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Forest Health, Collective Behaviors, and Management

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ABSTRACT / This study compares community-based managed forests under different purposes of management, namely, state-driven "conservation" or community-designed utilization in two villages located in the Sopsai watershed, Nan Province, northern Thailand. The forest health under different intensity of uses is assessed in association with the collective behaviors and long-term purposes embedded in village social–cultural context. The study found no significant differences in forest succession and proportion in diameter at 1.3 m (dbh) class and height-class distribution of the forest under different use intensity. The forest for utilization also showed higher density and basal area of the local preferred species than the "conservation" forest. In the utilization forest, we also found a higher number of multipurpose and preferred species than in the "conservation" forest, which actually responded to the needs of the community in the long term to have more wood products (both firewood and timbers). The community-based forest management (CBFM) for utilization can also lead to natural regeneration and biodiversity similar to "conservation" forests. Through CBFM, forest resources can be managed to maintain the healthy condition under different intensities and respond to both community needs and external expectation. The findings also emphasize the importance of recognizing community needs and management objectives in watershed restoration and improving the productivity of forests under collective management.

In response to increasing concerns about forest and biodiversity loss, there have been worldwide efforts to promote forest conservation in developing countries, particularly in the tropics. Despite general agreement among stakeholders regarding the need to conserve forests, there is less agreement on how rural communities can be integrated into the solution. In general, two major paradigms have emerged. On one hand, concepts such as deep ecology and wilderness suggest that large areas free from human disturbance are required to maintain biodiversity (Allin 1990, Noss 1990). These authors suggest that the only way to protect diversity is through the establishment and management of protected areas (PAs) under strict control of direct resource uses. This group considers that the exploitation of resources by humans is the principal cause of forest degradation (Soulé and Kohm 1989). A second paradigm suggests that the forest-dependent communities should be part of conservation strategies. The lives of millions of rural people cannot be maintained without accessing the forest resources (Poffenberger and McGean 1993). In several scientific circles, there has been substantial convergence of these two paradigms.

Thailand is similar to many developing countries that have adopted the model of forest conservation by excluding local communities from protected areas such as national parks, wildlife sanctuaries, and legal headwatershed areas (designated watershed Class 1 and 2). Thailand's conservation strategy has evolved from the heavy influence of the West and the politically powerful middle class in Bangkok (Ganjanapan 1998). As described by Hirsch (1997a, p. 2), this approach is "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."

Despite having a policy emphasizing forest protection by exclusion, many communities in the northern region traditionally manage their forests according to their spiritual beliefs, uses, and biophysical and cultural circumstances (Ganjanapan and Kaosa-ard 1995). A survey by Ganjanapan and Ganjanapan (1991) in northern Thailand reported 150 cases where communities have initiated headwater forest *patonnam* protection in order to maintain their water supply. Moreover,

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many communities link their spiritual beliefs with areas of the forest that are ecologically sensitive.

Local forest management practices were not recognized by the Thai state (Ganjanapan 1992). Traditional practices have deteriorated in part because of the state's centralized control over forests (i.e., the Royal Forest Department (RFD)) and its awarding of timber concessions to outside agencies before 1989 (Ramitanondh 1989). The negative impact of these state policies on local communities has in turn driven communities to initiate social organizations (e.g., the Northern Farmer Network) (Narintarangkul Na Ayuthaya 1996, Wittayapak 2002) and collective action for forest conservation (Ganjanapan and Kaosa-ard 1995, Wittayapak and Dearden 1999). Community-based forest management (CBFM) in Thailand, perhaps more than other Asian countries, has evolved through people's movements to gain power and "control over decision making" of forest resources in their locality (Gilmour and Fisher 1998). These movements have resulted in numerous often widespread protests and conflicts between local people and the state (Duaglamyai 2001).

More recently, the government of Thailand has begun to recognize the necessity of people's participation in forest conservation. This has come about as a result of both local movements and state-sponsored pilot projects such as the Sam-maun Highland Development Project and the People Participation in Village Woodlot Project of the RFD (Pragtong 1993, Apichatvullop 1993, Tan-Kim-Yong 1993). Although these developments are encouraging, we have observed that the implementation strategy is based on the application of state-derived rules on the community in order to achieve state objectives.

These two main controversial ideas have been shown explicitly in the events of people submitting and fighting for the Community Forest Act over a long period of time. The people's network and organization in partnership with development-oriented, nongovernmental organizations need the formal recognition of optimizing utilization of their forest resources, not just natural protection as proposed by government officers and elite environmentalists (Sukrung 1997, Noikorn 2000, Ekachai 2000, Samabuddhi 2002). This issue has become a contemporary conflict of natural resource management in the country (Hirsch 1997a, Hirsch 1997b).

Therefore, an important question for Thailand is: Is it possible to maintain good forest health when decision-making over use and management is done through community collective action for community objectives rather than by communities under state-influenced objectives for "conservation"? An answer to this question would be useful to guide the development of forest conservation strategies using community-based approaches.

In this study, we surveyed the forests of two communities in northern Thailand, both of which divide their forests into zones according to two different strategies: "conservation," which is influenced by state policy and middle-class society's expectations, and "utilization," which is designed through community collective action. Forest health parameters were compared in order to address the question of whether forest management used to achieve community objectives could be consistent with state objectives for "conservation."

Methods

Study Site

This study was undertaken in two villages, Huai-muang and Nahai, in the Sopsai Watershed, Nan Province (Figure 1). Nahai is located near the Nan River, and villagers use the flood plain area for growing rice in the rainy season and vegetables and peanuts in the dry season. Villagers irrigate their land with water supplied from the two small reservoirs above the settlement area. To the west are low hills where regenerating forests of old-fallow areas can be found interspersed with agriculture fields. Only a few (four to five) households were continuing the practice of shifting cultivation. Therefore, the overall land-use pattern can be described as a mosaic of regenerating forest and annual and perennial cropping areas (Figure 2). Most Nahai villagers have access to agricultural areas, especially in the lowland and near the road in the upland areas. There is also a very good road to the district center. It takes 45 minutes to get to the provincial center.

Huai-muang is an upland village found in relatively steep hills approximately 6 km to the west of Nahai. Access to the village is difficult because the road is not paved. During the rainy season, passage becomes extremely difficult. Huai-muang villagers grow paddy rice on limited irrigated land that does not allow dry-season cropping. They also practice extensive shifting cultivation with upland (dry) rice. Many households have changed from shifting cultivation to perennial cropping. The areas under different land use in both villages are illustrated in Table 1.

