MASTERS

THESIS

Shifting Cultivation Practices By Hmong, Khamu and Lao ethnic categories

In The Nam Nane Watershed, Nane District, Luang Prabang Province, Lao PDR

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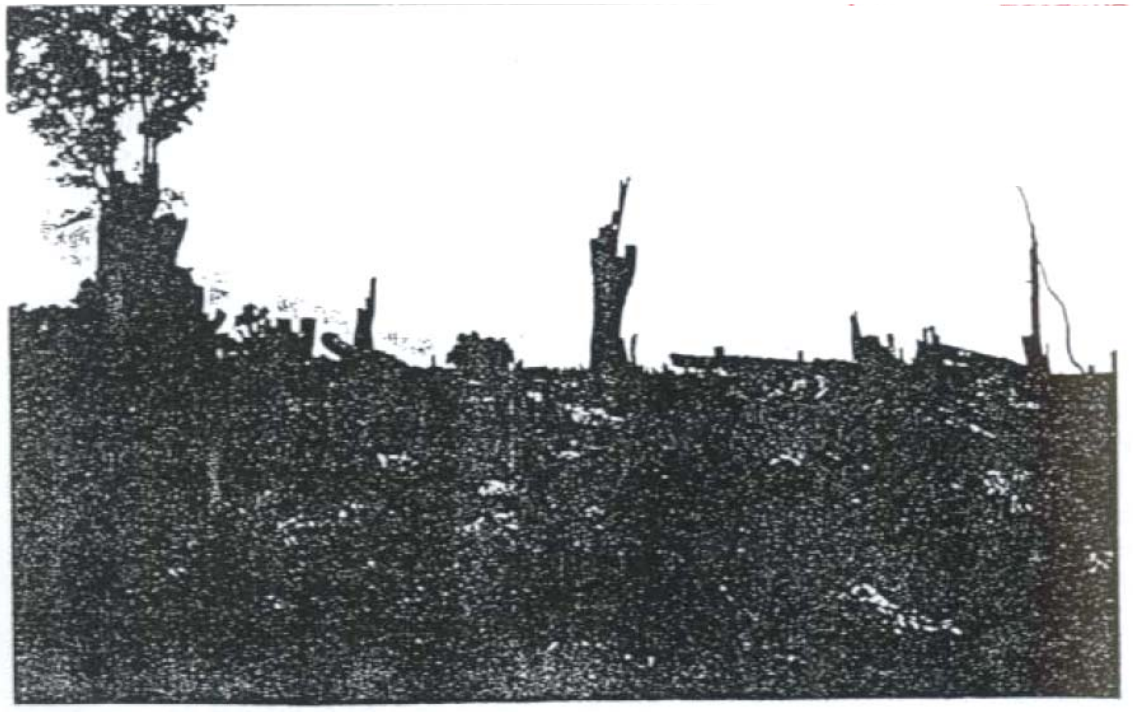

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Abstract

Throughout the world the practices of shifting cultivation are changing rapidly. In upland areas of the Lao PDR, shifting cultivation has long been practiced as a sustainable agriculture system. Two thirds of the shifting cultivation areas of the country are located in the Northern Part of Lao PDR. Shifting cultivation forms part and parcel of day-today life of the people living in Nam Nane watershed area. It is often associated with minority groups who use fragile or poor soils, face land tenure problems, and live in hilly and remote areas.

This study was undertaken in the Nam Nane watershed area of Luang Prabaing Province, which is inhabited by Lao, Khamu, Hmong and ethnic groups. Shifting cultivation is dominant of land-use. Over time forest is gradually being transformed to brush or grasslands, leading to decreased agriculture production capacity, which can have serious implications for the well being of rural people. Fallow periods are becoming shorter and new forest areas are being cleared. As a result, these shifting cultivators have to reduce the cultivation cycles. But shifting cultivation cannot be controlled by laws, regulations and/or policemen. Rather development efforts need to be carefully planned and should address the needs and aspirations of shifting cultivators as well. Such plans have so far not been based on farm level studies, and the merits and constraints of shifting cultivation as practised by different ethnic groups. This study has shown that shifting cultivation systems provide subsistence and usually cash income. Agriculture yields are comparatively low but reliable, and farmers' adoption of new technologies is often hampered by the predominantly mountainous topography, the undeveloped infrastructure, the limited market demand, the relative poverty of the population, and other constraints. The practices of and dependence on shifting cultivation of Lao, Khamu and Hmong ethnic groups are different. Also, the major problems they face vary. These must be taken into account while formulating development plans and policies for the people. This is particularly important now when the Government of Lao has given high priority to the idenfication and promotion of alternative production systems to shifting cultivation. Reducing poverty by at least insuring food self-sufficiency and protecting the national environment in context of growing population represents a big challenge. Yet, no single technical solution for the shifting cultivation is available. Finally, areas for further research and aspects requiring development interventions have been examined.

Keywords: Lao PDR, Shifting Cultivation, Fallow, Weed, Labour, Fertility.

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Comments are Welcome!

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1 Background

1.1 Introduction

Lao People's Democratic Republic (Lao PDR) is a small and landlocked country located between 14° and 20° N latitude and 100° and 108° W longitude, in Southeast Asia. Its neighbouring countries include the Republic of China in the North, the Kingdom of Cambodia in the South, the Socialist Republic of Vietnam in the East and the Kingdom of Thailand in the West (see Map 1).

The total land area of the country is 23,68 million hectares, of which about 79% is regarded as mountainous region, with altitudes varying from 300m to more than 2,500m above sea level. In the north and Northeast, elevations of 1,000 to 1,500m are not uncommon. The permanent agriculture areas are on the flat land along the Mekong River and its tributaries, which mostly are located in the central, and in the southern part of the country. The country is located in a tropical zone. The monsoon rainy season usually starts in mid-April and continues to the end of September or early October. There is a distinct rainy and dry season, the number of dry months vary from 3-5 months. The annual rainfall ranges from 1,000mm to 2,500mm per year. Luang Prabang the proposed field area, receives about 1,360mm. Temperatures ranges from highs of around 40°C along the Mekong in March and April to lows of 5°C or less in the uplands of Xiang Khoung and Phongsali provinces in January. The average temperature varies from 15°C - 26°C.

Lao PDR has a population of 4,6 million with an annual growth rate of about 3%. Lao PDR is a multi-ethnic society. The major ethnic and linguistic groups have been broadly classified as Lao Lum (Lowland Lao), Lao Theung (midland Lao) and Lao Sung (Upland Lao). Groups within the Lao Lum category constitute 50% of the country's population, while Lao Theung and Lao Sung make up 40% and 10% respectively. About 85% of the population are living in the rural areas and the majority of them are subsistence farmers and highly dependent on the forest for their supply of benefits. In terms of socio-economic development Lao PDR is the least developed country in South - East Asia region, with an income of $320 per year/cap (NSC, 1995).

1.2 Deforestation and shifting cultivation

1.2.1 *Deforestation*

Forests cover 27 percent of the land surface of the earth (Sanchez, 1994). Forest products are of critical importance for most rural dwellers in the developing world. They provide a principle source of energy and building materials, help maintain environmental stability, yield products that increase food security and furnish a source of off-farm income and employment. Forests are also an integral component of biosphere, helping to stabilise natural systems. Forest ecosystems provide a broad range of environmental services, some of them necessary for the operation of the system itself, and some directly useful to humans (Learman and Sedjo, 1994). To survive the many pressures being placed on them by increasing population and their associated needs, the value of forest as prospering ecosystems must exceed their potential worth as other forms of land use. Conserving biological diversity in tropics has become an issue of increasing priority and urgency in recent years.

Tropical forests are extremely rich ecosystems which support a disproportionately large share of the world's plant and animal species (Kahn and McDonald, 1995). Originally, tropical forest in Asia, Africa and Latin America covered about fifteen million square km of land area, about 12 percent of earth's land surface. Today, tropical forest cover has shrunk to half, or 7,5 million square km (Gillis, 1996). Tropical deforestation is one of the most serious environmental concerns of the world today and is likely to remain so during the first decades of the 21st century (Sanchez, 1994). To fix blame for tropical deforestation on cause or causes invites a diversity of view points.

Deforestation means that the land is converted permanently from forest uses to non -forest purpose. Between 1850 and 1980 about 15 percent of the earth's forest and wood lands

disappeared as a result of human activities (Sharma, 1992). The tropical forest can be affected by human activity in many different ways and different scales. The main causes of deforestation are agriculture and livestock expansion, fuelwood gathering and increased demand for commercial and non commercial forest products. People everywhere are concerned about rate at which forest are being depleted and the extent of destructive deforestation. Deforestation has different types of impact at local, national level, and regional levels that may span several countries. As deforestation progresses and trees and other forest products become scarce, rural people feel the effects first. Deforestation is a critical problem not only because it depletes a natural resource of critical importance to the people of the region that cannot be replaced overnight, but also because of its far-reaching side effects (Sharon et al., 1998). Deforestation, together with land degradation and loss of biological diversity, exacerbates the problem of poverty in rural areas. In addition, other adverse environmental and social consequences, and reduction of agricultural productivity often occurs. Deforestation in Asia is caused mainly by the collection of fuelwood, commercial logging, degradation through grazing and fire, and shifting cultivation. It has been estimated that conversion to agriculture is the source of 94% of deforestation in tropical countries, equally divided between permanent agriculture and shifting cultivation (Siren, 1997). Deforestation in the tropics and other development countries is part of an overall land-use change process land-use change that not only affects the tropics (Nilsson, 1996). Shifting cultivation and agricultural expansion occupy a central position in the debate on tropical deforestation.

Lao PDR suffers from a number of environmental problems, the most important of which are related to deforestation. The ecological conditions in Lao PDR are being degraded rapidly. In many regions of the country, the natural vegetation cover has been destroyed or altered through human impact at an alarming extent. During the end of the dry season, for example, the dry dipterocarp forest, bushland and savannah are often burnt by the local population (Persson, 1983). The rate and extent of commercial logging in Lao PDR has been quite high. It has been concentrated to the most accessible areas. Felling should be selective, based on the species and diameter guidelines. But in practice, it has been poorly controlled and operated without adequate forest management plans (Young et al., 1998).

Agriculture is the predominant activity of a large majority of the world population. Perhaps one of oldest agricultural system that is still persists today is shifting cultivation. Also referred to as slash and burn, swidden and fallow agriculture. Shifting cultivation is a common practice in tropical regions. Shifting cultivation has been practised in different parts of the world such as in tropical Africa, Central and South America, Northern Europe, Oceania and South-east Asia.

In much of the tropics, humans underwent a transition from hunting/gathering to use of domesticated plants and livestock. Humans have probably used fire for more than five hundred thousand years (Peters and Neuenschwander, 1988). R.F. Watter in shifting cultivation in Latin America writes: Reference to general, shifting cultivation techniques are similar everywhere, the felling and burning of the woody vegetation, followed by one, two or three years of cultivation of cleared ground and return of a long period to forest or bush cover. Thus was born slash-and - burn agriculture, a primary forerunner of present-day agroforestry and practice that may have originated on the Neolithic period, around 7000 B.C. (Swaminathan, 1987). Shifting cultivation in Southeast Asia has been practised for at least 2,000 years (Myers, 1980). In most systems of shifting cultivation in forested areas, suitable field sites are usually selected from secondary and sometimes primary forest (Peters and Neuenschwander, 1988). Shifting cultivation is a farming system the farmer uses simple handtools to clear, burn and plant. The land is periodically cleared, farmed and then returned to fallow (Sharma, 1992). Other authors use 'shifting cultivation' to mean practices of rotational agriculture that may or may not have long fallow, and that may or may not be associated with long-term conservation of forest (William et al., 1996).

Shifting cultivation is referred elsewhere in the region as. Milpa (Mexico and Central America), Conuco, Roza, Monte and Chaco (South America), Chena (Ceylon), Thum (India) (Ramakrishsnan, 1992), Kaingin (Philippines), Huma (Java), Ladang (Malay-speaking countries), Taungya (Burma), Tamrai (Thailand), Lua (Vietnam) Ray (indo¬china) (Whitmore, 1975) and hay (Laos).

Presently, shifting cultivation continues to be widespread in the tropics. It is estimated to account for 70% of deforestation in Africa, 50% in Asia and 30% in Latin America. Over 250 million people practice shifting cultivation, which accounts for the clearance of more than 10 million hectares of tropical forest each year (ICRAF, 1998). This cultivation method occupies about 30% of the world's exploitable land area and provides food for 8% of the world population (Hatch, 1982).

Rice is the world's most important food crop. Rice is the most important food crop in developing countries, and accounts for 29% of total calorie intake of these populations. Almost 100 million people depend on upland rice as their as staple, including some of the world's poorest farmers (Johnson, 1996).

1.2.2 *Shifting Cultivation in Lao PDR*

As eighty percent of Lao PDR is mountainous area. More than 90% of the farmers are subsistence oriented and market economies are heavily dependent upon its natural resource base. With a rapid of population growth, it has been suggested that the resources are being depleted at a faster rate. For centuries upland communities have been practising subsistence shifting cultivation which is one of the major causes of deforestation in Lao PDR (DoF, 1996). In the 1940s' the country had about 17 million ha of forest, covering 70% of the land area. In 1989 the forest cover was estimated at 47% of the land area. The government of Lao PDR estimates that 100,000ha of mature forest and 300,000ha of secondary forest areas are degraded by shifting cultivation each year (DoF, 1996). As the population increases and as the availability of land suitable for agriculture is limited, the sustainability of shifting cultivation is at risk and forest degradation can occur.

Traditional shifting cultivation with a long fallow period has been used for centuries (Watters, 1971). In Northern part of Lao PDR the average fallow periods reported for the 1950s, 1970s and 1992 were 38, 20 and 5 years respectively (Roder et al., 1997). In addition to shorter fallow periods mountainous forest areas are being cleared. Invasion by weeds is a principle reason for abandoning land after periods of cultivation. Over time forest are gradually being transformed to brush or grasslands, leading to decreased production capacity, which can have serious implications for the well-being of rural people. It is even possible to argue that rice cultivation in the Northern part of Lao PDR was a device to get rid of the weed problem. Weeds are one of the most serious problems in all upland farming, regardless of whether it is shifting cultivation or continuous cultivation. Imperata grasslands are common in deforested areas, especially in areas subject to burning, as its resistance to fire give it a competitive advantage under these conditions (Kasasien, 1971). On the political side, government may also want to 'develop' shifting cultivation into a more sedentary practice which may be easier to control politically or due to the economics of the scale in the supply of public services (Arild, 1994).

Shifting cultivation is mainly practised by the poorest rural population of the tropics-who also have to bear the main immediate costs of the associated environmental degradation. The system is characterised by abundant land in which labour is considered the constraining factor. A system with effortless self-fertilisation of soil through a long fallow period and burning of the vegetation before one or few years of cropping is therefore a rational response from the farmer's side to relative scarcity of input. In this situation, the shifting cultivation system may yield higher output per unit of labour input than sedentary agriculture (Boserup, 1965; WorldBank, 1990).

Since, shifting cultivation forms part and parcel of day-today life of ethnic groups in Lao PDR. Shifting cultivation is practised by some 300,000 families (or about 40 percent of the population) of all ethnic groups (Lao Sung, Lao Theung, Lao Lum). Shifting cultivation often belong to minority groups, uses fragile or poor soil resources, is characterised by land tenure disputes and practise in hilly, remote areas. Shifting cultivation is dominant of land-use in northern Lao PDR. Two thirds of shifting cultivation areas are located in northern provinces. Shifting cultivation rice production is the major land-use practice in the hilly areas of Lao PDR. Agricultural production in Lao PDR is dominated by cultivation of rice, staple food in Lao diet. Rice is the single most important crop. Glutinous or waxy rice is the most important crop for subsistence farming economies in the hill of northern Lao PDR (Roder et al., 1996). Upland rice is cultivated on about

36% of the total area under rice cultivation but accounts only for 22% of production. Over 70% of the upland rice production comes from the northern provinces (DoF, 1996). Traditional shifting cultivation is not necessarily destructive of valuable resources, but the situation is changing rapidly (Peters and Neuenschwander, 1988).

1.3 Social dimension

Shifting cultivation has a special significance in the ethos of concerned tribal society and the social relationship, cultural values and mythical belief are directly linked with it. Most of the rural population in Lao PDR rely entirely upon nature and what nature can provide. In the rural people's effort to find way to survive, they often are forced to choose options which are not sustainable.

In the first place, the social structure of shifting cultivators is based on households of varies size who members are generally closely related. Head of the household are usually between the age 20-45 and draw most of their labour supply from the households. Accordingly, about some 300.000 families (or about 40 percent of the population) of all ethnic groups (Lao Sung, Lao Theung, Lao Lum) are engaged in shifting cultivation in one form or another. Beside this, more or less all rural people utilise what the forest can produce. As a result of recent population increase the freehold system of shifting cultivation has changed substantially. The land tenure pattern follows the freehold system in which members of the family can use, but not sell, family land. Because the growing population has increased the demand for land, farmers have reduced the fallow period so much that the land has not sufficient time to replenish its fertility (Tommy, 1984). For example, in the local market it is impossible to find a large variety of products from the forest such as flowers, leaves, herbs, Bamboo shoots, mushrooms, wild animals etc. Many of these products can only be produced under stable forest conditions. They generate small incomes for some people and survival for many people.

1.4 Policies

During 1986, the Government of Lao PDR (GOL) embarked upon an ambitious program of economic reform. Environment degradation in connection with population growth is for the Lao PDR, as for many other countries, one of the most important problems to be addressed in context of its growing agricultural sector. Land use planning and land allocation (LUP and LA) is an integral part of the Government of Lao PDR (GOL) rural development programs directed at sustainable management of forest and agricultural land. The Government of Lao PDR (GOL) has a long-standing policy of handing over lands and forests to the people for their protection, management and use. In part, this policy is linked to a clear recognition of the need to reduce shifting cultivation in important forest areas. As a result, land management and land-forest allocation is currently one of the key government policies and programmes.

It is important to note that the use of the term "allocation" is somewhat misleading, since allocation of land is only one part of the process. In fact the programme is an approach which covers allocation of land, development of agreed management rules and procedures at the village level, extension services to increase capacity for conservation management of land and forest resources and conservation agricultural practices, and development of a process of review and revision to improve results. The plan to put such a sweeping programme of land use management into effect over the whole country represents a novel and exciting approach to resource management on a very large scale.

The Government of Lao PDR (GOL) has established the year 2000 as a deadline for the completion of land-forest allocation in protected areas, watersheds, catchment areas for hydropower projects, and in other areas affected by shifting cultivation. The ongoing land-forest allocation aims at encouraging farmers to invest in permanent agriculture. It has become an important tool used by the government to address shifting cultivation (Sandewall et al., 1999). All land in Laos is owned by the state, but private land-use rights can be granted to farmers and

these can be sold and inherited. Ownership of paddy fields is locally recognised and is rarely a cause of dispute, although official ownership certificates have not been issued in the pilot area.

Customary land rights to shifting cultivation fields have in practice been accepted both in the local communities and by government institutions. Traditionally, people obtained land by clearing the forest or other unclaimed land. When the land is laid fallow, ownership remains with the family who cleared the land. To continue to make the policy on land management and land -forest allocation absorbed more deeply and extensively by state cadres and population in order to make the authorities at all levels and all citizens clearly know their obligations benefits and responsibility in protection, management, use and rehabilitation of land and forest resources so that they become enriched perpetually and:

- To reduce and progress "towards total termination of shifting cultivation by developing permanent agricultural-forestry system and occupation in view to gradually uplifting the livelihood of pluro-ethnic population, particularly the shifting cultivators families and poor families to satisfactory level.
- To manage land and forest in accordance to national socio-economic development plan, contributing in the improvement and uplifting of livelihood of pluro ethnic population protecting the environment and transforming the subsistence economy to commodity economy.

Since late 1989, a number of decrees have been issued which concern forestry and land use planning. The most relevant ones are the decree on land, the decree on the management and use of forest and forestland, decree regarding the allocation of land and forestland for tree plantations and the decree on conservation. These decrees elaborate how all types of land should be owned, how forest lands of various categories and uses should be used, managed and protected and how forest and agriculture land will be allocated. They have guided the forest management program until the end of 1996. The latest step in development of legal framework has been the preparation and enactment of the Land Law; Forestry Law; Water and Water Resource Law respectively. The Forestry Law became effective on 2nd November 1996, the Water and Water resource Law on 3rd March 1997 and Land Law on 12th April 1997. At the same time, the Government of Lao PDR (GOL) gives high priority to stabilise shifting cultivation through a national land use planning and forestland allocation program (Sawathvong and Vongleck, 1999).

1.5 Land allocation

Shifting agriculture has become an important land use problem of the tropical world. Over the centuries it has destroyed and degraded millions of hectares of forest and forest soils. Today is it a major obstacle to development of many countries and to efforts to increase the food supply of the topics (FAO, 1967).

Land tenure is an area of public policy making which can influence the process of agricultural development. Land tenure in shifting cultivation areas of Lao PDR is traditionally acquired by bringing unclaimed land under cultivation. The initial pilot activity on land use planning and land allocation (LUP and LA) started in Lao PDR in late 1980 in Luang Prabang Province in Northern mountainous region. In this region the livelihood system is based on shifting cultivation which has contributed substantially to forest and land degradation. The early attempts were aimed at stabilising cultivation in areas where population pressure, land pressure and land degradation was increasing (Sawathvong and Vongleck, 1999).

Until recently, land was abundant and therefore rarely a limited resource that required extra-local control. The authorities moreover had little interest or capability in regulating farmers' access to land. With increasing population pressure and competing land-use objectives - especially forestry, irrigation and hydropower generation - the authorities have decided to regulate the acquisition of land. This is done through village-based land allocation schemes that entail:

- Demarcation of village territories.

- Demarcation of forest areas for conservation, watershed protection and production.
- Allocation of agricultural land to individual households.

In Lao PDR land and forest allocation is supposed to assist in the development of community based resource management. Although the authorities would ideally like to promote permanent land-use, it is realised that shifting cultivation currently is the only realistic option for many farmers. Cyclical shifting cultivation with up to three years fallow is therefore promoted in many areas, especially in the North.

The Government of Lao PDR (GOL) aims at a rapid reduction in shifting cultivation through land allocation the promotion of permanent types of land-use, and through socio-economic development (Hansen. 1998a). The achievements were very modest until 1993. Decree 169 in 1993, on the management and use of forestland, provided for the allocation of forest areas to communities and agricultural land to families (DoF, 1997). The land allocation procedures and regulations vary between provinces and between projects, but shifting cultivators are usually allocated up to four plots of land. The plot sizes depend on how much land the household can be managed with its available labour resources and production form. In practice, one to three hectares are allocated for annual use per families, or about four to ten hectares for a four-year rotation.

Where population densities are high, land allocation has not necessarily shortened the field rotations, which are already down to 3-5 years. In such areas, farmers have often been positive towards land allocation, as it helps solve land disputes within and between villages. However, where long rotation periods are still in use, land allocation reduces farmers' land access and is therefore less likely to be adopted and adhered to.

A four-year rotation is probably unsustainable in most areas, unless farmers rapidly adopt conservation measures, crop rotation, fertilisers, improved fallow or other techniques that can replace the positive effects of long fallow periods. Technology development, testing and extension are consequently needed concurrent with land allocation.

Local conditions will determine the possibilities of both short-rotation cyclical shifting cultivation and permanent cultivation. The main factors are probably:

- Soil fertility,
- Slope conditions,
- The rate of forest regeneration,
- The crops being produced,
- Market access, and
- The possibilities of mechanisation and soil tillage.

Because these conditions vary from one place to another, it may be argued that field rotations longer than four years should be permitted in some areas. This may include areas of low soil fertility, high erosion potentials, or areas with high reliance on subsistence upland rice production (Hansen and Sodarak, 1996).

The customary land tenure system allows farmers to clear any land not already claimed by other families. The land-use rights are retained during the following fallow periods, but may be handed over to other families at the discretion of the original owner. With the decreasing length of fallow periods most of the land under shifting cultivation is used for several cycles of alternating cultivation and fallow, in a more or less fixed rotation. The exceptions may be land that has turned out to be unsuitable for cultivation or where other forms of land-use are taken up, e.g., plantations or protected forest. In most upland fields were never bought and sold.

In, 1996 the First National Review Conference on Land Management and Forestland Allocation discussed the experience of difference provinces. The primary document issued by Ministry of

Agriculture and Forestry (MAF) to outline land and forest allocation procedures to provincial authorities is directive No. 822/MAF on Land and Forest Allocation for Management and use. Instruction 03/PM from the prime Minister's office on the expansion of land management and land and land forest allocation was augmented by Directive 822/MAF on land and forest allocation for management and use from the Ministry of Agriculture and Forestry (MAF). Part of this Directive stated that land allocation must be implemented “with a clear understanding of the area's ecological system and it's biological conditions, in addition to firm understanding of experience related to the efficient agro-forestry system of multi-ethnic population, in combination with new technologies" (Sawathvong and Vongleck, 1999).

