

# Effects of fire managements practises on villagers livelihood strategies in Ban Huai Khanun 1-3, Mae Tia sub-watershed, Chiang Mai Province, Thailand



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Joint field course at location 3 (Ban Huai Khanun 1-2-3)

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# Abstract

Fire is used in tropical regions as an effective way to burn forests and thereby minimizing labour input in different forms of farming systems and forest utilizations. This includes Northern Thailand, where field studies for this report were conducted January 2005. The aim of the report is to investigate how fire management practises of a Karen hill tribe affects their livelihood strategies.

Being situated next to the Ob Luang National Park (estab. 1991), where the use of fire is prohibited legally, the implementation of proper fire management practises in the local community for controlling the spreading of fire has become essential for the village community.

The creation and maintenance of a firebreak since the mid 1990s surrounding the village was an effective method of protecting the villages from uncontrolled fires originating outside the village community. This has a dual purpose of protecting their access to the limited natural resources around the village boundaries and protection from uncontrolled fires outside of the village community.

The local institutional arrangements regarding fire management seemed effective in the area. They could be described in terms of a strategy for community participation aimed at solving overall livelihood constraints imposed from outside the community.

*Key words: Thailand, hill tribes, Karen, shifting cultivation, fire management, participation*

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Frederiksberg, March 18th 2005,

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# 1. Introduction

During 3 weeks in January 2005 the three Danish authors of this report and seven Thai students prepared and conducted a field trip in the Chiang Mai province of Northern Thailand. The main objective of the joint interdisciplinary field course was to investigate forest fire management of Karen hill tribe people living in the villages Ban Huai Khanun no. 1-3 (Mae Tia sub-watershed, Chom Thong district, Chiang Mai Province) and how these practises are related to their livelihood strategies (See Appendix A). In the following the Karen people, the research area and the report's research questions will be presented:

## 1.1 The Karen People

The Karen people lives among the Indo-Chinese hill-tribes of South East Asia and are situated in the mountainous forested areas in eastern Burma and North-western Thailand (Marshall 1922). Instead of Chinese heritage the Karen seems to have a cultural background of Tibetan heritage. The Karen population is about 5 million, of which approximately 400.000 people are situated in Thailand near the Thai-Burmese border (The Travelers Club 2004).

In Northern Thailand the Karen comprises about 50 % of the hill-tribes, which are as a whole considered an ethnic minority in Thailand (Buergin 2000). Although most of the hill-tribes in the area consider themselves as indigenous people of their particular area, they are all a result of a slow exodus of people from southern China due to population pressure about 2000 years ago. All of these semi-nomadic people slowly made their way south driven by their need for new land to replace the exhausted by their slash and burn farming techniques (The Travelers Club 2004).

As other long-established hill-tribes in the area (the *Khmu*, *H'tin* and *Lawa*) the Karen is practising rotational swidden agriculture in altitudes approximately between 700 m and 1000 m in the transitional zone between lowland forest and lower montane forest types. The traditionally swidden practise consists of clearing and burning an area of secondary forest (slash-and-burn technique), a short cultivation period for 1 or 2 years then followed by a long fallow period for 12 to 17 years. The rotation of fields is done periodically within boundaries unchanged for generations (Schmidt-Vogt 2001).

This traditional agricultural practice is declining due to population growth, infrastructure improvements and land use intensification since the middle of the 20th century until present in Northwest Thailand. It is being substituted by other swidden farming methods with longer cultivation periods and shorter fallow periods and conventional farming with cash crops products.

## 1.2 Hilltribes and Modern Thailand

Perceptions of the forest and people using forest lands have changed in Thailand during the last 150 years. In pre-modern Thailand forest lands was perceived as wild and disarranged, an area that needed to be tamed and remade into human habitation. Forest users, such as the Karen hill-tribe, were rewarded for activities that turned forest and barren fields into cultivated fields. The general idea of that period was that people who cleared forest land were considered respectable citizens (Laungaramsri, 2002).

The second half of the 19<sup>th</sup> century marked an turning point Thailand's economic and political history. Fierce competition over exploitative rights prompted the Thai society to develop its own prospects of reaping the benefits from logging and controlling the forest, which, by then, was valued as the country's economically most important asset. In order control and exploit the

forest resources, Royal Forest Department was established 1896. In this development, the forest people, being outside the space of civility and viewed as unsuitable for modern life, were of little positive interest to the Thai government (Buergin, 2000) In fact, forest people in general, and their slash and burn practices in particular, were viewed as economically destructive to the welfare of the nation, as they were blamed of occupying and misusing valuable forest assets. In spite of this, forest use of local people was widely unrestricted by forest legislation until the middle of the 20<sup>th</sup> century. It was only in the 1960s that slash and burn practices were officially banned although it was largely tolerated until the end of 1980s when control was tightened (Tomforde, 2003)

Under the auspices of the Royal Forest Department logging and commercial exploitation of the forests in the 20<sup>th</sup> century took place on a huge scale. In the beginning of the 1950s, almost two thirds of Thailand was still forested. In the 1980s, when deforestation in Thailand was beginning to be recognized by the public as a serious problem, the forest cover then estimated was less than one third of the total land area (Buergin, 2000).

Legislation were gradually introduced in the 20<sup>th</sup> century to classify forest lands and how to make appropriate use of it. In this respect, the content of this legislation demonstrates not only the shifting priorities in forest policies, but also how new thinking in government led to new ways of representing the forest and the local people living inside.

The first Five-year development plan in 1961 strengthened the concept of territorial zoning, as it designated 50 per cent of the country as state-owned 'permanent' forest (Sato, 2000). Since then, the government has continued to classify land and forest as a way of determining the purpose of use, and to whom access must to be granted.

The general concern about forest fires in Thailand began in 1970 after Mr. J. C. Macleod of the Canadian International Development Agency studied many fire situations in Thailand. He gave several general and specific recommendations on the future management of forest fires in Thailand (DNP 2003).

The forest policy of various governments in the last decade or so has been simplifying in character, straddling between views either to convert the forest or conserve it. At another dimension regarding land tenure, the view has been to picture property relations in land as either exclusive state ownership or private property rights. These processes of simplification have created ambiguous lands<sup>1</sup> and put pressure on the northern Thailand hill-tribes, who have no private property rights, and whose access to state-owned lands is guaranteed only in the form of usufruct rights based on customary law.

As global market demands for rice cultivation and later cash crop production have increased, a heightened demand for land under private property has resulted in encroachment and in the expansion of private farm lands. Both ethnic minorities without Thai-citizenship and landless Thai have been sidelined in this process of economic development, while the efforts by the government to simultaneously counter this encroachment have created national parks and protected forests. These efforts have left the hill-tribe minorities to bear the costs of conservation, and in a need to vigorously defend their usufruct rights to remain in forests now classified as conservation zones. Hill-tribes, such as the Karen, have been particularly hit by this simplification of forests into either conversion or conservation zones, as their practices of shifting cultivation are increasingly used by government authorities and environmentalists to demand their expulsion from protected forests (Sato, 2000).

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<sup>1</sup> The concept of ambiguous lands is referring to land owned by the state, but privately accessible. It is a common land that people have been using customarily without state recognition.

In the process, where forest lands are categorized, the Karen is left without any legal status or permission to use the forest surrounding their villages. Production and uses of secondary forest – a consequence of practising swidden agriculture – is not an intelligible option within the dominant ideology of conservation forestry in Thailand, not even if it can be practised in a sustainable manner with some high levels of biodiversity (Schmidt-Vogt, 2001).

### **1.3 Topography, climate and ecology**

The research site is situated in surroundings of the extensive, north-south running mountain range of Northern Thailand which also comprises the highest mountain of Thailand, Doi Inthanon (2565 m). The elevation range lies between 280-1980 meters above sea level and the area is very rugged. Soils are generally acidic with low nutrient content (Pangfan 2002). According to Nabangchang (2003) the area has sub-tropical climate with an average rainfall of 2000 mm/year and three distinct seasons:

- 1) The rainy season (May-September) with occasional heavy thunderstorms and strong winds
- 2) The cold season (October-January) with night temperatures as low as 10 °C, but pleasant day temperatures
- 3) The hot season (February-April) with high day temperatures up to 40 °C

The area consists of mixed forest, dry dipterocarp forest, dry evergreen forest, hill-evergreen forest and mountain-pine forest. The important low-level plants such as bamboo, palm and fern are also found here. Furthermore the area is a habitat for several mammals (e.g. deers, wild pigs, monkeys) and 200 kinds of birds are also found here (DNP 2004).

### **1.4 Description of research area:**

The Karen village of Ban Huai Khanun no. 1-3 lies in approximately 1100 meters of altitude and consists of 72 Karen households with a population of 394 individuals. The Karen community arrived to the area for approximately 150 years ago and until the mid-1930s the area comprised Lawa hill tribe people as well.

Between 1937 and 1981 the production of opium represented a vital cash crop, and forest land was cleared and turned into opium fields. Merchants from the lowland supplied the investment for opium cultivation and bought the production. After the official ban on opium cultivation in 1981, cash income had to be generated from other crops such as cabbage, taro and coffee. The 1997 economic crisis in Thailand led the Karen community to focus increasingly on subsistence crops. Today's subsistence crops, mainly rice, are for household consumption, or alternatively used in a local barter system.

The main agricultural system of the villages comprises:

- Lowland paddy rice cultivation primarily for household consumption
- Upland rice cultivation primarily for household consumption
- Vegetables as source of cash crop income
- Grazing of cattle as storage of wealth

Ban Huai Khanun 1-3 is situated in the vicinity of the Ob Luang National Park, which was announced as the 68th national park of Thailand in 1991 after surveys done by the Royal Forestry Department (Pangfang 2002). Some of the village's farming areas are inside the National Park, the rest is outside in the Conservation Zone. This entails some legal issues especially on the practice of shifting cultivation, because the National Park Act clearly states a

total ban on burning forest in the National Parks of Thailand (Appendix B – Chapter 3, Section 16).

A major event each year in February for the community is the maintenance of a firebreak east of the village, which is a part of a network of firebreaks surrounding the villages in the upper watershed area. The first known construction of a firebreak followed immediately after the establishment of Ban Huai Khanun 1-3, but the current system of community-based constructions of firebreaks was established in the beginning of the 1990s. Since then co-operation with neighbouring villages on this issue has been developed.

## **1.5 Research questions**

In the Karen villages of Ban Huai Khanun No. 1-3 our overall research question is:

*What are the villagers' livelihood strategies; how have these developed in recent years and how are they influenced by the National Park and National Reserved Forest areas?*

This question is complemented by an in-depth study of *Prevention and Management of Forest Fires*. This will include the sub-questions:

- Has the traditional uses of fire in swidden agriculture and forest changed from the past to present?
- What are the institutional arrangements (local and departmental) for prevention and management of forest fire?
- What are the economic/environmental costs and benefits of fire prevention and management for the local community and for the national park authority?

These questions will be answered partly by conducting 'soft science' investigations such as questionnaires, interviews and PRA methods, but also by conducting 'hard science' investigations such as vegetation and soil sampling.



## 2. Methodology

During field work, the authors split in to three sub-research groups: social-, forest-, and soil science. Therefore are the methodology and results from the three groups also divided into three parts:

### **2.1 Social science methods:**

The methodological approaches for the collection of social data were by the use of questionnaires, interviews, and participatory rural appraisal methods (PRA).

#### Questionnaire

The questionnaire is a method for generating quantitative data (Mikkelsen 1995). It was used as a structured survey in Ban Huai Khanun 1-3 for collecting information about the distribution of households with respect to wealth status and livelihood strategies. We used a sample size of 18 households which were divided into three categories according to economic standing:

- Rich households
- Average households
- Poor households

A questionnaire guide was prepared and printed out in the field after getting a impression of the area (See Appendix C for the questionnaire guide). The surveyed households were appointed in the field by the village headman Mr. Som Auan. Selecting 18 household for the interview survey meant that we were able to produce data that were statistically reliable (18 out of 72 households is exactly 25 %, which is the very minimum for statistical reliance). The time spent with each individual household for completing the questionnaire was about 1-1½ hour; if the informant was a woman, the survey was completed outside or in front of her house.

#### Interviews

A total of 9 informal and semi-structured interviews were conducted during field work. These comprised interviews with key informants within governmental and non-governmental organisations as well as with villagers of Ban Huai Khanun 1-3. The key informants interviewed included:

- Royal Forestry Department
- Department of National Parks
- TAO (Chomtong District)
- IMPECT
- CARE
- Headman of Ban Huai Khanun 1-3 (Mr. Som Auan)
- Villagers on the impact of Ob Luang National Park (8 informants interviewed)
- Educated villager (Mr. Pee Kipart) during community mapping

The conducted interviews were a mix of informal conversations and standardized open-ended interviews. However, in the field each type of interview had to be adjusted to local constraints. Some interviews were done with the presence of only one interviewer and the informant. Other interviews, because of lack of time, took the form of group gatherings with representatives of more field work groups participating and asking questions to a single informant. Interviews conducted with only a few people present could normally be finished in less than an hour.

### Participatory rural appraisal

Following PRA methods were applied:

- Forest fire calendar/mapping
- Transect walk
- Community resource mapping

During the field work a focus group discussion was conducted addressed at the community level forest fire management and prevention. The exercise was held late one evening at the headman's house in Ban Huai Khanun 3. It was to be an event where community members through discussion were supposed to do participatory mapping of issues related to fire management practices. There were several people present in the small house: All the Danish students and Thai students were present as well as the headman Mr. Som Auan accompanied by a fire guard and 10-12 villagers. This meeting of community members produced a map of important information, which was later translated into a summarized version of research questions.

To get an overview of the area, a transect walk of the 3 villages were conducted (Appendix F).

A community resource mapping was performed at the temple site between Ban Huai Kanun 2 and 3 with a villager, Mr. Pee Kipart. This map was a sketch of land use and crops in the village area, but it was handed over, because the villagers referred to a better map made by IMPECT, a local NGO. This map was acquired by the Thai students, but got lost along the way, therefore is the conducted community resource mapping not mentioned in the results.

## **2.2 Sampling in forest and shifting cultivation:**

During the field course 9 forest plots and 11 soil plots in the vicinity of Ban Huai Khanun 1-3 were measured by the forest and soil group, but only 6 plots were considered in the interest for further research by the Danish group. The 6 plots can be divided in:

- Vegetation and soil sampling in *forest*:
  - Forest burned 1 year ago (outside village firebreak)
  - Forest burned 5 years ago (inside village firebreak)
  - Forest 'never' burned (conservation forest area)
- Vegetation and soil sampling in *shifting cultivation* upland rice fields
  - 1 year fallow forest
  - 3 year fallow forest
  - 5 year fallow forest

The aim of the forest sampling was to investigate if the firebreak has had an effect on improving the forest inside the village firebreak, which should be relatively better protected from fire compared to the forest outside the firebreak. To get an overview of this, the species composition and the soil fertility of the forest plots burned 1 and 5 years ago were measured.

A control plot was set up in a conservation forest, which was the least disturbed and utilized forest in the area of Ban Huai Khanun 1-3. Measurements of species composition and soil fertility were also made here for the comparison between the conservation forest containing the most optimal and natural conditions of all the forests in the area and the recently burned forests.

The aim of the shifting cultivation sampling was to investigate, how different lengths of fallow periods after upland rice cultivation would have an effect on the soil fertility of an area. The longest used fallow period in Ban Huai Khanun 1-3 was 5 years, but secondary literature suggest that for restoring an almost optimal soil fertility, the fallow period should be between 12-17 years (Schmidt-Vogt 2001).

Before the sampling could be started, the students consulted Mr. Som Auan (headman of Ban Huai Khanun 1-3) about which kind of forest and shifting cultivation types the student group wanted to investigate, and thereafter Mr. Som Auan appointed the exact locations of the sampling sites. This decision was made due to time constraints and little knowledge of the area, but optimally several plots in each category should had been randomly selected to get more representative data.

Vegetation sampling method:

The vegetation sampling method used in the forest plots was a standard Thai method suitable for Thai conditions and measures. The Thai equivalent for hectares as a measurement for land size is *rai*<sup>2</sup>, and as a result every sampling plot consisted of a square comprising 40 x 40 meters. For making the sampling systematic the 40 x 40 m plot was divided in to sixteen 10 x 10 m quadrants for measuring trees<sup>3</sup>. Seedlings<sup>4</sup> were measured in a single 5 x 5 m quadrant.

In the shifting cultivation fallow forests the plot size was 20 x 20 m with four quadrants instead of 40 x 40 m with sixteen quadrants.

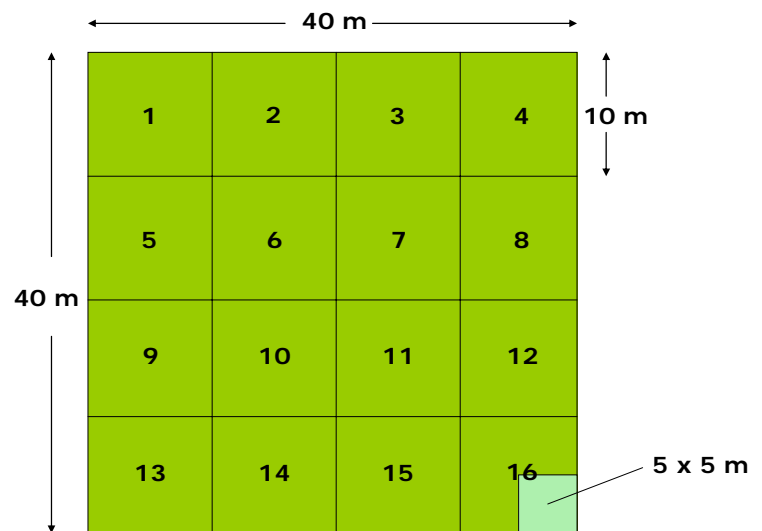


Figure 1. Vegetation sampling plot

When performing the vegetation sampling, the forest group split in to 2 teams dividing the plot's quadrants between them. A team usually consisted of 5-6 people with one group member performing the DBH measurements, one group member keeping track of trees measured and trees to be measured, one or two locals identifying the tree species in Karen language and one group member taking notes of the DBH and Karen species name of each tree.

The DBH measurements were used for calculating the tree density, frequency, basal area, relative density (RD), relative frequency (RF), relative dominance (RDom), and species importance value index (IVI) for each species in every plot. The IVI is useful for determining and ranking the most prominent species in a plot and thereby revealing species composition for forest type classification. The forest type can – held together with other information – tell, to which extent the forest is in a good and natural condition or if it is in a degraded state. Additionally size class distributions were calculated and a categorization of the species in tree families for each plot was conducted for further consolidation of the forest type determined by the IVI ranking (See appendix C for explanations of calculations of e.g. IVI).

<sup>2</sup> 1 rai = 0.16 ha = 1600 squaremeters

<sup>3</sup> For this study trees were considered having a Diameter in Breast Height (DBH) above 2 cm and a height above 1.3 m

<sup>4</sup> For this study seedlings were considered having a height less than 1.3 m

## **2.3 Soil sampling methods:**

In order to investigate the effects of fire on the soil fertility in the forest and shifting cultivation plots, different methods were used in the field. The parameters to be measured in the soil were:

- content of organic matter
- content of phosphorus
- content of nitrogen
- content of potassium
- soil infiltration rate
- texture
- humidity
- surface biomass

To determine the content of organic matter, phosphorus, nitrogen and potassium, soil samples were collected in small aluminium cylinders at 0–5 cm, 10–15 cm and 20–25 cm depth and then brought to a laboratory to measure the above mentioned parameters. Soil infiltration was measured *in situ* with water running through plastic tubes pushed in the soil and the time of water infiltration was recorded. Surface biomass was conducted by collecting all the biomass (leaves, branches etc.) from a 1 x 1 m square on the ground. The texture and horizons of the soil was observed by the use of an Auger drilling tool and displayed on a piece of plastic to analyse its type. Humidity was measured by a soil meter and the percentage of humidity was recorded (for pictures of soil methods – see Appendix D).

## **2.4 Constraints to the methods used:**

It was not possible to conduct the research in an optimal methodological fashion, since the limited amount of research time in area led to certain compromises for collection of data. In the following major constraints to the research are summed up to point out eventual biases and flaws in the results. The description of the major constraints is put in the *Methodology* section partly to prepare the reader in advance about influences on the results while reading the *Results* section and partly to focus on the results in the *Discussion* section instead of methodology biases.

One of the critical factors during our field work in Ban Huai Khanun 1-3 was headman Mr. Auan Som. For timesaving purposes, the group decided to let the headman point out the respondents in the village for the questionnaire. He also gave the position of the specific sampling plots for forest and soil investigations. This made the use of random sampling impossible, thereby reducing the reliability of data (Ragin 1994). With respect to the questionnaire, we were told afterwards by our Thai counterparts, that the headman had relatives included in the group he appointed for surveying. Therefore it was hard to conclude if the sample of households in our study was representative of the entire community. Another issue were tensions between our Thai counterparts and certain Karen villagers. This could sometimes lead to misleading answers in the questionnaire, because these villagers for some unexplained reason did not trust the Thai students.

The headman also played a crucial role during a PRA group discussion in the village concerning community involvement in fire management. Afterwards our Thai counterparts explained that the PRA discussion was totally controlled by the headman, who in his own right decided which information should be handed to the students.

During preparations for an interview guide, the Danish group experienced lack of co-operation with the Thai counterpart on the National Park issue, which in their opinion was a politically

sensitive theme. The Thai students would not include any questions related to the national park in the joint interview guide, and without investigating this issue, the authors could not fulfil their objectives completely. Therefore an *ad hoc* interview guide was created by the authors with help from an interpreter, but no Thai counterparts were involved. As the interviews were conducted there were no problems with Karen individuals not wanting to participate in the session in, much in contrast to the hai counterparts' warnings.

A last concern was the authors' residence in a Buddhist temple between Ban Huai Khanun 2 and 3. Not being located in a village, it was a time consuming process to collect data from the households. It offered few opportunities as well for socialising with people from the villages and experiencing everyday life, since most of the trips to the villages were for research purposes only.

## 3. Results

The following results are the main findings of each method used presented in a summarized and clarifying manner. For further examination of the results, please refer to the attached appendices.

### **3.1 Social data results**

This section presents some of the relevant results obtained in the field by applying social science methods. The results derived from these methods are analysed and presented in a summarised and synthesized form and focus on answering the research questions mentioned in the overall introduction.

The interviews completed in the field included a clarifying session with the headman along with several specific interviews conducted on given topics. The results presented in the following are organised by status; Karen, government organisations, and non-government organisation.

#### *Interviews with Karen people*

The first interview was with the headman and produced some interesting results in relation to our research questions. The main line of questions concerned livelihoods, and the information given was that the village comprised a population of 330 and 72 household. When asked about the economic standing, he considered the village to be mostly poor. The livelihood strategies of the villagers had changed in recent years. This was mostly in reaction to the economic crisis in Thailand in 1997. According to the headman, the households produced for subsistence, although some also participated in production of cash-crop. After the crisis, households had increasingly turned their attention towards food crops. The headman pointed to the insecurity involved in cash crops: Unfavourable prices, too high investments, and damaging effects of chemical fertilizers in the long term. Regarding the use of animals, cattle had replaced cash crops as the most important source of household income. Investing in cattle and buffaloes was seen by households as a form of wealth accumulation.

Regarding practice of agriculture and use of forest, the headman told that households were practising shifting cultivation, and that soil conditions now was such that the fallow period had come down from 5-7 years to only 2-3 years. The forest was used mainly as a source of hunting, collection of firewood, grazing purposes and the collection of non timber forest products (NTFP's).

The headman informed that the village had problems with outsiders using fire in the forest. But the villagers tried to protect themselves by constructing firebreaks and using fire guards. When burning agricultural land in the village, the household had exclusive rights to decide when to set fire. Regarding the method of fire used in agriculture and the size of land burned over the last 30-40 years, the headman stated that things had not changed. The most serious challenge to their livelihood was a declining fallow period. The headman, aware of the fact that the village held agricultural land inside the Ob Luang National Park, finished the interview by saying that the villagers simply had no knowledge of the demarcation of the national park area.

Households from Ban Huai Khanun 2 were interviewed regarding perceptions of the impact of the Ob Luang National Park on livelihoods and natural resource management. The general picture from these interviews was that they regarded the national park as contributing to their declining livelihood. With the implementation of the national park it had become impossible to acquire new land and the fallow period had therefore been decreased. It was no longer possible to burn forest for the collection of NTFP, because officers from the national park regularly

patrolled the area. Some households, not knowing about the demarcation of the national park, said they needed to burn trees in order to get some sun for their upland rice fields. A local teacher in Ban Huai Khanun 2, who also practised agriculture informed, that bringing infrastructure, for example electricity to the village, was ruled out by the national park authority, as this would be considered an acceptance of Karen rights to areas within the national park.

When asked about conservation issues, the household representatives felt that the national park did almost nothing to conserve the forest and that the Karen people could provide more sound management. According to the villagers, many species had disappeared so that people now did get fewer benefits from the natural resources than before. At the same time they accused the park authorities of doing nothing to stop the spread of fires originating in the national park.

To sum up interviews conducted with Karen people, the overall results emphasised their continued dependence on shifting cultivation and subsistence crops and the declining livelihood because of land shortage and the presence of the national park.

#### Interviews with GOs and NGOs

Several interviews were conducted with representatives of governmental and non-governmental organisations. These interviews mainly focused on topics related to management and prevention of forest fire and how to solve the conflicts over villagers' continued possession and use of conservation forest and national parks.

The following organizations were interviewed:

- Government organisations
  - Royal Forest Department (RFD)
  - Department of National Parks
  - TAO (Chomtong District)
- Non-government organisations
  - CARE
  - IMPECT

#### *Government interviews*

The interviews conducted with RFD and the Department of National Park both touched upon the conflict between government and hill-tribes settled within national parks and conservation forest. Both organisations recognised the problem that official policy was detrimental to the current livelihood strategies of the Karen. The national park officer stated that according to the law, it was not possible to have local people residing inside the park. When considering conservation forest, the RFD officer was open to possibilities of creating community forests if the Karen could come up with schemes that would work. The RFD officer mentioned that schemes related to eco-tourism might provide a framework for community forestry.

The National Park officer held the opinion, that in order to have an effective strategy for combating fire in practice, people with stakes in the forest should assist each other. The issues of fire were a critical problem to the country, which the authorities could not solve alone. The local Karen did have the knowledge to manage the forest ecologically sustainable simply because they had come to understand the importance of managing the resources by their livelihood. As it was not possible to get the Karen to change their livelihood without presenting them with alternatives, he mentioned the custodian approach to natural resource management, that is, hiring Karen people to protect the forest. To sum up the interview with RFD and the national park, in particular, these authorities clearly were opposed to Karen following their traditional livelihood inside protected areas, and therefore wanted to separate the question of

local knowledge from that of livelihood. They held the view that Karen local knowledge could be put to meet other ends than merely that of their traditional livelihood.

The TAO officer stressed the role that TAO had in organising the Karen to protect the forest. Since 1997 TAO started implementing government policy of protecting the forest. TAO provided a budget year after year to Karen communities involved in construction of firebreaks. In the standing conflict between central government and Karen people, the role of TAO was one of not taking side. Regarding support for villagers right to use land in the forest, TAO did not represent the villagers inside the national park or were concerned with defending their livelihood. The main focus of TAO was that of facilitating negotiations and assisting in finding solutions to ongoing problems. Therefore, TAO supported the Karen in their effort to protecting the forest through construction of firebreak. To sum up the interview with TAO, this organisation mostly acted as a body for implementing government policies and reducing conflicts. As a local government organisation, it did not put forward the interests of Karen people.

#### Interviews with non-governmental organisations

An interview took place with the local representative of CARE, Mr. Witun Kaloy. Addressing the problem of Karen livelihood inside the National Park, the representative of CARE mentioned the restrictions put on the planting area of Karen people. The fallow period had been shortened which posed a threat to the livelihood of the people. The Karen was practicing shifting cultivation long before this area was declared a national park.

When talking about CARE's position in the disagreement between government and villagers, the representative of CARE stated, that his organisation tried to take a somewhat neutral position: CARE 'wanted the government to understand the people, and people to understand the government'.

As we had no chance of conducting interviews with every stakeholder involved in issues of natural resource management, questions related to other NGOs involvement were asked. Mr. Kaloy mentioned, that besides CARE, there were two important organizations working with the Karen people. One was the Sustainable Development Foundation, which mainly focused on social rights, and the other was Thamanart, an NGO with an exclusive focus on environmental issues. This organisation had a violent past and once participated in revolts against hill-tribe people. Thamanart wanted the hill-tribe people to be thrown out of national parks and conservation forests. Therefore, Thamanart was in strong support of strict implementation of already existing laws and regulations.

Another interview conducted with IMPECT didn't lead to useful information. The appointment made the director had to be cancelled, because he didn't show up at the interview. Instead the interview was conducted with low rank person who wouldn't tell us much about IMPECT policies.

#### PRA

Several PRA's were conducted, but the only ones with useful information was a PRA performed in the village concerned with community involvement in management and prevention of forest fire and a community mapping exercise performed at the temple site by the villagers Pee Kitart. This sketching of a community map was later replaced by an excellent map from IMPECT, which eventually was lost during the field work. A transect walk based on own observations (no villagers' participated) was also performed (Appendix F)

The information obtained from the PRA on fire management led to the construction of a forest fire/crop calendar, which later was replaced by a summarized version.



The results obtained from PRA on fire management indicated that the local community had proper institutional arrangements in place using the traditional ceremony of *Le Me To*. The PRA also presented relevant information on the methods of field burning.

According to the PRA The village of Ban Huai Khanun was established some 150 years ago and the construction of firebreaks followed immediately after this (Appendix G). The current system of community-based forest fire management in Ban Huai Khanun was established in the beginning of the 1990's, As the prevention of forest fire, had do to mostly with fires originating outside the village, the Karen of Ban Huai Khanun co-operated with Mhong people from a neighbouring village in the firebreak construction. Regarding internal regulations of agricultural fire, the villagers also had method to prevent fires from escaping the village areas into the forest. When addressing procedures and techniques of forest fire management at the community level, the PRA as well as results from the questionnaire point to the importance of the ceremony of "Le me to".

According to PRA and household questionnaire the community of Ban Huai Khanun will restore the firebreak line that separates the village from the forest during this ceremony on February 15th each year. The dry leafs will be swept away and grasses removed in order to prevent fire from crossing that line. Each household has to send at least one person to participate. If the household are unable to participate, they must inform the headman beforehand, otherwise, the household will be fined 100 Baht.

Findings also suggested the practice of sending community patrols to manage and prevent the spread of fire. This is done in the period when fires occur most often from February to April.

From 1997 onwards TAO has provided an annual budget of 3000 Baht to cover the expenditures.

From our findings presented in Appendix I, it was clear that all households except one did participate in the ceremony as part of a community strategy to manage forest fire. The one household not participating in forest fire management was due to the fact, that women are not allowed to participate in the ceremony, and as this one household comprised on of female members, it was impossible to send someone.

#### Questionnaire:

The questionnaire was conducted in order to provide quantitative data on livelihood strategies of individual households and community involvement in forest fire management and prevention (Appendix H). The findings of the questionnaire indicated strong community involvement in the management of forest fire. Most households participated in the 'Lu Me To' ceremony. The only household that never participated in the ceremony comprised of women only, and according to ceremonial rules, women were not allowed to participate. The results of the questionnaire also indicated strong support for participating in proper management of forest fire. In the construction of forest firebreak and field firebreak every household had representatives participating. The villagers were prepared to help each other combating fire when it was needed. The institution of fire guarding also seemed well established as more than 70 pct. of the household had members working as patrols in the forest areas. With regards to purpose and methods of burning, all households practised agricultural burning and field firebreak construction. Less than 30 pct. of the households set fire for collection of NTFP.

About assistance from outside organisations in forest fire management, almost every household mentioned TAO. Less than 30 pct. mentioned the National Park. When asked about the role of TAO, their financial contribution year after year was mentioned, though most people agreed, that sending 3000 Baht to the community was not enough to cover expenditure. If households decided not to participate in firebreak construction – without informing the headman about it – they were fined 100 Baht. To households in the questionnaire – rich and poor – 100 bath were

not considered a considerable amount of money. Thus, it may be concluded, that the strong support for community-based fire management was not a result of economic pressure levied on the individual household.

Another issue touched upon related to their livelihood strategies. In order to assess differences in livelihood assets and strategies, a comparison between the 18 household in the sampling was conducted. The aim was to analyse if there was a correlation between availability of land and relative importance of food crops vs. cash crops to each individual households (Appendix I). The analysis indicated that the households in Ban Huai Khanun with most available land, but average in terms of household size (for example rich no. 1 & 2) were proportionally involved in cultivation of traditional food crops (rice) as much as were households with less land available. Households in Ban Huai Khanun with big size landholdings and a possible surplus in rice do not reduce output of rice in favour of cash crops. This, in our opinion, could indicate that households with a surplus in terms crops for food self-sufficiency do not necessarily change livelihood strategies to specialise in cash crops and become more oriented towards the market economy.