The forests in Nahai village are dominated by bamboo and deciduous tree species with good coppicing ability. Locally, this forest type is known as *pa-pai* (directly translated as "bamboo forest"). Forests in Huai-muang are at a higher elevation and are dominated by deciduous species with fewer evergreen species in the understory. This forest is known as *pa-dong*. In general,

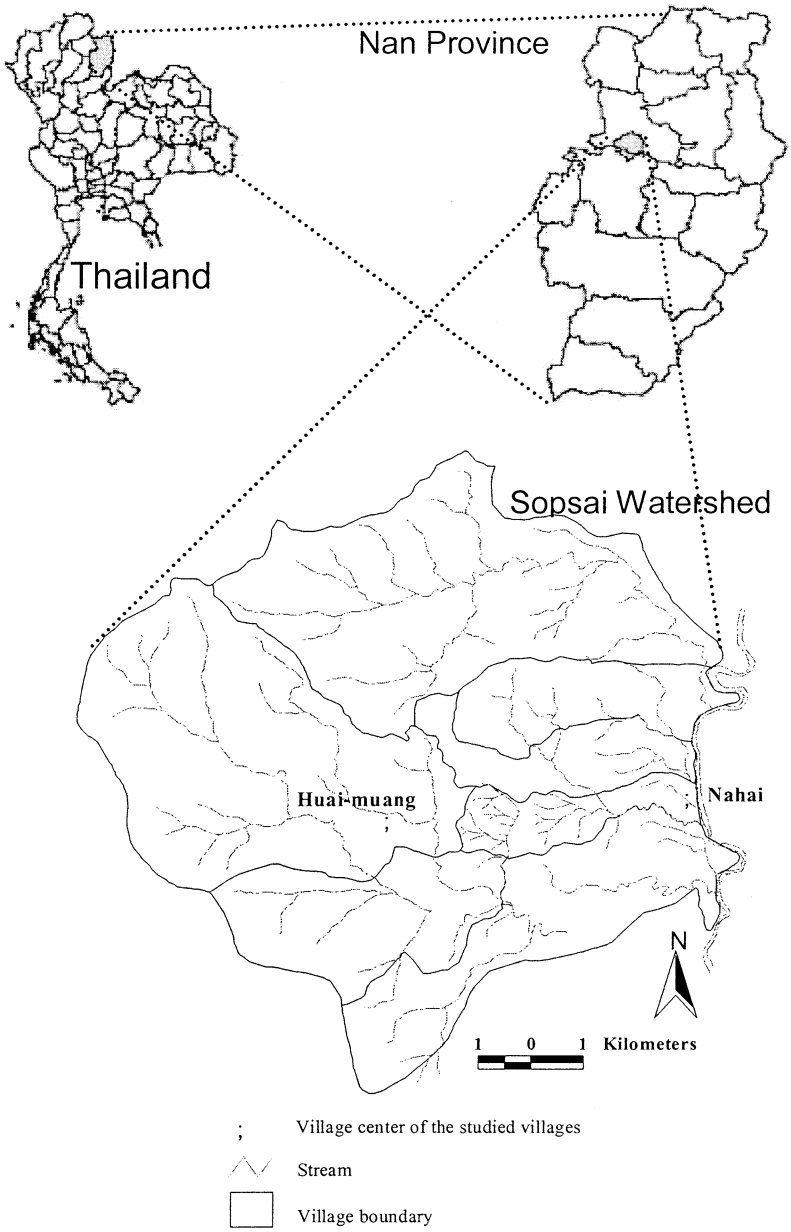

Figure 1. Forests managed by Nahai and Huai-muang villages in the Sopsai Watershed, Nan Province Thailand.

these forests would be classified as "mixed deciduous" according to most classification systems. A summary of biophysical conditions and a history of land and forests in both villages is given in Table 2.

Data Collection Methods

In this study, the interdisciplinary framework of the International Forestry Resources and Institutions (IFRI) was used for data collection (Ostrom 1999). IFRI uses several tools including rapid appraisal and a forest resource inventory.

Participatory mapping techniques using 1998 aerial photographs as a reference (scale 1:10,000), were used to identify the villages and the forests accessed by each village. In-depth interviews, group discussions, and participant observations were used to collect information on management practices by the communities, forest uses, rules and institutions governing the use, silvicultural manipulation monitoring, and protection. Particular emphasis was placed on how the communities divided the forest into management units with separate objectives, namely, state-driven "conservation" or com-

