QBS Biodiversity Survey (QBS) of TUL-SEA in Chiang Mai, Thailand

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"Roles and Importance of Sacred Groves in Biodiversity Conservation in Chiang Mai"

Project title: **Trees in multi-Use Landscapes in Southeast Asia (TUL-SEA): A negotiation support toolbox for Integrated Natural Resource Management**

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TRANSFORMING LIVES AND LANDSCAPES

Introduction/ Background

Today we are losing earth's greatest biological treasures just as we are beginning to appreciate their true value. Rainforests once covered 14% of the earth's land surface; now they cover a mere 6% and experts estimate that the last remaining rainforests could be consumed in less than 40 years (Taylor, 2010). Tropical rainforests are disappearing from the globe; they continue to be destroyed at exceeding 80,000 acres (32,000 hectares) per day. Along with them, the planet looses as many as several hundred species to extinction because the tropical rainforests are incredibly rich ecosystems that play a fundamental role in the basic functioning of the planet. There are home to probably 50 % of the world's species, making them an extensive library of biological and genetic resources. In addition, rainforests help maintaining the climate by regulating atmospheric gases and stabilizing rainfall, protect against desertification, and provide numerous other ecological functions. Deforestation of tropical rainforests has a global impact through species extinction, the loss of important ecosystem services and renewable resources (Butler, 2010).

Forest not only provides people with food, medicine and livelihood but also contribute to the maintenance of indigenous culture (Pei, et al. 2009). The consequent destruction of natural resources has prompted to creation of conservation group in several countries. Many countries around the world have been vigilant in preserving their natural resources. Primary focus is upon maintaining the heath of nature especially forest conservation. It’s also known that nature conservation is a political and social movement that seeks to protect natural resources including plant and animal species as well as their habitat for the future (Gadgil, 1987).

Ecologists have started to appreciate how traditional people use their resources without destroying them. Different human societies have elaborated a striking diversity of ways of working with nature. The conservation of this rapidly diminishing pool of experience, a kind of cultural diversity, is as pressing as the conservation of biological diversity (Ramakrishnan, 1996). In conclusion, the diversity of traditional resource use practices represents a pool of human experience spanning many millennia. In some ethnic groups in remote areas there have culture that always believe in some spirits on something or somewhere such as sacred site or sacred places.

Sacred places have long and diverse histories in human cultures and demonstrate ancient links between peoples and their environments (Anderson, et al. 2005). In many regions of the world, sacred sites have been shown to have a major effect on conservation, ecology and environment due to the special precautions and restrictions associated with them (Anderson, et al. 2005). Traditional respect for the environment and access restrictions to sacred sites have often led to well-conserved areas with high biological diversity within otherwise degraded environments (Schaaf and Lee, 2003). The same sacred place may be recognized as special by individuals from very different cultures, religions, histories, and ecologies, although they may interpret it quite differently. One important form of sacred sites is sacred forest or sacred groves. The sacred forests are found in Africa, Asia, Europe, Australia and America. Their existence has also been reported in Ghana, Syria, Nigeria, Turkey and Japan (Khumbongmayum, et al. 2004).

The sacred groves or sacred forest are protected areas of forest because of religious belief and constitute an important aspect of the culture life of various communities throughout the world (Huges, 1997: Chandrashekara and Sankar, 1998). It is an old tradition of preserving small patches of old growth forest as a part of their culture and religious beliefs and manifested by a range of traditions and cultural value of the indigenous people who respect the groves with beliefs in nature worship inherited from their ancestors (Upadhaya, et al. 2003). There are segment of landscape or forest patch that containing tree and others form of life rich in biodiversity. The sacred forests are informal managed as part of a local cultural tradition, without much intervention from State Forest Departments and represent a functional link between social life and forest management system of a regional. They act as reservoirs of much local biodiversity preserving unique flora and fauna because their worshiping of the sacred groves can lead to relatively undisturbed landscape compared to surrounding areas (Khumbongmayum, 2006). As a result, it is expected that these landscapes are blessed with great biodiversity. Not only in biodiversity conservation, the groves also play an important role in water and soil conservation. These sacred groves, which were once highly revered and maintained, are now fast degrading under the influence of rapid socioeconomic transformation and materialistic attitude (Jaryan, et al. 2010).