### **3.2 Results of vegetation sampling in the forest plots**

The following results were derived from Appendices C, J, K and L. The information presented in the tables are species with scientific names and ecological descriptions, all ranked by descending IVI scores. Unidentified species and species without ecological descriptions were excluded. A forest type classification for each plot was proposed for each plot by comparing the species composition results with information from secondary literature. The ecological descriptions were used from Gardner *et al.* (2000) - the forest type classifications were based on species composition descriptions used from Anderson (1993) and Gardner *et al.* (2000).

#### **Plot burned 1 year ago**

The area outside the fire-break was situated approximately 7 km northwest of Ban Huai Khanun 3 and was according to the village headman very prone to fires spreading from lowland Thais further down the Mae Tia valley (See Appendix M). The elevation of the plot was 888 m and the slope was 23 %.

During the vegetation sample 467 individual trees of thirty-two species were recorded in Karen. Fifteen species in 9 families could be translated to Thai and be given scientific names. Twelve identified tree species with descriptions are presented in Table 1:

<b>Species</b>	<b>Description</b>	<b>IVI</b>
<i>Anneslea fragrans</i>	Small/medium-sized tree: Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests	40
<i>Adina cordifolia</i>	Deciduous tree. Scattered in semi-open forests, often associated with Teak	32
<i>Diptocarpus tuberculatus</i>	Deciduous tree. Extremely common in dry dipterocarp forests – listed by the RFD as the most abundant tree in Chiang Mai Province often growing in very degraded and fire damaged sites	22
<i>Gluta obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests	19
<i>Reevesia siamensis</i>	Shrub or small tree. Uncommon in N. Thailand	18
<i>Shorea obtusa</i>	Deciduous tree. Extremely common in dry degraded areas	18
<i>Quercus kingiana</i>	Deciduous tree. Fairly common in semi-open forest, sometimes with dry dipterocarp spp.	15
<i>Wendlandia tinctoria</i>	Evergreen shrub/small tree. Very common under storey of hill evergreen forests	14
<i>Terminalia bellerica</i>	Deciduous tree. Common in semi-open forests in N. Thailand	8
<i>Gardenia sootepensis</i>	Deciduous tree. Fairly common in semi-open and dry dipterocarp forests	6
<i>Phyllanthus emblica</i>	Small deciduous tree. Very common in drier semi-open forests, fire resistant	<1
<i>Eugenia paniaia</i>	Evergreen/partly deciduous tree. Introduced, commonly cultivated for its fruits	<1

**Table 1.** Identified tree species with description from forest plot #1 ordered by species importance value

Of the 46 recorded individual seedlings divided in fifteen species, 21 individual seedlings of seven species could be translated from Karen to be given scientific names. Five identified seedling species with descriptions are presented in Table 2:

Species	Description	Seedling count
<i>Reevesia siamensis</i>	Shrub or small tree. Uncommon in N. Thailand	6
<i>Shorea obtusa</i>	Deciduous tree. Extremely common in dry degraded areas	4
<i>Gluta obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests	4
<i>Anneslea fragrans</i>	Small/medium-sized tree: Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests	3
<i>Adina cordifolia</i>	Deciduous tree. Scattered in semi-open forests, often associated with Teak	2

**Table 2.** Identified seedling species with description from forest plot #1 ordered by seedling count

Several characteristics from the tables about the species composition of forest plot #1 can be mentioned:

- A couple of members of the Dipterocarpaceae family (*Diptocarpus tuberculatus* and *Shorea obtusa*) are partly dominating the species composition with IVI scores in the high end and *S. obtusa* also has the 3<sup>rd</sup> highest abundance of seedlings in the plot. These two species are typical of lowland *dry dipterocarp* forests and are also extremely common in degraded and often fire-damaged sites
- Species of the Euphorbiaceae (*Phyllanthus emblica*), Rubiaceae (*Gardenia sootepensis*) and Fagaceae family (*Quercus kingiana*) are present and common in lowland *dry dipterocarp* forests.
- As the plot is situated in the transitional vegetation zone (800-1200 m) between lowland and highland forests, a proportion of species from each zone would be expected. Two highland forest species is present (*Anneslea fragrans*, *Gluta obovata*), where *A. fragrans* with the highest IVI score is common in dry, fire-affected areas, whereas *G. obovata* with an average IVI score is common in hill evergreen forests
- There is an overweight of deciduous trees compared to evergreen species and also an overweight of species common in semi-open forests, which suggest they are pioneer species instead of climax species

These characteristics make it possible to classify this forest type as a *dry deciduous dipterocarp* forest. Situated in a transitional vegetation zone at approximately 900 m between lowland and highland forests, the general rule is that more disturbed sites tend to contain a higher proportion of lowland species, whereas less-disturbed sites is pre-dominated by hill evergreen species. The mentioned information about species composition is a good indication of severe habitat degradation of the area created by annual fires over a long period of time.

### **Plot burned 5 years ago**

The area inside the fire-break was situated approximately 5 km north of Ban Huai Khanun 3 and was apparently protected by the fire-break from fires coming from outside the community (See Appendix M). The elevation of the plot was 894 m and the slope was 27 %.

During the vegetation sample 558 individual trees of forty-eight species were recorded in Karen. Twenty-three species in 11 families could be translated to Thai and be given scientific names. Twelve identified tree species with descriptions are presented in Table 3:

Species	Description	IVI
<i>Reevesia siamensis</i>	Shrub or small tree. Uncommon in N. Thailand	37
<i>Adina cordifolia</i>	Deciduous tree. Scattered in semi-open forests, often associated with Teak	23
<i>Anneslea fragrans</i>	Small/medium-sized tree. Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests	22
<i>Wendlandia tinctoria</i>	Evergreen shrub/small tree. Very common under storey of hill evergreen forests	18
<i>Diptocarpus tuberculatus</i>	Deciduous tree. Extremely common in dry dipterocarp forests – listed by the RFD as the most abundant tree in Chiang Mai Province often growing in very degraded and fire damaged sites	15
<i>Aporosa villosa</i>	Small deciduous tree. Common understory tree of both deciduous and pine forests	14
<i>Gluta obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests	10
<i>Quercus kingiana</i>	Deciduous tree. Fairly common in semi-open forest, sometimes with dry dipterocarp spp.	10
<i>Terminalia bellerica</i>	Deciduous tree. Common in semi-open forests in N. Thailand	8
<i>Pinus kesiya</i>	Common in semi-open forests between 1000-1700m. Favours exposed ridges w. thin sandy soils	7
<i>Gardenia sootepensis</i>	Deciduous tree. Fairly common in semi-open and dry dipterocarp forests	6
<i>Gluta usitata</i>	Semi-evergreen or briefly deciduous tree. Very common, favouring dry, open areas along ridges. Irritating sap	6
<i>Litsea glutinosa</i>	Small deciduous or semi-evergreen tree. Common and widespread, semi-open forests.	6
<i>Castanopsis argyrophylla</i>	Semi-evergreen tree. Common in drier forests	3
<i>Phyllanthus emblica</i>	Small deciduous tree. Very common in drier semi-open forests, fire resistant	2
<i>Quercus kerrii</i>	Deciduous tree, often coppicing. Locally common in semi-open forests, sometimes with dipterocarp spp.	1
<i>Castanopsis diversifolia</i>	Deciduous/partly deciduous tree. Common and widespread in hill evergreen forest, often gregarious	<1
<i>Schima wallichii</i>	Large tree. Very common throughout the region, forming a characteristic element of hill evergreen forests, but also found more scatteredly in many other forest types	<1

**Table 3.** Identified tree species with description from forest plot #2 ordered by species importance value

Of the 63 individual seedlings divided in thirteen species, 11 individual seedlings of six species could be translated from Karen to be given scientific names. Three identified seedling species with descriptions are presented in Table 4:

Species	Description	Seedling count
<i>Castanopsis diversifolia</i>	Deciduous/partly deciduous tree. Common and widespread in hill evergreen forest, often gregarious.	3
<i>Reevesia siamensis</i>	Shrub or small tree. Uncommon in N. Thailand.	3
<i>Diptocarpus tuberculatus</i>	Deciduous tree. Extremely common in dry dipterocarp forests – listed by the RFD as the most abundant tree in Chiang Mai Province often growing in very degraded and fire damaged sites.	1

**Table 4.** Identified tree species with description from forest plot #2 ordered by seedling count

Several characteristics from the tables about the species composition of forest plot #2 can be mentioned:

- A single member of the Dipterocarpaceae family (*Diptocarpus tuberculatus*) is somewhat dominating the species composition with an average IVI score and is also represented with a single seedling in the plot. *D. tuberculatus* is typical of lowland *dry dipterocarp* forests, extremely common and often found in very degraded and fire-damaged sites
- Species of the Euphorbiaceae (*Phyllanthus emblica*, *Aporosa villosa*), Rubiaceae (*Gardenia sootepensis*) and Fagaceae family (*Quercus kingiana*, *Quercus kerrii*, *Castanopsis argyrophylla*) are present and common in lowland *dry dipterocarp* forests.
- As the plot is situated in the transitional vegetation zone (800-1200 m) between lowland and highland forests, a proportion of species from each zone would be expected, and several highland forest species (*Schima wallichii*, *Gluta obovata*, *Pinus kesiya*) is present

- There is an overweight of deciduous trees compared to evergreen species and also an overweight of species common in semi-open forests, which suggest they are pioneer species instead of climax species

These characteristics would also classify this forest type as a *dry deciduous dipterocarp* forest. To find this lowland forest type at approximately 900 m is a good indication of habitat degradation of the area through annual fires over a long period of time.

### **Control plot conservation forest**

The area in conservation forest was situated inside the fire-break approximately 1½ km south of the temple between Ban Huai Khanun 2 and 3 (See Appendix M). It was a so-called ancestral forest where the spirits of the villagers' ancestors lived therefore who should be left undisturbed by for example fire, but another explanation for this convenient arrangement could also be the difficult terrain and access to the area. The elevation of the plot was 1374 m and the slope was 57 %.

During the vegetation sample 554 individual trees of ninety-seven species were recorded in Karen. Thirty-one species in 19 families could be translated to Thai and be given scientific names. Twenty-six identified tree species with descriptions are presented in Table 5:

<b>Species</b>	<b>Description</b>	<b>IVI</b>
<i>Schima wallichii</i>	Large tree. Very common throughout the region, forming a characteristic element of hill evergreen forests, but also found more scattered in many other forest types	28
<i>Erythrina subumbrans</i>	Large deciduous tree. Very common, distinct of both dry and moist forests	7
<i>Quercus kingiana</i>	Deciduous tree. Fairly common in semi-open forest, sometimes with dry dipterocarp spp.	7
<i>Goniothalamus griffithii</i>	Shrub or small tree. Uncommon, scattered in the understorey of less-disturbed forests	7
<i>Prunus cerasoides</i>	Deciduous tree. Common in open disturbed areas – often planted along roadsides because of its beautiful flowers & fastgrowing habit	6
<i>Dalbergia assamica</i>	Deciduous tree. Common, semi-open forests but avoiding very degraded areas	6
<i>Gluta usitata</i>	Semi-evergreen or briefly deciduous tree. Very common, favouring dry, open areas along ridges. Irritating sap	6
<i>Castanopsis diversifolia</i>	Deciduous/partly deciduous tree. Common and widespread in hill evergreen forest, often gregarious	6
<i>Ternstroemia gymnanthera</i>	Small or medium tree. Widespread in lowland and hill forests from 700-2000 m	6
<i>Gluta obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests	5
<i>Ficus hispida</i>	Small independent evergreen or partly deciduous tree. Very common, open areas	5
<i>Wendlandia tinctoria</i>	Evergreen shrub/small tree. Very common under storey of hill evergreen forests	4
<i>Azadirachta indica</i>	Deciduous tree. Scattered in open areas, particularly south of Lamphun, frequently planted throughout North Thailand	3
<i>Eugenia paliana</i>	Evergreen/partly deciduous tree. Introduced, commonly cultivated for its fruits	3
<i>Terminalia alata</i>	Deciduous tall tree. Common in semi-open forests	2
<i>Phyllanthus emblica</i>	Small deciduous tree. Very common in drier semi-open forests, fire resistant	2
<i>Michelia floribunda</i>	Evergreen tree. Rare, in less-disturbed forests usually above 1500 m	2
<i>Baccaurea ramiflora</i>	Small evergreen tree. Common understory tree of fire-free forests	1
<i>Antidesma sootepense</i>	Shrub or small tree. Common in both deciduous and evergreen forests	1
<i>Dolichandrone spp.</i>	Deciduous trees. Scattered in open forests from Chiang Mai southwards	1
<i>Buddleja asiatica</i>	Shrub or small tree. Very common in waste-ground and along forest edges	1
<i>Symplocos laurina</i>	Shrub or small tree. Fairly common, understory of hill evergreen forest to 2500 m	<1
<i>Diospyros undulata</i>	Evergreen tree. Fairly common, semi-open areas	<1
<i>Quercus kerrii</i>	Deciduous tree, often coppicing. Locally common in semi-open forests, sometimes with dipterocarp spp.	<1
<i>Aporosa villosa</i>	Small deciduous tree. Common understory tree of both deciduous and pine forests	<1
<i>Anneslea fragrans</i>	Small/medium-sized tree. Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests	<1

**Table 5.** Identified tree species with description from conservation forest plot ordered by species importance value

Of the 31 individual seedlings divided in eighteen species, 5 individual seedlings of three species could be translated from Karen to be given scientific names. Two identified seedling species with descriptions are presented in Table 6:

Species	Description	Seedling count
<i>Azadirachta indica</i>	Deciduous tree. Scattered in open areas, particularly south of Lamphun, frequently planted throughout North Thailand	3
<i>Castanopsis diversifolia</i>	Deciduous/partly deciduous tree. Common and widespread in hill evergreen forest, often gregarious	1

**Table 6.** Identified seedling species with description from conservation forest plot ordered by seedling count

Several characteristics from the tables about the species composition of forest plot #2 can be mentioned:

- *Schima wallichii* with the highest IVI score is a common species and characteristic element in hill evergreen forest. Other species common in this type of forest are *Gluta obovata*, *Engelhardia spp.* and *Antidesma spp.*
- A couple of species with medium IVI scores (*Michelia floribunda*, *Dalbergia assamica* *Goniothalamus griffithii*) is common in respectively fire-free and less disturbed forests
- Species of the Fagaceae family often forms over 50 % of the main canopy in hill evergreen forests and several species of this family is present (*Castanopsis diversifolia*, *Quercus kingiana*, *Quercus kerrii*)

These characteristics make it possible to classify this forest type as a *hill evergreen* forest. This is backed up by the fact that conifers and most dipterocarps are absent in this area, but with species members of Fagaceae, Theaceae, Lauraceae, Euphorbiaceae and Magnoliaceae families all present.

### **3.3 Results of vegetation sampling in shifting cultivation plots**

#### **One-year fallow plot**

The one-year fallow plot was situated approximately 4 km east of Ban Huai Khanun 3 (Appendix N). This plot had remnants straws from upland rice cultivation last season, but no trees were present, so therefore only seedlings and saplings were measured. Elevation was 1124 m and the slope was 22 %.

Of the 25 individual seedlings divided in ten species, 17 individual seedlings of six species could be translated from Karen to be given scientific names. Five identified seedling species with descriptions are presented in Table 7:

Species	Description	Seedling count
<i>Diospyros undulata</i>	Evergreen tree. Fairly common, semi-open areas	6
<i>Dalbergia oliveri</i>	Deciduous tree. Common, semi-open forests but avoiding very degrading areas	3
<i>Lithocarpus calathiformis</i>	Evergreen Tree. Scattered in semi-open forests	3
<i>Dalbergia assamica</i>	Small deciduous tree. Very common in open, fire-prone areas, often shrubby & coppicing	2
<i>Wendlandia tinctoria</i>	Evergreen shrub/small tree. Very common under storey of hill evergreen forests	1

**Table 7.** Identified seedling species with description from 1-year fallow forest plot ordered by seedling count

The ecological descriptions of the mentioned species are very sparse, but they are most likely examples of fast-growing pioneer species intolerant to shade and thereby indicators of ecologically degraded areas. As the one year fallow forest continues its succession, these species usually dies out in the competition with climax species.

### **Three-year fallow plot**

The three year fallow plot was situated approximately 2 km north of Ban Huai Khanun 2 (Appendix N). In the plot, several relict emergents remained from the previous stand. The elevation of the plot was 1169 m and the slope was 60 %.

During the vegetation sample 121 individual trees of thirty-two species were recorded in Karen. Twenty-one species could be translated to Thai and be given scientific names. Eighteen identified tree species with descriptions are presented in Table 8:

<b>Species</b>	<b>Description</b>	<b>IVI</b>
<i>Lithocarpus sootepensis</i>	Small or medium evergreen tree.	26
<i>Schima wallichii</i>	Large tree. Very common throughout the region, forming a characteristic element of hill evergreen forests, but also found more scatteredly in many other forest types	21
<i>Wendlandia tinctoria</i>	Evergreen shrub/small tree. Very common under storey of hill evergreen forests	19
<i>Ternstroemia gymnanthera</i>	Small or medium tree. Widespread in lowland and hill forests from 700-2000m	18
<i>Quercus kerrii</i>	Deciduous tree, often coppicing. Locally common in semi-open forests, sometimes with dipterocarp spp.	13
<i>Annaslea fragrans</i>	Small/medium-sized tree: Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests	13
<i>Quercus kingiana</i>	Deciduous tree. Fairly common in semi-open forest, sometimes with dry dipterocarp spp.	12
<i>Goniothalamus griffithii</i>	Shrub or small tree. Uncommon, scattered in the understory of less-disturbed forests	12
<i>Gluta usitata</i>	Semi-evergreen or briefly deciduous tree. Very common, favouring dry, open areas along ridges. Irritating sap	11
<i>Phyllanthus emblica</i>	Small deciduous tree. Very common in drier semi-open forests, fire resistant	9
<i>Gardenia sootepensis</i>	Deciduous tree. Fairly common in semi-open and dry dipterocarp forests	8
<i>Gluta obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests	7
<i>Aporosa villosa</i>	Small deciduous tree. Common understory tree of both deciduous and pine forests	6
<i>Dalbergia assamica</i>	Small deciduous tree. Very common in open, fire-prone areas, often shrubby & coppicing	5
<i>Canarium subulatum</i>	Deciduous tree. Common in semi-open forests, often with bamboo	4
<i>Castanopsis argyrophylla</i>	Semi-evergreen tree. Common in drier forests	3
<i>Castanopsis diversifolia</i>	Deciduous/partly deciduous tree. Common and widespread in hill evergreen forest, often gregarious	3
<i>Terminalia alata</i>	Deciduous tall tree. Common in semi-open forests	3

**Table 8.** Identified tree species with description from 3-year fallow forest plot ordered by species importance value

Of the 9 individual seedlings divided in six species, 8 individual seedlings of five species could be translated from Karen to be given scientific names. These five identified seedling species with descriptions are presented in Table 9:

Species	Description	Seedling count
<i>Gluta obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests	3
<i>Aporosa villosa</i>	Small deciduous tree. Common understory tree of both deciduous and pine forests	2
<i>Dalbergia assamica</i>	Small deciduous tree. Very common in open, fire-prone areas, often shrubby & coppicing	1
<i>Annaslea fragrans</i>	Small/medium-sized tree: Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests	1
<i>Wendlandia tinctoria</i>	Evergreen shrub/small tree. Very common under storey of hill evergreen forests	1

**Table 9.** Identified seedling species with description from 3-year fallow forest plot ordered by seedling count

To put a forest type label on a three year fallow forest would be out of place. A mix of deciduous and evergreen tree species gives a very different tree/seedling composition than the one-year fallow. *Styrax apricus* is rated as the most ecological important tree species with an IVI score of 27, but is not mentioned in table 8 due to a missing description.

#### **Five-year fallow plot**

The five-year fallow plot was situated approximately 2 km east of Ban Huai Khanun 3. The elevation of the plot was 1109 m and slope was 45 %.

During the vegetation sample 196 individual trees of thirty-five species were recorded in Karen. Seven species could be translated to Thai and be given scientific names. Six identified tree species with descriptions are presented in Table 10:

Species	Description	IVI
<i>Ternstroemia gymnanthera</i>	Small or medium tree. Widespread in lowland and hill forests from 700-2000m	26
<i>Dalbergia assamica</i>	Small deciduous tree. Very common in open, fire-prone areas, often shrubby & coppicing	20
<i>Schima wallichii</i>	Large tree. Very common throughout the region, forming a characteristic element of hill evergreen forests, but also found more scatteredly in many other forest types	15
<i>Aporosa villosa</i>	Small deciduous tree. Common understory tree of both deciduous and pine forests	8
<i>Phyllanthus emblica</i>	Small deciduous tree. Very common in drier semi-open forests, fire resistant	6
<i>Goniothalamus griffithii</i>	Shrub or small tree. Uncommon, scattered in the understory of less-disturbed forests	4

**Table 10.** Identified tree species with description from 5-year fallow forest plot ordered by species importance value

Of the 7 individual seedlings divided in two species, 3 individual seedlings of a single species could be translated from Karen to be given a scientific name. That single identified seedling species with description is presented in Table 11:

Species	Description	Seedling count
<i>Ternstroemia gymnanthera</i>	Small or medium tree. Widespread in lowland and hill forests from 700-2000m	3

**Table 11.** Identified seedling species with description from 5-year fallow forest plot

The five year fallow forest shows a somewhat different tree species composition than the three-year fallow forest. *Styrax apricus* is again rated as the most ecological important tree species with an IVI score of 33, but is not mentioned in table 10 due to a missing description.



### 3.4 Results of soil sampling in the forest plots

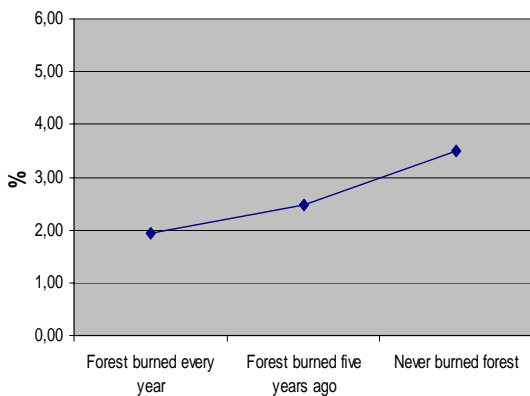
The following data presentation is to show a connection between soil fertility and the period of time an area has been protected from fire. The graphs are made from soil data derived from the table in Appendix O.

The average content of total organic matter in the soils of the three different forests plots were according to Graph 1 ranked in the following order starting with the lowest content first:

*Forest burned one year ago < forest burned 5 years ago < conservation forest*

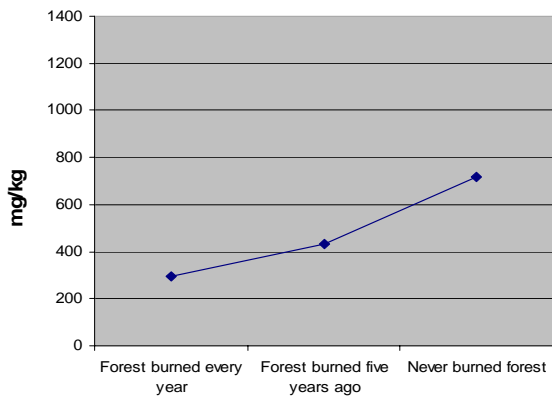
The content of phosphorus, nitrogen and soil humidity showed the same tendency to increase after not being affected by fire for a longer period of time (Graph 2, 3, and 4).

Average content organic matter in soil of different forests



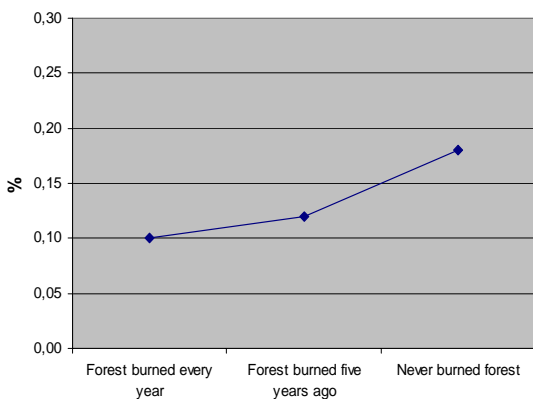
**Graph 1.** Content of organic matter

Average content of phosphorus in soil of different forests



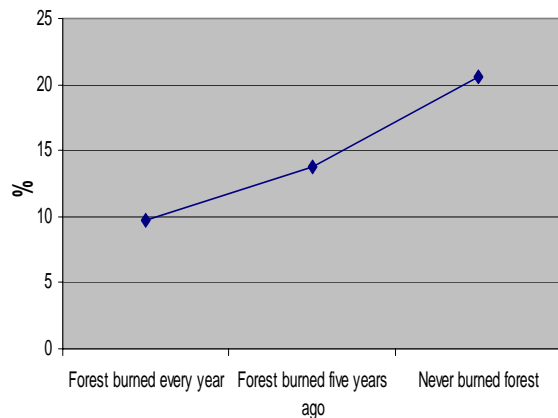
**Graph 2.** Content of phosphorus

Average content of nitrogen in soil of different forests



**Graph 3.** Content of nitrogen

Humidity of soil in different forests



**Graph 4.** Humidity

The results in Graph 1-3 shows that the fertility of soil in the forests were at the lowest right after a forest burning, but fertility could be re-established to some degree by letting the forest being unaffected by fire. In addition, an increase of humidity in the soil could also be detected (Graph 4).

Sampling site	Surface biomass (kg/m <sup>2</sup> )	Soil infiltration (minutes)	Soil humidity (%)
Forest burned one year ago	No biomass	8,93	9,75
Forest burned five years ago	1,0	5,28	13,78
Conservation forest	3,6	2,13	20,55

**Table 12.** Comparison of infiltration and humidity of soil and surface biomass

Table 12 shows that the conservation forest soil had the most surface biomass (3,6 kg/m<sup>2</sup>), fastest infiltration (3,13 minutes) and highest humidity (20,55 %), which all are indicators of a soil in good condition. The conservation forest soil is in the best condition compared to the forests burned one year and five years ago. These numbers has the same tendency as with soil fertility to rank the soil condition from worst to best:

*Forest burned one year ago < forest burned 5 years ago < conservation forest*

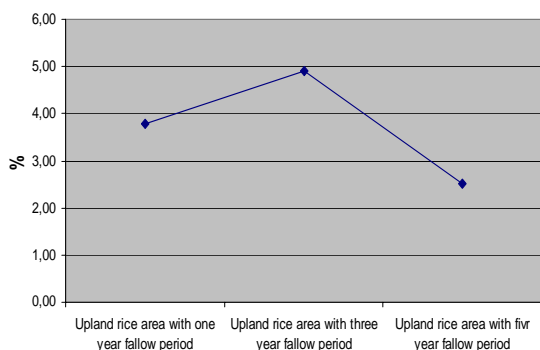
### **3.5 Results of soil sampling in fallow forests plots**

The average content of total organic matter in the soil of the three different fallow forests was according to Graph 5 ranked in the following order starting with the lowest content first:

*five year fallow forest < one year fallow forest < three year fallow forest*

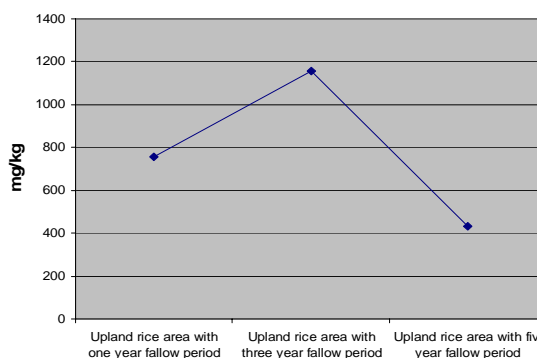
The content of phosphorus, nitrogen and soil humidity showed the same tendency to increase after not being affected by fire between one and three years, but then the contents drops in the five year fallow forest below the values of the one year fallow (Graph 6, 7, and 8).

Average content of organic matter in soil of different upland rice fields



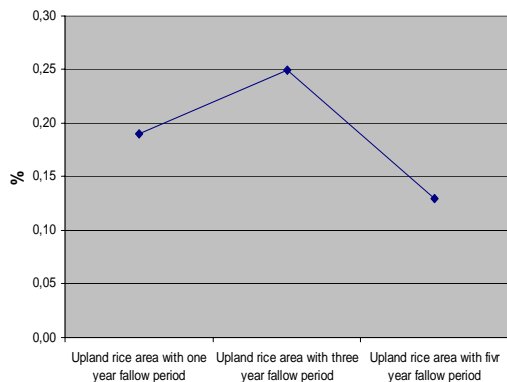
**Graph 5.** Content of organic matter

Average content of phosphorus in soil of different upland rice fields



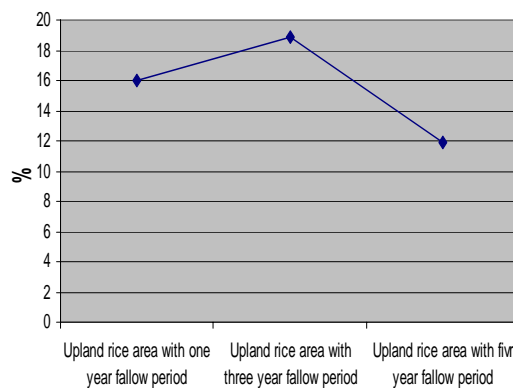
**Graph 6.** Content of phosphorus

Average content of nitrogen in soil of different upland rice fields



**Graph 7.** Content of nitrogen

Humidity of soil in different upland rice fields



**Graph 8.** Humidity

From the results in Graphs 5-7, the fertility of soil increased from the one year fallow forest plot until the three year fallow forest period, but decreased thereafter until the five year fallow forest plot below the one year fallow forest values. The same pattern occurred of soil humidity in Graph 8.

Sampling site	Surface biomass (kg/m <sup>2</sup> )	Soil infiltration (minutes)	Soil humidity (%)
<i>Upland rice field with one year fallow period</i>	1,5	1,02	16,01
<i>Upland rice field with three year fallow period</i>	3,0	4,55	18,91
<i>Upland rice field with five year fallow period</i>	1,0	4,94	11,92

**Table 13.** Comparison of infiltration and humidity of soil and surface biomass in three upland rice fields

Table 13 shows that the three year fallow forest soil had the most surface biomass (3,0 kg/m<sup>2</sup>) and the highest humidity (18,91 %), but the one year fallow forest soil had the fastest infiltration (1,02 minutes). The five year fallow forest shows the same tendency as with soil fertility to have the poorest soil conditions of them all.

## 4. Discussion of results

Looking at the results from the vegetation and soil sampling in the forest in Table 14, certain differences can be seen in the forest and soil composition between the forest plot #1 outside the firebreak and the forest plot #2 inside the fire break.

	Plot #1 burned 1 year ago	Plot #2 burned 5 years ago	Conservation forest (Control plot)
Individual trees	467	558	554
Species	32	48	97
Seedlings	46	63	31
Families	9	11	19
Forest type	Dry deciduous dipterocarp	Dry deciduous dipterocarp	Hill evergreen
N, P, K	Lowest content	Medium content	Highest content
Elevation	888 m	894 m	1374 m
Surface biomass (kg)	No biomass	1	3,6
Organic matter (%)	1,94	2,48	3,50
Soil infiltration (min.)	8,93	5,28	2,13
Humidity (%)	9,75	13,78	20,55

**Table 14.** Comparison of different parameters between the three forest plots

With regards to the methodological constraints that only one sampling of forest and soil were made respectively inside and outside the firebreak, the forest inside the firebreak seems to be in an improved condition compared to the forest outside of the firebreak. The forest types are classified to be the same kind of lowland *dry deciduous dipterocarp* forest, but being situated at a midlevel forest elevation of approximately 900 m, the forest type is unnatural to the area. This is a good indication of very disturbed, fire-prone and degraded forests.

Being left undisturbed by fire for five years, plot #2 seems to be at a better ecological state than plot #1. Plot #2 inside the firebreak has more trees, seedlings, species and families represented than in plot #1. The size class distribution charts of the two plots (Appendix L) shows only one significant difference and that is in the category of trees with a DBH between 5-9,9 cm, where plot #2 has over twice the amount of trees as plot #1. This could indicate that more and other seedlings than just the most fire-resistant species has been able to grow during the five years absence of fire. The soil condition and fertility is also improved in plot #2 compared to plot #1, where the recent burning is particularly visible in the results, as all the surface biomass was gone in flames.

This indicates that a forest can attain a significant and measurable higher biodiversity and soil fertility by being protected from burning for a relatively short period of time.

