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Forest health under institutional development for community-based upland resource management: comparison of villages in lowland and upland settlement, Northern Thailand

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Abstract

This study compares between Nahai, a lowland settlement village, and Huai-muang, an upland settlement village, located in Sopsai watershed, Nan Province, Northern Thailand in terms of their collective behaviors and management practices associated with their forest health. The forest areas in both villages are classified into 2 zones according to villagers' collective choices in uses and management: conservation zone (CZ) and utilization zone (UZ). In the CZ, collective rules are very strict for the purpose of watershed head protection while people have more access to use and manage forest resources in UZ. The findings of forest resources inventory found that: (1) there are no substantial differences in forest succession and proportion in DBH-class, and Height-class distribution between UZ and CZ, and (2) there is better regeneration and biodiversity in UZ than CZ. Forests in UZ also showed the higher density (particularly in total seedling and sapling density), and presence of higher number of multipurpose and preferred species than CZ. Moreover, basal area of Pterocarpus macrocarpus (which is the most useful tree species) is double in UZ than in CZ. The analysis showed that tree-planting program for watershed head rehabilitation had little impact on density and biodiversity.

Therefore resource extraction under clear defined users and certain intensity can be not only benefited for forest areas themselves but for landscape level as forest patches have been restored among agricultural landuses. These findings also emphasize the importance of collective decisions in rules and different bundles of rights in forest resource health and productivity of forest resources managed by the villagers themselves. The interventions for institutional development particularly in formal recognition of people right over land and resources are necessary toward the community-based approaches.

KEY WORDS: forest health; collective behaviors; biodiversity conservation; community based forest resource management; secondary forest; shifting cultivation.

Introduction

The issues concerning forest conservation can be viewed from several perspectives. The concepts of forest conservation such as “deep ecology” and “wilderness” are the most popular among environmentalists. The effort of protecting “wilderness” are the only goal of mostgovernment officials, and academicians (Allin 1990) but for the rural people who depend their life upon these natural resources the issues are different (Hircch 1997a). The wilderness managers believe that “only in large wilderness areas can native biodiversity be maintained”(Noss 1990). There are also increasing concerns on global environmental change and biodiversity being threatened among the scientific community, who think the only way to protect the diversity is through the establishment of protected areas (PAs). These groups consider exploitation of resources by human are the principal causes of the problem (Soulé and Kohm 1989).

In Thailand, these strict protections of natural areas in the name of ‘conservation’ through formal declaration of PAs are widely adopted as general approach by the Royal Forest Department (RFD). But ideas and approaches concerning forest conservation and environment are diversified in the country. As described by Hirch (1997a and b) these differences are “based in part on the joint influence of western education of the elite and Buddhist values, and in part on countervailing elite and subaltern influences”. Especially among leading groups of the society, ‘conservation’ in the form of establishment of PAs including national parks, wildlife sanctuaries, and A-1 watershed class areas have been adopted almost for the second half of last century and are widely spread over the country for almost last two decades (Duaglamyai 2000).

Although, in the management strategies of the PAs, people participation have been increasingly recognized and, over the last decade, there has been a progress in the effort to promote rural people is participation to ‘conserve’ forest resources nearby their communities. However, conservation can have different meanings to individuals, and thus are practiced in a different manner. People themselves claim the right to manage their own resources for benefits of their own communities by providing legal recognition. This can be clearly seen from events of people themselves summit for the Community Forest Act and have a long period of movement for the Act to promote sustainable management by communities themselves by optimizing utilization of their forest resources, not just natural protection as proposed by governmental officers and elite environmentalists (Sukrung 1997, Noikorn 2000, Ekachai 2000, Samabuddhi 2002). These people only recognize roles of rural communities in forest protection (but generally called ‘conservation’) but not rights to manage over the forest resources.

These ideas and approaches have led to conflicts over resource uses and management (Hirch1997a and b, Luangaramsi 1998, BangkokPost 30 May 1996). Through the enforcement of PAs by strict control of human activities, some local communities were relocated outside those areas, some were prohibited to use land for shifting cultivation, and some were restricted only to the utilization of land and resources. However in Thailand, forest conservation by strict control of uses of resources seem to be not feasible for on the ground implementation. This can be illustrated by the legal declaration of various types of forest zones in Nan. For example, 90% of provincial area has been classified as forest reserve areas but only 84% of the total have been marked for conservation purposes. In order to acquire the proposed conservation areas, a national park, *Doi-puka*, has been declared and other 4 national parks are in the process of legal declaration which would cover the area of 240,000 ha. So, if we include all areas of protected areas, comprising national parks, 1st class watershed, and others, almost all areas except the lowland along main rivers come under protected areas.