In northern Thailand, there are many groups of hill tribes such as Karen, Lahu, Hmong, Lisu, Akha, Mien and Lawa. Each group of hill tribe has its own customs, language, dress and spiritual beliefs. For example, the customs of Karen and Lawa are respectful of the natural surroundings of their community. Karen and Lawa have developed their culture, traditional belief, knowledge, customs and resources use systems through their productive activities and living practices over many times or generations. The sacred groves or sacred forest is the one of their culture that has played a critical role in conserving local biodiversity. These sites are cultural treasures that have been tended through traditional stewardship for many years, and their preservation is crucial to maintaining their cultural system. Local laws and customs often limit human activity in these forests: hunting, grazing and logging may be prohibited or restricted, and villagers take care not to damage the natural surroundings.

Landscape of mountainous northern Thailand is a mosaic of agricultural, forested, communal, and degraded agricultural lands. Indigenous landscape of the Karen and Lawa are often fragmented forest or sacred groves connecting various types of land use such as swidden cultivation and swidden fallow. The sacred forests have been habitat and conservation sources for plant species movement. There has been a little knowledge about how sacred forest actually functions in developed and fragmented landscapes. Due to the changing land used in northern Thailand, however, evidences of the benefit of sacred forest have been scarce.

The Forest Restoration Research Unit (http://www.forru.org), Chiang Mai University, has been experimenting and planting framework, which are fast-growing, fire-resilient, native species, in degraded areas in Chiang Mai since 1998. Forest restoration relies on the natural process of seed movement, via seed dispersers, from the other areas to accelerate the forest recovering process. As a consequence, even though the first stage of forest restoration can be successful considering seedlings achieving high survival rate and fast growth, the success of the later stage depends large on seedling recruitment via various means. The accomplished results will be used to assess potentials of highland sacred groves as sources for species movement in fragmented landscape of Northern Thailand, which should be applicable in forest restoration and biodiversity conservation.

Objectives of the study and expected outputs

1. To assess plant diversity and species composition in sacred groves in the highland of northern Thailand.
2. To assess potential of sacred groves in providing knowledge of ecological conditions suited for seed dispersal via sacred groves in forest regeneration applicable for forest restoration.
3. To evaluate landscape position and configuration of the study area to determine landscape connectivity using maps (e.g. Google Earth and best available maps).

Methodology

1. Site selection

The rotational shifting cultivation landscape is composed of crop and fallow fields of different ages. Villages also have remnants of sacred (protected) and utilized forests. Villagers are only allowed, by the village committee, to extract minor forest products from the sacred forests. On the other hand, the villagers can extract timber from the utilized forest, however, in agreeable quantities. This study determined plant species composition in the sacred forests.

One Karen and one Lawa were included in this study (Figure 1, Table 1, Figure 2, Table 2, Figures 3, 4, 5, and 6). The villagers of these villages practice rotational shifting cultivation with a comparative fallow length. A difference between them is that one is located at about 1,000 m above sea level, while another below 1,000 m. The 1,000 m elevation is often used as a boundary between deciduous and evergreen forests in northern Thailand. Therefore, it was expected that plant species composition and dynamics should be different between the two groups of the villages.

