tha district of then Oudomxay (now Bokeo) and had settled in Luang Nam Tha in 1973 but up in the mountains. Later other White Hmong families came in from Xieng Khwang In 1975 they moved down to the present site of B Hat Nyao in search of paddy rice land. From 1975 to 1980 more than 160 people died as villagers tried to adjust to the lowlands at a lower elevation than their mountainous villages. Because of the relative sparsity of anticipated potential paddy land many households returned to the nearby mountains to practice shifting cultivation. During this period the size of the village was reduced to a mere 17 households.

Then sometime in the latter part of the 1980s various Hmong communities were encouraged to resettle in B Hat Nyao so it's population began to gradually increase. This included Hmong refugees from China[15], who had relatives in B Hat Nyao and requested to be allowed to resettle and they made the move in January 1994. While sojourning in the Chinese agricultural collective they cultivated para rubber and gained much rubber experience over the fifteen year period.

As the village population started to burgeon with these newcomers and others, with limited hope for paddy rice land, they explored various other alternatives to enhance their livelihoods[16]. They went to Sip Song Panna (SSPN), China to look at various alternatives, including fruit tree and vegetable cultivation, livestock rearing, aquaculture and finally rubber tree cultivation. With the newcomers' experience with rubber trees they decided that rubber production was the most promising of the alternatives.

Concurrently at the time, the Vice Governor of the province was a Hmong, who did much to encourage and support to the community in their decision-making process and assisted in facilitating a provincial funds for subsidized loans in aid for rubber tree cultivation in 1994[17] and later assured that they had technical assistance in cultivation. His status also seemed to have been a big influence for families to innovate.

Concerned families and the leadership in B Hat Nyao saw rubber tree cultivation as compatible with their existing livelihood systems including opium poppy cultivation and the subsequent skills derived from bleeding poppy postules. They felt it would that their renowned work ethic and community organization fit in with the requirements for rubber production. In addition, with the encouragement of the provincial government rubber was foreseen as an alternative to shifting cultivation and opium poppy cultivation. In summary, the community was motivated, exhibited resourcefulness to inquire into alternatives, sought external resources, and retained the flexibility to change their approach based on lessons learned and to adjust to changing circumstances.

Livelihoods Systems

[15]In 1980 these Hmong families had been transferred from in Thailand were transferred to an agricultural collective farm in Meuang La (Mengla County) of Sip Song Panna, Yunnan province, China.

[16]Of course, government policies discouraging shifting cultivation and opium poppy cultivation further stimulated the decision-making process.

[17]Actually the total provincially provided funds were Kip 14,249,100, of which Kip 1,376,760 were deducted for service fees for the PAFO to provide technical advice for a net figure of Kip 12,872,340.

Land allocation was undertaken in the village in 1997 (cf Table 2 below). Since then households have cultivated upland rice, corn, cassava, chillies, vegetables and rubber trees on the village's agricultural land area. Theoretically since land allocation they have cultivated these upland crops under shifting (swidden) cultivation in a rotational three year fallow. This upland crop use has resulted in very low yields due to low soil fertility and weed competition. Thus, in order to survive they have had to resort lengthening their fallow periods to more than five years in order to attempt some sort of food self-sufficiency. As in most upland highland villages, this exigency has resulted in using either more agricultural land or encroaching into forest lands.

It is difficult to determine how much of their agricultural land is used for upland rice cultivation under shifting cultivation, since village leaders de-emphasize this activity because of perceived non-compliance with the government policy on eradicating shifting cultivation. In fact, it is still a necessity to most village household's food security. Thus we might estimate that at least 80 of the 91 households would have to cultivate upland rice and conservatively each might cultivate an average of two hectares per year. With a reported 5-7 year rotation this would amount to at least 960 hectares of total land under shifting cultivation of upland rice, corn, roots and tubers and vegetables. In fact this is probably a conservative estimate. Thus, at least 1,000 hectares of their agricultural land is used for their subsistence rice and other food crops.[18]

Table 5.2: B Hat Nyao Land Allocation in 1997

Type of Land	Area (ha)	Comments
Conservation Forest	700	planned rubber tree expansion in 2005 (200 ha) & 2006 (100ha)
Protection forest	1,300	
Agricultural Land	1,700	paddy rice area (24 ha), remainder rubber trees and upland crops *hai*
Forest Planting Land	700	
Livestock Feeding	200	
Village	4	
Total	4,604	

By 1996 about 154,000 of rubber trees (342 ha) had been planted on older fallow land, ie, 7-12 year fallows. After the frost of December 1999, approximately 34,000 trees died (75.5 ha), thus resulting in about 120,000 trees (267 ha) remaining.[19] Tapping began in 2002 until the present on these surviving trees. In 2003 and 2004 another 170 hectares have been planted for a total of about 437 hectares. This all has been planted on the 1,700 hectares of agricultural land mentioned in Table 2 above.

It is planned that in 2005 and 2006 another 200 and 100 hectares will be planted, respectively. In order to accommodate this expansion, land now designated as conservation forest (700 ha) will have to be brought into cultivation. Apparently this land has been under fallow for more than

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[18]This is likely to be under estimated since they say that they will have to more into other bush fallow land to plant their rubber trees in 2005 and 2006. This suggests that either the currently designated agricultural is either fully utilized or the remainder is not fit for cultivation.

[19]It is difficult to verify both the number of trees planted and tapped and the areas. The village calculates 450 trees per hectare so the village figures are at that planting density. However, later for the individual households the densities are according to spacing. For example, a spacing of 2.5 x 6 meters would result in 667 trees/ha, and 2 x 5 meters amounts to 1,000 trees/ha.

seven years. They say that there is no objection from the DAFO or PAFO authorities about this expansion into this previously designated conservation area.

In summary, there are approximately 120,000 mature trees (267 ha) is currently being tapped, and the village has approximately another 76,500 trees (170 ha) of recently planted immature trees, which can possibly begin to be tapped in 2011 or 2012. In addition, the 300 hectares planned for 2005 and 2006 will begin to be tapped in 2013-2015.

Table 5.3: Rubber Trees Planted in B Hat Nyao

Year	Trees Planted (#)	Area Planted (ha)	HHs	Comments
1994	53,000	117.78	60	an estimated 34,000 trees (75.5 ha) died of frost in December 1999
1995	81,000	180.00	"	
1996	20,000	44.44	"	
Sub-Total	154,000 [120,00]	342.22 [266.72]	60	120,000 trees or 266.72 ha remaining
2003	76,500	170	?	some of these are replanted trees for those killed in the frost, total = 436.72 ha
2004			?	
2005	90,000	200	?	planned (tap 2013 or 2014)
2006	45,000	100	?	planned (tap 2014 or 2015)
Total	331,500	736.72	88	

Households were allocated land to plant rubber based on its available labor. In 1994 at first only 30 households were interested, but as the time came to plant rubber trees, another 30 households expressed their interest in planting. Thus, the initial number of households planting rose to 60.

The labor provided to rubber tree cultivation is mixed between household and hired labor. Obviously, less well-off households supply virtually all the labor required. If HHs can afford hired labor, they will at least hire them for: slashing and burning of the bush fallow; terracing and planting of seedlings planting; and annual weeding. Family labor is usually used for nursery work, care and maintenance in the immature stage, and for all tapping work since it is considered too delicate to have hired labor undertake.

This hired labor is from neighboring villages, usually of other ethnic groups, eg, Khmu, Akha, and Yao. The current wage rate is Kip 20,000/day for light work and Kip 25,000/day for heavy work. There don't appear to any hired labor shortages at this time.

Capital

All producing households received subsidized loans from the province for the cost of seedlings and some fencing. Each producing household received between 1-3 million Kip in credit to plant rubber trees.

The provincial funds were lent by the PAFO for rubber tree cultivation in 1994. The funds were used for seedlings and barbed wire. As mentioned in Table 4 below, a total Kip 12,872,340 was lent out at an two percent interest rate for a period of 15 years. At first these funds were handled by the Provincial Agriculture and Forestry Office (PAFO). Then in the second year, 1995 Kip 10m were given by the Agricultural Promotion Bank (APB). These funds were also supplied by the provincial government but through the APB at an interest rate of seven percent for farmers –

again for a period of fifteen years. Because of the lack of records the exact costs of establishment of rubber trees in the first year can only be roughly estimated, and no one seems to know the repayment status of the first year's funds. It is estimated that about one-third of the second year (1995) funds have been already repaid.[20]

Table 5.4: B Hat Nyao Loans for Rubber Tree Cultivation in 1994-95

			Approx	Loan
	HHs	Trees	Area	Amt
Year	(#)	(#)	(ha)	(Kip)
1994	60	42,450	94.30	12,873,340
1995	93	104,000	249.70	10,000,000

The remainder of the investment funds required for establishment and later maintenance of immature trees was funded out of these families own funds. So out of the estimated Kip 5.1m required for an hectare probably no more than Kip 1m would have been supplied through the provincial funds or about 20 percent of what was needed.

Performance

Rubber tree cultivation and harvesting is now one of the most important elements of the livelihoods systems of B Hat Nyao. Households in B Hat Nyao have been tapping their rubber trees since 2002 when 23 households tapped raw latex and sold 20,000 kilograms as lumps and earned about ¥ 70,000 (Kip 91,000). Then in 2003 67 households sold 52,336 kilograms of lumps amounting to ¥ 285,346 (Kip 370.9m) of total revenue. After paying a fee to the Rubber Grower's Association Fund[21] (RGAF) they received a net revenue of Kip 324.4m for the village. In 2004 total village sales were 148,067 kilograms for a total revenue of ¥ 814,367 (Kip 1.058bn), and after they paid a fee they received Kip 1bn in net revenues.

Table 5.5: B Hat Nyao Sales & Income

	HHs			Total	RGA	Net
	Tapping	Total	Price	Revenue	Fee	Revenue
Year	(#)	(kg)	(¥/kg)	(¥)	(¥)	(Kip)
2004	125	148,067	5.5	814,367	37,017	1,010,555,910
2003	67	52,336	4.0	285,346	35,810	324,396,848
2002	23	20,000	3.5	70,000	0	91,000,000

NB: In 2004 these figures were recorded for families instead of households.

Meanwhile the village still does not rely totally on rubber for its cash income and for rice. Livestock sales are quite important for some of the village's families. Especially the well-off and mid-level households. Rice self-sufficiency for this year based on last year's production. About 60 households[22] had 9-12 months supply of rice; eleven HHs had enough rice for 6-8 months; and twenty households had only enough rice for 3-5 months. Now with cash income from rubber

[20]There is still a fair amount of uncertainty about the status of repayment of the 1994 loans.

[21]There will be a further explanation of the RGA and RGAF in the section on Community Organization.

[22]Twenty-four households cultivate 20 hectares of paddy land with obviously contributes to their subsistence needs.

sales households can better purchase rice.

Table 5.6: Rice self-sufficiency of households

Total HHs	Sufficient (mos)					Sell Surplus
	<3	3-5	6-8	9-12	>12	
91		20	11	60		0

This rice cultivation, be it mostly from the shifting cultivation of upland rice is still very important for their livelihoods systems. They still mentioned that mid-level and less well-off households still gave priority to their swidden upland rice over rubber during peak labor demand periods.

Community Organization

B Hat Nyao has the traditional type of Hmong strong community structure and cultural norms. With it's emphasis on community cohesion and unity, community decisions are made and then carried out under strong leadership. Apparently the discussions and deliberation concerning rubber tree cultivation was undertaking in an indigenous community forum where the strengths and weaknesses of the proposal were throughly discussed over a period of time. Then after community discussions and consultations with then Vice Governor, the decision was made to plant para rubber trees, and a plan was prepared to for assistance from the province. This plan at first only included 30 households (later expanded in 1994 to 60 households). In this designated area all interested households were to cultivate rubber trees on contiguous plots which had previously been used for swidden cultivation of upland rice, corn, roots and tubers, etc.

At first the structure of the village with its four units (*nuay*)[23] and a special unit for households who had land in the village, but who lived elsewhere, were used as production units and a precursor of the village rubber grower's association (RGA).

This strong sense of community organization lead to the formation of a Rubber Grower's Association (RGA) to facilitate the establishment of rubber trees, the maintenance of them through the immature phase before tapping, and the tapping of mature trees and sale of the rubber lumps. This is all elaborated on in the following section.

Rubber Grower's Association

The Village Development Committee (VDC) prepared a plan for the province which included: potential designated rubber tree cultivation land to be divided amongst producing households according to available their respective labor. They then gave each of the four production units the responsibility for clearing land, planting seedlings, managing cultivation (including regular weeding of the intercrops in immature rubber trees) and then monitoring. They then created fifth unit for the small group of households who had land in other locations. These production units would also arrange for fencing around the perimeter of the large rubber tree field.

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[23]In fact, another special unit (#5) has been created for community households who also cultivate rubber trees in other villages.

The province first arranged for low interest loans through the Lao National Bank (LNB)[24] and received about Kip 12 million for 1994. The individual household loans ranged from Kip 1-3 million with an interest rate of two percent per annum and a fifteen year pay back period. The 60 households mostly borrowed for the clearing land, cost of seedlings and planting and fencing. Then in the second year (1995) another loan was negotiated for about Kip 10m, however. It was not until January that the funds were received at the same rate. However, since the Agricultural Promotion Bank (APB) was administering it, however, the effective interest rate amounted to seven percent with a fifteen year pay back period again.

Table 5.7: B Hat Nyao loans in 1994 and 1995

			Approx	Loan
	HHs	Trees	Area	Amt
Year	(#)	(#)	(ha)	(Kip)
1994	60	42,450	94.30	12,873,340
1995	93	104,000	249.70	10,000,000

NB: Funds for 1995 were not released until January 1996

The seedlings were delivered in small amounts, of say 3-5,000 seedlings, and they were then distributed to the interested households – sometimes no more than 50 seedlings to each. Each village unit was responsible for managing the cultivation techniques (ie, digging holes: 60 cm in diameter x 70 cm deep and constructing a terrace/path of about 80 cm in width.

Regulations were written for the households to sign in agreement in order to cultivate rubber. If they failed to act upon infractions of these regulations, they would be fined or if they ignored these warnings they could even lose their land. A series of resolutions were issued to address certain concerns as they arose. For example, regulations emerged concerning the failure of farm families to properly care for their young seedlings. For example, if they destroyed their seedlings in the process of intercropping they would have to pay a fine of Kip 1,000/seedling in year one and Kip 2,000 in year two. There was no need for this fine by year three (cf Baan Hat Nyao 1994 Rubber Plantation Plan #2[25]).

As far as weeding goes at first admonition for those failing to weed receive field instruction by village respected elders. If they still failed to weed they would receive additional instruction. After a third warning they were threatened reminding them their not being able to pay their off their loan obligations. If there was a need for a fifth warning households would be threatened either with the handover of household rubber land to others who would care for it or possibly even possible ostracization from the village. The bottom line was that by 2001 ten households failed to maintain their rubber tree stand and subsequently lost their rubber tree land.

As time went on with real world experience gathered from rubber tree cultivation newer clauses were introduced for the members consideration and agreement.

In 1994 through 2001 the Village Rubber Grower's Association (VRGA) was rather informal. The

[24]Madame Pany Yathotu, the then Vice Governor of the LNB personally approved the first loans after she visited the village.

[25]Unfortunately the written Plan #1 had been eaten by rats in the village office. This contained of the earliest regulations.

heads of the production units would report to the chairman and the inspection unit twice a month, especially during the time of rubber tree establishment in the three years of early planting in 1994, 1995, and 1996. Later on they would report on the maintenance of the rubber tree orchards.

Overseeing the VRGA operations is a chairman, who is the headman (*nai baan*), the first deputy headman, an inspection unit (comprised of three persons, including the headman), the heads of the various production units, and a collection and sales unit, which is comprised of four persons[26].

In 2001 the first tapping was undertaken experimentally amongst 6-7 households, but the real tapping began in 2002. By then the collection and sales unit (CSU) was formed to supervise the sale of the product of their labors, ie, lump rubber. In 2004 there were nine different sales of rubber lumps. Each time the headman under the auspices of the CSU had to go to Mengla County to negotiate with various companies.

Table 5.8: Sales of rubber tub lumps in 2004 (kg)

Sale	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Date	24/4/04	24/5/04	2/6/04	16/6/04	15/7/04	4/9/04	6/10/04	24/11/04	17/12/04
Total	2,936	1,027	6,103	7,766	5,432	43,657	29,517	19,416	33,936

For example, during our interactions with the village, the leadership of the VRGA went to China to negotiate for the last sale of rubber lumps. They were in Mengla County for almost three days. The best offer they could get was a price ¥ 5.3/kg for lump rubber. Then two trucks arrived on December 12 and then later on December 17 for the final sales of the season. From Table 8 the amounts sold in the nine different occasions are presented. As the season progresses the sales increase.

In 2004 these rubber lumps sold for an average of about ¥ 5.5/kg. They were of fairly low quality with a fair amount of dirt and small stones incorporated because of poor storage techniques.

Village Rubber Grower's Association Fund (VRGAF)

In 2003 the village created a village rubber welfare fund (VRWF) from which they levy a fee for of about five percent which goes towards the payment of those who devote a considerable amount of time to the VRGA as committee members. In 2004 the fee will be ¥ 0.25 on every kilogram of rubber sold.

In 2003 after their first year the VRGA membership decided that they should pay for the services of their members who gave their time for the VRGA and contribute the payment of community activities and infrastructure. A fee levied for administrative costs of the VRGA and to compensate members for their work and then for contribution to the village development fund (VDF). At first this amounted to about eight percent, of which 40 percent was used for the VDF and 60 percent was for administrative costs of the VRGA. Later before the 2004 season this was revised. It was agreed upon that a fee of ¥ 0.25 would be levied on each kilogram of rubber

[26]The collection and sales unit is currently comprised of Bounmee Lee Chongkwang, chairman and deputy headman; Cheu Sao Hang; Cheu Lao; and Lin Som.

lumps sold (ie, about 4% of the value). Of these fees 60 percent would be earmarked for the VDF for people to borrow or use for community activities. Then the remaining 40 percent would be used for the administration of the Collection and Sales Unit (CSU).

Thus, the fees paid to the VRGAF[27] in 2003 (cf Table 5 above) amounted to ¥ 35,810 (Kip 46.5m), and in 2004 fees were ¥ 37,017 (Kip 48m). So out of the 2004 funds ¥ 22,210 (60%) would be put into the VDF for community determined activities. Then ¥ 14,807 (40%) would go to the CSU, of which ¥ 8,884 (60% of that 40%) is earmarked for remuneration of unit members for their services and ¥ 5,923 (40% of that 40%) is earmarked for the Unit's expenses.

Leadership

During the past twelve years (from 1994 until the present) the village was fortunate to have two astute and active village headmen. Both men are relatively well educated and have been former government officials. The previous village headman has been a medical doctor (the equivalent of a medic) and the present headman has been the Party leader for some years now. The have exhibited vision of the future potential of rubber. Then they would go (and still do) to Sip Song Panna to seek technical advice, purchase for inputs, and after tapping look for sales opportunities. It was they who led several village initiated study tours with village elders to SSPN several times to look at farm level rubber tree cultivation and processing factories. Then there were some trips taking some household heads for a study tour. Undoubtedly some of the families who had lived and worked on rubber collective farms had made suggestions of where to visit.

> The village headman must arbitrate disputes, organize village festivals, and supervise public works projects such as opening of new trails and maintaining existing ones. If a village moves, the headman organizes the migration (LeBar, Hickey and Musgrave 1964:76).

Sampled Households in Baan Hat Nyao

Six households were selected for interviews. These were purposefully selected for the quality of information they could provide by the village headman. They were then interviewed for about two or so hours for detailed information on their rubber tree cultivation, harvesting and its fit into their livelihood systems.

All these households began rubber tree cultivation in 1994, and all but one planted again in 1995.[28] They all experienced losses from the frost of December 1999, resulting in less trees tapped than planted. One household even lost 600 trees to the construction of an irrigation canal, which came through the village. Because of their satisfaction with production of the early planted trees, five of the six households planted again in 2003 and 2004. All stated that they would plant even more trees in 2005 or 2006.

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[27] There will be a further explanation of the RGA and RGAF in the section on Community Organization.

[28] All households knew their planting spacing, and based on that the densities were calculated. The actual number of trees tapped are roughly estimated by them. Of course there normal attrition of young saplings was experienced with an estimated 5-10 death rate. These were usually replaced in the second year.

Table 5.9: Overview of sampled households

HH	S-E Status	HH Size (#)	Full Time Labor (#)	Part Time Labor (#)	Approx Upland hai (ha)	Paddy Land *na* (ha)	Rice Self Sufficiency 2004 (mos)	Rubber Tree Area (ha)	Other Sources Income (than rubber)
1	well-off	13	3	5	?	1.20	4.5	1.8	buffalo, cattle, pigs
2	less well-off	4	2	1	2	0.00	7	0.9	none
3	well-off	24	8	5	2.5	2.00	12	2.8	livestock, NTFPS
4	mid-level	8	2	2	?	0.67	8	1.4	NTFPS
5	well-off	9	4	2	?	1.67	8	4.8	buffalo, cattle, pigs
6	less well-off	8	2	2	1	0.70	4	0.9	NTFPS

Two of the households were considered less well-off, one household had no paddy land, cultivated about two hectares of upland rice and had sufficient rice for family consumption for about seven months. The other household had less than a hectare of paddy land and also cultivated about one hectare of upland rice, and it experienced only about four months of rice sufficiency. Both of them cultivated less than a hectare of rubber trees. Both of these households had labor constraints. Both had few alternative sources of cash income.

Three households were considered as *well-off* with paddy land of 1.2, 2.0, and 1.67 hectares, respectively. Only one of those well-off households reportedly still cultivated upland rice under shifting cultivation since they had 24 mouths to feed. One of the households had a year's supply of rice, another had eight months supply, and the third only had 4.5 months but they had sufficient other sources of income (including from rubber sales) to assure food security. Their tapped rubber tree land amounted to 1.8, 2.8, and 4.8 hectares, respectively.

The one *mid-level* household had some paddy land and cultivated upland rice in a swidden. It tapped 1.4 hectares of rubber trees and relied also on NTFPS for cash income. This household was rice sufficient for 8 months. His family labor was somewhat sufficient. One of the two *less well-off* households had 0.70 hectares of paddy land [supplemented by one hectare of upland rice], and he still experienced a four month deficit. The other had no paddy thus relying on upland swidden rice, and his deficit was seven months.

Rubber Tree Cultivation Preparation and Establishment Stage

Land

As mentioned, these households were given land according to available household labor to cultivate rubber trees in a contiguous zone of what is considered as old fallow in the classified agricultural land of the village. This was four years prior to the official land allocation of 1997.

Slashing and burning[29] of the fallow fields is many times hired out to others unless a family is less well-off. This clearing of these fields began in the early part of 1994. After clearing they started the process of terracing and digging holes in preparation for planting of seedlings.

[29]The term slash and burn here refers to clearing of the bush-fallow for agricultural production. It is undertaken by farmers throughout the world. Many farmers in developed countries in fact use bush hogs to slash and then of course they burn the brush later. Thus, slash and burn techniques are almost universally practiced and are not unique to shifting or swidden cultivation.

Terracing was done by eye so there is some problems with the terraces and paths. They planted the already budded seedlings from China after the onset of the monsoon rains in April/May. In that first year planting was done in a piecemeal fashion since whenever a truck carrying seedlings arrived they would divide them amongst the various households. So it is reported that maybe 50 seedlings at a time were planted by each household. At this time they also put in fire lines which were along the common fence lines.

The six informant households cultivated rubber trees on land ranging from 0.92 to 3.9 hectares of which they tapped.

On only one rubber tree plot of the six households had anyone received any kind of permanent tenure document, such as a permanent land use document (*bai taa din*) or a land title even though they had used the land for eleven years – contrary to the arrangements of the land allocation program.

All the sampled households planted intercrops of rice and corn in the first two years. Only a couple of them planted anything in the third year.