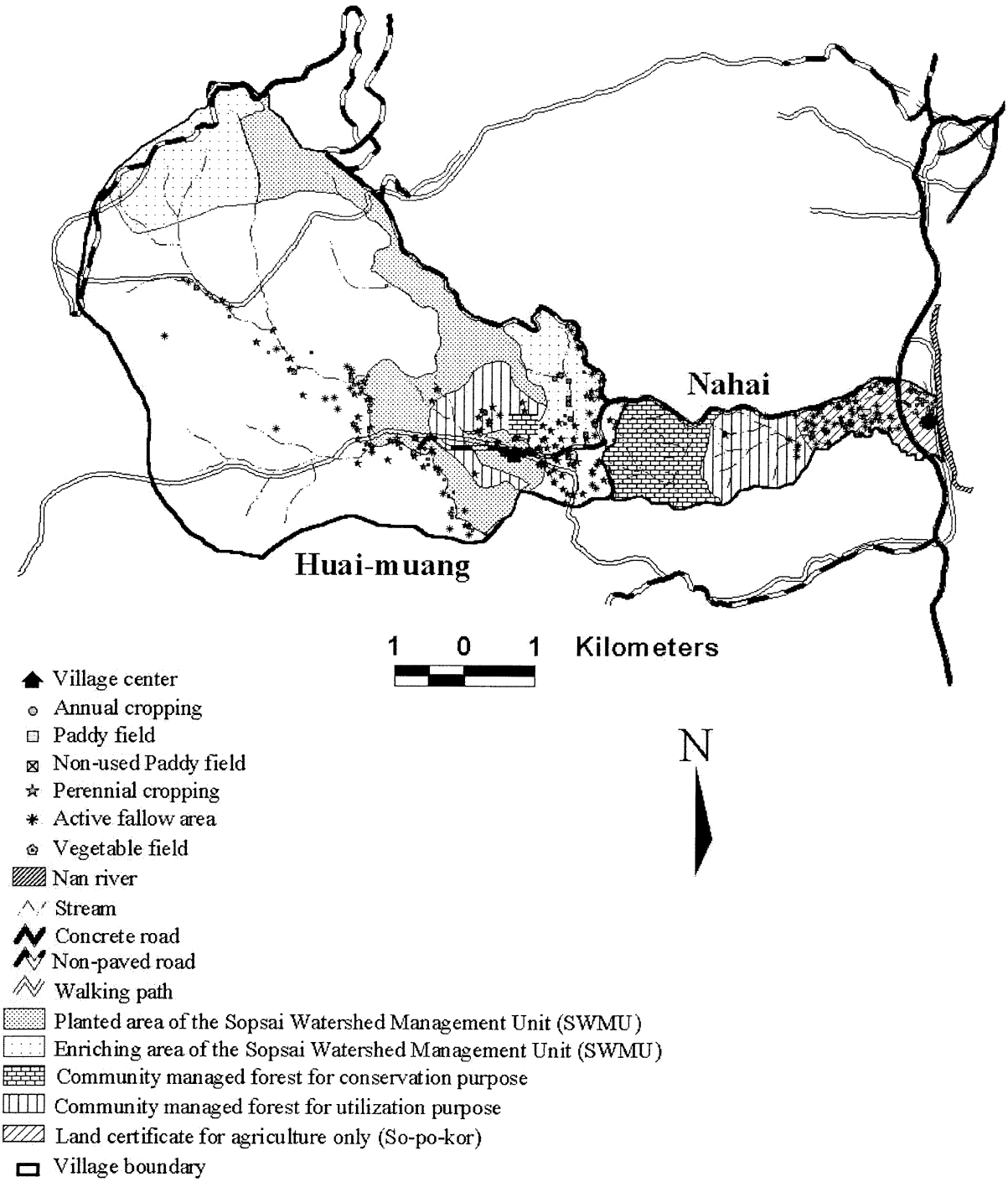

Figure 2. Community forest management overlapped with the forest restoration schemes (planted or enrichment forests) of Sopsai Watershed Management Unit (SWMU) and agricultural land-use in 2001.

munity-designed utilization objectives (hereafter, "conservation" and utilization, respectively).

After the forest management zones were mapped, a random sampling method was used to establish nested circular plots to survey forest conditions. At each survey point, three concentric plots were constructed. A large plot with a radius of 10 m was used to sample trees with a diameter greater than 10 cm at 1.3 m (dbh). A plot of

Table 1. Areas under different land-use of nonforests in Nahai and Huai-muang villages

Village	Areas under different land-use (rai)				
	Lowland paddy	Upland paddy	Perennial cropping	Annual cropping (under shifting cultivation)	Fallow land (under shifting cultivation)
Nahai (n = 73)	109.8(1.5)	4.5(0.1)	194.3(2.7)	43.6(0.6)	316 (4.4)
Huai-muang (n = 66)	—	94.8(1.4)	313.0(4.7)	52.5(0.8)	396.5(6.0)

Numbers in parentheses are average areas claimed per household. 6.25 rai = 1 ha; Data collected from village census (all existing households)

Table 2. Summary of biophysical conditions in association with land-use history in Nahai and Huai-muang villages

Characteristics	Nahai forest		Huai-muang village	
	Conservation purpose	Utilization purpose	Conservation purpose	Utilization purpose
Biophysical conditions	Elevation: 290–470 m msl Soil type: sandy clay loam Soil A depth: 4–12 cm Soil organic: 95–100% pH of soil A: 5–6 Crown cover: 35–95%	Elevation: 300–470 m msl Soil type: sandy clay loam Soil A depth: 3–7 cm Soil organic: 95–100% pH of soil A: 3–7 Crown cover: 45–80%	Elevation: 380–420 m msl Soil type: sandy clay loam Soil A depth: 5–9 cm Soil organic: 90–100% pH of soil A: 5–6 Crown cover: 30–85%	Elevation: 250–510 m msl Soil type: sandy clay loam Soil A depth: 3–15 cm Soil organic: 80–100% pH of soil A: 4–6 Crown cover: 30–90%
Local classified forest type	*Pa-pai*—bamboo forest	*Pa-pai*—bamboo forest	*Pa-dong* or *Pa-dip*—dense forest	*Pa-dong* or *Pa-dip*—dense forest
Forest ecosystem type	Dry deciduous forest	Dry deciduous forest	Moist deciduous forest	Moist deciduous forest
History of land use	Under shifting cultivation Then lay in fallow for 15–20 years	Under shifting cultivation Then lay in fallow for 15–20 years	Under shifting cultivation Used for a People Voluntary for Self-Defense Camp (UVSDC) during the opposition to the Communist Party of Thailand (CPT)	Under shifting cultivation Taken by Sopsai Watershed Management Unit for tree planting

3-m radius was used to survey saplings with a dbh 2.5–10 cm, and a plot with a radius of 1 m was used to sample tree seedlings and shrubs with a dbh <2.5 cm or a height <1 m. All individuals of woody climbers were also inventoried. Within the 10-m and 3-m plots, the species was identified and the dbh, height, and vegetative form were recorded for each stem. In the 1-m plots, only species name and number of individuals were recorded. To ensure botanical accuracy, a botanical reference collection was made that linked local name with scientific name.

A performance curve using the mean stem density per plot was used to determine the statistically appropriate number of sampling plots per management unit. Topographic and physical data such as location, soil depth, color, drainage, and texture were also recorded as reference base for site consistency. The inventory was carried out between January and April 2001 (the dry season).

Forest health was compared by using the following parameters: (1) height-class distribution of trees and sapling, (2) dbh-class distribution of trees and sapling, (3) density of trees and bamboo, (4) basal area, and (5) diversity index as suggested by Kent and Coker (1992) and Ludwig and Reynolds (1988).

Because the CBFM in Thailand is an issue of concern to the public, local communities cannot only manage based on their need for resource uses. They also need to be aware of the expectations of the state and public group. In this case, forest health was measured in association with the expectations of the state, public groups, and local objectives on particular parameters as described in Table 3.

The above parameters are used to illustrate forest condition under community-managed purposes. They are both influenced by external pressure, expectation, and internal need in association with sociocultural context. Each parameter implies some characteristics that are important to long-term management purposes of local communities. State management, on the other hand, may have very different concerns. For example, the highest diversity index may not be a concern of

Table 3. Local, state, and public group expecting objectives in forest health parameters

Parameter measured	State and public groups' objective	Local objective
Height and dbh distributions	Height and dbh distributions should indicate a forest that is "maturing" or "regenerating"	No specific objective
Density of trees and bamboo	Higher tree density, lower bamboo density	Higher tree density of preferred species, including bamboo
Basal area	Maximize total basal area	Maximize basal area of preferred species
Diversity index	Maximize number of species	No specific objective

Table 4. Number of households and population in Nahai and Huai-muang villages

Village	Monthly household income (baht)	No. of households	Population (persons)		
			Male	Female	Total
Nahai	10,143	77	137	154	291
Huai-muang	11,093	67	136	129	265

local communities in the forest managed for direct resource utilization. On the other hand, high basal area and density of local preferred species (for firewood and timber) would be more of a concern for utilization in community-managed forests than "conservation."

Using forest measurement, the ecological function can be indirectly assessed through the diversity, species composition, and basal area. Basal area especially reflects indirectly the greater crown cover, which is one of the important characteristics of ecosystem function.