Continue to make the policy on land management and land -forest allocation more deeply and extensively absorbed by government official and people, in view to making the authorities of all levels clearly understand their obligations, benefits and responsibility in protecting, managing, utilising and enriching land and forest in perpetuity. The Government of Lao (GOL) has outline a range of strategies for improving land management, land use planning and land allocation. There is need to provide the umbrella for consistency of land use plan of all sectors, and for uniform development of province level land use plans in order to support village land use planning and forest allocation programs (Sawathvong and Vongleck, 1999). Manage land and forest over the country in accordance with the national socio-economic plan. The land use planning and forest - allocation is considered as a key national strategy for eradication of poverty in rural areas special emphasis is paid to the shifting cultivation stabilisation and participatory natural resource management along the line of decentralisation process in sustainable development. Land allocation will also serve in poverty alleviation for the people in rural areas, particularly in the uplands. Land allocation is being implemented under the Land Law, Forestry Law and a number of Decrees and Instructions. More recently, in support of its policy goal, the government has begun land and forest allocation activities at village level several provinces

1.6 The institutional dimension

The process of establishing and guiding land allocation is occurring under the National Land Management and Land-Forest Allocation Committee, established by Decree 137/PM in 1996. This is an inter-ministry committee charged with studying policies, plans and regulations and co-ordinating, monitoring and controlling land-forest allocation. Its members in different departments (Prime Minister's, Forestry, Agriculture, Land) take responsibility for different aspects of implementation. The Committee has a permanent head, located in the Prime Minister's Department. The national-level committee is paralleled by committee structures at the province and district level, and when land allocation occurs at the village level a similar committee is established.

Planting by farmers, infrastructure development, and socio-economic development. But then is the little information as to their relevance to the study areas.

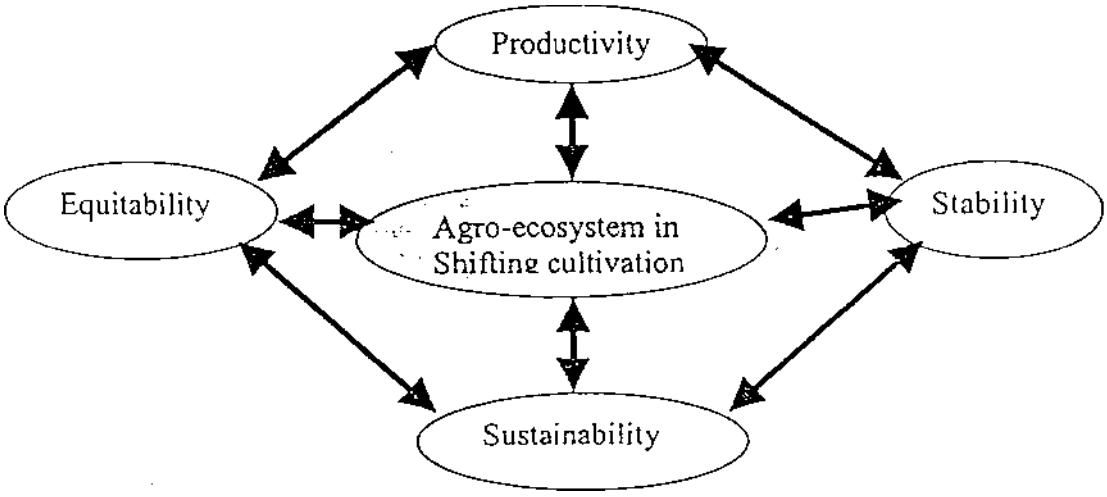
Conway (1985) and Mettrick (1993) referres to an agro-ecosystem as a complex agrosocio-economic-ecological system that arises from agricultural intervention in the natural ecosystem. It is assumed that the behaviour of agro-ecosystems can be satisfactorily described by four system properties: *productivity, stability, sustainability and equitability.*

- *Productivity:* is the net output of valued product per unit of resource input. Basic resources are land, labour and capital. Each ratio of output to input is measure of efficiency of product (Yield or net income per unit of resource).
- *Stability:* is the constancy of productivity in face of perturbations caused by the normal fluctuations in the surrounding environment (The degree to which productivity: is constantion face of small disturbances caused by normal fluctuations of climate and other environmental variables).
- *Sustanabilitv:* is ability of the agro-ecosystem to maintain productivity when subject to a major disturbing force.

- *Equitability:* expresses how evenly the products of an agro-ecosystem are shared among the human beneficiaries. The more equitable the system the more evenly are agricultural products shared among the members of, say, a farm household (Conway, 1985).

The influence, forest and nature have given the people life and sustained them. This is arguably why the people (Hmong, khamu, Lao) and the forest are linked like a pair that can't be separated from each other. For many thousands of year ethnic groups in Lao PDR have been clearing their land, felling and burning the trees. Thus, a system where forest is cut, the vegetation is burned to fertilise the soil, and crops planted for one or two seasons before the land is left fallow to regenerate, may provide the highest return on labour inputs (World Bank, 1990). Techniques of shifting cultivation and burning differ according to their culture and geographical setting. The ability of the shifting cultivation to provide subsistence for relatively stable population for thousands of years without extensive environment degradation certainly indicates its sustainability.

The following diagram therefore summarises the conceptual framework of the study.



2 Objectives and study areas

2.1 Objectives

Shifting cultivation is a traditional farming system which include much traditional agriculture in the Third World countries. It is used by small farmers who have only the most traditional tools, and who have little or no capital for work which provide barely enough food for their families (Tommy, 1984). A traditional agricultural system such as shifting cultivation generally has low productivity and stability, but high equitability and sustainability (Conway, 1985). Shifting cultivation has long been practised as a sustainable agriculture in upland areas of Lao PDR. Many rural communities in the study area continue to use shifting cultivation system. Shifting cultivators should be supported and encouraged to modify their shifting cultivation practices, by developing more productive alternatives based on adapted technologies or new opportunities.

A need exists to support improved farming systems and the development of other economic alternatives. The productivity, stability, sustainability, and equability characteristics of agro-ecosystem performance, blended into the screening criteria of technical viability, economic feasibility and social acceptability needs to be applied when determining to what extent an 'improved' system really does have positive implications concerning the practice of shifting cultivation. In order to contribute to above needs the main objective of the research study is to understand **how the different ethnic groups (Hmong, Khamu, Lao) in the study area practice shifting cultivation and to assess ways and means used to improve the system.**

2.2 Conceptual framework

The basic direction for the forestry sector development in Lao PDR was set in the first national forestry congress in May 1989 and adoption of Tropical Forestry Action Plan (TFAP) in September 1991 later, in 1994; it became the National Forestry Action Plan (NFAP). During these events it was concluded that a new system of sustainable forest management needs to be established along with the promotion of people's participation in conservation and management as well as natural environment protection. The government of Lao PDR places high priority on the reduction and stabilisation of shifting cultivation in the country in order to protect its natural resources and environment. The government of Lao PDR is also concerned about equitable development of the country by bringing the population of upland areas into the market economy to share the fruit of national socio-economic development (DoF, 1997).

Recommendations were made by the government for improving the policy process regarding the understanding and development of sustainability criteria for assessing land use planning and land allocation. They included promotion of permanent cash cropping, expansion of the paddy area, expansion of livestock production, tree

2.3 Research questions

The research questions for the study are as follows:

1. How do Lao Sung (Hmong), Lao Theung (Khamu) and Lao Lum (Lao) people practise shifting cultivation in the Nam Nane watershed? What are the impacts of this on labour for weed control and other practices? What are the negative and positive affects as observed by the people themselves?
2. What further areas of study could be identified and what measures (technical, policy) might be recommended to improve the current practises of shifting cultivation by Lao Sung (Hmong), Lao Theung (Khamu), Lao Lum (Lao) ethnic categories in the Nam Nane watershed in light of the current government policy to bring about changes in the shifting cultivation practices of the study area?
3. Does the criteria to evaluate system properties of an agroecosystem adequately capture what is sustainable in a shifting cultivation system?

2.4 Methodology

To satisfy the above-stated objectives and to find the answer to the research questions the system development methodology had been applied. This includes collection of information, and data analyses. Obviously, both technical and socio-economic data were needed in the development of relevant improved technology for farmers. The field survey and collection of information would include a part from a discussions with the village-village leader, elders, women, individual households, during field visits to shifting cultivation plots. In some instances RRA/PRA methods had been used, such as participatory, maping, develop of village seasonal calendars for shifting cultivation work include: specific operations by crop, level and distribution of labours. Questions on family size, and the rice production system.

2.5 Study area

2.5.1 *Location*

The study area for this research is situated in the Luang Prabang Province (Northern Part of Lao PDR), which has the greatest area used for shifting cultivation representing about 25% of national area (Roder, 1997). Shifting cultivation is the predominant type of Land-use in Luang Prabang province. The study area covers whole ***Upper Nam Nane watershed*** and has total area about 9,170 ha. It consists of seven villages including two Lao Sung (Hmong) villages, three Lao Theung (Khamu) villages and two Lao Lum (Lao) villages (see Map 2).

3 Environment and socio-economic situations in the study area

3.1 Environmental Condition

3.1.1 *Altitude and Rainfall*

The area may be divided into the lower, mid - and higher elevation, referring to areas below, between 700 and 1000m, and above 1000m, respectively. These three classes each represent about a third of the total area, and happen to coincide with agroecological zones. Most shifting cultivation is concentrated on slopes with altitudes ranging from 600-1,300m (Sandewall et al., 1998). Elevations vary from 480 to 1,380 meters above sea level, but areas higher than 1,000 meters account for only about 12 percent of the total area. The altitude range induces different climatic conditions, which in turn cause variations in soil properties, vegetation, crop suitability, etc. The average rainfall is about 1,600mm per year, which is relatively low for mountainous areas in Laos (Hansen and Sodarak, 1996).

3.1.2 *Climate*

The annual weather pattern is characterised by two seasons: a rainy season from April through October, and a dry season from November to March. The dry season includes a cool period from November to February, and a hot period starting in February and extending into the early rainy season. The climate in Ban Thong Khang Sub-district probably follows the same pattern as at Luang Prabang Weather Station, although air temperatures are lower due to the higher elevation (Figure 1).

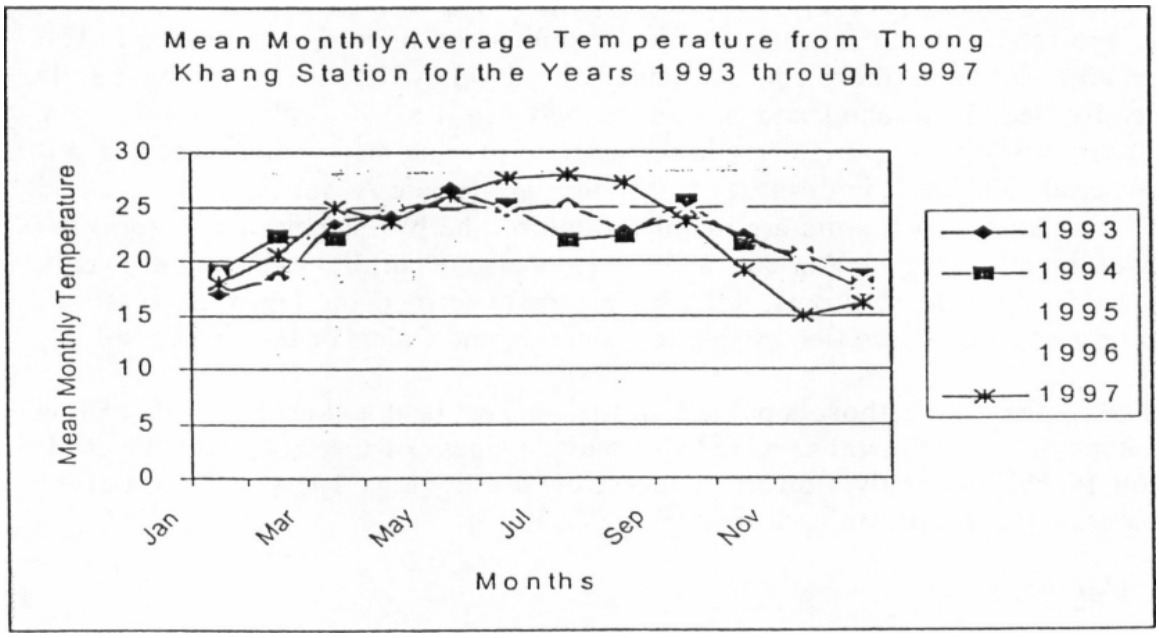


Figure 1. Average temperature at Thong Khang Station, Luang Prabang

The rainy season accounts for 90 percent of the annual precipitation. In terms of rainfall and number of rainy days, August is the most humid month and December the driest. Large variations occur in the annual rainfall pattern. The range in annual precipitation during 1970-90 was 1035 -

1841 mm. The onset of the monsoon-rains also varies considerably; thus, April's rain-fall figures vary between 0 and 267mm, which causes considerable risk to the early established crops.

May is the hottest month of the year, followed by a drop in mean monthly temperatures due to more rain and clouds in the rainy season. In November to February temperatures drop as a result of less insulation, less cloud cover and cooler winds brought by the north-east monsoon. December is the coolest month, but the average temperature remains above 18° C. Ban Thong Khang Station is located at an elevation of 640m, i.e., 330m higher than Luang Prabang Town. At elevations above 1000 m.a.s.l. the annual mean temperature can be expected to be 3.5 - 5.5 degrees lower than in Luang Prabang.

The relative relief in the pilot area of 900m is likely to induce a difference in average air temperatures between the lowest and the highest areas of 4.5°C. Evapotranspiration is therefore lower at higher elevations, and rainfall may be expected to be lower, but no data are available. The cropping season lasts up to ten or eleven months at elevations above 1,000m, whereas rainfed cropping at lower elevations is only about eight months. The diverse climatic conditions also affect the choice of crops and natural vegetation. Crop damage due to unusual weather is mainly related to rainfall. As already mentioned, the onset of the monsoon rains is uncertain, and sometimes makes replanting necessary. In some years, dry spells in the early rainy season cause problems, particularly for upland rice, as happened in 1993.

3.1.3 *Soil*

The land is mountainous, consisting mostly of steep and very steep slopes. The fertility and morphology of upland soils depended particularly on the soil parent material, the rate of natural erosion and conditions for humus accumulation. The mountain areas in the northern consist mainly of red-yellow laterite soils. These soils are generally heavily leached and pH varies between 4.5-5.8. Soil properties vary greatly in the study area, particularly in response to varying slope conditions and soil parent material. The most widespread soil groups are Haplic Alisols, and Dystric and Farallic Cambisols. Such soils are mainly found on the hill slopes, which form the majority of the area. Haplic Acrisols and Luvisols also occur, but to a smaller extent. At foot hills and valley bottoms, soils have mostly formed on deposited material. These soils are usually classified as Haplic Calcisols, and Calcic or Eutric Gleysols.

Rankers, Regosols and Lithosols prevail on the steepest land and escarpments resting on limestone. The shallowness of the soil and steepness of the land make the soils unsuitable for shifting cultivation and inaccessible for logging. Therefore, most of the more mature forest occurs on such land (SSLCC, 1997).

3.1.4 *Vegetation*

The area under forest cover has decreased from about 60% in 1952 to between 40-50% in the 1990s (Sandewall et al., 1998). Most of the vegetation is in some stage of secondary regeneration. Younger stage are often dominate by "nga farang." (*Eupatorium odoratum) (syn. Cromolaena odorata)* other herbs and bushes, although grassland of "nga kha" (*Imperata cvlindrica*) are formed where longer or repeated cultivation period are practised. Bamboo thickets are common, particularly where the land has been under repeated and short-term cultivation. Regeneration of forest is usually good and dense low tree stand may establish in 6-10 years.

Today, the natural resources and food production system in the Nam Nane watershed are under substantial pressure. For centuries communities have been practising subsistence shifting cultivation. Shifting cultivation has been defined as an agricultural system in which the field are cleared, usually by fire and cultivated for shorter periods than they are fallow. Shifting cultivation practice has a complex structure of land—use decision and management under different cultural groups. According to some estimates the agriculture area increased from about 40% in 1952 to 58% in 1989. The increase was particularly rapid during the 1970s and early 1980s when population also increased fast. Over the years, about 56% of the total area of 9,170 has been under shifting cultivation. It means that some 9 % cultivation in the past have been abandoned.

Some 93% of households are engaged in shifting cultivation with average about 2 ha being used annually by households (Sandewall *etal*., 1998). The natural vegetation is used intensively for gathering of materials, food, fodder and sales the products. Forest products are particularly important to diet during the dry season and early rainy season when few vegetables and spices are produced in the field.

3.1.5 *Crop production*

This cultivation system was well adapted to environment under certain socio-economic conditions of the ethnic people who practised it in a traditional manner. The traditional customs, and the knowledge of people for growing crops, catered for maintenance of ecological balance. Crop production is largely based on shifting cultivation; nowadays using fallow periods of only 3-6 years, alternating with one or two years of cultivation. Fallow periods are becoming shorter and new high forest areas are being cleared. Over time forest lands are gradually being transformed to bush or grassland, leading to decreased production capacity. Rice is the main short-thern output, and is considered the main reason to open shifting cultivation. Crop production is low, and alternative income opportunities are few mainly from farm labour in rice. The main reasons are that yield was poor, due too heavy weed problems (mainly Imperata cylindrica). Shifting cultivation and its relationship to rapid expansion of Imperata grasslands in South East Asia is complex (Powell, 1990). Weed are one of the most serious problems in all upland farming, regardless of whether it is shifting cultivation or continue cultivation. Weed would seem to be much more problem. Land degradation is the most important environmental problem affecting extensive land area. There is an erosion of traditional labour exchange, shifting cultivators have to depend on hired labour. It is expected that, when labour requirement for weeding increase, poor shifting cultivators may choose to go for waged income abandoning or leasing their pilots (Uraivanh. 1998).

The shifting cultivators in the Nam Nane watershed area practice a subsistence-oriented agriculture economy. The primary goal of every household is to produce enough rice for their own consumption during the year and some for livestock and other purpose, entertaining guest, liquor etc. Rice is intimately involved in the culture as well as the food ways and economy of many societies. Rice is the main crop produced by secondary forest. Most farmers prefer glutinous rice varieties. However, some ethnic groups, particularly the Lao Sung or Hmong, have a tradition of growing and consuming non-glutinous types. The Hmong were primarily subsistence rice growers.

3.1.6 *Animal husbandry*

Livestock production for domestic needs and export has become a current and potential economic opportunity of major importance (Chapman, 1998). Crop-livestock integration is not common, but is seen to be inseparable. Livestock production is important to almost all farmers. Animal husbandry is an important activity for most shifting cultivators. Demand for livestock production is very strong in the lowland and even in the upland. Animal husbandry is economically important to shifting cultivators in Lao PDR (Sodarak et al., 1998).

Shifting cultivators in Nam Nane watershed produced domestic animals include chickens, turkeys, ducks, pigs, buffalo, cattle, horses, goats for food consumption, sale and for use ceremonies, whereas buffalo and horses were kept for work purposes, dog, are kept by some households as watch dogs and sometime for hunting by khamu and Hmong ethnic groups. Free-range system are used in most villages (Photo 1).

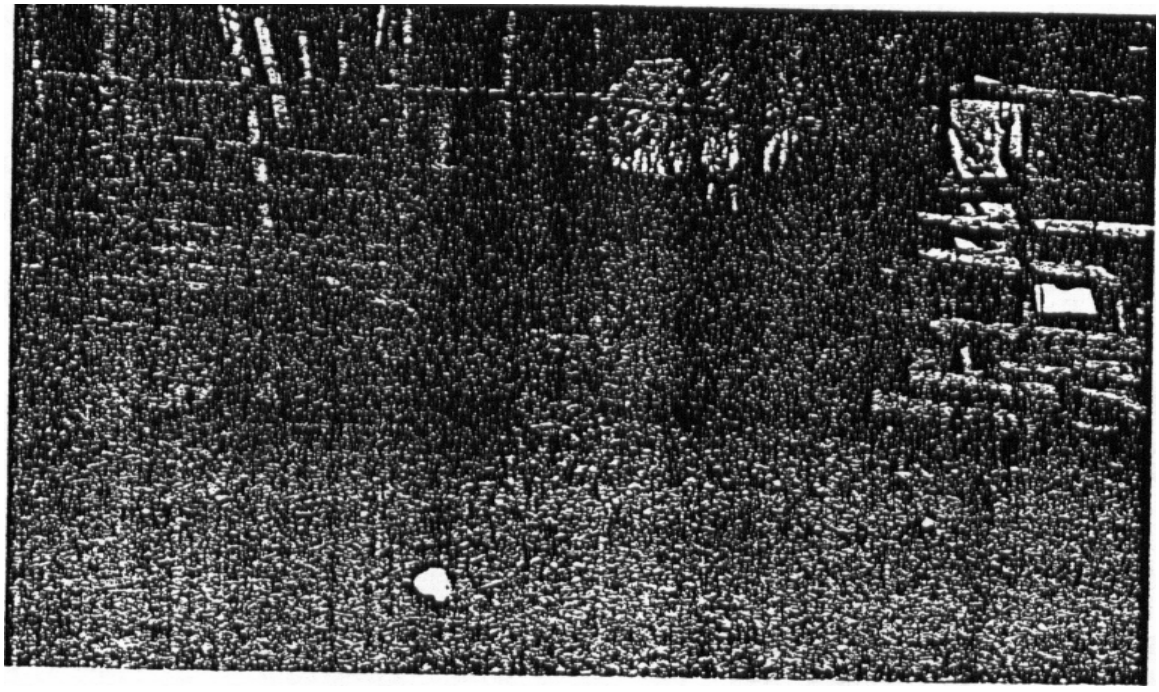


Photo 1. Pig raising by Hmong people in Ban Pha Hen (Photo: Author, July, 1999).

Animal production is relatively common among the wealthy and medium households, while poorer households have few livestock due to lack of capital. The production was constrained by low feed quality. Animals are raised only on locally produced fodder, such as rice bran, broken rice, water spinach and banana stem. Local feed resource are very abundant. The animals raised in Nam Nane watershed are small local breeds, probably with a low growth potential even under good fodder management. Low feed quality limits the growth rates, and hunger periods leads to substantial weight losses. A major production constraint is frequent outbreaks of epidemics, which kill or impede the growth of many animals, particularly pigs ducks and chicken Vaccination is not practised although vaccine is readily available in lowlands and probably would reduce the mortality substantially.

The husbandry differed between villages at higher and mid elevation, as a result of different cropping systems, sources of income and environments. Chickens are raised for household consumption of meat and eggs. Chicken may be sold in the village, but this income is not significant. Chickens are used in many ceremonies by the Hmong and Khamu. Virtually all households raise chickens, usually 2-10hens and there off-spring or about 30-60 in total. However, the stock varies considerably due to frequent epidemics of Newcastle disease and possibly other diseases.

Pig production was important part of farming system of Hmong and with the exception of few destitute households, all families raised pigs. Hmong have a more intensive pig production based on maize feed. Khamu pig production was smaller, with many households only raising fattening pigs bought from the neighbouring village. Traditionally, Khamu raise the pigs in free range system, allowing the pigs to scavenge in the village and village forest areas, and only calling the pig to households compound for feeding in the morning and evening. This production was partly based on maize produced in rotation with rice. Horses are kept as pack animals, but are not used for transport of people. The long distances from the fields to village and from the village to the lowland. Buffalo are kept for plowing and puddling paddy fields. Buffalo are only kept by the people with the paddy fields. The shifting cultivators make little or no attempt to improve pasturage for grazing animals, although the burning of areas for shifting cultivation fields may result in increased amounts of grass in fallow system.

Sale of animals provides an additional income, Cattle are raised by Hmong because of the large grazing areas in that areas. Cattle are mainly raised as a relatively profitable way of investing surplus capital, rather than storing it as cash or silver. Surplus capital is therefore very often invested in farm animals, and farmers generally see increased livestock production as a plausible way of improving their livelihood (Sodarak et al., 1998). Apart from subsistence use, animals are the main source of income, accounting for about 50 percent of the average farm's cash or barter income. Thus, most animal are eventually sold when cash is needed, and only on rare occasions is an animal slaughtered in village, e.g., for religious ceremonies, new year or funeral of an older person.

Gathering, fishing, and hunting are regular supplementary subsistence activities which can be turned to when agriculture fails, or as a pleasant diversion from other routine activities. Fish raising in ponds has been tried in many villages. However, the production was never sustained for longer periods because of flooding, insufficient water, other damage lack of fingerlings and inappropriate design of the ponds. Fishing yields and important but probably decline source protein for the diet. Several methods are used to get the fish from the small streams.

Hunting and fishing form additional activities, usually done with the help of self made primitive tools by a groups of men and able children at favourable times such as declining field work on suitable seasons. Hunter and fisher also go in a large or small group hoping to track down and catch the animal and fish. No one in Nam Nane watershed make his/her living by hunting and fishing.