Table 5.10: Rubber tree cultivation of sample households

	Plot #1					Plot #2					Plot #3		
	Year	Trees	Tap Area	Loss		Year	Trees	Tap Area			Year	Trees	Plant
HH	Plant	tap/plant	(ha)	# trees	Remarks	Plant	tap/plant	(ha)	# trees	Remarks	Plant	Plant	(ha)
1	1994	1800/2000	2.16	200	frost '99	2003	1,400	1.96			2004	1,000	1.40
2	1994	200/400	0.42	200	frost '99	1995	400/900	0.84	500	frost;root rot	2003	700	1.47
3	1994	1000/1600	1.40	600	canal	1995	1000/1700	1.40	700	frost '99	??	1,300	2.28
4	1994	1000/2000	1.00	1,000	frost '99	1995	448/1000	0.45	600	frost; fire	2003	1,500	2.25
5	1994	600/1200	0.90	600	frost '99	1995	2000/2600	3.00	600	frost	2003	2,400	4.20
6	1994	710/775	0.92	60	frost '99	1995							

Labor

As mentioned 17 families in B Hat Nyao had rubber production experience for about 13 years in China. So they provided a valuable function of instructing other villagers in all phases of rubber production. For example, at first the seedling nursery work was done either in China or hired out to Chinese laborers, and later as farm households gained experience by 2003 and 2004 they did virtually of the bud grafting themselves on the seedlings planted.[30]

This nursery work begins with the planting rubber tree seeds in seed beds both for root-stock (RRIM 600) and for bud-stock (GT1). They plant seeds and root-stock in September/October. Then the following May/June they pull up seedlings it for shield-budding and then later do direct out planting.

On average for establishment of one hectare of rubber trees the labor requirements were about 436 person days (cf Tables 11a&b below) labor for mostly for land preparation, nursery work and establishment of the trees.

Capital

The capital requirements in 1994 for rubber tree establishment were considerable especially

[30]In the early years farm households were frustrated with the quality of seedlings purchased from China. They had problems with seedlings which could not be tapped and with the mixing of clonal varieties.

since farm households had never had such a future-orientation (ie, lag time until harvest) in their livelihoods decisions. (Thus far all the prices are current, ie, those at the time of incurred cost. For example, the labor cost in 1994 was Kip 2,500 per person day as opposed to Kip 20-25,000/PD in 2004.) The capital required to establish their rubber trees ranged from Kip 345,350 to Kip 12,136,500 for material costs of purchasing seedlings, and fencing without accounting for family labor depending on the area cultivated (cf Table 11a). For establishment of one hectare they averaged Kip 1.5m in material costs and Kip 2.5m total costs without family labor (cf Table 11b).

Table 5.11a: Total costs of land preparation and rubber tree establishment

	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam Labor	Total Cost (Kip)	Area (ha)
1	200	178	3,100,900	4,202,136	2,025,450	5,126,350	6,227,586	1.8
2	111	440	1,267,250	1,543,672	1,105,600	2,372,850	2,649,272	1.2
3	915	870	6,075,000	9,282,556	3,924,000	9,999,000	13,206,556	2.8
4	150	536	1,671,875	2,047,900	3,128,730	4,800,605	5,176,630	1.4
5	1,944	0	0	13,174,722	12,136,500	12,136,500	25,311,222	3.9
6	306	0	0	765,000	345,350	345,350	1,110,350	0.9

Table 5.11b: Average costs of land preparation and rubber tree establishment PER HA!

	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam Labor	Total Cost (Kip)	Area (ha)
1	111	99	1,722,033	2,333,586	1,124,800	2,846,833	3,458,386	1.8
2	92	367	1,056,042	1,286,394	921,333	1,977,375	2,207,727	1.2
3	327	311	2,168,775	3,313,872	1,400,868	3,569,643	4,714,740	2.8
4	104	370	1,154,610	1,414,296	2,160,725	3,315,335	3,575,021	1.4
5	499	0	0	3,379,823	3,113,479	3,113,479	6,493,302	3.9
6	334	0	0	835,035	376,967	376,967	1,212,002	0.9
Avg	245	191	1,016,910	2,093,834	1,516,362	2,533,272	3,610,196	2.0

Each producing household received between Kip 0.5-3 million in credit to plant rubber trees, which covered a portion of their costs. The remainder of the costs they had to take from their own or their extended family's savings.

- How did you calculate the costs for labor? Every HH has a different cost per PSD
- Inconsistency with area. HH 2 has 1,2 Ha (table 5.11) or 0,9 Ha (table 5.9)
- Surprising is that both 'less-well off' families (No. 2 and 6) have around the same area but family 2 hires a lot of outside labor. You would say that they don't have the funds for that.
- Why calculate averages? The households all have very different profiles: HH size, HH labor, areas etc. By making an average you might compare incomparable entities?
- Why are the entry data different between the two tables?
- HH 5 is well off, has a small family, the biggest area of all, but hires no outside labor
- HH 3 is well off, has a big family, an average area, but needs almost as much labor (sum of household and hired labor) as HH 5, which has almost twice as much land
- HH 1 and 4 are well-off and mid level. The mid level has a smaller family (half) but hires

almost 4 times more outside labor

Immature Stage – Maintenance

The total costs of maintenance excluding family labor ranged from no cash costs for the household with the least area planted to a total of about Kip 7.8m for the largest rubber producing household for the eight year period (cf Table 12a). The average total cost of maintenance for one hectare was Kip 754,228 with an average material cost of Kip 18,462, mostly for weedicides (cf Table 12b).

Table 5.12a: Maintenance total inputs in immature phase (Years 2-8)

HH	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam Labor	Total Cost (Kip)	Area (ha)
1	502	367	2,880,000	2,880,000	0	2,880,000	2,880,000	1.8
2	436	0	0	3,768,944	24,000	24,000	3,792,944	1.2
3	1,806	?	7,806,771	14,676,694	0	7,806,771	14,676,694	2.8
4	615	0	0	3,021,700	72,000	72,000	3,093,700	1.4
5	1,700	20	110,000	5,751,000	160,000	270,000	5,911,000	3.9
6	630	0	0	4,020,000	0	0	4,020,000	0.9

As for maintenance a total of 68 person days were required on average per hectare during the immature phase. Most of this maintenance was mostly in weeding three times a year. Well-off families would have hired labor to do this, whereas, mid-level and less well-off households undertake these tasks themselves. The average labor cost for the seven year period was Kip 18,462. The average total cost without accounting for family labor was Kip 754,228 for the period.

Table 5.12b: Maintenance average inputs per ha in immature phase (Years 2-8)

HH	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam labor	Total Cost (Kip)
1	279	204	1,599,360	1,599,360	0	1,599,360	1,599,360
2	363	0	0	3,140,787	20,000	20,000	3,160,787
3	645	0	2,787,017	5,239,580	0	2,787,017	5,239,580
4	425	0	0	2,086,809	49,724	49,724	2,136,533
5	436	5	28,219	1,475,353	41,046	69,265	1,516,399
6	688	0	0	4,388,028	0	0	4,388,028
Avg	473	35	735,766	2,988,319	18,462	754,228	3,006,781
Avg/yr	68	5	105,109	426,903	2,637	107,747	429,540

Mature Stage – Tapping (Years 9-11)

Rubber trees are not considered mature until they reach a girth of about 48-50 centimeters. If they are tapped before then it would be physiologically damaging to the tree. In B Hat Nyao tapping did not begin until 2002.[31] Probably the main reason for such slow maturing is because farmers did not fertilize the seedlings and young trees as recommended, thus the trees exhibited retarded growth patterns.[32] Tapping begins after the leaves come out again on the rubber trees – usually about the first of April, and it extends until about the end of November.

Tapping is usually undertaken by members of the household since they are concerned about possible damage to trees by outsiders. It seems to be some sort of guideline in rubber circles that one person should tap no more than about 500 -600 trees per day. When it is dry or the rains are not heavy[33] they usually begin tapping at about 03:00 until finished which seems to be about 06:00. Then after a break for breakfast they collect the raw latex finishing by about 09:00 and bring it back to their houses and pour it into pits lined with plastic sheets, wash tubs, or small plastic garbage cans to coagulate for several days. Then these "tub lumps" are then piled for storage in a shed or in a protected area near the house. It is estimated that on average that they tap about 100-105 days per year depending upon the rains in the Wet Season.

The costs undertaken in the mature period of tapping for the three years ranges from Kip 640,367 to Kip 11.9m costs are mostly for tools, anti-fungal treatments, and increasingly more weedicides. Except for household #1 there was nor hired labor cost, and that was for weeding.

Table 5.13a: Tapping total inputs in mature phase (Years 9-11)

	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam labor	Total Cost (Kip)
1	163	300	9,000,000	11,625,000	2,904,600	11,904,600	14,529,600
2	202	0	0	4,983,333	1,232,046	1,232,046	6,215,379
3	941	0	0	15,077,778	3,035,250	3,035,250	18,113,028
4	428	0	0	6,664,000	2,793,450	2,793,450	9,457,450
5	680	0	0	10,080,000	3,445,900	3,445,900	13,525,900
6	248	0	0	4,600,000	640,367	640,367	5,240,367

During the mature stage of tapping about 219 person days per hectare is used in the three years (or 73 person days on an hectare) mostly for tapping and some weeding. The material costs average about Kip 401,971 per hectare. The average total cost without family labor was Kip 2m per hectare for the period.

Table 5.13b: Tapping average inputs per ha in mature phase (Years 9-11)

	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam labor	Total Cost (Kip)
1	90	167	4,998,000	6,455,750	1,613,021	6,611,021	8,068,771
2	168	0	0	4,152,778	1,026,705	1,026,705	5,179,483

[31]However, if few did tap a few trees that were mature experimentally in 2001.

[32]However, now that they have begun to see returns they state that they will fertilize future plantings.

[33]In the Wet Season they wait at least a day after the rains and usually then tap after dawn.

	Family Labor PDS	Hired Labor PDS	Hired Labor Cost (Kip)	Total Labor Cost (Kip)	Material Cost (Kip)	Total Cost w/o fam labor	Total Cost (Kip)
3	336	0	0	5,382,767	1,083,584	1,083,584	6,466,351
4	295	0	0	4,602,210	1,929,178	1,929,178	6,531,388
5	174	0	0	2,585,908	884,006	884.006	3,469,914
6	270	0	0	5,021,127	698,992	698,992	5,720,119
Avg	219	28	833,000	4,601,214	1,205,914	2,038,914	5,807,129
Avg/yr	73	9	277,667	1,533,738	401,971	679,638	1,935,710

Thus far, rubber production fits into the labor patterns of household livelihood systems (cf labor calendar for B Hat Nyao in Appendix 3). Since they tap every other day (except during the Wet Season rains), they can do other livelihood systems chores on opposite days. Even though rubber is becoming increasingly dominant less well-off and mid-level families still give priority to rice cultivation (either paddy or upland swidden rice) for their subsistence needs.[34] Other than at the time of Hmong New Year at the time of the new moon in the first lunar month (11th- 15th December in 2004) there are no other festivals or holidays except for normal family crises during the life cycle, which would compete for villagers' time.

Rubber Production

Rubber yields are roughly estimated[35] in Table 5 below. The yields are highly variable due to inherent soil fertility of different fields and some due to management. Since none of the farmers sampled used any fertilizer.

Table 5.14: Rubber yields in sampled households in 2004

HH	Prodn (kg)	Approximate Trees Tapped	Area (ha)	Yield/ tree (kg/tree)	Yield/ land unit (kg/ha)
1	4,952	1,500	1.8	3.3	2,750.1
2	1,130	600	1.2	1.9	942.0
3	2,052	2,000	2.8	1.0	732.6
4	1,122	1,448	1.4	0.8	774.9
5	3,895	2,600	3.9	1.5	999.3
6	1,805	710	0.9	2.5	1,970.0

These yields (ranging from 775 kg/ha to 2,750 kg/ha) can be compared to that of Loei province (the most mountainous in NE Thailand) in 2003 where on average they obtained 1,402.5 kilograms per hectare (224.4 kg/rai). Two households obtain better yields than this while the other four had lower yields. Whereas, it was reported to us in Sip Song Panna that the average productivity of smallholders is 1,200-1,350 kilograms per hectare (80-90 kg/mu). Again these generally lower yields reflect the lack of fertilizer application and perhaps tardy weeding in the immature stage.

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[34]When the study team was in the village in November they stated that some households perhaps did not tap and sell during the rice harvest.

[35]Farmers estimated the number of surviving trees. The area which they occupy is based on spacing .

Rubber Marketing

Rubber is sold in the form of tub lumps which are coagulated rubber poured into a wash tub, small plastic garbage can, or a pit dug into the ground lined with a plastic bag. These lumps are stored inside if there is space and if not then outside. These tub lumps get contaminated with sand, dirt and small stones. Reportedly if they are stored for more than a month their weight is somewhat reduced.

Beginning in about June the Collection and Sales Unit (CSU) goes to Sip Song Panna, usually to Mengla County to seek the best prices for their rubber. They go around to various factories to obtain bids. When the team was in the village in the latter part of November, it took three days for them to find the best offer of ¥5.3/kg. Then about two days later two trucks came into transport the tub lumps to the factory. Households brought their tub lumps to the common ground of the village in push carts, in small carts drug behind motorcycles, and a couple of households used pick-up trucks. These tub lumps were weighed and recorded by the CSU. Based on these sales the fees to be paid to the rubber grower's association fund (RGAF) is calculated. Then when the payments to households are made, this fee is then deducted and put into the RGAF.
The CSU complains that the Chinese merchants always complain of depressed prices when we find that world prices generally are stable or increasing. They have no idea what world rubber prices are. Prices in this year for this low quality lump rubber ranged from about ¥5.2 - 5.7/kg.

Baan Hat Nyao Financial Analysis

This financial analysis of the six households is undertaken using constant 2004 prices for only the eleven years of rubber tree cultivation and three harvests thus far. Usually such a financial analysis is undertaken for the life of an enterprise either has completed its cycle and an analysis is done *ex post* or an analysis of an activity enterprise into the future *ex ante*. Projections into the future are done on the hypothetical one hectare farm in Chapter 8.
The purpose of this analysis here is to see status of their investment at the present. Obviously discounting is not used in the past, but sometimes a deflator might be used. While we explored the consumer price index (CPI) and the gross domestic product (GDP) deflator, but because of the turbulent times created by the infamous *Asian financial crisis* of 1997 and it effects afterwards, we chose not do use a deflator. The costs of establishment, maintenance and tapping were used at constant 2004 prices. In a similar manner the values of the upland rice intercrops[36] in years one and two were added to the values of the rubber tub lumps sold from 2002-2004 as the revenues using constant 2004 prices.

Five of the six responding households have been tapping for three years and other one for two years. At first analysis (using current prices since the farmers themselves view it that way) it is difficult to say whether there is much difference in net returns by socio-economic category since their net income after the deduction of variable costs is quite varied irrespective of category. Without accounting for family labor all six households had positive cumulative net incomes[37] for the life of the rubber trees (ie, years 1-11). All six of the households experienced a positive cumulative net return in their first year of tapping, ie, in their ninth year of cultivation, thus they paid off their investment costs by that year (cf Table 5.15).

After three seasons HH #1 and HH #5 (both well-off) have very high positive cumulative net incomes of Kip 28.1m (1.8 ha) and Kip 34.1m (2.8 ha), respectively. For some reason HH #1 hired labor in rubber tree establishment for unusually lower wages than other farmers did in 1994, thus he did well. Household #3 (also well-off) also experiences cumulative a positive net return, eg, Kip 13.2m. One suspects that he has so much inexperienced household labor (probably young people) that is not as productive

- HH1 has the highest cost for hired labor (see first table on total costs)

Households #2 and #6 (both less well-off) show accumulative positive net income of Kip 11.4m and Kip 3.7m both on only on 0.9 hectare at the end of three seasons. This is only the second year of tapping for HH #6.

Household #4 is the only mid-level household sampled, and it has a positive net income of Kip 14.4m on 2.8 hectares – the second highest cumulative three year net income of the six households.

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[36]It is assumed that all six HHs planted upland rice as an intercrop in the rubber trees for the first two years and that the yield attained in year 1 was 1t/ha and in year 0.8t/ha. The price of the unmilled rice was valued at Kip 1,500/kg or Kip 1.5m/t.

[37]Cumulative net incomes are total revenues minus all investment costs in establishment, maintenance, and for tapping.

Table 5.15: Net Income, Gross Revenue - Variable Costs (current prices)

			2002		2003		2004		Total	Total Cumulative*
		Area	Qty Sold	Net Income	Qty Sold	Net Income	Qty Sold	Net Income	Qty Sold	Income
HH	Status	(ha)	(kg)	(Kip)	(kg)	(Kip)	(kg)	(Kip)	(kg)	(Kip)
1	well-off	1.8	1,700	5,005,477	1,459	4,962,272	4,952	26,744,838	8,111	28,123,037
2	less well-off	0.9	850	3,335,977	1,021	4,616,073	1,130	5,968,004	3,001	11,360,204
3	well-off	2.8	1,250	4,044,830	3,653	14,425,597	3,066	13,379,038	7,968	13,150,466
4	mid level	1.4	950	3,574,977	2,069	7,938,616	1,765	7,779,435	4,784	14,402,233
5	well-off	4.8	1,280	4,675,367	3,603	16,209,539	3,895	25,434,742	8,779	34,073,147
6	less well-off	0.9	n/a		1,581	2,471,099	1,805	5,379,972	3,385	3,706,871

NB: This is the running total of cumulative net income (ie, revenue - variable costs) from years 1 - 11.

Thus, without accounting for the cost of family labor[38] all six of the households did quite well, and this undoubtedly is the main factor for most of them to replant in 2003 and 2004 and for all of them to expand their areas under cultivation in the next two years.

- If I calculate the costs for HH 1, I come to a total cost (without family labor) of 18,9 mio. Kip. This would lead to a lower net income: 36,6 mio. – 18.9 mio. = +/- 17 mio. Kip.

If we do a financial analysis of these six households with constant 2004 prices (for both costs and income?), the results are as in Table 5.16. Household #5 (well-off) had the highest net income of Kip 57m ($5,539), that is total revenue minus total variable costs, or sometimes referred to gross margin. This returns to land were Kip 18.8m/ha ($1,825) or the lowest of the sampled households since they had the largest area cultivated in the sample, and the returns to HH labor were Kip 13,196/PD ($1.28), the second lowest.[39] Household #1 (another well-off HH) is second with a net income of Kip 36.8m ($3,573), with a return to land of Kip 34.8m ($3,389) and returns to HH labor of Kip 42,540/PD ($4.13). The other well-off HH # 3 has a net income of Kip 28.6m ($2,775); returns to land of Kip 20.5m/ha ($1,986) or the next to the lowest amongst the sampled HHs; and returns to HH labor of Kip 7,806 ($0.76), which are the lowest and well below the agricultural wage rate.

- What are the 2004 prices? 5,5 * 1,300 Kip per kilo? 25,000 per PSD? Calculate: 62,8 mio / 8,111 Kg = 7,400 Kip per kilo (= 5,9 Yuan)?

The mid-level HH # 4 has a net return of Kip 18.7m ($1,818); their returns to land were Kip 26.3m/ha ($2,556); and their net returns to HH labor are Kip 15,691 ($1.52), which is still below the agricultural wage rate.

Table 5.16: Net revenues and returns in sampled HHs of B Hat Nyao (constant 2004 prices)

HH	Total Revenue (Kip)	Total Variable Costs (Kip)	Net Income (gross margin) (Kip)	Total Revenue (minus) Total Costs (Kip)	Returns to Land (Kip/ha)	Returns to HH Labor (Kip/PD)	Area (ha)

[38]In fact, at present due to increasing off-farm employment family labor could possibly have an opportunity cost of the existing wage rate in some months but probably not year around.

[39]The reader should be aware that the standard wage rate now ranges between Kip 20-25,000 per day or $1.94-2.43 per day, depending upon the type of work.

1	62,852,735	26,046,717	36,806,018	15,175,601	34,904,219	42,540	1.8
2	24,700,010	13,373,035	11,326,975	(7,381,692)	20,583,342	15,136	0.9
3	57,289,845	28,709,250	28,580,595	(62,958,849)	20,452,475	7,806	2.8
4	38,116,630	19,390,708	18,725,922	(11,109,328)	26,323,640	15,691	1.4
5	73,292,443	16,242,400	57,050,043	(51,034,680)	18,802,330	13,196	4.8
6	26,678,443	1,626,084	25,052,359	(4,535,141)	29,120,836	21,168	0.9

The two less well-off households #2 and # 6 faired somewhat differently. Household #6 has a net income of Kip 25.1m; returns to land of Kip 29.1m/ha; and returns to HH labor of Kip 21,168 ($2.06), which is in the neighborhood of the wage rate. What is amazing about HH #6 is that this is only after two years of tapping on a mere 0.9 hectare, ranking fourth in net income, second in returns to land and second in returns to HH labor. They obviously are quite efficient. Household #2 has a net income of Kip 11.3m ($1,100) for the lowest of the six in the sample. Their returns to land are Kip 20.6m/ha ($1,998) or ranking fourth, and the returns to HH labor Kip 15,136/PD ($1.47) also ranking fourth.

In Table 5.16 if one looks at column 5, total revenue minus total costs, factoring in an imputed value to household labor, only one household, eg, HH #1 has a positive return. Which means that for the other five HHs the value of the overall enterprise accounting for all costs, was negative. However, as we mentioned at the outset, it is difficult at this time to attribute an opportunity cost for HH labor.

When undertaking a financial analysis (cf Table 5.17) of each household only for this eleven year period, two of the well-off HHs, HH #5, the largest producer, has the greatest net present value of Kip 53.5m ($5,193) for an internal rate of return of 41.33 percent and a benefit/cost ratio of 3.78. Household #1 ranks second with a NPV of Kip 38.5m ($3,742); an IRR of 19.23 percent; and a B/C ratio of 2.73. Whereas, HH #3, the second largest producer has an NPV of Kip 21.2m ($2,055); fourth ranking NPV, the lowest IRR of 8.96 percent; and the lowest B/C ratio of 1.46 of all the sampled HHs.

Table 5.17: Financial analysis of six sample HHs (11 years)

HH	Area (ha)	NPV	IRR	B/C
1	1.8	38,540,667	19.23%	2.73
2	0.9	19,748,006	13.79%	3.95
3	2.8	21,167,398	8.96%	1.46
4	1.4	24,950,179	39.70%	3.09
5	4.8	53,485,053	41.33%	3.78
6	0.9	8,975,183	12.67%	1.53

Household #4, the only mid-level HH, has a NPV of Kip 25.0m ($2,422); an IRR of 39.70 percent (the second highest); and a B/C ratio of 3.09.

The two less well-off HHs, HH # 2 has an NPV of Kip 19.7m ($1,917); IRR of 13.79 percent; and a B/C ratio of 3.95, the highest of the 6 HHs. Whereas, HH #6 has the lowest NPV of Kip 9.0m ($871), which would be expected after only two years with less than a hectare of land; an IRR of 12.67 percent; and a B/C ratio of 1.53.

In summary, no matter what the area cultivated some households were more efficient in use of their resources, ie, land, labor and capital than were others.

Chapter 6
Rubber Technology and Environmental Implications

Forest and Watershed Considerations

We have already discussed monocrop rubber planting on sloping lands and the impact on various watersheds in China. In addition, we discussed how monocrop rubber's lack of structural complexity at both the field level and watershed level effects faunal populations and movement. The canopy structure of a rubber tree is simple, and due to pruning, weed control, and canopy shade (related to tree density) the vegetation beneath the canopy is minimal. In addition, rubber canopies in northern altitudes tend to be sparser and the trees shorter. This then creates a structurally simplistic tree crop, and when that lack of complexity at the field level is magnified over an entire watershed the erosion potential increases. Furthermore, we briefly discussed how a zonal approach to planting rubber can be advantageous to villagers by reducing costs and simplifying protection, but the zonal approach applies the monocrop system to an entire area or watershed. The mosaic model for a given land area or watershed allows for rubber but requires other perennial, annual, or natural forest systems.