Local communities, however, have been involved in conservation and management of forest resources in and around their vicinity. Whatever the strategies of PAs for conservation may be in place. Community forests can be classified into 2 types according to the main purposes of management: one for 'conservation' which is called *"Pa-chum-chon A-nu-rak"* in Thai and the second for direct utilization called *"Pa-chum-chon Chai-choi"* in Thai. As mentioned earlier, many governmental officers and environmentalists particularly in the group of most middle-class and elite people in urban society more appreciate people participation in 'conservation' by demarcating the area. And they would only support the setting up rules as *"Pa-chum-chon A-nu-rak"* but not *"Pa-chum-chon Chai-choi"* if possible. It is expected that by demarcating *"Pa-chum-chon A-nu-rak"*, rural people can enjoy better environment quality and water supply as a result of provision and maintenance of natural-like conditions without or little human interference.

Although some communities who are living near urban areas and depend on industrial and service sectors for maintaining their livelihoods, have shown their ability to protect their forest areas as preferred by the officials and middle-class environmentalists. Most of communities still need to use forest resources as necessary assets for household consumption and income generation activities. This article is not intended to debate ideas and perspectives of conservation but to show an evidence of different intensity in resource utilization – little uses in the name of 'conservation' VS direct utilization under collective behaviors and decisions instead. It is

expected that the finding will be useful for further development of strategies in sustainable forest resource management through community-based approach.

Therefore challenging question was developed whether it is possible that the condition of forests under different intensities of utilization and management by local communities could be best maintained by the communities themselves. Moreover, to assess whether good forest health with recognition of rural people's rights to access and manage their local forest resources were ensured, this study was carried out by relating forest health with user's collective behaviors and management practices in two villages, *Huai-muang* (a upland settlement) and *Nahai* (a lowland settlement) in Sopsai Watershed, Nan Province, Northern Thailand (Figure 1). The objective, thus, was to assess influence of people behaviors and management practices on forest health by comparison within these two villages. Apart from this, comparison between these two villages were made to provide suggestions on how to develop community-based forest resource management.

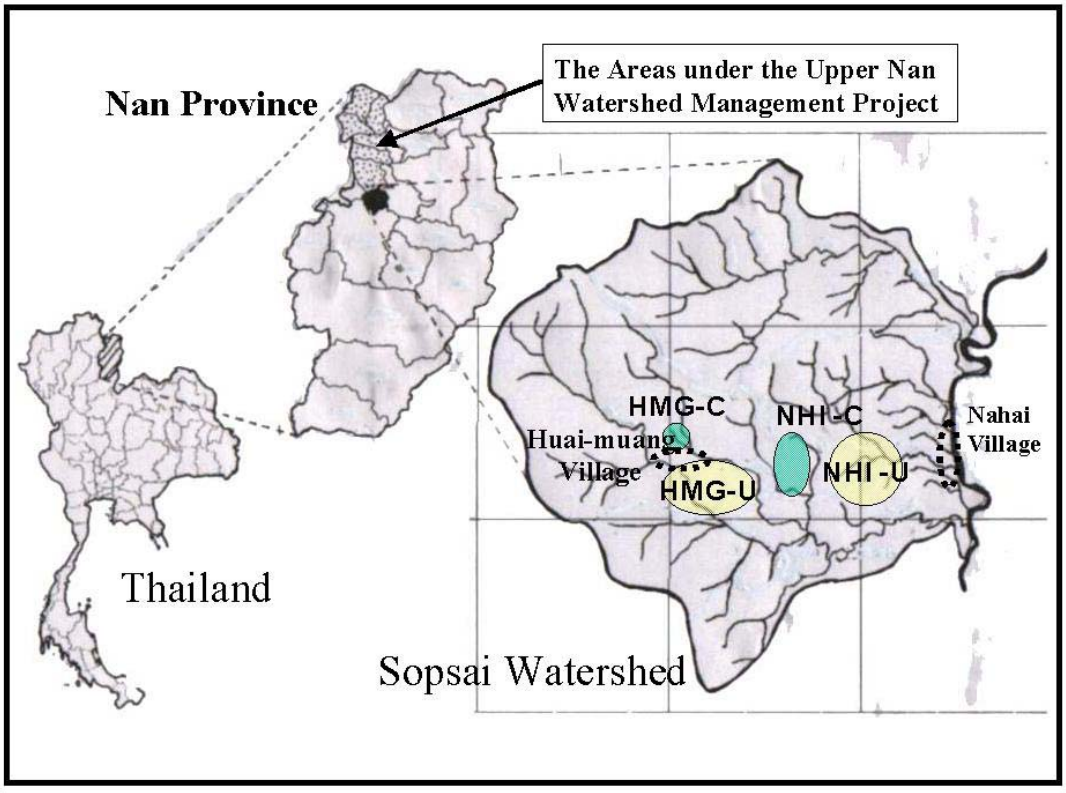

Figure 1. *Sopsai* Watershed and studied villages and their forests.