Results and Discussion

Evolution, Goals, and Operational Strategies in Community-Based Forest Management

Nahai village has been settled for more than 200 years in its present area. In the past, villagers were dependent not only on paddy fields for lowland rice cultivation, but they also practiced shifting cultivation in their nearby settlement area. The production of the area was low, unreliable, and often insufficient. Until the 1960s, most Nahai villagers as well as people from other nearby villages were encroaching further into the higher altitude areas (upland and highland) on the west for shifting cultivation. In the 1970s, some households started to permanently resettle in that area, and it was named Huai-muang village. Therefore, both Nahai and Huai-muang communities have similar backgrounds as lowlanders traditionally depending on shifting cultivation in lower altitudes to supplement their lowland paddy cultivation. At present, Nahai and Huai-muang generally have similar income and population (Table 4). Nahai, however, is more accessible to public resource facilities and information than Huai-muang village.

The "Conservation" Forest of Huai-muang Village

After permanent settlement in the present area, Huai-muang villagers started to protect the forest in order to prevent the risk of fire encroachment. After the termination of the group Station of the People Volunteer for National Security (Ministry of Defense) in 1974, the ex-village headman of Huai-muang initiated the process to keep the area a commons. This area, called *Huai-nam-rin* is the nearest head-watershed of the Huai-muang village that supplied water for daily use by the villagers. The area has been protected and the forest has been restored. At present, this is known as community forest for "conservation" purposes of the Huai-muang. By the time the "conservation" community forest was established, Huai-muang and many villages in the upland and highland forest areas in the northern region were being pressured by the state as illegal settlers or forest encroachers. Therefore, setting up a community forest was an adaptation mechanism in response to the negative attitudes of external agencies and to gain legitimacy. Their concern was not just head-watershed degradation. In the "conservation" forest of Huai-muang, the direct uses of forest resources are very limited. Regular maintenance and guarding of firebreak lines has been carried out. Although the institution of the "conservation" forest in Huai-muang was partly because of the concern for watershed function, the villagers have increased their willingness to

protect well-regenerating forest as a result of the perceived changes for improved water supply after a decade of protection.

It should be noted that there are many head-watershed forests that originate a water supply, and the Huai-muang villagers have shown their interest in conserving these areas. However, the state and local state agencies are not as accepting because many of these areas are targeted for their reforestation programs.

The Utilization Forest of Huai-muang Village

In 1977, the Sopsai Watershed Management Unit (SWMU), under the Watershed Conservation Section of the RFD, was established in Huai-muang village. The SWMU asked people to stop shifting cultivation and work with the unit as temporary labor workers. Then, in the following year after a negotiation with a few ex-leaders of Huai-muang, the SWMU opened the areas around the settlement to plant tree seedlings under a watershed restoration scheme. In the mid 1980s, the SWMU office moved from the village to a higher altitude (far from Huai-muang). The tree planted areas around the settlement started to regenerate naturally through the protection of the Huai-muang villagers. Huai-muang villagers have claimed these replanting areas as their *de facto* community forest for the purpose of a fire-invasion buffer. After the forest was restored, the villagers used them for forest resources, household consumption, and income generation. This utilization-community forest is an important source of firewood, timber, and various NTFPs for all villagers of Huai-muang, especially disadvantaged groups who are not able to access other sources of income. Therefore, the utilization forest of Huai-muang has evolved through the needs of people to maintain their livelihood in the upland environment. In order to achieve the long-term goal of having abundant volumes and growth of preferred species in this utilization forest, many collective rules have been developed to control timber selling and to maintain forest resources by making firebreak lines. The CBFM of Huai-muang effectively excludes access to their forest area from outsiders. The establishment of community-managed forests, especially in the utilization zones, is not appreciated by the SWMU, which is regarded as the most related local state agency in the area. This is because the chief recognizes that the forest cannot be maintained without compromising local needs.

The "Conservation" Forest of Nahai Village

Nahai dwellers did not set up their community forests until 1997 when the Upper Nan Watershed Management Project (UNWMP) was supported. The forest area of Nahai has regenerated for the last 15–20 years because of individual villagers' willingness to stop shifting cultivation and to leave the area under inactive old-fallow.

The UNWMP that was implemented by the SWMU has proposed to promote people's participation in watershed restoration through forest protection. The UNWMP staff is aware that the regenerating forest area has been traditionally claimed by many individuals of the Nahai village. Many forums were organized for negotiations among the villagers of Nahai and the staff of the UNWMP. The staff claimed that the state through SWMU has legal rights to control and manage the forest land, and much of the area can possibly be declared a national park. If the declaration becomes official, people will have lost their rights to control or even access minor products from the forest. After long discussion, people decided to "participate" in forest "conservation" by adopting rules of forest resource uses and maintenances. By establishing "conservation" community forests, people expect to maintain the community rights over the land and forest resources at a negotiable level and hope it will be better than to lose control of the resources under the National Park Act. The National Park Act is said to be the strictest forest law established to prohibit local community access. Therefore, the initial stage of "conservation" of community forest is driven by the need to maintain collective rights over the land and resources and to respond to the state purpose of forest protection and community. After only 4 years of establishing the "conservation" forest of Nahai, people have increasingly recognized the need to maintain good forests for the purpose of watershed protection. This new recognition was influenced by the improvement of water reservoirs in the "conservation" forest, which in turn ensures the Nahai people better access to the water supply from the watershed. Nahai's village committee has managed the "conservation" forest by establishing rules with effective enforcement and monitoring. In addition, individual households in Nahai have been more recognized in the collective decision-making and management than the Huai-muang villagers.

The Utilization Forest of Nahai Village

During the process of establishing the conservation forest in Nahai, the villagers also negotiated to set up the utilization zone. The Nahai people are aware that they need to access forest resources in the short term and important intermediate benefits such as protection of the head watershed in the long term. Within the utilization zone of Nahai, regenerating forest is interspersed with agricultural land uses such as rotational

and sedentary cropping systems. The utilization forest, much like the conservation forest, has been kept for 15–20 years under inactive fallow at the size of approximately 1–2 ha. The establishment of the utilization zone ensures the Nahai people their right to access land and resources under the recognition of local state agencies.

In the utilization forest of Nahai, the Nahai people have established long-term management goals to ensure the supply of firewood and timbers for individual households. This clear goal influences their operational strategies such as selective cutting of firewood and maintaining some good stand of the preferred species for timbers. Making fire-break before shifting cultivation is just one rule that has been developed and adopted and is allowed only by the permission of the village committee.

The summary of collective behaviors, management purposes, and operational strategies of each forest is illustrated in Table 5.