A critical concern for resource managers should be what types of ecosystems or natural vegetation complexes does rubber replace. In the case of villages surveyed in Muang Sing and Nam Tha districts we found that most villagers are planting rubber on land previously in short term fallow of one to five years. They do so in order to plant an upland rice crop with their rubber in the first two to three years. However, two of the six Ban Hat Nyao farmers interviewed cleared 20 to 30 year fallow for their first rubber planting in 1994-1995. More relevant is what are the current trends in Luang Nam Tha. Ban Hat Nyao plans to expand the village's land under rubber by 700 ha in order to provide families, particularly poorer ones, with more rubber plantation land. However, the village plans to clear their designated conservation forest land of 700 ha. for the rubber. The village leaders state that the conservation forest is very degraded, and that they plan to strictly protect remaining forest land. They also will not allow expansion of rubber beyond the above area. Nevertheless, resource managers must be aware of the fragility of forest resources designated under the land allocation program when faced with pressure to expand economic opportunities for villagers.

Two other key issues must be considered. First, in addition to vegetation complexes replaced by rubber the majority of villagers will look for additional land to plant upland rice after the second year of rubber (rice yields in year three are minimal according to villagers). Therefore, lands effected by the conversion to rubber may double, particularly in villages without paddy. The question becomes how much additional land area is converted to agriculture beyond that replaced directly by rubber. Or does the overall intensity of land use increase spatially and temporally? This question has direct bearing on the second key issue. That is to what degree do the labor demands, both short and long term, of rubber affect land use and resource management.

Part of the enthusiasm about rubber by local GOL officials is that rubber seems to be a solution to the problems of the upland farmers, and thus it addresses the three goals of the GOL for upland farmers: elimination of swidden systems, cessation of opium cultivation, and reduction of poverty. Many seem to see it as a win-win crop creating a stable perennial cropping system that offers good economic returns. There seems to be the hope that those returns, solely or in conjunction with other cash crops, will lead to the elimination of the swidden system for upland rice. Possibly, some envision rubber and other cash crops creating a stable fixed field farming system that meets the three goals while preserving forest resources. While we should note that fixed field farming in a zero input system is not possible, in terms of the second issue mentioned above officials at all levels must recognize that the labor pool and labor availability will determine in part how much land area is converted into rubber.

Some may see rubber once tapped as having high labor requirements, particularly if sheets are made, and high returns so that the majority of villagers will be able to make a living from rubber alone. Yet not only does this scenario rest on the false promise of continued strong prices for rubber, but it does not draw lessons from other upland areas in S.E. Asia where farmers with available land cultivate other crops or expand their rubber plantings. If we consider only the labor resources available to the typical upland farm family in Luang Nam Tha then anything beyond three hectares of rubber probably represents an excessive labor demand. However, and most importantly, if the available labor pool for rubber continues to be distorted by contractual arrangements with Chinese businesses or business people and the labor they import for all rubber operations, then rubber plantation land may expand rapidly and without proper planning. If that happens then the uplands (to 1000 masl) of Luang Nam Tha will resemble those in southern Yunnan. For example, due to a contractual arrangement between Chinese from across the border and Ban Bouak Khou imported Chinese laborers rapidly converted 230 hectares in Ban Bouak Khou to rubber. In addition, they will conduct all the relevant operations save for tapping.

Angelsen and Kaimowitz (Angelsen and Kaimowitz 2004) have an extensive discussion of the effects of agroforestry systems on deforestation. While rubber is not an agroforestry system as it is currently cultivated in Luang Nam Tha there are important similarities and lessons in the authors review of agroforestry systems and deforestation. (Table 1 below)

Table 1. Three typical cases of agroforestry adoption (Angelsen and Kaimowitz 2004)

Case	***Land Availability***	***Driving Factor***	***Typical Examples***	***Possible Impact on Deforestation***
Introducing agroforestry in shifting cultivation systems	Land abundance	Population, knowledge of new technologies	Fruit trees for household consumption, cattle fodder	Probably small effects (limited market opportunities) or a reduction of deforestation
Introducing agroforestry with commercial tree crops	Land abundance	Markets (national and international), technology	Cocoa, rubber	Potentially significant increase in deforestation, particularly if market outlets and migration exist
Using agroforestry on farmland to substitute for forest derived products	Land scarcity	Markets (local and regional), forest scarcity	Fuelwood, building materials, woodlots	No direct effects because natural forests are scarce; possible positive indirect effects (output, labor markets)

In the second row we note that many of the same conditions in northern Laos are present, eg land abundance, international markets for rubber, and Chinese labor (in lieu of migration).

The evaluation of the potential effect of rubber plantations on watersheds and forest in Luang Nam Tha must consider the slopes utilized for rubber. Thailand's extension pamphlets all recommend flat or sloping lands less than 35% or 20°.If the slope is greater than 30% or 15° then terraces must be made. These recommendations may reflect the historical establishment of rubber plantations on flat or gentle slopes and the tendency of large crowned rubber trees in windy areas of southern Thailand to topple. Nevertheless, one must consider their technical expertise. (In Loei Province, Thailand farmers plant rubber on fairly steep slopes of up to 25^0.) However, the reality of rubber planting in southern China and the evolving reality in Lao is that villagers plant rubber on slopes far in excess of the above recommendations. In China one sees slopes in excess of 30^0 possibly approaching 35^0. In Luang Nam Tha, villagers have yet to plant rubber on slopes that steep except along the road from Luang Nam Tha to Muang Sing where one sees maximum slopes from 25^0 to 30^0. All rubber in China and in Lao is planted on terraces for ease of harvesting rather than with soil conservation as a main goal. Yet the terraces do seem to provide some measure of soil conservation. We were not able to observe any established rubber plantation during the rainy season, and, thus, were unable to observe the degree of soil erosion. However, a meter wide mini-bench terrace in a clean weeded rubber plantation probably will not prevent substantial soil erosion. Xu Zaifu (Xu 1997) has old observations for soil erosion under rubber compared with other systems. (Table 2)

Table 2. Soil and water erosion in different land use systems (Xishuangbanna, 1965-1966)

	Soil erosion		Water Erosion	
Land use systems	**kg/ha/yr**	**Comparison in times**	**kg/ha/yr**	**Comparison in times**
tropical rain forest	63	1	99	1
rubber + tea	2,241	31	206	2
pure rubber plantation	2,690	43	293	3
shifting cultivation	48,697	778	3,395	35

We assume that the above figures measure terraced rubber. No other data is presented by Xu Zaifu regarding spacing, ground cover, or slopes so the above data is indicative at best. Mr Udom, a Thai rubber consultant, says that planting bare root seedlings as opposed to bagged seedlings allows for the development of a better tap root. The tap root enables the tree to grow better on slopes although soil depth is an important factor. Most extension manuals for rubber indicate that there should be at least one meter of soil depth.

Villagers in Muang Sing and Nam Tha districts say that when cold is a concern rubber should be planted on slopes which as they see it allows rubber early exposure to sunlight on cold mornings. They say this is particularly important for RRIM 600.

The reality of planted rubber in China and in Loei Province, Thailand demonstrates that rubber can be planted on slopes. However, we are not aware of a comprehensive review of rubber productivity on sloping lands. Clearly, soil fertility, soil depth, soil type, wind, precipitation, degree of slope, cover, spacing, soil organic matter, variety, root morphology, etc. are some of the numerous factors that influence rubber productivity on sloping lands. In terms of watershed concerns, we observed above that a monocrop rubber plantation has minimal structural complexity and therefore is not a desirable farming system when applied to vast areas of a watershed. We assume that increasing slopes accentuate problems in the watershed and cause declining rubber yields, but caution that is only an assumption.

Several villagers commented that they have concerns about how much water a rubber plantation uses and how that might affect water resources and other crops. We did not conduct a literature review on the hydrology of rubber plantations nor are we familiar with water use efficiency in rubber versus other perennial tree crops. Villages assume that when the product is primarily water, latex, then the tree must require substantial moisture. The Muang Sing DAFO plan for rubber excludes areas near water sources for paddy irrigation. They seem to be making a similar assumption. We leave this topic for someone with greater expertise in rubber.

Water use by rubber factories and it effect on watersheds should be a central concern for watershed and resource managers. Currently there is only one small rubber factory located in Luang Nam Tha. We did not meet with the factory managers. They use water to produce rubber sheets and have a small settling pond for waste water from the factory. Mr. Sounthone from PAFES said he had told the factory manager several times that the settling pond is not big enough for waste water particularly in the rainy season. As noted in the section about rubber in China factory managers informed the team that they use approximately 20 tons of water to produce one ton of rubber sheets. They treat the waste water from the operations in a series of settlings ponds using water hyacinth as an end stage water treatment. We do not know the effectiveness of this methodology although similar more complex systems are used for sewage treatment in some countries. Certainly the amount of water used in processing has to be of concern for people reliant on local water resources, especially springs and rivers. The potential impact on village water resources and watershed function may be obviated to some extent by the lack of latex production during peak dry season and thus stoppage of processing.

An additional area of future concern for watershed and resource managers in Laos should be the amount of fuel wood consumed by rubber factories producing smoked rubber sheets. Ban Hat Nyao has discussed building their own village factory to produce smoked sheets. When asked about the amount of fuel wood required the village leaders say that there will not be a problem. Yet as discussed previously a large amount of wood is used for commercial level processing in Thailand and China. With the continued conversion of fallow land and demarcated forest land in Ban Hat Nyao to rubber, it is possible that the village proper will be unable to sustainably meet the fuel needs of a small factory. In which case, the village could purchase fuel wood from other villages. The Chinese alcohol factory in Muang Sing buys large amount of fuel wood for distilling whiskey from local villages in Khet Mom. Local PAFO officials should prepare an analysis of fuel wood use by a small scale factory and potential fuel wood production from Ban Hat Nyao lands. There should be estimates made of sustainable cutting levels, assuming no outside sales, in order to prepare for the possibility of a factory.

Indiscriminate use of herbicides, pesticides, and fertilizers ought to be an additional concern of those involved in watershed management. Some provincial level officials are under the mistaken assumption that herbicides, pesticides, and fertilizers are not being used by villagers cultivating rubber. The following villages are examples of the level of use of agrochemicals. (One should assume that similar degrees of use can be found in other villages.) In Ban Hat Nyao about 30% of the village rubber farmers use herbicides to control *Imperata cylindrica*. The village, as a whole, plans to use fertilizer for rubber in 2005. In Ban BuakKu most of the 60 families who have rubber trees use herbicides and fertilizer. In Ban Udomsin, two families use herbicides, and this year they started to use fertilizer.

We saw two types of herbicide in villages. Gramoxone (made by Sygenta) at 20% concentration is sold in China in 16 liter bottles. The bottles are semi-opaque with dark green liquid. In Chinese the local name or the trade name may be *Nung Dta*. It cost 3.2 *Yuan* per bottle. Gramoxone or paraquat is commonly used in northern Thailand as well. Paraquat is a contact herbicide. Watson states that its effectiveness is not diminished by rain, does not damage brown bark, and is inactivated upon soil contact. It is effective against grass and broad leaved species, but does not provide long term control of perennials (Watson 1989). The NCAMP fact sheet of paraquat says that the herbicide has a soil half life of 45 days, and although tightly bound to clays can be water soluble in low clay soils. If that occurs it can enter and poison local water resources (NACMP fact sheet 1986) (See Appendix ?). The second herbicide was sold in a small semi-olive green plastic bottle of about 500ml. capacity. The bottle had only Chinese writing. Villagers call this herbicide by its Chinese name transliterated as either *Sau Cong Lee*, *Jaw Gaw Lee*, or *Chaw Gaw Lee*. It is used for grass and broad leaf weed species with Fab as a sticking agent. Some villagers said that this controls *Imperata* better which might indicate that this is systemic or translocated herbicide.

Given the dependence of local communities on surface and groundwater resources for food and water respectively, relevant government agencies, particularly PAFO, should monitor the degree of herbicide and pesticide use. In addition, PAFO and DAFO must help villagers understand what proper practices are for use of the above agrochemicals should they use them. This is critically important particularly for the majority of illiterate villagers. Furthermore, all of the herbicides that we encountered in villages were from China with no Lao writing. The prevalence of agrochemical use in China is known by many educated Lao, but villagers may not have the same level of awareness about the dangers of some products. We saw villagers washing out herbicides containers in a fish pond with their bare hands.

Herbicides will probably become more frequently used by villagers with the proximity of China and the lessons learned from China. However, we do not know the degree of herbicide use in Sip Song Panna. It is possible given the large labor pool in China that herbicides are not cost efficient compared to hired labor, but we have no information on weed control methods in Sip Song Panna. If villagers were to adopt rubber as their primary cash crop it is possible that they might not rely on herbicides for weed control. In a situation where family livelihood is totally dependent on rubber, family labor may be viewed as having a cost advantage over herbicide purchase depending on opportunity costs. On the other hand, if farmers manage a mixed cash and subsistence system with a high labor demands spread across the system they may utilize herbicides to fill labor gaps. Increased use of share contracts where Chinese investors split rubber plantations with Lao villagers may result in increased herbicide use if imported Chinese labor is not as cost efficient as herbicide applications. Whether herbicides become more frequently used in northern Lao will depend on the relative cost of labor and herbicides as well as cropping practices.

Biological factors and agronomic practices will affect weed pressure in rubber plantations. Spacing between rubber trees, intercropping (both in the initial three to four years before canopy closure and thereafter) with agroforestry practices or cover crops, soil fertility, and field history all affect levels of weed pressure or prevalence of perennials versus annual weed species.

We suspect that if farmers apply fertilizers to their rubber that they will be more likely to under apply than over apply fertilizer. Furthermore, the dispersed fine surface root morphology of rubber probably means that nutrient uptake is rapid and leaching and runoff are minimal. In this still early period of rubber in Lao over application of fertilizer and contamination of watersheds through an increased nutrient load is probably not a concern. (We note though that Cheo [Cheo 2000] states that over application of fertilizer and runoff is a concern in China.) However, those concerned with watershed management must monitor herbicide use.

Technology: Fertilizers

As discussed above, villagers are using fertilizer for their rubber plantings, but the number of villagers is still limited compared to those who do not. Most villagers say that the soil is fertile enough for good establishment of rubber trees. The primary reason for initiating fertilizer use in Ban Hat Nyao is the recommendation of Chinese experts and buyers of coagulated latex. Similarly, Ban BuakKu's use of fertilizer is the result of the Chinese implemented contract. The villagers using fertilizer in Ban Udomsin do so because they wish to increase the rate of rubber tree growth and decrease time to tapping. However, they established their trees without using chemical fertilizer.

Should villagers use fertilizer for the establishment of rubber trees? All the Thai extension manuals have exact fertilizer recommendations based upon years of research. (See appendix for Thai fertilizer recommendations.) The Thai government agencies supporting the establishment of smallholder rubber in Thailand all support or directly subsidize fertilizer use for participating villagers. Every villager we interviewed in northeast Thailand (Isaan) fertilized their rubber. In China, Guangxia (Guangxia 2005) reports common use of fertilizer by rubber farmers. Several soil fertility management projects have looked at economically and ecologically efficient models of fertilizer application and intercropping (Lefroy pers. com. IBSRAM) in particular for replanted rubber. Yet, for rubber newly planted on previously long term fallowed land fertilizer does not seem to be necessary. Watson (Watson 1989) states that residual soil fertility from newly cleared and burned forest is usually sufficient for early growth and the promotion of a good root system. In a review of articles comparing cover cropping and green manures to fertilizer treatments the same author finds no significant benefit of either green manures or fertilizers for rubber growth on newly cleared forest. Indeed, in jungle rubber systems in Indonesia which are established or replanted on 40 to 50 year old rubber agroforests villagers do not use fertilizer (Dove, various dates).

It is probable that when villagers in Luang Nam Tha province choose fallowed land for planting rubber that will also give them good upland rice yields in the first two years then they do not need to apply fertilizer. Most villagers would probably indicate that a fallow of an absolute minimum of five years, preferably seven to twelve would be their ideal fallow. If, on the other hand, villagers were to plant rubber on recently cropped sugar cane land, as some villagers are doing, then fertilizer application to rubber at planting time might be beneficial. Crude province and district level data could be generated by doing field sampling and soil testing on range of farmer chosen fields for rubber, eg five to seven year fallow, ten year fallow, post sugar cane, post upland rice, *Imperata* grassy areas, etc.

In all situations access to and cost of fertilizer, cost comparison with green manures (to be discussed later), field history, and farmer priorities ought to be considered. If fertilizers are to be included as part of a promotion package as suggested in the Sino-Lao proposal, the above recommendations should still be considered.

Technology: Rubber Clonal Varieties

As discussed earlier, there are two main varieties of rubber planted in northern Lao: GT1 and RRIM 600. Indeed, these are the two main varieties found in Sip Song Panna, Yunnan as well, though Yunnan apparently has a wider varietal selection due to a longer history of rubber cultivation. Northeastern Thai rubber farmers also seem to have RRIM 600 as their main rubber variety. We present an overview of the commonly found or potentially appropriate varieties below. (See also the appendix for Thai varietal yield tables.)

The GT1 variety was developed in Malaysia although the Meng La, China government rubber extensionists seemed to think the variety came from the Pao Ting Research Institute in Canton (Guangdong), China. Several sources confirm its origin in Malaysia. It is described as an average size tree with average yields. Villagers in Luang Nam Tha recognize that although it has greater tolerance to cold and diseases than RRIM600 the yield of GT1 is less. However, officials in Meng La, China said that while their results showed a yield per tree of six kilograms for GT1 compared to eight kilograms per tree for RRIM 600, when the two varieties are compared on a per hectare basis GT1 yield is greater due to fewer disease problems and greater cold tolerance. Statements about the yield characteristics over time are entirely contradictory with the Chinese saying that GT1 has initial high yields declining over the initial years while a NAFRI publication states that GT1 yields increase over time. Villagers in Luang Nam Tha also give conflicting testaments about GT1 yield characteristics. These contradictions probably reflect site and treatment differences as well as difficult to access research results. In Meng La, China, Chinese government officials estimate that GT1 accounts for about 30% of all rubber trees planted in the area with RRIM 600 accounting for 60%.

RRIM 600 also is a Malaysian clonal variety. As mentioned above, RRIM 600 has higher yields than GT1 although that may not be the case on a per hectare basis particularly in areas with cold stress and disease problems. Thai extension manuals state that RRIM 600 has a ten year average yield of 289 kg/rai (1,860kg/ha.) although one manual gives a figure of 342kg/rai (2113 kg/ha). The manuals say that it has very good growth but the clone is susceptible to a number of diseases. Interestingly, Thai farmers made no comments to us about disease problems in RRIM 600, and Thai rubber experts said most of the disease problems with RRIM 600 are in the south. This contradicts what most villagers say in northern Laos and what the Chinese say, but the contradiction may reflect climatic differences between northeastern Thailand and northern Laos as well as agronomic practices. Thai extension manuals stress that RRIM 600 should have within row spacing of no less than three meters yet many Lao farmers plant at two and one half meters, or even two meters, spacing within row. Lao rubber farmers, as well as the Chinese, also state that RRIM 600 is susceptible to the cold particularly when the tree is young. They say that RRIM 600 can not be planted in low lying areas near streams. According to Chinese experts met on the team study tour RRIM 600 is being phased out as an important rubber clone in Sip Song Panna. Thai extension manuals do note that RRIM 600 is appropriate for sloping lands, but they do not include it in a list of rubber clonal varieties appropriate for smallholders. Yet the majority of Northeastern farmers seem to have planted RRIM 600 though we have no data to support that estimate.

The Chinese variety 774 is a promising variety, but it has yet to be released by Chinese rubber researchers as it has only been in trials for 20 years. This is an insufficient time period to determine whether the overall economics are beneficial to farmers. This variety is also called

cee pee jung (CP Jung) by villagers. This variety is already in the private sector despite it not being released (or possibly fake 774 seedlings are being sold); possibly individuals took the variety from field trials. Interestingly, this variety is one element of the extension package under the agreement with Sino-Lao, and GOL officials had assumed it to be a variety worth promoting until they learned during the team study tour that 774 was still under study. There are also stories among villagers about how promising 774 is, and 774 has been planted in at least one village. (Mr Law Meu planted 200 trees in Ban Law Meu; he paid four *Yuan* per tree though the price in Muang Yuan is usually five *Yuan* per tree.) Villager stories about 774 abound and vary widely. Mr. Law Meu said 774 will produce latex after six years but only produce for 30 years. In Ban Udomsin they have heard that 774 will produce latex within five years. A Chinese tapper employed to work at the rubber trial plots of the Sip Song Panna Tropical Botanical Garden told the study team that 774 could be purchased for 5.7 to 6 Yuan a tree. She said that 774 was cold tolerant, high yielding, tapping tolerant, could be tapped in 5 years, and had a life span of 45 to 50 years. Perhaps the rumors about 774 indicate the primary problems that villagers feel need to be addressed with current rubber clones in circulation.
PR107 is another rubber variety found in China. The variety is probably Indonesian (PR indicates Proefstation voor Rubber). Officials in Meng La stated that the variety occupies about six to seven percent of total rubber land in the area. They said that in the area it yields about seven kilograms per tree. PR 107 is wind resistant, tolerates tapping, somewhat cold resistant, and has an initial high yield. Farmers are increasing their plantings of this clonal variety in Meng La.

Thai researchers think that BPM 24 may be a promising variety for rubber growers in cold areas. BPM 24 is an Indonesian variety and it is a cross between GT1 and Avros 1734. Thai researchers indicate that it has the best cold season latex production, 335 kg/rai (2070 kg/ha.). They also describe it as having lots of branching and high soil moisture needs. They do not recommend it for sloping lands possibly due to a large crown structure. (A NAFRI publication says that BPM is recommended for sloping lands.) Currently, there are experimental plots at the Rubber Research Center in Phonpisai, Nong Khai, Thailand focusing on cold tolerance.

The Rubber Research Institute of Thailand is also looking at HK1 (Hikien 1) and SCATC 93-114 for cold tolerance. Thus far they say that HK1 appears to be the most promising. The RRIT mentions that Tian-ren 231-45 and IAN 873 are also appropriate for cold areas particularly those with strong radiative cooling regimes.

A NAFRI publication (NAFRI 2004) mentions KRS 156 as a potential variety appropriate for Laos. The publication states that the variety is from Thailand though it is not mentioned in any Thai extension manual. The variety is not recommended for sloping lands according to the publication.

Technology: Tapping Techniques

Currently the only villages tapping rubber, that we are aware of, in Luang Nam Tha province are Ban Hat Nyao, Ban Bouam Phiang, Ban Buak Kou, Ban Phapuk, and Ban Lo Meu. Ban Hat Nyao has tapped for three years now and they have the most expertise. The other three villages have hired Chinese relatives to teach them how to tap. (Each of the latter three villages had at most two individuals tapping in 2004.) The major difference in tapping between Laos and Thailand is the type of tapping knife and the technique used. Lao farmers are drawing their lessons from the Chinese as they do everything in rubber. The Lao use a tapping knife that requires the tapper to push the knife up along the tapping angle. The knife used in Thailand requires the tapper to pull or draw the knife at an angle downwards towards the spout. A Chinese rubber extensionist said he heard that at one time they used a tapping knife like the Thai, but when India began to assist the Chinese with rubber they borrowed the Indian tapping knife. The Thai, Malaysians and Indonesians all use the same basic knife and technique.

Skilled tappers from all the aforementioned countries can probably tap rubber trees equally well, but it seems to us that drawing the knife downwards and towards the tapper allows the tapper to better control both the angle and the depth of the cut. Controlling the depth of the cut is crucial. If the cut is too deep and extends into the cambium then not only will the tapping life of the tree be shortened but also disease problems may increase. Extreme cases of cutting into the cambium may cause tree mortality. Informal observations of bark in the villages where tapping has already begun revealed numerous lumps on the healed tapping surface. This indicates that the tapper cut too deep and hit the cambium in places. The study team gave Ban Hat Nyao villagers three Thai tapping knives and all the villagers commented that they liked the Thai knives better although the villagers had to adjust to the feel and technique at first. Villagers already tapping all commented that many of the Chinese knives were of poor quality and rusted or broke easily. The Thai tapping knives (both Thai and Malaysian knives are sold in Nong Khai, Thailand) are more expensive than the Chinese knives but not prohibitively so.