If left undisturbed in the future, one could think that plot #2 inside the firebreak would get closer to resembling a forest and soil condition as the conservation forest. Unfortunately were the selection of the control plot by the headman in the least disturbed forest in a highland forest zone, making it impossible to use it for direct comparison with forest plot #1 and #2 situated at a lower altitude in the transitional vegetation zone. But even though the species composition and forest type is different, some pointers can be drawn out by comparing the data in the table between forest plot #2 and the 'control' plot. More species of different families will move in and change the species composition with an increased biodiversity and different forest type as a consequence. As the surviving seedlings in the DBH category 5-9,9 cm over time slowly would move in to larger DBH categories, the crown cover and tree density

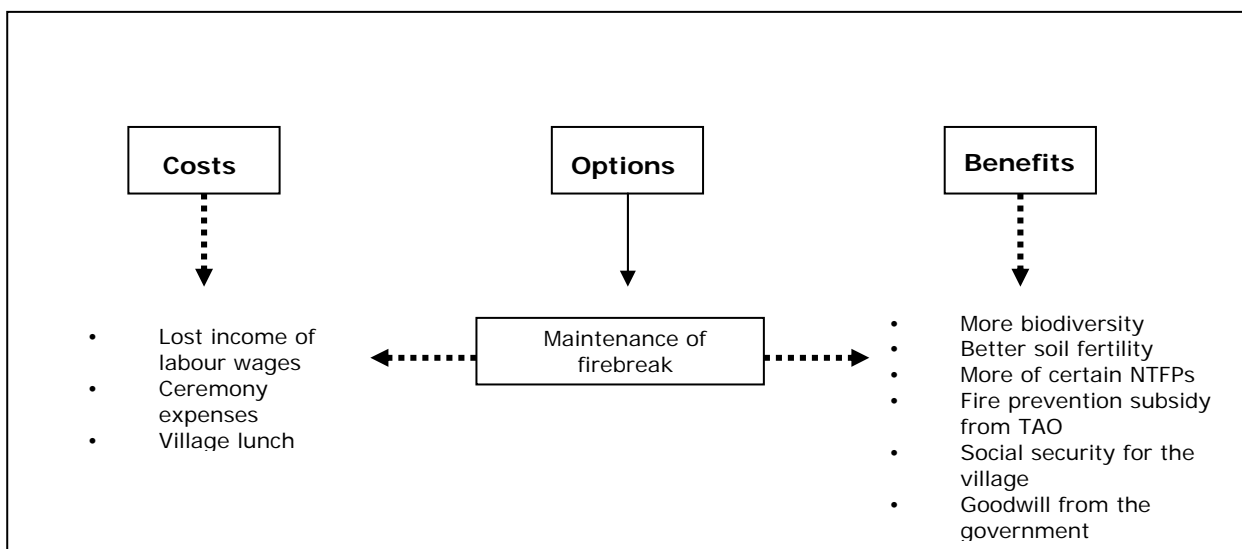
will increase, making the forest less open than before. The soil fertility would also continue to improve, as more biomass and organic matter accumulates over time.

If the main interest of the villagers in maintaining the firebreak is to promote biodiversity in the forests, a question arises which is difficult to explain to the full extent with the results at hand.

The benefits of increased biodiversity for the villagers seem limited in terms of their use of the forest for grazing of cattle and collection of certain NTFP's such as mushrooms and bamboo. In order for the forest to be suitable for grazing or mushroom and bamboo shoot collection, the forest structure should be open for light penetration to promote growth at the forest floor. This is best achieved by disturbing the forest for instance with the use of fire.

Increased biodiversity in the forest could on the other hand promote other types of NTFP's for example an increase in wild animals for hunting. During a village interview it was reported that many species of unspecified NTFPs in the forest had disappeared as a result of poor management of forest fires spreading from further down the watershed. The villagers meant the National Park authorities did nothing to prevent this, therefore they had to protect themselves and their natural resources via the firebreak from uncontrolled fires coming outside of the community. Household surveys as well indicated that the National Park does not do much to stop fire originating in forest now designated as national park. This was partly confirmed by the NP officer, who stated that the National Park cannot manage forest fire without assistance. Local participation was necessary condition if the National Park was to prevent and manage forest fire.

The questionnaires indicated positive perceptions of the villagers on maintaining the firebreak, as villagers at present feel more secure in terms of livelihood by having the firebreak than before. These local institutional arrangements put in place in Ban Huai Khanun 1-3 shows that the villagers are able to manage and prevent forest fire originating outside of the community.



**Figure 2.** Economic and environmental cost/benefits of maintaining fire break

Nevertheless, the local arrangements for the management of fire of the individual villagers have strong support within the community. With answers from the questionnaires it seems that community fire regulations and guidelines regarding controlled fires for agricultural purposes are well understood and used properly.

Some of the results derived from the vegetation and soil sampling in the different fallow forests shown in Table 15 are not easy explainable.

	<b>1 year fallow forest</b>	<b>3 year fallow forest</b>	<b>5 year fallow forest</b>
Individual trees	No trees	121	196
Species	10	32	35
Seedlings	17	9	31
Elevation	1124 m	1169 m	1109 m
N, P, K	Medium content	Highest content	Lowest content
Surface biomass (kg)	1,5	3	1
Organic matter (%)	3,78	4,91	2,51
Soil infiltration (min.)	1,02	4,55	4,94
Humidity (%)	16,01	18,91	11,92

**Table 15.** Comparison of different parameters between the three forest plots

The vegetation sampling shows an expected increase in tree numbers, species and partially also in seedlings from the one year fallow forest plot to the five year fallow forest plot. The soil fertility increases from the one year fallow to the three year fallow plot, but the five year fallow plot's values plunges beneath the one year fallows. This is also the case in organic matter and humidity values. A plausible explanation for this could be the fact that fertilizer of some kind has been applied to the one-year and three year forest fallow plots during cultivation, but not the five year fallow plot. The practise of adding fertilizer to shifting cultivation upland rice areas is confirmed by the Agricultural Intensification group working in the next village, Ban Huai Sompoi.

This is surprising information, since the Danish group always assumed the aim of using shifting cultivation was the practical issue of the minimal labour-input into the system. The use of fire is the easiest way to clear a forest area to prepare for cultivation, the ashes from the burned biomass acts as a natural fertilizer and the fallow period is natural way of restoring fertility without any artificial inputs. Adding of fertilizer indicates a flaw somewhere in the above described process and in Ban Huai Khanun 1-3, the flaw is obvious.

The headman explained during interviewing, that the fallow period of shifting cultivations had changed from 7 to 5 years and sometimes 2-3 years in. The reasons for this are:

- 1) Population pressure had led to a lack of available land in the vicinity of Ban Huai Khanun
- 2) The National Park could claim land left uncultivated for more than 4 years

The headman also pointed out, that the declining fallow period with its negative effect on soil fertility is the biggest challenge to the village community.

One interesting finding in the household surveys is about the importance of cultivation of subsistence crops among the richest households in Ban Huai Khanun 1-3. According to the questionnaires, households with much land available and a surplus in rice do not reduce output in favour of cash crops. These households continue a livelihood strategy focused on cultivation of rice. How can this resilience of rice cultivation among rich household be explained?

The village headman gave the explanation in the interview: because of falling cash crop prices and too much use of chemicals damaging the environment around Ban Huai Khanun, the households had returned to rice cultivation.

Another explanation is given by Delang (2003), who in 1999 conducted a field work in other Karen villages. Delang seeks the explanation of the continued popularity of rice among rich households in the social nature of village community, which stresses the importance of

indigenesness that induces the Karen to be risk-averse towards what comes from outside the village. He also points to the fact that economies of subsistence and cash crops are incompatible, and that cash crops - when introduced - increase the costs of households that remains in subsistence production. For example pollution of drinkable water by chemicals used in cash crop production could strain subsistence households because of their need to buy potable water. It is basically a question of incompatible livelihood strategies, as cash crop households unlike subsistence households do not require a sustainable environment for their livelihood.

When some households in the community turn to cash crop production, the others must follow suit or put up with an ever decreasing resource base. In order to prevent households from shifting to cash crops, pressures are exerted upon individual households in the name of the common good, and threats of economic sanctions are often applied. A household in a Karen Community is too small for many agricultural activities, and all households sometimes need the help of other, whether for clearing the forest or burning the field, or for some other activities. Although most households in Ban Huai Khanun cultivate rice as well as cash crops, it is important to notice these contradictions between subsistence-oriented and cash-crop oriented livelihood strategies.

## 5. Conclusion

With the use of the applied methods the research questions have been answered to a certain extent:

- The use of fire in swidden agriculture has changed in that sense that the fallow period of 7 years traditionally used by the Karens of Ban Huai Khanun 1-3 has been altered due to pressures to the village community from the outside. The presently used fallow period is 2-3 years. This was expressed as the most important challenge within the local community by the village headman. The use of fire as a mean to promote the growth of NTFPs (eg. mushroom, bamboo shoots) in the forest is presently very limited.

- The management and prevention of forest fires is locally arranged by the maintenance of a firebreak bordering the eastside of the village boundaries from the lower part of the Mae Tia subwatershed. The firebreak is considered very important by the villagers in protecting their existing livelihood strategies. Patrolling the village boundaries to detect fires during the fire season (February-April) is also implemented within the community to function day and night. These arrangements are backed up by the entire village community as a necessity for protection from fires originating from outside the community. Guidelines on community fire regulations appear to function in controlling fire used within the village boundaries. The departmental arrangements for fire prevention appear to be non-existent in practise. Ob Luang National Park has implied, that they can not lift the task on their own and need to work together with the local community to establish effective fire management

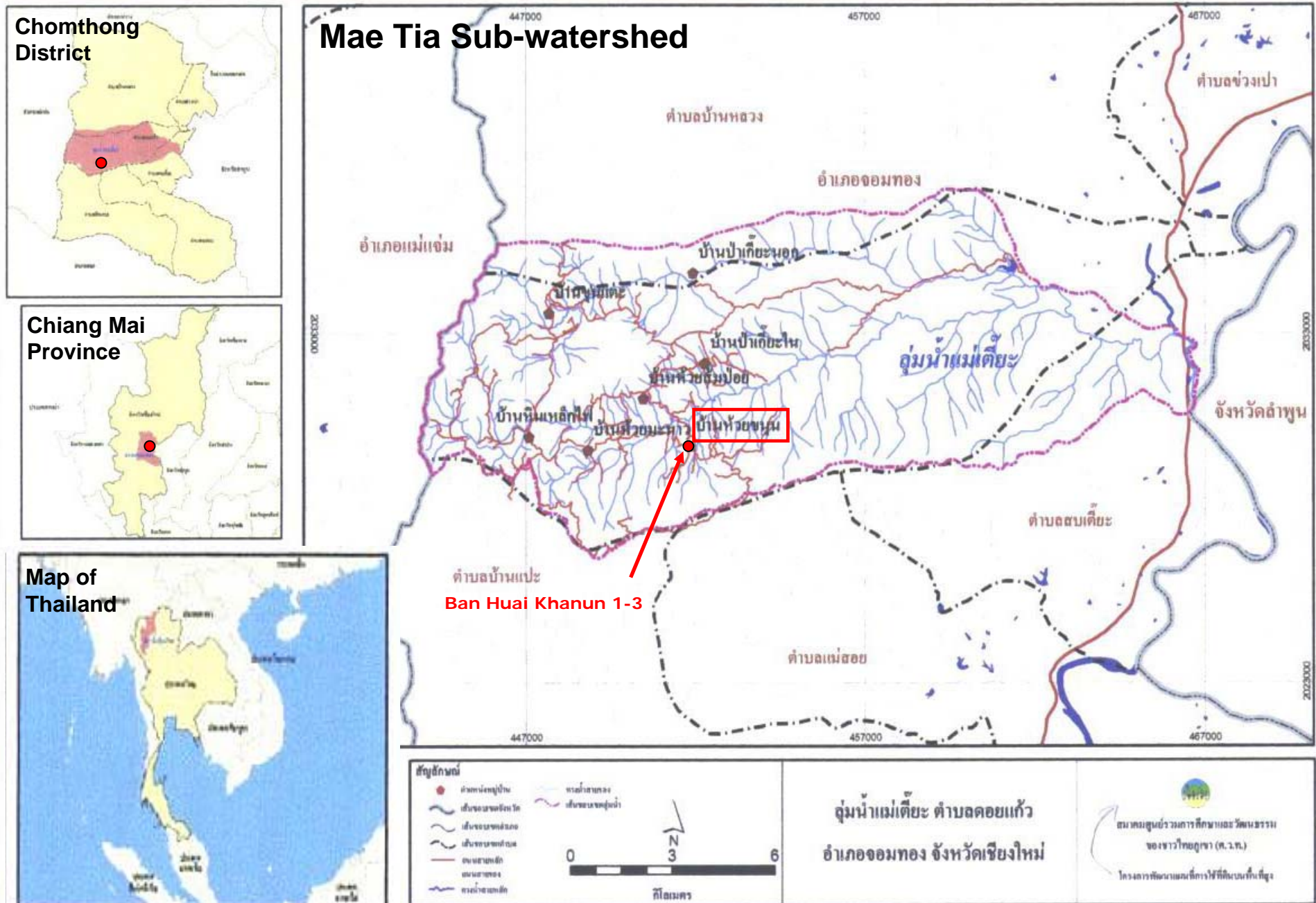
- The benefits for the community of maintaining the firebreak and having fire-detecting patrols by protecting are an increase of biodiversity and thereby an increase of certain NTFPs. A social security of the villages is also maintained. The costs of maintaining the firebreak and conducting patrolling appears relatively small compared the significant benefits achieved.



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# APPENDIX A - Overview of research area



# APPENDIX B - NATIONAL PARK ACT

BHUMIBOL ADULYADEJ, REX.

Given on the 22nd day of September, B.E. 2504; Being the 16th Year of the Present Reign. His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that; Whereas it is expedient to have a law on national park;

Be it, therefore, enacted by the King, by and with the advice and consent of the Constituent Assembly acting as the National Assembly, as follows:

**Section 1.** This Act shall be called the "National Park Act, B.E. 2504"

**Section 2.** This Act shall come into force as and from the day following the date of its publication in the Government Gazette.

**Section 3.** All other laws, rule and regulations in so far as they are already provided by this Act, of are contrary to or inconsistent with the provisions of this Act shall be replaced by this Act.

**Section 4.** In this Act:

- (1) "Land" means surface of land in general, and includes mountain, creek, swamp, canal, marsh, basin, waterway, lake, island and seashore
- (2) "National park" means the land which is determined as national park under this Act;
- (3) "Woody plant" includes all kinds of plants which are trees, brushwoods or creepers, including all parts thereof;
- (4) "Animal" means all kinds of animals including all parts thereof, and things obtained from or produced by the animals;
- (5) "Competent official" means the person appointed by the Minister for the execution of this Act;
- (6) "Director-General" means the Director-General of the Forestry Department;
- (7) "Minister" means the Minister who takes charge and control for the execution of this Act.

**Section 5.** The Minister of Agriculture shall take charge and control for the execution of this Act, and shall have the power to appoint competent officials and to issue Ministerial Regulations for the execution of this Act. Such Ministerial Regulations shall come into force upon their publication in the Government Gazette.

## CHAPTER 1

### Determination of Land to be National Park

**Section 6.** When it is deemed appropriate to determine any area of land, the natural features of which are of interest and to be maintained with a view to preserving it for the benefit of public education and pleasure, the Government shall have the power to do so by a Royal Decree, A map showing the boundary lines of the determined area shall be annexed to such Royal Decree. The determined area shall be called the "National Park." The land to be determined as national park must not be owned or legally possessed by any person other than public body.

**Section 7.** The extension or the cancellation for the whole or a part of the national park shall be made by a Royal Decree. In case of cancellation not for the whole of the national park, a map showing the changing area shall be annexed to the Royal Decree.

**Section 8.** The competent official shall provide the boundary posts and signs or other marks sufficiently for enabling the public to know the boundary of the national park.

## CHAPTER 2

### National Park Committee

**Section 9.** There shall be a committee called the "National Park Committee" consisting of the Under-Secretary of State for Agriculture as chairman, Director-General of the Forestry Department, representative of the Department of Interior, representative of the Land Department, and other members not more than eleven in number appointed by the Cabinet.

**Section 10.** The member appointed by the Cabinet holds office for a term of two years. The retired member may be reappointed.

**Section 11.** Apart from retirement on account of expiration of the term of office under Section 10, the member vacates his office upon :

- (1) death;
- (2) resignation;
- (3) being removed by the Cabinet;
- (4) being incompetent or quasi-incompetent;
- (5) being imprisoned by a final judgment, except for a petty offence or offence committed through negligence.

When a member vacates his office before the expiration of the term of office, the Cabinet may appoint another person to fill the vacancy. The member appointed under the preceding paragraph remains in office only for the term of office of the person he replaces.

**Section 12.** At the meeting of the committee, if the chairman does not attend it or is absent therefrom, the committee shall elect one of its members to preside over the meeting. Any decision of the meeting shall be taken by a majority of votes. In voting, each member shall have one vote. In case of a tie, the presiding chairman shall have an additional vote as casting-vote.

**Section 13.** At every meeting there must be an attendance of not less than one half of the total members in order to constitute a quorum.

**Section 14.** The committee may appoint a subcommittee to consider or perform any activity as assigned by it,

**Section 15.** The committee has the duty to give advice to the Minister in the following matters:

- (1) Determination of land to be reserved as national park and extension or cancellation of the national park;
- (2) Protection and maintenance of the national park;
- (3) Matters consulted by the Minister

## CHAPTER 3

### Protection and Maintenance of the National Park

**Section 16.** Within the national park, no person shall:

- (1) Hold or possess land, or clear or burn the forest;
- (2) collect, take out, or do by any means whatsoever things endangering or deteriorating woody plant, gum, yang, wood-oil, turpentine, mineral or other natural resources;
- (3) Take out animals or do by any means whatsoever things endangering the animals;
- (4) do by any means whatsoever things endangering or deteriorating soil, rock, gravel or sand;
- (5) change a water-way or cause the water in a river, creek, swamp or marsh to overflow or dry up;
- (6) close or obstruct a watercourse or way;
- (7) collect, take out, or do by any means whatsoever things endangering or deteriorating orchids, honey, lac, charcoal, barks or guano;
- (8) collect or do by any means whatsoever things endangering flowers, leaves or fruits;
- (9) take in, take out any vehicle or drive it on the way not provided for such purpose, unless permission is obtained from the competent official;
- (10) cause any aircraft to take off or land in the place not provided for such purpose, unless permission is obtained from the competent official;
- (11) take cattle in or allow them to enter;
- (12) take in any; domestic animal or beast of burden, unless he has complied with the rule prescribe by the Director General and approved by the Minister;
- (13) carry on any activity for benefit, unless permission is obtained from the competent official;
- (14) post up a notification or advertisement, or scratch or write on any place;
- (15) take it any gear for hunting or catching animals or any weapon, unless permission is obtained from the competent official and the conditions on prescribed by the latter have been complied with;
- (16) fire any gun, cause any explosive article to be exploded or let off any fireworks;
- (17) make a noisy disturbance, or do other act causing trouble or nuisance to any person or animal;
- (18) discharge rubbish or things at the place not provided for such purpose;
- (19) leave any inflammable article which may cause fire.

**Section 17.** No person shall remove, deface, damage or render useless the boundary posts, signs or other marks furnished by the competent official under this act.

**Section 18.** Any person entering the national park must comply with the order of the competent official given in compliance with the rule prescribed by the Director-General and approved by the Minister.

**Section 19.** The provisions of Section 16 and Section 17 shall not apply to the official carrying out any works for protection and maintenance of the national park for education or technical research, or for facilitating tourism or sojourn, or rendering safety or giving knowledge to the public provided that it be in accordance with the rule prescribed by the Director-General and approved by the Minister.

**Section 20.** In suppressing illegal activities according to this Act, the competent official shall be the administrative official or police under the Criminal Procedure law.

**Section 21.** The competent official shall have the power to order the person committing the offence under Section 16 to get out of the national park or to refrain from doing any act therein.

**Section 22.** In case any violation of this Act has caused anything into being or rendered a change in condition to anything in the national park, the competent official shall have the power to give the offender an order to have such thing demolished, removed from the national park, or restored to its former condition, as the case may be. In case the

offender fails to comply therewith or the offender is unknown or for prevention or alleviation of the national park from damage, the competent official himself may take any of the said actions as may be appropriate. The expenses incurred thereby shall be borne by the offender.

## **CHAPTER 4**

### **Miscellaneous**

**Section 23.** If the Director-General thinks it appropriate to require from the public any payment for services of facilities given by the competent official in the national park, or to require any person to pay fee of remuneration for permission to carry on any activity or to sojourn therein, he is empowered to fix the rates and lay down rules concerning the collection of the said service charge, fee or remuneration, with the approval of the Minister. Money collected under the preceding paragraph, fund donated for maintenance of the national park, fine accruing from settlement of the case conducted by the competent official under Section 28 and other kinds of income shall be exempted from any tax or duty, and kept as the expenditure for maintenance of the national park according to the rules and methods prescribed by the Director General and approved by the Minister.

## **CHAPTER 5**

### **Penalty**

**Section 24.** Whoever violates Section 16 (1), (2), (3), (4), or (5) shall be punished with imprisonment not exceeding five years or fine not exceeding twenty thousand baht, or both.

**Section 25.** Whoever violates Section 16 (6), (7), (9), (10), or (11), Section 17 or Section 18 shall be punished with imprisonment not exceeding one month or fine not exceeding one thousand baht, or both.

**Section 26.** Whoever violates Section 16 (2), (3), (4), or (7) shall, in case the animal or property collected or taken out is of small value or a slight damage is caused thereby, be punished with fine not exceeding five hundred baht.

**Section 27.** Whoever violates Section 16 (8), (12), (13), (14), (15), (16), (17), (18) or (19) shall be punished with fine not exceeding five hundred baht.

**Section 28.** The competent official shall have the power to settle the case in respect of offences under Section 25, Section 26 and Section 27.

**Section 29.** All weapons, instruments, utensils and vehicles used by any person in committing the offence of clearing or burning the forest under Section 16 (3) or offence of endangering animals under Section 16 (3) or offence of endangering or deteriorating soil, rock, gravel or sand under Section 16 (4) shall be forfeited regardless of whether they belong to the offender, and whether any person is convicted.

### **Transitory Provision**

**Section 30.** Any concession or licence for working timber or collecting forest product under the law on forest, licence for residing in or exploitation of a protected or reserved forest under the law on protection and reservation of forest, prospecting licence, mining concession or licence under the Land Code which was granted or issued to any person before the day of enforcement of the Royal Decree valid issued under Section 6 shall be valid only for the remaining period of such concession, prospecting licence, mining concession or licence.

Countersigned by  
Field Marshal S. Dhanarajata  
Prime Minister

(Source: [http://www.dnp.go.th/npo/Html/Law\\_Rule/Law/Law\\_ENationPark\\_2504.htm](http://www.dnp.go.th/npo/Html/Law_Rule/Law/Law_ENationPark_2504.htm))



## APPENDIX C - Vegetation sample results from forest plots

Forest plot #1 burnt 1 year ago

Karen Name	Transliteration	Thai Name	Scientific Name	Density <sup>a</sup> (Trees/ha)	Frequency <sup>b</sup> (%)	Basal Area <sup>c</sup> (m <sup>2</sup> /ha)	RD <sup>d</sup>	RF <sup>e</sup>	RDo <sup>f</sup>	IVI <sup>g</sup>
ที	Tue	สารภีป่า	Anneslea fragrans Wall.	438	88	1,9947	14,9893	8,1395	17,0506	40,1795
ทอเนอ	Tene	ขี้ขาว	Adina cordifolia Hook. f.	581	100	0,3762	19,9143	9,3023	3,2161	32,4328
หล่าเทอ(ไม้ตั้ง)	La te	พลวง	Dipterocarpus tuberculatus Roxb.	206	81	0,8470	7,0664	7,5581	7,2397	21,8642
ซุเกอแม		รักน้อย	Gluta Obovata	75	44	1,4891	2,5696	4,0698	12,7291	19,3684
เสบอเบะ		โมลี	Reevesia siamensis Craib	163	50	0,9319	5,5675	4,6512	7,9656	18,1843
หล่านิ		เต็ง	Shorea obtusa Wall.	44	38	1,5107	1,4989	3,4884	12,9135	17,9008
ไม้ก้อหมาก		ก้อแดง	Quercus kingiana Craib	169	44	0,5859	5,7816	4,0698	5,0081	14,8595
เสคอบอ		แข่งกวาง	Wendlandia tinctoria A. DC.	131	63	0,4374	4,4968	5,8140	3,7388	14,0495
เคาะ		เคาะ	Scleropyrum maingayi Hook. f.	56	44	0,6949	1,9272	4,0698	5,9396	11,9366
เสแบะซา		ไมทราบ 17	Unknown 17	181	50	0,0853	6,2099	4,6512	0,7295	11,5905
เซลจะ		ไมทราบ 10	Unknown 10	125	50	0,0575	4,2827	4,6512	0,4917	9,4255
ไมรัก		ไมทราบ 16	Unknown 16	94	44	0,2217	3,2120	4,0698	1,8951	9,1768
เซบอชะ		ไมทราบ 4	Unknown 4	94	38	0,2227	3,2120	3,4884	1,9037	8,6041
ไม้ก้อทอง		ไมทราบ 15	Unknown 15	63	31	0,3280	2,1413	2,9070	2,8037	7,8520
มะนะสา		สมอพิเภก	Terminalia bellerica Roxb.	56	38	0,2703	1,9272	3,4884	2,3104	7,7260
พลอบลีคลี		ไมทราบ 14	Unknown 14	50	38	0,2411	1,7131	3,4884	2,0611	7,2625
บลีคลี		ไมทราบ 13	Unknown 13	56	44	0,1190	1,9272	4,0698	1,0175	7,0144
เซพลอมุกะ		ไมทราบ 7	Unknown 7	31	19	0,4548	1,0707	1,7442	3,8878	6,7026
เซเพลคละ		ไมทราบ 9	Unknown 9	81	31	0,1135	2,7837	2,9070	0,9702	6,6609
เซเกละบละ		ไมทราบ 3	Unknown 3	50	31	0,1699	1,7131	2,9070	1,4522	6,0723
พลอเดะกะ		คำมอกหลวง	Gardenia sootepensis Hutch.	56	38	0,0514	1,9272	3,4884	0,4396	5,8552
เซกวาโดะ		ไมทราบ 2	Unknown 2	19	13	0,1175	0,6424	1,1628	1,0044	2,8096
เซพลอบลีปว่า		ไมทราบ 6	Unknown 6	25	6	0,0640	0,8565	0,5814	0,5466	1,9846
เซเพลกละ		ไมทราบ 8	Unknown 8	6	6	0,1388	0,2141	0,5814	1,1860	1,9816
เซเบละชะ		ไมทราบ 5	Unknown 5	6	6	0,1358	0,2141	0,5814	1,1605	1,9561
ไม้ก้อซีหุม		ก้อซีหุม	Castanopsis pierrei Hance	19	6	0,0112	0,6424	0,5814	0,0961	1,3199
เซพลอบอ		กำยาน	Styrax apricus Fletch.	13	6	0,0060	0,4283	0,5814	0,0514	1,0611
ทีปโล		ไมทราบ 11	Unknown 11	6	6	0,0069	0,2141	0,5814	0,0588	0,8543
เซกละ		ไมทราบ 1	Unknown 1	6	6	0,0069	0,2141	0,5814	0,0588	0,8543
บลีโคคลี		ไมทราบ 12	Unknown 12	6	6	0,0050	0,2141	0,5814	0,0427	0,8383
เสหยาส่า		มะขามป้อม	Phyllanthus emblica Linn.	6	6	0,0025	0,2141	0,5814	0,0214	0,8169
มะเกียง	Maklange	มะเกียง	Eugenia paniala Roxb.	6	6	0,0013	0,2141	0,5814	0,0107	0,8062

a) Tree density: trees per hectare (converted from trees per rai)

b) Frequency: no. of quadrants in which a species occurs/total number of quadrants x 100

c) Basal area: cross-section area of tree stem in square meters per hectare (converted from square meters per rai)

d) Relative density: no. of individuals of a species/total no. of individuals of all species x 100

e) Relative frequency: frequency of a species/total frequency of all species x 100

f) Relative dominance: total basal area of a species/basal area of all species x 100

g) Species importance value index: IVI = RD + RF + RDom

## Forest plot #2 burnt 5 years ago

Karen Name	Transliteration	Thai Name	Scientific Name	Density (Trees/ha)	Frequency (%)	Basal Area (m <sup>2</sup> /ha)	RD	RF	RDo	IVI
เสบอเบะ	Molee	โมลี	Reevesia siamensis Craib	238	75	2,4465	6,8100	6,6298	23,6486	37,0885
ทอเนอ	Tene	ขว้าว	Adina cordifolia Hook. f.	388	94	0,4192	11,1111	8,2873	4,0523	23,4507
เสแบะซา	Sebasa	ไม้ทราบ 25	Unknown 25	413	88	0,3065	11,8280	7,7348	2,9629	22,5257
ที	Tue	สารภีป่า	Anneslea fragrans Wall.	388	88	0,3593	11,1111	7,7348	3,4734	22,3193
เสคอบอ	Se kre bo	แข่งกวาง	Wendlandia tinctoria A. DC.	294	81	0,2666	8,4229	7,1823	2,5768	18,1821
หล่าเทอ		พลวง	Dipterocarpus tuberculatus Roxb.	163	69	0,4899	4,6595	6,0773	4,7358	15,4726
เซสเบะ	Sesubae	ไม้ทราบ 14	Unknown 14	419	19	0,0828	12,0072	1,6575	0,8002	14,4649
เปอครือ		เหมือดโลด	Aporosa villosa Baill.	194	75	0,1898	5,5556	6,6298	1,8346	14,0199
ซูกอแม		รักน้อย	Gluta Obovata	69	50	0,3831	1,9713	4,4199	3,7036	10,0948
ไม้ก้อหมาก		ก้อแดง	Quercus kingiana Craib	19	13	0,8595	0,5376	1,1050	8,3083	9,9509
มะนะสา		สมอพิเภก	Terminalia bellerica Roxb.	25	25	0,4756	0,7168	2,2099	4,5976	7,5244
เซกวา		ก้อขาว	Castanopsis argentea A. DC.	13	13	0,5756	0,3584	1,1050	5,5643	7,0277
ซุ		พะยอม	Shorea hemslayana King ex Foxw+A2.	100	38	0,0647	2,8674	3,3149	0,6255	6,8078
ซโคล		สนสามใบ	Pinus kesiya Royle ex Gordon	13	13	0,5388	0,3584	1,1050	5,2078	6,6713
เซบอบี		ไม้ทราบ 12	Unknown 12	25	13	0,4907	0,7168	1,1050	4,7433	6,5651
เสบอสา		ไม้ทราบ 22	Unknown 22	63	13	0,3683	1,7921	1,1050	3,5597	6,4568
พลอเดอะกะ		ค้ำมอกหลวง	Gardenia sootepensis Hutch.	88	38	0,0208	2,5090	3,3149	0,2006	6,0245
ซุ		รักใหญ่	Gluta Usitata	25	25	0,2825	0,7168	2,2099	2,7308	5,6575
ซูกอเม		หมีเหม็น	Litsea glutinosa C.B. Robinson	94	31	0,0193	2,6882	2,7624	0,1861	5,6367
เสนูที		นมนาง	Unknown	19	13	0,4065	0,5376	1,1050	3,9290	5,5716
เซเคอปลอแม		ไม้งาข้าง	Nenga pumila Wendl.	44	38	0,0325	1,2545	3,3149	0,3140	4,8834
ครือ		ไม้ทราบ 3	Unknown 3	13	31	0,1789	0,3584	2,7624	1,7295	4,8503
คอเนอ		ไม้ทราบ 2	Unknown 2	88	6	0,0144	2,5090	0,5525	0,1390	3,2004
เสซ่า		ก้อหยม	Castanopsis argyrophylla King	6	6	0,2231	0,1792	0,5525	2,1568	2,8886
เซนูซา		ไม้ทราบ 10	Unknown 10	19	6	0,1749	0,5376	0,5525	1,6907	2,7808
เซซุซา		ไม้ทราบ 9	Unknown 9	19	13	0,0720	0,5376	1,1050	0,6957	2,3383
เซคอบะชะ		ไม้ทราบ 7	Unknown 7	19	13	0,0660	0,5376	1,1050	0,6379	2,2805
เซบอชะ		ไม้ทราบ 11	Unknown 11	19	13	0,0621	0,5376	1,1050	0,6005	2,2432
บลีคลี		ไม้ทราบ 17	Unknown 17	6	6	0,1144	0,1792	0,5525	1,1056	1,8373
เคลอมา		ไม้ทราบ 4	Unknown 4	6	6	0,1050	0,1792	0,5525	1,0150	1,7467
เสหยาส่า		มะขามป้อม	Phyllanthus emblica Linn.	13	13	0,0200	0,3584	1,1050	0,1933	1,6568
เซพลอบอ		ก่ายาน	Styrax apricus Fletch.	31	6	0,0072	0,8961	0,5525	0,0698	1,5183
พลอบลีคลี		ไม้ทราบ 19	Unknown 19	13	13	0,0029	0,3584	1,1050	0,0281	1,4915