3.2 Socio-economic Situation

3.2.1 *Migration*

Laos was inhabited five or more millennia ago by Austro-asiatic peoples (Mortimer, 1994). Reconstructing the pattern of migration of the Khamu and other proto-Indochina groups appear to have originally been widely distributed in both the mountains and plains. About eight centuries a go the valley- dwelling, wet rice cultivating Lao-Thai appeared in Laos, migrating south in response to the expanding pressures of Han Chinese. Later, largely during the past few centuries, the Hmong and the Yao tribes moved in from Yunnan and Tonkin, engaging in shifting cultivation. In general the Lao live along the rivers and in the valleys, the Tai in higher valley. The Hmong and Yao inhabit the mountains from about 1,000 meter to 2,300 meter while Lao Theung groups are irregularly distributed in between on mountain slopes.

3.2.2 *Minorities*

A part of the myths of minorities is the exotism ascribed to them. They are different but basically, there men and women, working for livelihood, giving birth to children, upholding arid maintaining a village or minority culture and having their share of hardships. The population of Laos consists of 66 officially recognised ethnic groups, many of which contain several subgroups (Chazee 1995). Laos' many ethnic groups are often divided into three main ethnic categories: Lao Lum (lowlanders), Lao Theung (midlanders) and Lao Sung (highlanders), classified by many factors-language, history, religion, customs, dress, etc, (Table 1).

Table 1. Ethnic groups in Lao PDR

Categories	Ethnic Groups
Lao Lum	Lao, Black Tai, Lao Leu, Nyuam, Phuam, Luh, Meui, etc.
Lao Theung	Khamu, Lamet, Phong, Srila, Lawen, Karen, Katu, Katang, Alak, etc.
Lao Sung	Hmong (white, red, black), Yao, Phu Noi, Ko, Kui, Musser, Haw, Akha, Lisu, Lisu, Lolo, etc.

Source: Cumming. J. 1998 (Lonely Planet).

The Lao Lum consists of the Lao or Tai speaking, mostly Buddhist groups and accounts for about 60 percent of the population (NSC, 1997). Although most Lao Lum farmers are engaged in paddy farming, a large proportion practices shifting cultivators. The Lao Theung and Lao Sung groups make up 30 and 10 percent of population, respectively (NSC, 1997). In general, they are more dependant on shifting cultivation than the Lao Lum groups, but the land-use is very diverse and ethnic stereotypes often prove misleading (Roder et al., 1991, Hansen, 1995). Three ethnic groups live in the Nam Nane watershed. In order of population numbers these are: Lao, Khamu, Hmong. Each of these groups is unique in terms of culture, and language; and shows some differences in land-use and socio-economic conditions (Table 2). For statistical and other purposes the Laotian population is often categorised as Lao Lum (lowland Lao, i.e., ethnic Lao), Lao Theung (upland Lao, including Khamu) and Lao Sung (highland Lao, including Hmong and Mien). However, it should be mentioned that the conventional assumptions that ethnic Lao (Lao Lum) are predominantly paddy cultivators and Khamu and Hmong are shifting cultivators.

Table 2. Ethnic groups and number of households in the seven villages of Nam Nane watershed.

Village	Ethnic groups (number of households)
Tha Lie	Lao Phuan, Lao (140)
Pha Kuang	Lao (42)
Pha Tong Lom	Khamu (57), Lao (7), Thai Dam (4), Thai Yuan (3), Hun (2), Thai Phuan (1).
Thong Khang	Khamu (58), Lao (7)
Houy Oun	Khamu (33)
Pha Haen	White Hmong (Hmong kao) (27)
Tou Ho	White Hmong (Hmong kao) (50),
Total	431 Households in seven ethnic groups

Source: Villages survey in July 1999.

3.2.2.1 *Lao Lum*

The Lao, descendants of the Tai peoples who began migrating from China in the first millennium A.D., constitute approximately half the people of Laos Lao Lum are the ethnic Lao who have traditionally resided in the Mekong river valley or along lower tributaries of the Mekong, and who speak the Lao Language. They are an ethnic subgroup of Austro-Thai peoples who have proliferated throughout South-East Asia, Southern China and the north-eastern Indian subcontinent. Under the official government classification they supposed to be found at elevation between 200 and 400m above sea level (Cummings, 1998). As a result of stagnating and inadequate rice production in lowland, these farmers are cultivating the lower slopes and mountain valleys. Except for the tai who are only spirit worshipers, Lao Lum usually practice a mixture of Buddhism and spirit worship. Status between men and women is relatively equal with ownership usually held communally. Lao Lum men and women tend to be more educated, usually attaining 3 to 5 years of primary schooling. They also tend to be healthier than other peoples, having a sufficient diet of glutinous rice, vegetable, fruit, meat and fish.

In recent years as a result of poor management and increased demand, the Lao Lum farmers are beginning to move up the hillsides. Lao Lum men spend their non-farming time building and repairing their houses, fishing, hunting and making bamboo baskets.

3.2.2.2 *Lao Theung*

The Lao Theung is the general name applied to very diverse group of indigenous inhabitants. In certain connections the word is also used to distinguish the Khamu from Lao. The Khamu are one of the original old lines of inhabitants of Indochina land, that have lived here before other arrived (Simana and Preisig, 1997). Khamu is one of these upland Mon-khmer language. Who live on mid-altitude mountain slopes (officially 300m to 900m) (Cummings, 1998). Khamu speaking ethnic groups are found all over northern and southern Lao PDR, which seem to be the home land of Khamu culture (Lindel et al., 1982). We can observed that Khamu tend to make their village in elevated areas, but not really on the top of mountain. Most Khamu like to live the mid-altitude so they can easily find mountain animals and creatures from the water as well. Khamu villages are established near upland stream, their houses have dirt floors like those of the Hmong, but roofs and roof-beams similar to northern Thai. Those few who are Buddhists have adopted the faith of the Lao relatively recently, but the majority are animists and worship spirits.

Khamu children, particularly girls of six years and older also endure heavy workloads, carrying siblings, carrying water, gathering firewood, pounding rice and working in the field after they are ten. As a result, few children in rural villages complete primary school, most drop out after 2-3 years. These low attendance rates greatly affect adult literacy, which is low. Khamu men do much of initial clearing of upland slopes, as well as hunting. The Khamu with few exceptions cultivate shifting cultivation. In the evening and early morning, men often tend small children while women pound rice, fetch water and collect vegetables. The Khamu have a much lower standard of living than any of three other groups describe here.

3.2.2.3 *Lao Sung*

Lao Sung include those hill tribes who make their residence at altitudes greater than 1000m above sea level. Lao Sung moved from southern China (Sino-Tibetan origin) into Northern Laos only 100-150 years ago, occupying the highest slopes and mountain tops. Following the suppression of their uprising by the Chines in 1881, many Hmong migrated to North Vietnam, Laos and Thailand. They have carried on with their own handicraft especially in regard to cloth-making from hemp, black smith and traditional crops

This movement is said to have already began in 1868 with ten thousand Hmong from Kweichow, Yunnan and Kwangsi and continued sporadically until 1954. Some settle near the border of China and Laos, but many bypassed this region, moving on to northern Laos, through to Thailand with a few going as far as the southernmost part of Yunnan. In Laos they are believed to have established themselves "less than ten years" in the high mountains before 1883. In 1894, they were reported to crossed the Mekong river into Thailand. The largest group are the Hmong. In Lao PDR the Hmong setlled in highland of Houphan and Xieng khoung province, gradually spreading westward to Luang Prabang, Namtha, and Saygnahourie province.

Hmong have the same education and health problems as Khamu. Since few Hmong women are encouraged to go to school or even to learn Lao, the national language, their exposure outside of their village is quite limited. Yet, for several reasons they are not so desperately poor and seem to have ready access to cash or goods for exchange.

They also raise many pigs, cows and horses, which can easily be sold during difficult periods. Horses appear to have been their basis means of transportation through their long history.

3.2.3 *Population*

The population increased from few households at the turn of the century to about 130 households in 1953 (Sandewall et al., 1998). The total population in the Nam Nane watershed is estimated to be 2,403 peoples, which 1219 are female (Table 5).

Table 3. Populations in Nam Nane Watershed area from 1993-99.

Village	No Families						
	1993	1994	1995	1996	1997	1998	1999
Tha Lie	124	124	124	128	128	140	140
Thong Khang	53	58	58	66	66	64	65
Tou Ho	45	53	53	62	56	50	50
Pha Haen	43	35	37	25	27	27	27
Pha Tong Lom	57	60	62	72	70	73	74
Pha Kuang	34	36	36	40	42	40	42
Houy Oun	39	34	34	30	34	32	33
Total	395	400	404	423	423	426	431

Source: Villages survey in July 1999.

The population is composed of several ethnic groups that are often divided into three major ethnic categories. The first one is the Hmong ethnic group of Lao Sung categories (upland Lao). The second one is Khamu group of the Lao Theung categories (midland Lao), usually preferring the lower elevation to settle. It is as people of mountains, independent and proud of their distinctive languages, dress and cultures that they entered modern history. The third one, which is the biggest groups in the country's, who often live in low-land areas, is Lao or Lao Lum (lowland Lao).

The population in Nam Nane watershed is growing quite rapidly. As can be seen from the data presented in the Table above and as illustrated in the table below most population is child bearing age. This indicates that the internal rate of population growth is high. Indeed, the actual growth rate is approximately 1.5% per year. At this rates the population of Nam Nane watershed area will double in 46 years. This has serious implications for economic and land use of the areas. Currently, the overall population density is approximately 26 people per km^2. But this raw table is misleading. Most the land within the Nam Nane watershed is unsuitable for agriculture.

Table 4. Age distribution in Nam Nane Watershed (1999).

Age group	Numbers	Percent
0-6	517	21.5
7-15	654	27.2
16-30	586	24.3
31-50	446	19
50+	200	8
Total	2403	100

Source:Villages survey in July 1999.

3.2.4 *Ban (villages)*

"Ban" is a Laotian term, meaning "village". There is seven villages in Nam Nane watershed areas. A village status is ascribe to an area containing not less than 50 houses. They vary in size from 30 to 124 nuclear families, with an average of 57 families per village. Households are the basic economic unit in agrarian societies in Lao PDR. The average household size in Nam Nane watershed area is 5.5. The ethnic composition of the population is shown in Table 5 Lao and Khamu represent 47 and 36 % of the population, respectively, with smaller groups of Hmong (17 %). The Khamu are generally accepted by the local villagers to be the original inhabitants of the area, but for various reasons many Khamu villages have relocated at rather frequent intervals, sometime only over short distances.

The oldest village entered the area in the 1880s. Six of seven current villages settled in area before 1953 (Sandewall et al., 1999). The oldest permanent communities in the area are the Lao village (Ban Tha Lie), which are said to be "200 years old." These villagers and most other Lao living in the area are Lao Phuan, a Lao sub-group originally from the Xieng Khuang area of Laos.

The migration involved considerable direct and indirect costs to the households. Before departing from their old villages people had to part with most their possessions. Most Hmong people live in Southern China, but some immigration to Laos and neighbouring countries has taken place within the last 100 years. Hmong villages have probably been present in the district for at least 50 years and also in the study area. During the Lao Civil War in the 1960's and early 1970's much movement took place in and out of the area. Some of the villages were abandoned for some years, and refugees passed through or settled in the area.

Table 5. Population and household numbers in villages of Nam Nane watershed

Village	Population				Households
	Total	Lao	Khamu	Hmong	
Tha Lie	776	776	-	-	140
Pha Kuang	209	209	-	-	42
Pha Tong Lom	434	90	334	-	74
Thong Khang	408	70	338	-	65
Houy Oun	175	-	175	-	33
Pha Haen	160	-	-	160	27
Tou Ho	241	-	-	241	50
Total	2403	1145	875	401	431

Source: Villages survey in July 1999. Calculated from number of households

The organisation and institutions in the villages are similar to most other villages in the country. Each village has a Headman, elected by the villagers. His (all Headmen in the area are men) main function is to communicate with the District authorities and other external agencies. In principle, the Headman does not have special authority or command, but, being elected, he is often a respected figure in the village. Decision making on communal issues is taken by representatives of all households, ideally based on common consent rather than majority vote. Frequently, decisions are stalled because consent cannot be reached. Lao Women's Union (LWU), the Lao Youth Organisation and the elders' group have members in all the villages. These

organisations carry out a number of activities and distribute information related to development, etc.

3.2.5 *Occupation*

After settling in the Nam Nane watershed, most families gradually accumulated resources, such as claims to good land. Only two of the 431 families in the Nam Nane watershed report that they derive their main income from non-agricultural activities, mainly from trading and teaching.

These families do however, supplement their income by some sort of agriculture. Of the 429 families predominantly occupied in agriculture, 375 families (87%) live exclusively from shifting cultivation. Twelve families (3%) are mainly paddy farmers, while 42 families (10 %) combine paddy and shifting cultivation (Table 6). A small number of farmers supplement their income with trading, rice milling, or employment in Luang Prabang or other towns.

Table 6. Population, ethnic composition and main farming systems in villages in Nam Nane watershed.

Village	Fam'l	Pop'l	Ethnic composition (no of people)			Main farming system (no of families)		
	no.	No.	Khamu	Lao	Hmong	Shift cult.	Paddy	Shift paddy
Houy Oun	33	175	175	-		33		
Thong Khang	65	408	338	70	-	52	-	12
Pha Tong Lom	74	434	344	90		59	5	10
Pha Kuang	42	209		209		41		
Tha Lie	140	776		776	0	113	7	20
Tou Ho	50	241		-	241	50		
Pha Haen	27	160			160	27	-	
Total	431	2403	857	1145	401	375	12	42

Source: Villages survey in July 1999. 2 families are completed outside agriculture (Teacher and trader)

3.2.6 *Health*

Maintenance of good heath is very important factor in the household economy of the villages in Nam Nane watershed. The health situation is bad in the area, but probably comparable with most other rural areas in Laos. Thirty percent of the children die before they are five years old, mainly from malaria, and gastro-intestinal diseases (Leacock et al., 1993). The most common complaints are cough, fever, dysentery and injuries sustained during fieldwork. Malaria is, however, rampant in all age groups and the most common reason for people to seek medical treatment at the Sub-district clinic. A severe epidemic of typhoid broke out in 1990-91, which killed many people; in some villages as much as one third of the young children.

Various parasites are endemic in the population and likely to exacerbate nutrient deficiency problems, and may cause acute illness. The spread of parasites is facilitated by the consumption of raw meat and fish, lack of toilets, free ranging pigs and the lack of treatment and awareness of the problem.

Levels of illness are very high, especially at the beginning and during the rainy season many of the more serious diseases flourish, e.g., malaria, dengue fever and diarrhea. Consequently, many people are sick or weak during the main cropping period, which sometimes seriously affects the food production for the afflicted families. During the cool season, night temperatures may drop close to freezing point, and children particularly suffer from colds and lung problems. High levels of illness is not only of immediate humanitarian importance but is also a grave barrier to economic progress and ability of farmers to adopt more sustainable land use practices.

Many children are unusually small for their age, and many adults seem to be of stunted growth. The major reason for this is probably the frequent spells of sickness experienced during childhood. In some cases, protein deficiency may be the reason, but the staple consumption of rice will normally provide sufficient protein for normal growth.

A sub-district health clinic is located at the Ban Thong Khang Station, and is served by two nurses. The clinic provides medicine at normal market rate, can perform simple diagnoses and tests, and give some advice on preventive health care, family planning, etc. However, there is a great need for improved health service and more awareness of preventive medicine. Apart from the public health service, many people seek help from practitioners of traditional medicine, injection quacks and shamans.

Costs for medical services are high in comparison with the general income level, and may bring unfortunate families in debt for years. According to a socio-economic survey (Leacock et al., 1993) the average family spent 15,000 kip per year on medical service and medicine, including both modern and traditional methods.

Moreover, the earlier population growth and socio-economic pressure in the Nam Nane watershed and improved means of transportation, despite the dangers they pose in the spread of disease organism, pests and parasites from one village to another village of the Nam Nane watershed.

3.2.7 *Nutrition*

The principle domestic use for food crops is direct human consumption. Most diets contain both vegetable and animal products. Everyone needs to pay attention to the quality quantity and diversity of food sources to have a balanced diet. Most families subsist on a simple diet of rice, a few vegetables and chilies. Beans are most commonly eaten as unripe pods, and there is no tradition for eating pulses on a daily basis. Vegetable production is small and seasonal. Meat is eaten only occasionally, and some families consume meat only a few times a year. Much of the meat is consumed during festivals or used to entertain guests, which often means that women and children get only a small share of the meat and other special food. Moreover, much of the produced meat is sold to the markets in towns. Forest products have traditionally formed a substantial part of the diet. However, dwindling forest resources and reduction of wildlife seems to be decreasing the importance of hunting and gathering.

Iodine deficiency is a big problem in the area, as it is in much of the country. Vitamin A deficiency is suspected to be common, since night blindness has been observed. Moreover, many women suffer from anaemia.

The diet could probably be upgraded relatively easily, by making people more aware of the value of pulses, appropriate kinds of vegetables, proper cooking of meat, and the use of iodised salt.

3.2.8 *Education*

All villages have school buildings, five of which are served by the provincial education system, the others by teachers employed directly by the provincial.

Education is essential to improving the status and economic prospects of the ethnic groups. Adult literacy rate is 46 %, but considerably lower for women than men. For the generation of children growing up today, the situation seems to be better than for their parents' generation. The majority of children get some degree of education, and most of them seem to obtain at least basic reading

skills. A small number of youngsters are attending primary or secondary school in Nane district and Luang Prabang province.

However, progress was minimal because the teachers were often absent and many children have to work in agriculture or nurse younger siblings, particularly during busy periods. Better education is a key to solve some of the main problems related to shifting cultivation, including the lack of alternative occupations and rapid population growth.

3.2.9 *Infrastructure*

In Nam Nane watershed, Only three out of the seven villages can be reached by gravel roads, namely Ban (village) Thong Khang, Pha Tong Lom, and Tha Lie. The other villages can be reached only by foot. Although the infrastructure remains poor, it has improved since 1998. That year, Tou Ho, Pha Hen, Pha Kuang and Houy Oune villages were connected with the new dry-weather road linking Tha Lie with Nane district (Photo 2).

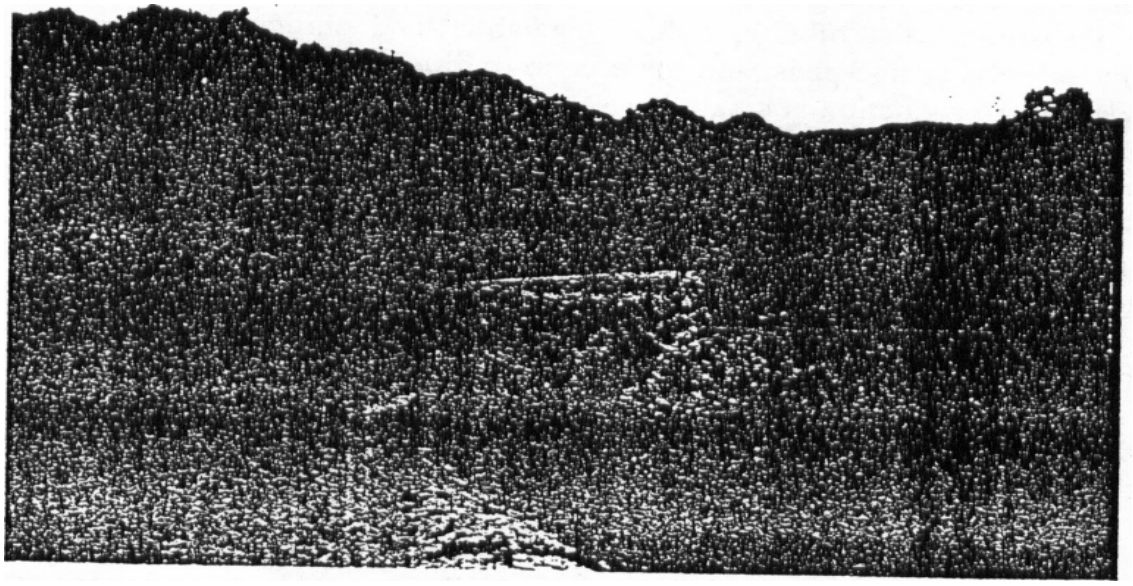


Photo 2. The roads construction by the villagers from Ban Pha Kuang to Ban Tha Lie (Photo: Author, July, 1999).

This also meant that many village in the upper Nam Nane watershed area became within easy reach of the road, which facilitated the production of new cash crop, where as job tears cultivation was further hampered. The area is situated on hilly terrain varying from moderate to steep slop. Neither of the villages has access to electricity. Such a poor infrastructure means that access to the market and all the possible information is limited.

3.2.10 *Market*

Marketing has developed in importance and complexity as economic development and specialisation has increased productive capacity and separated food producers from consumers. Today's food system is the product of many forces operating over many years (Kohls and Uhl, 1998). The goal of food system is to satisfy consumers. Shifting cultivation also includes a wide variety of production and collection of Non Timber Forest Products (NTFP) (Ohlsson, 1990). In terms of economic diversification, the villages have very different strategies. Some villages are very actively and engaged in an evolving market economy whilst others have different outlook. The main production goals of villagers in the Nam Nane watershed area are subsistence

production and self sufficiency of rice. However, for several generations farmers have sold parts of their production to obtain various external products such as medicine, kerosene, farm tools, iron, and salt. During the last decades various manufactured goods have also become commonly used, including batteries, detergents, soap, noodles, sweets, drinks, rubber sandals, and textiles. In latter years, rice production has been insufficient to meet most families' requirements (probably because of shortening fallow periods and changing production goals) and substantial quantities of rice are now being bought. The people in Nam Nane watershed have thus increasingly become involved in the market economy.

The principal markets for sale and purchase are in the towns of Luang Prabang, Xieng Ngeun and Nane district. As mentioned above, the relatively easy access to good roads and river transport may well facilitate economic development in the future.

There are shops in all villages selling small quantities of daily household goods, such as washing powder, soap, tooth paste, cigarettes, matches, candy, plastic sandals, etc. The most common way for the villagers to acquire cash for their purchases is sale of rice, fruits, vegetable, domestic animals. Traders come to most of the villages to buy pigs, cattle, and other products. Livestock may eventually be sent as far away Vientiane and Thailand, where the prices are 40-60 percent higher.

The local prices of most agricultural products are considerably lower than in Town and in recent years some Lao traders have attempted to establish production contracts with farmers in the area, e.g., of soybean *(Glycine max (L.) Merr),* Cowpean *(Vigna unguiculata (L.) Walp.),* castor *(Ricinus communis L.),*sesame *(Sesamum indicum L.).* job's tears *(Coix lachryma-jobi L.).* In most cases these attempts have failed because the traders did not come back, the prices offered were lower than originally suggested, and the product quality was not as required.

4 The farming system associated with the three ethnic groups

The practice of shifting cultivation is an ancient technique, which has been used on all continents. It is still practised in many countries and it allows to feed a numerous population, often isolated from communication networks and markets without access to education and new techniques. Shifting cultivation is an extensive type of agriculture adapted to the mountainous terrain of the Lao, Hmong, Khamu but lacking the long-term stability of intensive irrigated cultivation, which is capable of supporting much large and more stable populations. Thus while a shifting cultivation may give a higher yield per hectare when new, it can support only a relatively sparse population because of its declining fertility. Shifting cultivation practised develop and change overtime in response to various factors, including: availability of land, type of land, population dynamics, climate, availability of labour, need for cash, market access, past practised, food preferences, ethnic group, government policies (Roder et al., 1993).

This product system, close to proto-agriculture, situated between gathering-hunting and sedentary agriculture, has allowed, from generation to generation, to establish close links between nature and mankind. These linkages have formalised through experiences and empirical observations, where different technical, social, religious and traditional value were mixed. They have organised themselves to exploit natural resources, through not very perfect production modes, but in a way sufficiently sustainable' to be able to maintain the system until now (Chazee, 1994). They are farmers who supplement sedentary farming with shifting cultivation because they have limited other options. Most shifting cultivation takes place at higher altitudes and most likely by different ethnic groups using different agricultural practices. “I cannot stop growing rice because I want to eat as my neighbour” Nang Khernma, Ban Nam Phak

4.1 Shifting cultivation system

This method was adopted when man changed from the food-gathering to food-production habits. In most system of shifting cultivation in forested areas, suitable field sites are usually selected from secondary and some time primary forest (Peters and Neuenschwander, 1988). Firstly from indiscriminate logging in which clear felling of timber is practices and secondly from shifting cultivation in which due to population pressure or restrictions on land use, the recovery of the fertility of the system.

Shifting cultivation covers more land and contributes to the economy than other forms of crop production. The origin of shifting cultivation is linked with ethnic traditions, but also with soil fertility problems. They do serve, however, to indicate the possibility that hectare for hectare in any given season shifting cultivation, at least in the first year, they can be more productive. Its must also be remembered that the yield begins to decline by second year and may drops as much as eighty percent by the third. The shifting cultivation system is described below.