An additional tapping difference between the Chinese and the Thai is that some Chinese made their tap cuts ascending rather than descending. The latex flowed across the former tapped surface guided to the spout by either the bark or a piece of tarred felt. We do not know how this technique compares with the more traditional technique of descending cuts. The Chinese will also double tap both sides, and use two cups, on a very mature rubber tree. They start to do this when the tree is 28 to 30 years of age. The lower tap is called the *yang* tap and the higher tap is called the *ying* tap. Webster (Webster 1989) calls this slaughter tapping. We did not see this in Thailand, but none of the rubber plantations in northeast Thailand are of that age.

Technology: Nursery Management

Lao production of rubber seedlings, sometimes done with Chinese aid and advice, is widespread, and most villagers seem fairly confident in their abilities to produce their own rubber seedlings. The techniques that we saw in the field were sound and seemed to produce quality seedlings. Some Ban Hat Nyao villagers commented that they would like to improve their techniques, because they said about 30% of their budded rubber trees do not accept the graft. However, the village chief responded by saying that if one uses good techniques throughout there should only be a 10% loss.

Most villagers buy rubber seeds from China, because the rubber that has been planted in Lao is mixed GT1 and RRIM 600. When the rubber seeds are on the ground villagers can not differentiate between seeds. It is easier to purchase seeds with known parent trees. The seeds sell for 1 *Yuan* per kilogram. They take the seeds and scatter them in a seed bed. After emergence and growth to 10 to 15 centimeters height they plant them in the final seedling orchard with an in-row spacing of 20 centimeters and between row spacing of 30 centimeters. Then there is a 40 to 50 centimeter space between this double set of rows. Some farmers just use a 30 centimeter spacing but it makes the budding operation more difficult. This planting operation is done around July when sufficient rain is more likely. The next year farmers select their bud wood for the budding procedure. Great care is taken by farmers to select proper bud wood. Some farmers buy their budwood in China while it seems that most of the Ban Hat Nyao villagers are using budwood from their own trees. The price of a good branch of budwood in China is 2 *Yuan*, and there are about 10 to 20 potential buds on one branch of budwood. When harvesting the budwood careful farmers use candlewax to seal the end of the branch to prevent dessication.

Budding is done with a patch bud and when the seedling is about the diameter of large pencil or pen. A very skilled person can bud about 500 trees in one day while a person with average skills can bud 350 trees in one day. After the trees are budded, farmers allow the bud to set for three weeks without making a top prune. The top cut of the stock is made about two to three weeks prior to out planting. When the cut is made the top is often painted to prevent dessication. It may take two to three weeks or longer for the bud to break. When the bud is about one centimeter in length a piece of wood is tied to the trunk to prevent damage to the bud when the seedling is dug up. The bare root seedlings are dug up according to the needs of the buyer or the owner, i.e. seedlings with slow bud emergence can stay in the ground until needed. The bare root seedlings are put into a manure slurry prior to transport to prevent root dessication.

In Thailand there are variations on the above system. There seems to be a preference for bagged seedlings in some areas of northeastern Thailand. As a result the budding operation is done while the seedling is in a plastic bag. Thailand also has a monitoring and certification system for sellers of scion wood and seedlings.

At the end of 2004, the market for locally produced seedlings is quite good. Locally produced seedlings are cheaper in terms of transport, and there are serious concerns about the trustworthiness of Chinese sellers of rubber seedlings. Some farmers report being sold fake rubber seedlings by Chinese. Due to a strong local demand for seedlings establishment of a rubber nursery for direct sales to farmers can generate sizable income. Mr Khaejiam in Ban Udomsin estimated the costs of establishing his 40,000 plus seedling nursery at 12,000 *Yuan.* If he sells his seedlings at a below market rate of 2.5 Yuan per seedling, he will net over 80,000 *Yuan* without considering land costs. Another poor farmer in Ban Hat Nyao has a 10,000 seedling nursery. He will sell approximately 6,000 seedlings after accounting for his own use and mortality. He will sell his seedlings for about 5000 *kip* (3.8 *Yuan*) per seedling. Without accounting for labor costs or other inputs the sales will gross 30,000,000 million *kip*. The strong local market will probably continue for the next few years.

Villagers in Khet Mom also expressed interest in improving their nursery management techniques, particularly budding skills. These needs could be easily addressed with a training program emphasizing good budwood selection, tool sanitation, and good budding techniques. We suggest that PAFO and DAFO request the cooperation of village experts like Mr. Khaejiam in Ban Udomsin and Ban Hat Nyao villagers and design a hands on field based training for interested villagers.

Technology: Contour Planting

When villagers plant rubber on sloping lands they all construct simple meter wide terraces. In every village the team surveyed, villagers built their terraces by sighting along their estimate of the rough contour. While this seems to have had good results, simple tools like A-frames or tube water levels would help villagers establish accurate contour lines and would only help decrease soil erosion. This should be an emphasis of any Sino-Lao rubber promotion work. With proper contour planting future mechanized access to rubber plantations could be accommodated (see Sheng 1986). We did not determine whether the Chinese utilize simple tools for determining contour lines.

Technology: Disease Control

We did not survey the prevalence of rubber disease among rubber farmers in Luang Nam Tha. Farmers interviewed by the team did not mention disease problems as a primary concern. Yet some commented about the greater vulnerability of RRIM 600 to disease. Any survey of disease prevalence in rubber in northern Lao will require an expert in that area. Expertise in this area is beyond the scope of this consultancy.

Technology: Information Sources

We have discussed the complete dependence of area farmers on information and technology from China. Given the proximity of rubber resources and, of course, market outlets for rubber in China this makes complete sense. Chinese experience with rubber in climatic conditions not suitable for maximum rubber production also provides valuable insights for GOL officials and rubber farmers. However, we suggest that the flow of information from China be balanced by accessing the information, experience, and resources available in Thailand.

Thailand has a longer history of rubber cultivation, more developed marketing and manufacturing experience, and a rich supply of available, documented information about rubber and rubber cultivation. Information exchange between government agencies is also more open and available. Other relevant factors are ease of communication for lowland Lao or hill people with good Lao language skills, greater standardization of products for rubber farmers, and the possibility of competitive market outlets particularly after the A3 road is completed. Laos will better situate itself in terms of supporting rubber cultivation and product marketing if it increases it contacts with Thai rubber professionals, both government and rubber farmers.

Technology: Abiotic and Biophysical Aspects

Several authors state that rubber in Yunnan is well outside of its adapted latitudinal range. Guangxia notes that the standard latitudinal range for rubber is 15^0N to 15^0S latitude, and Sip Song Panna with latitude between 21^0N and 22^0N and Yunnan with 21^0N to 25^0N are far outside of the ideal range for rubber. The same could be said for rubber in Luang Nam Tha (latitude 20^0 to 21^0N). Careful consideration and analysis of climate, rubber growth, and productivity may ultimately show that the returns from rubber are not competitive with other land uses. Yet that level of analysis is beyond the scope of this consultancy. However, a review of the available data demonstrates the potential risk to the farmer. Traveling through Sip Song Panna and observing the vast plantings of rubber and the obviously successful cultivation of rubber may make the questioning of the viability of rubber seem moot. Yet, we must recognize the tremendous level of state support to establish rubber in China. Without that level of support and the view of rubber as a nationally strategic crop, rubber may have never been established in Yunnan. Much of the discussion of cold temperatures and rubber may become moot if mean global temperatures continue to increase with increasing levels of greenhouse gases. However, the lack of current discussion in Laos about the climatic risks to rubber growers is simply short-sighted. These risks must be recognized and planned for by GOL officials.

The major abiotic concern is the effect of cold temperatures on rubber. Temperature is an important factor in rubber growth. According to the Rubber Research Institute of Thailand (RRIT) the best temperature for rubber is between 25 to 28^{0}C. RRIT also suggests that the lowest temperature appropriate for rubber is 15^{0}C. Lower temperatures cause rubber to grow more slowly (RRIT 2003). Low temperatures affect rubber in India and China. Jianchu (Jianchu et. al., in press 2005) notes that harsh winter temperatures (min<10^{0}C) have affected Sip Song Panna in 1963-1965, 1969-1971, 1973-1974, 1980, and 1999-2000. He cites Chapman (Chapman 91, in Jianchu et. al. in press 2005) as saying that periodic cold temperatures have greatly affected local rubber farmers causing unstable income generation.

The RRIT says that the Chinese distinguish between two types of temperature regimes (or heating and cooling) and the resultant differing effects on rubber.

> ***Advective type***: *Cold temperatures in the cold season from winds or cold fronts and extended periods of with insufficient sunlight causes temperatures of less than 10^{0}C for approximately 20 days. This causes the shoot of the rubber trees to shrivel, dry dead leaves, and dead conductive tissues in the inner bark and outer bark. This causes small breaks in the trunk and latex to seep out of the bark.*
> ***Radiative type***: *In the cold season if there are daytime temperatures of between 15 to 20^{0}C and strong sunlight and then nighttime temperatures drop to 5^{0}C or less or sharp changes in temperature within the same day occur then rubber trees exhibit clear symptoms in the shoots and young leaves. Other symptoms will occur up to two months after such a sharp temperature change.* (RRIT 2003)

The brief history of rubber cultivation in Luang Nam Tha province clearly shows the risks to rubber growers of very cold temperatures. According to Muang Sing DAFO officials approximately 70% of the rubber planted by villagers in the mid 1990s died in the cold spell at the end of 1999. Random samples from a few of the villages that planted rubber at that time manifest the level of loss.

Table 3. Rubber trees lost in the December 1999 frost

Villages	**Rubber trees killed**
Ban BoakYaSaiMai	18,736
Ban Law Meu (1 person)	1,600
Ban Udomsin (1 person)	4,300
Ban Hat Nyao	34,000
Ban Huay Dam	7,000

As noted previously, the extreme levels of loss caused many farmers to give up on rubber planting and cultivation. Without a doubt, variety and planting location were important factors in determining tree survival. However, these factors are still very minor considerations in the rubber planting strategy of farmers and the policy considerations of GOL officials.

An additional abiotic factor that remains poorly considered is the affect of elevation, and temperature, on rubber. (Elevation has direct bearing on temperature, because temperature drops 0.5^{0}C for above 100 meters increase in elevation. To the extent that Thai rubber extension manuals written for southern Thailand consider elevation related to cold temperatures they use a benchmark figure of 900 meters above sea level (masl) as the limit for rubber cultivation. However, the extension manual written for northern Thailand states that rubber should not be planted above 600 masl. We did see rubber in Ban Nam Kiew Loei, Thailand planted at a fairly high elevation, but we were not able to check the elevation. A few farmers have planted rubber in Pu Reau, Loei which is certainly above 600 masl, but those planting are very recent. (Although Loei province is not considered to be northern Thailand, the climate is similar.)

Jianchu referring to Yunnan states anything above 700 masl is an extreme elevation for rubber, and if combined with an annual minimum temperature of $<10^0$C then farmers ought to be well informed of the risks (Jianchu et. al. 2005). They also note that state rubber farms in Jinghong County have most of their rubber land below 700 masl whereas the majority of small farmers have established rubber between 700 to 850 masl.

In Muang Sing, the DAFO office has drawn up rough guidelines for areas appropriate for rubber. They seem to have used approximately 900 masl as the maximum elevation allowed for rubber. In Khet Mom where villager interest in rubber is very strong, the DAFO GIS map of rubber zones shows substantial areas with elevations between 700 and 900 masl. With reference to Jianchu above villagers should be well informed at village meetings about the risks to rubber at these elevations. Certainly aspect and the microclimate of a specific location ought to be considered in a more selective consideration of areas suitable for rubber in each village. Both DAFO and PAFO should consider revising the use of the 900 masl benchmark for rubber, and instead consider the totality of the site along with rubber variety for each location. These agencies should assist villagers in making informed decisions about the possibilities and problems for rubber where they live.

As noted previously, the risk of fire to rubber planting seems inadequately considered by villagers. Ban Udomsin rubber farmers have lost 4000 trees to fire, and even the strong community organization of Ban Hat Nyao rubber farmers lost 800 trees to fire. If rubber organizations take root as an organizing force in villages heavily invested in rubber, it seems logical that fire risk might be one of the first issues that intra or inter-village organization might draft rules and regulations to prevent. If DAFO and PAFO conduct extension work on rubber to help farmers improve their rubber cultivation practices, such work should include sessions on the risks of cold and fire.

As above DAFO Muang Sing has drawn up a rough guideline for areas appropriate for rubber, and they have designated zones on a GIS map. DAFO used the following criteria: slope, presence or suitability for annual cash crops, proximity to or potential to be irrigated, proximity to the Nam Ha NPA, elevation, and proximity to water source for paddy area. These criteria are quite reasonable, but they should be revised as per the above comments.

Technology: Agroforestry and Cropping Systems for Rubber

Cropping Systems and Cover Crops

The research and extension literature is replete with multiple types of cropping systems for plantation rubber. In addition, systems exist for rubber that fall outside of the idealized plantation system. These systems share a general term of jungle rubber yet there are variants within this categorization related to relative intensity (spacing and tapping frequency), structural complexity, age limit of stand, etc. Within the diverse range of rubber systems one can delineate a number of agroforestry practices and systems. We briefly review the range of cropping and complex agroforestry systems below. We should note that most of the information is gleaned from reviewed articles, grey literature, and government extension publications. The team saw only a very limited number of different rubber cropping and AF systems.

As previously mentioned, the predominate rubber cropping system in Luang Nam Tha is rubber established with upland rice followed sometimes by pineapple or some vegetable crops. A very limited number of farmers choose not to plant other crops with their rubber. After the fourth year, sometimes the fifth, villagers do not plant anything in their rubber due to excessive shade.

There are well documented opportunities for improving or diversifying the current Luang Nam Tha rubber cropping system. The degree of improvement will depend on the inherent soil fertility, length of swidden fallow into which rubber is established, and degree of nutrient removal from harvest of an annual intercrop compared to a cover crop or green manure. Farmers will also need to consider whether an annual cash crop is preferable to upland rice and issues such as household food security and maintenance of cultural traditions regarding upland rice. Peanut established with rubber is an important intercrop in Malaysia and Indonesia. Lefroy (pers. comm.) says that heavy broadcast applications of rock phosphate (one metric ton per hectare) with peanut, or sugarcane, resulted in earlier tapping dates by up to 18 months. (Thai rubber extension manuals do not recommend planting sugarcane, casava, or castor bean trees with rubber though. However, cassava is apparently intercropped with rubber in Indonesia.) This system had two additional elements other than the heavy P application for farmers: a responsive variety (annual crop in the rubber) and soil erosion control. All farmers recovered the cost of the fertilizer application with harvest of first crop. This may not be possible in northern Laos given the high cost of fertilizer due to transportation costs although rock phosphate costs little in Thailand. Also rock phosphate supplies a relatively small amount of slowly available P in a very heavy bulk weight. Thai extension manuals suggest that farmers mix their own fertilizer using a mix of urea, di-ammonium phosphate (DAP) and potassium chloride. DAP might be a better alternative to rock phosphate. DAP also can decrease soil pH near the application area which would benefit rubber. Other short term perennial intercrops mentioned in some of the Thai rubber extension manuals include banana and papaya. Long term perennial/trees with rubber will be discussed below in a review of agroforestry systems with rubber. (Strictly speaking the interplanting of any annual with a perennial tree crop, rubber in this case, is an agroforestry practice yet we wish to separate the obvious interplanting of annuals with rubber during the first four years with longer term agroforestry systems with implications for long term diversity of production, sustainability, watershed function, and biodiversity.)

Watson states that early rubber planters established clean weeded plantations. They found the labor costs for this system prohibitive, particularly beginning with the depression of the 20's and 30's. Dove (Bauer 1948 in Dove 2002) notes that the clean weeded plantations had problems with diseases and pests whereas the rubber plantations established by small holders in a forest like system did not. He says two systems developed to replace the clean weeded system. The first utilized naturally occurring vegetation as a ground cover, and the second system required planting legume ground covers (Watson 1989).

The first system initially replicated the natural conditions for rubber. Rubber seedlings were allowed to establish naturally from seedfall and grow to tapping size within an existing plantation. Other growth was selectively cut to retain a complete ground cover. For estate holders of large scale rubber plantations this was not an attractive system due to the length time before tapping. However, growers retained naturally occurring ground covers in the rubber as a new modified system. As Dove and others show the complex agroforestry system developed by villagers in Indonesia predated large scale grower experimentation with this system. (Watson seems to believe that all knowledge about rubber emanates from large scale growers and research institutes. Dove's work is an important reminder that villagers can experiment with, develop, and influence systems to the same or greater degree as "formal" research.)

The second system of creeping legume cover crops is according to Watson now a widespread practice for new rubber plantings. Three main species are used: *Pueraria phaseoloides*, *Centrosema pubescens*, and *Calopogonium mucunoides*. (The former is called tropical kudzu or *piad* in Lao .) The covers are kept weed free and fertilized with rock phosphate (soils in southern Thailand and Malaysia are typically low in P and thus the importance of P additions for good legume growth and N fixation may be more critical in those areas than in northern Lao where P levels are not as low). Soil erosion is controlled from the cover crops' vigorous growth, but there is nutrient competition with rubber. The legume covers release accumulated nutrients and organic matter when they gradually die out from shading by the rubber. The released nutrients and OM contribution greatly benefit rubber growth (Watson 1989).

Watson cites several of the numerous studies on the effect of cover crops on rubber growth. In one study a mix of *P. phaseoloides* and *C. pubescens* was compared with naturally regenerated covers (no legumes) with high and low N treatments for all combinations during immature rubber. The legume covers significantly improved tree growth even within the high N treatment regime. The first trees with the legume covers were tapped at 67 months after budding. Over the first ten years of tapping the legume cover treatments had a mean advantage of 20% in cumulative yield. He says a review study (Broughton 1977 cited in Watson in Webster and Baulkwill 1989) calculated that the yield benefit from legumes lasted 18.6 years, or up to 20.9 years if compared with the low N treatment of natural covers. Watson states given the cost of bringing trees to tapping size with the legume cover/low N treatment being no more expensive than the natural cover/high N treatment, the earlier and higher yields of the former had highly significant profit advantages. Watson makes a key point brought forth from the reviewed research. It is worth quoting in full given its applicability to the general situation in northern Lao (Watson in Webster and Baulkwill 1989).

> *Indications are that on fertile sites, and particularly those newly cleared from forest, where organic matter and N levels are high, legume covers may show little advantage over natural covers. On poor to moderately fertile replanting sites, however, earlier and higher yields can be achieved by use of legume covers. These will more than offset their costs of establishment, and give substantially higher cumulative discounted returns.*

A number of alternative legume covers exist. Watson mentions several relevant to northern Laos: *Calopogonium caeruleum*, *Mimosa invisa* var. *inermis*, *Mucuna cochinchinensis*, *Styloanthes gracilis*. A *Mucuna* species is very common in parts of Luang Nam Tha. It exhibits very vigorous climbing growth and villagers say that when burned the smoke can irritate the skin. It might not be appropriate for rubber of a young age given its climbing nature, but if that could be controlled in small plots it might be an appropriate native legume cover for the area. We do not know if this species is *M. cochinchinensis*, but the species name suggests that might be the case. Watson says that *Stylo* sometimes depressed tree growth due to its high C/N ratio.

However, *Stylo* is an attractive species for cut and carry or controlled grazing systems. It might be very appropriate for some villagers and given CIAT's knowledge about this species in Lao farming systems it would seem to be a logical fit. The thornless *Mimosa invisa* mentioned by Watson has been planted by various projects in northern Lao and northern Thailand. It has done well in places, but as Watson concurs the rapid dessication of the plant in the dry season can be a fire hazard. Also, the plant tends to return to its thorny morphology over several generations according to some or be invaded unrecognized by the thorny *Mimosa*. The team saw one farmer in Nong Khai, Thailand using *Centrosema pubescens* as an experimental forage under rubber. Cover was not the goal of this planting, and he did not indicate that it benefitted the rubber. However he did say that the goats free grazing on the *Centrosema* improved the rubber through their droppings and weed control.

It is equally clear that CIAT's knowledge about non legume forages/grasses ought to be exploited to see what possibilities there are for species that provide cover and forage under the increasing shade levels of maturing rubber. Although *Chromolaena odorata* is regarded by some as a noxious weed under rubber Watson says that with regular slashing it is an effective cover though the rubber cycle. That is not the case for *Imperata cylindrica* which depresses rubber growth. A Thai extension manual for northern Thailand suggests planting Ruzi grass as a cover if legumes are not selected. Although the labor involved would probably be excessive, rice straw could be used as a mulch for new rubber seedlings within the rubber row or around the tree. Most lowland farmers in Muang Sing burn their rice straw, and if transportation and labor were not prohibitively expensive the rice straw might be important for select farmers.

Spacing in rubber varies incrementally ranging from 2.5x6 meters in hilly areas of Ban Hat Nyao to 3x8 meters in newer rubber plantings in Thailand. A rubber expert farmer and consultant in Nong Khai is experimenting with cluster plantings of two to three trees within a two to three meter cluster and 10 to 12 meters between clusters with fruit trees in the gaps. In China, the team saw an experimental plot of five to six rubber trees in an approximately 8 meter diameter circle. Chinese authors report AF systems of rubber and tea with 10 to 12 meters spacing between rows. Schroth (Schroth et.al. 2004) reports that Indonesian smallholders establish rubber in post harvest swidden fields with very high densities of 1500 to 2000 trees per hectare. They allow time and competition to reduce densities to 500 to 600 trees by onset of tapping. By year 40 density may approach 150 to 200 trees per hectare. Rubber trees in the native habitat of Amazonia are found at densities of 3 to 4 per hectare. It is clear that a wide range of planting densities is possible if farmers and researchers wish to experiment with more diverse cropping arrangements. For example, smallholders could establish rubber trees along fencelines; with a two meter spacing around the perimeter of a one hectare field a smallholder could have 200 trees. Other models in development include tightly spaced parallel lines of rubber with very wide gaps between the lines for planting other crops.

Agroforestry Systems and Rubber

A number of rubber agroforestry systems exist. We wish to distinguish between those systems involving simple combinations of one to a few perennials or trees with rubber and systems with a great deal more complexity including a wide range of species. The former would be most likely utilize the typical layout of a rubber plantation and the trees or perennials would be planted between the rubber rows. The spacing of rubber in such a system would vary according to the light needs on the nonrubber tree crop and other factors. The latter system might include spatially disarrayed rubber usually at the canopy level and then a mix of other tree crops, perennials, and even annuals. It might appear to be a native forest even from close proximity or with greater levels of intensity would resemble some of the well known home gardens of Indonesia.

A number of articles can be found about the rubber/tea system in China (Xu 1993, Cheo 2000, Parnham 2002, etc). This system is described as a simple agroforestry combination of rubber aligned in rows with tea planted in the inter-row areas. The between row spacing of the rubber may be widened to increase light levels for tea. We located only a single source with information on the extent of the rubber/tea system in China that gives the area as 10,000 hectares in Yunnan (Xu 1993 in Parnham 2002). Meng La County, Yunnan officials told the study team that there were 76,000 hectares of monoculture rubber in Meng La alone. During the study team's week in Sip Song Panna, China we saw no rubber/tea except for trial plots on the XTBG and an area near Meng La that had very widely spaced single rubber trees in a tea orchard. An XTBG scientist told us that there was more rubber/tea in the back roads, but he did not have area figures. It is clear that the area occupied by this system needs clarification.