เขปรำ		ไม้ทราบ 13	Unknown 13	31	6	0,0000	0,8961	0,5525	0,0251	1,4737
เสกัวะปา		ก่อพะชน	Quercus kerrii Craib	6	6	0,0644	0,1792	0,5525	0,6223	1,3540
เขอเขช		ไม้ทราบ 15	Unknown 15	19	6	0,0246	0,5376	0,5525	0,2377	1,3279
ขำบิขำ		ไม้ทราบ 6	Unknown 6	19	6	0,0051	0,5376	0,5525	0,0490	1,1391
โพย		ไม้ทราบ 20	Unknown 20	6	6	0,0419	0,1792	0,5525	0,4048	1,1365
เสเบาะอี		ไม้ทราบ 23	Unknown 23	6	6	0,0263	0,1792	0,5525	0,2537	0,9855
ไฝ		ไม้ทราบ 18	Unknown 18	13	6	0,0018	0,3584	0,5525	0,0178	0,9287
จืขำ		ไม้ทราบ 5	Unknown 5	6	6	0,0200	0,1792	0,5525	0,1933	0,9250
เขโพปริ		ก่อแป็น	Castanopsis diversifolia King	6	6	0,0100	0,1792	0,5525	0,0967	0,8284
เขชขำ		ไม้ทราบ 8	Unknown 8	6	6	0,0100	0,1792	0,5525	0,0967	0,8284
เสโทเบอะ		ไม้ทราบ 21	Unknown 21	6	6	0,0081	0,1792	0,5525	0,0785	0,8103
เสแบ		ไม้ทราบ 24	Unknown 24	6	6	0,0069	0,1792	0,5525	0,0665	0,7982
ค้อ		ไม้ทราบ 1	Unknown 1	6	6	0,0032	0,1792	0,5525	0,0308	0,7625
เดอย็อสะ		ทะลั้(ม้งตาน)	Schima wallichii Korth.	6	6	0,0019	0,1792	0,5525	0,0181	0,7498
เทอซ็อบ	Te see bor	ไม้ทราบ 16	Unknown 16	6	6	0,0019	0,1792	0,5525	0,0181	0,7498



## Conservation Forest (Control Plot)

Karen Name	Transliteration	Thai Name	Scientific Name	Density (Trees/ha)	Frequency (%)	Basal Area (m <sup>2</sup> /ha)	RD	RF	RDo	IVI
เดอยื่อชะ	Te-yi-sa	ทะโล้(มังตาน)	Schima wallichii Korth.	144	75	3,6736	4,1516	4,5455	19,1120	27,8091
เสโปสะ		ไม้ทราบ 63	Unknow 63	106	38	1,0325	3,0686	2,2727	5,3717	10,7130
เซปรีดา	Seprida	ไม้ทราบ 18	Unknow 18	225	44	0,1016	6,4982	2,6515	0,5285	9,6782
เสพลอบอ		กายาน	Styrax apricus Fletch.	100	50	0,6824	2,8881	3,0303	3,5502	9,4686
เคลอทีปอ	Kre ti por	ไม้ทราบ 3	Unknow 3	181	44	0,0361	5,2347	2,6515	0,1877	8,0739
เสบออี		ไม้ทราบ 59	Unknow 59	25	13	1,1530	0,7220	0,7576	5,9983	7,4779
เซอ		ทองกลางป่า	Erythrina subumbrans Merr.	13	6	1,2777	0,3610	0,3788	6,6473	7,3871
เสบอเบ	Se bor be	ก้อหมาก	Quercus kingiana Craib	113	50	0,1549	3,2491	3,0303	0,8060	7,0854
เสโปซา		สะบั้งงาป่า	Goniothalamus griffithii Hook. f. & Th.	63	25	0,7050	1,8051	1,5152	3,6679	6,9882
เสกอ		ก้อแดง	Quercus kingiana Craib	25	13	0,9813	0,7220	0,7576	5,1050	6,5846
เสเนอซี		ไม้ทราบ 58	Unknow 58	113	38	0,1847	3,2491	2,2727	0,9607	6,4825
ทีแพะ		พญาเสือโคร่ง	Prunug cerasoides	88	31	0,3829	2,5271	1,8939	1,9923	6,4132
เสมี	Semi	เก็ดดำ	Dalbergia assamica Benth.	81	56	0,0408	2,3466	3,4091	0,2125	5,9681
ซู		รักใหญ่	Gluta Usitata	31	25	0,6278	0,9025	1,5152	3,2660	5,6837
เซโปปรี		ก้อแป้น	Castanopsis diversifolia King	63	44	0,2243	1,8051	2,6515	1,1669	5,6234
เดอสิชย		ไก่แดง	Ternstroemia gymnanthera Bedd.	113	31	0,0827	3,2491	1,8939	0,4301	5,5731
เสเจอะบะ		ค่าหด	Engelhardtia apicata	25	19	0,6660	0,7220	1,1364	3,4648	5,3232
ซูเกอแม		รักน้อย	Gluta Obovata	19	19	0,6738	0,5415	1,1364	3,5052	5,1832
เสพะทอ		ไม้ทราบ 62	Unknow 62	31	13	0,6476	0,9025	0,7576	3,3694	5,0295
เปอดะ		ไม้ทราบ 35	Unknow 35	38	31	0,3652	1,0830	1,8939	1,8997	4,8767
เคลอโป		มะเดื่อปล้อง	Ficus hispida Linn. f.	94	25	0,0853	2,7076	1,5152	0,4437	4,6665
เสคอบอ		แข่งกวาง	Wendlandia tinctoria A. DC.	75	31	0,0827	2,1661	1,8939	0,4303	4,4902
เซทีอชะ		ไม้ทราบ 14	Unknow 14	31	13	0,5129	0,9025	0,7576	2,6685	4,3287
แซว		ไม้ทราบ 9	Unknow 9	19	19	0,5063	0,5415	1,1364	2,6338	4,3117
สะพีดา		ไม้ทราบ 49	Unknow 49	31	31	0,2547	0,9025	1,8939	1,3249	4,1213
มอว่า		ไม้ทราบ 46	Unknow 46	75	25	0,0488	2,1661	1,5152	0,2540	3,9352
เสคอป		ไม้ทราบ 53	Unknow 53	63	31	0,0019	1,8051	1,8939	0,0098	3,7087
ไม้ทราบ		ไม้ทราบ 67	Unknow 67	38	25	0,1926	1,0830	1,5152	1,0020	3,6002
เมอะโมบอ		ไม้ทราบ 47	Unknow 47	19	13	0,4178	0,5415	0,7576	2,1737	3,4728
เคอทีพอ		ไม้ทราบ 5	Unknow 5	81	13	0,0462	2,3466	0,7576	0,2404	3,3446
สะเดาป่า		สะเดาป่า	Azadirachta indica Juss. var. Siamensis	56	25	0,0113	1,6245	1,5152	0,0585	3,1983
เสจะ		ไม้ทราบ 54	Unknow 54	81	13	0,0013	2,3466	0,7576	0,0065	3,1107
ซีซัน		ไม้ทราบ 8	Unknow 8	19	19	0,2469	0,5415	1,1364	1,2844	2,9623

ขาลีโปีะ		ไม้ทราบ 10	Unknow 10	38	13	0,2056	1,0830	0,7576	1,0698	2,9104
เสมีวะ		มะเกียงขาว	Eugenia paniala Roxb.	38	19	0,1274	1,0830	1,1364	0,6631	2,8825
เพอเดโพ		ไม้ทราบ 42	Unknow 42	56	19	0,0082	1,6245	1,1364	0,0425	2,8034
เสซุ่ย		ไม้ทราบ 55	Unknow 55	50	19	0,0398	1,4440	1,1364	0,2071	2,7876
เสกวาง		ก้อขาว	Castanopsis argentea A. DC.	31	25	0,0467	0,9025	1,5152	0,2431	2,6608
ตะแควซ่า		ไม้ทราบ 23	Unknow 23	31	25	0,0404	0,9025	1,5152	0,2100	2,6277
เปือคุย		ไม้ทราบ 34	Unknow 34	13	13	0,2850	0,3610	0,7576	1,4827	2,6013
เสเน่		ไม้ทราบ 57	Unknow 57	44	19	0,0338	1,2635	1,1364	0,1757	2,5757
เขเนอมา		ไม้ทราบ 16	Unknow 16	38	13	0,1405	1,0830	0,7576	0,7312	2,5718
เกาะ		ไม้ทราบ 1	Unknow 1	38	19	0,0646	1,0830	1,1364	0,3359	2,5554
ตะซีสอ		ไม้ทราบ 24	Unknow 24	31	19	0,0896	0,9025	1,1364	0,4661	2,5050
เสแบ		ไม้ทราบ 60	Unknow 60	31	25	0,0019	0,9025	1,5152	0,0098	2,4275
มอเมาะ		ไม้ทราบ 45	Unknow 45	25	6	0,2513	0,7220	0,3788	1,3072	2,4080
เขเน่		ไม้ทราบ 15	Unknow 15	56	13	0,0013	1,6245	0,7576	0,0065	2,3887
งอโย		รูกฟ้า	Terminalia alata Heyne ex Roth	25	13	0,1744	0,7220	0,7576	0,9072	2,3868
เขจุมิ		ไม้ทราบ 12	Unknow 12	38	19	0,0048	1,0830	1,1364	0,0252	2,2446
เปือห่อ		ไม้ทราบ 36	Unknow 36	19	19	0,1006	0,5415	1,1364	0,5235	2,2014
เสยาส่า		มะขามป้อม	Phyllanthus emblica Linn.	25	19	0,0089	0,7220	1,1364	0,0462	1,9046
จำปีป่า		จำปีป่า	Michelia floribunda Finet & Gagnep.	6	6	0,2506	0,1805	0,3788	1,3039	1,8632
เสลาจะ		ไม้ทราบ 65	Unknow 65	50	6	0,0040	1,4440	0,3788	0,0209	1,8438
เสโทเบอะ		ไม้ทราบ 56	Unknow 56	13	13	0,1379	0,3610	0,7576	0,7176	1,8362
เสก้อ		ไม้ทราบ 50	Unknow 50	19	19	0,0108	0,5415	1,1364	0,0560	1,7339
บ่อวา		ไม้ทราบ 29	Unknow 29	25	13	0,0405	0,7220	0,7576	0,2109	1,6905
เขปรีอว่า		ไม้ทราบ 19	Unknow 19	31	6	0,0649	0,9025	0,3788	0,3374	1,6187
เสล่า		ไม้ทราบ 64	Unknow 64	25	13	0,0117	0,7220	0,7576	0,0607	1,5403
โพแตะ		ไม้ทราบ 43	Unknow 43	25	13	0,0038	0,7220	0,7576	0,0195	1,4991
ชะมูซื่อ		มะไฟป่า	Baccaurea ramiflora Lour.	19	13	0,0373	0,5415	0,7576	0,1943	1,4934
เสก้อเว		ไม้ทราบ 51	Unknow 51	25	13	0,0013	0,7220	0,7576	0,0065	1,4861
เคาะ		เคาะ	Scleropyrum maingayi Hook. f.	13	13	0,0706	0,3610	0,7576	0,3674	1,4860
เทเพดละ		ไม้ทราบ 26	Unknow 26	6	6	0,1756	0,1805	0,3788	0,9137	1,4730
เขเพดละ		ไม้ทราบ 20	Unknow 20	13	13	0,0606	0,3610	0,7576	0,3154	1,4340
ตะกึ		ไม้ทราบ 22	Unknow 22	19	13	0,0188	0,5415	0,7576	0,0975	1,3967
เขบอแล		ไม้ทราบ 17	Unknow 17	19	13	0,0103	0,5415	0,7576	0,0538	1,3529
เสซึ		มะเม่าสาย	Antidesma sootepense Craib	19	13	0,0046	0,5415	0,7576	0,0242	1,3233
เบอจะะ		ไม้ทราบ 30	Unknow 30	6	6	0,1244	0,1805	0,3788	0,6471	1,2064
แค		แค	Dolichandrone app.	13	13	0,0063	0,3610	0,7576	0,0325	1,1511

เซ		ไม้ทราบ 11	Unknow 11	13	13	0,0050	0,3610	0,7576	0,0260	1,1446
เส้ที		ไคร้บค(ราชาวดีป่า)	Buddleja asiatica Lour.	13	13	0,0044	0,3610	0,7576	0,0228	1,1414
เส้พอเยาะ		ไม้ทราบ 61	Unknow 61	6	6	0,1006	0,1805	0,3788	0,5235	1,0828
พลอบลีคลี		ไม้ทราบ 37	Unknow 37	6	6	0,0838	0,1805	0,3788	0,4357	0,9950
เดอะเซซี		ไม้ทราบ 25	Unknow 25	13	6	0,0098	0,3610	0,3788	0,0510	0,7908
เส้ลาแม่		ไม้ทราบ 66	Unknow 66	13	6	0,0094	0,3610	0,3788	0,0491	0,7889
ริโคคี		ไม้ทราบ 48	Unknow 48	6	6	0,0432	0,1805	0,3788	0,2246	0,7839
เส้คลี		ไม้ทราบ 52	Unknow 52	6	6	0,0383	0,1805	0,3788	0,1993	0,7586
เทอคลี		ไม้ทราบ 27	Unknow 27	13	6	0,0032	0,3610	0,3788	0,0168	0,7566
พอดะคอ		ไม้ทราบ 39	Unknow 39	13	6	0,0022	0,3610	0,3788	0,0115	0,7513
คอกุแม่		ไม้ทราบ 2	Unknow 2	6	6	0,0338	0,1805	0,3788	0,1756	0,7349
ปะดะ		ไม้ทราบ 33	Unknow 33	6	6	0,0263	0,1805	0,3788	0,1366	0,6959
พะหอสะ		ไม้ทราบ 41	Unknow 41	6	6	0,0244	0,1805	0,3788	0,1268	0,6861
เคอะปีพลอ		ไม้ทราบ 6	Unknow 6	6	6	0,0143	0,1805	0,3788	0,0746	0,6339
เซดาไฮ		ไม้ทราบ 13	Unknow 13	6	6	0,0100	0,1805	0,3788	0,0520	0,6113
เส้ลูหมือ		เหมือดหลวง	Symplocos laurina Alston	6	6	0,0094	0,1805	0,3788	0,0491	0,6084
เส้คุมอ		พลับป่า	Diospyros undulata Wall.	6	6	0,0069	0,1805	0,3788	0,0358	0,5951
เส้เกาะกิ		ก้อแพะ	Quercus kerrii Craib	6	6	0,0050	0,1805	0,3788	0,0260	0,5853
เบอะช้อ		ไม้ทราบ 31	Unknow 31	6	6	0,0050	0,1805	0,3788	0,0260	0,5853
เป้อเครีอ		เหมือดโลด	Aporusa villosa Baill.	6	6	0,0038	0,1805	0,3788	0,0195	0,5788
ช้อ		ไม้ทราบ 7	Unknow 7	6	6	0,0038	0,1805	0,3788	0,0195	0,5788
พะเนอเทอ		ไม้ทราบ 40	Unknow 40	6	6	0,0038	0,1805	0,3788	0,0195	0,5788
ที		สารกึป่า	Anneslea fragrans Wall.	6	6	0,0031	0,1805	0,3788	0,0163	0,5756
มอดิโค		ไม้ทราบ 44	Unknow 44	6	6	0,0031	0,1805	0,3788	0,0163	0,5756
เดอะเซ		ไม้ทราบ 21	Unknow 21	6	6	0,0025	0,1805	0,3788	0,0130	0,5723
พอกะ		ไม้ทราบ 38	Unknow 38	6	6	0,0019	0,1805	0,3788	0,0098	0,5691
เคอเซปรี		ไม้ทราบ 4	Unknow 4	6	6	0,0013	0,1805	0,3788	0,0065	0,5658
เทอมีนอ	Te mee bor	ไม้ทราบ 28	Unknow 28	6	6	0,0013	0,1805	0,3788	0,0065	0,5658
แบลลอคอ		ไม้ทราบ 32	Unknow 32	6	6	0,0013	0,1805	0,3788	0,0065	0,5658



# APPENDIX D - Pictures of soil methods



Soil Sample



Infiltration



Auger

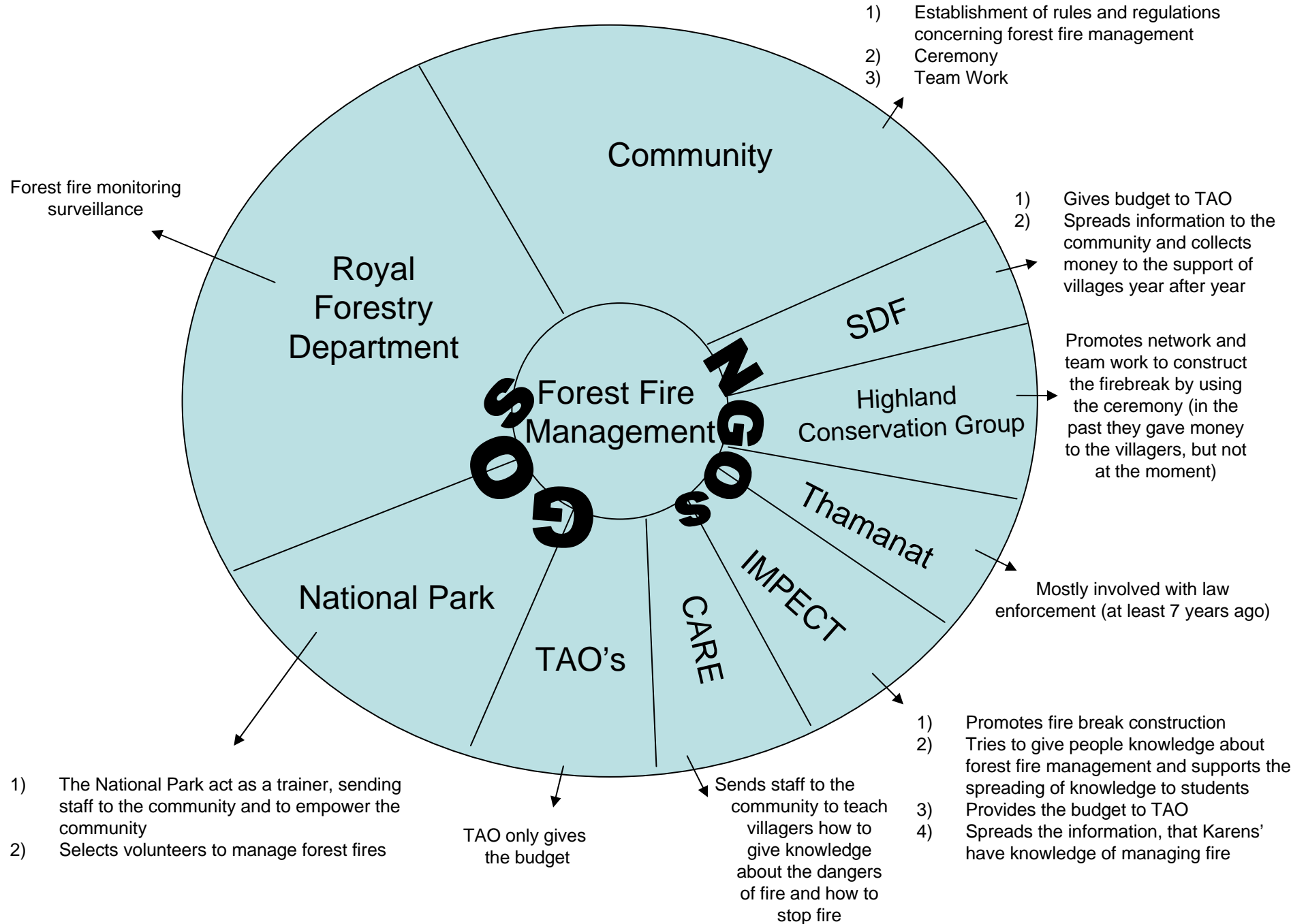


Surface Biomass



Soil Humidity

# APPENDIX E - Interview results from Government Organizations and NGOs





# APPENDIX F - Transect walks of Ban Huai Khanun 1-3

## Transect Walk - Ban HuaiKhanun 1

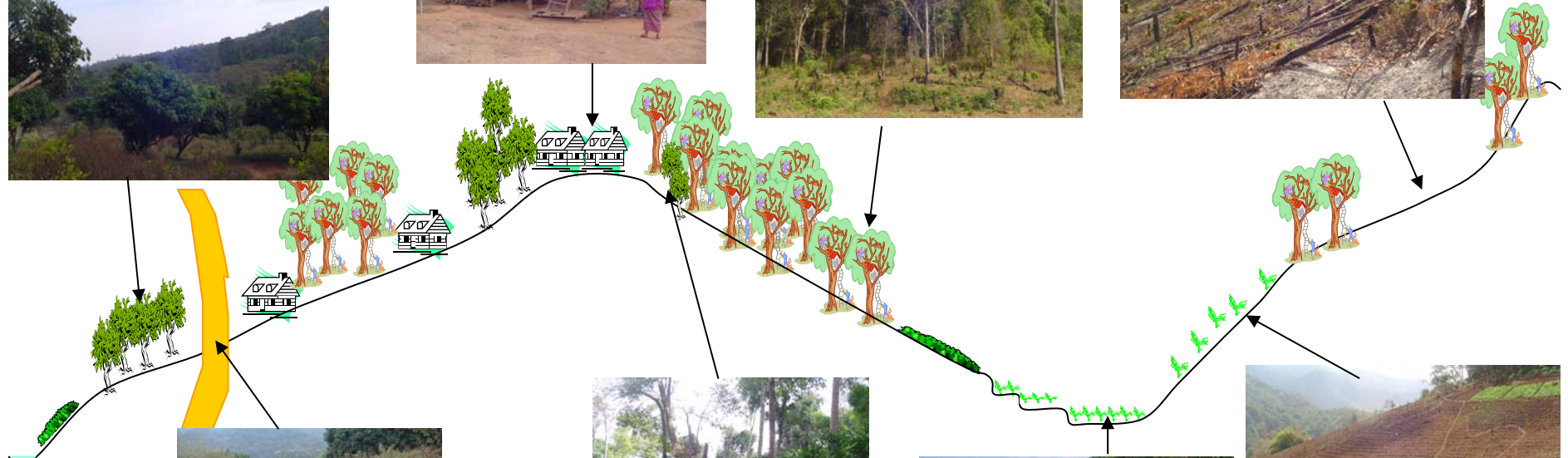
Orchard field  
 GPS: 0451669/2029783  
 Elev 1139



Utilization Forest  
 GPS: 0451669/2029783  
 Elev 1139



Burned Area For Upland Rice  
 GPS: 0451155/2029858  
 Elev 1125



Khanun River



Village road  
 GPS: 0451989/2029700  
 Elev: 1123



Forest with coffee tree  
 GPS: 0451773/2029721  
 Elev: 1159



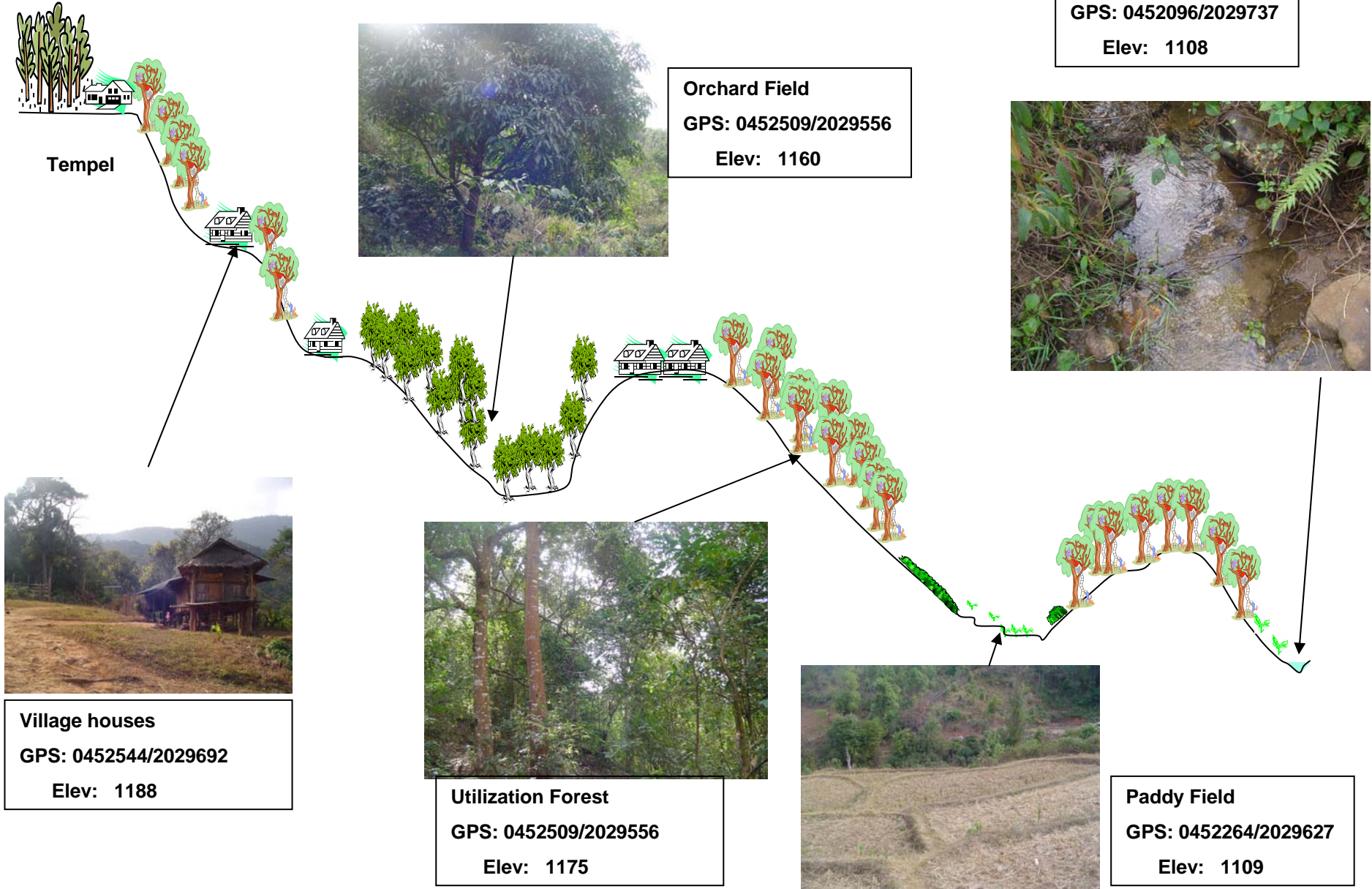
Paddy Field  
 GPS: 0451412/2029763  
 Elev: 1067



Taro Field  
 GPS:  
 Elev

# APPENDIX ?

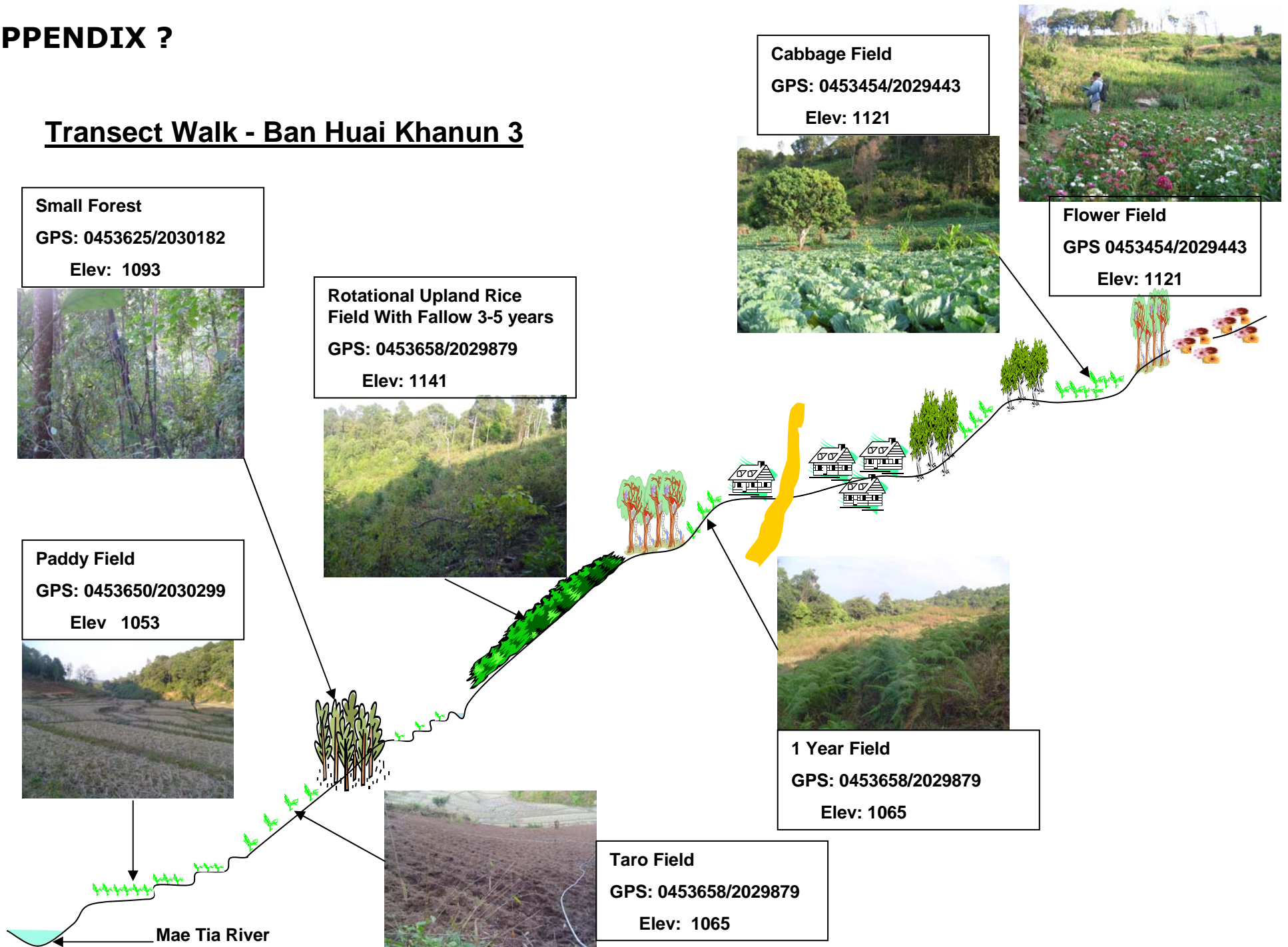
## Transect Walk - Ban Huai Khanun 2





# APPENDIX ?

## Transect Walk - Ban Huai Khanun 3





# **APPENDIX G - Summarization of PRA and interviews**

## **Summarized from PRA and interview - Forest fire management by Community**

In the study of forest fire prevention and management, it is found that Baan kanun village has prevention and managed the forest fire as follows:

Firebreak construction.

Agricultural firebreak construction

Patrol

Strategy for stop the fire

Establishment of forest fire prevention regulation

### **Firebreak construction**

According to the study, firebreak line was built at the same of the beginning of the community. As the livelihood strategy of Karen people is involved in rotational planting, they have to make the firebreak to prevent to fire into other' s area and the forest. The firebreak construction became practical and be known in 1992or for 13 years ago. The Mhong from Pa Kuay village has joined with the Karen to make this firebreak construction.

- The community will restore the firebreak line 1 time per year on 15 February.
- The dry leafs and grass will be cleared out of the firebreak, so, nothing could not catch fire in the firebreak.
- The width of the firebreak is up to the geographical aspect. In the windy area, the width of the firebreak may be 6-8 meters. In unwind area; the width of firebreak will be 3 meters.

Sometimes, the creek or the road can be considered as a firebreak as well.

- In each firebreak restoration, each household has to send someone, at least one person, to participate. If the household can not participate, they have to inform the headman first, otherwise, they have to pay 100 Baht.
- Their equipment is a knife that they used for cutting bamboo.
- There was a ceremony “ Le me” that concerned to firebreak construction. The purpose of ceremony is to show respect to the nature and a curse to the one who destroy the forest.

#### **In field firebreak**

- When the Karen in Huay Kanun village burns the field, each household has to make a firebreak at the boundary of the field in order to prevent the forest fire. The firebreak line has to be cleared before burning. The burn has to be done in a small area when the wind is not too strong. Sometimes, people would burn at the top of the field to reduce the intensification of the fire.
- If the area of burning is not large, villagers would watch out the fire. But if the area is larger than the household can control, people in that location will be asked co-operation to guard the fire.

## **Patrol**

According to the study, the period of patrol is the period that forest fire occurs very often, mostly from February – April. Each time, there will be 2 persons in charge of patrol. Patrol will be conducted twice daily in daytime and nighttime.

- Community will set a schedule in each patrol, if the person who is in charge of the duty can not does his assignment, he will be fined for 100 Bhats. The money will be the budget of lunch in the forest fire prevention activities.

## **Strategy for stop the fire**

If the fire was not too strong, each household will send at least 1 person to stop the fire. The way they stop the fire is up to the situation.

- Using wood to slap on the fire.
- Making firebreak, get rid of everything that could catch fire. In case that the fire was very difficult to stop. The width of firebreak will be 3-4 meters.
- If the villager can not control the situation, they would ask for help from another village.

## **The establishment of the forest fire prevention and management regulation**

- Even though, the rule is not written, it was taught by their process the forbidden of conserved forest burning.