Data Collection Methods

Several research methods and approaches have been used in the current study. Notable among them include the framework of the International Forestry Resources and Institutions (IFRI) (Ostrom 1999) with tools/methods of (1) bio-resource inventory in forest of 2 villages (Nahai and Huai-muang); (2) rapid appraisal for preliminary identification of different habitats, rules-in-use, exogenous factors that might be influencing forest health; and (3) ethnographic interview and participant observation to understand people's perceived rights toward their community forests by consideration of historical interaction of villages with their resources in association with outside influences.

Participatory mapping techniques were used to make boundary of forests accessed by each village in 2 groups according the differences in rule-setting: (1) utilization zone (the more intensive and direct uses of wood for household consumption), and (2) conservation zone (to maintain natural-like condition for in-direct uses especially in water discharge and erosion control). Major details about factors influencing forest health were identified with reference to positions on Aerial photograph (1:10,000) taken in 1998 for further exploration through participatory tools.

After the zones were identified, random sampling method was used to determine sampling plots on the aerial photograph. The circular plots at the radius of 10 meters were used for sampling trees (DBH >10cm), 3 meters for saplings (2.5 <DBH <10cm), and at the radius of 1 meters for sampling seedling (DBH <2.5cm). For each sampling plot, local name of the plants, DBH, height, and vegetation forms were recorded. And a Performance Curve was used to determine the statistically minimum number of sampling plots in a forest unit. Topographic and physical data were also recorded (such as location, soil depth/color/ drainage/texture) as reference base for site consistency. This inventory was carried out between January and April 2001 (the dry season).

Forest health is compared by using the following criteria: (a) height-class distribution of trees and sapling; (b) DBH-class distribution of trees and sapling; (c) total density of trees and bamboo; (d) total basal area; (e) diversity index as suggested by Kant and Coker (1992) and Ludwig and Reynolds (1988); and (f) relative dominance-diversity curve (Rank abundance diagrams) calculated from basal area of trees which imply evenness.

Results and Discussions

Community Collective Behaviors and Management Regimes

Nahai village has been settled for more than 200 years in the north eastern mountain area along the Nan River. In the past villagers were dependent not only on paddy fields for lowland rice cultivation but they also practiced shifting cultivation particularly for upland rice supplementing lowland rice which production was low, unreliable, at that period, and then insufficient. Until 1960s, most Nahai villagers as well as people from other nearby villages encroached further to the higher altitude areas (upland and highland) with domination of evergreen forests for shifting cultivation. And later, some households started to permanently resettle in that area and were named Huai-muang village during 1970s.

In the permanent settlement, on the other hand, a Huai-muang leader initiated forest protection from fire encroachment and created firebreak lines around the village settlement. He also demarcated the forest area and set rules to protect Huai-nam-rin head-watershed in 1974. This is known as community forests for 'conservation' purpose (HMG-C) of the Huai-muang. This community forest allows only collection of non-timber forest products (NTFPs) but not timber and firewood. In 1977, the Sopsai Watershed Management Unit (SWMU) under the Watershed Conservation Section, the Royal Forest Department (RFD), was established in *Huai-muang* village. The SWMU asked people to stop shifting cultivation and work with the unit as temporary labor workers. Therefore, in the following year, the SWMU slashed and burned fallow areas around the settlement to plant tree seedlings for reforestation of head-watersheds. Through people's cooperation, these areas have regenerated and become *de facto "Pa-chai-soi"* (utilization forest) of *Huai-muang* (HMG-U) which is an important source of firewood, timbers and various NTFPs. Many collective rules have been developed particular in control of timber selling and maintenance of forest resources through making firebreak lines. *Huai-muang* is able to effectively exclude outsiders to access their forest area. However, due to less recognition of the villagers' right over the *"Pa-chai-soi"*, many villagers feel insecure in their management and reluctant to talk very explicitly about their resource accessibility.

Unlike *Huai-muang, Nahai* dwellers did not set up their community forest until 1997 when the Upper Nan Watershed Management Project was initiated. However, the recently set up community forest for watershed 'conservation' of *Nahai* (NHI-C) have regenerated for last 20 years due to individual villagers' willingness to stop shifting cultivation and leave these land fallow. In order to ensure recognition of individuals' right over old-fallow as well as the collective right, villagers also demarcated utilization zone. Within the utilization zone of *Nahai*,

there is combination of various agricultural land uses, rotational (mainly upland rice) and sedentary (mainly fruit trees and teaks) cropping systems, and particularly forest areas for utilization (NHI-U). The forest areas for utilization, in this case, are not the whole area of land but they are patches of secondary forest areas that people leave them for self-restoration for 10-20 years after shifting cultivation. These forest patches are scattered and small in size of approximately 1-2 ha.