Parnham states that research on rubber/tea began in the early 1960's in Hainan. Researchers wanted to look at how to best protect rubber plants from cold temperatures (Parnham 2002). They theorized that the addition of tea plants to the rubber plantations would protect rubber trees from cold by creating a near surface level canopy insulating the shallow rubber roots from heat loss. In addition, they postulated that the shallow rubber roots and the deeper tea roots would minimally compete for nutrients and water. They found that temperatures and wind moderated in the winter season in the rubber/tea agroforestry combination. In addition, relative humidity was higher in rubber/tea than rubber alone. (Dove [Dove 2002] notes similar improved microclimates in the complex rubber agroforests of Indonesia.) Subsequently, other researchers have confirmed that rubber/tea system moderates microclimate fluctuations, i.e. the rubber/tea system is warmer in the winter and cooler in the summer. Other findings show that runoff and soil erosion decrease (see Table 2) and soil moisture increases under the rubber/tea. Other research indicates that net primary productivity (NPP expressed as t/C/ha/yr) is higher in rubber/tea, and also that rubber tree root development in the top ten centimeters of the soil is higher. The same author cites several research findings showing that the rubber/tea system's income/unit area ranged from 58 to 131.5 percent higher than that of monoculture rubber and 75.6 to 96 percent higher than monoculture tea. Another finding cited by the same author determined that rubber/tea income was 82.7 to 85.6 percent higher than monoculture rubber. As noted by Angelsen and Kaimowitz (Angelsen and Kaimowitz 2004), discussed above, the high labor demands of agroforestry systems may limit deforestation, assuming closed labor market. A Chinese researcher (Xu 1993 in Parnham 2002) notes that the high labor requirements of rubber/tea create labor opportunities for local people. Cheo (Xu 1993 in Cheo 2000) cites other research showing the benefit of rubber/tea.

Table 4. Comparison of rubber yields between a single crop rubber plantation and a dual crop rubber and tea plantation

	Rubber Plantation Yield in kg./ha	Rubber/Tea Plantation Yield in kg./ha.	
Year	Plot 1	Plot 1	Plot 2
1	943.5	835.5	856.5
2	826.5	951	840
3	855	993	856.5

4	720	1093.5	978
5	1165.5	1573.5	1446
6	1609.5	1851	1416
Overall	6045	7297.5	6393
Average	**1009.5**	**1216.5**	**1065**

Source: Cheo (2000)

The relevancy of the Chinese rubber/tea model for northern Laos is uncertain. Although tea is grown in many Akha (and other ethnic groups as well) villages in northern Lao, with the notable exception of those villages forced to move by GOL policy, the tea is generally for home consumption. Yet many lowland merchants or guesthouses continue to buy Chinese or Vietnamese tea for sale to local markets. It would appear that there are markets for locally produced tea, and, indeed, a number of development projects in northern Lao are trying to market villager produced green tea. In the current group of GTZ target villages only Ban Sopee Gao grows tea. It seems logical that were GTZ to enter into some type of support for rubber growing in Muang Sing that Ban Sopee Gao would be a place to trial a rubber/tea system. However, one might ask if rubber/tea reaps such benefits why is it not more widespread in China. The answer might be related to family labor demands, i.e. family labor is already fully allocated on a given land unit; in addition, the hiring of outside labor on the typical small Chinese farm is not common or seen as a poor return on investment. Another answer might have to do with elevation and good growing condition being different for tea. Tea is generally thought of as a high elevation crop, and as discussed rubber performs poorly at high elevation. However, the team saw extensive tea orchards at fairly low elevations along the road from the Laos border to Meng La, and the XTBG had healthy looking rubber/tea. We conclude that should GTZ become interested in rubber/tea that intensive research should precede any implementation.

GTZ and Friends of the Upland Farmer (FUF) have tried cardamon plantings in a variety of locations with little success by most accounts. This is despite the success of cardamon orchards in southern Laos and China. A recent GTZ report points out the weaknesses and many failures in previous project work on cardamon, but it also mentions some villages where the cardamon has done quite well with even greater future potential. Rubber and cardamon may compete for soil moisture to the detriment of the latter. Nothing is known about the rubber/cardamon combination beyond its mention in the agricultural Chinese grey literature.
GTZ has significant experience with coffee, but the project leader believes that the work on coffee was a total failure. GTZ agricultural workers have a somewhat more moderate viewpoint. They point out that the project chose the wrong variety, and that planning for marketing was poor. If rubber/coffee were to have any potential in the GTZ target area this history would have to be better understood, and a better understanding of market venues would be needed.

No data are available on the extent of simple agroforestry combinations with rubber in Thailand. RRIT (RRIT 2001, RRIT 2003) has two extension manuals describing rattan under rubber and *ragam* (*Salacca wallichiana* and *Salacca zalacca*) under rubber. Both manuals do not describe the geographic extent of these combinations, but they do give planting instructions and as well as expected income. For instance, the manual on rattan (the Thai manual focuses in *wai dta ka tawng* used for furniture and handicrafts) cropped under rubber gives spacing of 2.5 to 3 meters apart offset in the middle of a rubber alley with rubber at the same spacing. Fertilizer is applied from year two on, and it takes 7 years for the rattan to reach marketable size. At that point, RRIT estimates rattan yield at 100 kilograms/rai (625kg/ha), and a market price of 25 to 30 baht/kilo would return 2,500 to 3,000 baht per rai (about 18,000 baht per hectare). An equivalent amount can be harvested yearly thereafter according to the RRIT. For the four species of ragam RRIT recommends spacing 5 or 6 meters apart between rubber rows spaced 2.5x8 meters or 3x7 meters respectively. Watering is needed for *ragam*. RRIT estimates irrigation costs at 2,000 to 12,000 baht/rai. With a 22 year lifespan for two species of *ragam* (RRIT assumes a 25 year rotation for rubber) RRIT estimates yearly profit at 3,000 baht/rai exclusive of rubber. For the two more expensive species of *ragam* they estimate yearly returns of 29,000 and 41,000 baht/rai. Although *ragam* is poorly suited to Laos, both the rattan and *ragam* agroforestry combinations are testament to the profitability of a more diverse farming system.

The study team visited one farmer in Nong Khai who had rattan for shoot cultivation planted as a fence row around a part of rubber plantation. The rattan showed no ill effects. Rattan for shoot cultivation is grown in Sakhon Nakorn and Nakorn Phanom and in neighboring provinces across the Mekong in Laos. Some rattan farmers in Sakon Nakorn have portions of their rattan under mango or coconut. Rattan under rubber appears to hold promise for Lao rubber farmers.

Above we discussed the possibility of *Stylo* under rubber for cut and carry forage or controlled grazing. Also mentioned was the above farmer who free grazed goats on *Centrosema* under rubber. These types of agro-silvo-pastoral systems have clear potential for Lao rubber farmers. Livestock under rubber may cause problems. Cattle may rub against trees damaging the bark. Goats may knock down the latex cups from the rubber trees. Excessive livestock numbers could result in soil compaction between rubber rows. However, the Nong Khai rubber farmer with goats used simple portable net fencing to control where goats grazed, and he tended to keep goats on the portion of his rubber plantation that he was not tapping on a given day. In addition, to the manure benefit accruing to the rubber, the direct market sale of livestock benefits family income. The Nong Khai farmer sold his goats to an ever present market in Bangkok and southern Thailand. Individual goats were sold for 2,000 to 3,000 baht for small goats up to 4,000 to 5,000 baht for large goats. He kept from 90 to 150 goats on 22 rai of rubber.

Beyond simple combinations of perennials with rubber in agroforestry systems, there are a number semi-complex to complex agroforests. These are often called jungle rubber, and these systems are found mostly in Indonesia (the original jungle rubber is in the Brazilian Amazon where it is harvested as an NTFP or semi-cultivated). Some southern Thai rubber farmers grow rubber in multi-story plots with fruit trees in what can best be described as semi-complex agroforests. There can be at least 6 different canopy levels in these agroforests. There are several types of agroforests with local names. RECOFTC students drew up a matrix with subjective descriptions of communities with rubber agroforests and those with typical rubber plantations (see Appendix).

Table 5. Comparison of communities with rubber agroforests and rubber plantations (RECOFTC 1998)

Characteristics	Rubber Agroforest Villages	Rubber Plantation Villages

Diversity of plant species	Very high	Very low
Strength of village organizations	Medium	Little
Sustainability of production	High	Variable
Income	Low	Variable
Initial investment	Low	High

Productivity	Low	Medium
Consumables (food, wood, etc)	High	None or Little
Village unity	High	Little
Benefits to the larger Thai society (watershed protection, forest cover)	High	Low
Potential for additional understanding of the system	High	Low

Although some of the above determinations are highly subjective, the overall thrust of the table still manifests some fundamental differences between the two types of communities. The RECOFTC study also describes rubber agroforest communities as being older, having better access to water sources, sometimes better soils, and a long history of planting rubber in agroforests. In fact, many of the agroforests are older than the majority of village inhabitants. These agroforests incorporate both old varieties of rubber and modern clones, and the rubber agroforests contain up to 55 plant species among them some 40 fruit or other tree species.

Interestingly, the study makes similar findings to those of Jianchu et. al.'s work on Sip Song Panna rubber farmers (Jianchu 2005). Both find that rubber monocultures tend to weaken community knowledge of natural resource management and the very availability of those resources. We will briefly discuss the implications of diversity and sustainability in relation to agroforestry and rubber later.

Yield and total hectares under rubber reveal several differences between rubber production in Thailand and Indonesia.

Table 6. Rubber Production, Land Area, and Ownership: Thailand and Indonesia

Countries	Year 2001	Year 2002	Year 2003	Large scale farmers	Small scale farmers	Total
Indonesia	1607 (1000 tons)	1630 (1000 tons)	1792 (1000 tons)	549,000 ha.	2,795,000 ha.	3,344,000 ha.
Thailand	2319 (1000 tons)	2615 (1000 tons)	2573 (1000 tons)			1,972,000 ha.

Source: IRSG 2004, BKK Post 2004

Indonesia has approximately 40 per cent more land under rubber than Thailand yet its production is approximately 40 per cent lower. The above figures show that smallholders account for approximately 83 percent of total rubber land in Indonesia. While the above table does not break down production according to small and largeholders, Dove (GOI 2000 in Dove 2002) using Indonesian government figures has smallholders with 86 percent of total rubber land and 79 percent of total production. (Using Indonesian government figures from 1992 and 1993 Dove [Dove 1994] has more than 1million smallholders with 2.6 million hectares.) Dove notes that the success of rubber smallholders in Indonesia overtime has been achieved with no government support and sometimes in spite of active government hostility to smallholder rubber. He comments further that the ability of smallholders to compete in this situation is predicated upon the mix of cultivating food crops, usually through swidden agriculture, for subsistence and cultivating rubber for cash needs.

Much of this smallholder rubber is in various gradations of complex rubber agroforests. According to the literature the particularities of the jungle rubber system vary through Indonesia, and no information was found that presented a broad scale survey of the variations of jungle rubber across Indonesia. We will briefly examine some of the general components of the system, because it is the general nature of the system that is relevant for Laos.

Farmers establish jungle rubber by planting rubber seedlings into upland rice. The rubber reaches maturity in about 10 years, and maybe tapped past 40 years, though one author found 80 year old rubber). As noted previously, initial planting densities are very high and decline to 500 to 600 trees per hectare by tapping time. By 40 years density may approach 200 trees at which point tapping profitability is marginal. Jungle rubber may be replanted after slashing and burning, but there may be a transition period during which villagers replant rubber in gaps created from dead rubber trees. One of the reasons that farmers may gap replant for a period is that completely replanting rubber reduces income for rubber farmers. For the poor rubber farmer the period after complete replanting until tapping may be a time of great difficulty (Schroth 2004). Schroth uses the term cyclic to describe these rubber agroforests, because the light needs of rubber trees and particularly seedlings limit a transition to a permanent agroforest where constant shade would be a limiting factor. Yet despite the cyclic nature of the rubber agroforests they have a structure similar to that of secondary forests in Sumatra. More than 70 tree species per hectare (dbh>10cm) have been found in productive rubber agroforests. The rubber agroforests have a closed canopy of 20 to 25 meters in height dominated by rubber but with a dense understory of many different tree species including seedlings of canopy trees. The dominance of rubber in the canopy creates a canopy based agroforest to distinguish between understory tree agroforests like shaded coffee (Schroth 2004). As the rubber agroforest ages species richness increases due to the declining density of rubber trees. Thus, as Schroth and others point out as the conservation value of agroforests increases rubber (latex) production decreases. As a result, research has begun to focus on the maintenance of rubber productivity in rubber agroforests to continue profitability for farmers while enhancing biodiversity.

Gouyon (Gouyon 2000) presents data from farmer interviews comparing jungle rubber with clonal plantations (see Table 6 below). There are marked differences between the profitability of the two systems based on the data. However, if one were to weight the conservation value and account for the alternative resources (NTFPs) coming from the jungle rubber the benefits arising from the jungle rubber would become more apparent. Apparently, as noted above, the ongoing research on jungle rubber improvement includes developing clonal varieties for rubber agroforests. Many of the small rubber farmers (50 percent in south Sumatra according to Gouyon) cannot afford to invest in clonal seedlings, and they often establish smallholding with unselected seedlings. Rubber varieties may account in part for the lower yields in rubber agroforests. In southern Thailand, villagers say that older rubber varieties dominant in the rubber agroforests (RECOFTC 1998).

Table 7. Average incomes of farmers with jungle rubber and clonal rubber

	Annual yield of dry rubber kg/ha/yr	Gross income (Rp)	Costs (including amortisation of initial costs)	Net income (Rp/ha/yr)	# of ha. needed to maintain a household
Old jungle rubber (>30 yrs)	400	1,200,000	50,000	1,150,000	3.8
Jungle rubber	600	1,800,000	100,000	1,700,000	2.6
Clonal seedling plantation	750	2,250,000	225,000	2,025,000	2.2
Young clonal plantation (7-10 yrs)	1000	3,000,000	500,000	2,500,000	1.8
Mature clonal plantation	1500	4,500,000	500,000	4,000,000	1.1

Source: Gouyon 2000

Dove (Dove 2002) describes four unique aspects of the development of jungle rubber by

Indonesian smallholder farmers. (Much of Dove's research is based on the Kantu people's integrated swidden and rubber system of West Kalimantan. Certain aspects of this system of jungle rubber may or may not be similar to other jungle rubber cultivators in Indonesia.) First, they linked rubber cultivation and their swidden system. During periods of intensive swidden labor, rubber is left alone. Conversely, during idle swidden periods rubber is tapped. Furthermore, multiple and dispersed rubber forests are created in proximity to swiddens. The rubber is generally only tapped if it is near the currently used swidden field. Second, the agroecology of these rubber agroforests helped with recovery from tapping and reduced diseases. The cyclic rubber agroforests reduced costs and fit with the swidden. Third, the socio-economic nature of the rubber/swidden system has several innovations. Women participate in production unlike trends for many global traded cash crops. Rubber is only part of the overall livelihood; it is cash crop for those household market needs as opposed to food crops for subsistence. Rubber production varies in intensity and timing. Production can be increased or decreased or stopped according to needs or market conditions. Rubber agroforests establish tenure over a given land unit in a climate where threats to land tenure by outside actors are omnipresent. Fourth, the overall system is a balanced, integrated system of cash crop and food crops which helps smallholder buffer against difficult economic conditions.
Dove's latter point speaks to this section's emphasis on agroforestry options for rubber rather than pure rubber monocultures. While the latter may certainly be a functional and economically important agricultural system, for smallholders, especially the type of farmers in the GTZ target areas, monoculture rubber would be neither ecologically nor economically resilient. At some point in the not too distant future, the typical price fluctuation cycle of a global commodity crop will resume leaving the ecologically marginal Lao rubber production subject to downward price movement and decreasing returns to labor.

It must be noted that the success of Chinese rubber is based on state subsidies and state farms. Although private rubber farmers now are significantly involved in rubber production in China, several sources state that national price supports continue at attractive levels. Chinese land pressure, interest in maximizing return from land, and the desire to create a favorable microclimate in cold stressed areas for rubber have all contributed to the development of the rubber/tea system. However, we do not know the true extent of the system, and therefore we cannot definitively determine the attractiveness of the system to smallholders.

Nevertheless, we believe that the various agroforestry systems discussed previously offer villagers in the GTZ target area the opportunity to move a potential rubber plantation towards greater ecological and economic resiliency. John Raintree (pers. com.) comments that Indonesian and Philippine swidden farmers incorporate more perennials into their swiddens. Thus, the fallows become low intensity agroforests. He does not believe that the incorporation of perennials into swiddens exists to the same degree among Lao farmers of all ethnicities. This argument appears to have some validity. Although there are Lao ethnic groups who have agroforestry systems (Lao Phrai and the miang system), the majority of crops introduced into swidden fields in Laos are annuals. Yet many Lao ethnic groups incorporate trees or perennials, some due to contemporary economic motivations, into their farming/livelihood systems, eg *paw saa*, silk mulberry, teak, field rattan, etc. So while a historical template may not exist among Lao ethnicities for complex agroforests to the degree it does in Indonesia, some ethnic groups are willing to adopt tree or other perennials to their farming systems. It is on this basis that we suggest that at least some of the agroforestry systems with rubber may be appropriate for Laos.

Whether it is a simple agroforestry combination of rubber and some other perennial, e.g.

rubber/tea, or a semi-complex to complex agroforest, eg, jungle rubber, all to an extent increase the range of products from a given land unit. A range of products can buffer against price fluctuations, create economic flexibility, and provide for livelihood needs and enhanced food security. Agroforestry systems make a land unit more structurally complex thus enhancing light, nutrient, and water capture (admittedly in stressed environments this may be a net deficit). The complexity may enhance biodiversity. Agroforestry systems may quite likely enhance watershed structure and function compared to rubber monocultures.

The majority of northern Laos is still dependent on swidden agriculture. Political dogma inveighs against swidden agriculture without offering any feasible alternative to nutrient input in a zero input system. Some at the policy level may think of rubber as the palliative cure for a system dependent on swidden. Some may also see the vast monoculture of rubber spread from hill to hill in southern China as the model for Laos. Should this viewpoint exist we take strong exception to it. We believe that those with the opportunity to assist villagers in developing alternative land use models ought to present the broadest range of farming system options with an emphasis on systems that are flexible, offer a range of products, are not completely at odds with village reliance on NTFPs, enhance food security, and where possible provide larger societal benefits related to watersheds and biodiversity.

To that end we suggest that the proposed rubber research center for Luang Nam Tha should look at the entire system and not just rubber. It will be more than a few years until Laos has scientists capable of doing varietal research on rubber. There probably will be a need for field testing of varieties from Thailand and China. However, the center should focus on how rubber can best integrate with the overall farming system. The center should look at agroforestry systems and rubber and be prepared to conduct, with farmer input and ideas, both on-station and on-farm research. Some potential suggestions might include complex agroforest rubber research with the remnant abandoned rubber from the post 1999 frost in Ban Huay Dam. The villagers say that the trees can be tapped, but the trees are so few that the return from sales will not cover equipment cost. Such a situation seems most appropriate for relevant research on the integration of rubber with NTFPs, cardamon, rattan, or other useful species. As noted earlier Ban Sop Iii Kao might be a village where research on rubber/tea would be met with interest. Any remnant coffee plots from earlier GTZ fieldwork might also be a venue for rubber/coffee research. An exploration of possible combinations of teak and rubber might also be appropriate. There are several other possibilities that could be generated from an open-minded dialogue with villagers, but initially the center should limit itself to a small group of trials based on relevancy, villager interest, and some element already present in Luang Nam Tha.

Chapter 7
Socio-Economic Implications

There are certain socio-economic implications of rubber tree cultivation in Luang Nam Tha. First are the risks which farm households have to take to cultivate rubber trees, eg, that of climate, market uncertainty, and availability of land and secure land tenure.

Risks

Climate

There are certain risks which farmers in Luang Nam Tha are confronted with in cultivating rubber trees. The first and foremost is that of the climate at about 21° north latitude and an elevation of almost 700 meters above sea level and above. At present there seems to be a killing frost at least every ten years in which immature saplings (ie, 1-7 years old) are vulnerable, especially if they are not planted on south facing slopes. This is much more the case with the RRIM 600 clone, which is thus far the most popular one planted, than it is with the GT1 clone, ie, the Chinese clone which is more cold tolerant.

Market Uncertainty

Another of the risks is that of market uncertainty. At present, B Hat Nyao the only village tapping rubber is a price taker when negotiating with the Chinese. They have virtually no independent rubber price information other than that which the Chinese merchants in the Mengla area tell them. Farm households are under the impression that the 'rubber boom' currently experienced now will continue indefinitely, and that they can continue to expand area cultivated.

Land and Tenure

In B Hat Nyao there is a limited amount of agricultural land under present land use planning and land allocation (LUP/LA) undertaken in 1997. They have a total of 1,700 hectares of agricultural land, which apparently is insufficient if they want to expand rubber tree cultivation. This is setting somewhat of a questionable precedent. Either the original designation of agricultural land was in correct or they are actually encroaching (so to speak) into a forest conservation area. Clearly LUP/LA has to be revised for most of the villages to reflect the realities of food security and cash income. There are other areas where rubber trees have been planted which may be jeopardizing watersheds, for example along the NR17 from Nam Tha to M Sing at about Km 25 (in the Nam Ha Conservation Area).

Insecure land tenure arrangements for land under rubber trees have not had much of an effect thus far on planting rubber trees, but as previously low value bush-fallow land becomes more productive with a valuable crop, it could become a real issue perhaps within the village and with outsiders.[40] This issue of issuing more permanent land certificates and titles really needs too be addressed – otherwise future investment in rubber trees will be hindered.

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[40]Which we saw in Baan Huay Dam when various investors tried to make arrangements which would deprive households of their land.

This whole issue of rubber tree planting, especially on land hitherto considered only valuable for shifting cultivation of upland rice, corn, roots and tubers, etc, will now be more worthwhile with expectation of high cash incomes from the sale of rubber. Some of this potential land has been classified as protected forest.

Other Important Factors

Cultivation Practices and Technical Information

Rubber producers at this time have received limited technical information concerning rubber tree cultivation, post harvest processing into various types of products. Most of this information has come from either relatives in SSPN or from Chinese merchants. Virtually none of the farm families use fertilizer on their saplings during the eight year immature stage, thus stunting proper growth to the required 50 centimeters in girth subsequently delaying tapping to year eight or nine. As related to processing and sale, now they only pour the raw latex into containers or pits (tub lumps) where the coagulated rubber is contaminated with dirt and small stones. Consequently they receive a relatively low price for a poor quality product. While the DAFO and PAFO attempt to be helpful, their staff still have little training and extension information to assist farmers.

Labor

Labor requirements for rubber tree cultivation are considerable for establishment, maintenance, and harvesting.[41] Thus far, the B Hat Nyao households have fit rubber into their livelihoods systems. The alternating days of tapping have facilitated working on other livelihoods activities. Less well-off and some mid-level household's subsistence upland rice activities have taken precedence over rubber cultivation activities.

At some time labor could become a limiting factor in tapping since households prefer to undertake the delicate task themselves in fear of hired labor harming the trees. According to rubber specialists the maximum number of trees which should be tapped by a person in a day is no more than 600 trees, amounting to a limit of about 1.3 hectares per person in the household. So with full-time available labor three persons in the household the area tapped would not recommended by them to be more than 3.5 hectares unless the household taps half of their trees on alternating days. If they do so, then this obviates most other livelihood activities and contributes to the risks of a monocrop.

Funds

The costs of rubber tree establishment and a maintenance in the immature stage are considerable especially due to the lag time in waiting for returns to investment and for profits and the relative inexperience of most Lao farmers with long term investments. Most of the cash costs are for hired labor to prepare land and establish their rubber trees. Some materials for fencing, fertilizers, weedicides and other chemicals are needed even though most of the current para rubber farmers in Luang Nam Tha presently use very little fertilizers and chemicals, they realize that it is important for earlier tapping and better harvests.

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[41]Of course, this would even be more if post-harvest processing includes raw rubber sheet making.