- ***Site selection***

The cycle of shifting cultivation begins in January with site selection. The selection of the field site is most important. The cropping cycle starts with the selection and demarcation of land to be cultivated during the coming year. In general shifting cultivators seek out areas with the best soil available or the soil most suitable to the particular crop, planting, planting done, so far as possible, to utilise varying qualities of soil (Spencer, 1966). Field sites are often selected in mature secondary forest or fallow because the slash dries more quickly and burn more thoroughly than primary forest. If shifting cultivators don't know how to select a good place the field will be bad and the soil poor. As a result the rice won't become nice and strong. Farmer's criteria for evaluating soil are related to texture, structure, colour and stoniness. The preferred soils are clayey. The top soil should be dark or black or else the soil would be considered an old soil where erosion has removed the top layer. Furthermore, there should be no stones on the surface. For shifting cultivators, usually chooses slopes of 20-60% inclination. The hilltops and ridges are usually left uncultivated, because of rapid internal drainage that renders the soil relatively and for

forest protection and conservation. At lower elevation, normally only foot-slopes are cultivated. Shifting cultivators are very careful in choosing the location of the land to be cultivated

- ***Slashing***

Clearing shifting cultivation areas is primarily the responsibility of individual households. The practice of slash a shifting cultivation area it also intimately related to subsequent burning process. Slashing the vegetation is a village community activity built on reciprocal relations. In forested areas the shifting cultivators usually slash the undergrowth and small three stumps fell most of the large trees, often leaving the slash undisturbed to dry before it is ignited. The duration of slashing operations depends on biomes to be cut. The timing depends on kind of vegetation, the availability of households labour and the need to do other kinds of work. On the other hand, clearing of young fallow vegetation or field cultivated the previous year requires less time both for slashing and for the vegetation to dry sufficiently to burn easily. Slashing is done with a small traditional axe and a manual saw for the big trees. The annual cycle of work starts in January or February when the vegetation is slashed and left to dry.

- ***Drying***

The organic matter is left on soil to dry for 3 to 4 weeks in general. A few days more or less of drying time at the beginning of the drying period are not felt to be too important by the villagers (Kunstadter and Chapman, 1978). This technique presents the advantage of completely covering the soil, constituting a humid natural mulch protecting the soil against sun drying and impact of violent tropical rains. The structure of the soil is not only preserved but its microbial fauna is stimulated by organic matter being degraded. The combination of these effects is agronomically excellent for the germination of seeds.

- ***Burning***

Primitive humans presumably did not drastically modify the natural environment until they learned to produce and use fire ten to twenty thousand year ago (Johnston, 1970). Fire has received much attention as a disturbance (Kozlowski and Ahlgren, 1974; Mooney et al., 1981).

Fire is also the most versatile tool available to a shifting cultivator. Field burning involve community co-ordination and action because of the perceived dangers to life, and to the village itself. Timing is of the utmost importance in determining the success of the burn. Timing is, of course, tempered by other considerations. The weather on day of the burn is crucial. Usually, an ideal day is cloudless and only moderately breezy (Conklin, 1957; Ruddle, 1974; Zinke et al., 1978). The month and the moment of the day are generally carefully chosen for burning since it is a delicate activity. If they wait more than six weeks, burning will be difficult because the slash becomes infested with termites and rapidly decays (Carter, 1969). The slashed vegetation is usually burned in the late March or early April. This normally takes only a few hours, starting around noon when the dew has died out and the wind is stable. The whole family field must be burnt the same day and as quick as possible to insure the maximum consumption of the organic matter. A poor burn will incur a great cost in terms of additional labour. Before burning, firebreak construction is an integral part of swidden burning in many shifting cultivation societies. The efficiency of such firebreaks varies widely, and some shifting cultivators groups do not use them at all. In the burning season the sky is often obscured by smoke.

- ***Unloading and second burning***

Unloading trucks is generally a family activity, but the system of mutual assistance or labour exchange will prevail if volumes to be removed are important. Re-burning is often used to disposed of the unburned material, which is piled up and fired. Some of the large trunks may be cut up or rearranged to allow more planting space (Wagley, 1977). Sometimes, to supplement re-burning, the remaining branches are removed by hand. Slash will often be placed around stumps and trees to be killed by the re-burn fires (De Schilippe, 1956). This activity requires between 2 to 10 days depending on the volume of organic matter to be re-burn or to be removed from the field. At this point the remaining litter is subject to a second burning in some place where preferably vegetable, fruits and spices will be sow.

It should be noted that, for the families within sufficient labour or those cropping land with a fallow period of only two years, the second burning is very important activity. Rice and it related crops are sown where organic matter has been accumulated and burn.

- ***Land preparation***

Shifting cultivators needs to prepare the soil comparatively little. Some ethnic groups weed the shifting cultivation area before sowing, using a small hoe. The crust of topsoil is thus broken with advantage of some drying some weed roots and also favouring the infiltration of rain water in the soil. This is a long and exhausting family activity mostly executed by women. One land preparation weeding with hand tools requires a minimum of work per hectare.

- ***Sowing or planting***

The field normally regenerates a vegetative cover, a process begins soon after the fires have cooled down. Immediately after burning, planting can often be carried out without cultivating the soil. However, most shifting cultivators do in fact disturb, loosen, and move small amounts of surface soil as part of operation of planting (Spencer, 1966). Sowing starts after the initial heavy rains. The method of sowing seeds under shifting cultivation in different regions is more or less similar. Sowing is certainly the master activity in the shifting cultivation system, from a religious, traditional and social point of view.

In shifting cultivation, seeds are generally sown in mixed pattern. The proportion and types of crop mixture depend, by and large, on traditional wisdom which conforms to the soil conditions and climate. Sowing, as well as burning, must be achieved in one day by women, men and children. Sowing is done after the first rain showers. If the field is too big, the family will ask for help from friends. Each worker sows a quantity of seed on an area he is able to weed. Men make holes every 18 to 25 centimetres using a dibble stick made of wood or rattan with a reinforced or iron pointed end. Women with a seed bag attached to their waist come after, throwing 8 to 20 seeds per hole. With a density of 15 hills per square-meter and an average of 12 seeds per hole, the quantity of seeds is between 68 and 75kg per ha with maximum of 90kg. The principal crop is upland glutinous and non glutinous rice supplemented by various cash crops (vegetable, cotton, maize, bean, chilies, etc.) planted after cultivation of the main crop.

The first crop to be sown is maize the date of sowing depends on the wording of other field operation and on the weather, but usually it takes place in early or mid April. Rice is the primary crop. Rice is often mixed with maize or separate fields. Vegetables (gourd, cucumber), fruits (watermelon), spices (chillies, basilics) and tobacco are also sown in the same field by the Khamu but generally on spots where ashes accumulate and on termite mounds. Cotton, cassava, groundnut, soybean and sesame are generally sow along the boundaries of the rice field. Root crops such as ginger, cassava and taro, are also sometimes planted before the rainy seasons has started. In all crops shifting cultivators use home produced seed. The use of home produced seed material caused few or no problem in traditional crops, such as rice *(Oryza sativa L),* maize *(Zea mays L),* sesame *(Sesamum indicum L),* job's tears *(Coix lachryma-jobi L),* cotton *(Gossypium ssp),* sorghum *(Sorghum bicolor(L.)* Moench), chilie *(Capsicum frutescens L),* etc.

- ***Fencing and field huts***

Fencing takes place before or after sowing, using non burnt wood and bamboo or by digging trenches or holes around the shifting cultivation area. The fence protects the field against buffaloes, cattle, horses, goats and also large wild mammals are wild pig, sambar deer and wild hoar etc. There required for fencing is highly variable according to its quality (Picture 6). Fence construction requires up to 10 days of labour per hectare; but is generally less, averaging 2 days per hectare (Roder et al., 1997), because farmers group their fields together in blocks and share labour for fencing perimeters of cropped area. Most fences are constructed from bamboo and fence failure is common. Jatropha curcas know locally as "*holing kaew*" is also commonly planted as a living fence, usually reinforce with bamboo or barbed wire (Fahney et al., 1998).

After the vegetation has been burned, but before sowing, small but are constructed in the field that are some distance from the village. These huts consist of a porch and a levelled earthen area

under a common roof, but have no walls. They are only intended to last a few years and are usually made from bamboo, with thatched Imperata roofs. Field huts are used for taking midday meals and rests, for shelter during heavy rain and for storing harvest products, seed, etc.

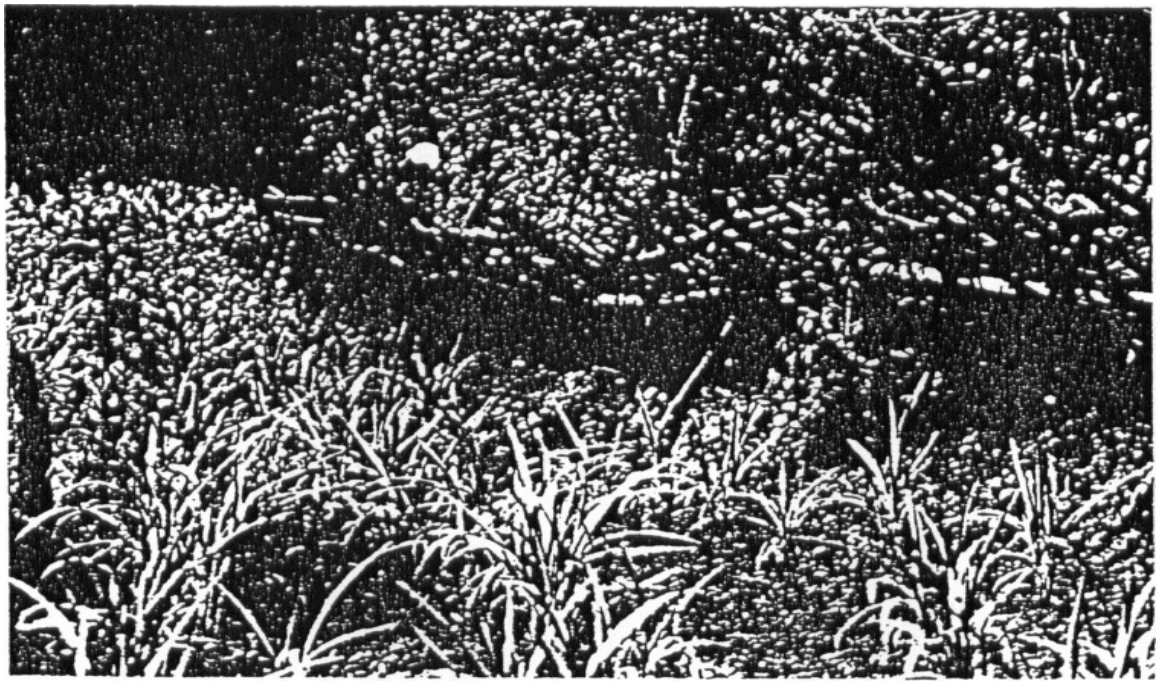


Photo 3. The fence make by the Hmong shifting cultivators at Ban Pha Hen (Photo: Authors, July, 1999).

- ***Weeding***

Throughout the cropping period, weeds pose a problem. Weeding is the most time consuming, most uncomfortable, and most disliked portion of shifting cultivation. Weeds and re-growth from tree stumps and root stock will there fore start to emerge before sowing. Weeds are generally considered as the main constraint to rice production (Roder et al., 1994). The traditional shifting cultivation system is well adapted to temporary weed control. The degree of weed competition depends on history of the field, the crop's ability to compete, and management practices. When forest clearing was still possible, the weed problem was relatively small, but since most fields today are cultivated semi-continuously and are cleared in young fallow vegetation exists the weed problems have increased considerably. The fallow suppresses the growth of weeds, and after fire clearance the soil is often weed free. After the first showers many offshoots from the stumps of the trees come out. The most common weeds are root sprouts, rhizome sprouts, stump sprouts, three seedling grasses and herbs. It should be noted that exotic species tend to he more prevalent in disturbed sites throughout the world (Ramakrishnan, 1992).

It is continuous process to tackle the rapid growth of the weeds. Weeding starts soon after crop establishment. Weeding is done solely by human labour. Weeding represents the most labour consuming and the most tedious activity of cropping cycle as well as the greatest limiting factor to production. At least three weeding are required annually. A good burn normally ensures a delayed emergence of weed, which will reduce the early weed competition and postpone the first weeding. This task consumes 30-40 percent of the total labour required for cultivating upland rice, or around 90 labour days per hectare (Hansen and Sodarak, 1996). People would also say that steep land is easier to weed because one done not have to bend over so much.

Weeding in maize and cassava is less laborious due to the greater competitiveness of these crops and the wider plant spacing that makes weeding faster. Weeding is an activity generally

reserved for women and children. Women consider that weeding is most difficult and toilsome work (Hakangard, 1990).

If the fields are distance from the fields farmers will often stay in the fields from May to October, with the head of family insuring the contacts with the village and being responsible for the food. Most families weed almost every day for five month until the rice has flowered. The labour input for weed control increases dramatically with cropping. The amount of labour needed to control weeds during the second crop is often twice that required for this purpose during the first crop after clearing, according to Nye and Greenland (1960).

- ***Harvesting***

In a shifting cultivation cycles the time of harvest is not subject to rules of precedence dependent on ethnic groups social structure. In shifting cultivation generally farming is mixed with the harvesting of different crops being done as and when they are ready. Harvesting is done by both men and women. When the manpower is sufficient, but it is generally conducted with exchange of labour within the village. The method of harvesting is also a crude one. The duration varies according to the method in use. Sickles are used to harvest and in some hand picking is done. The cut rice is left to dry at least one day, sometimes for several days, depending on its ripeness, the weather, other work pressure, the amount of rice left to be cut. When harvesting root crops like cassava, taro, ginger, when digging is necessary, a hoe used.

Most maize is harvested in August and September, whiles cassava is harvested 10-18 months after planting. The main period for rice harvesting is the beginning and the end of October or early December, but most farmers cultivate a smaller area of early maturing rice, which ripens in September. After the crops have been brought to the village, the fields may be used for grazing, whiles re-growth gradually invades. At higher elevations, the more humid climate allows a second crop after maize cultivation. Only about 10-15 percent of the land is used for a second year. Seed rice is harvested separately and may be specially selected to improve the quality of the crop.

- ***Threshing***

Threshing and beating is exhausting labour and the worker usually rests and changes the jobs every hour or so, while the piles and carriers restock the supply of unthreshed rice at the platform. This family activity takes place in the field after harvesting by reaping the rice crop. When harvesting is done by stripping, threshing is avoided. The rice sheaves are directly stored in rice barns and the houses.

- ***Transportation***

Transportation is done by both men and women. Rice is carried manually in rice baskets which hold between 10-30kg for upland rice. Hmong may use horses for transportation, and some Lao use buffalo. If the harvest has been good and the distance to the fields is great, it may take two - three weeks or more after threshing to carry all the rice back to the village.

- ***Storage***

The safe preservation of the produce is major problem for the farmer. If fields are very close to the village, the rice grain may be carried directly to the store or porch of farmer house, but usually the shifting cultivators makes temporary store out of their fields shelter by reinforcing the walls and lining the floor and walls with mats. The tube crops are directly brought in from the fields for consumption or sale. Vegetables such as pumpkins that can be preserved for a longer periods, are kept either in the kitchen or in the granary. Some ethnic groups (Hmong) do not store the grains in their houses, and granaries are built at some distance from the houses. This method saves the foodstuff should the house get burn. The Khamu store grains in their houses. Usually two or more family members sleep in the temporary store to guard the rice against animals pest and human thieves until it can be carried to the village.

4.2 Organisation of shifting cultivation production

It is obvious that stable shifting cultivators have well organised living pattern. Strong territorial rights have been established in each compound, which have been maintained from generation, interwoven with and sanctimonious by customs. Regarding the way shifting cultivation in Nam Nane watershed are organised, each village has it own formula and it is difficult to give a general description of this organisation. One can simply note a general trend from a community-based organisation of work towards a more family-or individual-based system. Traditional Khamu and Hmong villages were divided into groups of shifting cultivators (8 to 15 families per group) and all activities except weeding, threshing and transporting were communal within each group. Today, groups still exist, but only clearing, weeding, sowing and threshing are compulsory village activities. For the rest, families try to rely alone otherwise they request assistance from the group to which they belong, which in fact is rather a kind of reciprocity. Burning, fencing and transportation is most often done families activities.

4.3 Crop selection

Many crop species and varieties were produced in shifting cultivators fields in most areas under shifting cultivation, shifting cultivator's no longer grow only indigenous crops. Several exotic crops have been introduced during the last two centuries and integrated or grafted into production system of indigenous domesticates (Okiglo, 1984). Cropping systems are influenced by various physical and socio economic factors, varying from the slash and burn system to short-term rotations, from mono cropping to very complex multiple cropping (Cuc et al., 1990; Doungdara et at, 1991; Gillogly et al., 1990). Shifting cultivation has very little scope for specialization as diverse crops are sown in a single plot of land. Hundreds of different species may be grown. Shifting cultivators understanding of their environmental suited to his needs. Farmers with a stationary home and land that is permanently cropped try to create favorable growing conditions for crops, by attempting to control nature. Shifting cultivators, on the other hand, are usually highly skilled at adapting their stopping practices to the environment in which they are working. Between these extremes are mixed economies, which are based on root crops as well as grain crop. According to Spencer (1966, P. 169), a change from vegetative cropping with root crops to grain cropping with rice can be observed in Asia.

Rice is the staple food of all people in the Name Nane watershed. Most families plant one of one or more varieties of glutinous rice in relatively small quantities. Rice (*Oryza sativa L*) is mainly produced for subsistence use, but a few shifting cultivators produced enough rice for consumption. In the past, maize (*Zea mays L*) chilies (*Cassicum frutescens L*), taro (*colocasia esculenta (L.) Schott*), sweet potato (*Ipomoea batatas(L) Lam*), Cassava (*Manihot esculenta Crantz*), cotton (*Hibicus sabdariffa L*), sesame (*Sesamum indicum L*) and tobacco (*Nicotiane Tobacum L*) were the most important crops. Since the 1997 new crops have been adopted, including soybean (*Glycine max (L)* Merr), peanut (*Arachis hypogaea L*), jobs tears (Coix *lachrymal-jobi L*). Hmong and Khamu produce most of the vegetables in the shifting cultivation fields including, Chines cabbage (Brassica chinensis L), pumpkin (*Cucurbita moschata Duch.ex Poir*), egg-plant (*Solanum melongena L*) tomato (*Lycoperson esculentum Mill*), ginger (*Zingiber officinale Rose*), melon (*Cucumis melo L*). Gardening in the households compound in only practiced by the Lao.

Fruit tree plantation was previously limited to a few trees including tamarind (*Tamarindus indica L*), jackfruit (*Artocarpus heterophyllus Lam*), pomelos (*Citrus grandis L*), orange (*Citrus sinensis (L) Osbeck*), mango (*Mangifera indica L*). banana (*Musa cvs*), papaya (*Carica papaya L*), pineapple (*Ananas comosus (L)*), sugar cane (*Saccharum sp*), sometimes remaining from past settlements. The production was entirely eaten in the village.

4.4 Labour input

Shifting cultivation is a system of production, almost without with consumption being measured in terms of labour and soil fertility. In the additional forms of shifting cultivation, the execution of

labour operations is usually governed by the customarily. The labours input for upland rice production averages about 294d/ha. In, an other study in shifting cultivation carried out in Luang Prabang province (Vieng kham, Xieng ngeun and Luang Prabang district), Leacock et al., (1993) reported labour input of 268, 205 and 194 d/ha or return to labour of 4.3kg grain/d for upland rice, 8.6 for lowland and 13.3 for maize production. Practically the whole input consists of manual work. The return on labour input for upland rice production is thus much lower that in lowland production system (Roder et al., 1996). Both men and women tend to cultivate their own plots. From labour economy standpoint, clearance is the most strenuous activity (Ruthenbergh, 1971).

Households heads usually draw most their labour supply from the households. Weed control is by far the most labour consuming task in upland rice production, accounting for 40-50% of total crop labour input. Generally, 3-4 weeding are required per season with the labour input average between 45-55days ha^{-1}. Men do most of the heavy work and the women perform the task requiring more dexterity (weeding, harvesting). House-work and collecting firewood are almost always women's and children's tasks, while men are responsible for cutting the wood used for building the house and rice storage huts.

Table 7. Labour requirement for shifting cultivation

Activity	Number of Days per ha	
Slashing	33	11%
Burning	2	1%
Fencing	2	1%
Re-burning	14	5%
Weeding before planting	13	13%
Planting	29	10%
Weeding	146	50%
Harvesting/Thrashing	33	11%
Transport	22	7%
Total	294	100

Source: Lao-IRRI Project, 1994.

4.5 Pest and diseases

Traditional shifting cultivators have learn to avoid or minimise pest and diseases by using inter-cropped sequences and often by planting as mixture several crops varieties that have disease tolerance (Sanchez, 1976). Often only one or two harvests can be performed before decline in soil fertility, competition from weeds, or insect or disease outbreak forces abandonment of the field. Yields are often severly suppressed by pest attacks. Ants and other creatures begin to carry off the seed as soon as crops are planted. Rat problem can become particularly serious, as ample breeding habitat is provide by shrubs with invade abandoned areas, left over corners and patches of forest.

The only strategy that farmers have to ward off, many insect and diseases is prayers. These ethnic groups have neither the knowledge nor resources to apply insecticide to the crops.

Wild animals damage more than 50% of all crops. Wild pigs are major threats to the fields, especially when maize and other crops begin to ripen. Shifting cultivators use wind-and water-powered noisemakers to scare animals and birds, but the animals quickly learn to ignore then. A number of implements are used to kill and scare away the wild animals and birds destroying crops. Others shifting cultivators area to watch their crops day and night close the harvest, particularly the fields lying within the reach of wild animals from the adjoining forest.

4.6 Production and yield

Upland farmers, especially those living in remote areas, have little incentive to produce surplus rice. Already 100 years ago the lack of a market was considered the main deterrent to increased rice production in Laos. Shifting cultivators must content with variability as well as quantity of yield. As a result of shortening fallow periods, yields have declined markedly and much more labour must be invested in weeding. Yields of upland rice cultivated in clearings of old forest were allegedly in the range of 2000-2800 kg per hectare, compared with the average yield today of 1400 kg per hectare. Shifting cultivation today is characterised by severe over-exploitation of soil with far too short fallow periods. Yields are consequently low (Thongphachanh and Birgegard, 1982). The falling yields are caused by several factors, often in combination, including fertility decline (probably mainly due to erosion), increasing weed competition, and increased pest attacks, especially by nematodes and white grubs.

4.7 Use of shifting cultivation areas after harvest

Shifting cultivation areas continue to be used after the harvest and during the fallow period. Growing of chillies had already been mentioned, and a variety of wild products appear as the secondary growth in the fallows. Women continue to go to fallows, as part of their daily search for firewood, and they may gather a variety of edible and otherwise useful plants while they are there.

At the end of shifting cultivation year rice is stored away. By late December the rites are complete, the old year ended, and a new has begun with a period of relatively limited activity, including wedding, for cutting roofing grass (*Imperata sp.*) and weaving grass shingles (Photo 4), for re-roofing and repairing houses and barns, for hunting and fishing, for gardening and for visiting the market.

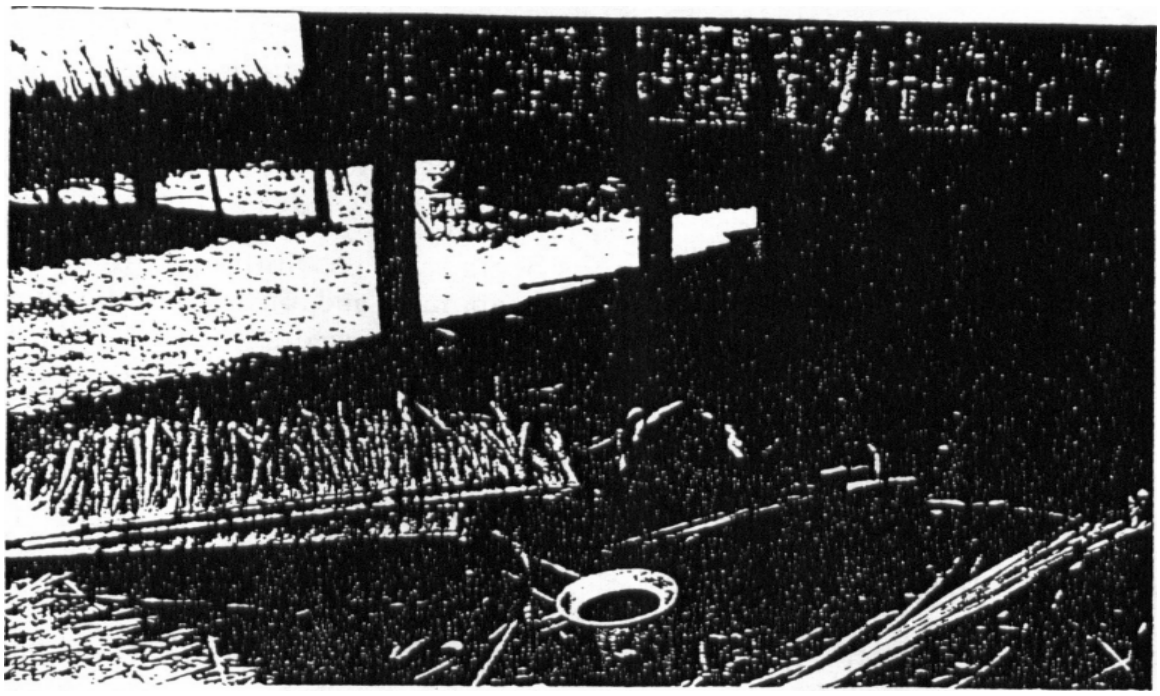


Photo 4. Khamu woman weaves roofing shingle of Imperata grass at Ban Thong Khang (Photo: Author, July, 1999).