Comparison of Forest Health Measurement

DBH- and Height-class Distribution

DBH-class distribution indicates health and succession of a forest unit. Figure 2 and 3 illustrate forest health of both villages which can roughly be divided into 3 zones. Trees with DBH-class distribution over 30 cm are evenly distributed in forests of both villages. There is a slight difference in the DBH distribution of 10-30 cm within two villages. Forests in *Huai-muang* have greater number of trees at each DBH-class than those in *Nahai*. However, the forest in conservation zone of *Nahai* has the smallest number of trees with DBH between 10 and 30 cm.

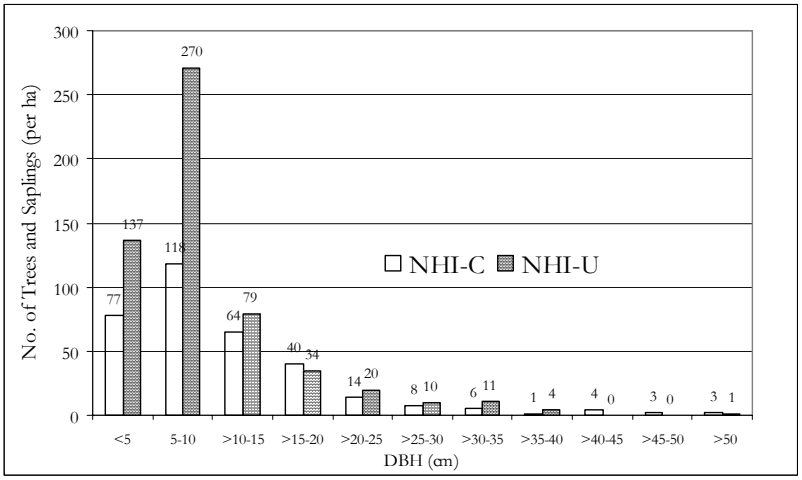

Figure 2. DBH-class distribution of trees and saplings of forests of *Nahai* village.

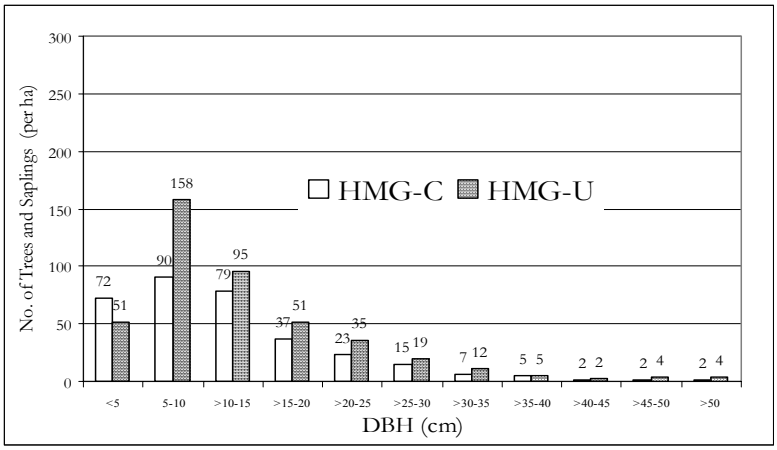

Figure 3. DBH-class distribution of trees and saplings of forests of *Huai-muang* village.

However, the vast difference between forest areas have occurred in the number of individuals of the DBH lower than 10 cm (counted as saplings). The substantial higher numbers of individuals exist in utilization zones of both *Nahai* and *Huai-muang*'s forests than those in 'conservation' zones. Especially, the highest number of individual saplings are found in the patch of forest areas like NHI-U, which have been maintained among upland rice and perennial cropping fields.

In addition, it is generally assumed that the healthier or more succession of a forest can be seen in the greater average height of the forest compared to others. As shown in figure 4 and 5, there are more than fifty percent of trees and saplings in the range of height between 5 and 10 meters. Their height-distribution thus, is similar. By considering height-class distribution only, in this case, there is not much difference in forest health between these forest areas