Only a portion of the investment costs were self financed from either nuclear or extended family savings. Debt in these early years was not excessive especially with inflation and the effects of the economic crisis of 1997, but in future it is likely to become more serious and mechanisms will have to be developed to offer credit to smallholders. The effect of the frost kills of 1999 on the early villages who planted para rubber have yet to be fully evaluated. Some of the villages' (except for B Hat Nyao) rubber trees were virtually wiped out after the frost of 1999. There still has yet to be any decision by the province as to whether those loans will be forgiven or have to be repaid. Obviously these kinds of provisions for natural disasters will have to be anticipated in any future loans.

The Agriculture Promotion Bank (APB) thus far has been administering provincial funds for the costs of establishment, especially seedlings and fencing, and it also provides short-term working capital. To the team's knowledge there is still no formalized credit from any of the banks for longer run capital needs for long-term perennials such as para rubber trees. In the past year or so there have been some cases of local business peoples, government employees, and others providing capital for land preparation and para rubber tree establishment. However, the arrangements are suspect since the lenders try to obtain ownership of some of the land to be planted in para rubber (see Chapter 9 Legal).

If somehow these credit needs are not addressed in the near future, it will be more and more difficult for smallholders to cultivate rubber trees. They will only become more vulnerable to speculators who will supply the capital – only to get titles to the land.

Profitability

Profitability is a major concern for farmers engaging in commercial enterprises throughout the world. The sampled farm households of B Hat Nyao have experienced quite good profits from their rubber enterprise which began by the plantings in 1994 and 1995. This was in part due to the windfall gained through inflation plus the devaluation of the Lao Kip after the Asian financial crisis of 1997, which amounts to about 1,000 percent. Thus, the funds that they invested, their own or that provided by the province thorough APB, were considerably cheaper then than now. However, when considering this change constant 2004 prices were used to calculate profitability. Without accounting for household labor they still showed considerable net returns for the life of their rubber enterprise, ie, eleven years (cf Chapter 5).

We then projected out the costs and returns into the *future* for a thirty year period beginning in 2004 (cf Chapter 8). When undertaking this financial analysis of rubber trees into the future the results are mixed. In this analysis we projected the increased use fertilizer which increased costs considerably. Also, we projected that farm households would continue to sell tub lumps, since their profitability is limited to lower prices and little value added. However, if households would transform their latex into clean cup lumps, raw rubber sheets (or even smoked sheets), or possibly raw liquid latex in the future, their profits should be higher.

Ethnicity

It is clear that the success of rubber production in B Hat Nyao is related to their Hmong ethnicity and its concomitant societal structure and its culture. The traditional community organization which exhibits a great deal of solidarity behind its leadership once decisions are made. This includes the community's initiatives to seek information on viable livelihoods alternatives and then to pursue their common goals with gusto.

While each ethnic group has its own unique social structure, culture and customs, they have differing views of 'development' than do either the dominant lowland culture or the foreign donors large and small. Obviously agricultural practices, marketing, community organization and ways of borrowing money are not only unique to the various ethnic groups but vary within ethnic groups in different locations. It is clear that different ethnically sensitive extension methods will be required to assist with individual farm households and with communities in organizing villages to cultivate rubber trees in consolidated areas, to do group purchasing inputs, and to sell as a group.

The B Hat Nyao community should be lauded for its setting up the village rubber welfare fund [VRWF] to channel some of the benefits of the rubber enterprise to the community. Hopefully other villages will see the necessity of this type of sharing of rubber benefits within the community. But one should be mindful that ethnic groups not only are diverse, but that villages within an ethnic group vary in their types of community organization. Much of this variation depends on their history and the types of ecosystems they reside in.

Livelihoods Systems

The cross border relations of the Hmong in B Hat Nyao, the Yao in B Oudomsin, and the Akha in Khet Meuang Mom were very crucial for then as innovators and early adopters.[42] On the other side it seems as thought the Khmu villages at the time had less contact with either relatives or other trusted acquaintances in China and are likely to have suffered for the lack of such a meaningful experience. It probably may not be as crucial for the relatively later adopters to have these networks of the present time since these farm families will undoubtedly be more influenced by family, friends and other trusted contacts in their own and in nearby villages when they consider para rubber tree cultivation.

Clearly rubber production requires changes in livelihoods systems. First and foremost is that of a future orientation investing in planting any long-term perennial crop with it deferred profits. The farm households presently cultivating rubber either in B Hat Nyao or in M Sing have altered their livelihood systems somewhat to 'fit' rubber into them. The most important adjustment is that of allocation of labor for the alternate day tapping early in the morning. While their livelihood systems are likely to become more para rubber tree-based, they still practice other important components. Thus, households distribute their labor inputs across various enterprises as deemed necessary. Land use planning at the village level has to be reconsidered according to the new realities not only of para rubber tree cultivation but also for other possible commodities for the market, especially industrial production.

Food Security

Clearly food security is the first and foremost concern in all villages studied with most households in these rural, remote and mountainous areas. All village leaders reported overall village rice deficiencies, and in B Hat Nyao five out of six households experienced rice

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[42]See Rogers 1983 for this classification.

deficiencies. From reports of the less well-off and mid-level households many would temporarily discontinue their rubber activities to work on the upland swidden rice. This distinctly illustrates rubber is important for cash income, that households have strategies for *food first*. We must be mindful of this when we plan interventions.

Markets

The proximity to the number one consumer of rubber products in the world (ie, China) its promising trends within the near future forebodes well for existing and potential para rubber tree cultivators in Luang Nam Tha. However, because it is the Lao PDR, local small markets still prevail with their rather inelastic demand, where increases in supply will lower prices. The Chinese merchants are aware of this and will continue to squeeze farmers until there are more traders and options to increase competition.

As compared to what the team saw in NE Thailand, the technologies both at the farm level and in factories seemed to be lacking somewhat. The Chinese companies in Mengla County have thus far not deemed to improve the quality of the product offered[43] and thus have indirectly limited value added at the farm level for the farmers of B Hat Nyao. While the Collection and Sales Committee always tries to negotiate the bests prices for their members, they are still price takers. They are never sure what so-called world prices are. Even though the village rubber grower's association is extremely active, it has yet to really negotiate bulk purchasing of inputs.

Since rubber is being considered by both the provincial and central government as playing such an important role in eliminating shifting cultivation, poverty elimination and eradication of poverty, surely some measures will have to be taken towards making it a strategic commodity. To begin with a policy (or policies) will have to be formulated to deal with production, processing, marketing, etc. This undoubtedly will involve number of ministries, beginning with the Ministry of Agriculture and Forestry (MAF), the Ministry of Industry and Handicrafts (MIH), the Ministry of Commerce (MOC) and perhaps some others. A number of programs will have to developed for various agencies at all levels. Perhaps some new agencies dealing with rubber may have to be developed. An example of this maybe some agency similar to Thailand's ORRAF. Then there is the fledgling agricultural extension service, which has yet to really include much information on para rubber cultivation, processing, marketing, etc.[44]

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[43]This refers to the tub lumps, which sold this year for about ¥5.5/kg. Reportedly, raw rubber sheets sold for about ¥9/kg and smoked rubber sheets sold for about ¥13-16/kg.

[44]The PAFO/PAFES in Luang Nam Tha is the leader thus far, and it is still somewhat lacking.

Chapter 8
Financial Analysis of Rubber

Background

The financial viability of smallholder rubber production is based mostly on data gathered from Baan Hat Nyao village from a panel of rubber farmers and from the six households interviewed about their rubber enterprises. It is an idealized model of for the cultivation of one hectare of para rubber trees. It assumes a spacing of 3x7 meters for a density of about 476 trees per hectare.[45] Farm households in B Hat Nyao, B Oudomsin and in other places planted mainly two clones of rubber trees, eg, RRIM 600 and GT1. A time period of 30 years is considered since this seems to be the outside limit for rubber tree cultivation in NE Thailand.[46]

Factors and Costs

Immature Stage (Years 1-7)

Establishment (Year 1)

The investment costs, which are incurred in the establishment stage are mostly for materials, eg, seedlings, fertilizer, and fencing. Most of the labor is supplied by the household and is not costed out since it is assumed to have zero opportunity cost at present since there is no real labor market other than for agricultural labor, which many farm households with land do not see off-farm employment in agriculture as a viable alternative.[47]

Table 8.1: Resource use in stages (25% fertilizer use))

	Labor			Materials	Variable	Total
		Hired				
Stage	HH (PDs)	(PDs)	(Kip)	Cost (Kip)	Cost (Kip)	Cost (Kip)
Immature (yrs 1-7)	***606***	***140***	***3,500,000***	***3,484,000***	***6,984,000***	***22,134,000***
Establish (yr 1)	24	140	3,500,000	3,484,000	6,984,000	7,584,000
Interrcropping (yr 1)	194	0	0	0	0	4,850,000
Maintenance (yr 2-7]	388	0	0	0	0	9,700,000
Mature (yrs 8-30)	***1,451***	***140***	***3,500,000***	***25,372,220***	***28,872,220***	***65,147,220***
Maintenance	230	0	0	0	0	5,750,000
Tapping	1,221	0	0	25,372,220	25,372,220	55,897,220
Rubber Timber	0	140	3,500,000	0	3,500,000	3,500,000
Total	**2,057**	**280**	**7,000,000**	**28,856,220**	**35,856,220**	**87,281,220**

[45]Five hundred trees are accounted for to include 5 percent death loss in establishment.

[46]The study in northern Thailand (Supawadee 2004) found that the optimal growth period to be 21 years.

[47]In fact, there might a slight opportunity cost of household for some months of the year.

- It is stated that these figures are from Hat Nyao. However, I can't find them in Chapter 5.
- The lack of opportunity costs: what about the opportunity cost of growing another cash crop?
- For clarity: explain why at 25% level in header for the table

Hired labor (100 PDs, valued at Kip 2.5m) is used for land preparation, including cutting and burning, digging holes for seedlings and terracing. Household labor (3 PDs) is used for digging postholes, cutting fence posts, filling holes and stringing fence. Most all the nursery and planting is done by household labor (21 PDs), however, the slashing of weedy growth and clearing of fire break are sometimes hired out (40 PDs).

It is estimated that only households who hire labor at present are mostly those households classified as well-off in the village and of course this adds to their costs of production at the current wage rate of Kip 25,000 per day in B Hat Nyao. Hired labor would have been used for land clearing by many of the households except the lower socio-economic level households whereas, land clearing, fencing, making of fire breaks are hired by the better-off households.

Thus, we are not assuming any fertilization of the trees at establishment or during the immature stage (years 1-7) for these types of soil conditions which have been lying fallow for 5-10 years.[48] Other than for a manure slurry used on seedlings no fertilizer was used by the households of B Hat Nyao for the trees planted in 1994 and 1995. Farmers state that now they realize the benefits of rubber they should have used fertilizers on their rubber trees, and that they would use them in the future. But as is the case of most farmers in mountainous areas of Laos, they are highly reluctant to use many purchased inputs. Also, since the soils in many of these areas of Luang Nam Tha are in either production forests or other agricultural land which has been lying fallow for 5-10 years, it does not necessarily need so much fertilizer in the immature stage.

Other factor costs are the cost of the seedlings and budded stumps, which now cost on the average about ¥3.5 or ($0.44 or Kip 5,000). farmers in B Hat Nyao and some other villages are beginning produce them in their own nurseries. Not only will this bring the cost down but it will also reduce the risk of buying inferior seedlings in China. Since the farmers of B Hat Nyao planted rubber trees on consolidated contiguous fields fencing for one hectare was approximately 100 meters long, which implies 50 post holes to be dug and filled, 50 posts to be either cut or purchased, and 400 meters (four strands) of barbed wire to be strung. The materials cost for fencing is Kip 984,000 for posts, wire and nails.

The total investment costs (cf Table 8.1) in establishing rubber trees is Kip 6,984,000 ($678.06), including Kip 3.484m ($338.25) materials and Kip 3.5m ($339.81) for hired labor. However, accounting for all labor, ie, both HH and hired, the cost of establishing rubber trees is Kip 7.6m ($736.31), and including all labor in intercropping in the first year it would be Kip 12.4m ($1,207.18).

It is uncertain as to how much of this can be financed with external funds. In the past the provincial government has supplied funds through APB to provide funds for credit for certain

[48] This is unlike both northern and northeaster Thailand, where rubber trees have been planted on land which has recently been used for cultivation of other crops.

earmarked villages. One of the problems with lending to households and groups in mountainous and remote areas is that the borrowers cannot use land without titles as collateral, thus they will not receive credit.

Intercropping of upland rice is assumed here during the first two years.[49] This is all done with household labor for a total of about 284 PDs (Roder 2001:10) for planting, weeding and harvesting for each year. There are no materials costs incurred since the rice seed was from their own stock.

Maintenance (Years 2-7)

Maintenance is undertaken on the rubber trees from years two to seven. Households labor is used for weeding except where hired labor is used by households who are better-off. Households labor amounts to 284 PDs for maintenance and 194 PDs for intercropping in the second year. There are no cash costs for materials, since we are assuming no fertilizer use over the six year period. Household labor is used for maintenance, ie, mostly for weeding.

Mature Stage (Years 8-30)

Here we assume that with proper care tree growth will reach the standard of 50 cm and tapping can begin in year 8 and last until year 30. The period of tapping in Thailand for both the north and the northeast ranges from 25 to 30 years.

Projections of fertilizer use during the mature stage (years 8-30) are according to RRIT's recommendations for northern Thailand under similar circumstances. However, these recommendations are adjusted down to 50 percent since Lao farmers are quite averse to such high input costs.[50] RRIT recommendations for this mature stage in northern Thailand are 475 kilograms per year (of which 237.50 kg would be 50%) amounting to Kip 845,500 (or $82.09) for a total of Kip 19.45m over the 23 year period. This one high factor cost makes this enterprise somewhat risky.

- What about the 25% mentioned in table 8.1?
- How did you calculate the improved yield caused by using fertilizer?

Once trees are in the mature stage weedicides are becoming increasingly important. Of course, in tapping disinfectants and chemicals to induce latex flow are crucial. These are not very expensive (Kip 122,000/yr or $11.84) and easily obtained in China.

Production

[49]In fact some households also intercropped corn during the first two years, and a few households cultivated pineapples until the fourth or fifth years.

[50]It is a matter of conjecture what the effect of fertilization would be at establishment and during the immature stage, on speeding up growth of trees to a girth of 50 centimeters for earlier tapping under these types of conditions. The late beginning of tapping in Year 9 experienced by the farmers of B Hat Nyao could be attributed to this lack of fertilization, latitude or even elevation, which will have to be carefully examined in a program of on-station and on-farm trials once the research station is established in Luang Nam Tha.

During the first two years an intercrop of upland rice is planted. With a seven year fallow period it could yield 1.5 tons per hectare in the first year and perhaps 1.0 tons in the second year. Here we will assume yields of 1.0 and 0.8 tons per hectare, and thus gives benefits in the first two years. This is rather conservative since some farmers reported cultivating pineapples from years 2-5. There are many possibilities for intercropping with the rubber tree seedlings during the early immature stage, and there are a number of options concerning agroforestry production throughout the life of the rubber trees. The rice itself is consumed by the household and thus does not have to be purchased.

Rubber yields are based on the actual yields in the first three years of tapping (2002 - 2004) from the six responding households, eg, 585 tons/ha, 1,151 tons/ha, 1,285 tons/ha, and respectively. The projected yield estimates (for the period from years 11-30) are adjusted from the RRIT production data for RRIM 600 to the average of 105 tapping days in B Hat Nyao (cf Table 8.2). It must be kept in mind that the production data for B Hat Nyao indicate performance at a range of about 650-700 meters above sea level. These yields peak at 1,694 tons per hectare.

Table 8.2: Projected rubber yields by years (kg/ha)

8	9	10	11-14	15-19	20-30	Total
585	1,151	1,285	1,593	1,542	1,200	30,305

- The average yield in table 5.14 is different from the one mentioned here (year 2004 = year 10?): 1,361.48 kg/ha

Sales

Present rubber sales is limited to that of tub lumps, which are the only form of rubber currently sold in Luang Nam Tha. We are not sure of the parameters in Luang Nam Tha for the other rubber forms, such as raw rubber sheets, smoked rubber sheets, and raw latex liquid. The average price obtained in 2004 was ¥5.5/kg (US$ 0.69/kg), but in calculating financial benefits into the future a conservative price for tub lumps of ¥5.0/kg (US$ 0.63/kg).[51] We would to have liked to have estimated the possible benefits from the sale of other rubber forms, such as raw rubber sheets and liquid latex, but we were uncertain of the parameters and the subsequent prices.[52]

While it is conventional to include the sale of rubber timber at the endo of the production cycle, while there is market in Sip Song Panna, there is virtually none in Laos yet. A rubber timber price of ¥360/m³ ($45/m³) is cited in Mengla and estimate that the farm gate price in Laos would be about ¥280/m³ ($35/m³) in Laos (cf Hatten 2004). They estimate that the 70 m³/ha would be available for timber sale (valued at $2,450 or Kip 25,350,000) and another 130 m³ of branched wood for charcoal (valued at $1,300 or Kip 13,390,000). It is estimated that 140 PDs of hired labor would be required to harvest this.

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[51]The price of rubber is likely to go up even more in the future.

[52]It was rumored that raw rubber sheets sold for ¥9/kg and smoked rubber sheets for ¥13/kg in Mengla County.

Financial Analysis of Rubber

In the financial analysis of rubber cultivation we will look at three different scenarios: 1) that with the Thai recommendations for the north, but with no fertilizer in years 1-7 but for years 8-30 as stated above; 2) 50 percent of the Thai recommended use for years 8-30; and 3) 25 percent of the Thai recommendations for years 8-30. For these recommendations see Appendix 2, Table 3.

The total revenues or benefits of planting one hectare of rubber trees undiscounted for the thirty year period is Kip 238.4m ($23,147.79). Depending upon the level of fertilization[53], as discussed above, the total variable costs (without HH labor) ranges from Kip 35.7m ($3,471) to Kip 64.9m ($6,303), and the net returns range from Kip 187.5m ($18,204) to Kip 202.7m ($19,677). These are the returns to land (cf Table 8.3 below).

For the northern Thai full fertilizer recommendations the returns to household labor are Kip 116,154/PD ($11.28), and for all labor the returns are Kip 105,233/PD ($10.22). Subsequently the annual average returns per person day are Kip 3,872/PD/yr ($0.38/PD/yr) for HH labor and Kip 3,508/PD/yr ($0.34/PD/yr)[54]. The returns to capital obviously are dependent on in fertilizer use, ie, including HH labor returns to capital are Kip 3.67 Kip per each Kip invested and Kip 2.05 per Kip invested with all labor.

With 50 percent of the recommended fertilizer use the returns to HH labor are Kip 118,800/PD ($11.53) or an annual average of Kip 3,960/PD/yr. The returns to all labor are Kip 107,561/PD ($10.44) or an annual average of Kip 3,585/PD/yr. The returns to capital are Kip 5.24 per Kip invested without HH labor and 2.84 Kip per Kip and with all labor.

And finally for 25 percent the recommended fertilizer use the returns are Kip 123,476 ($11.99) or an annual average of Kip 4,116/PD/yr. The returns to all labor are Kip 111,678/PD ($10.84) or an annual average of Kip 3,7234/PD/yr ($0.36) The returns to capital are Kip 6.65 per Kip invested without HH labor and 2.73 Kip per Kip and with all labor.

Table 8.3: Undiscounted costs and return of rubber production in constant 2004 prices

Fertil-ization	Total Variable Costs (w/o HH Labor)	Net Return	Returns to HH Labor	Returns to all Labor	Capital

[53]Increased fertilization level should increase yield and thus returns, but the response is not exactly known until trials are done under similar circumstances.

[54]These average returns are considerably below the present agricultural wage rate of Kip 25,000 per day.

Fertil-ization	Total Variable Costs (w/o HH Labor)		Net Return		Returns to HH Labor		Returns to all Labor		Capital	
	(Kip)	(US$)	(Kip)	(US$)	(Kip/PD)	(US$/PD)	(Kip/PD)	(US$/PD)	(Kip/Kip)	(Kip/Kip)
100%	64,923,100	6,303.21	187,504,195	18,204.29	123,476 (4,116/yr)	11.99 (0.40/yr)	111,678 (3,723/yr	10.84 (0.36/yr)	6.65	2.73
50%	45,476,600	4,415.00	192,945,612	18,732.58	118,800 (3,960/yr)	10.44 (0.38/yr)	107,561 (3,585/yr)	10.44 (0.35/yr)	5.24	2.84
25%	35,753,350	3,471.20	202,668,862	19,676.59	123,526 (4,118/yr)	11.99 (0.40/yr)	111,722 (3,724/yr	10.85 (0.36/yr	6.67	3.69

If we examine the costs and returns over time we normally discount them. Here we will present three different levels of discounting, eg, 10, 15 and 20 percent. Due to the nature of such a long term perennial crop and the imperfections in the credit market, the higher discount rate is probably more realistic. Again, we will examine this with the assumptions mentioned above without accounting for family labor (cf Table 8.4).

Obviously the financial indicators, ie, net present values (NPV), internal rates of return (IRR), and benefit/cost ratios (B/C) are highest for lower discount rates and for lesser fertilizer applications.

Full fertilizer

If we examine closer the returns for full fertilizer recommendations in northern Thailand, the net present values of net returns (ie, revenues above variable costs) range from Kip 26.4m (10%), Kip 11.3m (15%), and Kip 4.6m (20%). The internal rates of return (IRR)[55] are 16.75 percent (10%), 11.96 percent (15%), and 6.72 percent (20%). The respective benefit/cost ratios are 2.52 (10%), 1.96 (15%), and 1.50 (20%).

50% fertilizer

At fifty percent of fertilizer recommendations in northern Thailand, the NPVs are Kip 3.4m (15%), and Kip 5.7m (20%). The IRRs are 18.11 percent (10%), 13.22 percent (15%), and 8.02 percent (20%). The respective B/CS are 3.25 (10%), 2.37 (15%), and 1.72 (20%).

25% fertilizer

The returns for 25 percent of the northern Thailand fertilizer recommendations, the NPVs are 32.1m (100%), Kip 14.3m (50%), and Kip 6.3m (25%). The IRRs are 18.89 percent (10%), 14.00 percent (15%), and 8.63 percent (20%). The respective B/CS are 3.78 (10%), 2.64 (15%), and 1.86 (20%).

Table 8.4: Discounted returns oo one hectare of rubber tree cultivation

Discount Rate	NPV (Kip)	IRR (%)	B/C
100% N Thailand			
10%	26,372,933	16.75%	2.5228
15%	11,344,730	11.96%	1.9612
20%	4,561,980	6.72%	1.5027
50% N Thailand			
10%	30,227,141	18.11%	3.2450
15%	13,378,631	13.22%	2.3696
20%	5,723,988	8.02%	1.7234
25% of N			
10%	32,132,734	18.89%	3.7800
15%	14,389,912	14.00%	2.6432
20%	6,303,411	8.63%	1.8596

Source: RRIT 2547
NB: no fertilizer yrs 1-7; fertilization from years 8-30

Summary

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[55]The IRR is the rate at which the present worth of the cost is equal to the present worth of the benefit. Sometimes it is referred to as the discounted yield or discounted cash flow rate of interest (Wicks 1984). It is actually the interest rate received for receipts and expenditures over the life of the investment.

As mentioned above 25 percent of the northern Thailand fertilizer use during the mature stage (years 8-30) would be most likely for northern Laos. Also, that using a 20 percent discount rate would seem most realistic due to the nature of a perennial crop with such a long period before reaping the benefits and a risky capital market as in northern Laos. This means that the net present value of the income stream for the period is Kip 6.7m. This is rather low for such an investment. Obviously the NPVs are higher for lower discount rates.

- According to the table, it's Kip 6.3 m. For clarity, explain what NPV means and why 6.3 m Kip is "low for such an investment"
- For instance: the farmer makes Kip 6.3 m. for working 30 years?

The internal rate of return or interest rate for the investment is 8.63 percent, which is also quite low. However, looking at present sparsity of alternatives for farmers in Luang Nam Tha it is probably worthwhile.
The benefit/cost ratio is 1.86 at a discount rate of 20 percent reflecting the approximate opportunity cost of capital. At a B/C ratio 1.86 the enterprise would be considered feasible.