## Beliefs & ceremonies of Karen in Baan Huay Kanun concerning to the forest fire management

According to the study, the “ Le me “ ceremony was used as a strategy in forest fire management. The ceremony of Karen people in Mae tia watershed is a reflection of the application of ceremony to the forest fire management. The ceremony was initiated by IMPECT in 1992. The Mhong & Karen have participated this activity in the Op Luang National Park.

### **Definition of the ceremony**

“ Le me to’ can be translated as “ the feast for firebreak’ s spirit “

Le means Sacrifice

Me means Fire

To means Line

### **Aspect of “ Le me to” ceremony**

Component used in ceremony

For village level

2 Chickens

1 Bottle of whisky

For multi-village level  
same type

Animal use has to be the

( IMPECT use pig to perform

the ceremony at huay som poy

village)

The ceremony is performed by the senior people in the village ( Mr. La )

### **Participants**

- At least 1 person from each household
- In the multi-village level, the representative of the village can be anyone.

### **Locations**

- For community level, the ceremony will be performed at the middle of the firebreak as they believe that the forest spirit would reside in the big tree.
- For multi-community level, IMPECT will choose the location from the consent of the meeting. Last year, the location was in Huay som poy.

## APPENDIX H - Example of questionnaire

ชุดที่ Number.....

แบบสอบถาม [Questionnaire]  
บ้านห้วยขนุน อ.จอมทอง จ. เชียงใหม่  
[Baan Huay Kanun, Jomthong District, Chiang

ที่อยู่ของผู้ให้สัมภาษณ์ [Address]

บ้านเลขที่ [House's number].....หมู่บ้าน

[Village].....หมู่

ที่ [moo] .....ตำบล [ Tumboon ] .....

อำเภอจอมทอง จังหวัดเชียงใหม่ Jomthong District, Chiang Mai Province

ผู้ให้สัมภาษณ์ [Interviewee]

ชื่อ [Name].....นามสกุล

[Surname].....

อายุ [Age]..... ปี

มีฐานะเป็น .....ของครัวเรือน [Household Financial  
Status]

ผู้สัมภาษณ์ [Interviewer]

ชื่อ [Name].....นามสกุล

[Surname].....

**ตอนที่ 1 ข้อมูลพื้นฐานครัวเรือน**

**Part 1 Household basic information**

1.1 การนับถือศาสนา Religion ( ) พุทธ Buddhism ( ) อิสลาม Islamic ( )

คริสต์ Christianity ( ) นับถือผี Spirit ( ) อื่น ๆ Others (ระบุ Please)

1.2 เป็นครอบครัว ( ) ไทยพื้นราบ ( ) ชาวไทยภูเขา (ระบุชาติพันธุ์)

You are ( ) Lowlander ( ) Highlander/ Please

specify.....

1.3 ประวัติการตั้งถิ่นฐาน ได้ย้ายมาจากที่ไหน When and from where did you

move into the area.....ย้ายมากี่ปี for how

many.....

ทำไมถึงย้ายมาหมู่บ้านนี้.Why did you move to this

village.....

1.4 สมาชิกทุกคนในครัวเรือน How many

household.....คน person [s]

อายุ Age	ชาย Male	หญิง Female	การศึกษา Education	อาชีพ Profession
0-15 ปี [Year]				
16-60 ปี [Year]				
มากกว่า 60ปี Over 60 Years				
จำนวนคนที่ออกไปทำงานถาวร One who is gone to out farm working permanently				
จำนวนคนที่ออกไปทำงานช่วงฤดูแล้ง Person who is go for out farm work in dry season				

**แรงงานในครอบครัว Household labour force**

1.1 จำนวนคนที่เป็นแรงงาน ทำงานในบ้านนี้ มี ..... คน / Person [s]

The number of labor in household

1.2 จำนวนแรงงานในภาคการเกษตร..... คน/ Person [ s]

The labor in agriculture

### 1.3 จำนวนคนที่ไปทำงานนอกหมู่บ้าน

The number of out farm labor

#### 1.3.1 ไปทำงานมากกว่า 1 ปี

For more than 1 year

##### คนที่ 1 First person

อายุ Age..... ปี สถานภาพในครอบครัว Household

status .....

งานที่ทำ

Profession .....

สถานที่ทำงาน

Workplace .....

รายได้ Income..... บาท/เดือน Baht per month

##### คนที่ 2 Second person

อายุ Age..... ปี สถานภาพในครอบครัว Household

status .....

งานที่ทำ

Profession.....

สถานที่ทำงาน

Workplace .....

รายได้ Income .....

##### คนที่ 3

อายุ Age..... ปี สถานภาพในครอบครัว Household

status .....

งานที่ทำ

Profession .....

สถานที่ทำงาน

Workplace .....

รายได้ Income .....

#### 1.3.2 ไปทำงานชั่วคราวตามฤดูกาล น้อยกว่า 6 เดือน

Seasonal out farm working [ less than 6 months ]

##### คนที่ 1 First person



อายุ Age ..... ปี สถานภาพในครอบครัว Household

status .....

งานที่ทำ

Profession .....

สถานที่ทำงาน

Workplace .....

รายได้ Income ..... บาท/เดือน Baht per month

คนที่ 2 Second person

อายุ Age ..... ปี สถานภาพในครอบครัว Household

status .....

งานที่ทำ

Profession .....

สถานที่ทำงาน

Workplace .....

รายได้ Income ..... บาท/เดือน Baht per month

คนที่ 3

อายุ Age ..... ปี สถานภาพในครอบครัว Household

status .....

งานที่ทำ Profession .....

สถานที่ทำงาน

Workplace .....

รายได้ Income ..... บาท/เดือน Baht per month





พื้นที่ในการเพาะปลูกเพิ่มขึ้นหรือลดลงเมื่อเทียบกับตอนที่ได้รับพื้นที่มา The planting area was increased and decreased compared with the time you get the land.

.....  
.....

ผลผลิตเพิ่มขึ้นหรือลดลงเมื่อเทียบจากปีก่อนหน้า In order to compare with the previous year, does the yield increase or decrease?

.....  
.....

ข้าวนาดำและข้าว เข้ามาในชุมชนได้อย่างไร เข้ามาเมื่อไหร่ How the lowland rice and rice

.....  
.....

มีการเลือกพื้นที่ในการปลูกอย่างไร (ข้าวไร่ และ พืชไร่) how do you choose the location for grow upland rice and upland plant

.....  
.....

อดีตถึงปัจจุบัน การเผาไรทำอย่างไร มีการเปลี่ยนแปลงหรือไม่ เผาบ่อยแค่ไหน From the past until present, has the way of field burning change? How often do you burn the field?

.....  
.....

รอบหมุนเวียนของข้าว ไร่มีวิธีการอย่างไร How the rotational round in the field be used?

.....  
.....



## การใช้ประโยชน์จากป่า-อาหารของชาวบ้าน Forest utilization- food for villagers

ชนิด Type	ช่วงเวลาในการเก็บ Period												ปริมาณ Amount			รายได้ / ปี Income per annum	ประเภทป่า Type of the forest	
	ม.ค. Jan	ก.พ. Feb	มี.ค. Mar	เม.ย. Apr	พ.ค. May	มิ.ย. Jun	ก.ค. Jul	ส.ค. Aug	ก.ย. Sep	ต.ค. Oct	พ.ย. Nov	ธ.ค. Dec	กิน For eating	ขาย For sell	รวม Total			
4. สัตว์ (animals) 4.1 4.2 4.3																		
5. แมลง ( Insect ) 5.1 5.2 5.3																		

ตามความคิดของท่าน ท่านคิดว่าของป่ามีเพิ่มมากขึ้นหรือลดลงหลังจากการเกิดไฟป่า ชนิดใดเพิ่มขึ้น ชนิดใดลดลง In your opinion, do you think NTFPs will increase or decrease after forest fire, which kind was increased and which kind was decreased?

.....

.....

.....

## การใช้ประโยชน์จากป่า-อาหารของวัวและควาย Forest utilization- food for cattle

ชนิด Type	ช่วงเวลาในการเก็บ [ Period ]												เพื่อ [purpose]		พืชในป่า Plant in the forest	
	ม.ค. Jan	ก.พ. Feb	มี.ค. Mar	เม.ย. Apr	พ.ค. May	มิ.ย. Jun	ก.ค. Jul	ส.ค. Aug	ก.ย. Sep	ต.ค. Oct	พ.ย. Nov	ธ.ค. Dec	กิน To eat	ขาย To sell		
วัว [ Cow ]																
ควาย [ Buffalo ]																
อื่นๆ [ Others ]																

ช่วงเกิดไฟป่าอาหารของสัตว์เพิ่มขึ้นหรือลดลง อะไรที่เพิ่มขึ้น อะไรลดลง ถ้าลดลงชาวบ้านนำอาหารสัตว์มาจากไหน อะไรบ้าง

When the forest fire occurs, the animal's food was increased or decreased? And for what kind of food? If the food was decreased, how do you get the food for animal, and from where?

.....

.....

**Part/ตอนที่ 2 การจัดการไฟป่า Fire management**

การจัดการไฟป่า Forest Fire Management	มี Yes	ไม่มี No
1. การทำแนวกันไฟ Firebreak construction		
2. การลาดตระเวนพื้นที่ Forest monitoring		
3. การช่วยดับไฟ Helping each other to stop the Fire		
4. การตั้งกฎเกี่ยวกับไฟป่า Forest fire regulation		
5. การทำแนวกันไฟในไร่ Firebreak in field		

วิธีการคุมไฟในไร่มีวิธีอย่างไร How do you manage the fire in your field?

.....  
 .....

การเกิดไฟป่าแต่ละครั้งมีพื้นที่ที่ได้รับ ความเสียหายประมาณเท่าใด In each time, how large of the area has been affected?

.....

มีวิธีการจัดการไฟป่าอย่างไร How is the Method of forest fire management?

.....  
 .....

มีวิธีการฟื้นฟูป่าหลังจากเกิดไฟป่าอย่างไร How do you rehabilitate the forest after the fire occurs?

.....  
 .....





ระดับการเข้าร่วม Level of participation

การเข้าร่วมพิธีกรรม	ทุกครั้ง Always	บางครั้ง Sometimes	ไม่เคย Never
หลือ เม โต (เลี้ยงไฟ) “Lu me to” ( Fire ceremony)			

ท่านเคยใช้วิธีการเหล่านี้หรือไม่ Have you ever been use this method?

วิธีการ Method	เคย Yes	ไม่เคย No
- มีการเผาหัวไร่เพื่อมิให้ไฟลามเข้าป่า ( burning in the top of the field to prevent the fire to the forest )		
- มีการเผาเพื่อการเกษตร ( Agricultural burning )		
-มีการใช้ไฟเพื่อหาอาหารในป่า ( Using fire for collecting food in		
- มีการทำแนวกันไฟในไร่ (Making Firebreak in the field )		

ในกรณีที่เกิดไฟป่าท่านคิดว่า

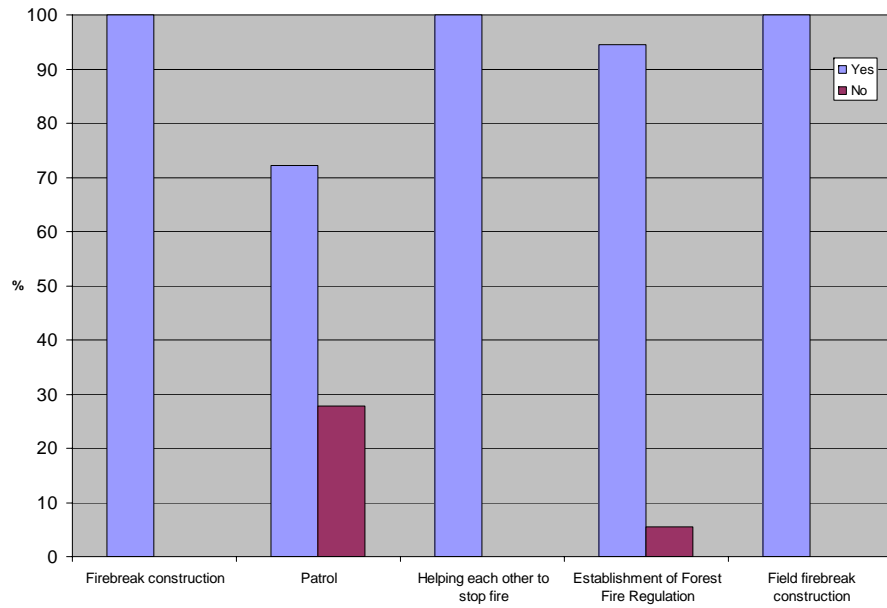
ต้นไม้ที่ได้รับความเสียหายจากไฟป่าสามารถแตกกิ่งก้านขึ้นมาใหม่ได้อีกหรือไม่ อย่างไร In case that the forest fire occurs, do you think the tree can regenerate itself or not and how?.....

ท่านคิดว่า พื้นที่ที่โดนไฟเผาและไม่โดนมีความแตกต่างทางด้านผลผลิตอย่างไร Do you think affected and Unaffected area has differences in term of the yield?

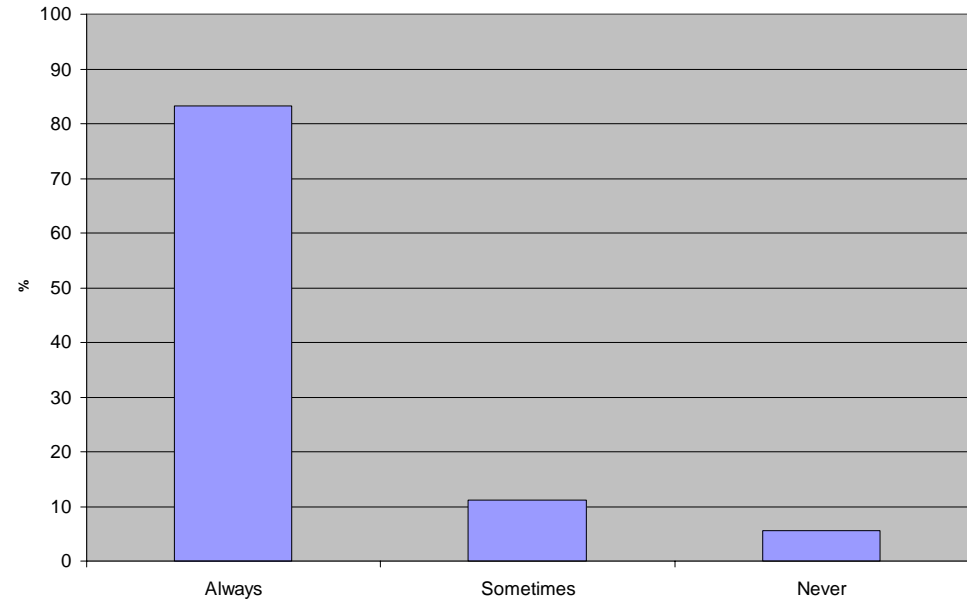
ในอดีตและปัจจุบันชาวบ้านมีวิธีการอย่างไรในการบำรุงปรับปรุงดินเพื่อให้ผลผลิตดีขึ้น From the past until present, how the villagers improve the soil quality?

# APPENDIX I - Summarized questionnaire results

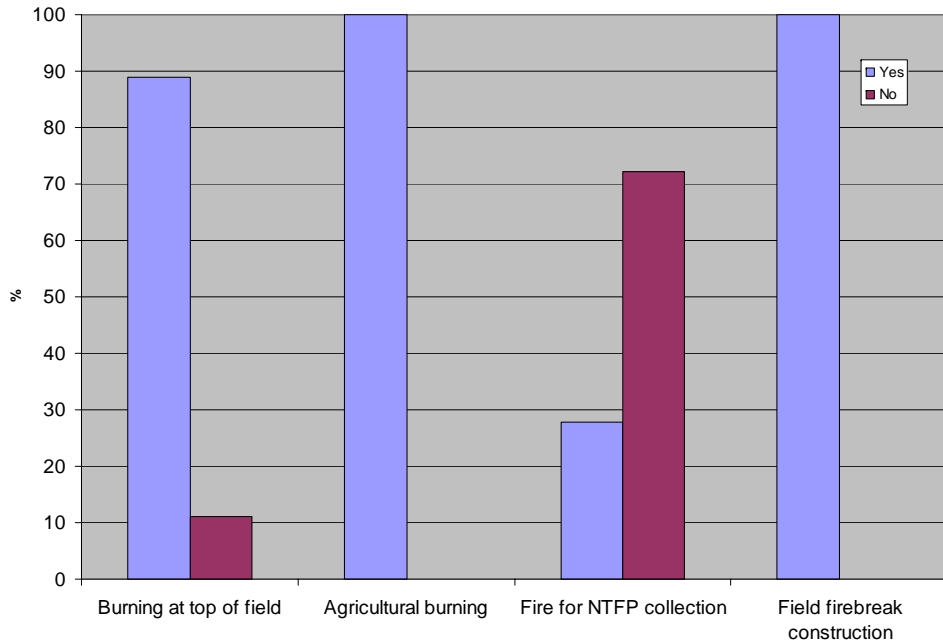
## Community/Forest fire management (n = 18)



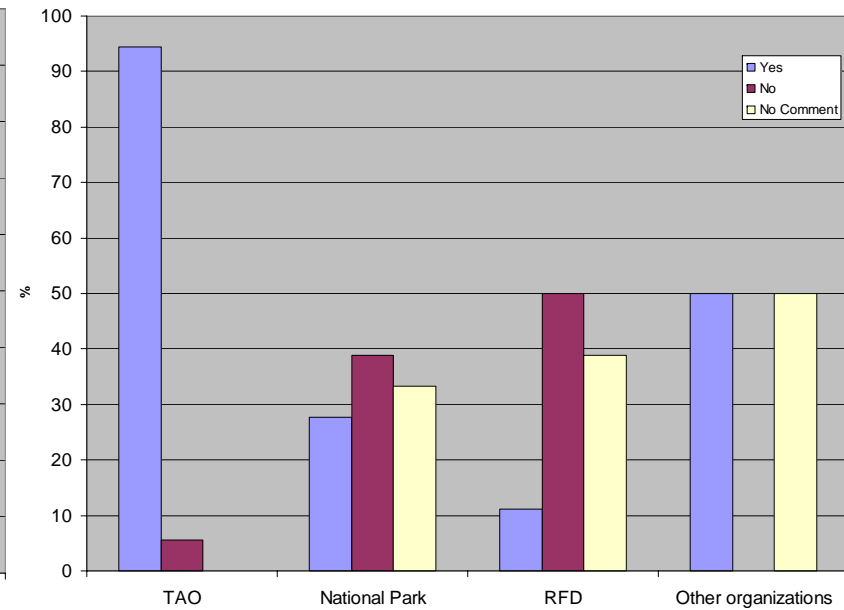
## Participation level in the 'Lu Me To' ceremony (n = 18)



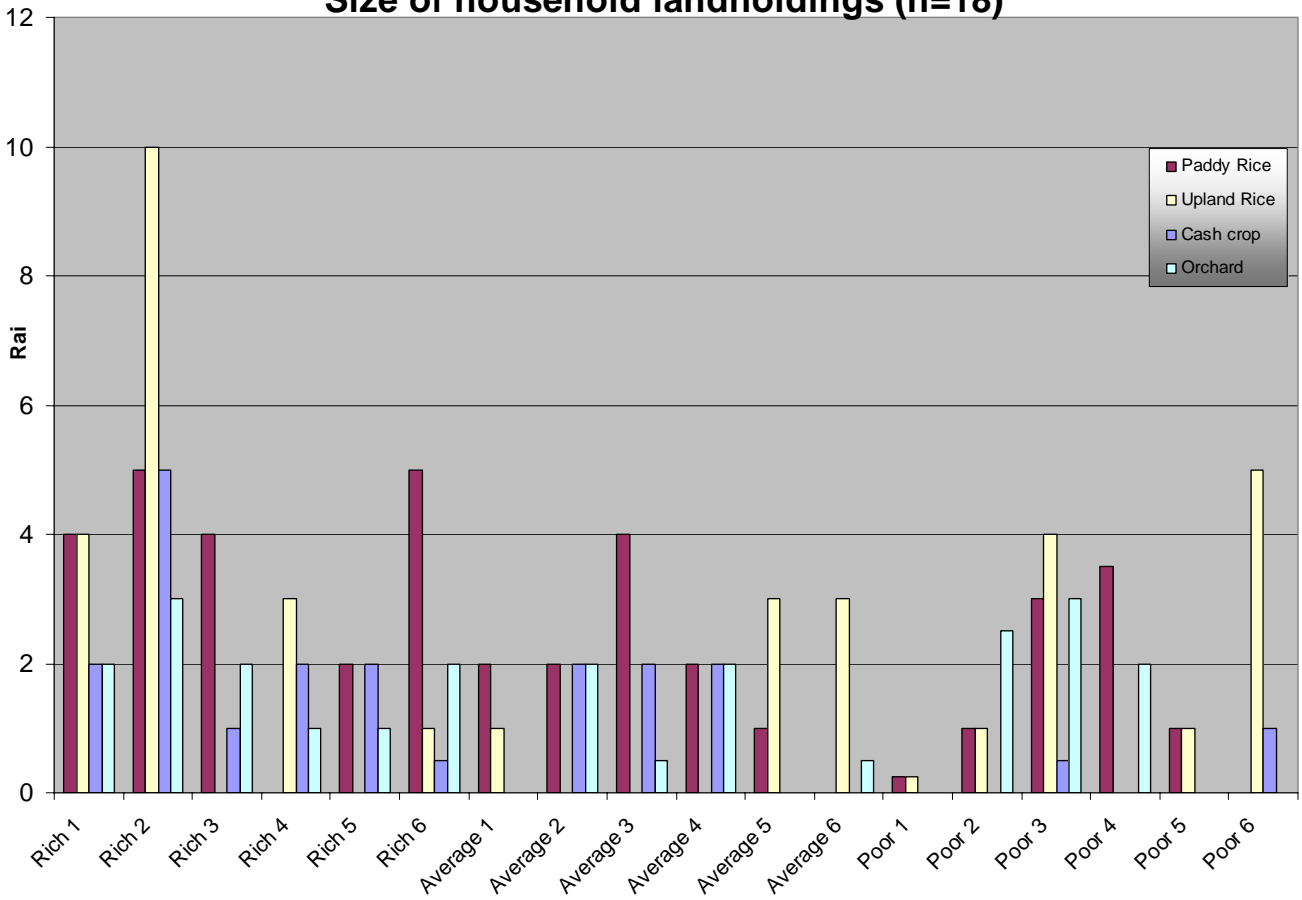
## Methods of fire use (n=18)



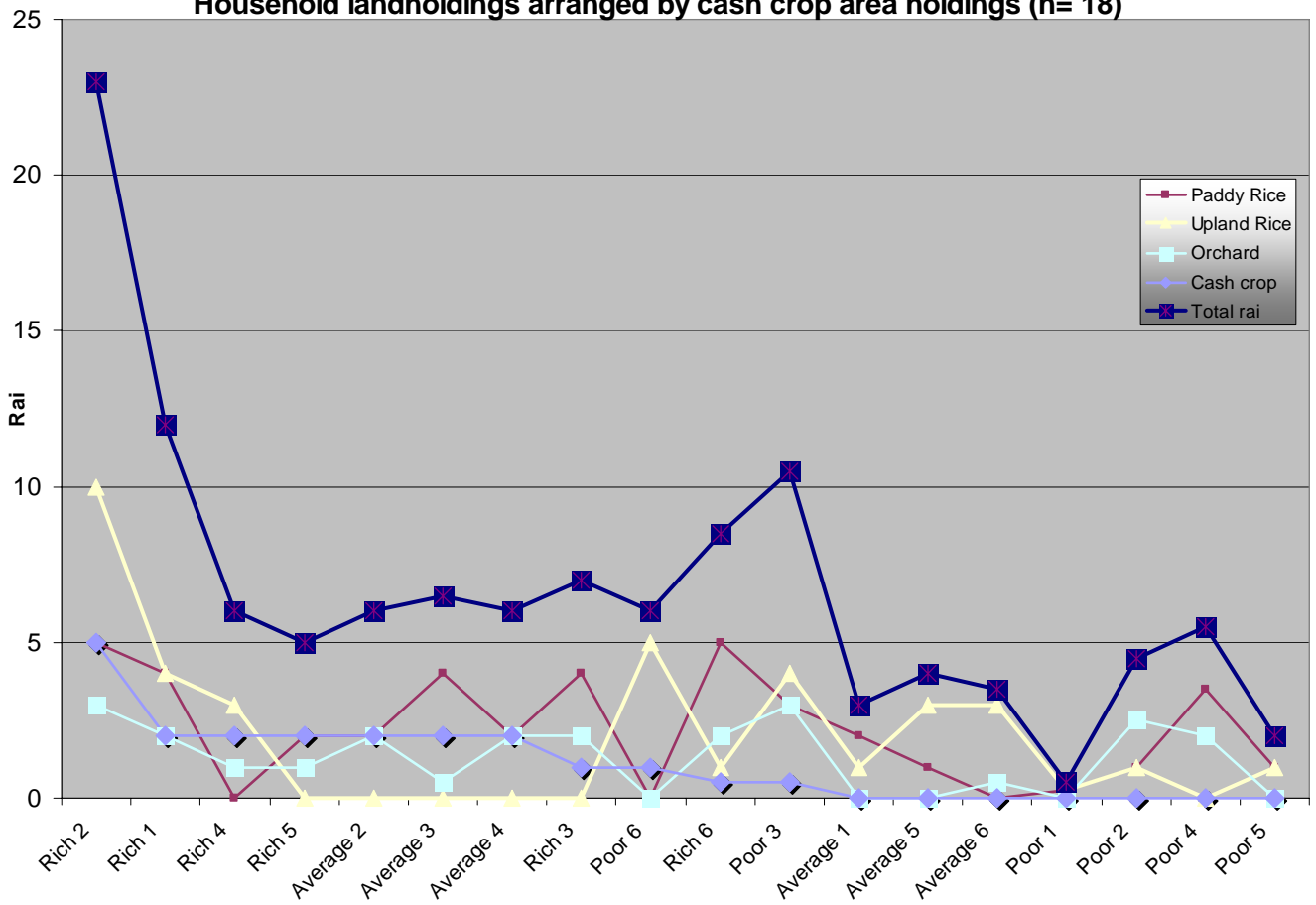
## Organizations participating in forest fire management (n=18)



Size of household landholdings (n=18)



Household landholdings arranged by cash crop area holdings (n= 18)

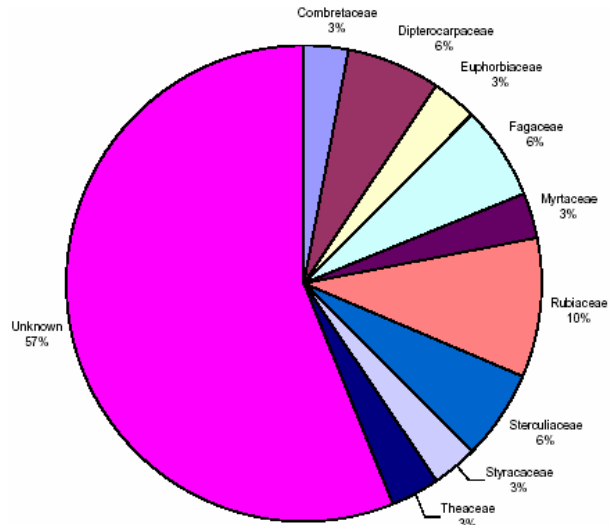


## APPENDIX J - Frequency of tree families found in forest plots

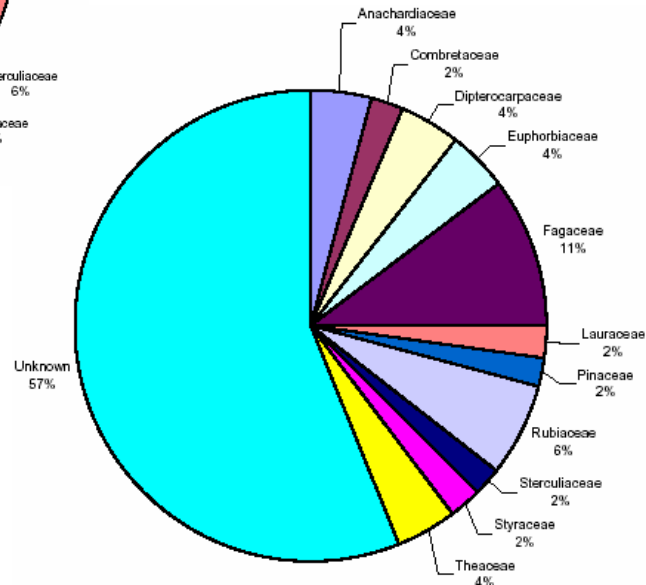
Species	Description (Gardner et al)
<i>Adina cordifolia</i> Hook. f.	Deciduous tree. Scattered in semi-open forests, often associated with Teak
<i>Anneslea fragrans</i> Wall.	Small/medium-sized tree: Very common, especially on open rocky ridges with pine, but is also sometimes found in moister forests
<i>Antidesma sootepense</i> Craib	Shrub or small tree. Common in both deciduous and evergreen forests.
<i>Aporosa villosa</i> Baill.	Small deciduous tree. Common understory tree of both deciduous and pine forests.
<i>Azadirachta indica</i> Juss. var. <i>siamensis</i> Valetton	Deciduous tree. Scattered in open areas, particularly south of Lamphun, frequently planted throughout North Thailand. (Neem tree!!!)
<i>Baccaurea ramiflora</i> Lour.	Small evergreen tree. Common understory tree of fire-free forests.
<i>Buddleja asiatica</i> Lour.	Shrub or small tree. Very common in waste-ground and along forest edges.
<i>Canarium subulatum</i> Guill.	Deciduous tree. Common in semi-open forests, often with bamboo.
<i>Castanopsis argentea</i> A. DC.	NA
<i>Castanopsis argyrophylla</i> King	Semi-evergreen tree. Common in drier forests.
<i>Castanopsis diversifolia</i> King	Deciduous/partly deciduous tree. Common and widespread in hill evergreen forest, often gregarious.
<i>Castanopsis pierrei</i> Hance	NA
<i>Dalbergia assamica</i> Benth.	Small deciduous tree. Very common in open, fire-prone areas, often shrubby & coppicing.
<i>Dalbergia oliveri</i> Gamble	Deciduous tree. Common, semi-open forests but avoiding very degrading areas.
<i>Diospyros undulata</i> Wall.	Evergreen tree. Fairly common, semi-open areas.
<i>Dipterocarpus tuberculatus</i> Roxb.	Deciduous tree. Extremely common in dry dipterocarp forests – listed by the RFD as the most abundant tree in Chiang Mai Province often growing in very degraded and fire damaged sites.
<i>Dolichandrone</i> spp.	Deciduous trees. Scattered in open forests from Chiang Mai southwards.
<i>Engelhardtia apicata</i>	NA
<i>Erythrina subumbrans</i> Merr.	Large deciduous tree. Very common, distinct of both dry and moist forests.
<i>Eugenia Limnaea</i> Ridl.	NA
<i>Eugenia paniala</i> Roxb.	Evergreen/partly deciduous tree. Introduced, commonly cultivated for its fruits.
<i>Ficus hispida</i> Linn. f.	Small independent evergreen or partly deciduous tree. Very common, open areas
<i>Gardenia sootepensis</i> Hutch.	Deciduous tree. Fairly common in semi-open and dry dipterocarp forests.
<i>Gluta Obovata</i>	Semi-evergreen tree w. toxic sap. Very common in semi-open forests
<i>Gluta Usitata</i>	Semi-evergreen of briefly deciduous tree. Very common, favouring dry, open areas along ridges. Irritating sap.
<i>Goniothalamus griffithii</i> Hook. f. & Th.	Shrub or small tree. Uncommon, scattered in the understory of less-disturbed forests.
<i>Lithocarpus calathiformis</i> Rehd. et Wils.	Evergreen Tree. Scattered in semi-open forests
<i>Lithocarpus cantleyanus</i> Rehd.	NA
<i>Lithocarpus sootepensis</i> A. Camus	Small or medium evergreen tree.
<i>Litsea glutinosa</i> C.B. Robinson	Small deciduous or semi-evergreen tree. Common and widespread, semi-open forests.
<i>Michelia floribunda</i> Finet & Gagnep.	Evergreen tree. Rare, in less-disturbed forests usually above 1500 m.
<i>Nenga pumila</i> Wendl.	NA

<i>Phyllanthus emblica</i> Linn.	Small deciduous tree. Very common in drier semi-open forests, fire resistant.
<i>Pinus kesiya</i> Royle ex Gordon	Common in semi-open forests between 1000-1700m. Favours exposed ridges w. thin sandy soils.
<i>Prunus cerasoides</i>	Deciduous tree. Common in open disturbed areas – often planted along roadsides because of its beautiful flowers & fastgrowing habit.
<i>Quercus kerrii</i> Craib	Deciduous tree, often coppicing. Locally common in semi-open forests, sometimes with dipterocarp spp.
<i>Quercus kingiana</i> Craib	Deciduous tree. Fairly common in semi-open forest, sometimes with dry dipterocarp spp.
<i>Reevesia siamensis</i> Craib	Shrub or small tree. Uncommon in N. Thailand.
<i>Schima wallichii</i> Korth.	Large tree. Very common throughout the region, forming a characteristic element of hill evergreen forests, but also found more scatteredly in many other forest types.
<i>Scleropyrum maingayi</i> Hook. f.	NA
<i>Shorea hemslayana</i> King ex Foxw.	NA
<i>Shorea obtusa</i> Wall.	Deciduous tree. Extremely common in dry degraded areas
<i>Styrax apricus</i> Fletch.	NA
<i>Symplocos laurina</i> Alston	Shrub or small tree. Fairly common, understory of hill evergreen forest to 2500 m.
<i>Terminalia alata</i> Heyne ex Roth	Deciduous tall tree. Common in semi-open forests.
<i>Terminalia bellerica</i> Roxb.	Deciduous tree. Common in semi-open forests in N. Thailand
<i>Ternstroemia gymnanthera</i> Bedd.	Small or medium tree. Widespread in lowland and hill forests from 700-2000m
<i>Wendlandia tinctoria</i> A. DC.	Evergreen shrub/small tree. Very common under storey of hill evergreen forests.