Comparison of Forest Health Measurement

Diameter and height–class distribution. Dbh-class distribution indicates maturity and succession of a forest unit. Figures 3 and 4 illustrate the dbh-class distribution of Nahai and Huai-muang villages, which can be divided approximately into three zones. Trees with dbh-class distribution over 30 cm are evenly distributed in the forests of both villages. It is suspected that the trees with dbh over 30 cm have been left over from shifting cultivation. There is a slight difference in the dbh-class distribution of 10–30 cm within these two villages. Forests in Huai-muang that have taken a longer time to establish *de facto* community forests have a greater number of trees at each dbh-class distribution of 10–30 cm than those in Nahai.

However, a vast difference between forest areas has occurred in the number of individual trees with a dbh lower than 10 cm (known as saplings), which implies a significant change during the very recent years. Higher numbers of individuals are found in utilization zones in both Nahai and Huai-muang rather than in "conservation" zones. The highest number of individual saplings is found in the utilization zone of Nahai. This may reflect the effective management of utilization in Nahai, even though the collective decision to set up community forests was made only 3–4 years ago.

It is generally assumed that the more mature the succession of a forest can be seen, the greater the average height of the forest compared to others. As shown in Figures 5 and 6, there are more than 50% of trees and saplings in the height range between 5 and 10 m. Thus, their height distribution is similar under different management practices. In this case, there is not much difference in forest health between the forest area under "conservation" and the forest area under utilization when considering height-class distribution only. Therefore, CBFM through utilization can also accelerate succession as "conservation."

Density, basal area, and regeneration. Basal area can imply forest biomass and wood volume, which respond to both the state conservation objective and the local need for wood products. Local communities are more interested in locally preferred species for use as timber and firewood. As seen in Table 6, the total basal area in the utilization zone of Huai-muang is approximately two times higher than in the conservation zone of the same village. For Nahai, the total basal area of the conservation (9.27 m^2/ha) and the utilization forest (9.08 m^2/ha) areas are similar. See Appendix 1 to consider the basal area of the 10 priorities of preferred species for timber and firewood. It is much higher in utilization forests than in the conservation forests of both villages. Therefore, the CBFM for utilization responding to local need of direct resource uses can increase forest biomass as well as the forest with high protection. Under the utilization practice, people in Nahai have carried out some silvicultural treatments such as selective cutting and prioritizing tree species so the more valued tree for timber would be conserved and the optimum size of firewood would be selected for the long-term benefits.

Similar trends in dbh-class distribution and density of tree species (including tree, sapling, and seedling) are recorded in Table 7 with higher trends in Huai-muang than in Nahai. By comparison within the villages, the forests in the utilization area had higher tree density than in the conservation zone. The highest tree density was found in the utilization forest of Huai-muang, but the highest sapling and seedling densities were found in the utilization forest of Nahai.

Similar trends in basal area of preferred species and the difference in the density of preferred species for timber and firewood were higher in utilization forests than in the "conservation" forests of Nahai and Huai-muang. The densities of preferred species for timber and firewood in utilization forests were almost double that of "conservation" forests, especially in Nahai. Therefore, in people's views based on their needs and preferences, the forest areas under utilization have higher productivity than the ones under "conservation." However, the people are aware that the "conservation" forests are also necessary for management purposes.

One way of looking at forest regeneration is to take into account the sapling and seedling density as men-

Table 5. Collective behaviors, management purposes and initiation of community-based forest management in Nahai and Huai-muang villages

	Nahai forest		Huai-muang village	
Characteristics	Conservation purpose	Utilization purpose	Conservation purpose	Utilization purpose
Indirect/direct uses (timber firewood)	*Direct uses* 1) Collect dead-stand or fallen broken wood for household use 2) Timber harvesting for public uses only 3) Collect NTFPs *Indirect uses* Head watershed protection	*Direct uses* 1) Timber or firewood harvesting for household use in individual old-fallow only 2) Collect NTFPs 3) Open for agriculture under permission of the village committee	Head watershed protection	*Direct uses* 1) Timber harvesting for household use under permission of the village committee 2) Timber harvesting for public uses 3) Firewood collection for household use only 4) Collect NTFPs *Indirect uses* Buffering fire-invasion to the settlement
Maintenance	Forest guarding against non-authorized users and possible harm to the forests Making fire-break lines	Maintenance by individual households that claim old-fallow areas, i.e., selective harvesting, making fire-break lines	Forest guarding against nonauthorized users and possible harm to the forests Making fire-break lines	Forest guarding to against nonauthorized users and possible harm to the forests Making fire-break lines (some part)
CBFM initiatives and driven factors	Project intervention through discussion of the significance as head-watershed of the stream going to their lowland farms Public awareness in CBFM of the forest at local, provincial and national levels	Community initiative by using the negotiation forum of establishing "conservation"-zone to differentiated utilization zone Less interest in shifting cultivation in the upland areas	Community initiative by an ex-village headman with agreement of the members The area, which used to be the stream supplying water for household consumption was abandoned for the UVSDC, so no individual claimed External pressure on the upland settlement	The tree planting plots under The Sopsai Watershed Management Unit (but very little planted trees found) Community adaptation for their intermediate benefits by developing collective behaviors and rules to use and maintenance of forest resources
Management purposes of the community	Maintain good forest for head watershed protection and sources of forest resources for public uses	Multipurpose of direct uses to maintain livelihood security	Maintain good forest for head watershed protection	Multipurpose of direct and indirect uses to livelihood improvement

CBFM = community-based forest management, NTFPs = non-timber forest products; UVSDC = People Voluntary Self-Defense Camp.

tioned above. Another indirect way to consider it is repetition of observations and recording of differences within each forest unit. This is illustrated in Table 8. It was found that approximately half of the total tree species existing in the area have equal tree size. This shows more or less similarity among forest units. The

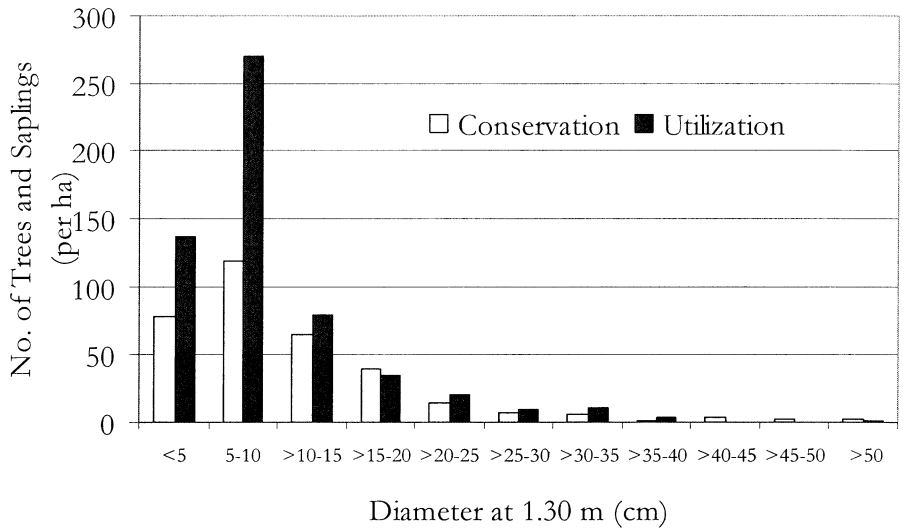

Figure 3. Diameter at 1.30 m (dbh)-class distribution of trees and saplings of forests of Nahai village under "conservation" and utilization purposes.