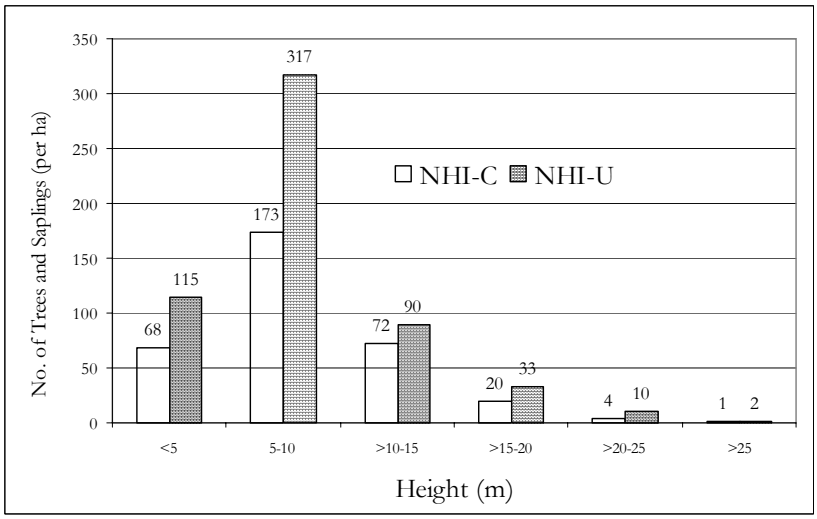

Figure 4. Height-class distribution of trees and saplings of forests of *Nahai* village.

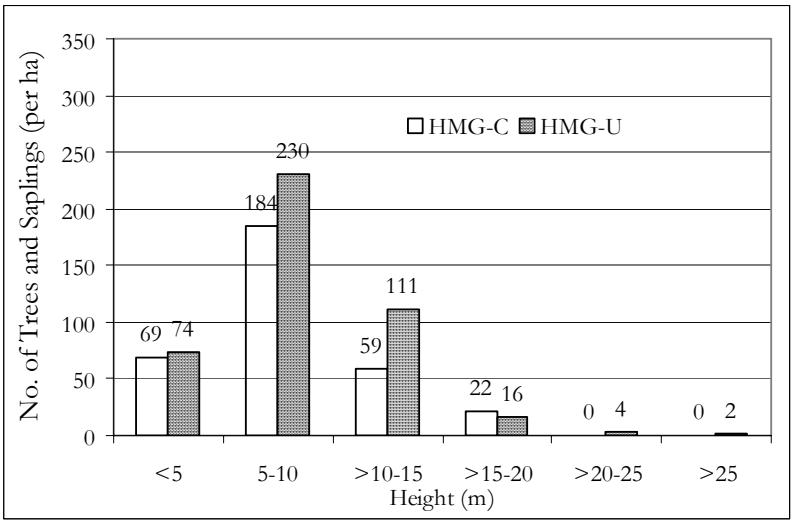

Figure 5. Height-class distribution of trees and saplings of forests of Huai-muang village.

Density, Basal Area, and Regeneration

Similar trend on DBH-class distribution and density of tree species (including tree, sapling, and seedling) were recorded with higher forest areas in *Huai-muang*'s forest areas than those of *Nahai*. And, by comparison within the villages, the forests in utilization area had higher tree density than the conservation zone. The highest tree density was found in HMG-U but the highest sapling and seedling density were found in NHI-U. The lowest density in all sizes were observed in HMG-C. Table 1 shows the findings analyzed from sampling plots in studying forest units.

Table 1. Basal area and density of tree and bamboo species in both villages' forests

Forest Units	Basal Area of Tree and Bamboo (m^2/ha)		Density of Tree species (/ha)			Density of Bamboo (clumps/ha)
	Total	3 most dominance species	Tree	Sapling	*Seedling*	
NHI-C	9.27	5.26 (*G. albociliata, P. macrocarpus*, and *Helicia* sp.)	144	195	*37,227*	237
NHI-U	9.08	6.08 (*G. albociliata, P. macrocarpus, and B. natans*)	159	407	*61,330*	283
HMG-C	7.52	2.11 (*H. robusta, P. macrocarpus*, and *I. Malayana*)	171	162	*12,409*	159
HMG-U	14.55	6.38 (*C. pergracile, P. macrocarpus, G. arborea*)	227	209	*18,920*	111

Remark : Seedling density includes seedlings of all life-forms including tree, woody climber, bamboo species.

Bamboo plays a significant role in people's livelihood as well as on ecology being one of the dominant species of forest in this region. It was observed that if better succession occurs, it might reduce the occurrence of bamboo species. Although the change in the biomass of bamboo cannot be quantitatively assessed, the earlier succession of *Nahai*'s forest areas with the most dominance of a bamboo species like *G. albociliata* can easily be compared with the lesser dominance and lower density of bamboo in forest areas of *Huai-muang*.

In addition, basal area, which is an important indicator of forest biomass were recorded highest in the utilization zone of *Huai-muang*, approximately 2 times higher than the conservation zone of the same village and over 1.5 times higher than forests of *Nahai* in both zones.

One way of looking at forest regeneration is to take into account of sapling and seedling density as mentioned in above section. Another indirect way to consider is repetition of observations and record differences within each forest unit. This is illustrated in Table 2. It is found that approximately half of total tree species existing in the area have equal tree-size. It shows more or less similarity among forest units. The highest percent of sapling and seedling species compared to total numbers of species within its forest unit is found in the NHI-U. This implies the better regeneration of overall species in the NHI-U as well.