4.8 Shifting cultivation practices in Nam Nane watershed

In Nam Nane Watershed shifting cultivation is the dominant farming system in terms of area, rice production, and general crop production. The shifting cultivation system practised by most farmers is based on one year of cultivation, alternating with 3-7 years of fallow. The average fallow period is believed to be about 4 years, but reliable information is difficult to obtain from farmers, because provincial regulations prohibit slashing of fallow older than two years. The fallow periods have declined steadily in response to the rising population density in the area. Only twenty years ago many fields were cleared in older secondary forest, but today fields are mostly cleared in bush-land, bamboo groves and other young secondary growth. Stable settlements force the cultivators to shift their fields to within close promitity of their, and hereby decreasing and availability subsequently adopting to shorter rotations.

Actually very little is know about the types of shifting cultivation in Nam Nane watershed. Despite absence of any specific and comprehensive study, it is commonly agreed that a distinction exists between at least three main groups of shifting cultivators, namely the Lao Lum (Lao) originating from valleys, the Lao Theung (Khamu) of the medium and Lao Sung (Hmong) of the high altitudes (Sodarak, 1991) (Figure 2).

Nor is it at all clear today that all members of these ethnic groups practice shifting cultivation. The remaining mature forest is almost exclusively found on land unsuitable for cultivation, e.g., very steep slopes, escarpments, hill tops, rocky land, etc. Shifting cultivation is broadly divided into three types based (Lao, Hmong, Khamu) on combination of landforrn and ethnic criteria (Phanthanousy, 1993). Shifting cultivation in Nam Nane watershed has been found to consist of complex farming systems, in which most ethnic groups are involved, but different practices.

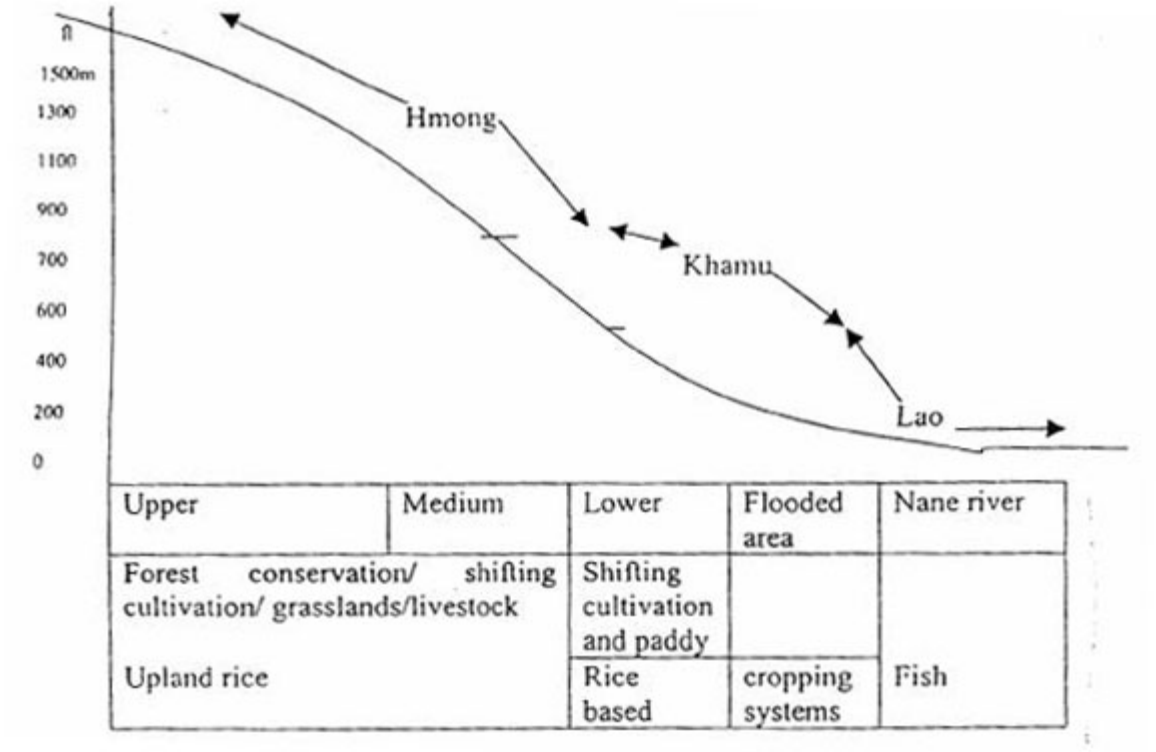


Figure 2. Transact of the ethnic groups in Nam Nane watershed.

4.8.1 *Shifting cultivation practised by Lao, Hmong and Khamu in Nam Nane watershed.*

Lao farming experience and practices are developed for lowland glutinous rice cultivation along the river and in the mountain valleys. In recent years as a result of poor management and increased demand, for land Lao farmers are beginning to move up the hillsides. Khamu people follow the rhythm of the work in shifting cultivation areas. The Khamu peoples live on medium mountain. Some areas still contain dense forest and normally Khamu carry out the traditional shifting cultivation in this areas, up to medium altitude. Khamu traditionally practice rotational cultivation. They use crop rotations with fallow periods of 3 to 5 years, depending on soil condition and land availability. Most of the fields are cropped for a single years left fallow. Since it is a secondary forest system, regeneration does not reach the same proportions of biomass and nutrient availability as highly regenerated forest, but this is compensated for by being able to use the land again after relatively short fallow. They don't own plains of paddy fields like others, all they have is mountain rice fields. Did the Khamu in former generations have rice field like other people of the region? A few Khamu attempt to raise the cattle and other domestic animals for sale to lowlanders. Some Khamu families can not meet year-round subsistence needs without supplementary resource. Rice supplies often run out before harvest, when maize and food other than rice provide some relief. This is apt to occur around July, and it is at this time, when weeding requirements also begin to lessen, that many Khamu men look for wage labour while the weeding is continued by the women. Wage labour has become extremely important to Khamu peoples.

The forest plays a vital role in the economy of the Hmong people. It plays an essential role in the supplying of land for subsistence cropping. Burning the forest is a means of preparing land for planting. The forest tree bring up the necessary minerals from the subsoil and deposits them on the surface in form of decayed matter, and also bring them above surface in the leaves and stems of tree. After burning, the residual ash is available for nutrition of cultivated plants (Keen, 1978). Hmong prefer to establish shifting cultivation areas in primary forest because the yields of

rice is better, they can expect for the labour. Obviously, the forest is vital to the continuation of the way of life of the Hmong as shifting cultivators.

The Hmong who resisted this assimilation, retreated gradually to mountains fastness where they carried out various forms of subsistance farming. It was the descendants of the groups that migrated to Nam Nane watershed with the legacy of their shifting cultivation practices. The Hmong live in upland above approximately 1000m, some cultivate poppy as a cash crops or payment labour for weeding the shifting cultivation field, together with a number of subsistence crops such as rice, maize and vegetables. Shifting cultivation of Lao, Hmong and Khamu shifting cultivators are similar as follow.

4.8.1.1 *Farm tools preparations*

Slashing tools and materials are prepared from the early of the January. Tool preparation for shifting cultivation of Khamu is generally started in January, or 5 days after Khamu celebrate the new year, locally known as *greh festival*[1]. Some shifting cultivators buy them directly from the market in the town, some steel springs from cars into slashing tools, and some have to exchange there products for the tools with the local traders. Head of families prepare chopping knives, weeding, hoes, digging hoes, and slashing knives.

The Hmong usually make their own farm tools. Normally, each administrative group of 5-7 families will have an iron works of their own so that all the tools are shaped and made from the iron-works. In the early February, the head of each family collects the firewood "may tiou" (*Cratoxylon pruniifolium*) "may khom" (*Muntigia calabura*) to make charcoal for the iron-works. In late February each family will start making slashing tools such as chopper knives, digging hoes, axes, etc.

Photo 5. Hmong in Ban Tou Ho prepare hand tools before slashing fields (Phot: Author, July, 1999).

4.8.1.2 *Site selection*

Site selection is most important. If one does not know how to select a good place, the field could be bad and the soil poor. Thus the cycle has been the same from generation to generation, from very early days till today. If wrong places are chosen or used in the wrong order, harvests will be poor (Tayanin, 1992).

Site selection is undertaken by the head of each family and is normally initiated in late January. A meeting among shifting cultivators, which is headed by the village leader, is held to discuss the site for shifting cultivation. Hmong shifting cultivators are very careful in choosing the site to be cultivated. In selecting a site, the Hmong consider the physical characteristics of the site, the type of soil and its vegetation. The plots to be allocated are mostly former swidden fields of 6-7 years fallow. In contrast, the Lao having farmed the sites over and over in past, so rather than using of indicator plants, site readiness is generally judged by regeneration and re-establishment of woody, broadleaf vegetation. The Fourth year of a fallow is considered to be one of the criteria for selection. Generally, the percentage of the slope of shifting cultivation areas is approximately between 10 - 60%. They have to examine the quality of the ground. It needs firm and moist soil without too many stones, in order to grow well. If the ground is stony, but the stones are only small, the fields are not too had. Good soil and the absence of weed "nga kha" (*Imperata cylindrica*) are desirable characteristics in newly opened fields. Desirable soils are black (*din dam*) or black-yellow (*din lueug ten*) rather than red soil (*din deng*) not stony and fresh, cold after burning (Fujisaka, 1991). Fields for rice should not be too steep or to flat, so that the clearing and fieldwork will not be excessively difficult. The best soil for long-term rice is tree forest and short-term rice grows best in bamboo forest (Tayanin, 1992). Rice needs abundant rain and sun. Therefore, whether a place to receives enough rain as well as sun. The aspect shifting cultivation fields is usually East. There are very few plots facing West due to people's perception that such land will give smaller yields and the crops will be destroyed by the insects. The distance of the plots ranges between 0,5-3 km from their village. This has had the effect of increasing the time spent in walking to the fields.

Shifting cultivation areas of individuals farmers are located close proximity to one another to enable collective fencing. It is also a useful strategy to collectively protect fields from wild animals. After the decision has been made, each farmer will demarcate his own area. Practically groups of shifting cultivators will be set up in the course of site allocation, and each site may consist of 6-10 families.

Practically groups of shifting cultivators will be set up in course of site allocation, and each site may consist of 6-10 families.

At night, before going to bed, shifting cultivators will do a spirit guest i.e.: they will pray to the ghost to tell them in the dream in order to confirm that the area selected is good or not. If a farmer has a bad dream, he will have a right to propose a change with the village authorities.

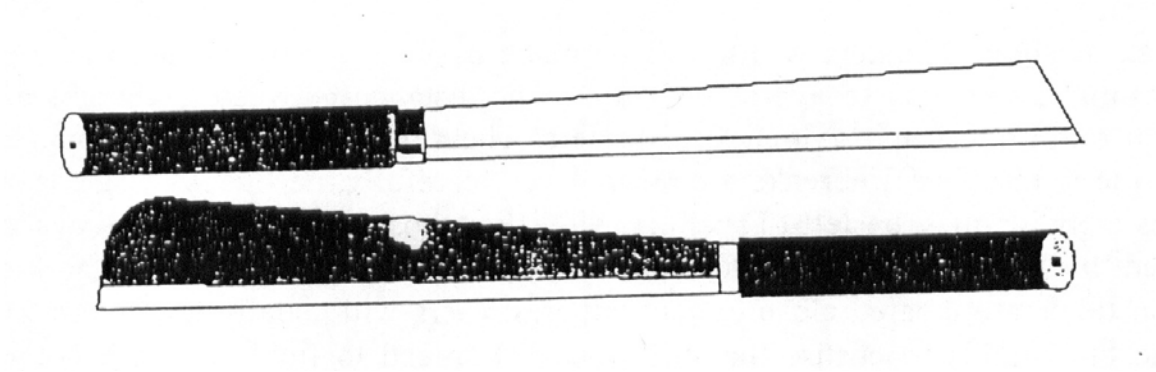
Sites often contains tree species such as; "may ko" *(Quercus spp), "may moat" (Symplocas racemosa), "*may tiou*" (Cratoxylon prunifolium), "*may peuy*" (Largesstroemie balansae)* may khaemoo*" (Larstraemia villosa), "*may tong kaow*" (Macaranga denticulata), "*may nam sompho*" (Streblus aspei),* "may pohoo" *(Hibiseus macrophyllus),* "may khom" *(Muntigia calabura),* "nga farang" *(Chlomolaena odorata),* "nga ngung" *(Microstegium ciliatum),* "nga kha" *(Imperata cylindrica).* The Lao shifting cultivators generally have the opportunity to choose sites with few serious weeds.

When the families have reached a decision about which land is to be cleared and which families are going to work together, the chopping and clearing of land can begin. After the decision has been made, each farmer marks the trees at four corners of their plots to inform that the land is already occupied.

4.8.1.3 *Slashing*

Slashing generally starts in February. The timing depends on the kinds of vegetation, the availability of household labour and the need to do other kinds of work. Each family works on its own plots. The work force is mainly provided by the husband and wife. Depending on the Work force of the family, the plot ranges from 1-2 ha.

At first, the heads of the families will make a start and two days later, they will organise groups of labour exchange. The method of organising groups depends on the willingness of each family. The number of the group ranges from 10 to 15 peoples. Slashing activities will proceed from one family to another. Slashing activities normally finish by late March. The normal tools used for land clearing (slashing) are slashing knives (Picture 1).



Picture 1. Slashing knives used by Lao shifting cultivators

For the Khamu, in mid February, which is first day of slashing season, The head of the families will sacrafice chicken and pray to the ghost with the purpose of asking for permission for slashing the selected area. It is also believed, according to Khamu tradition what is believe? that the ghost will protect the rice fields from wild animals and will make the select sites more productive. Khamu people always care about spirits of the forest and the bigger trees. They believe that when they were born into this world, they only borrowed the land. The spirits are the true owners of land, and they also own all kind of wild animal and trees (Tayanin, 1992).

The plots of individual shifting cultivators are slashed in turn through reciprocity. The slashing activities of whole village is generally completed within 45 days. The size of each plot ranges between 1- 4 ha depending on the size of each family. No machinery of any kind is used for shifting cultivation system, and clearing of the field.

After the completion of the slashing of the areas for upland rice cultivation, Hmong farmers clear land for maize plantation. The areas used for maize are usually 2nd year fallow but some families will take the 1st year fallow as well. It usually takes about 5 days to clear the land. Maize is not planted in the same manner as rice. Around January and February, the Khamu select a site for cultivated maize. The size of a maize field is small compared with the Hmong upland rice fields. Maize is produced primarily for pig fodder, but small quantities are eaten as young cobs and popcorn. Poor families with in sufficient rice production may eat maize mixed with rice in the month before the rice harvest. Maize areas are usually larger than the rice fields, often about 1-2 ha per family. There is no labour exchange for slashing activity but some families will hire extra labour from Khamu with a daily wage of 4.000kip per labourer or 10 kg of unhooked rice. Maize was cultivated by most of households in the study areas.

The slash for both upland rice and maize is completed in March and a slashing of young fallow vegetation continues. This field will be left to dry sufficiently to burn easily.

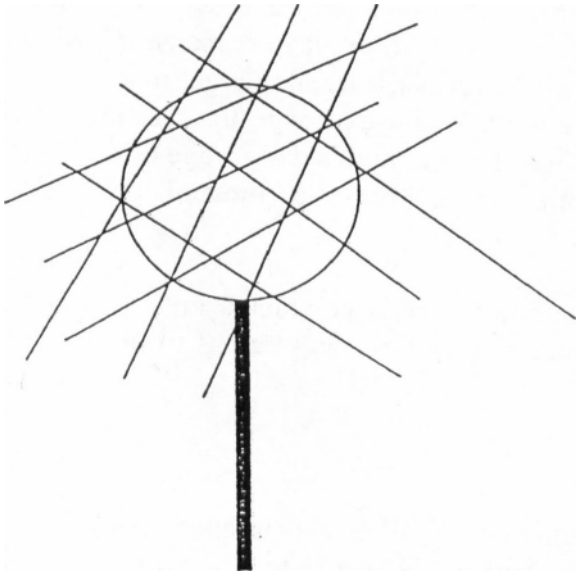
4.8.1.4 *Burning*

After, slashing the shifting cultivators will let the slashed weed dry for three to four weeks. Secondary forests take four to six weeks to dry, whereas bamboo and bush land requires only three weeks. The tradition of burning has been practised for centuries.

A firebreak of about 3 meters width will be made by each family around the areas where burning is intended to avoid forest fire. The distance between firebreaks and the area to be burnt is approximately 5 meters. The firebreak should be along the border of the fields. The firebreaks are cleared very carefully, no bushes or grass, no dry leaves or twigs may be left (Tayanin, 1992). For those whose burning plays are surrounded by others will have to help the others make firebreak. If shifting cultivation fields are located close to each other, owners will usually try to agree on the day to burn fields to ensure that fire does not spread to fields that are not yet sufficiently dry.

Shifting cultivators burn fields in order to eliminate slash, to reduce weeds in the fields, to "cook" the soil and to get fertiliser from the ash. The burning season, generally begins around the end of March or early April. The most suitable time of fire setting is between 11.00am to 3.00pm. The weather should be hot and sunny with a slight up-hill wind. The fire is started at the bottom of fields and is lit at different points simultaneously. They only let fire burn little by little, step by step (Tayanin, 1992). In this way, a hot burn is obtained which will move uphill by itself. Windy conditions are avoided since the turbulence may make the burn difficult to control, and may send burning debris up in the air that could spread the fire to other fields or to the village. Bundles of dry pieces of bamboo are used to start fire. Some shifting cultivators use the abandoned roof material made of Imperata grass to start fires. The burning of each plot will be completed in one day. If it is carried out prematurely, an incomplete burn may result, and crucial nutrients will be lost and competing flora not destroyed; if too late the rain may come and prevent and effective burn. This work is done mostly by the men of the families. Women and children do not attend the burning as it is very dangerous, and there is even danger of death. In the burning season the sky is often obscured by smoke.

Normally it will take about 10 days to complete burning for a whole village. When areas are ready for burning, sacrifices are first made to the ghost of fire and a few taleo are placed at the boundary of the shifting cultivation areas (Picture 2).



Picture 2. Taleo (make from the bamboo)

4.8.1.5 *Cleaning and Fencing*

Three days after burning, the farmers will to start cleaning their plots. Even when the burn has been successful, some plant debris may remain. These will be collected in small piles and re-burned. Clearing shifting areas is primarily the responsibility of individual families. Both men and women do the work of clearing. Clearing activities generally begin in late April. If the trees are burned off thoroughly there is only a little cleaning up work left, and it is easy. The quantity of work for cleaning varies depending on the amount of residues post burn. The cleaning activities last for approximate 20 days.

- First, women will do the cleaning and pile up the residue. Many tree trunks and large branches will not succumb to the fire, but are often collected for firewood (Photo 6). The men will prepare materials for hut construction.

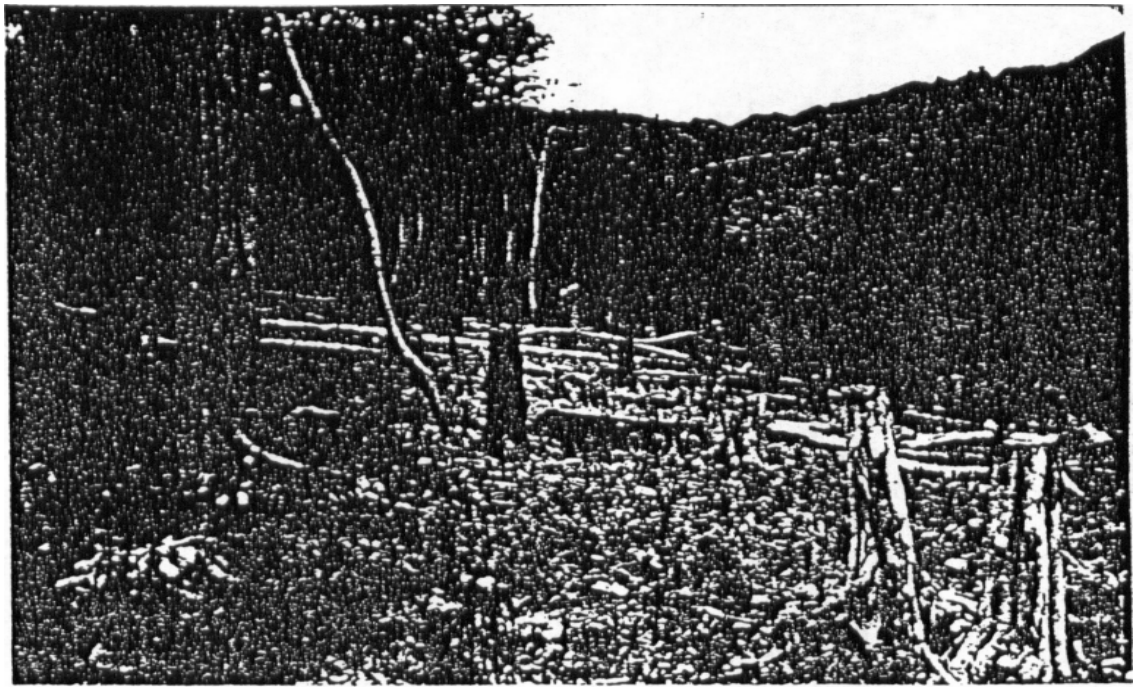


Photo 6. The large branches not burnt in the shifting cultivation fields (Photo: Author, July, 1999)

Second, women will burn the residue while the men construct the hut. This is a temporary house used during the cultivation cycle. After 2 days of re-burning, field huts of about 2x4 meters are constructed. The roof of the hut is made of Imperata grass and these huts consist of a porch and levelled earthen area under a common roof, but no walls (Photo 7).

They are only intended to last a few years and are usually made from bamboo, with thatched Imperata roofs. The shifting cultivators retreat to the hut during heavy rains or when the sun is too strong, and it is here that sacrificial meals are prepared and shrines are erected during planting, harvesting and others activities. Shifting cultivators and their children may stay here overnight to guard the field just before and during harvesting. The hut is also used as temporary barn to store rice during harvesting time. Generally, Lao shifting cultivators do not stay overnight in the fields. Since the distance to the village is normally short.

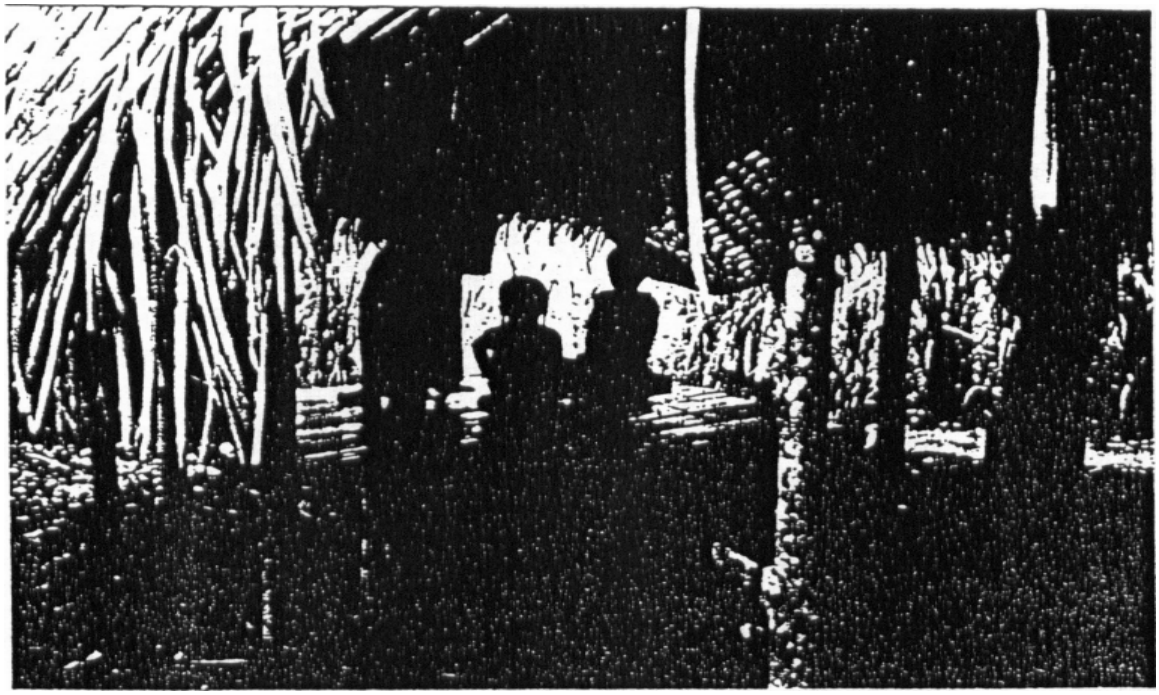


Photo 7. The construction of the field hut by the Lao shifting cultivators in Ban Thong Khan (Photo: Author, July, 1999).