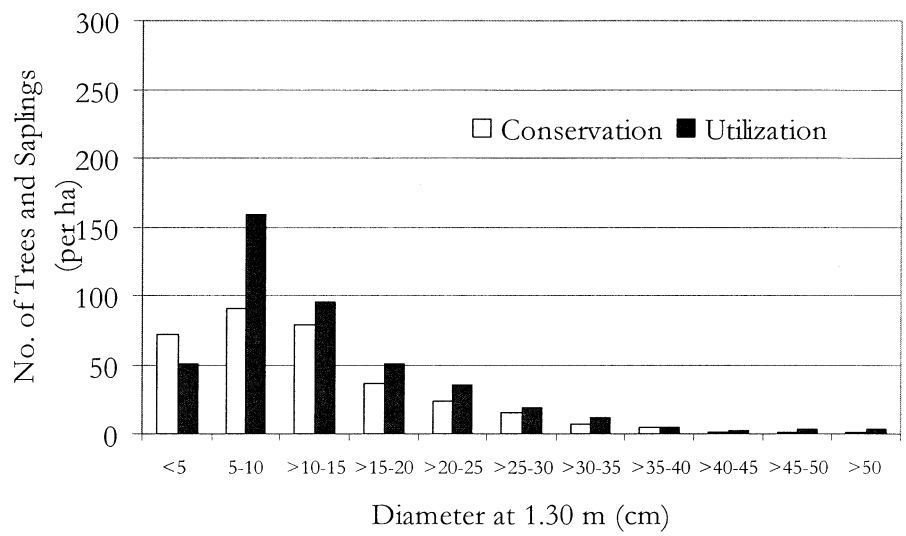

Figure 4. Diameter at 1.30 m (dbh)-class distribution of trees and saplings of forests of Huai-muang village under "conservation" and utilization purposes.

highest percent of sapling and seedling species compared to total numbers of species within its forest unit was found in the utilization forest of Nahai. This implies better regeneration of overall species in the utilization forest of Nahai as well.

Moreover, by considering individual species in the Huai-muang village, there were no species that were only found in the conservation zone, but not in the utilization zone. There were 10 species found in the forest for utilization, but none in the conservation zone of Nahai village. Eight of the 10 species are locally preferred species for use as 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-generating species. This is confirmed by the higher input in silvicultural intervention in utilization forest than in the "conservation" forest.

Biodiversity. In this study, the biodiversity index was calculated from the tree-form biodiversity of the tree species. Species diversity was measured using two components: richness (the number of species in the communities) and evenness or equitability (how species abundance was distributed among the species). The summary of evenness and the biodiversity index are shown in Table 9.

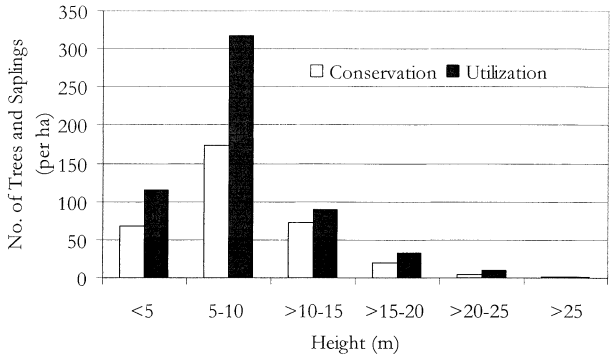

Figure 5. Height-class distribution of trees and saplings of forests of Nahai village under "conservation" and utilization purposes.

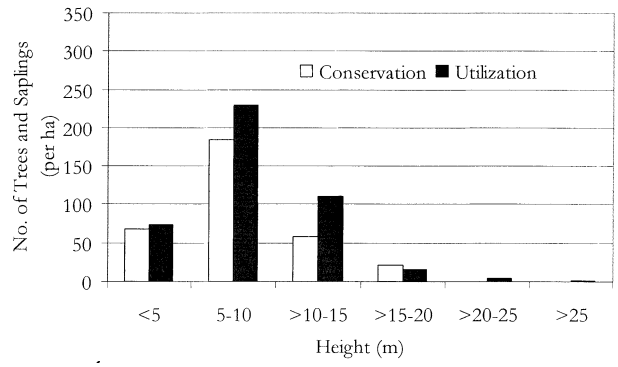

Figure 6. Height-class distribution of trees and saplings of forests of Huai-muang village under "conservation" and utilization purposes.

The statistical method introduced by Hurbert (1971) was used to compare species richness and rarefaction (Ludwig and Reynolds 1988).

The utilization forest of Huai-muang is the highest species diversity existing in the diversity index, evenness index, and richness (seen in the rarefaction curve of Figure 7) and higher than the 'conservation' forest in that village. However, it is difficult to say whether the forest under the more intensive uses in utilization would have higher species diversity than the less intensive uses in "conservation." As seen in the historical land use, the utilization forest of Huai-muang was planted as seedlings and well maintained during the first few years under the watershed restoration scheme, which has encouraged better natural regeneration. On the other hand, the "conservation" forest was the Station of the People Volunteer for National Security (Ministry of Defense) which has resulted in soil compaction. This has discouraged natural regeneration and biodiversity.

It would be more suitable to compare forests under different intensities of use in the "conservation" and the utilization forests in Nahai, because they both have similar histories of land use and biophysical conditions. In general, both the "conservation" and the utilization forests of Nahai have similar species diversity, which is reflected in the diversity index (Table 9). However, the "conservation" forest is higher in richness than the utilization forest, but lower in evenness. The evenness of species implies stability of the ecosystem; therefore, the utilization forest may be more stable than the "conservation" forest.