Fig. 1 Map of Thailand showing the location of Mae Chaem watershed, Chiang Mai

(World Agroforestry Centre, 2010)

Table 1 Locations of swidden fallow and sacred forest in Ban Mae Hae Tai Karen village, Chiang Mai, Thailand

Fallows age	**1-year**	**3-year**	**7-year**	**Sacred forest**
Aspect	Southeast	East	South	North
Geographical Location	N 18° 25' 20.22"	N 18° 25' 32.77"	N 18° 26' 38.83"	N 18° 24' 21.4"
	E 98° 7' 53.91"	E 98° 8' 21.20"	E 98° 9' 8.65"	E 98° 9' 20.5"
Elevation (m)	1,066	1,112	1,104	1,342
Distance from the sacred forest (km)	1.95	2.12	4.36	

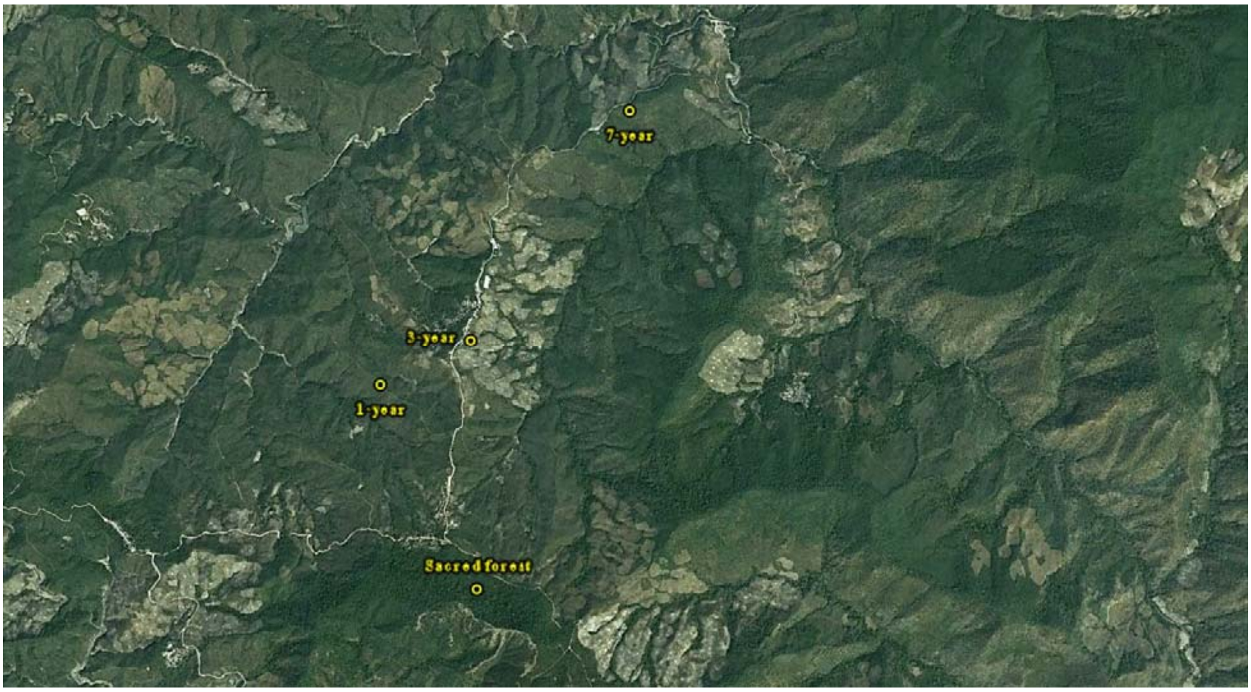

Fig. 2 The sacred forest and the swidden fallow fields (1-year, 3-year, and 7-year) of Ban Mae Hae Tai Karen village, Chiang Mai, Thailand

Table 2 Locations of swidden fallow and sacred forest in Ban Mude Lhong Lawa village, Chiang Mai, Thailand

Fallows age	**1-year**	**3-year**	**5-year**	**Sacred forest**
Aspect	South	East	South	Northeast
Geographical Location	N 18'24'17.6"	N 18'24'51.9"	N 18'24'25.6"	N 18'25'14.6"
	E 98'10'43.2"	E 98'10'30.3"	E 98'10'29.0"	E 98'09'54.1"
Elevation (m)	1,040	1,063	1,093	950
Distance from the sacred forest (km)	2.26	1.27	1.82	