- Third, women will continue cleaning and burning of the residue and the men will prepare fence materials and do the fencing.

Some families may hire extra labour from Khamu villagers to help cleaning and re-burning plots, paying wages of 4.000 Kip/day per labourer. It normally takes about 20 days to complete cleaning and re-burning. Maize fields are not weeded before sowing, but fences are often made. Immediately after burning, planting can often be carried out without cultivating the soil. However, most Hmong shifting cultivators do in fact disturb, loosen and move surface soil as part of the operation of planting. In latter years, more opportunities for wage work have emerged.

Fencing is also an important task which has to be completed before sowing. Fencing is the responsibility of individual households. It is usually done by one or two members of the households, with little or no exchange of labour. The fence is usually about 3 meters away from the border of the rice field. Unburned trees with diameters of 10-30 centimetre are often kept for fencing.

The cleaning up job can be very hard. If they do the clearing work well the burning will proceed well also, and weeding will be easy too.

4.8.1.6 *Sowing*

After the Lao New Year in mid April, which is the beginning of the rainy season, Lao shifting cultivators will start to do the sowing of maize. Early sowing is considered to be important by most shifting cultivators. The maize which is sown first, is more drought resistant. The local maize variety is relatively tolerant and often performs surprisingly well on very little soil moisture.

Rice is sown only after the rain season is well established, usually in early June. Groups of 15-20 people will organise themselves on labour exchange basis. One group will sow one plot per day. Within a group, mostly men will make the holes with digging sticks and there after mostly women will fill the holes with 5-10 rice seeds. Spacing between the holes is between 20-30cm. The high seed density per hectare is related to large degree of uncertainty interns of seed germination, as

the seeds are damaged by ants, rats and would also be eaten by birds. This cultural practice is considered by the authors as correct, and is adopted by the most shining cultivators. Local varieties are usually planted by the Lao shifting cultivators such as khao dodeng, khao dohin, kha dosoun, khao deng kay, khao tonto, khao eo, khao meo, khao phay, khao xiou, khao xeng, khao luang and khao khoy (Table 7). Shifting cultivators' use three varieties (short, medium and long-term) of rice varying in maturity from 90 to 125 days.

The materials used for seeding is seeding sticks, seed bags, rice seeds, bamboo baskets or cotton bags for holding the seeds. If it rains regularly for one week after seeding, the seeds will start germinating and then the first weeding will be started.

Before sowing, the head of the family has to kill a chicken to pray the ghost. The ghost will be requested to protect the rice field from insects and wild animals. Usually there is a seeding ceremony just at the beginning of sowing activity. The head of the family will be the first one who initiates the dibbling in line from the point of eagle eye or Taleo (Picture 2).

Khamu have many different traditional ways of planting rice because it is believed that putting the seed into the ground could be considered and often to the spirits. Normally the first days of sowing start at the end of April (if it rains regularly) or after Lao new years finish. Other shifting cultivators follow on days of the week they choose as propitious, depending on the past experience which days they have been lucky or unlucky.

Rice is also very important for the Khamu peoples because it represent their staple food. Rice is the primary crop for the Khamu peoples. The Khamu elders say "Making rice fields means eating rice" and eating rice is everything. Rice was also distinguished by grain colour, shape and size. Most Khamu plant one or more varieties of glutinous rice. Khamu peoples like to prefer glutinous rice than non-glutinous rice. The rice seed for sowing is carried to the field in big baskets from the rice -barn, from outside the village. The rice they sow is glutinous rice, which can be raised without irrigation. They are familiar with a number of different varieties of this kind of rice. Each variety has a different name which indicated its colour, whether it is an early variety or not and other qualities. A difference is indicated between white, red and black (Izikowitz, 1951).

The variety of the seed sowing in this ceremony is black rice varieties belong to the field owner (ghost). Each family has different traditions, depending on their totemic ancestry, when it comes to the rituals they need to perform before planting the first rice seeds into the ground. The rice varieties which are popular for Khamu are khao non, khao meo, khao chantha, khao seng, khao khay, khao to and khao do deng. Most of these varieties are sticky rice (Table 7). The seeding and dibbling will be completed in one day for one plot. If there is a good rain the seed will start to gerniinate within 5 days after seeding. The tools use for dibbling and seeding by Khamu are dibbles, bamboo baskets, hand bags.

Hmong shifting cultivators prefer to grow non-glutinous rice whereas other ethnic groups preferred to grow glutinous rice. Sowing generally starts in May or later depending on rains. Since the Hmong were primarily subsistence rice grower. Most of upland rice grower were found to follow a three year fallow rotation or with one year of maize on the same land if the land was fertile. Thus, Hmong shifting cultivators do not grow rice continuously for two or three years. They grow rice only after the fourth year with bush fallow. The rice varieties are non-glutinous rice khao chao ngeun and khao chao khao and glutinous rice, khao do deng, khao pik, khao phay, khao khoy, khao lai, khao xeng and khao leuang (Table 8). Glutinous and non glutinous varieties of rice must be considered the main crop, though in time of rice crop failure the Hmong turn to maize as a major human food.

Most of the shifting cultivators finish their upland rice planting between the third week of May and the first week of June. It normally takes about 15 days to complete the dibbling and seeding activities in the whole villages.

Table 8. Rice varieties used by Lao, Khamu and Hmong shifting cultivators in Nam Nane watershed

Rice varieties used by Lao shifting cultivaors	
Time	Varieties
Short-term	khao do deng, khao do hin.
Medium-term	khao phay, khao khoy, khao tonto, khao dosoun, Khao deng kay, khao xiou.
Long-term	Khao xeng, khao eo, kha meo, kha meo, khao noen.

Rice varieties used by Khamu shifting cultivators	
Time	Varieties
Short-term	khao do deng
Medium-term	khao phay, khao khoy, khao chantha, khao kay, khao to
Long-term	khao seng, khao eo, kha meo, khao non

Rice varieties used by Hmong shifting cultivators		
Time	Varieties	
	Non glutinous	Glutinous
Short-term		Khao do deng
Medium-term		Khao play, khao khoy
Long-term	Khao chao ngeun, khao chao khao,	Khao xeng, khao lai, khao leung, kha pik.

Source: Villages survey in July 1999.

Most of Khamu, Hong shifting cultivators have a small area, usually close to the hut, which is used as a chilli pepper (*Capsicum frutescens*) garden. Chillies are planted at home in old pots or cans and then it is transplanted to the shifting cultivation fields early in the rainy season. They are grown primarily for home consumption, very rarely in quantities large enough for sale or trade.

The borders of Khamu and Lao fields, especially where they adjoin other shifting cultivators, are marked with logs running up down the slope, and a row of sorghum (*Sorghum vulgare*), Job's tears (*Coix lachrymal-jobi L*) and maize (*Zea mays L.*). Root and tuber crops, including several varieties of taro (*Colocasia esculenta (L) Schott*), sweet potatoes (*Ipomea batatas*), yams (*Discoreas alata*), cassava (*Manihot esculenta Crantz*) and other pumpkin (*Cucurbita moschata Duch. ex Poir*) cucumbers (*Cucumis melon L*), gourds (*Luffa acutanggula*), bitter gourd (*Monodica charantia L*) lablab. (*Dolichos lablab Linn*), pigeon pea (Cajanus casan) are common supplemental shifting cultivation crops and Other species such as egg-plants (*Solanun spp*), grown in shifting cultivation fields. Several varieties of eggplant grow wild around the village and are gathered occasionally (Kunstadter, 1978).

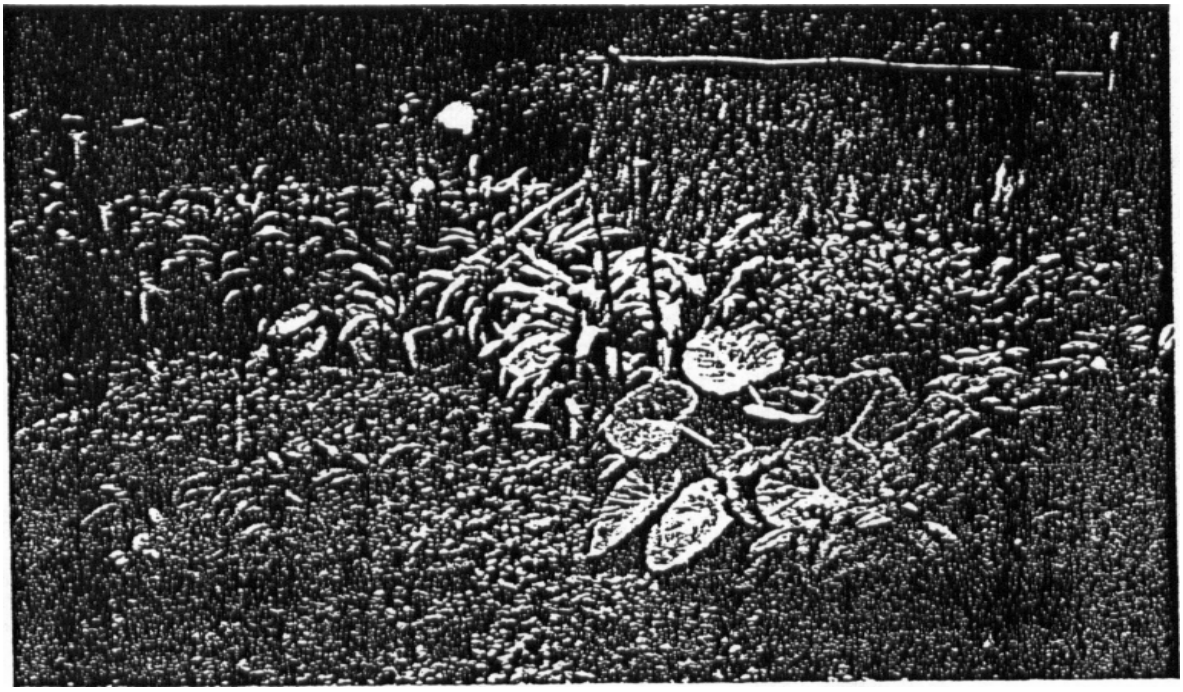


Photo 8. The Khamu in Ban Thong Khang planted some vegetables around the hut (Photo: Author, July, 1999).

Leaves and flowers from some of the squash vine is an important dietary supplement from the middle of rainy season onward to harvest time. Several of cucumber and squash species are stored for use in the dry season. Separate garden plots contain longer-living plants, such as sugar cane (*Saccharum sp*), banana (*Musa cvs*), ginger (*Zingiber officinale Rose*) as well as tobacco (*Nicotiane tobacum L*) and cotton (*Gossypium ssp*) in small quantities for home consumption by Lao and Khamu peoples.

4.8.1.7 *Weeding*

Weeding is the most labour demanding task in the shifting cultivation cycle. Weeding is this an onerous task in which both men and women must participate. However beautifully the rice may sprout and ground up, if one does not weed on time there would not be anything to eat (Simana, 1997). From June through mid-September, weeding of shifting cultivation areas are continuous to be major task. Then after which rice Khao dor (Short-term) plants are tall enough to keep ahead of the weeds and weeding requirements are greatly reduced. Various methods of weeding are used. They weed two to three times.

- ***First weeding***

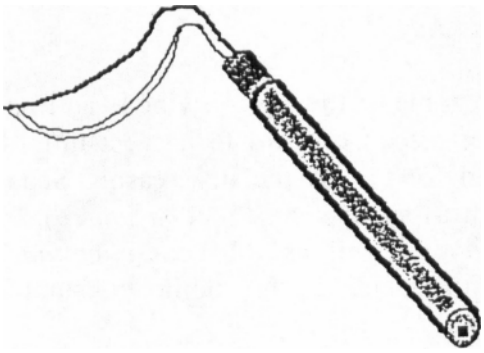
The first weeding usually starts in early June. The weeds removed during the first weeding are called “fire weeds".

The seeds will start to germinate within 7 days after seeding. Hmong shifting cultivators therefore have to spend more time on weeding. Though traditionally weeding is women job, some time men will join weeding together.

The first weeding takes place when the rice reaches about the height of finger span (about 15 cm). As the weed is not so dense, there will not be labour exchange until they finish the first weeding. Generally shifting cultivators will weed their plots individually or in some cases they will hire labour, by paying about 3.000kip per one man/days, or 600g grain of rice per one man/day. The labour needed for one plot is about 55 – 60mandays. For field with not too many weeds, Khamu say that the first weeding will already secure the family food.

Weed species generally found in the plots include "nga farang" (*Chromoleana odorata*), "nga heomoo" (*Cyperus rotundus*)," nga kappi" (*Aneilema lourein*), nga kiew" (*Scoparia dulcis*),"nga kha" (*Imperata Cylinda*), "may tiou" (*Cratoxylon prunifolium*), "may maot" (*Symplocos racemosa*), "may kaw moo" (*Largestraemia villose*)," may khom" (*Muntigia colabura*)," may ko" (*Quercus spp*), "nam khachai" (*Legumineuses dysenteric*), "nam khountha" (*Clerodendron garrettiam*). Some

shifting cultivators have serious problems with bamboo. The tools used for the first weeding are vack (blade knife) (Picture 3) and knives.



Picture 3. Tools used for weeding

- ***Second weeding***

The second weeding is normally carried out in early July, which is coincident with the flowering period of rice plants. There high competition between the growing weed and the rice plants so that the farmers will have to work hard to complete the second weeding which is more difficult than the first one due to high density of the rice plants. The labour needed for the second weeding in one plot is about 65mandays, which is higher than the first time. Some shifting cultivators are forced to hire extra labour to do the weeding paying the same rate as for the first weeding.

The weed species that are generally, found during the second weeding are "nga farang" (*Chlomolaena odorata*),"nga kappi" (*Aneilema lourein*), "nga kiw" (*Scoparia dulcis*), "nga kha" (*Imperata Cylinda*), "nga khay" (*Pogona therum crinitum*), "nga nhoung" (*Microstigium ciliatium*),"nga hoebin" (*Grassocephalum coepidioides*),"may tiou" (*Cratoxylon prunifolium*), "may ko" (*Quercus spp*), "may moat" (*Symplocos racemosa*). et,. The tool used for second weeding is vack (blade knife).

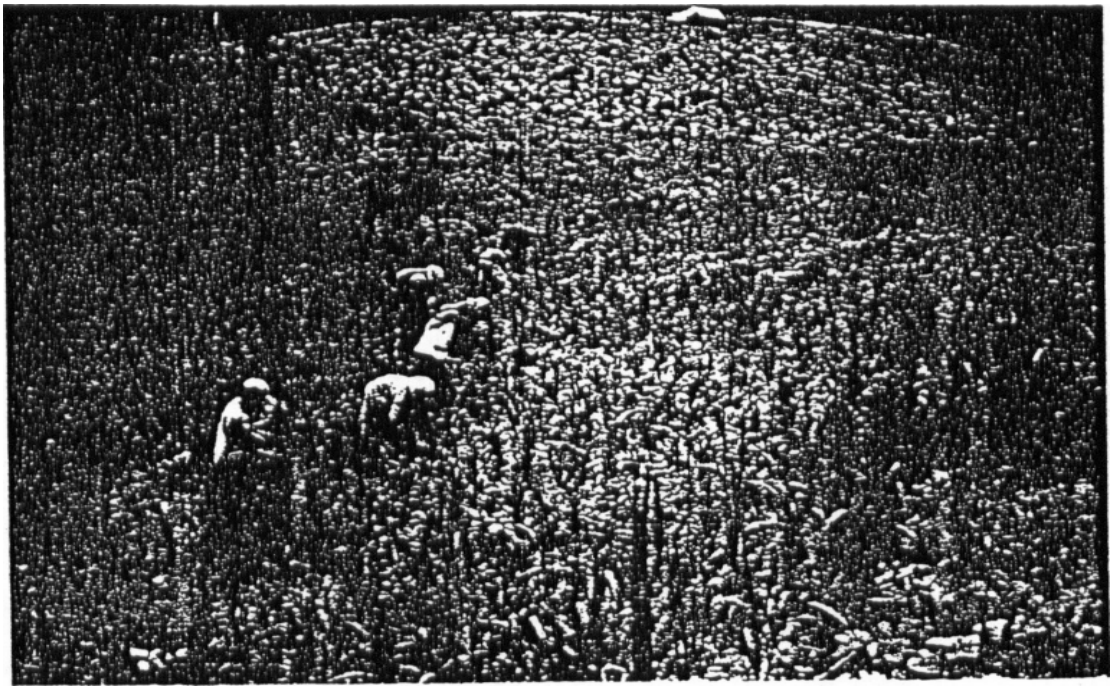


Photo 9. The second weeding in Ban Tha Lie (Photo: Author, July, 1999).

- ***Third weeding***

The third weeding normally starts in August. Each family will do the weeding individually, which will be completed within three days. The labour required in one plot is about 20mandays. Weeding must be performed carefully because the short-term rice varieties have started to produce seed.

The weed species generally found during this weeding are "nga hoebin" (*Grassocephalum coepidioides*), "nga farang" (*Chlomolaena odorata*), "may khom" (*Muntiga calabura*), "may tioum" (*Cratoxylon prunifolium*), "may maot" (*Symploces racemosa*) "may ngai" (*Tetrastigma harmandiip*). The tool used for this weeding is a knife.

Three weeding are common, but some ethnic groups are able to get through four weeding cycles. More over, each weeding has become more demanding because of greater weed density and more rhizome weeds.

4.8.1.8 *Harvesting*

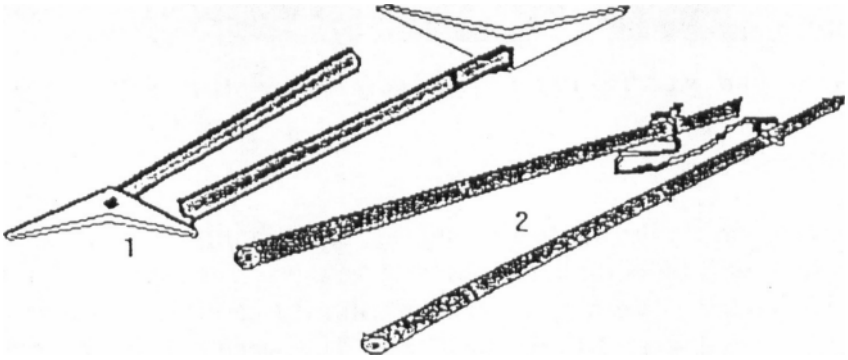
The harvesting season starts anywhere between September and November. The period of harvesting is, according to rice varieties divided into the three a following harvest sequences:

- ***Khao dor (short - term) rice variety harvesting***

The harvesting period for short-term rice variety starts in early September. The variety "Kao dor" (short-term), is the local glutinous and non glutinous rice variety. The harvesting will be finished within 3-5 days.

The Khamu are always afraid that the previous years supply will not be sufficient. Moreover, the early varieties have the peculiarity of rice grain easily dropping when ripe. Therefore, it must be harvested quickly. For this reason, they are not cultivated in large quantities. The khao dor (short-term rice) plants turn yellow as the heavy rains of the monsoon begin to decline. No tools are used as the rice is not cut. The harvesting method is by bare hands (without sickles) the farmers will carry bamboo baskets and walk around the field to collect the upland rice which is pulled from the stern to the top end by bare hands. Some families will, before drying the harvested fields, do the threshing and carrying it back home by bamboo baskets. The harvested upland rice will be spread on the bamboo mats and chide in the sunlight for about 3 days. These varieties include khao nhoy and khao do kao.

The advantage of harvesting with bare hand is that there are not so many steps (no piling and no threshing), and thus no paddy loss. The disadvantage is time consuming and the hands may be injured.



1. Harvesting tools “Ngong”
2. Hitting tools

Picture 4. The tools used for harvesting and threshing by Hmong.

In mid September, Hmong shifting cultivators will start to harvest the short-term rice varieties (khao chao kao). The harvested rice will be dried and kept in their cottages. The harvest is often completed without labour exchange. The harvested rice will be dried in the sunlight for 3 days before collecting and piling in a proper place. There will be 4-6 pillars in a plot. The harvesting tool used by Hmong is called " Ngong" (Picture 4).

- ***Khao kang (medium - term) rice variety harvesting***

The harvesting period for khao kang (medium term) rice varieties is normally started in October. Harvesting will be finished within about a week. After 3 days of drying in the sunlight the harvested paddy will be piled in the middle of the rice field. The yield from medium term varieties is normally higher than that of short-term varieties. There may be two or more piles in one rice field. In order to protect the rice from animals and unexpected rain, a special method of paddy piling is used. The harvested paddy will be piled up by putting the top end of the bunch of paddy inside the pile. The local glutinous rice varieties are khao eo, khao xeng, khao leuang.

Khamu, the method of harvesting is to cut the bunch of the rice plants and sacredly dry in the field about for three days before gathering them in huge piles in the middle of field. The tools used for harvesting these varieties are sickles, which are similar to those of Lao. The Hmong do not plant the khao khang (medium term) rice.

- ***Khao Pi (long - term) rice variety harvesting***

The harvesting of long-term rice varieties starts between late November and early December. The activity of harvesting take between 7-10 days. This is preceded by 3 days of drying in the middle of the field. The yield of long-term varieties is much higher than early and medium varieties, or more paddy piles more. Harvesting is performed individually without hiring extra labour the tool used for harvesting is the sickle.

The local glutinous varieties which are widely used by Lao shifting cultivators are khao deng, khao xiou, khao khoi. The Khamu use khao lai and khao xeng (glutinous varieties) and khao chao ngeun, the local variety that is suitable to the hilly areas (Hmong). The method of harvesting is similar to those of medium term varieties (Khao kang). If the fields are very close to the village, the rice grain may be carried directly to the barn in the village.

Most seed crops are taken at the same time as the harvest. During threshing, the seed has to be tapped out carefully to avoid too much debris being mixed with the light seed. The following table summarises the normal harvest times of the major shifting cultivation crops.

Table 9. The normal harvest times of the major crops

Varieties	Month
Upland rice	September-December
◆ Short-term	◆ Late September
◆ Medium-term	◆ October - November
◆ Long-term	◆ November – Early December
Paddy rice	October – November
Maize	August – October
Sesame	August – September
Soybean	August – September
Ginger	January – March (next year)
Opium	December – November
Job tears	October - November
Cassava	One year late
Taro	November - December

Source: Villages survey in July 1999.

During the study shifting cultivators identified following major problems: weeds, rats wild pigs, birds, nematodes, insect (grubs, termite, ants, grasshopper and stemborer) and drought. Termites are serious problems in some fields, ants may remove the newly sown rice seed, which can cause barren patches in the rice stand, but the attacks are rarely serious.

4.8.1.9 *Threshing*

Threshing generally begins in early December in the fields. The piles of rice (long-term varieties) will be kept in the middle of the rice field for 1-2 months depending on weather conditions before threshing. Threshing done by Lao include labour exchange are hence each family has got to do it in turn. The labour required for one plot is about 20-30 mandays according to the size of the plot. Just before the threshing activities begin, shifting cultivators will lay down the bamboo mats on which the threshing is to be performed. Shifting cultivators will use a pair of sticks joined by a rope holding the bunch of rice. This bunch is then boards which are placed on bamboo mats. The purpose of hitting is to remove grain from the stalk. After that the bunch of stalk will be cut and hit a gain by a stick which curves one end, in order to make sure that all the grain is taken off from the straw. When threshing is completed the grain will be fanned remove to take away what the empty grain will remain. The tools used for threshing are pains of hitting sticks knives and fans (Picture 5).

1. A Pair of hitting sticks 2. Bamboo fan, 3. A Hitting stick

Picture 5. Threshing tools

After threshing is completed, individual farmers will carry the rice back home. The main grain will be kept in a temporary storehouse. Seed for sowing next year will be stored in special bamboo basket in the barn. Rats and weevils are serious post-harvest pests. To protect the seed material, maize, sesame, job tears, chillies seed are often stored under the eaves of house, where smoke from the fire place will reduce the weevil damage.

4.8.1.10 *Yield*

Yield vary considerably between years, households and individual fields. As mentioned before, rice yields from older forest clearing is much higher than in fields made in young secondary growth or fields cultivated for several year. Rice yields range from 1t/ha to 1.5t/ha for the first planting after fallow and decline to 1t/ha and 0.5t/ha in second and third year. The overall average yield is estimated to be 1.3 t/ha.

Table 10. Average upland rice yields in 7 villages in Nam Nane watershed area

Village	Ethnic group	Year				
		1995	1996	1997	1998	Aver
Tha Lie	Lao	1.1	1.2	1.6	1.25	1.6
Pha Kuang	Lao	1.0	1.2	1.6	0.83	1.3
Pha Tong Lom	Khamu	1.1	1.1	1.7	1.26	1.3
Thong Khang	Khamu	1.2	1.0	1.3	1.00	1.1
Houy Oun	Khamu	1.1	0.9	1.5	1.68	1.2
Pha Hen	Hrnong	1.2	1.5	0.7	0.71	1.0
Tou Ho	Hmong	1.4	1.5	1.5	2.06	1.9
Total		1.48	1.2	1.4	1.25	1.3

Source: Villages survey in July 1999

4.8.1.11 *Transportation*

Transport of the harvest to the village is a tedious job. There are different ways of transporting the rice from rice field to home of shifting cultivators. The rice will be transported by the farmers themselves or by horses. Labour exchange is not often used and task is normally completed within 15 days. The materials that shifting cultivators use for carrying upland rice are various kinds of bamboo baskets and bags.