Forest Health and Community-Based Forest Management: The Implications

Establishment of CBFM and forest health. As seen from the public hearing events on the Community Forest Act (CFA) of Thailand, the right to establish community forest has been an issue for discussion. Most people and state agencies have recognized the rights of the old settling communities, particularly the ones who have traditionally conserved the forest and have tried to establish a community forest legally (Community Forest Section 1994). The study by Chamarik and Santasombat (1993) has proved that community forests have traditionally existed in Thailand for many purposes such as responding to the needs of local communities for utilization, grazing areas, environmental protection, and spiritual values. However, it becomes a controversial issue when the people-oriented group proposes to support communities that are able to show their capability to manage the forest in their nearby communities. The wilderness-oriented group and many urban societies have not agreed upon the rights to establish a community forest of new-settling communities in the upland and highland areas (Wittayapak 2002, Punthasain 1999, Punthasain 2002). The group, as well as the state and the urban people, believe that most people in the upland and highland communities are forest encroachers and illegal settlers. Therefore, this group felt it unfair to give rights to the new-settling communities to establish community forests (Ganjanapan 1998). Whether it is a new or old settlement under traditional or recent management, the communities that intend to be legally recognized (the community forests) need to go through procedures and mechanisms of checks-and-balances to ensure their capability to manage forest resources, as many academics have explained (Punthasain 1999, Punthasain 2002, Ganjanapan 2000, Makarabhirom 1999). Using Nepal as an example of one of the most progressive countries in community forest development, it has been proved that through process-oriented support and facilitation, forests can be

Table 6. Basal area of tree and bamboo species in forests of Nahai and Huai-muang villages under "conservation" and utilization purposes

Village	Purpose of management	Total basal area of tree and bamboo (m^2/ha)	Basal area of preferred species of the villagers (m^2/ha)	
			Timber	Firewood
Nahai	"Conservation"	9.27	2.22	2.31
	Utilization	9.08	3.07	2.76
Huai-muang	"Conservation"	7.52	1.55	2.91
	Utilization	14.55	5.54	4.53

Table 7. Density of tree and bamboo species in forests of Nahai and Huai-muang villages under "conservation" and utilization management purposes

Village	Purpose of management	Density of preferred species of the villagers		Total density of tree species (/ha)			Density of bamboo (clumps/ha)
		Timber	Firewood	Tree	Sapling	Seedling	
Nahai	"Conservation"	42	54	144	195	37,227	237
	Utilization	84	72	159	407	61,330	283
Huai-muang	"Conservation"	17	82	171	162	12,409	159
	Utilization	106	97	227	209	18,920	111

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

Table 8. Number of total tree species and the distribution in the forests of Nahai and Huai-muang villages under "conservation" (C) and utilization (U) management purposes

Village	Management purpose	No. of tree species (in all sizes)	No. of tree species in different sizes				
			Tree size (>10 cm dbh)	Sapling size (<10–2.5 cm dbh)		Seedling (<2.5 cm dbh)	
				Total	Found in tree size	Total	Found in tree-/sapling-size
Nahai	C	103	48 (47%[a], -[b])	49 (48%, 100%)	19 (18%, 39%)	54 (52%, 100%)	25 (24%, 58%)
Nahai	U	71	35 (49%, -)	51 (72%, 100%)	31 (44%, 61%)	43 (61%, 100%)	27 (38%, 50%)
Huai-muang	C	50	28 (56%, -)	26 (52%, 100%)	10 (20%, 38%)	24 (48%, 100%)	6 (12%, 25%)
Huai-muang	U	158	90 (57%, -)	96 (61%, 100%)	61 (39%, 64%)	69 (44%, 100%)	31 (20%, 45%)

[a]Percentage of species number found in particular sizes compared to total species.
[b]Percentage of species number found within its particular size (saplings or seedlings).

managed well by local people themselves (Gilmour 1995, Blockhus and others 1997).

This research found that a recent-settling community like Huai-muang has longer established community forest in comparison to an old-settling community like Nahai. The longer established community forests of Huai-muang have the higher dbh-class distribution and total tree density in comparison to the recently established forests of Nahai. It should be noted, however, that the Pa-pai of Nahai is generally dominated by worse biophysical conditions in comparison to the Pa-dong of Huai-muang. The increased succession in Huai-muang forests has been influenced by the higher elevation and moisture content in that area. The Pa-pai of Nahai has rapid natural regeneration, as seen from the increased density of seedling and sapling compared to the same management practices in the forests of Huai-muang. The dry deciduous forest has a higher regeneration capacity under repeated disturbances and direct exploitation.

In addition, the external support and facilitation led to the establishment of the community forest in Nahai. The institutional features include collective behaviors of individuals to reduce shifting cultivation, maintaining natural regeneration of their inactive fallow areas, and the exclusion of the nonauthorized users to access

Table 9. Biodiversity index in the forests of Nahai and Huai-muang villages under "conservation" and utilization management purposes

Biodiversity index	Nahai village		Huai-muang village	
	Conservation	Utilization	Conservation	Utilization
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 (λ)	0.3284	0.3126	0.2046	0.0800
Shannon's index (H')	2.0407	1.9043	2.3745	3.2314
N1 (the number of abundant species)	8	7	11	25
N2 (the number of very abundant species)	3	3	5	13

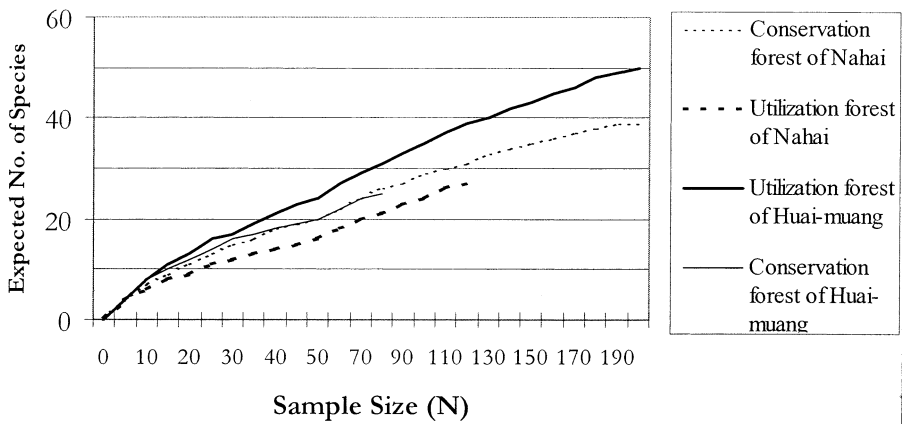

Figure 7. Rarefaction curve of Nahai and Huai-muang villages' forests for "conservation" and utilization purposes.

land and wood products. These features have been incorporated in the negotiation between the Nahai community and the UNWMP staff.

The use of only two villages in this study is not enough to state the capability of communities to manage their forest resources in the long term. More action-oriented research is needed to determine the processes or mechanisms needed to support the establishment and capacity building of community forest management sustainably.

Evolution of community based forest management: purposes and locally perceived benefits. Most community forests in Thailand have developed in response to the external pressure by the state in the form of policies to control land and resources (Ganjanapan 2000). Therefore, the first priority of forest management by the communities was not for the betterment of forest resources, but to ensure the security of land and resource use for their own communities (Ganjanapan 2000, Wittayapak 2002).

Similarly, the CBFM of Huai-muang is lesser recognized by the SWMU and the UNWMP. Collective behaviors have been developed through the needs of people and their immediate benefits with little support from outsiders. Public awareness of upland degradation and overexploitation by local communities has pressured the Huai-muang people to control land and timber uses.