Table 2. Number of total tree species and the distribution of both villages' forests.

Forest Units	No. of Tree Species (in all size)	No. of Tree Species in Different Sizes				
		Tree Size (>10cm DBH)	Sapling Size (<10->2.5cm DBH)		Seedling (<2.5cm DBH)	
			Total	Found in Tree-size	Total	Found in Tree-/Sapling-size
NHI-C	103	48 (47%[a], -[b])	49 (48%, 100%)	19 (18%, 39%)	54 (52%, 100%)	25 (24%, 58%)
NHI-U	71	35 (49%, -)	51 (72%, 100%)	31 (44%, 61%)	43 (61%, 100%)	27 (38%, 50%)
HMG-C	50	28 (56%, -)	26 (52%, 100%)	10 (20%, 38%)	24 (48%, 100%)	6 (12%, 25%)
HMG-U	158	90 (57%, -)	96 (61%, 100%)	61 (39%, 64%)	69 (44%, 100%)	31 (20%, 45%)

Remark: [a] is percentage of species number found in particular sizes compared to total species.

[b] is percentage of species number found within its particular size (saplings or seedlings)

Moreover, by considering individual species, in *Huai-muang* village, there are no species that only found in conservation zone but not in utilization zones. There are 10 species found in the forest for utilization but none in conservation zone of *Nahai* village. Especially eight out of the ten species are locally preferred species such as for wood and edible or income generating fruits. These species include: *Protium serratum*, *Lagerstroemia tomentosa, Crypteronia paniculata* which are valuable for timber uses and *Oroxylum indicum*, *Camellia sinensis* and *Zanthoxylum limonella* which are valuable as local food and income generation species.

Biodiversity

In this study we have considered only tree-form biodiversity of tree species. Species diversity are measured through two components: richness (the number of species in the communities) and evenness or equitability (how species abundance are distributed among the species). The summary of evenness and biodiversity index is shown in Table 3.

Table 3. Biodiversity indix of both villages' forests.

Biodiversity Index	*Nahai Village*		**Huai-muang Village**	
	Conservation Zone (NHI-C)	Utilization Zone (NHI-U)	Conservation Zone (HMG-C)	Utilization Zone (HMG-U)
Evenness Index				
D	0.4416	0.4602	0.5895	0.7399
E	0.4942	0.5263	0.6675	0.7951
J'	0.5116	0.5235	0.6915	0.6958
E5	0.3054	0.3848	0.3988	0.4730
Diversity Index				
Simpson's Index (lamda)	0.3284	0.3126	0.2046	0.0800
Shannon's Index (H')	2.0407	1.9043	2.3745	3.2314
N1 (the no. of abundant species)	8	7	11	25
N2 (the no. of very abundant species)	3	3	5	13

For comparing species richness, rarefraction, statistical method introduced by Hurlbert (1971) was also used (Ludwig and Reynolds, 1988).

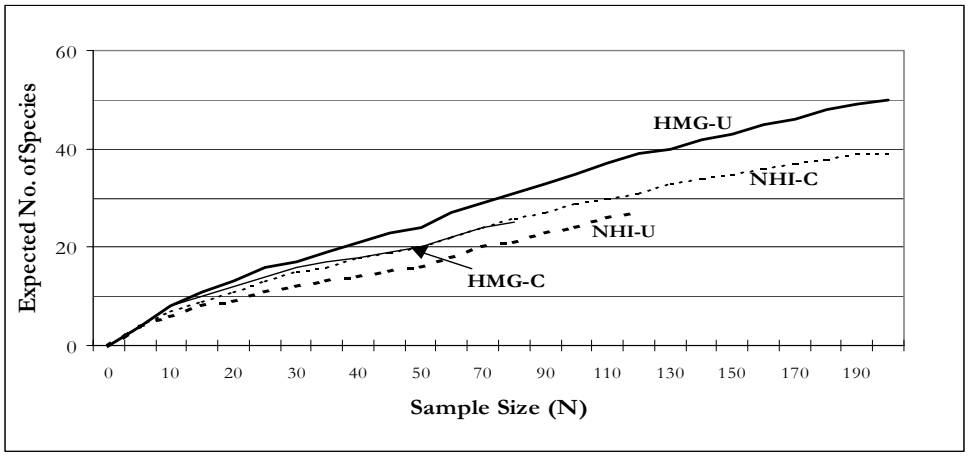

Figure 6. Rarefraction curve of Nahai and Huai-muang villages' forests

As seen in figure 6, it was found that the richness in the HMG-U was the highest while the NHI-U was the lowest. Forest in conservation zone of *Nahai* and *Huai-muang* are similar in terms of the value of species richness.