4.8.1.12 *The situation of the field after harvesting*

After harvesting is complete the farmers will let the rice field be come a fallow. Different species of vegetation subsequenty appear, including "nga farang" (*Chlomolaena odorata*), "nga Khiou" (*Scopama dulcis*), "nga haobin" (*Grassocephalum coepidioides*), "nga khai" (*Pogonatherum crinitum*),"nga kha" (*Imperata Cylindrica*), "nga khay" (*Pagonathe rum corylifolia*), "nga gnung" (*Microstigium ciliatum*)," nga kappi" (*Aneilema loureiri*), "nga khat" (*Psooralea lorylifolia*), "khoi khao khat" (*Ventilago calyculata*), "khoi tot ma" (*Paederia tomentosa*), "may khom" (*Muntigia calabura*), "may ko" (*Quercus spp*) and *bamboosa spp*.

A summary and comparison of Lao, Hmong and Khamu ethnic catergories.

a. Duration

Shifting cultivation practice of Lao peoples started from the early February up to the mid December the following year. The actual period of the shifting cultivation practice in one season lasts about 10 months. The Hmong and Khamu start the cycle in early January to late November or early December (threshing/ transporting) which is the last days of the work. It takes about 1 1 months.

b. Crops management

The way (Hmong) of taking care of the crops in comparison with those of Lao is better and more skill full. This is evidence that the shifting cultivation area of a sample family is larger and good fencing arrangement of crops in the fields such as maize, cucumbers and beans (planted separately so that no crops interference is resulted) lead to good yields.

The most difficult tasks with the shifting cultivation cycle are fencing and weeding because the practice of 3-4 year rotations in this farming system has brought an increase of weeds. The younger the fallow, is slashed, the more weed will occur. Moreover, it is not easy to get materials (wood) for fencing.

Table 11. Variation in Farming Practices among different ethnic groups

	Lao	Khamu	Hmong
Elevation	Low	Middle	High
Shifting cultivation	Supplementary-often near to paddy	Greater on shifting cultivation	Rely on shifting cultivation often far from the village
Weeding	Weeding knife	Weeding knife	Small hoe
Harvesting	Cut straw with sickle	Strip heads by hand	Cut straw with sickle
Post harvest in shifting cultivation	Dry for 3 day in field, thresh, carry to village	No drying, store in field and carry as needed.	Collect and make pile, dry and thresh in field, store in field or village depending on distance
Shifting cultivation cropping pattern	Upland rice inter cropped	Inter cropped	More single crop
Shifting cultivation field pattern	Often individual plots	Household groups (5 to 10)	Large household groups
Rice varieties	Glutinous	Glutinous	Non glutinious/glutinous
Livestock	More buffalo	Fewer livestock, high mortality	More cattle and pig
Home garden and fruit	More tree, garden area and cash crops	Less	Less

Source: Villages survey in July 1999.

4.9 Paddy production

Twelve percent of the families in the Nam Nane watershed owns paddy fields. Four of the seven villages in the area do not have any paddy fields. Only in 3 villages (Pha Tong Lom, Thong Khang and Tha Lie) is paddy rice a major contributor to the total rice production, accounting for 25 and 36 % of the total rice yields. There is some variation between the ethnic groups. The Lao and Khamu have about the same proportion of paddy farmer. Ownership of paddy fields seems somewhat related to the length of residency in the area. Paddy production is believed to more stable and productive than upland rice production. Moreover, it does not require slashing of forest or potential forest areas.

Since its start in 1980 the paddy area has increased from 10 to 63 ha, and the dry season irrigated paddy area has expanded from 5 to 21 ha. A weir has been built in Ban Tha Lie, which has an irrigation potential of 90 ha of wet season and 40 ha of dry season cropping. Technically, it may he possible to expand the paddy area considerably by constructing more weirs and irrigation canals. However, the capital investment would currently be unrealistically high.

The annual paddy cultivation cycle starts in the dry season, when water canals and embankments are repaired. Plowing and puddling usually starts in late June after the fields have been soaked. At about the same time seed-beds are prepared and seeds sown. After three to four weeks the seedlings are transplanted in the paddy field.

Most varieties take about four months from transplanting to ripening, and most fields are harvested around mid-December. Where irrigation water is available for a second crop, transplanting usually takes place in February and harvested in June. Very few paddy fields are used for a second crop other than rice, probably because farmers aim at self sufficiency in rice and surplus production is easy to sell locally.

5 Discussion

Shifting cultivation systems are largely subsistence-based. Shifting cultivation and related bush fallow systems are diverse and practised in different part of the world by various peoples, who use a wide variety of tools, practices, crop/livestock enterprise mixes on soil of different fertility capabilities and in a range of topographic situations. They also vary in proportion of produce used for subsistence or sold and in the amount and range of supplementary foodstuffs harvested from the wild. With the development of sedentary agriculture where shifting cultivation was the vogue, socio-economic pressure is associated with changes in the farming systems. The food comes from the farmer, who in turn receives goods and services from them. Shifting cultivators are among the world's poorest, but they are a silent majority in the tropics (FAO, 1984).

In Nam Nane watershed Lao PDR, different types of shifting cultivation are practised by the different ethnic groups that are meant to provide reasonably stable yields of subsistence and good services in specific ecological circumstances, and to deal with normal vagaries of climate, pest outbreaks, etc. Practices of shifting cultivation are thought to generally lead to decline in habitats for wildlife in productive and watershed protection forest, and in the productivity of land for agriculture. Most of the shifting cultivation practised in the Nam Nan watershed occurs in areas of natural forest. At the same time, there are increasing demands on land for other development activities. Moreover, a relatively fast population growth is reinforced by shortage of cultivated land, forcing the rural poor to move into mountains where they engage in shifting cultivation.

In Nam Nane watershed like other places in the country in recent decades, is seeing its traditional, rice-dominant, shifting cultivation practices in the uplands changing under a combination of pressures, as evidenced by the increasing weed problem (with high demands on farm labour) declining rice yields and shorted fallow periods. It is an intrinsically extensive form of production and consequently highly susceptible to ecological constraints and population pressure. More recently, they have been under stress, due to shortening of the fallow period. This shortening has been caused by number of factors. One of them is endogenous population growth with limited land available for expansion of shifting cultivation. Reduced soil fertility, is a leading cause of soil erosion and land slides.

Socio-cultural aspects are also important In Nam Nane watershed, the three major shifting cultivating groups namely, the Lao, Khamu and Hmong, have their own social system, distinct from those people on the plains despite the fact that Lao, Khainu and Hmong have remained in 'regular contact with the plains, participating mainly in trade activities. Consequently, the change that are now visible in the production system in the use of shifting cultivation, leading to intensification are the result of number of factors.

5.1 Changes caused by continuous cultivation

The strategy of increasing crop yield without altering the shifting cultivation cycle has been successful only in the instances where the recommended practices are realistic in terms of farmer's economic resources. It is necessary that technologies for increasing food production based on expanding the area under cultivation must be supported by others that help attain increased food production per unit area. This is also a land saving device that enhance multiple land use. This could facilitate not only increased availability of land for food crops when fallow periods are shortened considerably, but also make more land available for other competing land uses and for production of non-food industrial crops, fuelwood and other forest products (FAO, 1984).

5.2 Soil

Soil is the natural anchor for land plants and their source of nutrients. Soil infertility is frequently cited as constraint to crop production in the topics in general and for slash and burn systems in particular (Jordan, 1985; Sanchez and Logan, 1992; Warner, 1991). A major difference, with respect to soil fertility, between natural ecosystems and a man-managed ecosystem such as agriculture lies in the fact that substantial quantities of soil nutrients removed through crop harvest never get recycled back into the system, apart from other losses that many occur (Ramakrishnan, 1982). Traditional shifting cultivation is almost entirely based on nutrient cycle, often associated with soil nutrient declines. Consequently, an examination of nutrient cycling during the fallow period is in order (Sanchez, 1976). During each clearing and cultivation phases, various farm operations result in change in soil properties and in farm environment. Decline in soil fertility accelerates by

shorter fallow periods appears to be a major constraint in shifting cultivation rice production system in Nam Nane watershed.

The effectiveness of shifting cultivation will depend on availability of land and labour for clearing new land each year. When vegetation is burnt, the nitrogen and sulphur literally go up in smoke while the other nutrients generally remain in the ash. Although burning forest slash produces ash rich in phosphorus (P), potassium (K) and calcium (Ca) and serves to temporarily neutralise acidic soils, continued burning and cultivation result in deterioration of soil nutrient status and physical condition, change in soil flora and fauna composition, and increase of weed, pest, and diseases (Clarke, 1976; Gagney, 1981; Nye and Greenland, 1960; Parfitt, 1976).

These nutrients however, gradually accumulate during the fallow period and provide an alternative for fertilisation. The nutrient content of slashed vegetation in managed fallow is significantly different from that of leaf litter, which is naturally abscised. Clearing and burning associated with cultivation in traditional shifting cultivation and related fallow system cause

- Effects, surface soil temperature to increase and due to high insulation, moisture levels fluctuate (Ramakrishnan, 1982). Loss of most of nitrogen, sulphur and carbon in gases during burning and rendering a lot of plant nutrients more available to the crop and prone to loss through leaching and erosion.
- At burn, a high percentage of nitrogen and sulfur reserves of felled vegetation to be lost into atmosphere. A surprisingly small amount of nitrogen is added to the soil by as; only $1g/m^2$ (Zinke et al., 1978). But vitually all phosphorus in ash remains within the system; so too, the content of metallic nutrient cations will be maintained. These elements are added directly to the soil surface in ash, and constitute a significant natural fertiliser increment which is positionally and phisiologically available because of its concentration and inorganic form (Charley and MacGarity, 1978), when the re-growth period is not long enough plants can not bring sufficient nutrients above the soil surface where they can be made available for agriculture by cutting and burning (Kunstadter and Chapman, 1978). A period of rapid depletion of nutrients occur during the slash and burn and cropping phase and depletion process continue through the early secondary succession phases (Ramakrishnan, 1982).
- Destruction of humus and result in adverse effects on the soil physical and textural characteristics, particularly when intense burning is practised to burn thick wood piles as is used shifting cultivation system, and
- Adverse effect on soil macrofauna and destruction of soil microflora and fauna (Mouttapa, 1974).

Therefore, in Nam Nane watershed, where the average annual rainfall is about 1,300 mm, soil moisture is likely to be limiting rice yields in some years. Shifting cultivators also considered insufficient rainfall as more important constrain to rice production than soil properties.

Soil changes during the cropping period are associated with a decline in the amount of humus in the soil. It is necessary to redress this imbalance in the process of development of alternatives for the development of more efficient food production systems that enhance qualitative and quantitative increase in food production. The assessment of decrease in level of fertility and the increased difficulty to control the weeds result in decision whether or not to have a second upland rice crop cycle. However, shifting cultivators tend to cultivate more land per year when they want to produce at least the same amount of crops as they did before. Shifting cultivation causes soil erosion in the cultivated fields. The heavy rain in the early wet season may lead to erosion, especially in sloping areas. Especially where cultivation extends over several years. Erosion is probably a major cause of soil fertility decline as most plant nutrients are located in top 10-20 cm of soil. Soil erosion under shifting cultivation is not a serious problem

5.3 Labour

Shifting cultivation has always been a risky and time consuming agricultural practice. The seasonal interns of labour is an additional factor. Shifting cultivation in Nam Nane watershed is labour intensive, and the heaviest labour requirement is not in the intensive events of clearing and burning the fields, but rather in the continual weeding throughout the six-month rainy season. It was, however generally difficult for shifting cultivators to recall the labour input for the previous season and labour input reported were highly variable.

Table 12. Average labour requirement for shifting cultivation in Nam Nane watershed (man-days/ plot)

Activities	Lao	Khamu	Hmong
Select in the field	1	1	1
Slashing	60	45	30
Burning	1	2	1
Pilling and re-burning	10	20	46
Sowing	32	25	40
Fencing	5	5	10
Guarding	1	1	2
Weeding (3 times)	130	145	109
Harvesting	30	25	40
Threshing	20	20	52
Transporting	30	15	10
Total	295	314	341

Source: Villages survey in July 1999.

The greatest demands on the households labour force occur during the season of monsoon, when all workers are mobilised to keep the weed growth in check. Differences in weed cover, working habits distance from the village, rainfall all add to the variation (Roder et al., 1994). Shortage of labour among Nam Nane watershed shifting cultivators is reported to be a major problem, not only because it minimises the area they can bring in to cultivation and hence limits their productivity, but because the amount of drudgery in farm work in relation to its returns encourage a rural-urban migration with attendant social ills (FAO, 1984). Moreover, the shifting cultivator's inability to perform farm operation as needed is a major cause of low productivity.

Crop yields under shifting cultivation are extremely low. Upland cropping was generally characterised by low area productivity, high labour input and unstable yields and prices.

Assuming an average yields of 1.1t and labour inputs between 310days ha-1 shifting cultivators can expect 3.5kg of rice per working day. By appropriate technology is meant all environmental, resource and input manipulations that minimize drudgery and enhance productivity but are within the means of farmers to own, use, repair, hire and maintain.

5.4 Weeds

Some argue weeds play a positive role in shifting cultivation systems by recycling nutrients (Swamy and Ramakrishnan, 1988), maintaining soil fertility or productivities (Mishra and Ramakrislinan, 1984) and reducing erosion and/or nutrient run-off and leaching (Toky and Rarnakrishnan, 1981; Chacon and Gliessman, 1982). Weeds have been suggested to control insect population and the resultant damage to the crops. Shifting cultivators like to have "nga farang" (*Chromolaena odorata*) in their fields as a fallow species. Preference of "nga farang" (*Chromolaena odorata*) may be partly related to its dominance under good soil conditions but also because of its fast growth and large biomass production. This could explain the fact that shifting cultivators in general do not consider "nga farang" (Chromolaena odorata) as a noxious weed (Soukhaphonh et al., 1992). Weeds seriously affect agricultural production areas. Weed seeds will germinate at the same time as the crop. The seeds of many weeds retain their viability for twenty years or more when buried in the soil (Crafts and Robbins, 1962). Some farmers is reported species such as "nga kha" (*Imperata cylindrica*) as having extensive underground rhizomes protected from fire and they are difficult to eradicate during cultivation. Even when cut and left as mulch on the field before the rains start, it would still provide soil protection. Weeds in agro-ecosystems

are generally considered to be plants that are out of place, that adversely affect crop growth, and that for a variety of reasons are difficult to control.

There are many fire adapted plant communities-forest, shrub vegetation and grassland that are maintained due to fire (Keeley, 1981). Exotic species are prominent in disturbed sites throughout the world, on the continents as well as in the topics. In many slash and burn farming systems with sufficient land reserves, the manipulation of fallow and cropping periods is a major weed control strategy (Moody, 1975; De Rouw, 1991; Warner, 1991). Weed control can be accomplished with a number of methods including mechanical cultivation, biological control and hand weeding. Some are more effective than others in terms of labour required, efficiency, duration and selectivity. Herbicides has been used by some shifting cultivators. But some concern has been expressed that herbicides are too costly to be used by the shifting cultivators. Mechanical methods currently available are not suitable either (Anon., 1972; Renaut, 1972).

The traditional shifting cultivation system is well adapted to temporary weed control. When forest clearing was still possible, the weed problem was relatively small, but since most fields nowadays are cultivated continuously and with shorted fallow periods weed problems have increased considerably. Weeding has to be done during the rainy season, when the shifting cultivators are very busy. Cutting, on the other hand, is carried out during the drier months when there is less activity. The labour input for weed control increases dramatically with cropping, the amount of labour needed to control weeds during the first crop after clearing, according to Nye and Greenland (1960) finish it. Shifting cultivators reported that as a result of shorter fallow periods, labour requirements for weeding have increased substantially over the last few dlecades. Considering the extremely high labour input for weed control the farmer rating is realistic.

When the labour input for weeding exceeds that for clearing a new path of forest, the shifting cultivators shift. Weeding may take up to 40-80 percent of the farmer's time. Weed control in upland rice production requires about 150-200 days ha^{-1} or 40-50% of the total input (Roder et al., 1994).

In Nam Nane watershed, shifting cultivators are not concerned about soil erosion, they consider weeds to be the more important factor limiting their yields. The presence of weeds may cause rapid depletion of resources often resulting in reduced crop yields. Weeding competition rather than soil fertility, is reported to be the most obvious reason for slash and burn practices of farmer and their transhumance to new fields (Moody, 1974; Nye and Greenland, 1960; Sanshez, 1976; Warner, 1991).

5.5 Yields

Shifting cultivators tend to imitate the natural ecosystem by planting mixed assemblages of root crops, herbs, climbers, shrubs trees and such grains as maize, job's tears and upland rice. Job's tear and maize moved the way for the great expansion in to the upland.

Natural fallow rotations have shortened to the point of declining productivity of the natural resource base, with increasing weed problem and decreasing soil fertility. Commonly, the major problem being faced by farmers is decline in per hectare yields of their shifting cultivation fields (Home, 1998). This decline is largely due to the trend towards shorter fallow periods, which averaged 12 years in 1981-1992 (Chazee, 1994), but have fallen as low as 3-5 years in more -densely populated areas. These shorter fallow period have resulted in lower yield of crops in shifting cultivation fields. In Nam Nane watershed, upland rice yields have fallen to 700-1100kg/ha after 4-year fallow compared with 1500kg/ha after 9 years fallow in the same areas. As indicated earlier the critical feature of most shifting cultivation has been the low returns from the land and labour invested.

In the past, when the crops in shifting cultivation fields failed because of natural calamities or when seasonal food shortage occurred, shifting cultivators were able to rely on traditional coping strategies to provide their food requirements until the next cropping season (Horn, 1998). If the fallow periods are long enough, this type of land use system represents balanced exploitation of resource available to shifting cultivation system. Provided the fallow periods are long enough, a shifting cultivation system proves to be in no way harmful to the soil. In fact, the yields after a fallow period with secondary forest are sometimes higher than those after first clearing (Ruthenberg, 1974). The traditional shifting cultivation system is ecologically sound but guarantees perceptual poverty. If they really do

so depends on labour availability and other factors. But with decreased access to forest area to be cleared, shifting cultivators felt the need to increase existing land productivity and to improved the stability of their production system.

5.6 Technologies

More appropriate methods of technology development and adoption of available technologies are needed in Nam Nane watershed. Appropriate technology in this thesis means all environmental, resource and input manipilations that minimize drugery and enhance productivity but are within the means of farmers to own, use, repair, hire and maintain (Okigbo, 1984). The flow of technology is envisioned as being logically circular in nature, beginning with farmers and ending with better menu of choices for farmers in similar production environment.

The importance of indigenous technical knowledge as starting point for shifting cultivation development is now widely accepted, as shifting cultivators are engages in their own experimentation and are making changes to their systems in response to changing circumstances. Transfering technologies to shifting cultivators is easier said than done. Often the technologies are not adapted to the context. Consequently, as is the case in many areas, few relevant technologies have been developed to solve the crops and animal production problems of shifting cultivation living in Nam Nane watershed.

Under the current conditions, even the simplest modern technical devices are far too expensive for the average upland farmer. The costs of modem technology, including fuel and agricultural chemicals, are bound to increase in foreseeable future. Thus, unless economic conditions change radically, this form of technology-intensive or energy-intensive development will be of no utility in the hills the Nam Nane watershed.

5.7 Fallow system

Although shifting cultivation intensification can be conceived as continuum from long fallow to short and then to zero fallow, movement along the continuum is not always unidirectional. During the recent past, as a result of increasing population pressure, there has been a shift from more extensive to more intensive systems of land use in many parts of the third world (Boserup, 1965; Okafor, 1987).

In Nam Nane watershed area, rotational shifting cultivation has been practised continuously for several generation. Although the change in vegetation caused by shifting cultivation is usually viewed negatively, many fallow species are important sources of material, food, fodder and sale products particularly mushrooms, wild vegetables, bamboo shoots, bamboo, Imperata grass and broom grass. From the standpoint of fallow regeneration, crop types assemblages and sequences can be quite important. Where fallow periods are sufficiently long, shifting cultivation may limit soil degradation, weed competition and pest damage. But in practice, longer fallow systems have been replaced by shorter bush fallow systems of agriculture (FAO/SIDA, 1974). Fallows are shortened but the lenght of cropping period may remain the same, or even increase through the adoption of more sophisticated rotation practices (Okigbo, 1984).

With population pressure, fallow periods are drastically reduced and farmers are forced to return to the same piece of land in less than seven years of fallow. Decreases in length of fallow time leads to declining productivity and may make the land unsuitable for further cultivation for many years, due to replacement of forest with herbaceous vegetation. Furthermore, when the fallow period is shortened, complex and often adverse ecological changes occur, such as establishment of Imperata grassland and a reduced number of tree seeds left for re-growth. Re-establishment of secondary forest fallow vegetation is slowed or totally impeded, some areas become bare and erosion begins to take place.

During shifting cultivation and cropping phases a number of change occur in the physical and biological environment. Without fallow to restore soil fertility and control weeds, industrial inputs such as fertiliser and herbicides or, alternatively, high labour intensive practices are needed to sustain productivity (Raintree and Warner, 1986).

The pattern of shifting cultivation has been that a plot will be cultivated one year only and then allowed to return to bush fallow for three years, before being cleared and cultivated again. Fallow periods of 3-5 years probably return substantially less organic matter to the

soil per year of fallow than longer fallow periods 8-10 years. The fallow period, therefore does not improve the soil fertility per se; rather it accumulates nutrients in the plant biomass, accumulating them above ground for 10 to 20 years cycles. It is only then that the field will be ready to start growing crops again (Nye and Greenland, 1960, Szott and Palm 1986). Managed fallow provides, though it is patchy in nature, an association of successional states which over time constitute a temporally and spatially changing mosaic of micro-habitats. Such mosaic would be suitable, at any given time, for occupation by variety of valuable (as well as non-valuable) plants from distinct successional status, both planted and spontaneously occuring-to exist in managed fallow (Unruh, 1990).

The use of single year of cultivation also facilitates a fast regeneration of the forest and there by the possibility of re-cultivating the land after relatively short fallow period. Thus, the short cropping period ensures that probably most trees and many tree seeds survive the cultivation period. Also, planting leguminous trees in fallow periods offers potential to improve soil fertility and provide wood production. It is necessary to redress this imbalance in the process of development of alternatives for the development of more efficient food production systems that enhance qualitative and quantitative increase in food production.

In summary the reasons for and inputs of shifting cultivation can be briefly presented as follows.

Activity	Effects
Slashing and burning the vegetation	• Plant nutrients are made easily available in the ash. • The increased insolation leads to higher soil temperatures and, thus rapid mineralization of humus. • Fire removes plant material from the soil surface and may kill pests, rodent, weeds and seeds of weeds.
Cultivation	• Plant nutrients are lost through crop harvest, accelerated leaching and erosion. • The soil structure may degrade due to the loss of organic material, and by compaction and erosion. • Weed species adapted to the open field-conditions proliferate. • Crop pests may build up.
Fallowing	• Plant nutrients accumulate in the vegetation and in the soil. • The soil structure is improved through biological processes. • Potential weed species are suppressed by shading. • Many crop pests are suppressed by the lack of host plants and the change in environment.

5.8 Gender

The economic rationality of intensification and labour deployment by shifting cultivators tends to be distorted by man's self interest being put ahead of the interests of women. From this study, it was observed that while upland social systems tend to be more egalitarian than those in plains, most of them nevertheless exhibit varying degrees of male domination. Types of task, time-spent working and patterns of investment and consumption expenditure all indicate that men tend to work less time than women and they value this time more than do the women.

Shifting cultivation is a family affair where husband and wife share the work. Women's working tasks are manifold and their working -days are long. Women walk to their shifting cultivation fields in early morning and usually come back in the evening. Women are the primary collectors of fuel and food for home consumption. Women's general health status is low. They go through many child births and may not know much about birth control. Both

Hmong men and women tend to cultivated their own plots. They usually help each other as much as is necessary. The Hmong men do most of the heavy work e.g.; clearing, cutting the wood used for building and erecting house and the women do the weeding and harvesting. Household and collecting fire wood are almost always women's and children's tasks.

Moreover, in so far as men and women's awareness is concerned, men dominate the links of the family to the world outside the immediate community. This happens through trade and travel, to live for jobs and take any, opportunity. These are reserved for men. Thus, women subordinate to male interests.