After establishment, there was an institutional dynamic in both villages in which they tried to set up clear boundaries for their community forests in order to exclude others. Their expectations of the benefits from the CBFM have also changed. Both villages are increasing their interest in improving the forest resource harvesting and management for the long-term benefits of their own communities. The people do not just want to have direct access to forest resources everywhere. They propose to have both zones of conservation and utilization. Forests in the conservation zone can have limited accessibility by allowing use of forest resources for

public activities. By maintaining natural regeneration and limited use, the forest in the conservation zone can function as watershed head rehabilitation, and it may not need the management for maximum production. Villagers are also willing to approve zoning to limit rights in access and management of their forest resources by outsiders. Forest areas for utilization are also needed for villagers to have both *de facto* and *de jure* rights to use and manage their forest resources. This includes timber utilization, which is a sensitive issue of concern for officials, elite, and middle-class environmentalists.

The implementation of the UNWMP zoning of forest areas for "conservation" purposes in community-claimed areas has led to further negotiations. Community members discuss among themselves and with the project staff (including local RFD officials) to make sure that not all forest regeneration areas, particularly in old-fallow (both active and inactive areas), were demarcated for conservation purposes. Zoning for utilization is also needed. Presently, the promotion and incentive provision for sustainable management of the utilization forest is a major challenge for landscape biodiversity conservation and increasing capacity in community-based forest management.

It is challenging to support and facilitate people to maintain good environmental conditions based on their interests. The purpose of their management of forest resources at different intensities is so that the CBFM will be carried out even though the project is terminated. If the policymakers of the RFD maintain legal proclamation of the PAs and prohibit people's use of forest resources, it will not only cause increasing conflicts, but will also decrease community interest in collective management of their forest resources, which in turn can increase further degradation of watershed resources.

Community-based forest management for whose benefit? Direct resource utilization and "conservation" in head watershed areas. Nahai and Huai-muang villagers perceive that the forests under community-based management have better health because of the observed rapid natural regeneration. In the period before community-based management, the villagers experienced water shortages.

In the views of the state and urban people, the forest under "conservation" or less intensity of uses should reflect standard health parameters of forest management. The utilization forests show height-class distribution and total basal area similar to the conservation forests. Therefore, community management for utilization can be a strategy of forest and biodiversity conservation.

It was quite difficult to directly compare forest health under different management practices in the Huai-muang village because the forests have different land-use historical backgrounds. The comparisons of forest health were made between forest areas under different collective behaviors and management practices in the Nahai villages only because of their similarity in biophysical and land-use background. After the classification for "conservation" and utilization, the collective behaviors in uses and maintenance are different in both forests, responding to their evolved intermediate and long-term expectation of benefits.

In response to the people's purposes in the forest health parameter, the utilization forest of Nahai shows significantly higher total density (especially sapling and seedling), basal area, and density of preferred species than the "conservation" forests. This is confirmed by the more productive management of the utilization forest of Nahai than the "conservation" forest. 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 in the studies carried out by Habeak (1968) and Peet (1978) from the temperate region. The forest under utilization, therefore, is not only able to support conservation, but also to increase productivity in the forest. Because the plant community is dynamic and an intermediate disturbance can lead to an increase in biodiversity, Sukwong (2002) has suggested that an intermediate disturbance can be managed through appropriate size, intensity, and frequent use of resources.

Through the classification of management purposes and implemention of the operational strategies responding to the purposes, communities themselves can gain benefits from their collective action. At the same time, the state objective can also be achieved. However, no one can guarantee future success. People need to be trusted to manage their forest resources. Ekachai (1997), a senior journalist who follows the debate over CFA and discussion on community-based forest management, challenged her readers by stating that "We used the law for many years to punish people, and failed miserably. Why not use it to encourage positive behavior as intended by the CFA?"

Without neglecting roles and concerns of various groups in Thai society, it has been proposed by many academics to have an external monitoring system that outsiders can participate in together with local communities to monitor or develop other check-and-balance mechanisms to ensure proper management by communities (Makarabhirom 1999, Punthasain 2002, Wittayapak 2002).

Conclusions

In developing countries, such as Thailand, forest conservation by restricting human activities in natural forests causes conflicts between local communities and the state and in turn leads to further degradation. Natural resources such as water and forests are not only the socioeconomic buffer of poor people, but they are also important basics for the livelihood development of rural communities. Therefore, it is necessary to recognize the balance of ecological and sociocultural bases and roles of communities in forest resource management in response to their need for short-term and long-term benefits. Operational strategies of local communities are not static, but have evolved through pressure and internal need under changing circumstances as is evident in this study. The establishment of state-driven or social-pressure "conservation" forest for claiming rights on communities' own land and resources has evolved toward immediate and long-term benefits. In addition, if there is process-oriented support and formal recognition of local institutional arrangement, the recently established community forest also shows effective management, as is evident by the high sapling and seedling density of Nahai's forests. Although most communities have classified their forests into "conservation," utilization, or for some other purpose (i.e., spirit forests), people are aware of multifunctioning and have gained multibenefits from that. Under collective management for utilization, people have more access to resources and more silvicultural operation for improving productivity. The density and basal area of the local preferred species were higher than in the "conservation" forest without losing biodiversity and retarding natural restoration. CBFM is not only implemented for the benefit of the communities themselves, but it is also used to complement to state and public purposes of conservation. Therefore, in the forest areas under collective management or accessing by the communities nearby for maintaining their livelihood, process-oriented support and formal recognition by the state agencies would be an effective strategy. It is known that the many environmental groups and urban societies in Thailand have much uncertainty about community capacity to manage forest resources sustainably. Therefore, external or co-monitoring mechanisms should be developed to ensure that they are managed by including many stakeholders' concerns as well as securing community rights to access the resources for improving livelihoods.

Appendix

Local name (in Thai)	Scientific name	Local preferred species	
		Firewood	Timber
Tew	*Crotoxylum sumatranum*	√	
Now-nai	*Ilex umbullulata*	√	
Kab		√	
Gai	*Nephelium hypoleucum*	√	
Ma-kok	*Spondias pinnata*	√	
Tew-luang	*Crotoxylum foormosum*	√	
Odd-add		√	
Ja-nga		√	√
Pradu	*Pterocarpus macrocarpus*	√	√
Ma-muan	*Irvingia malayana*	√	√
Teen-nok	*Vitex limonifolia*	√	√
Ngew	*Bombax anceps*		√
Ton	*Albizia procera*		√
Saw	*Gmelina arborea*		√
Ma-geam	*Albizia lebbeckoides*		√
Ma-ha	*Syzygium albiflorum*		√
Jam-pee-pa	*Michelia bailonii*		√
Boo	*Lagerstroemia tomentosa*		√

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