Within various indices of evenness, the same trend as richness was observed. Evenness is highest in the HMG-U followed by HMG-C, NHI-U, and NHI-C respectively. So, forest areas in *Huai-muang* are more even than those in *Nahai*. In each village, the evenness is higher in forests for utilization than conservation. Similar result is confirmed by Dominance-diversity Curves as shown in figure 7, although the steep of the curves are not clearly illustrated and differentiated as indicated by evenness indices.

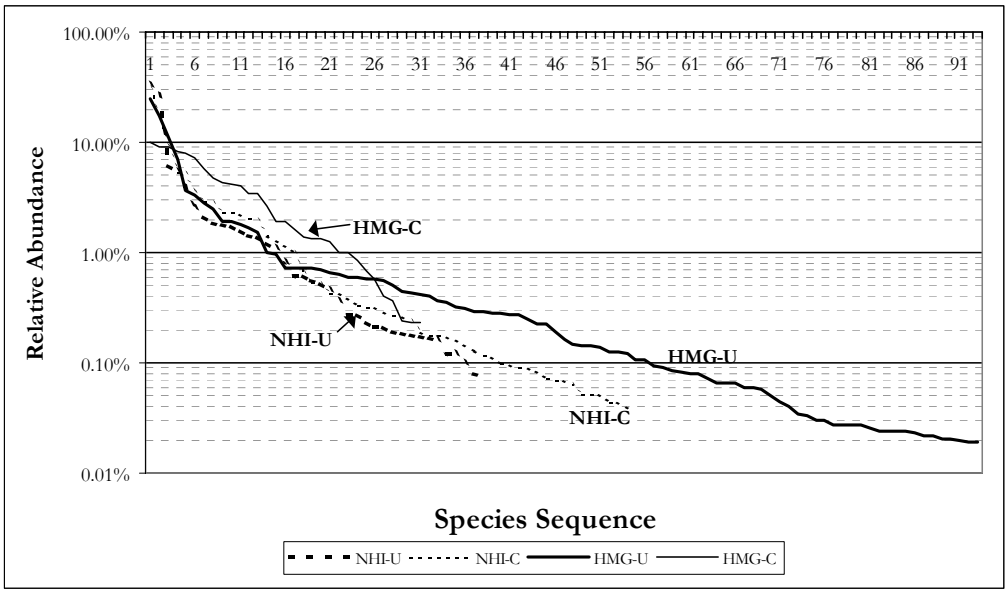

Figure 7. Dominance-diversity curves (of trees and bamboo) of *Nahai* and *Huai-muang* villages' forests.

By considering the biodiversity index (which includes species richness and evenness) forest areas in *Huai-muang* are also better than those in *Nahai*. And within *Huai-muang* species diversity is higher in forest for utilization than that for conservation. But forest areas in *Nahai*, the species diversity is almost similar both in conservation and utilization zones.

Strategies for conservation:

(1) 'Uses VS No-uses'

It is known that every individual forest stand is different. When comparisons were made between forest areas in *Nahai* and *Huai-muang*, the areas are connected and the conditions are generally similar. By consideration of geographical condition, *Huai-muang*'s forests are in the better position in term of their moisture content (as in the valley), soil properties and elevation (higher). People themselves also perceive the differences in their forests. They called the *Nahai* forests as *"Pa-pai"(*Bamboo forest formally called Mixed Deciduous Forest with Bamboo Dominance) and Huaimuang forests are called as *"Pa-dip"* or *"Pa-dong"* (Dry evergreen forest). *"Pa-pai"* generally is dominated by worse bio-physical condition of forests compared to *"Pa-dong"* but *"Pa-pai"* naturally has better capacity for self-regeneration.

The longer period of demarcation of *Huai-muang* forest boundary in conservation zone do not show significant differences in their health when referred to biodiversity, basal area, density of trees and sapling, DBH- and height-class distribution. This might be firstly due to the soil compaction of the conservation zone of *Huai-muang* settled after the establishment of Station of the People Volunteer for National Security (Ministry of Defense) and secondly, with less disturbance, widespread grass and vine compete with trees and seedlings. Therefore, the direct utilization may influence in the reduction of weed and vine spreading over the forest for conservation in *Huai-muang*.

Because forest patches in utilization zone of *Nahai* are close to agricultural areas of farmers, they have higher intensity of uses and management particularly in selecting and prioritizing harvest of the trees for firewood or timber. This implies that utilization of the forest areas at a certain level of intensity can benefit the forest conditions including biodiversity. Similar results have been reported from the studies carried by Habeak (1968) and Peet (1978). Since plant community is dynamic and intermediate disturbance can lead to increase of biodiversity, Sukwong (2002) has suggested that the intermediate disturbance can be managed through appropriate size, intensity, and frequent use of resources.