Table 13. Daily calendar for the shifting cultivator's in Nam Nane watershed

Time	Women activities	Men activities
4.00	Waking up	
4.30	Rice milling	
5.00	Collecting fodder from the field and preparing it for the pigs, the chickens and horses, then washing the clothes for the children.	Waking up
6.00	Cooking and having breakfast	Having breakfast
6.30	Child caring	
7.00	Preparing tools and going to the field	Preparing tools and going to the field
8.00	Starting the work in the field (sowing, weeding, harvesting)	Starting the work in the field (sowing, weeding, harvesting)
12.00	Cooking and having lunch in the field	Having lunch in the field
13.00	Continuing the work in the field	Continuing the work in the field
16.00	Returning home, collecting some fuelwood and food	Returning home, collecting some food and hunting
17.00	Preparing fodder for the pigs, the chickens and horses	Preparing fodder for the pigs, the chickens and horses
18.00	Taking a bath	Taking a bath
19.00	Cooking and having dinner	Having dinner
20.00	Weaving	
22.00	Going to the bed	Going to the bed

Source: Villages surrey in July /999.

5.9 Policies

In 1985 the Government of Lao PDR (GOL) adopted reforms aimed at achieving a market based economy through a series of measures called the New Economic Mechanism (NEM). Implementation of the NEM has directly affected agriculture by the opening of markets and development of infrastructure though allocation of lands including forest lands.

Land use planning and land allocation is an integral part of the Government of Lao PDR (GOL) rural development programs. It aims at and is directed towards the sustainable management of forest and agriculture lands of the country. The current land allocation strategies seem to have been developed in accordance with similar ideas. In Lao PDR

agricultural and forest land allocation is supposed to assist in development of community based resource management. The land use planning and forest land allocation is considered as a key national strategy for eradication of poverty in rural areas. Special emphasis is paid to the shifting cultivation stabilisation and participatory natural resource management along the line of decentralisation process in sustainable development.

Measures are being taken in line with the NEM, through improved communication and better access to the markets. This has made the villagers continuously search for ways of improving their situation, e.g., plant trees, grow cash crops, invest in irrigation schemes. Such developments require that farmers have secure land rights. Nevertheless, security of tenure is a necessary condition for intensification but not itself a sufficient one. Thus, security of tenure alone does not seem to entail changes in the shifting cultivation systems. This is mainly because in the absence of land and labour constraint and without financial inducements and means to change cropping patterns, shifting cultivators will tend to seek simply to extend their area of production under customary usage and regardless of tenurial considerations. However, if insufficient land is allocated to shifting cultivators, then existence of formal use rights may in fact serve to threaten the sustainability of their agricultural practices and ultimately the security of their livelihoods.

Much of the Nam Nane watershed area in the Lao PDR contains human settlements, some of which have been in existence for several hundred years and most of which have histories extending back at least several generations. In addition, many communities living outside protected areas use resources within those areas on a regular basis.'Consistent with the predominantly rural nature of the people, virtually all of these communities in and adjacent to protected areas are reliant on the natural environment for their livelihoods. Many are in a subsistence relationship with their natural surroundings, though the extent of their involvement due to recent changes in the economic policy is generally increasing rapidly and in some cases placing greater pressure on the natural resources in their surroundings. As peoples benefit from the forests, they also contribute to a better of ecosystem.

The presence of communities within Nam Nane watershed area provides some significant opportunities for enhancing protected area management. Some examples are given below.

- People who have been reliant on the natural environment for their survival over several generations generally develop a depth of ecological knowledge that can be duplicated by modern scientists only after long and expensive research efforts. This local ecological knowledge can make a significant contribution to bio-diversity conservation and management;
- People involved in subsistence production have a close relationship with their natural resource base and can usually be assisted to relatively easily adopt sustainable conservation management based on stewardship concepts, if they are not already practicing such an approach;
- The presence of communities, which are involved in management of the area and which feel that they derive some benefit from the maintenance of environmental quality, is likely to act as a deterrent to in-migration, and to some extent to unsustainable use of the area by outsiders; and
- Because of their reliance on the natural resource base and their frequent presence in the areas, local communities can provide very effective support for surveillance and law enforcement to support protected area management. Without their presence it would often be difficult, if not impossible, for protected area management agencies to police large areas effectively.

Land use management options are needed to improve the economic status of subsistence farmers and to maintain agricultural productivity on deforested land and even to recuperate productivity of degraded lands. Many of current practices that are now contributing to increased productivity and land use sustainability have come from the shifting cultivation themselves. Increasing population pressure implies the need for more intensive land use in Nam Nane watershed.

The government is expected to take all the necessary measures to protect the existing forest through the promotion of providing alternative occupations for shifting cultivators as well as through improving their living conditions. Of course, it is a difficult task for the

government to resolve these problems. These problems will certainly take many years to be addressed. Sustainability must be based on three legs. Sustainable natural resource management must be economically viable, ecologically viable and socially acceptable. In terms of these three properties, a shifting cultivation system operating under a low population pressure are likely to demonstrate relatively low productivity and medium stability, but a high degree of sustainability and equitability because of " the use of traditional techniques to maintain and reduce pest and disease attack while traditional land tenure and social practices ensure that the productivity is fairly evenly distributed" (Conway, 1985). Shifting cultivation is largely carried out with traditional technology.

Whatever the case, shifting cultivation societies have evolved through the same length of time as other societies and we have no reason to assume that their knowledge and ability to cope with their surrounding have not kept pace in adaptive sophistication. In Nam Nane watershed it is possible that shifting cultivation system and upland rice production have existed side for thousands of years, and they have continued to practice shifting cultivation because they found this method of agriculture highly suitable to local condition and were able to make good living from it.

Currently, the government's policy seems to be moving in the right direction. But it would be more useful if local knowledge of shifting cultivation tapped, and that they are made active participants of development understandings. This study is believed to contribute towards the understanding of the existing systems. It looked at why shifting cultivators change their production patterns, how they change, them the rationale for particular patterns of these change and who the main beneficiaries are as a result of these changes. Following Roger (1969), change in shifting cultivation systems, can be distinguished on the basis of these initiatives for change and the sources of change. Indigenous change or innovation consists of change from inside of the social system being considered. In such cases it is preferable that the idea comes from outside but the initiative for adopting originates from within the social system, so that accelerated intensification process occurs in shifting cultivation system. Also, policy makers aiming at intensifing shifting cultivation will have to be aware of the fact that limited availability of saving or restricted access to capital may make adoption of original systems difficult.

Thus, unless cautious measures are taken while attempt to intensify, the advantages of shifting cultivation may be undermined and, the sustainability and productivity of such systems are threatened.

6 Conclusion and Recommendations

6.1 Conclusion

The livelihood of the majority of the 4.5 million people of Lao PDR is based on the use of agriculture and forestlands. Most rural families plant rice, raise livestock and access forest areas for non-timber forest products and fuelwood. The rural uplands of Lao PDR comprise of, in most cases, areas with livelihood systems predominated by traditional shifting cultivation practices especially in northern part of the country. Shifting cultivation is practised in all parts of Lao PDR, in the lowlands, in midlands and in highlands, by all the ethnic groups of the country. Even though shifting cultivation has been a tradition of upland people for their subsistence for centuries, this farming system is being practised presently rather different because shorter fallow periods which causes harm to the natural resources resulting in the unstable life of upland farmers.

Due to increasing population density in rural areas and reduced fallow cycles, the different ethnic groups find it more and more difficult to make their living on the present land use (Sawathvong and Vongleck, 1999). In the past when populations size were low, traditional shifting cultivation in northern Lao PDR was well adapted to local conditions and largely geared toward production for household consumption.

But over time, a great deal of primary forest in the Northern of Lao PDR has been felled by Upland farmers as part of the shifting cultivation cycle. Every year new natural forest will be cleared for their cultivation until there is no more natural forest in the vicinity of a village, the village is then shifted and the process is repeated. During the last 30 years, almost all accessible primary forest has been destroyed by this farming system there by forcing farmers to repeat the cycle in old fallow or secondary forest. As a result, the fallow periods are being reduced year after year bringing about reduction of in soil fertility. Presently shifting cultivation areas are limited in to only using 3-6 years old fallow. This reduced fallow cycle cultivation is called rotation cultivation or cyclical bush fallow cultivation. Government policies given such developments, many argue that land for both rotation or shifting cultivation and for permanent agriculture must be allocated to the farmers taking a 4-year rotation system.

This particular study has focused on the shifting cultivation as practised by upland farmers of three ethnic groups in the Nam Nane watershed, the hilly northern part of Lao PDR for centuries. It has been learned that shifting cultivators are still following or practising the same traditional system of shifting cultivation rather than establishing stabilised permanent upland fields. They use it because it is the system that best ensures their survival under difficult environmental conditions while making the minimum demand on their limited labour supply and requiring few or no external inputs.

It has also been noted that the three ethnic groups practising shifting cultivation generally inhabit areas that differ in elevation and slope. Their dependence on shifting cultivation for survival also varies. The dependence on shifting cultivation for livelihood increases as we go from lower to higher altitudes, paralleling Lao through Khamu to Hmong people. The three ethnic groups do not vary significantly in the major problems they face and in terms of their management practices, even though there exist variation in use of tools and techniques that best fit the environment. This diversity of farmers and farming practices must be taken into account while designing improvement strategies.

Even though shifting cultivation is knows to result in serious deforestation and land degradation, farmers have no other alternatives. It remains the only and simple method of earning their living. As the population continues to grow the demand for agricultural land is consequently higher. This brings, shortened rotations in agriculture which in turn result in low crop yields. This further exacebutes food shortage. As a result, farmer have to encroach into conservation areas and primary forestlands in remote areas for their subsistence cultivation.

The major drawback of shifting cultivation is that it can support only very limited populations. The other is that under conditions of rapid cultural change and when due to population pressure people do not allow the forest to regenerate, the soil becomes exhausted and eroded at the same time.

Further, if shifting cultivation is left unchecked the forest resources of the of the country will be at risk, the government is expected, this and stars ahead started to protect the existing forest this requires providing alternatives for shifting cultivators in assisting to be settled of ricumulated and to improving their living condition. Many years will be leaded to effectively address the problem. But it begins with understanding people and their production system, while this study has attempted to, and to increase people's awareness toward government policy.

Shifting cultivation is not simple. Shifting cultivation is not mainly a "forestry" or "agriculture" problem, It is also linked to health, security of land-titles and the general socio-economic development of rural areas of Lao PDR. Most of ethnic groups practising shifting cultivation still live as isolated small rural communities, and do not generally have access to agricultural inputs, knowledge and technology. They have no access to roads and markets. As a result, services to assist them in developing alternative ways of survival are extremely difficult to deliver. Moreover, the task change lifestyles or customs which have been practised for centuries is not an simple task (Sodarak, 1991).

The Government of Lao PDR is aiming at a rapid reduction in shifting cultivation through land allocation, the promotion of permanent types of land-use, and through socio-economic development. It is gradually consolidating its efforts and making flexible adjustments to its policies and strategies to meet the objectives of the regional as well as the global level. And yet, adjustment to new technologies are constrained by both social and cultural factors, such as availability of labour and local traditions. My experience from Nam Nane watershed is that shifting is very much connected with the cultural belief of the local people. Their problems are interrelated and difficult to address.

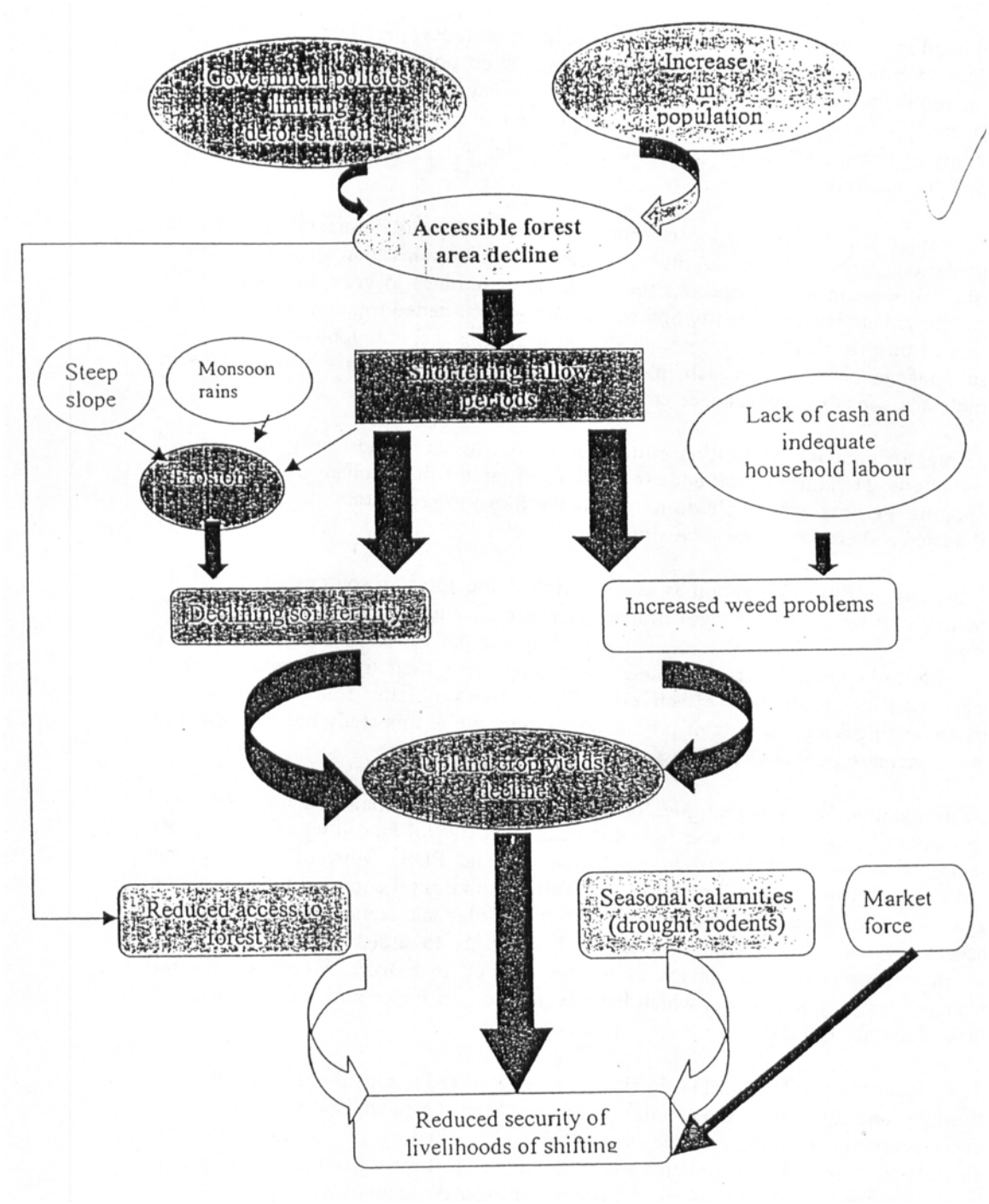


Figure 3. The changing dynamics of shifting cultivation in Nam Nane watershed and the impact on livelihoods of shifting cultivators.

Therefore for foreeseeble future, shifting cultivation practices will remain to be important activities in the Lao PDR in general and in the Nam Nane watershed in particular. Thus, it is important to have a broader perspective on this issue and this study is believed to have contributed to this end.

6.2 Recommendations

It seems that for the Nam Nane watershed, the best approach for sustainable development is one, which focuses on the internal resources of existing shifting cultivation systems including of course, the knowledge and effective participation of shifting cultivators themselves. No single technical exists solution for the problems of shifting cultivation.

Accordingly, recommendations are made concerning both development measures to be taken and research areas to be further studied.

6.2.1 *Recommendation for development interventions*

Development measures to be taken should have equal importance in preventing further degradation by shifting cultivation in Nam Nane watershed of Lao PDR as well as in improving the living standards of shifting cultivators. The following measures will directly and indirectly contribute to this end by reducing dependence of people on shifting cultivation. However

- Provide extension staff with the necessary knowledge, skills and attitude for extension and rural development through training, and better logistical support during implementation of plans.
- Provide shifting cultivators options concerning advice and communication with options and information to let them chose the best management practices and livelihood opportunities for themselves.
- Need for developing and testing alternative technologies for the small-scale farm.
- Extension service for agriculture and forestry should be introduced to educated the shifting cultivators about the importance and of better agriculture and forestry techniques.
- Provide credit for buying seed, fertilizer and hand tools to promote sedentary/intensive farming.
- Improved infrastructure and marketing channels to reduce the cost of marketing.
- Improving access to services such as education, health and public information for the overall well being of the people.

6.2.2 *Recommendation for future research*

Studies in the following areas are necessary to improve our understanding of shifting cultivation and its alternatives.

1. Further understanding of relationships between the various types of shifting cultivation practices, other forest uses systems, and their impact on forest loss and environment degradation.
2. Gain better insight and deeper understanding of shifting cultivation production conditions as well as their potentials and constraints for practical interventions in view of improving land-use through better management practices.
3. Developing or selecting and adopting, and then testing alternative technologies that could be appropriate to small-scale farmer practicing shifting cultivation.

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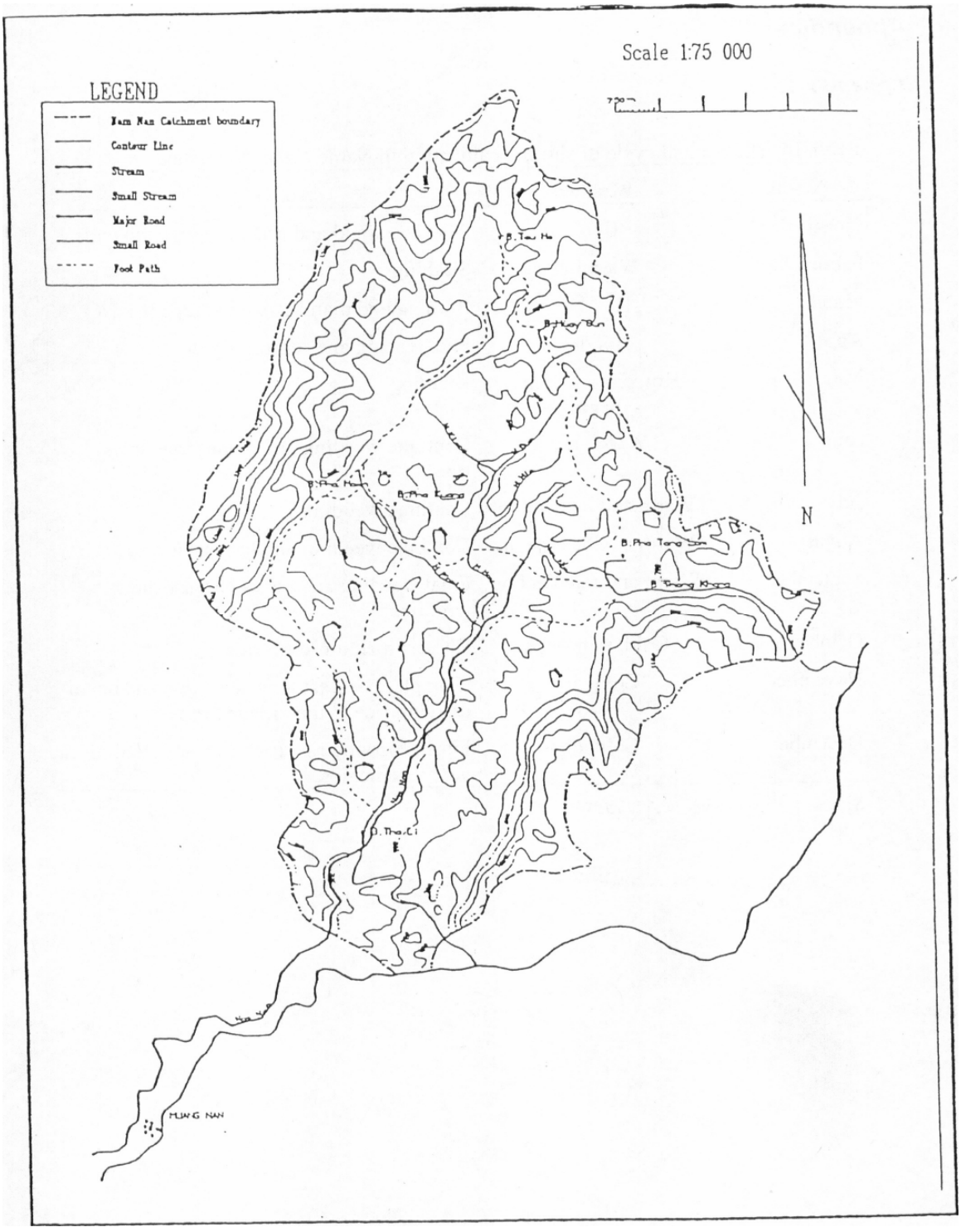
Map 1. Map of LaoPeople's Democratic Republic (Lao PDR)



Map 2. Map of Nam Nane watershed area (Scale 1:75 000)

Appendices

Appendix 1.

Table 14. The Annual cycle of shifting cultivation in Nam Nane Watershed

Month	Weather	Activities
January	Cool	Select the field and prepare/buy hand tools.
February	Warming	Slashing.
March	Hot dry	Burning and planting some crops (Maize)
April	Hot dry	Pile, fencing and re-burning
May	Hot, dry and rains begin	Dibbling
June	Warm, rain	Continue weeding and some vegetables ripen
July	Warm and heavy rain	Continue wedding
August	Warm and heavy rain	Continue weeding and harvest maize
September	Warm and rain decline	Final weeding and begin harvest short-term rice
October	Cold, rain stops	Harvest medium-term rice
November	Cold, dry	Complete harvest long-term rice and begin carrying rice to the village barns.
December	Cold, dry	Finish carrying rice to the village. End of year ceremonies.

Source: Villages survey in July 1999.

Appendix 4.

Table 15. Crop species cultivated in shifting cultivation areas in Nam Nane watershed.

Item	Lao Name	English Name	Scientific Name	LL	LT	LS
1.	Khao	Upland rice	Oryza sativa	✔	✔	✔
2.	Sali	Maize	Zea mays	✔	✔	✔
3.	Manton	Cassava	Manihot esculenta	✔	✔	
4.	Toedin	Groundnut	Arachis hypogea	✔	✔	✔
5.	Fay	Cotton	Gossypium hirsutum	✔	✔	✔
6.	Mak deuy	Job's tears	Goix lachrymal-jobi	✔	✔	✔
7.	Mak nga	Sesame	Sesamum indicum	✔	✔	✔
8.	Mak mo	Watermelon	Citrullus lanatus	✔		
9.	Mak teng	Cucumber	Cucumis sativus	✔	✔	✔
10.	Mak teng val	Sweet melon	Cucumis melon	✔	✔	✔
11.	Mak fak	Pumpkin	Cucurbita moschata	✔	✔	✔
12.	Man dang	Sweet potato	Ipomoea batatas (L.) Lam	✔	✔	✔
13.	Mak kouy	Banana	Banana sp.	✔	✔	✔
14.	Mak toihea	Piegeon pea	Cajanus cajan	✔	✔	✔
15.	Mak Phet	Chilli	Capsiom frutescens.	✔	✔	✔
16.	Pak peap	Lablab	Dolichos lablab Linn	✔	✔	✔
17.	Mak kieng	Orange	Citrus sinensis (L) Osbeck	✔	✔	✔
18.	Mak Muang	Mango	Mangifera indica L	✔	✔	✔
19.	Mak Mie	Jack fruit	Artocarpus heterophyllus Lam	✔	✔	✔
20.	Mak Hung	Papaya	Carica papaya L	✔	✔	✔
21.	Mak Nat	Pineapple	Ananas Comosus (L) Merr	✔	✔	✔
22.	Mak Phuk	Pomelo	Citrus grandis L	✔	✔	✔
23.	Khing	Ginger	Zingiber officinale Rosc.	✔	✔	✔
24.	Sikhay	Lemon grass	Cymbopogon citrates (DC.) Stapf	✔	✔	✔
25.	Oyt	Sugar cane	Saccharum sp	✔	✔	✔
26.	Pheuak	Taro	Olocasia esculenta (L) Schott	✔	✔	✔

Source: Villages survey in July 1999.

LL	Lao Lum	LS	Lao Sung
LT	Lao Theung		

Appendix 5.

Table 16. Village household settled within the Nam Nane watershed area								
Year	Th.L	P.K	P.H	TH	H.O	PTL	TK	Total(hh)
1900	6							6
1925	25	10						35
1950	35	20			3		60	118
1953	40	22			6		67	135
1957				27			86	
1961	52		11					
1963		32			20			
1965			35	30	18			
1967	60	35	35				86	216
1969	65						69	
1971		35				30	75	
1972								
1974		9	52					
1975	95	20	53	11	7	35	83	304
1976				15			125	
1977		30						
1982	100	32	55	58	25	50	130	450
1984				60				
1985				19				
1989	108	35	55	19	40	65	135	457
1990				28			68	
1992					32			
1994	124	36	35	53	34	60	58	400
1996	126	39	29	62	30	72	62	423
1997	128	42	27	56	34	70	66	423
1998	140	40	27	50	32	73	65	426
1999	140	42	27	50	33	74	65	431

Source: Villages survey in July 1999.

TL	THa Lie	TH	Tou Ho
PK	Pha Kuang	HO	Houy Oun
PH	Pha Haen	PTL	Pha Tong Lom
TK	Thong Khang		