Comparisons

Thailand and Sri Lanka

It would be ideal to compare rubber production in Sip Song Panna with Luang Nam Tha but then we did not obtain much data in China. So we will compare with data from northern and northeastern Thailand since the situations are similar. Comparison with Sri Lanka is does done because they are small holders with mixed systems and are reportedly somewhat representative internationally.

The yields in the N Thailand study are broken down by categories of years as in **Table 5** below. Those in B Hat Nyao are 585 tons/ha (year 9/1), 1,151 tons/ha (year 10/2) , 1,285 tons/ha (year 11/3). (The first number represents the age of the tree and the second number the tapping year.) Thus for years 9/1 - 10/2 in B Hat Nyao the average yield is 868 kg/ha or about half of that of that attained in northern Thailand. This is undoubtedly due to three factors, ie, lower latitudes, lower elevations, fertilizer use, and perhaps experience.

Table 8.5: Actual yields by ages of trees in Thailand, Sri Lanka & Luang Nam Tha (kg/ha)

N Thailand				Sri Lanka							Lao PDR			
8-10	11-14	15-20	>21	7	8	9-13	14	15	16	17-25	8	9	10	Avg
1,730	2,011	1,306	973	160	320	480	640	800	960	1,280	585	1,151	1,285	1,007

Source: Supawadee 2004

In the recent study on rubber production in northern Thailand [56] (Supawadee 2004), they found that the investment costs for 15 rai were THB 46,116 ($480.42/ha or Kip 5.1m/ha). In the study from Sri Lanka (anonymous 2004) the start up investment costs are $1,211.30/ha. This compares with an investment cost of Kip 6,984,000 ($678.06) without accounting for HH labor;

[56] This study was undertaken in nine provinces of the northern regions of Thailand, eg, Khamphaeng Phet, Uthaithani, Phitsanulok, Uttaradit, Nan, Phrae, Phayao, Chiangmai, and Chiangrai.

and including all labor Kip 7,584,000 ($736.31); and Kip 12,434,000 ($1,180.48) with all labor and including the first year intercropping in Luang Nam Tha. Luang Nam Tha and Sri Lanka require virtually the same labor requirement at around 340 person days. It's unfortunate that we do not have the number of person days required to establish an hectare of rubber trees (cf Table 8.6).

Table 8.6: Investment costs per hectare

	N Thailand	Sri Lanka	Lao PDR*	Lao PDR**	Lao PDR***
PDs	?	341	144	144	338
local currency	99,025	120,100	6,984,000	7,584,000	12,434,000
US$	$2,475.63	$1,211.30	$678.06	$736.31	$1,180.49

*w/o accounting for HH labor
**accounting for all labor
***all labor with intercropping

In comparing returns to land for similar years the northern Thailand returns are considerably more than those in Luang Nam Tha, reflecting the factors mentioned above, along with management and institutional reasons, such as both input and output markets, credit, and extension (cf Table 8.7 below).

Table 8.7: Net returns by ages of trees in Thailand, Sri Lanka & Luang Nam Tha ($/ha)

N Thailand					Sri Lanka					Lao PDR*			
8-10	11-14	15-20	>21	Avg	7	8	9-13	14-16	17-25	8	9	10	Avg
1,275.68	1,670.12	993.52	663.76	962.88	161.37	322.74	484.12	806.86	1,290.97	269.73	619.36	703.93	655.89

Source: Supawadee 2004
*NB: with 25% of northern Thailand fertilizer recommendations

In comparing the financial analysis of the three studies the net present values (NPV) of the farmers in the northern Thailand study[57] and the Sri Lankan study are higher by factors of about ten and twenty, respectively. Much of this difference is probably due to the higher priced forms of rubber sold, ie, raw rubber sheets versus tub lumps in Luang Nam Tha. The internal rates of return (IRR) were not very high for any of the three. The Sri Lankan study's rate is 12.11 percent, the rate for Thailand[58] is 9.12 percent, and the Luang Nam Tha rate is the lowest at 8.63 percent. The alternatives in Sri Lanka and northern Thailand are probably somewhat greater than in northern Laos. So their farmers' choices are probably greater.

Table 8.8: Financial analysis

	N Thailand			Sri Lanka			Luang Nam Tha		
	NPV*	IRR**	B/C	NPV	IRR	B/C	NPV	IRR	B/C
Local currency***	233,430	9.12%	2.09	1,195,188	12.11%	3.47	6,303,411	8.63%	1.86
US$	$5,836	9.12%	2.09	$12,054	12.11%	3.47	$612.02	8.63%	1.86

Sources: revised Supawadee (2004) and Anonymous (2004)
*Original NPV – THB 560,231 for 15 rai is adjusted to one hectare
**Upon recalculation of the original IRR of 16.76% is recalculated at 9.12%
***Local currency: Thailand US$ = THB 40; Sri Lanka US$ = 99.15 rupees; Lao PDR US$ = LAK 10,300

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[57]The NPV was actually Bht 560,231 ($14,006) for 15 rai or 2.4 hectares. We have adjusted this down to Bht 233,430 ($5,836) for one hectare.

[58]According to our calculations the Thai IRR rate is 9.12 percent rather than the 16.76% reported. Thus, modifications are made in Table 8.

Alternatives to Monocropping

Thus, far we have only examined a monocrop of rubber in Luang Nam Tha. In fact there are other alternatives. The two major categories are what has been termed as jungle rubber, where rubber trees are planted in a low density as part of the diversity of species within the forest. The rubber trees are tapped and NTFPs are gathered in the forest (cf the **Technical Section**). The other category is that of agroforestry under rubber trees. The possibilities could range from annual crops (eg, soybeans, corn, pineapple), perennials (eg, tea, coffee, cardamon), and improved pastures. These provide cash income not only in the immature stage but supplementary income in the mature stage, and raising the performance of the whole system.

The point here is to reduce risks of both the ecological systems, ie, the disadvantages of the upper limits of latitude, elevation above sea level for para rubber cultivation and possibly rainfall; and of markets, ie, price volatility, accessibility, information, etc. The cultivation of other crops spreads risks and allows for households to reap the benefits of other enterprises than rubber.

It diversifies both the sources of income for the system and also diversifies the crops and subsequent pests and diseases which are exhibited by monocultures (Raintree 2004b). Additionally it provides more cover to avoid erosion.

These alternatives need to be systematically explored in more depth for the northern Laos area by both on-station and on-farm trials.

Chapter 9
Legal Situation

There are villagers in Luang Nam Tha who are planting rubber with their own financing, yet the movement of rubber into the province often seems to be accompanied by various financing schemes. Rubber planting is capital and labor intensive particularly considering the financial and rainy season time constraints of the vast majority of Luang Nam Tha farmers. Although a farmer could conceivably establish a self-financed one hectare rubber plot over two or maybe even three years, most farmers choose to plant a full hectare in their first planting. Their reasons for doing this are probably related to following the example set by other rubber planters rather than trying to establish a physical equilibrium within the rubber plantation. There are also may be a desire to tap into the expertise of village outsiders for planting a still unfamiliar crop. Some farmers in Khet Mom have planted 100 to 150 rubber trees per season over the past two years. They have financed this in part by selling or exchanging rice for rubber. Nevertheless, the substantial input for seedling cost and fencing probably necessitates financing for many villagers. In at least two villages in Khet Mom the financing comes from Chinese entrepreneurs. In a Khmu village on the road to Botène, the financing comes from a Hmong businessman. There are certainly a far greater number and variety of outsider investors in rubber in the villages of Luang Nam Tha.

The motivations which compel villagers to decide to plant rubber may seem obvious. Certainly the obvious reasons include the example of relatives across the border prospering from rubber, the perceived attractiveness of perennial crop that provides good returns from reasonable levels of labor input, and a cropping system that may sustain family livelihood during a time of GOL suppression of swidden agriculture and consequent disruption of a highland culture and livelihood known for centuries. Yet there are other reasons explicitly identified by villagers such as the planting of rubber helps to establish tenure over land under threat from land grab schemes of powerful people or reasons implicit in a search for alternative income sources after the suppression of opium cultivation. In some instances, GOL fiat forced villagers to plant rubber as a livelihood after being relocated from deep within the Nam Ha NPA. (We do not yet know if GOL promotion programs for rubber will force rubber on villagers or look for only interested farmers. This will depend on the GOL’s interpretation of promotion versus extension.)

These reasons, singularly or in combination, force villagers to seek or accept outside financing schemes to plant rubber. In this section, we will briefly analyze the antecedents for the contracts and financing mechanisms and discuss the legal milieu the contracts exist in. We will analyze what we interpret to be the strengths and weaknesses of the various financial schemes and legal documents. It is crucial to examine how the contracts and the impact of rubber planting fit into the overall system of land use planning. Finally, we will attempt to make some suggestions about how village level financing of and contractual arrangements for rubber planting might best be conducted.

We have no historical knowledge about the use of contracts either during the pre-colonial or French colonial period. Certainly villages had commercial relations and some labor obligations with the larger world outside the immediate village. We strongly suspect that those outside of the hill peoples’ world conducted any sort of relation through verbal agreements, and to the extent that legal documents existed at all they fell under the purview of the ruling elite. If that is so then the introduction of written documents into illiterate societies has meaning for only those who understand what is written. It is tool that can be used by only one party - a language that can only be spoken by one person in a two person conversation.

What contemporary antecedents exist for the rubber financing and contractual arrangements? The Muang Sing DAFO and Planning Office signed a sugar cane contract with the Muang Pong sugar factory and the Meuang LA/Mengla governor in October of 2002 although the contract was drawn up earlier. The contract specifies the contractual obligations of each party regarding planting, technical advice, harvest, and transport. The contract stipulates two periods of four years with each period having a target area of 700 hectares of sugarcane planted in villages and an additional 66 hectares as a “model plantation” developed by the Chinese.

There are several elements to this contract that are worrisome. First, the language used in the Lao part of the contract is rather broad and vague in meaning despite the use of figures and numerical targets. Certain areas related to transport need further definition, and the specific villages and extension requirements are not defined. Second, the idea of the model plantation seems to be a euphemism for the development of a Chinese owned sugar cane plantation. There are no specifics as to site visits by farmers to the “model plantation” or how the model will be used other than to supply the Chinese sugar market. Third, although the contract attempts to define a relationship between Muang Sing DAFO and Planning there is no mention of how the contract will be understood at the village level. Indeed, we do not know if any copy of this contract or a version of it exists at the various villages growing cane. In some conversations with villagers we understood that there is a significant level of dissatisfaction about sugar cane selling and transport by the Chinese. We do not know how widespread this feeling is, but there certainly have been cases of cheating by the Chinese, lack of transport on specified days causing crop value to decline or be worthless, and failure to followup on extension obligations by GOL officials.

In addition to the Chinese push for sugarcane production they are also significantly involved in contracted vegetable planting. For an excellent review of contracted vegetable growing refer to Lyttleton’s et al report - *Making Progress: Watermelons, Bars, and Trucks on the Road to Sing* (Lyttleton et al 2004). From conversations during the study team’s trip to China and with Ban Hat Nyao villagers we understand that collective workers in China with no or little land engage in contracts with Chinese villagers wishing to grow rubber but lacking expertise. The collective worker takes some share of the future rubber harvest in exchange for technical support and assistance with rubber planting. Possibly this model is being employed in Luang Nam Tha.

Friends of the Upland Farmer (FUF) has signed contracts with small farmer groups in Luang Nam Tha for cash crop production (corn and soybeans). FUF supplies superior seed and technical advice and villagers are contractually obligated to sell the harvest to FUF. Despite the signed contracts FUF finds that villagers routinely sell the harvest or portions of it to businessmen, particularly those from China, offering a higher price per kilo than FUF. Villagers disregard the fact that the lower price offered by FUF reflects the seed supplied at planting. We do not know the true extent of awareness about small group contracts in a village by individual farmers or the exact stipulations of these contracts. According to the heads of FUF the violation of these contracts is due primarily to the attraction of higher prices and secondarily to a poor understanding of the meaning and weight of a contract. Interestingly, poor understanding of the profound meaning of a contract (in the sense of Western law) is not limited to villagers; a DAFO office in a northern province has violated a contract when a Chinese merchant offered a more attractive deal.
Various GOL representatives have described an involved procedure for the approval of

contracts between foreign owned businesses and Lao. The procedure is described in the annex. In addition, a Lao based foreign businessman informed the study team that to be fully legal a contract must be approved (at least in form) by the court for contracts which exists at every province.

The study team examined four contracts related to rubber production signed or still in the approval process at either the national or provincial level. We have previously discussed the contract signed with Huay Dam villagers. To reiterate, the most worrisome aspects of that contract are as follows. The clause stating that the investor has the right to register and pay taxes on the land carries the suggestion that ownership will move to the outside investor in the rubber, essentially a defacto land purchase for the price of rubber trees. In addition, the written 60-40 split in favor of the outside investor is at odds with a verbal agreement to split the land 50-50. The contract says that breaches will be compensated at twice the value, but it does not say anything about the nature of that compensation nor does it address what will be considered a breach of contract.

The Seunly contract is a proposed business venture between the Seunly Rubber Plantation Company, Muang LA, Yunnan (Mr. Sheng Rong Guang, President) and Muang Sing district. The proposal has a goal of planting 2000 ha. of rubber in 12 villages in Ban Sai, Xieng Kaeng, Muang Sing. The contract is ludicrously bad, and it potential impact on villagers should have raised serious concerns at the district level. The contract is replete with contradictions, vague wording, and falsehoods. The contract proposes that if the 2000 ha. goal is not met then the GOL will make up the difference with a land allocation to the company. The duration of the contract is for 40 years, but a clause states that the company reserves the right to renew the contract after that period. If that statement is read literally then the Seunly company makes all decisions and determinations exclusive of the villagers and GOL officials.

The company proposes three models for rubber planting: villagers planting on their own, villager and company initiation of rubber planting with company support subject to debt repayment, and poor villagers working as wage laborers for the company on their own land. The first model is clear in its meaning - privately initiated rubber planting. The second and third models raise very troubling issues. The second model envisions villagers obtaining all inputs from the company. Upon commencing tapping the latex will be split 50-50, and all debts incurred by the farmers in planting rubber will be deducted from the farmers share of the latex. The company states that the farmers will not be paid cash as the debts will be deducted from the sale. The potential for cheating by the company in this type of non cash payment is high. As emphasized earlier, an illiterate society is always subject to abuse when operating in the literate world of the powerful. The third model is so vaguely worded that it could be interpreted as a kind of bonded servitude. It says that poor villagers will work rubber on their own land in exchange for salary, insurance, food, and other benefits. The company will pay no rent and pledges to employ the villagers as above for 40 years. The model say nothing about salary and other compensation, nothing about the status of the land should the company unilaterally renew the contract after 40 years, nothing about compensation or the validity of the contract should the company go bankrupt, nothing about whether entry into this model will be voluntary or required, etc. In short, what may have appeared to some as a welfare program should have on closer examination been revealed as a potentially dangerous model. The company also included a clause stating that villagers will support Chinese specialists in the field, but we strongly suspect that no one has informed the villagers of this.
Another troubling and still unclear aspect of the Seunly contract is the inclusion of an analysis of

a 6,666 ha. rubber project with an additional 1,333 ha. concession. This has an earlier date and may represent a preliminary proposal since rejected. What is most troubling about this portion of the contract is the inclusion of projected yield data. The yield data to our best knowledge is highly exaggerated. For example, the projected yield range is from 2,250 kg./ha. to 3000 kg./ha. The highest yielding Thai variety with best practices in southern Thailand has a ten year average yield of 2,731 kg./ha. RRIM 600, widely planted in China (60% of all rubber trees in Mengla County), has according to the RRIT a ten year average yield of 1806 kg./ha. with best practices in a favorable climate. The gross exaggerations result in excessive projections of farmer income. One hopes that this degree of distortion is not intentional.

The Sino-Lao contract setting up a joint venture between the Sino-Lao Company on Yunnan, China and the Luang Nam Tha PAFO is straightforward in its written version. The study team understands that a meeting in October between representatives of the GOL and Sino-Lao did not resolve certain contentious issues. It is not known at what point the proposal will be officially approved although there is certainly a significant degree of forward planning based on the expectation of the proposal's approval. The basic points of the proposal are well known. The sum of 30 million Yuan is available for work on rubber. (There may be additional matching funding from the national level Chinese government, but official documentation of that is not known.) Of that total 5 million Yuan, 2 million Yuan, and 2 million Yuan will go to building either rubber research centers or extension centers in Luang Nam Tha, Bokeo, and Oudomxay, respectively. The three above provinces will each receive 7 million Yuan for rubber promotion with a target of 10,000 ha. by 2010.

There are no general points in the written contract that are controversial. However, we understand that Sino-Lao would like to obtain a concession to establish a rubber plantation. The study team has already expressed its serious concerns about this at the provincial level. The granting of a large land concession to Sino-Lao would be a terrible mistake. This type of concessionary plantation has proven disastrous for villagers the world over. Invariably, the company through more efficient and greater inputs on the concession controls the market and drives down local prices. The PAFO and the provincial administration should not under any circumstances agree to a land concession.

Other general points about the contract relate to the use of language. At one point, the document says that "villagers and ethnic minorities" will be supported in planting rubber. We would like to point out that ethnic minorities are villagers. To separate the two with a verbal distinction indicates that the writer places ethnic minorities on a lower level of society.

In numerous places, rubber planting is described directly or indirectly as "planted forest", "reforestation", "reducing idle land", "increasing forested area", etc. We want to note as suggested in previous chapters that rubber monocultures are not forests in either structure or function. To imply otherwise indicates a lack of understanding of forest ecology and forests.

The final contract to be discussed is one between the Akha village of Ban Bouak-kU, Khet Mom, Muang Sing and Mr. Maesa, a Chinese investor. Apparently, this contract was the subject of controversy between DAFO Muang Sing and Planning. DAFO disagreed with the contract and did not sign it. Reportedly, Mr. Saengnaw from Planning pushed the contract through. The contract basically entails the planting of 230 hectares of rubber (200 in Ban Bouak-kU and 30 in Ban Phapuk) by Chinese investors in two Akha villages immediately along the Chinese border. The contract has a 40 year duration written in the cover letter, but in the contract it says 45 years. The village chief thinks the duration is for 45 years. The Chinese make all the investments (seedlings, planting, fencing, etc) in the rubber plantation and retain harvest rights on 60% of the land for the length of the contract. Villagers get 40% of the rubber harvest/trees, but at the end of the contract the Chinese get all the rubber wood. The Chinese can sell their trees/harvest rights without any objection from the villagers. The written contract follows the pattern of other contracts in its use of vague language and unclear writing. For instance, the contract stipulates that if the villagers do not do what the Chinese ask them to do after three times then the villager's (villagers') share of the land will be given to someone else. Also a 30% penalty is required for contract violations, but the contract does not say what constitutes a violation. The contract states clearly that six copies will be made and one should be in the possession of all the major parties, i.e. two in the village, two in DAFO, and two at the District Office. The village did not have a single copy of the contract nor had they read the contract. The DAFO did not have a copy of the contract. Only Mr. Saengnaw had a copy which he kept at home.

Beyond the obvious problems with the above points what is most troublesome is that the rubber has been planted on 200 of the village's 460 hectares (more than 40%). When the study team expressed concerns about the diminution of agricultural land from rubber land some GTZ and DAFO staff said that the 70 hectares of paddy land did not justify those concerns. Yet another DAFO staff said only 17 hectares of paddy had been opened, and the remaining land had potential to be paddy as the result of an GTZ irrigation project. Villagers also said that they would be able to open up additional lands to the north to increase their agricultural land yet GTZ staff said that land was under military control. The land use allocation map in the village was very different from a recent DAFO participatory planning exercise. The participatory planning exercise had results that made little sense and had gross errors, particularly related to village economic groups and demarcated forest zones.

What the contract with Ban Bouak Khou makes perfectly clear is that as long as land allocation and participatory land use planning remain unclear or unfinished the impact of contracted rubber planting on village forest and agricultural land is potentially problematic. In all of the villages the study team visited we found an almost total absence of knowledge about land titles, casual regard for land allocation designated forest zones, and uncertain tenure subject to the vagaries of the GOL or powerful people. The subject of land use planning is outside of the purview of this consultancy and has been considered with considerable expertise by GTZ consultants. Their writings and thoughts, as well as that of other experts in the field, offer more insightful comments that we can hope to here. However, we emphasize the need to consider the establishment of rubber in a village within the larger context of land use planning. We will offer recommendations below that attempt to bring together previous observations made in other chapters.

Chapter 10
Recommendations

Rubber Research and Extension

Rubber Extension

First of all there is a problem in the Lao (also Thai) language with the English word for *extension* as in agricultural . The Lao language word *songseum* and *souk ngieu* usually refers to the promotion of a product, such as a toothpaste, laundry detergent, face cream, etc. It very much conforms in to the previous centrally-planned production programs. With the establishment of the National Agriculture and Forestry Extension Service (NAFES), there is the beginning of the formation of an extension system. one of the key tasks of this extension system is to redefine the meaning of extension in the Lao language (and subsequently in the various languages of the ethnic groups. Our definition of *extension* here is to provide farm households with an enhanced menu of increased livelihood's alternatives and concurrently with an improved means of assessing the alternatives for their respective livelihoods systems. These technical, organizational, and managerial alternatives either come from the national research system (NAFRI) of Laos or those of other relevant research systems and/or from the indigenous knowledge systems currently being practiced throughout the country.

9. While the PAFES staff try to be helpful, none of them have received any training in rubber or rubber extension. While the Deputy Head of NAFES is interested in pursuing an Master of Science (MS) in either agronomy or horticulture – specializing in rubber, no other PAFO, PAFES, or DAFES staff members have had any training in para rubber.

> *Some PAFES (PAFO) , DAFES (DAFO) staff, should go for a long-term MS degree specializing in rubber. Others who will be responsible for rubber extension should go for short courses in para rubber cultivation and processing. Due to language facility, Thailand would make the most convenient.*

10. Extension-research interaction is crucial. There is a feed forward of field level realities related to cultivation, harvest and sales – the opportunities, problems, and constraints from the extension system to the research system.

> *Extension staff should be in continuous contact with rubber researchers – be they at the proposed Luang Nam Tha Experiment Station or elsewhere in the NAFRI network. They should be constantly feeding relevant field information concerning opportunities, problems and constraints forward into the research program. For example, varietal selection is extremely important, especially in the latitudes and elevations of the north where cold tolerant clones are essential. Even though at first research may not have the luxury of time to undertake some of these trials, they will be familiar with relevant research results in say China, Thailand or Viet Nam.*

11. At present there has been no farmer training in Luang Nam Tha in para rubber cultivation. Most of the knowledge and skills have been attained informally from relatives or merchants in Sip Song Panna.

> *Farmers, both male and female, need to be trained in all aspects of para rubber tree*

cultivation practices, including: establishment, maintenance, tapping, processing, marketing, and timber sales. In processing they should be made aware of the opportunities, costs, and returns of selling other forms of rubber with more value added, such as clean cup lumps, raw rubber sheets, raw liquid latex, and smoked rubber sheets. There also needs to be some training on rubber grower's association group formation, which potentially might lead into a rubber cooperative.

12. At present the PAFES in Luang Nam Tha has prepared an extension bulletin concerning para rubber tree cultivation, which is basically a translation of a Thai publication. This is a beginning of an extension information system.

More publications need to be generated which are relevant to Lao conditions. These publications need to be done in the Lao language and in the local language if possible, eg, Hmong, Akha, and Khmu. If not possible some of these perhaps should be done in cartoon form. These publications should be made readily available in some centralized place. They should be distributed in villages interested in para rubber cultivation.