It does not mean that all forest areas should be managed for utilization purposes, people often propose to have both zones of conservation and utilization. Forest under conservation zone can be limited to the accessibility by allowing use of forest resources for public activities. By maintaining natural regeneration and limited use, the forest under conservation zone does function for watershed head rehabilitation, and it may not need the management for maximum

production. Villagers themselves are also willing to make zoning to limit rights in access and management of their forest resources by outsiders. But forest areas for the utilization are also needed for villagers to have both *de facto* and *de jure* rights to use and manage their forest resources including timber utilization which is more sensitive issue of concern for officials and elite and middle-class environmentalists.

In addition, through possessing secure right to manage and effective rules enforcement in *Nahai,* the forests have substantial succession as observed by villagers themselves. The security of rights in use and management of people is caused by the high recognition by local government officials.

(2) 'Managing small and scatter old-fallow patches

Conservation of forest patches through maintenance of fallow areas as forest-like conditions by leaving them for self-restoration, and appropriate uses and management, in this case, can increase landscape biodiversity. This phenomenon is a result of reduction of shifting cultivation of the community members to both other agricultural land-use (sedentary cropping) and non-agricultural activities (labors and governmental services).

Through implementation of the Upper Nan Watershed Management Project supported by the Royal Forest Department (RFD) and DANCED zoning of forest areas for conservation purposes in community claimed areas incidentally have led to further negotiation process. Community members discuss among themselves and the project staff (including local RFD officials) to make sure that not all forest regeneration areas particularly in old-fallow were demarcated for the conservation purpose, but zoning for utilization is also needed. The utilization zoning area is the land that lie in between land with title for agricultural purpose *("So-Por-Kor"*) and the community forest for conservation purpose. In the utilization zone, people have individual rights to manage land and resources. They can make decisions on uses and management as annual cropping or fruit tree orchards as well as maintaining old-fallow as private forest areas. However these people do not have complete right because their decisions for slashing and burning areas for annual cropping are still based on approval and control of the village committee. And there is a set of collective rules (e.g. making fire-break lines prior to burning, and penalty and fines for making fire into other forest patches and farms) developed to control uses of the common resources that can cause negative impacts to other villages as watershed users.

In term of institutional arrangement in managing forest patches as forest for utilization in *Nahai* as mentioned earlier, it is an important incentive since 1998 to make rapid regeneration. This is illustrated by the similar value of biodiversity index and the higher density (especially in sapling and seeding sizes) of the forest for utilization compared to that for conservation in *Nahai.* In addition, in term of productive management, the utilization zone has shown some differences significantly by its two time higher basal area of *Pterocarpus macrocarpus* and dominance of multipurpose species compared to the conservation zone. The promotion and incentive provision to sustainable management of these forest patches is a major challenge for landscape biodiversity conservation and increasing capacity in community-based forest management.

Concluding Remarks

In developing countries including Thailand, forest conservation by restricting human activities in natural forest is not the answer. Among the complexities of socio-economic and political issues especially addressing poverty issue in the societies, natural resources particularly water and forest are not only the socio-economic buffer of the poor people, but they are also important basis for livelihood development of rural communities. Therefore, it is necessary to build up the body of new knowledge of community-based natural resource management that recognizes the balance of ecological and socio-cultural base especially individuals and collective behaviors influencing on natural resources conditions. Management strategies should be based on location specific in bio-physical conditions, historical background, and dynamism of communities in association with the external circumstances.

The case study resulted from semi-rural area of the mountainous region of the Northern Thailand shows that the reduction of shifting cultivation lead to restoration of the secondary forest into the whole stand in the difficult to access area and into scattered patches mixed in agricultural land. For institutional development through community initiation like *Huai-muang* village or through project intervention like *Nahai* village, if the intervention programs are built up on existing institutions and are recognized by community themselves and officials, these institutions will be effective in implementation of such programs both in term of collective behaviors and enforcement. And it is a necessary basis for developing community-based approach toward forest restoration and biodiversity conservation. Community participation can not be considered voluntary because it demands sacrifices on part of users for protection of forest area without any direct benefits but they have to be able to make decisions on uses and management on sustainable basis. For example in the study area, with succession of mixed

deciduous and dry dipterocarp forest, institutional arrangement by communities themselves have encouraged forest restoration and biodiversity conservation both in forest stand and landscape levels. This can be illustrated by the rapid regeneration of seedling and sapling and distribution of species in different size-classes of forest areas in utilization zone which is higher than conservation zone.

Right recognition and security in forest resource management like forest patches in utilization zone of Nahai influence behaviors and practices of uses and management in the more productive way through selective cutting and species prioritized selection. But, ecological condition as edge effects may also influence the better regeneration on these forest patches as well. Finally, it is a great challenging period to increase enabling environment to people to maintain natural restoration and increase biodiversity conservation that would lead to sustainable natural resource management in the upland and mountainous regions.

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