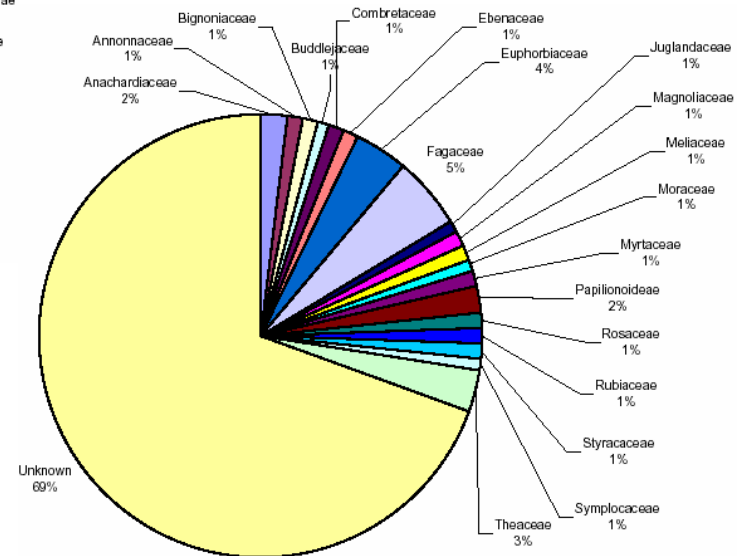
# APPENDIX K - Frequency of tree families found in forest plots



Forest plot #1 burnt 1 year ago



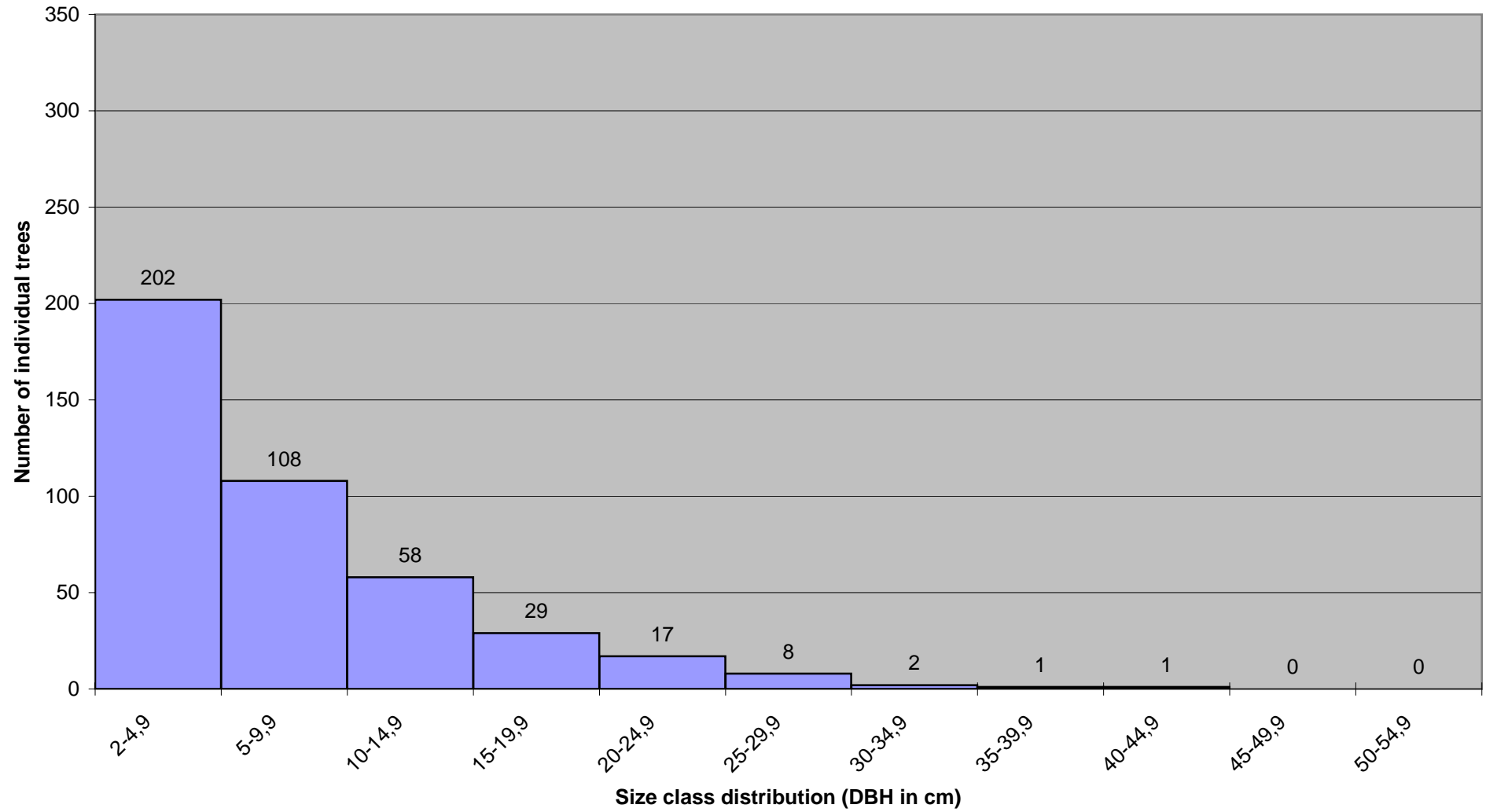
Forest plot #2 burnt 5 years ago



Conservation Forest (Control plot)

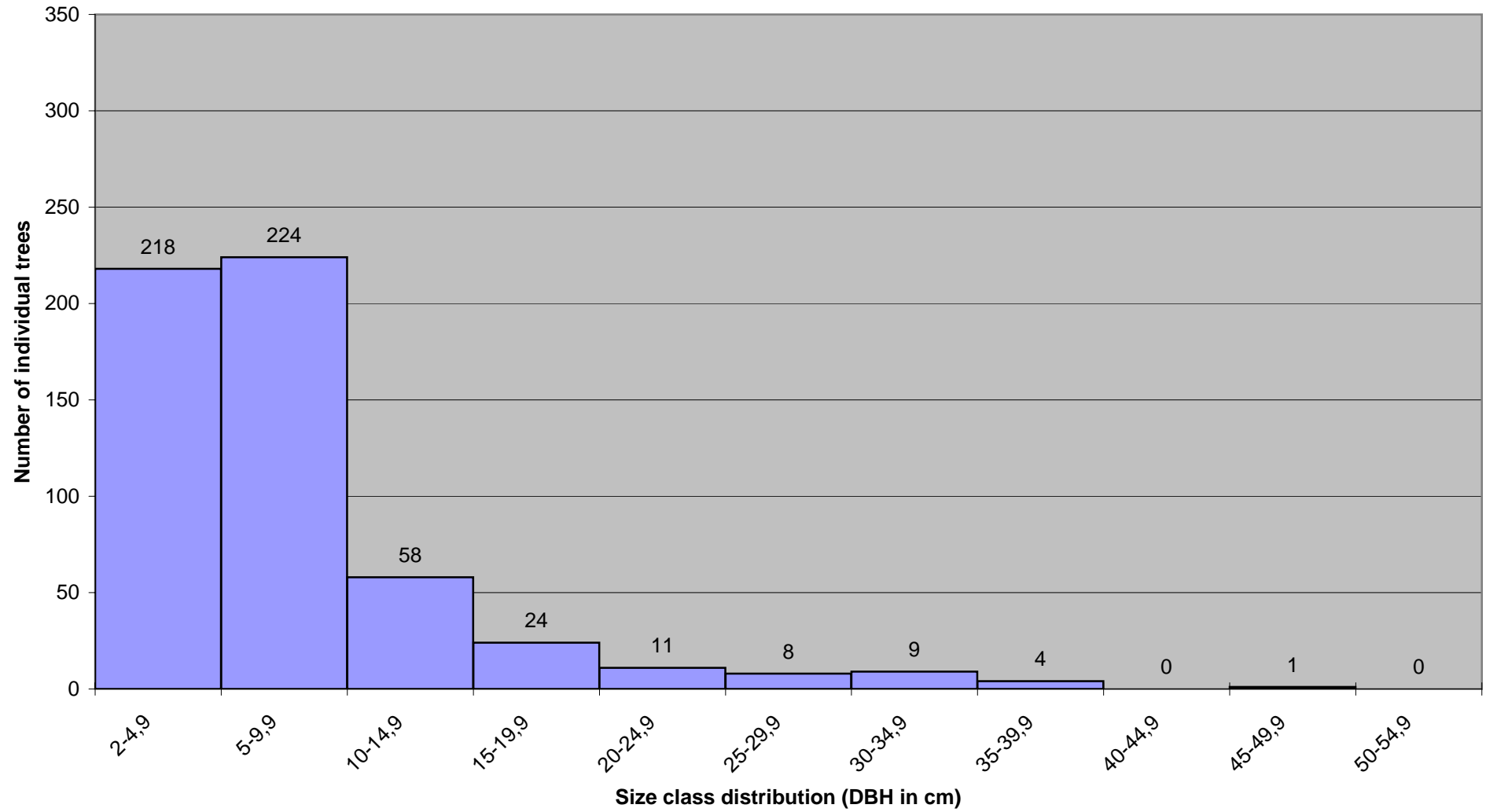
# APPENDIX L - Size class distribution charts

Forest plot #1 burnt 1 year ago

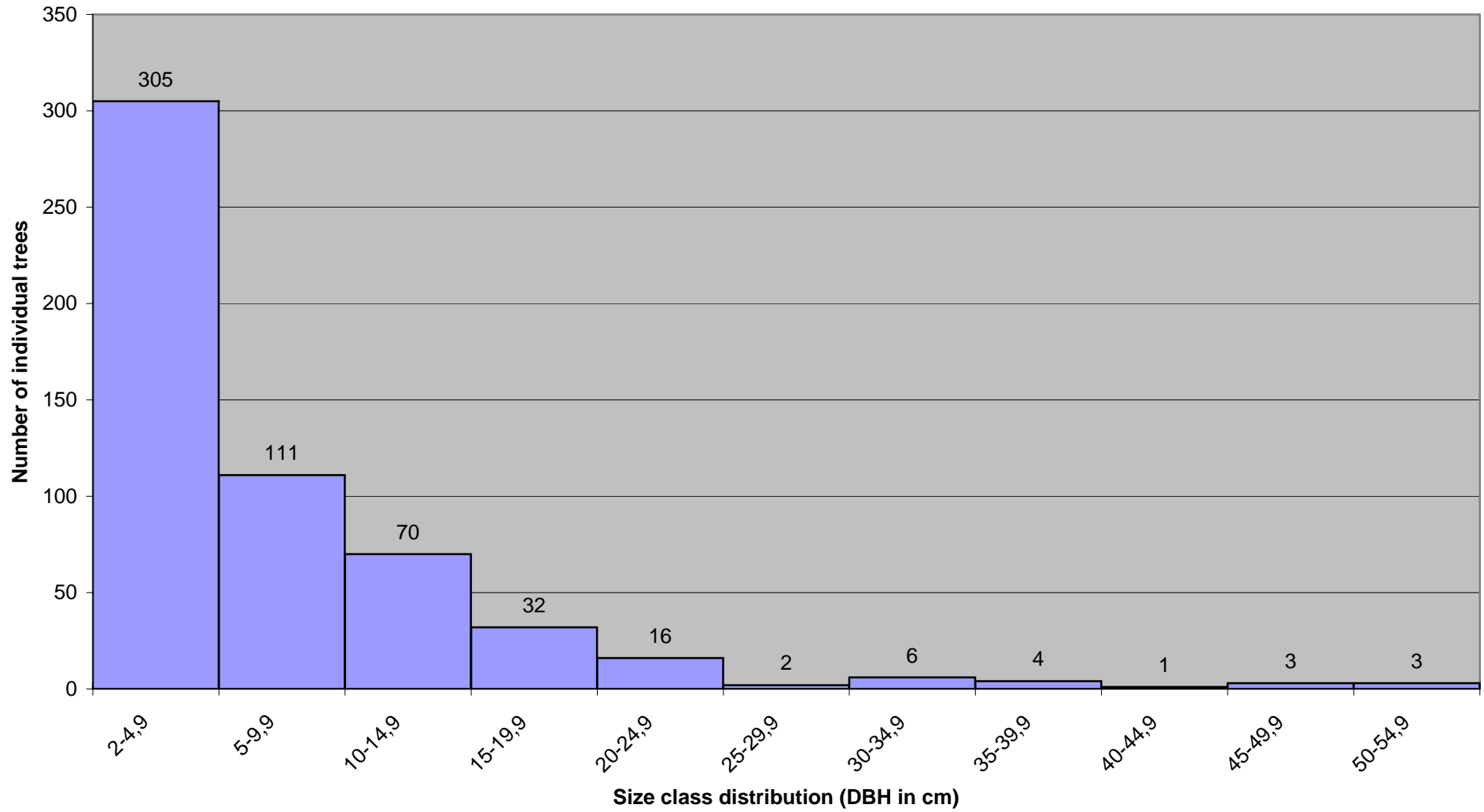




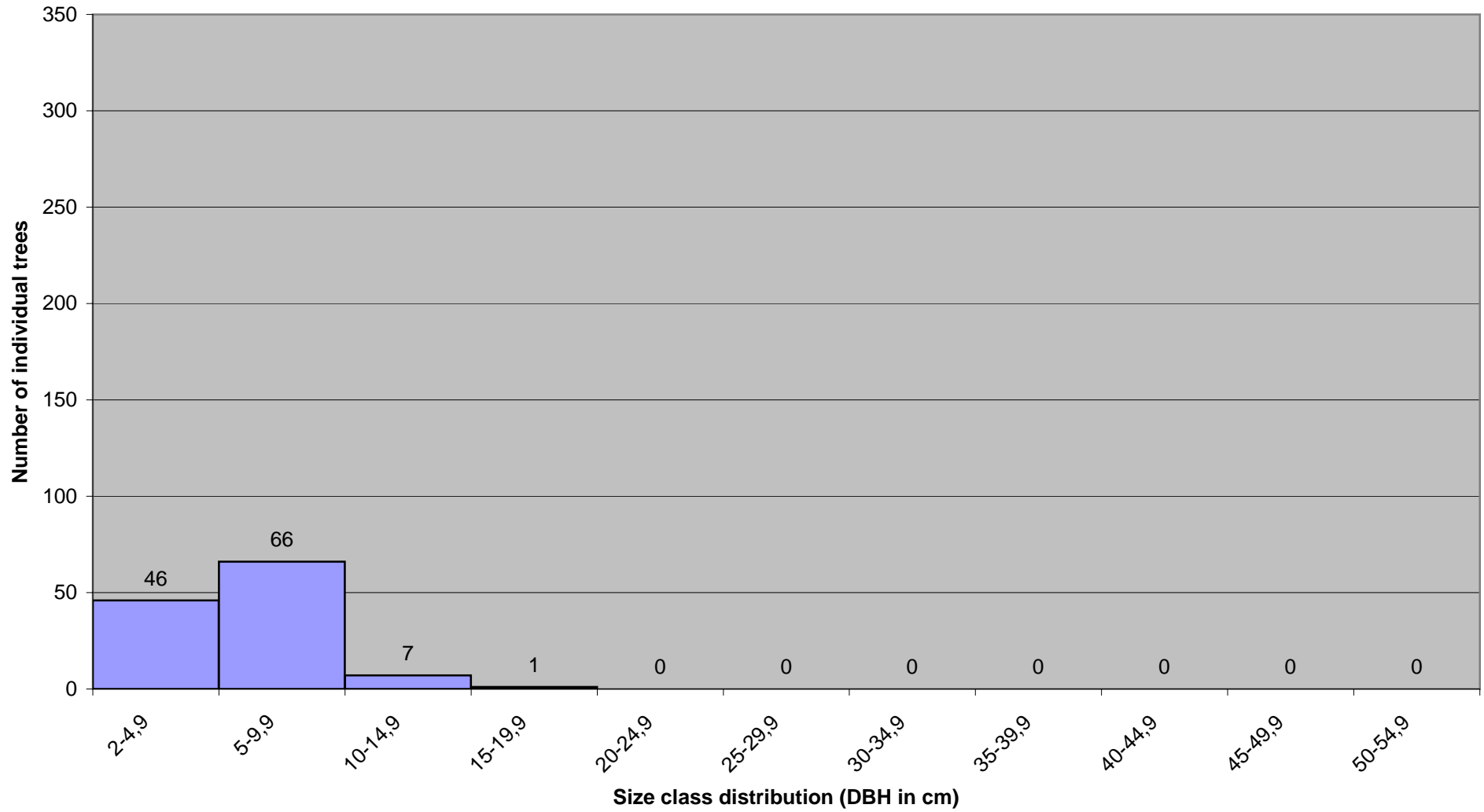
### Forest plot #2 burnt 5 years ago



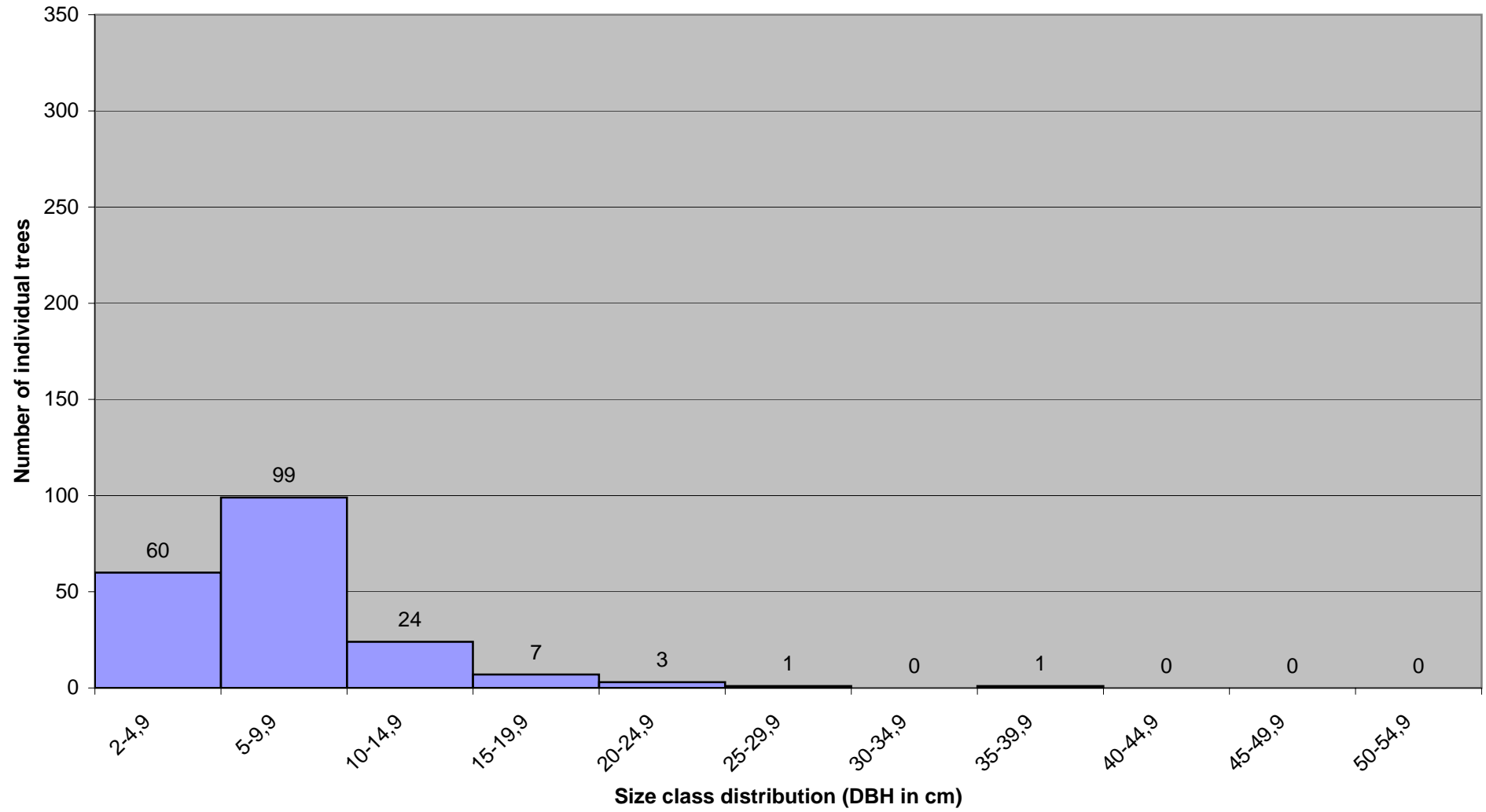
### Conservation Forest (Control plot)