13. Key farmers with valid experience are important for both extension demonstrations and dissemination of the messages.

Such key farmers should be identified, such as: Mr Khae Chiam and his wife, Mien (Yao), in B Oudomsin; Mr Lo Meu, Akha, in B Lo Meu; or a number of Hmong people in B Hat Nyao, including Mr Bounmy, Lao Ma, Mai Shua Veu. It is important for respected people be used as opinion leaders in their various ethnic groups. These can be utilized as one of the most important tools of extension, ie, farmer-to-farmer contact.

14. On-farm trials and demonstrations are a key part of extension. Of course, the trials are done in collaboration with research.

A network of such trials and demonstrations must be utilized with key farmers mentioned above. The on-farm trials in which extension is involved are usually farmer managed. *Such demonstrations can be either results or method demonstrations.*

15. Study tours are extremely important for both extension staff and farmers.

The farmers of Luang Nam Tha should be exposed more to the more 'progressive' Thai farm practices and quality factory standards as an alternative to the Chinese 'model'. This should provide them with an alternative vision.

Rubber Research

16. Smallholder para rubber tree cultivation in northeast Thailand is mostly undertaken on monocropped fields of rubber, but farmers still practice mixed farming systems with other crops, livestock, and fisheries. These systems allow farmers to manage their ecological and economic risks better.

Therefore any research on rubber should be undertaken as part of an agroforestry system (AFS), which may be para rubber-based. This may include, rubber-tea; rubber-cardamon; rubber-coffee; rubber-improved pastures and thus livestock; rubber-field crops; etc.

17. It looks as though rubber research will begin at the proposed LNT Rubber Research Station (LRRS) which will be funded under the auspices of the grant of ¥30+ million which is still being discussed by the GOC and GOL.

This station should focus on rubber as a part of the livelihood or farming systems. This could be accomplished by a system of on-station (OSTS) and on-farm trials (OFTS). Again, their work should be in close collaboration with extension.

18. According to our understanding of the current thinking about the LNT Research Station (LRRS) it will come under the NAFRI research network, being the nation's first rubber research station. The PAFO already has a site of about 50 hectares for the station near the Nam Leu stream – about 12 kilometers from town. On-station trials will be undertaken, and there will be a small nursery there. The PAFO would also like to establish two small nurseries (of about 25 hectares each) as a part of this station in Vieng Phoukhaa and Sing districts for better access. NAFRI is currently making a detailed plan for the station. It is foreseen that this station would become operational in 2006 or 2007. Some para rubber seedlings have been already planted.

It is an appropriate time now to begin to think about sending some of the potential staff for both degrees and short-term training in all aspects of para rubber cultivation.

The research agenda should be focused on the various combinations of rubber as a part of agroforestry systems, including 'jungle rubber'. There will also have to be some work on varietal selections developed by other nations' research systems. Research on management will be important and much of that will have to be done on-farm.

Marketing

19. At present farmers sell their tub lumps to the Chinese as explained in the section on B Hat Nyao. They are very much price 'takers' in whatever the merchants and traders offer. They are told that world prices are declining and many other sob stories in order to offer lower prices when they go to make arrangements for sale.

Market information concerning world prices of rubber or even prices in China are virtually non-existent. A regular mechanism of announcing price information on a radio program or some other means needs to notify farmers of the possibilities. This could give the world prices, Chinese and Thai prices for the various forms of rubber.

20. At present farmers can visualize only the Chinese market. Of course, this is the final market for most rubber in the region, but once the NR3 is completed from Botène to B Huay Sai, and as rubber comes on line increasingly in northern Thailand, rubber processing factories will be built there, new marketing opportunities will be opened for Lao farmers.

Thus, this alternative to selling to the Chinese should be considered. In addition farm families should consider other forms of rubber other than tup lumps, such as raw rubber sheets, raw liquid latex, and smoked rubber sheets.

21. From the B Hat Nyao experience it is clear that rubber grower's associations are crucial to success. It has helped them in organizing production and marketing.

The exact formation of these rubber grower's associations would be different for each village and ethnic group with their varying community organizations, cultures, customary rules and regulations, etc. It may be that these associations could eventually become cooperatives as is beginning to emerge in Isaan.

Legal Framework

22. The mechanisms for dealing with contractual disagreements are either vague or hopelessly inadequate. Most of the contracts say that any disagreement will be referred to Lao law without any notation as to whether Lao law has any relevancy. As one Lao businessman observed most Lao people do not trust or understand Lao business law so these statements are written as a talisman of sorts.

These legal mechanisms for recourse have to be tightened up, although we realize that the general legal framework in which these contracts are nested leaves a lot to be desired.

23. Nothing is written concerning the value of land. Rent is not charged or discussed in any document. This has to do in part with the absence of land titles and the incomplete nature of land use planning and allocation.

There has to be something included about land values since really they are taking about renting the land from farmers. A thorough economic analysis of the value of land and production compared to the value of inputs supplied by outside rubber investors might be revealing.

24. Not one contract that we reviewed had completed the final step spelled out in the series of steps necessary for a contract to become binding under Lao law. That step requires a contract to be approved by the Court of Justice for contracts.

These detailed steps must be included in the contracts to tie them to Lao law. And then they should be transparently reviewed and approved by the Court of Justice for contracts.

25. Contracts fail to stipulate quotas, baseline or ceiling, which might prove important in handling supply and demand in the future. Baseline production quotas guaranteeing a certain purchase level by the Chinese investor are needed beyond the vague promise that the Chinese will buy all the production.

Quotas must be specified with at least a range of prices, ie, floor and ceiling.

26. Not a single contract contained a word about exchange rates or an agreement about how to resolve future difficulties. Currently, the Chinese Yuan is pegged to the US dollar. If the Chinese are persuaded to float the dollar then most likely the Yuan will appreciate against the US dollar. If that is the case then all the inputs supplied by Chinese investors to Lao farmers and kept as debt would increase in value, ie, Lao farmer's debt burden would increase. Conversely, if rubber sales are paid in Yuan farmers would hold a more powerful currency. Currently, rubber is traded on international markets in dollars so the appreciation of the Yuan might affect rubber prices. A future decline in international rubber prices due to over supply might mean that Lao farmers would receive less money from rubber sales but hold a greater debt as a result of Yuan

appreciation.

The study team suggests that the standard banking practice of the non-deliverable forward, or NDF, could be applied to minimize the impacts of future currency fluctuations. With an NDF, a bank and a customer agree at the initiation of the contract on a later currency exchange rate. The settlement is usually in US dollars. For rubber contracts, an eight to ten year NDF could be arranged to reflect the time until tapping or meaningful latex yield.

27. All of the contracts are written in Lao or Chinese. There is no attempt to use one of the other many Lao languages to make the contracts more accessible.

Although Lao is the official state language, tape recordings could be made in Akha or another language describing the contract provisions.

28. The length of time of most of the contracts is for 40 to 50 years.

We suggest that the contracts could be limited to some point on the downward side of the production curve, ie, say, 20 years when production might start to decline in Laos. This would allow Lao farmers to have ownership over the rubber timber, and it would avoid the potentially serious problem of inter-generational inequities. Given the length of most of these contracts Lao farmers essentially consign their children to a predetermined land use system. If rubber monocultures prevail this could cause the next generation of Lao farmers to lose vast amounts of knowledge about the entire village natural resource system. One long term worker in northern Laos observed that villagers are selling their birthrights due to the length of the contracts. As suggested above, the state of land use planning and amount of land available to each family is directly related to how the amount of land in rubber and the duration of that land in rubber affects the whole natural resource system, food security, and land use systems.

29. The Friends of the Upland Farmer (FUF) signs their contracts with small groups in the belief that extension and learning is facilitated in a group setting. Despite this system there is still a failure to adhere to contracts. Nevertheless, the group concept with good leadership has worked remarkably well in Baan Hat Nyao. Similarly, in northeast Thailand most of rubber producers formed associations to better market their latex or sheets.

We suggest that rubber associations might be an appropriate means of assisting villagers to better counteract insidious tendencies from outside interests and to gain knowledge and understanding about a crop that will certainly shape their future lives.

Other Issues

Ethnicity

30. Luang Nam Tha has more than 30 ethnic groups. There are many people in these groups, especially women, who either cannot speak the Lao language or speak very little. Obviously Lao language literacy is low along with numeracy. At present there is very little special attention paid to this ethnicity.

It is clear that different ethnically sensitive extension methods will be required to assist with *individual farm households and with communities in organizing villages to cultivate rubber trees in consolidated areas, to do group purchasing of inputs, and to sell as a group.*

More extension staff needs to be recruited who are of these ethnic groups. This should contribute to better linguistic and cultural understanding of these groups.

The provincial and district offices of the Culture and Information and the Lao National Front for Construction (LNFC) should be consulted in tailoring ethnically sensitive interventions.

31. Community organization was crucial in the success of B Hat Nyao to date. Of course, this particular organization may only be relevant to a White Hmong village and partially to B Hat Nyao.

Attention has to be paid to this community organization by any extension effort. It is different for each ethnic group and there will be some variation within different villages of the same ethnic group. One has to be sensitive of the ethnic considerations and these variations also. The discrete dimensions of community organization of B Hat Nyao should be studied for their lessons, for example, the village rubber grower's association, the association fund, and the subsequent rubber welfare fund.

Land

32. The Participatory Poverty Assessment Project (ADB 2001) found that insufficient agricultural land has jeopardized household food security and contributed to poverty for many Lao farmers. In most villages agricultural land has been reduced by the land allocation process thus reducing the fallow periods for swidden agriculture and contributing to lower yields because of lower soil fertility, weed, and other pest infestation. Now with potential opportunities for rubber tree cultivation, villages have little agricultural land available for planting new rubber trees so there is pressure to reclassify forest land, usually regenerating forest, either 'young' fallows (5-7 years) or 'old' fallows (8-12 years) back into agricultural land.

The processes of and use planning (LUP) and land allocation (LA) are yet incomplete. Land use planning was usually undertaken in just a few days per village – not allowing villagers adequate time to participate. Many villages have inadequate agricultural land for households to attain food security but also to earn cash income. Households have been expected to immediately stop shifting cultivation. In fact many villages have already curtailed pioneering shifting cultivation, where they cultivate upland rice and other crops for a season or two and then they move on to another location. They now do rotating shifting cultivation, where they cultivate for a season or two and move to another location leaving the previous fields to lie fallow and regenerate. This cycle is done in a rotational pattern for 3-5 years after land allocation.[59] Out of necessity they continue to practice rotational shifting cultivation in order to contribute to food security. Of the six households in B Hat Nyao sampled only one was rice self-sufficient.

In order to protect mini watersheds within village boundaries and to provide enough agricultural land for food security and cash income, the land use planning and land

[59]With a little probing villages will admit that can not practice the 3-5 year fallows as land allocation designated.

allocation processes must be completely revised. We recommend that village territorial boundaries are clearly demarcated and that a participatory land use planning process is used to not only allocate agricultural land to households in sufficient areas for them to practice their livelihoods, ie, adequate for both food security and cash income but also to designate the various types of forest areas for watershed conservation and the gathering of NTFPS. Then as alternatives become available, gradually some shifting cultivation land will be put into more sedentary enterprises such as para rubber trees.

Land titles need to be handed over to households as soon as possible to protect farmers not only with their investments in rubber trees but other enterprises. This is especially crucial now that unscrupulous people are trying to trick farmers out of their uplands, which formerly were considered as useless swidden bush fallow land, but now that rubber can be cultivated they covet this recently valuable land.

Livelihood Systems

33. Farm households in mountainous and remote areas have complex livelihoods systems with multiple enterprises as a means of managing risk and maximizing their well-being and survival.

Para rubber tree cultivation should be considered as one component of this livelihood system, even though it appears to be promising. So when interventions in rubber tree cultivation are planned and implemented they should be done holistically within the context of the livelihoods system, including other crops, livestock, fisheries and NTFPS. Cultural dimensions (thus ethnicity) are an essential part of these livelihood systems.

Credit

34. Many of the early innovative farmers have been able to obtain some credit but have had sufficient internal funds to finance their rubber tree enterprise. This credit issue may be a greater problem with later farmers – especially when their numbers will be greater to compete for funds than earlier farmers.

If somehow these credit needs are not addressed in the near future, it will be more and more difficult for smallholders to cultivate rubber trees. They will only become more vulnerable to speculators who will supply the capital – only to get titles to the land.

Policy

35. At present there seems to the beginning of a ‘rubber boom’ for the Lao PDR. It is being considered by both the central and provincial government as playing such an important role in eliminating shifting cultivation, poverty elimination and eradication of poverty. Thus the commodity is envisioned as key to economic growth of the nation and development of producing households. However, very little has been done to support para rubber cultivation other than the signing of MOUs with foreign investors, eg, Chinese and Vietnamese, with Thais in the wings. The main effort thus far in the GOL is the discussions of the establishment of a rubber research program at the NAFRI with the first experiment station in Luang Nam Tha.

Since rubber is being considered by both the provincial and central government as playing such an important role in eliminating shifting cultivation, poverty elimination and eradication *of poverty, surely some measures will have to be taken towards making it a strategic commodity. To begin with a policy (or policies) will have to be formulated to deal with production, processing, marketing, etc. This undoubtedly will involve number of ministries, beginning with the Ministry of Agriculture and Forestry (MAF), the Ministry of Industry and Handicrafts (MIH), the Ministry of Commerce (MOC) and perhaps some others. A number of programs will have to developed for various agencies at all levels.*

Programs and Agencies

36. The lessons from Thailand are very clear about Royal Thai Government (RTG) support to smallholder rubber cultivators, especially with policy support with the Office of Rubber Replanting Aid Fund (ORRAF) and the Bank of Agriculture and Cooperatives (BAAC).

Perhaps some new agencies dealing with rubber may have to be established and developed. An example of this maybe some agency similar to Thailand's ORRAF. Then there is the fledgling agricultural extension service, which has yet to really include much information on para rubber cultivation, processing, marketing, etc.

37. Credit is unambiguously an important input into any commercial agriculture process. If credit is not offered to smallholders then this will either eliminate them or make them more vulnerable to opportunists who will try to swindle their land them for capital. It is our understanding that APB has no regular funds to supply credit to rubber in the long term.

APB should adjust it lending policies to fit longer-term investments such as perennial tree crops, small-scale irrigation systems, etc.

Rubber in Environment and Watersheds

38. A review about elevational constraints to economically productive rubber cultivation strongly suggest that planting rubber between 700 to 900 meters above sea level carries high risk for the farmer. Elevation is of course linked to latitude and many authors point out both the risks and low returns from rubber at extreme latitudes. Temperature corresponds to both elevation and latitude. The nexus of all three factors means that rubber production in Luang Nam Tha carries high risks. In the rush to rubber these risks and their documented history have been ignored.

We strongly recommend that the relevant GOL agencies build understanding of the risks of planting rubber at higher elevations. Furthermore, a zone between 700 to 900 meters elevation ought to be designated; if rubber is planted in these elevations villagers should be assisted with regard to varietal selection and possibly some type of insurance mechanism.

39. Planting rubber in zones helps reduce villagers' fencing costs and strengthens their ability to prevent fires. The fact that villagers plant in zones suggests strong institutional management and good village cooperation. Zone planting of rubber also has disadvantages namely the creation of a monoculture stand of rubber with resultant losses in agrobiodiversity and the creation of a landscape without structural complexity, thus incompatible to the movement of wildlife and to good watershed function. When the rubber planting zones reach a size large enough to become the dominant land use in a watershed then there are most likely negative impacts on the structure and function of the watershed when compared to native forest or long term fallow. The proper approach to planting rubber on large scale must seek to balance the

advantages of a zonal planting with the goals of watershed protection, maintenance of agrobiodiversity, and faunal movement where necessary. A mosaic approach to planting rubber would be most compatible with the above goals.

We encourage all the relevant actors to work towards more diverse rubber landscapes balancing the advantages of rubber zonal planting with the necessity of fostering mosaics of land use within a watershed. To that end rubber zones should be limited in size to a reasonable number of hectares or a number of families. A size limit should recognize the particular situation of a village, the geographic characteristics of the area, and the nature of the given watershed. A size limit might represent some portion of a village's demarcated agricultural land. Defining a limit on the total amount of agricultural land in rubber in a village, assuming equitable distribution of that rubber land, would also serve to foster agrobiodiversity of a villages crops.

40. Agroforestry systems with rubber not only increase the structurally complexity of a rubber stand, but also increase the mosaic of a watershed. They can lend greater economic and ecological resiliency to a farming system dependent to some degree on rubber. Monoculture rubber creates total dependency on a globally traded commodity and leaves the farmer at the mercy of local market outlets. Agroforestry systems with rubber, or without, often have higher labor demands with higher returns on a land unit. The higher labor demands may serve to restrict deforestation.

We highly recommend that the relevant actors pursue a research agenda strongly focused on agroforestry systems with rubber as a means of increasing the mosaic of a watershed and, by extension, the structurally complexity of a landscape. In areas of critical watersheds facing rubber cultivation, agroforestry systems with rubber absolutely ought to be part of the extension package. See below for more detailed comments on agroforestry systems.

41. Processing of rubber in its many forms can have negative effects on the environment. Levels of fuelwood use if Lao engage in the processing of smoked rubber sheets should be a concern. Rubber puts pressure on forest resources by virtue of its establishment. High fuelwood use for processing could magnify the effects on forest resources. Amounts of water used for rubber processing and the disposal or treatment of that water should also be a concern. In a country where reliance on surface or near surface level water resources for drinking water and food is almost total the introduction of any industrial type processing can have negative effects on water quality. Rubber processing uses vast amounts of water and the process contaminates water with a variety of pollutants. All actors should be critically concerned with the effect of rubber processing centers, point or non-point, on water quality.

Any location where rubber latex is processed for smoked rubber sheets or simply washed and pressed should be strictly monitored for water quality. Simple models for water treatment with adequate capacities, e. g. those involving aquatic plants as filters, should be mandated and continually monitored for effectiveness. Processing centers for smoked rubber sheets should be required to monitor amounts of fuelwood use, and they should be required to have management plans for where and how they intend to obtain fuelwood. It may be necessary for them to work with trained foresters to develop appropriate levels of fuelwood cutting intensity.

42. The dominant model for rubber management is China where herbicides, as well as other agrochemicals, are used intensively. MAF officials (at all levels) should not fall prey to the naive

notion that Lao people will not use herbicides. Villagers will increasingly use herbicides in their rubber plantations if they perceive the benefits and costs to outweigh labor expenditures. Yet they will use herbicides with complete ignorance about the effects of herbicides on the environment and their own health.

Relevant GOL officials should be very aware of the presence of herbicides in local markets and herbicide use in villages. They should develop a training curriculum and a mobile training show raising awareness of herbicides effects and proper use of herbicides.

Rubber Technology

43. There are a plethora of rubber varieties. Research and trials on clonal varieties requires a significant amount of time. Given the extent of work on rubber varieties in countries with long histories of rubber cultivation it makes little sense for the MAF to invest the majority of their efforts in experiment station based research. Rather the MAF should to the extent possible rely on cooperative ventures with RRIT and the Chinese equivalent for clonal varietal information. MAF efforts should focus on farm based trials/on-farm research with an emphasis on systems as discussed above in #10. MAF officials should carefully examine relevant research findings on varieties and not rely upon independent rubber companies for varietal information. For example, 774 is not yet released yet is prominently mentioned in the Sino-Lao agreement. MAF and PAFO should be prepared to provide sound, carefully vetted information and recommendations to farmers on the characteristics of rubber clones.

MAF and local PAFOS should rely on the RRIT and the PRC rubber institutions for varietal development and information. Research on varieties should focus on their integration into farming and agroforestry systems. MAF and PAFO offices must develop handbooks and extension materials on recommended rubber varieties. (The recent NAFRI newsletter with information on rubber varieties is inadequate for the task.) In Luang Nam Tha, PAFO should insure that villagers clearly understand the differences between GT1 and RRIM 600, and PAFO should develop a site criteria selection checklist for farmers wishing to compare the two varieties. Other promising varieties like BPM 24 should be obtained and planted in on-farm trials as above. Information centers should be developed at the district level where farmers can obtain non-biased, verified, technically sound information on rubber varieties in a range of media formats with some accessible to non Lao speakers.

44. The returns from fertilizer application at planting and before tapping remain uncertain. The soil fertility after a lengthy fallow may adequately serve the fertility needs of rubber during the establishment phase. Fertilizer applications are more likely to increase rubber returns during the tapping phase. The only way to determine the extent of needs would be for NAFRI to make a quick series of soil survey transects through rubber growing areas or areas soon to be in rubber production. While such an assessment would only provide a gross idea of the fertility needs in terms of rubber planting it would provide a better indicator of how to structure such large scale activities where fertilizer is prominently mentioned, eg the Sino-Lao agreement. Fertilizer investment is a significant cost, and the need for and amount of fertilizer application should be carefully assessed.

NAFRI should immediately conduct a gross scale soil survey transect to assess fertility needs for rubber in northern Lao. This survey could be supplemented with relevant existing information. Based on the survey NAFRI and relevant PAFOS could help farmers decide *what would be the returns from fertilizer application to their rubber.*

45. The upward pushing motion of the Chinese tapping knife differs dramatically from the downward pulling motion of the Thai tapping knife. While it is clear that the Chinese are quite adept using their knife, it is equally clear that the Lao farmers currently tapping need to improve their tapping skills and knife control. Many villagers comment that the quality of the Chinese tapping knives is highly variable. It is quite possible that the Thai knife is easier for beginners. It is certain that the manufacturing standard of Thai knives is higher.

The Luang Nam Tha PAFO should import a number of Thai tapping knives easily obtained in Nong Khai or Udorn or directly from the manufacturer. Alternatively, PAFO could determine the interest level of a private business in selling rubber tapping equipment. An intelligent business person should clearly see the growth potential in a business catering to the needs of rubber farmers in northern Lao.

46. Given that the majority of villagers will intercrop rubber with upland rice in the first two, maybe three, years of planting it makes little sense to extend the benefits of cover crops with rubber at establishment. (We should note that peanut might be an appropriate intercrop with rubber as an alternative to upland rice for farmers with a more market oriented perspective. The nitrogen benefits of peanut particularly with phosphate amendments could prove beneficial to rubber.) Also the development of a stable seed source for cover crops is generally prone to failure in a situation like that in northern Lao. However, the period that is of most interest to relevant officials, farmers, and researchers is that period when shade from the rubber canopy precludes the planting of annual crops. The synergistic potential for work between the CIAT project on forages and upland cropping systems and Lao rubber farmers is obvious. Slight adjustments in spacing and resultant increases in light may make certain forages, eg stylo appropriate for intercropping with rubber. This in turn would further open the rubber system to possibilities like cut and carry and controlled grazing for better livestock health. These agro-silvo-pastoral systems represent an extensive land use system that is one of several appropriate options for the uplands of northern Lao.

MAF and CIAT should discuss cooperative ventures on improved rubber systems with forages or fodder banks. Additional areas of cooperation might include how spacing enhances the possibility of the rubber system in the uplands to include annual or perennial crops. GTZ development project areas might be an appropriate place to support the development of such systems as well as other agroforestry systems.

47. Various agroforestry systems with rubber are highly suited to the integration of traditional farming systems with rubber farming in northern Laos. While the idea of rubber agroforests is theoretically sound based on the examples of other countries, the extent of existing systems in China is unclear. Agroforests with rubber are an important element in the farming systems of a minority of villages in southern Thailand. Agroforests with rubber or jungle rubber should be a significant focus of MAF, NAFRI, and PAFO involvement with rubber.

MAF, NAFRI, and concerned PAFOS should have rubber agroforests as a top priority for farm based research. With GTZ as a partner they could research rubber/tea systems in areas near Sop Iii Kao in Muang Sing. Ban Huay Dam and Huay Home, Luang Nam Tha would be appropriate villages to look at jungle rubber systems with existing scattered rubber trees from 1995. The above institutions should plan field trips to China specifically for *farmers (not just research institutions) working on rubber/tea systems. The institutions should obtain up to date, verified research results on rubber/tea. The above actors should also visit southern Thailand to look at rubber agroforests and Sakhon Nakhorn, or the equivalent areas in Tha Khek, where field rattan is grown for shoots to see how rattan might integrate with rubber.*