### 3-year fallow forest

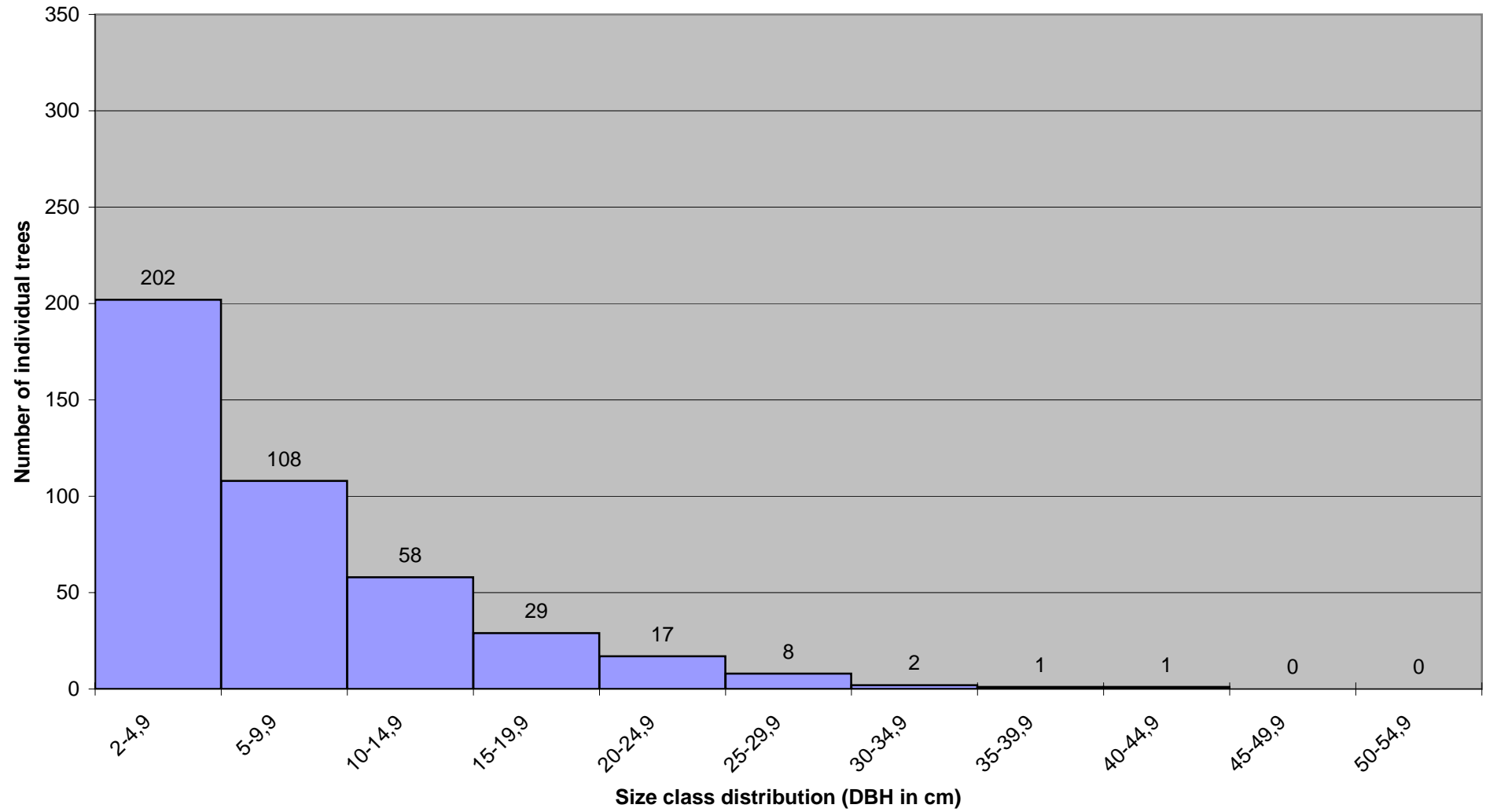


### 5-year fallow forest

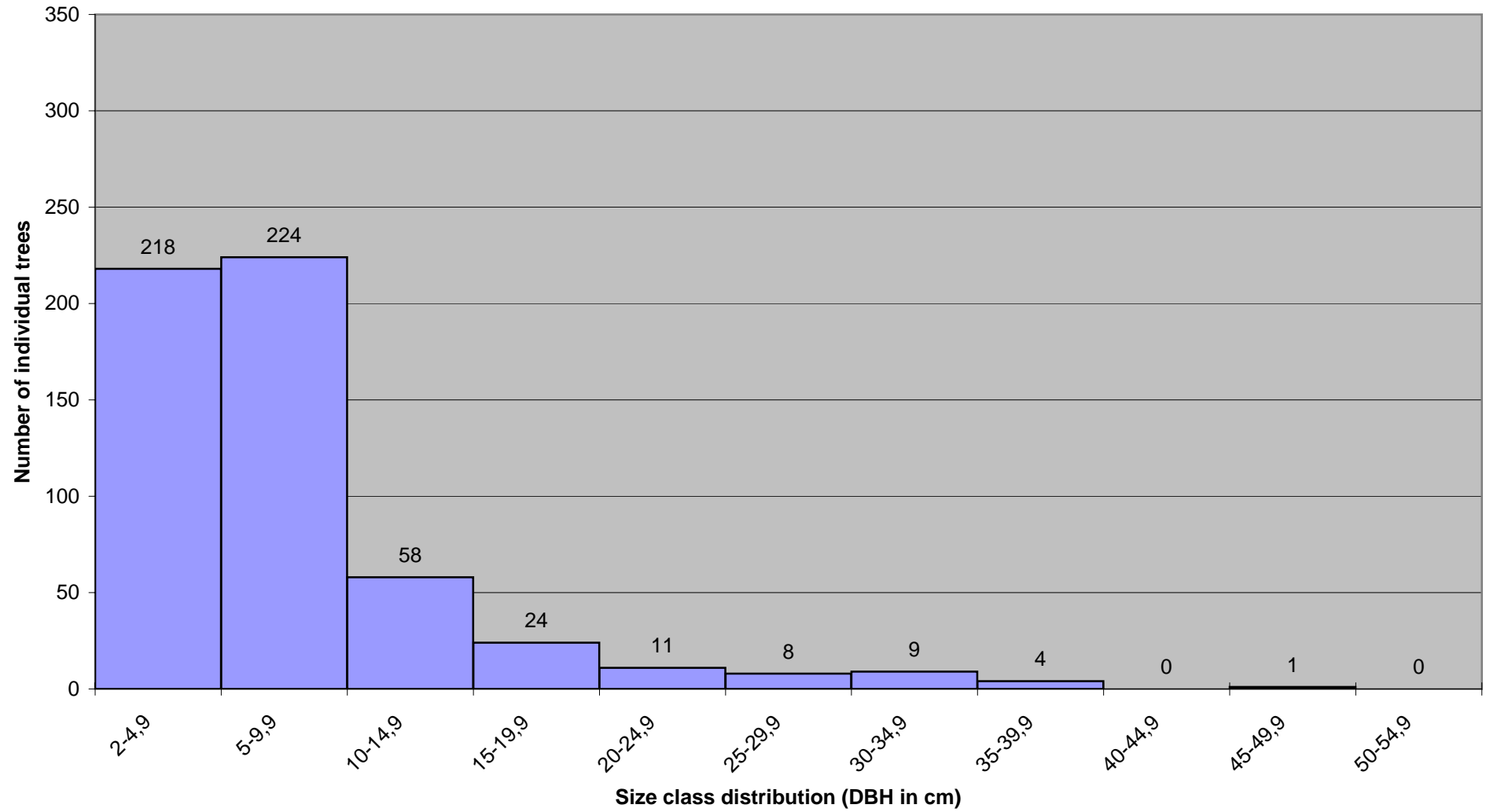


# APPENDIX L - Size class distribution charts

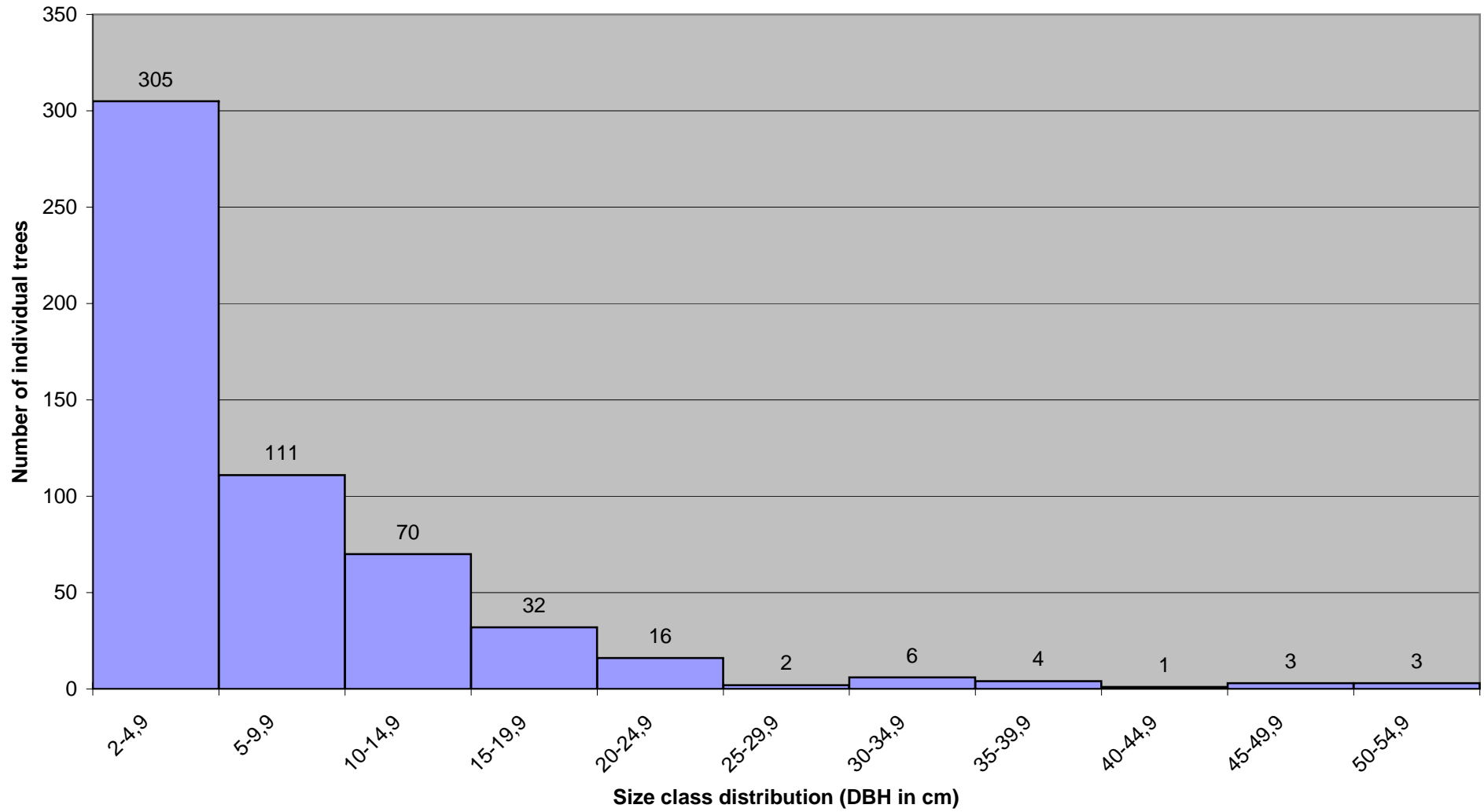
Forest plot #1 burnt 1 year ago



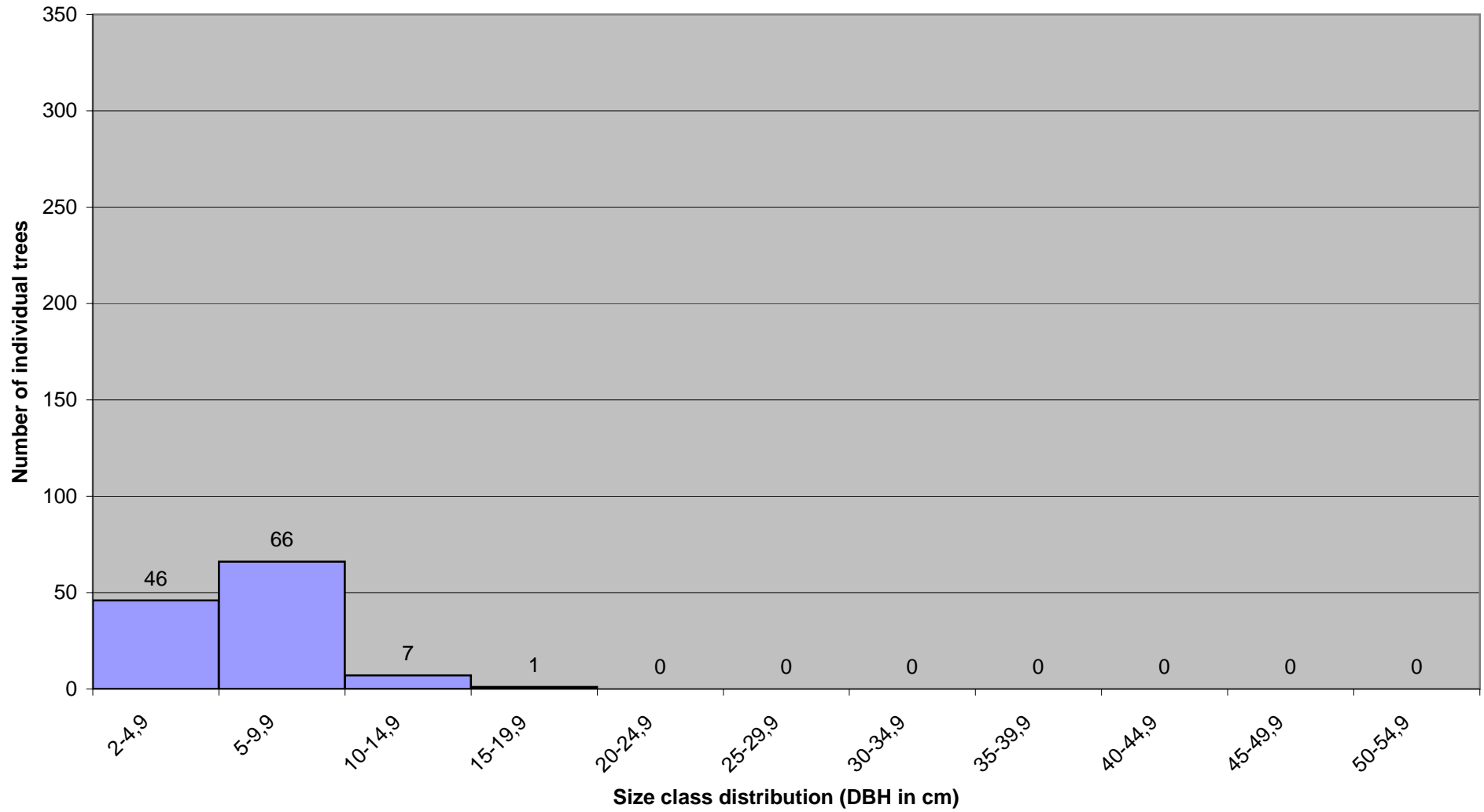
### Forest plot #2 burnt 5 years ago



### Conservation Forest (Control plot)

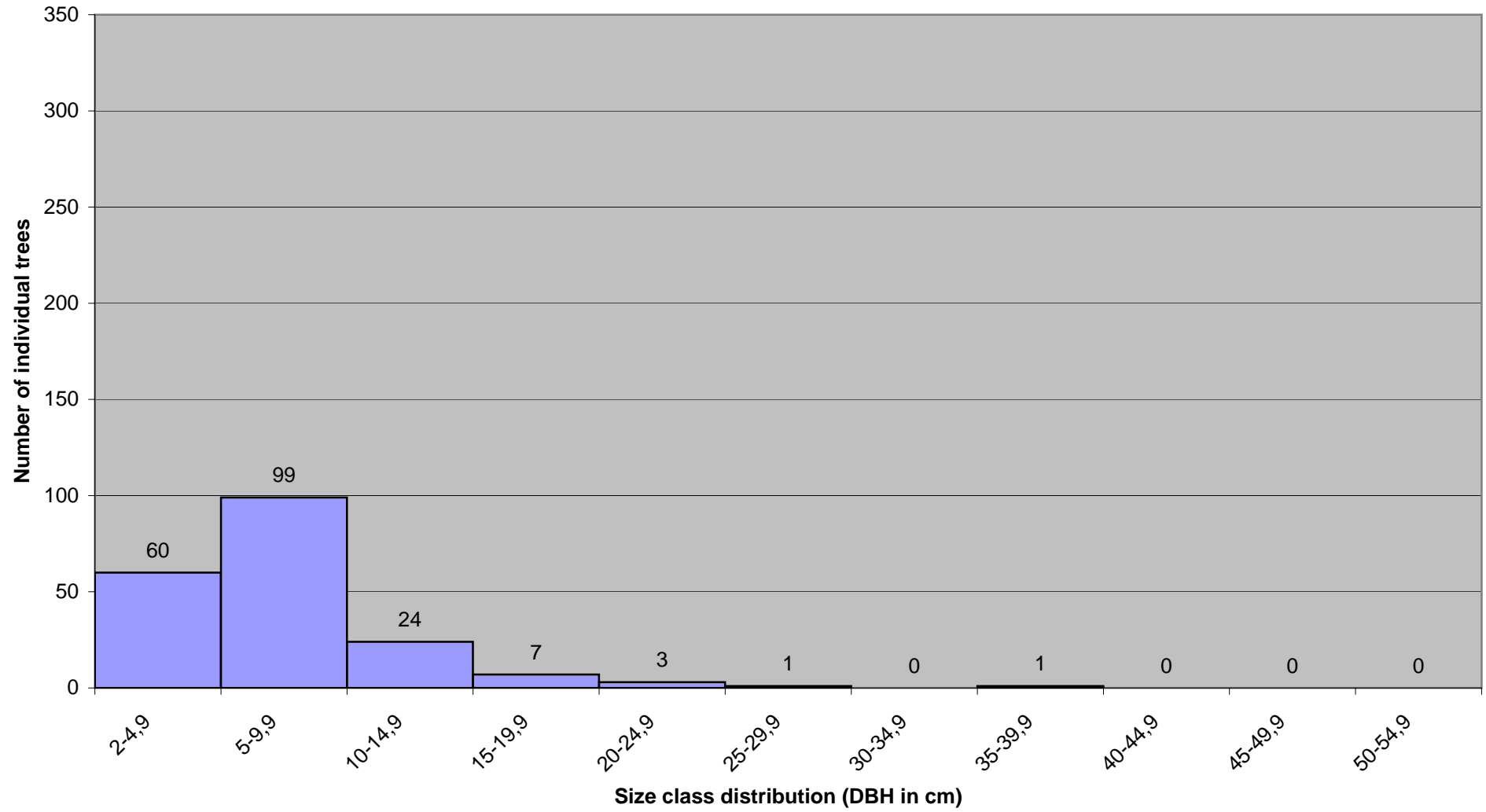


### 3-year fallow forest

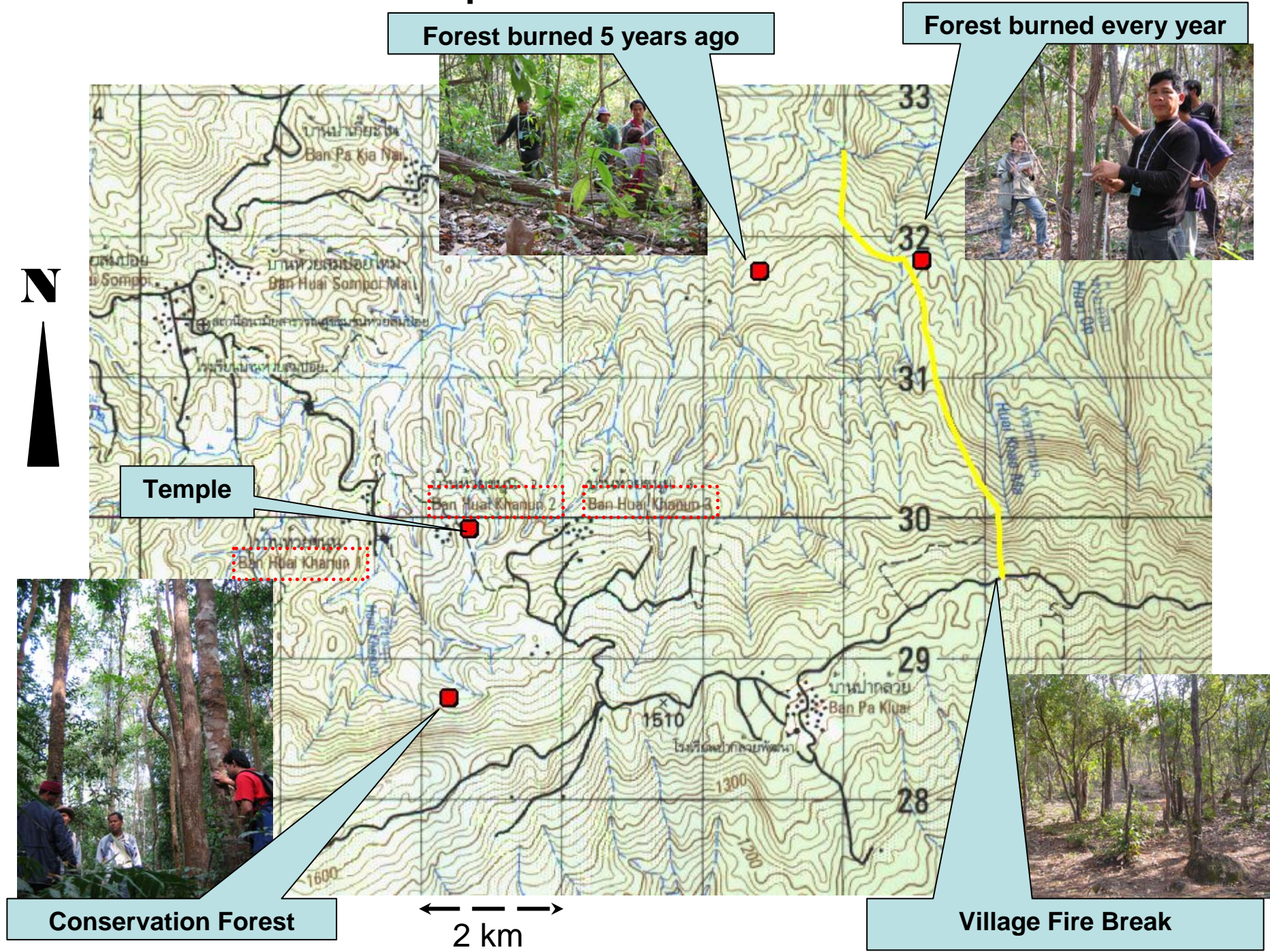




### 5-year fallow forest

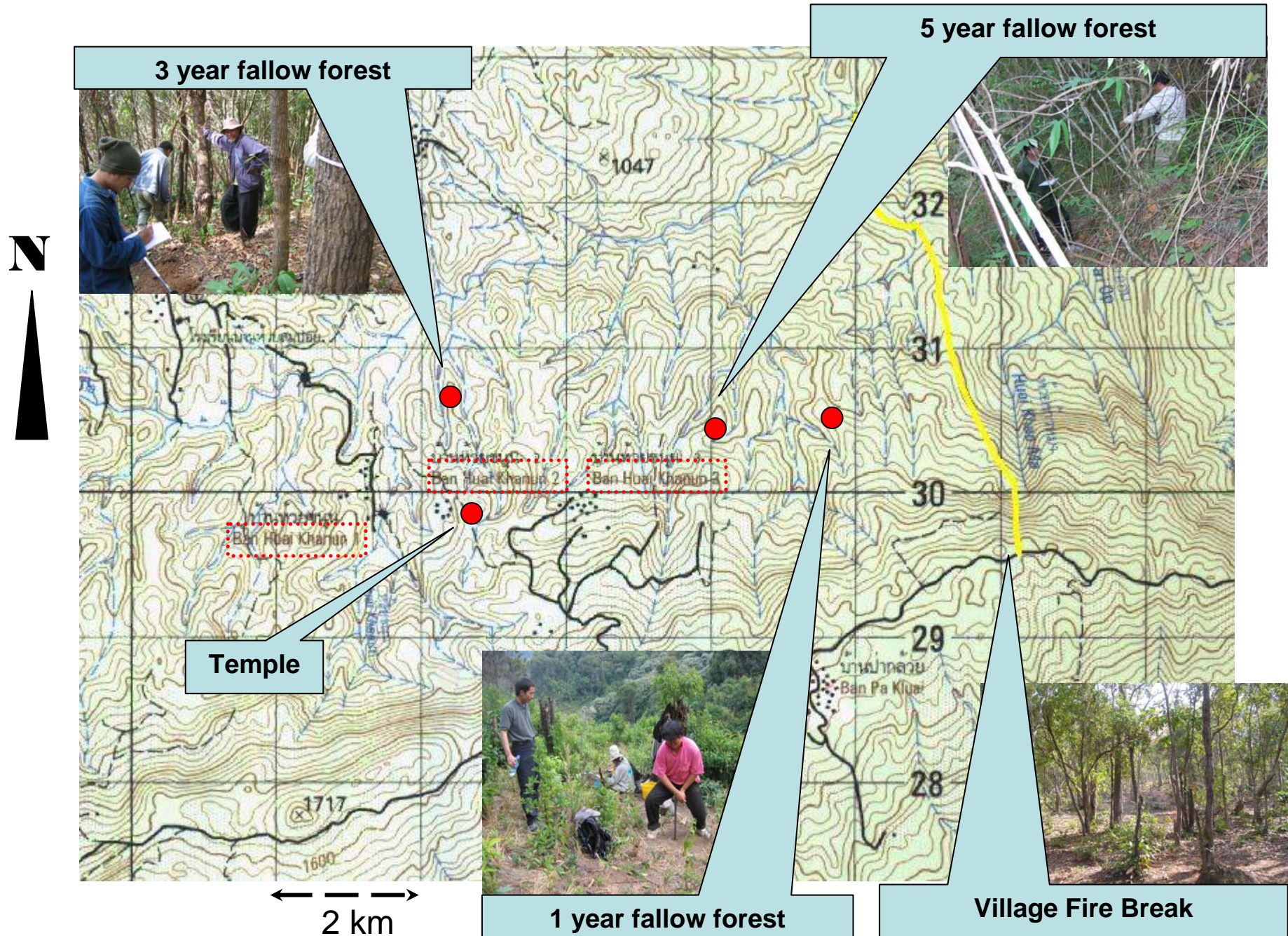


# APPENDIX M - Position of forest plots





# APPENDIX N - Position of fallow forest plots





## **Project proposal - 10. December 2004**

### **Fire management practises of the Karen hill tribes in the Mae Tia sub-watershed in Northern Thailand**



(Image source: <http://www.thaipage.ch/Gallery/thailand/images/15007.JPG>)

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**Appendix A:** Map of Northern Thailand and Ob Luang National park area

**Appendix B:** The Development of Forest Fire Control

**Appendix C:** National Park Laws of Thailand

**Appendix D:** Questionnaire/Interview example

**Appendix E:** Visual Guide of vegetation sampling

**Appendix F:** Sampling Form

# 1. Introduction

Our main purpose with this study is to investigate forest fire management of Karen hilltribe people living in the Ban Huai Khanun village no. 1-3 (Mae Tia sub-watershed area, Northwestern Thailand) and how these practises are related to the livelihood strategies of these people.

## **1.1 The Karen People**

The Karen people lives among the Indo-Chinese hill-tribes of South East Asia and are situated in the mountainous forested areas in eastern Burma and North-western Thailand (Marshall 1922). Instead of Chinese heritage the Karen seems to have a cultural background very like the Tibetan people, but this is still an uncertain subject to be discussed techniques. The Karen population is about 5 million, of which approximately 400.000 people are situated in Thailand near the Thai-Burmese border (See map in Appendix A) (The Travelers Club 2004).

In Northern Thailand the Karen comprises about 50 % of the hill-tribes, which are as a whole considered an ethnic minority in Thailand (Buergin 2000). Although most of the hill-tribes in the area consider themselves as indigenous people of their particular area, they are all a result of a slow exodus of people from southern China due to population pressure about 2000 years ago. All of these semi-nomadic people slowly made their way south driven by their need for new land to replace that exhausted by their slash and burn farming techniques (The Travelers Club 2004).

As other long-established hill-tribes in the area (the *Khmu*, *H'tin* and *Lawa*) the Karen practises rotational swidden agriculture in altitudes approximately between 700 and 1000 m of altitude in the transitional zone between lowland forest and lower montane forest types. The traditionally swidden practise consists of clearing and burning an area of secondary forest (slash-and-burn technique), a short cultivation period for 1 or 2 years then followed by a long fallow period for 12 to 17 years. The rotation of fields is done periodically within boundaries unchanged for generations (Schmidt-Vogt 2001).

This traditional agricultural practice is declining due to population growth, infrastructure improvements and land use intensification since the middle of the 20<sup>th</sup> century until present in Northwest Thailand. It is being substituted by:

- other swidden farming methods with longer cultivation periods and shorter fallow
- conventional farming with cash crops products

## **1.2 Hilltribes and Modern Thailand**

Perceptions of the forest and people using forest lands have changed profoundly in Thailand during the last 150 years. These changes are reflecting the historical development of modernity as well as the impact of national and international political and economical forces on the shifting priorities on forest policies in local contexts. In pre-modern Thailand forest lands stood external to the economy and distant from civilization. The forest was perceived as wild as disarranged, an area that needed to be tamed and remade into human habitation. Forest users, such as the Karen hill-tribe, were rewarded for activities that turned forest and barren fields into cultivated fields by exempting from tax the products of the deforested

areas for several years. The general idea of that period was that people who cleared forest land were considered respectable citizens (Laungaramsri, 2002).

The second half of the 19<sup>th</sup> century marked an important turning point Thailand's economic and political history. This turn was closely linked to the modernization of the country and caused by the expansion into the forests of Northern Thailand of the British logging industry. Fierce competition over exploitative rights prompted the Thai society to develop modern state functions to increase its own prospects of reaping the benefits from logging and controlling the forest, which, by then, was conceived as a valuable economic asset to the country. A new modern state elite based in urban settings increasingly came to view their own cultural identity or civility as compatible to that of the Western concepts of modernity and development. The incorporation into the profile of the state of Western notions of monitoring the economy led to development of negative stereotypes of the ethnic mountainous forest people, including the Karen people. As such, these people were now seen as being outside the space of civility and unsuitable for modernization (Buergin, 2001).

In order to control and exploit the forest resources, the newly emerged nation state established in 1896 the Royal Forest Department. In this development, the forest people were of little positive interest to the Thai government. In fact, forest people in general, and their slash and burn practices in particular, were viewed as economically destructive to the welfare of the nation, as they were blamed of occupying and misusing valuable forest assets. In spite of this, forest use of local people was widely unrestricted by forest legislation until the middle of the 20<sup>th</sup> century. It was only in the 1960s that slash and burn practices were officially banned although it was largely tolerated until the end of 1980s when control was tightened (Tomforde, 2003)

The primary task of the Royal Forest Department was to regulate the over-exploitation of teak in the north. Nevertheless, under the auspices of the Royal Forest Department logging and commercial exploitation of the forests in the 20<sup>th</sup> century took place on a huge scale. In the beginning of the 1950s, almost two thirds of Thailand was still forested. In the 1980s, when deforestation in Thailand was beginning to be recognized by the public as a serious problem, the forest cover then estimated was less than one third of the total land area (Buergin, 2001).

Legislation has been gradually introduced in the 20<sup>th</sup> century to classify forest lands and how to make appropriate use of it. In this respect, the content of this legislation demonstrates not only the shifting priorities in forest policies, but also how government perceptions of important issues have socially and spatially "constructed" the forest and local people's access to that resource.

With the Forest Protection Act of 1913, the Royal Forest Department extended its protection to cover non-teak trees for the first time. Twenty-five years later, in 1938, the territorial conservation policies were introduced for the first time to secure forest reserves for future logging operations. The first Five-year development plan in 1961 strengthened the concept of territorial zoning, as it designated 50 per cent of the country as state-owned 'permanent' forest (Sato, 2000). Since then, the government has continued to classify land and forest as a way of determining the purpose of use, and to whom access must to be granted.

The general concern about forest fires in Thailand began in 1970 after Mr. J. C. Macleod of the Canadian International Development Agency studied many fire situations in Thailand. He gave several general and specific recommendations (Appendix B) on the future management of forest fires in Thailand.

The forest policy of various governments in the last decade or so has been simplifying in character, straddling between views either to convert the forest or conserve it. At another dimension regarding land tenure, the view has been to picture property relations in land as either exclusive state ownership or private property rights. These processes of simplification have created ambiguous lands<sup>1</sup> and put pressure on the northern Thailand hill-tribes, who have no private property rights, and whose access to state-owned lands is guaranteed only in the form of usufruct rights based on customary law. As global market demands for rice cultivation and later cash crop production have increased, a heightened demand for land under private property has resulted in encroachment and in the expansion of private farm lands. Both ethnic minorities without Thai-citizenship and landless Thai have been sidelined in this process of economic development, while the efforts by the government to simultaneously counter this encroachment have created national parks and protected forests. These efforts have left the hill-tribe minorities to bear the costs of conservation, and in a need to vigorously defend their usufruct rights to remain in forests now classified as conservation zones. Hill-tribes, such as the Karen, have been particularly hit by this simplification of forests into either conversion or conservation zones (Sato, 2000), as their practices of fire management and swidden cultivation are increasingly used by government authorities and hard-line environmentalists to demand their exclusion from protected forests. In the process of simplification, where forest lands are zoned in this way, the Karen is left without any legal status or permission to use the forest surrounding their villages. Production and uses of secondary forest – a consequence of practising swidden agriculture – is not an intelligible option within the dominant ideology of modern forestry in Thailand, not even if it can be practised in a sustainable manner with some high levels of biodiversity (Schmidt-Vogt, 2002)

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<sup>1</sup> The concept of ambiguous lands is referring to land owned by the state, but privately accessible. It is a common land that people have been using customarily without state recognition.



## 2. Area Description

The following section describes the physical surroundings of our study site in North-western Thailand and the issues to be confronted in the area:

### **2.1 Topography, climate and ecology**

The research area is situated in surroundings of the extensive, north-south running mountain range of Northern Thailand, which also comprises the highest mountain of Thailand, Doi Inthanon (2565 m). The elevation range lies between 280-1980 meters above sea level and the area is very rugged. Soils are generally acidic with low nutrient content (Pangfan 2002). The area has sub-tropical climate with an average rainfall of 2000 mm/year (Nabangchang 2003). The area has three distinct seasons:

- 1) The rainy season (May-September) with occasional heavy thunderstorms and strong winds
- 2) The cold season (October-January) with night temperatures as low as 10 °C, but pleasant day temperatures
- 3) The hot season (February-April) with high day temperatures up to 40 °C

The area consists of mixed forest, dry dipterocarp forest, dry evergreen forest, hill-evergreen forest and mountain-pine forest. The important low-level plants such as bamboo, palm and fern is also found here. Several mammals (e.g. deers, wild pigs, monkeys) and 200 kinds of birds are also found here (DNP 2004).

### **2.2 Mae Tia sub-watershed and Ob Luang N.P.**

The Mae Tia sub-watershed is a large tributary<sup>2</sup> to the Mae Klang watershed (81 km<sup>2</sup>), which again is a part of the greater Ping watershed. The watershed is located in the Chomthong district in the Chiang Mai province and borders the north-western part of the Ob Luang National Park (Trek Thailand 2004). The upper part of the watershed has since 1966 been administered as a forest part classified as a Conservation zone (C-zone) with restrictions on activities such as logging, while the lower part is outside the C-zone.

The Karen village of Ban Huai Khanun no. 1-3 lies in app. 1100 m of altitude and consists of 72 households with a population of 394 individuals. The agriculture consists of:

- Upland paddy rice for household consumption
- Vegetables as annual cash crops

Some of the settlement and farming areas are inside the Ob Luang National Park, the rest is outside in the C-zone. This entails some legal issues especially on swidden agricultural practises, because the National Park Act clearly states a total ban on burning forest in the National Parks of Thailand (Appendix C – Chapter 3, Section 16).

The Ob Luang National Park was announced as the 68th national park of Thailand in 1991 after surveys done by the Royal Forestry Department. In the local language the word 'Ob' means 'narrow' and the word 'Luang' means 'big' – this refers to the big, but narrow canyon that the Mae Chan river created over the years (Pangfan 2002).

---

<sup>2</sup> A stream that flows into a larger stream or other body of water

# 3. Research questions and objectives

## **3.1 Research questions**

The use of fire has traditionally been an important component for Karen people practising swidden agriculture as part of their livelihood strategies. But with the establishment of the Ob Luang national park in 1991 and the ban on uses of fire, Karen agriculturalists, living in this area, and to the extent they have been practising traditional swidden agriculture, may have come under outside influence to change and develop alternative livelihood strategies. Challenges to livelihood in the aftermath of the national park may have inflicted upon other forest user groups as:

- Hunters (ignites forest in order to drive game animals towards the hunters)
- Mushroom collectors (ignites forest to potentially promote mushroom growth)
- Farmers (encroachment and conversion of forest to agricultural land by either controlled or uncontrolled upland burning)?
- Highway roadside fires?
- Cattle owners (ignites forest for grazing pastures)

In the Karen villages of Ban Huai Khanun No. 1-3 our overall research question is:

***What are the villagers' livelihood strategies; how have these developed in recent years and how are they influenced by the National Park and National Reserved Forest areas?***

This overall research question is complemented by a in-depth study of ***Prevention and Management of Forest Fires***. This will include:

- Traditional uses of fire in swidden agriculture as well as forest uses
- Changes in uses of fire in agricultural practises
- Changes in uses of fire in forest uses
- Institutional arrangements (local and departmental) for prevention and management of forest fire
- Economic costs and benefits of fire prevention and management for the local community and for the national park authority
- Environmental costs and benefits of fire prevention and management for the local community and for the national park authority

How these questions are related to the various stakeholders and livelihood strategies, we do not exactly know. We have no prior knowledge as to the extent of use of fire in Ban Huai Khanun, whether it is a problem or not for particular individuals and the community as a whole. We also do not know about costs and benefits accruing to different stakeholders' livelihood strategies, therefore we have formulated the following exploratory objectives and various ways of how to achieve them:

### **Objective 1**

1a: Identify locations of fire use and the extent to which fire is used as a tool in livelihood strategies and natural resource management.

1b: Identify different stakeholders' use of fire and purpose in terms of livelihoods.

## Objective 2

Identify changes and continuity in the use of fire in agriculture and forestry, and how this is related to livelihood conditions and awareness of problems related to the use of fire.

## Objective 3

3a: Identify how fire is perceived of by different stakeholders and managed at the community level and/or in collaboration with regional government authorities.

3b: If fire locally is perceived as a hazard, try to access if the community have effective rules for securing compliance in preventing and managing such fires.

3c: If fire locally is perceived as problem and hard to manage, try to access and compare interests that works for and against the management and prevention of fire.

## Objective 4

Identify the possible economic costs and benefits accruing to different types of stakeholders for prevention and management of fire, by analysing differences in decision-making related to objectives, options, and perceptions.

## Objective 5

Identify the possible environmental cost and benefits accruing to different types of stakeholders for prevention and management of fire, by analysing differences in decision-making related to objectives, options, and perceptions.

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### *Objective 1a.*

#### **What information is needed:**

- Location of watershed area.
- Location of the land used by the village in farming border area in relation to natural resource management.
- Identification of forest zones

#### **Purpose of the information:**

- Is fire to any significant extent used in the watershed adjacent to the national park and where is it used.

#### **How to obtain the information:**

- Information from remote sensing images
- Maps from Royal Forest Department compared to information from villagers through PRA: transecting, resource mapping.
- Interviewing the headman as key informant, fire calendar

#### **'Killer' assumptions:**

- Available images from remote sensing
- Villagers' willing to participate.
- Interpreter willing to cooperate (this assumption important in most of our field work).

*Objective 1b.*

<b>What information is needed:</b>	- Purpose of using fire and by whom
<b>Purpose of the information:</b>	- Which livelihood strategies are dependent on using fire in the investigated area, and who are representing these livelihood strategies in the village?
<b>How to obtain the information:</b>	- PRA; semi-structured interviews, village meetings, identification of focus groups
<b>'Killer' assumptions:</b>	- People afraid of revealing their livelihood and identify areas where they use fire to obtain it.

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*Objective 2.*

<b>What information is needed:</b>	- Use of fire as part of livelihood strategies in the watershed in the course of years (1960- ).
<b>Purpose of the information:</b>	- Which events and circumstances have determined the use of fire past and present?
<b>How to obtain the information:</b>	- Aerial photos, in-depth interview with 'old' people telling their 'life stories' ('old' people representing livelihoods of their time).
<b>'Killer' assumptions:</b>	- Photos available to produce time-series; the people we need to interview alive.

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*Objective 3a.*

<b>What information is needed:</b>	- The local communities' role in fire management and cooperation with outside authorities.
<b>The purpose of information:</b>	- To identify differences and agreements between stakeholders regarding the need to cooperate in management and prevention of fire. - What kind of cooperation exists between stakeholder and who makes the decision as to participate in cooperation? - How do each part judge the presence of fire (controlled – uncontrolled)?
<b>How to obtain information:</b>	- Village meeting, semi-structured interviews, in-depth interview with fire management officials
<b>'Killer' assumptions:</b>	- Stakeholder being willing to address the issue of cooperation; the research team being able to get transport to fire control stations.

### *Objective 3b & 3c*

- What information is needed:** - Information about how, when and where to use fire
- The purpose of information:** - Are people in the village aware of rules regarding fire management and prevention?  
- Are different livelihoods represented in the decision making process regarding defining compliance and sanctions if rules are broken?
- How to obtain the information:** - Semi-structured interviews obtained from the authorities and different village user groups.
- 'Killer' assumptions:** - Existence of rules and fire a problem for the Community.
- 

### *Objective 4*

- What information is needed:** - Information on focus groups, economic trends and livelihood strategies.
- Purpose of the information:** - Which economic values form the basis of their decision-making on how, when, where, why, or if to use fire?
- How to obtain the information:** - Semi-structured interview with informant group; fire calendar, crop calendar, season calendar
- 'Killer' assumptions:** - Local knowledge/ economic experience for some duration of time. Willing to answer on economy
- 

### *Objective 5*

- What information is needed:** - Information on focus groups, ecological trends and livelihood strategies.
- Purpose of the information:** - Which ecological values form the basis of their decision-making on how, when, where, why, or if to use fire?
- How to obtain the information:** - Semi-structured interview with informant group; fire calendar, crop calendar, season calendar
- 'Killer' assumptions:** - Local knowledge/ecological awareness for some duration of time.

## 4. Methodology

The tasks to be done in Thailand can in general be split up in three sections: interviewing of officials, data collection by various methods in the village and vegetation sampling in the forest. The methods to be used will be presented in the following chapter.

### 4.1 Qualitative Methods

In order to answer the questions mentioned a research strategy needs to be formulated. As we have no prior knowledge of the problem, that is, the extent to which fire is being applied by different actors as part of rural livelihoods, it is important to start out by clarifying the relevance of the issue, and the possible uses of fire by forest user groups in the area. Identifying problems and forest user groups at this point are done by secondary data obtained from university libraries. These consist primarily of a variety of articles describing the complexity of subject.

We then need to know about decision-making processes and parameters each and every stakeholder outlines in order to decide *if, why, when, and where* to use fire as part of her or his livelihoods strategy. To this end, different approaches might be in place:

**Interviews** are to be semi-structured with the use of probes and prompts. Probes are used as additional questions that go deeper into the subject and are most often improvised, as they have to respond directly to the answers. Prompts are understood as single words thrown in whenever the interviewee loses track or dries up in the middle of the answer. It is often recommended that questions in semi-structured interview guides are written as single key words. A draft version of relevant questions can be seen in Appendix D.

**Rapid Rural Appraisal** based on using semi-structured interviews is applied in order to collect data needed for answering the questions above. A sampling group of reasonable size is put to the test. The main goal is to establish a decision-making model revealing the costs and benefits accruing to the different user groups with respect to their possible management and use of fire.

The decision-making model can be view in terms of three major variables: objectives, options and perceptions.

As the decision-making model should relate to livelihoods strategies the cost-benefit analysis also need to focus on qualitative measurements, that is, on the choices and consequences experienced by the different forest users group in relation to the continued pursuing of specific livelihood strategies.

**Participatory appraisals**, including group meetings, map making and fire calendar, may be important tools in evaluating the functioning of institutional arrangements, and how the villagers as a body conceive of the fire management issue. Participatory appraisals at the village level also may serve as an appropriate means to discuss the environmental costs and benefits of management and use of fire (bringing the 'tragedy of the commons' to discussion).

**Logical framework analysis**, is a way of structuring the main elements in a project. The strength of this approach is that it highlights logical linkages between intended inputs, planned activities and expected results. The LFA also introduces external factors, assumptions and risks into the cycle of the project. The LFA analysis is carried through several interconnected steps, indicating how the project

is internally structured and dependent on critical assumptions. The following is a description of steps in an LFA approach which we in combination with PRA intend to apply as we make an exploratory investigation into the problems facing community involvement in fire management.

- Step **1. Problem Tree Analysis and Objective Tree Analysis.** The root cause of the problem is investigated through Problem Tree analysis. The facilitator asks the stakeholders to envisage on cards the current problematic situation. These contributions are then arranged into – Root Causes leading to problem and Negative impacts. The content of these cards are then reversed and rewritten as Solution, Objective and Positive Impacts.
- Step **2. Formulation of Objective Statement.** The formulation of the objective statement is perhaps the most crucial step in the entire participatory process of investigation. The facilitator the stakeholders to hypothesize what could be the most favourable state of affairs at the end of intervention. The more tangible the objective is, the easier it is to conceptualize outputs and activities to be carried out next. At this stage the stakeholders are also invited to provide verifiable indicators to justify their effort.
- Step **3. Output Formulation.** Based on the objective statement, the stakeholders discuss the pre-conditions to achieve the objective. Examples of outputs could be: Community Organization, Capacity Building, Management and Planning of Natural Resources.
- Step **4. Activity Breakdown.** The stakeholders brainstorm on the activity breakdown to achieve each output. The assigned activities that have been agreed-upon must be assigned duration, budget estimate and physical resources.
- Step **5. Validity check.** The stakeholders are asked what other pre-conditions are needed to achieve the output, after having completed all the activities. The pre-conditions are put as assumptions for the outputs. Similarly, the pre-conditions for achieving the objective, after having accomplished the outputs are assigned as assumption for the outputs. These assumption are scrutinized for 'Killer' or 'Redundant'.
- Step **6. Check in the integrity of the LFA.** The stakeholders are asked to check the logic of the LFA. Final changes and be incorporated and collective consent from the participating stakeholders should be obtained. The facilitator may then conclude that, to the best of the stakeholders' knowledge at that particular point of time, it is collectively understood that the conceived activities are carried out to deliver the outputs and the accomplishment of the outputs will lead to the realization of the objectives, providing that the conditions stated in the assumption are met. The objective, once accomplished, will lead the community one step closer to the specified goal.
- Step **7. Logic Diagram.** The activities that contribute to the outputs can be compiled into an activity list. The activities are then chronologically arranged into a logic diagram. The stakeholder determines the logical sequence of the activities.

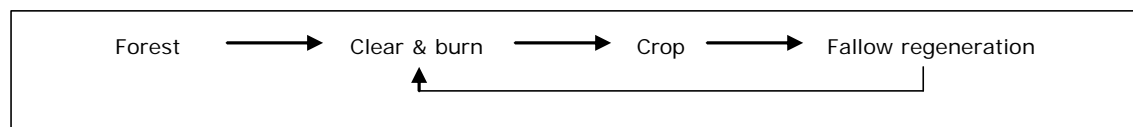
**Narrative approach**, to deal with changes in livelihoods strategies and fire practices over the past decades. In-depth interviewing with key informants such as headmen or village councils members would be an appropriate strategy in assessing the impacts of fire management practices on livelihoods in Ban Huai Khanun No. 1-3 Such narrative interviewing are to focus upon life stories (changes and continuity in family and working situations), and how this have been effected by or are related changes in natural resource and fire management practices. To

villagers, who do not have a precise sense of historical time, situating changes in management practices within histories of their lifecycles may assist villagers to remember when these changes in practices actually occurred. Such a narrative mode of knowing could be a useful tool to us, trying to get a picture of the historical development of fire management practices in the village. The narrative approach may be extended to include employees from the nearest Forest Fire Control Centre on questions regarding issues such as past and present frequencies of fires and development of cooperative frameworks of local forest groups and officials to combat fire.

## 4.2 Quantitative methods

To put the money where people's mouths are, we will try to triangulate all the qualitative information gathered on the official and local level on fire uses with quantitative information gathered in and above the forests of Ban Huai Khanun No. 1-3. In the beginning of our research process, we had some uncertainty and discussion about which methods would be the most appropriate to test this. It seems as a combination of remote sensing and vegetation sampling would be a way of proving the extent and history of fire uses in the area with the constraints of the short amount of time, we will be in the area.

An assumption is made about all the forest in the area is of a swidden fallow secondary forest<sup>3</sup> type (Chokkalingam & de Jong, 2001), which largely is due to the shifting cultivation practises with the use of traditional slash-and-burn techniques by the local hill-tribes over time. The cycle of the swidden fallow secondary forest is illustrated in *Figure 1*:



**Figure 1.** The cycle of swidden fallow secondary forests (Mod. a. Chokkalingam & de Jong, 2001)

The cycle describes the forest regenerating mainly through natural processes into woody fallows after practises of swidden agriculture. The purpose of the fallow period is to restore the land for cultivation again.

Being in an area classified as a Forest Conservation Zone and adjacent to the Ob Luang National Park, the use of fire for clearing the forest obviously becomes a sensitive subject, where values as e.g. conserving biodiversity is on the agenda. The impacts of slash-and-burn techniques on the forests ecological value is disputed, but it certainly has impacts on the livelihood strategies of the locals.

To assess the biodiversity of the forest and the importance for the villagers' use of it, a sample method has been put together and is presented in the following.

### **Vegetation sample:**

<sup>3</sup> The term secondary forest is defined by Chokkalingam & de Jong (2001) as: *'forests regenerating largely through natural processes after significant human and/or natural disturbance of the original forest vegetation at a single point in time or over an extended period, and displaying a major difference in forest structure and/or canopy species composition with respect to nearby primary forests on similar sites.'*



The sampling method for measuring biodiversity and forest resource use is a systematic plot survey modified to the field conditions in South East Asia (Pelz 2000) and with some emphasis on the livelihood strategies of the locals (Fujisaka & Escobar 1997). The survey is to be performed in different parts of the Mae Tia sub-watershed and inside the Ob Luang National Park.

The survey is made by conducting the vegetation sampling on interesting areas in the secondary forest, mainly pointed out by the local villagers as being important to them by using them for various purposes (e.g. collecting firewood, food, medicinal plants, timber for construction etc.). The use of the forest and GPS coordinates (if possible to obtain) are noted and different transects through the area on a specific compass course is made (Appendix E). During transects, some concentric circular samplings are made to gain knowledge of the forest structure and a hint of the biodiversity in the certain area is also gathered.

This method consists of noting seedlings in a 0,001 ha plot (circle with 2 m radius), saplings in a 0,01 ha plot (circle with 5,64 m radius) and trees in a 0,05 ha plot (circle with 12,62 m radius). The size of trees measured can be seen in *Table 1* and a draft sheet to data collection in the field is seen in Appendix F.

Concentric circular sample plot method				
Height	Up to 1,3 m		> 1,3 m	
DBH	<10 cm		10-14,9 cm	>30 cm
2 m (0,001 ha)	To be measured			
5,64 m (0,01 ha)				
12,62 m (0,05 ha)				

**Table 1:** Overview of vegetation sizes to be measured in the 3 concentric circles (Mod. a. Pelz 2000)

To have a baseline, we hope to conduct vegetation sampling in either forest owned by Buddhist monks or some sort of sanctuary forest, where human influence has had the least impact in Northern Thailand (Wechakit 1990).

*Materials:*

GPS, Compass, Diameter Tape, Center Pole, String of variable length (2 m - 5,64 m - 12,62 m), Tape Measure, Pens & Paper

**Remote Sensing:**

At this stage, this is still the unsure part of our research design mostly due to practical reasons. We have not been able to get satellite images over the Mae Tia sub-watershed area from the LANDSAT search engine on the internet, but we rely on the assurance from our lecturers, that our Thai colleagues at Chiang Mai University have brilliant expertise in this field. We hope to be able to see different stages of fallow in the secondary forest in the area, combining this information with our findings in the vegetation sampling.

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Reference list unfortunately not finished or fine tuned – sorry about that!

# APPENDIX A



# APPENDIX B

## The Development of Forest Fire Control

Thailand has been widely concerned about forest fire since 1970. Under the aid of the Government of Canada by the Canadian International Development Agency, Mr. J.C. Macleod, had visited and studied many forest fire situations in Thailand for approximately seven months, February to September, 1971. He gave both general and specific recommendations. In his general recommendations, he emphasized that: "even if no funds are budgeted for fire control, there need be no slackening of effort to provide protection against fire."

The specific recommendations can be summarized as follows:

- 1) The establishment of a forest fires Act is a primary requirement.
- 2) A Forest Fire Control Unit, or Section, should be set up now in the Royal Forest Department.
- 3) Training abroad for officers who are to provide initial leadership in fire control should begin as quickly as possible.
- 4) The information service of the Department should be provided with sufficient funds to greatly increase its forest conservation programme, particularly with respect to a fire education programme which should be started now.
- 5) Plans should be made and announced within the Department, for the orderly application of organized protection to the various forested areas.
- 6) It is imperative that organized protection against fire be afforded the pine plantations at Bo-luang and Bokao, starting in 1972 if at all possible.
- 7) Improved methods of conducting prescribed burning should be developed.
- 8) A large measure of fire prevention and probably some fire suppression could be achieved in areas where the Department employs several labourers by assigning just one man to fire control during the fire season. This should be tried out.
- 9) Training of potential Fire Fighters should be started now in those areas first to receive protection against fire.
- 10) At least a little equipment for fire suppression should be prepared and set aside now in those areas to be given protection against fire in 1972.
- 11) Forest fire control and the possible effects of fire should be taken into account when planning most activities involving the forest in the north and northeast.
- 12) A much stronger effort should be made to achieve the active cooperation of the Highways Department and the rail roads in preventing forest fire.
- 13) The curricula of the Forest School at Prae and the Forest Workers School at Tak should include courses in forest fire control.
- 14) Operational fire control measures, rather than fire research, are required by the Forest Department during the next several years.
- 15) The practice of observing and recording daily fire weather should be started soon in all areas to be afforded protection in the next few years.
- 16) The present methods used by resin tappers in natural pine forests should be changed immediately to reduce fire risk and fire damage.
- 17) Better strategies are required to curtail the extreme fire risk caused by shifting cultivation.
- 18) Areas for plantations might best be selected well away from public roads.
- 19) Greater effort should be devoted to improving the public image of the Forest Department.
- 20) A system for the orderly filing of written material on forest fire control should now be put into cooperation.

During 1972-1974, some forest officers were sent to study and to be trained in modern forest fire control in Canada and the United States. Two years later, in 1976, the Forest Fire Control Section was established in the Forest Management Division for working in the Forest Fire Control Project of the Forest Conservation Centre. Thus, that was the first era of Forest Fire Control in Thailand. A few years later, the Forest Fire Control Section was upgraded to the Forest Fire Control Subdivision to undertake forest fire control activities nationwide. This is largely due to the cabinet resolution on February, 24 and November, 3, 1981 which intended to tackle forest fire problems.

Since then forest fire control activities have expanded quite dramatically. The fire-

prone areas under fire control programme have been enlarged accordingly. Various fire prevention campaign techniques were initiated and practiced with different degrees of success. Fire suppression equipment was introduced, modified and applied. This included more sophisticated equipment such as high-technology fire tender, fixed-wing aircraft as well as helicopters. Suppression techniques and tactics have also gradually been developed in order to fit the current situation. This has been remarkably successful. However, due to the budget limitation, so far only 2.8 million hectares or 21% of the total forest land are placed under the intensive fire suppression programme.

The development promoting the fire control programme is the worldwide concern over environmental issues, especially the reduction of biodiversity and climatic changes caused by greenhouse effect. The consequences are recognized worldwide. In Thailand, unusual natural disasters such as drought, flood and wind storm are increasing. These circumstances led to the amendment of the forest fire control agency to an unofficial Office of Forest Fire Control and Rescue in late 1991. Later in 1993 the agency was promoted to a full Forest Fire Control Division. In 1999 the agency was upgraded to a Forest Fire Control Office.

In October, 2002 there was a major restructuring of Bureaucracy System. The fire control agency was reorganized according to the Bureaucracy System's restructuring Act 2002. Now the body designated to forest fire control is called "The Forest Fire Control Division" under the National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment. Fire suppression programme is able to cover 38% of the total forested land.

<http://www.dnp.go.th/forestfire/Eng/historical3.htm>

## **National Forest Policy 1985 on forest fire in Thailand**

### **1. Policies**

#### **1.1 The National Forest Policy**

The latest National Forest Policy No.18 (1985) stated that a substantial plan for tackling the deforestation problem (eg. shifting cultivation, forest fire etc.) must be determined. Suppression as well as law enforcement measures must be clearly set.

#### **1.2 The Cabinet Resolution**

The Cabinet Resolution dated November 3,1981 gave the following general directives for coping with forest fire:

- All commercial as well as state flights have to report discovered forest fires.
- Imposing measures to intercept forest traversers.
- Procuring aircraft equipped with fire suppression equipment in readiness to combat fire.
- Imposing a fire suppression plan.
- Coordinating with countries with successful fire suppression experiences in order improve fire suppression plan.

The measures approved by cabinet according to the above directives were as follows:

##### **1.2.1 Initial measures**

- The Royal Forest Department has to establish the organization to undertake forest fire control activities.
- In fire-prone areas, forest fire control units must be established.
- The Ministry of Interior must share responsibilities in fire prevention and suppression by organizing local fire fighting volunteers. In addition, they have to cooperate with the Royal Forest Department in delivering volunteer training.
- All government agencies nationwide, commercial aviation, and communication networks under the Ministry of Interior have to immediately report all discovered fires to the Royal Forest Department or its sub-units.
- Providing sufficient budget as well as essential fire suppression equipment in order to achieve effective fire control.

### **1.2.2 Long-term measure**

- The Ministry of Agriculture and Cooperatives in cooperation with the Ministry of Interior must plan the long-term project for fire fighting volunteer training in fire-prone areas nationwide.
- Because there is no particular law regarding forest fire, the Royal Forest Department must propose a Forest Fire Control Act emphasizing prevention measures.
- The Royal Forest Department must train all government employees based in adjacent fire-prone areas, and all employees are obliged to assist in fighting fire.
- The Royal Forest Department must assess all operations done in accordance with the above measures. The assessment must be used in planning the permanent regional and national forest fire control agency must be upgraded to Division level in order to effectively undertake the said-planned forest fire control activities.

### **1.3 The Royal Forest Department Policy**

The Royal Forest Department policy stated toward forest fire control in practical aspect as "to minimize damages caused by forest fire by using all means either prevention or suppression strategy."

### **1.4 The Office of Prime Minister's Order**

The Office of Prime Minister's Order dated March 25, 1998 appointed the National Forest Fire Management Committee and empowered the committee to:

- Formulate the coordination and command plan for executing units at province and district levels in order to obtain effective fire suppression operation.
- Mobilize all manpower as well as resources available for fighting fire.
- Seek cooperation from private sector as well as fire volunteer to support suppression operation.

## **2. Legislation**

There is no specific forest fire control Act in Thailand. Although 4 of the existing forestry acts contain sections stating the penalty for setting forest fire, however prevention measures are not stated. Present fire control legislation is found within these following laws:

- Forest Act 1941, section 54
- Wildlife Conservation and Protection Act 1960, section 24
- National Park Act 1961, section 16(1)
- National Forest Act 1964, section 14

## **3. Sanctions**

Violations of the above Acts by setting forest fire are liable to be fined and/or be imprisoned as follow:

- Violation of Forest Act 1941, section 54 not exceed 50,000 Bahts fine or 5 years imprisonment or both fine and imprisonment.
- Violation of National Forest Reserve Act 1964, section 14 5,000-50,000 Bahts fine and 6 months-5 years imprisonment
- Violation of National Park Act 1961, section 16(1) not exceed 20,000 Bahts fine or not exceed 5 years imprisonment or both fine and imprisonment
- Violation of Wildlife Conservation and Protection Act 1960, section 24 not exceed 30,000 Bahts fine or not exceed 5 years imprisonment or both fine and imprisonment

(Source: <http://www.dnp.go.th/forestfire/Eng/polices%20&%20Legislation.htm>)

# APPENDIX C - NATIONAL PARK ACT

BHUMIBOL ADULYADEJ, REX.

Given on the 22nd day of September, B.E. 2504; Being the 16th Year of the Present Reign. His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that; Whereas it is expedient to have a law on national park;

Be it, therefore, enacted by the King, by and with the advice and consent of the Constituent Assembly acting as the National Assembly, as follows:

**Section 1.** This Act shall be called the "National Park Act, B.E. 2504"

**Section 2.** This Act shall come into force as and from the day following the date of its publication in the Government Gazette.

**Section 3.** All other laws, rule and regulations in so far as they are already provided by this Act, of are contrary to or inconsistent with the provisions of this Act shall be replaced by this Act.

**Section 4.** In this Act:

- (1) "Land" means surface of land in general, and includes mountain, creek, swamp, canal, marsh, basin, waterway, lake, island and seashore
- (2) "National park" means the land which is determined as national park under this Act:
- (3) "Woody plant" includes all kinds of plants which are trees, brushwoods or creepers, including all parts thereof:
- (4) "Animal" means all kinds of animals including all parts thereof, and things obtained from or produced by the animals;
- (5) "Competent official" means the person appointed by the Minister for the execution of this Act;
- (6) "Director-General" means the Director-General of the Forestry Department;
- (7) "Minister" means the Minister who takes charge and control for the execution of this Act.

**Section 5.** The Minister of Agriculture shall take charge and control for the execution of this Act, and shall have the power to appoint competent officials and to issue Ministerial Regulations for the execution of this Act. Such Ministerial Regulations shall come into force upon their publication in the Government Gazette.

## CHAPTER 1

### Determination of Land to be National Park

**Section 6.** When it is deemed appropriate to determine any area of land, the natural features of which are of interest and to be maintained with a view to preserving it for the benefit of public education and pleasure, the Government shall have the power to do so by a Royal Decree, A map showing the boundary lines of the determined area shall be annexed to such Royal Decree. The determined area shall be called the "National Park." The land to be determined as national park must not be owned or legally possessed by any person other than public body.

**Section 7.** The extension or the cancellation for the whole or a part of the national park shall be made by a Royal Decree. In case of cancellation not for the whole of the national park, a map showing the changing area shall be annexed to the Royal Decree.

**Section 8.** The competent official shall provide the boundary posts and signs or other marks sufficiently for enabling the public to know the boundary of the national park.

## CHAPTER 2

### National Park Committee

**Section 9.** There shall be a committee called the "National Park Committee" consisting of the Under-Secretary of State for Agriculture as chairman, Director-General of the Forestry Department, representative of the Department of Interior, representative of the Land Department, and other members not more than eleven in number appointed by the Cabinet.

**Section 10.** The member appointed by the Cabinet holds office for a term of two years. The retired member may be reappointed.

**Section 11.** Apart from retirement on account of expiration of the term of office under Section 10, the member vacates his office upon :

- (1) death;
- (2) resignation;
- (3) being removed by the Cabinet;
- (4) being incompetent or quasi-incompetent;



- (5) being imprisoned by a final judgment, except for a petty offence or offence committed through negligence.

When a member vacates his office before the expiration of the term of office, the Cabinet may appoint another person to fill the vacancy. The member appointed under the preceding paragraph remains in office only for the term of office of the person he replaces.

**Section 12.** At the meeting of the committee, if the chairman does not attend it or is absent therefrom, the committee shall elect one of its members to preside over the meeting. Any decision of the meeting shall be taken by a majority of votes. In voting, each member shall have one vote. In case of a tie, the presiding chairman shall have an additional vote as casting-vote.

**Section 13.** At every meeting there must be an attendance of not less than one half of the total members in order to constitute a quorum.

**Section 14.** The committee may appoint a subcommittee to consider or perform any activity as assigned by it,

**Section 15.** The committee has the duty to give advice to the Minister in the following matters:

- (1) Determination of land to be reserved as national park and extension or cancellation of the national park;
- (2) Protection and maintenance of the national park;
- (3) Matters consulted by the Minister

### **CHAPTER 3**

#### **Protection and Maintenance of the National Park**

**Section 16.** Within the national park, no person shall:

- (1) Hold or possess land, or clear or burn the forest;
- (2) collect, take out, or do by any means whatsoever things endangering or deteriorating woody plant, gum, yang, wood-oil, turpentine, mineral or other natural resources;
- (3) Take out animals or do by any means whatsoever things endangering the animals;
- (4) do by any means whatsoever things endangering or deteriorating soil, rock, gravel or sand;
- (5) change a water-way or cause the water in a river, creek, swamp or marsh to overflow or dry up;
- (6) close or obstruct a watercourse or way;
- (7) collect, take out, or do by any means whatsoever things endangering or deteriorating orchids, honey, lac, charcoal, barks or guano;
- (8) collect or do by any means whatsoever things endangering flowers, leaves or fruits;
- (9) take in, take out any vehicle or drive it on the way not provided for such purpose, unless permission is obtained from the competent official;
- (10) cause any aircraft to take off or land in the place not provided for such purpose, unless permission is obtained from the competent official;
- (11) take cattle in or allow them to enter;
- (12) take in any; domestic animal or beast of burden, unless he has complied with the rule prescribe by the Director General and approved by the Minister;
- (13) carry on any activity for benefit, unless permission is obtained from the competent official;
- (14) post up a notification or advertisement, or scratch or write on any place;
- (15) take it any gear for hunting or catching animals or any weapon, unless permission is obtained from the competent official and the conditions on prescribed by the latter have been complied with;
- (16) fire any gun, cause any explosive article to be exploded or let off any fireworks;
- (17) make a noisy disturbance, or do other act causing trouble or nuisance to any person or animal;
- (18) discharge rubbish or things at the place not provided for such purpose;
- (19) leave any inflammable article which may cause fire.

**Section 17.** No person shall remove, deface, damage or render useless the boundary posts, signs or other marks furnished by the competent official under this act.

**Section 18.** Any person entering the national park must comply with the order of the competent official given in compliance with the rule prescribed by the Director-General and approved by the Minister.

**Section 19.** The provisions of Section 16 and Section 17 shall not apply to the official carrying out any works for protection and maintenance of the national park for education or technical research, or for facilitating tourism or sojourn, or rendering safety or giving knowledge to the public provided that it be in accordance with the rule prescribed by the Director-General and approved by the Minister.

**Section 20.** In suppressing illegal activities according to this Act, the competent official shall be the administrative official or police under the Criminal Procedure law.

**Section 21.** The competent official shall have the power to order the person committing the offence under Section 16 to get out of the national park or to refrain from doing any act therein.

**Section 22.** In case any violation of this Act has caused anything into being or rendered a change in condition to anything in the national park, the competent official shall have the power to give the offender an order to have such thing demolished, removed from the national park, or restored to its former condition, as the case may be. In case the offender fails to comply therewith or the offender is unknown or for prevention or alleviation of the national park from damage, the competent official himself may take any of the said actions as may be appropriate. The expenses incurred thereby shall be borne by the offender.

## **CHAPTER 4**

### **Miscellaneous**

**Section 23.** If the Director-General thinks it appropriate to require from the public any payment for services of facilities given by the competent official in the national park, or to require any person to pay fee of remuneration for permission to carry on any activity or to sojourn therein, he is empowered to fix the rates and lay down rules concerning the collection of the said service charge, fee or remuneration, with the approval of the Minister. Money collected under the preceding paragraph, fund donated for maintenance of the national park, fine accruing from settlement of the case conducted by the competent official under Section 28 and other kinds of income shall be exempted from any tax or duty, and kept as the expenditure for maintenance of the national park according to the rules and methods prescribed by the Director General and approved by the Minister.

## **CHAPTER 5**

### **Penalty**

**Section 24.** Whoever violates Section 16 (1), (2), (3), (4), or (5) shall be punished with imprisonment not exceeding five years or fine not exceeding twenty thousand baht, or both.

**Section 25.** Whoever violates Section 16 (6), (7), (9), (10), or (11), Section 17 or Section 18 shall be punished with imprisonment not exceeding one month or fine not exceeding one thousand baht, or both.

**Section 26.** Whoever violates Section 16 (2), (3), (4), or (7) shall, in case the animal or property collected or taken out is of small value or a slight damage is caused thereby, be punished with fine not exceeding five hundred baht.

**Section 27.** Whoever violates Section 16 (8), (12), (13), (14), (15), (16), (17), (18) or (19) shall be punished with fine not exceeding five hundred baht.

**Section 28.** The competent official shall have the power to settle the case in respect of offences under Section 25, Section 26 and Section 27.

**Section 29.** All weapons, instruments, utensils and vehicles used by any person in committing the offence of clearing or burning the forest under Section 16 (3) or offence of endangering animals under Section 16 (3) or offence of endangering or deteriorating soil, rock, gravel or sand under Section 16 (4) shall be forfeited regardless of whether they belong to the offender, and whether any person is convicted.

### **Transitory Provision**

**Section 30.** Any concession or licence for working timber or collecting forest product under the law on forest, licence for residing in or exploitation of a protected or reserved forest under the law on protection and reservation of forest, prospecting licence, mining concession or licence under the Land Code which was granted or issued to any person before the day of enforcement of the Royal Decree valid issued under Section 6 shall be valid only for the remaining period of such concession, prospecting licence, mining concession or licence.

Countersigned by  
Field Marshal S. Dhanarajata  
Prime Minister

(Source: [http://www.dnp.go.th/npo/Html/Law\\_Rule/Law/Law\\_ENationPark\\_2504.htm](http://www.dnp.go.th/npo/Html/Law_Rule/Law/Law_ENationPark_2504.htm))

# APPENDIX D

## Questionnaire/interview example

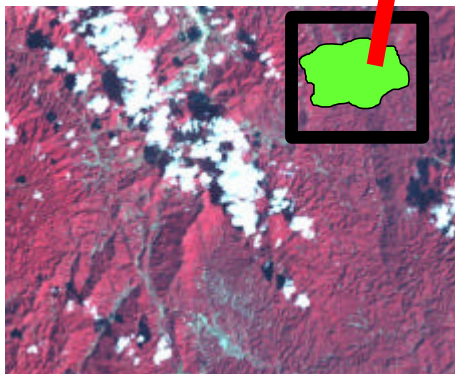
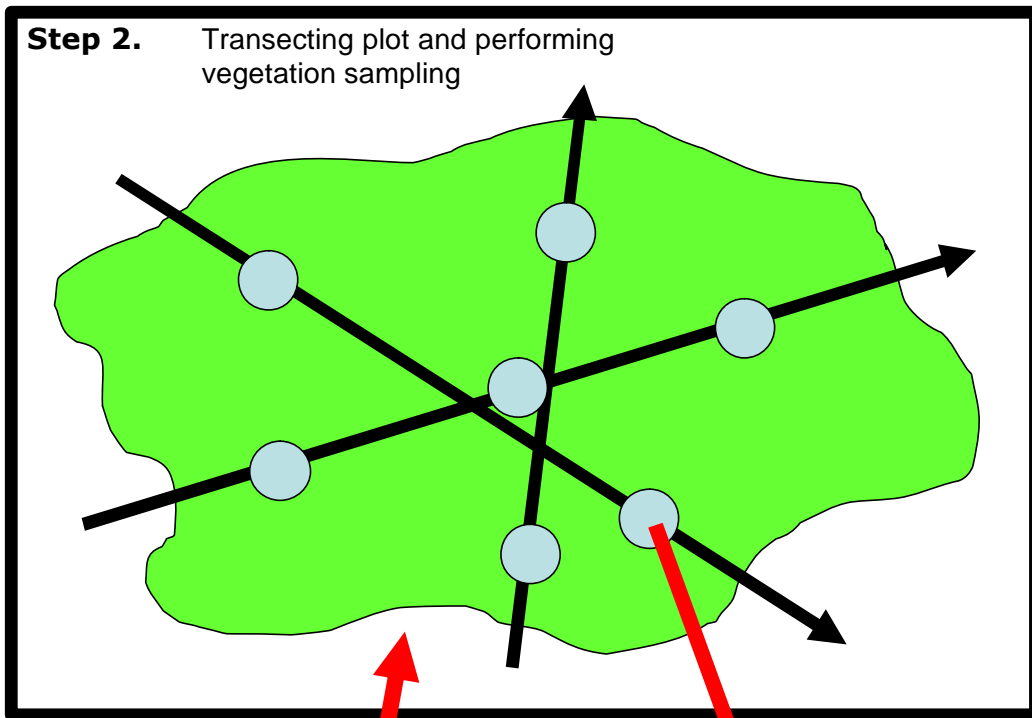
A draft proposal for questions to be asked of farmers related to use and management of fire.

Semi-structured question to be asked:

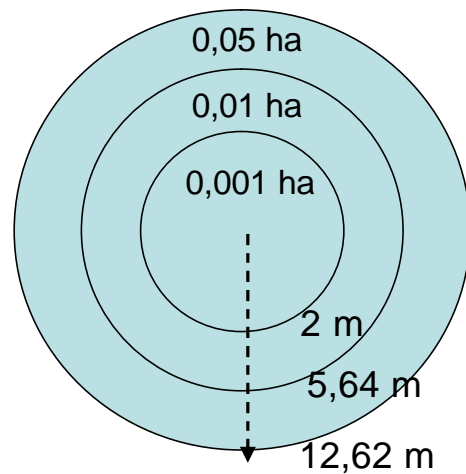
- For what purposes do you burn?
- Are there any alternative methods you can use to meet these objectives? *If so, what are they? If not, why not?*
- When during the year do you burn?
- How do you know when to burn i.e. are there any indicators?
- How often do you burn?
- Which areas are burned and how often are these areas burned?
- What size are the burns?
- What kinds of precautions are taken before and during the fires?
- How did you learn to use fire?
- What do you think are the effects of burning on your livelihoods and on the environment?
- Would you be able to sustain your present livelihood without the practice of burning? *If no, why not? If yes, why do you continue to practice burning?*
- Do you or have you in the past sought any permission from the community about burning?
- Have you ever been contacted by fire control officials telling you not to practice burning? *If yes, what did they do to you? If no, do you think it is because the fire control officials don't care whether you practice burning or not?*

*Still under construction...*

# APPENDIX E - SAMPLING DESIGN



**Step 1.** Finding interesting plot on map



**Step 3.** Performing the different vegetation samples

# APPENDIX F – Vegetation sampling form

## General & plot variables

Date:	
Field Crew:	

<b>Plot Variables</b>	
Plot #:	
Forest Name:	
Compartment:	
Soil:	
Altitude	
Slope	

<b>Crown Density</b> (Put X)	Very dense (80-100 %)	Dense (60-80 %)	Scattered (40-60 %)	Open (20-40 %)	Clear (0-20 %)

- Percentage of the plot area covered by the vertical projection of the tree crowns

<b>Harvesting status</b> (Put X)	No influence	Single stem harvesting	Stand harvesting	Plantation	Area destroyed

- Record of human influence for each plot

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## Seedling variables (1. circle – 2 m – 0,001 ha)

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## Sapling variables (2. circle – 5,64 m – 0,01 ha)

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## Tree variables (3. circle – 12,62 m – 0,05 ha)

Tree #	Tree Species	Species Code	DBH	Height	Quality	Risk	Azimuth	Distance	Horizontal Distance

*Under construction – to be continued...*

# APPENDIX G – Livelihood

## **Livelihood Analysis: The Overall framework.**

The livelihood perspective as a way of studying change from below has gained importance in recent years. It is an approach, which emphasizes actor diversity, and with that, also an emphasis on the role of non-agricultural income sources in constituting a rural livelihood. It can be viewed as an alternative approach to that of Farming Systems Research, which is only concerned with the farming aspects of local livelihood. Livelihood Analysis, as a contrast to Farming Systems Research, incorporates issues external to farming e.g., a diversified access to different resources under multiple tenure regimes, migration, off-farm income etc. Actually, the focus is on the whole spectre of ressource endowment differentiated by the scientist into varied forms of capital, such as social capital, psysical capital, natural capital, financial capital, etc. Some forms of capital are situated and controlled primarily within the household, other forms of capital under different forms of access are situated outside the household, and need to be analyzed at different community levels.

(In the phases of field work and report writing we need to elaborate more carefully on this approach regarding the whole range of ressource endowment and management, especially how changes in livelihoods and enviromental management are interconnected and perceived by actors at the different levels; household, intra-community and inter-community).