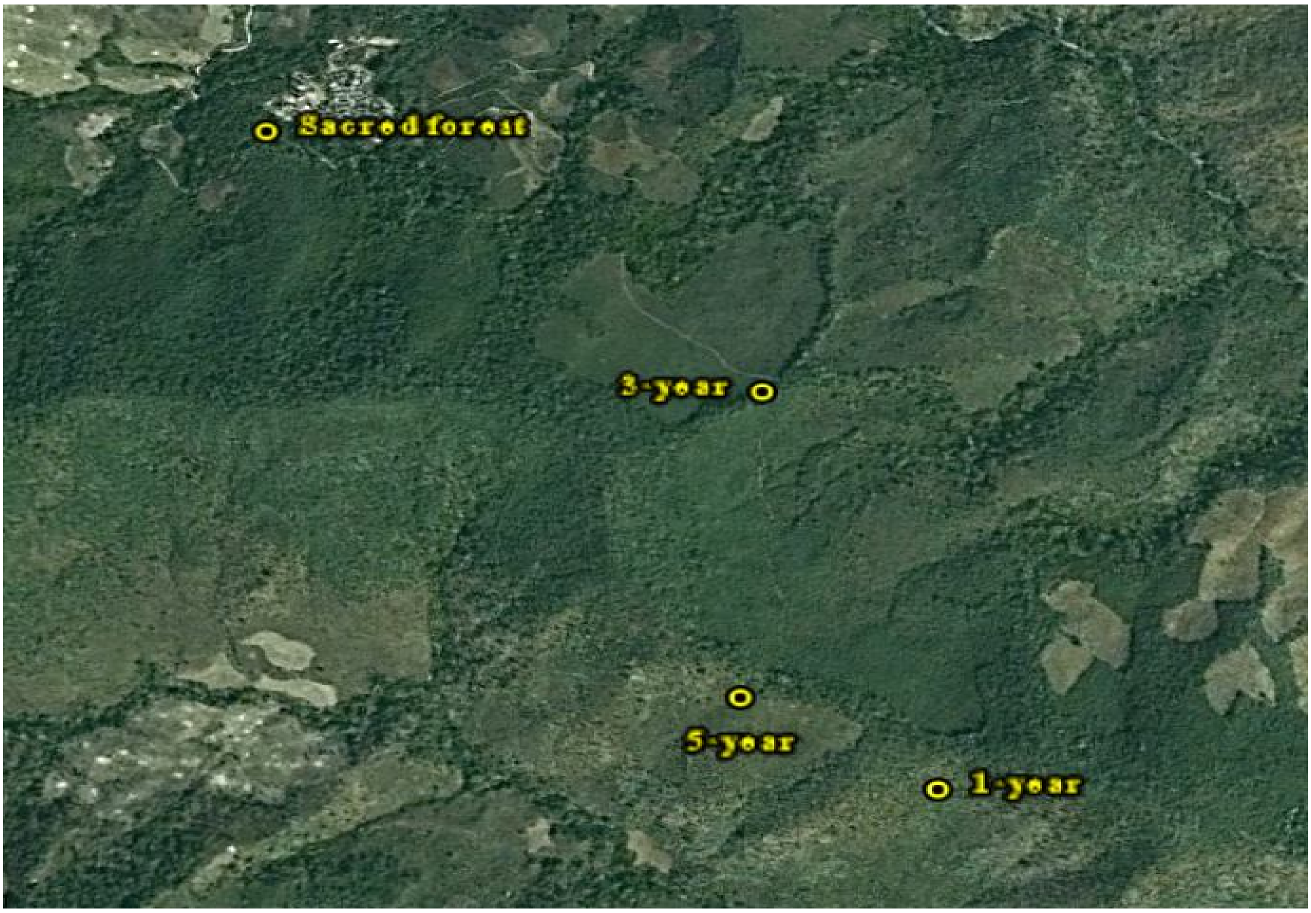

Fig. 3 The sacred forest and the swidden fallow fields (1-year, 3-year, and 5-year) Ban Mude Lhong Lawa village, Chiang Mai, Thailand

2. Quick Biodiversity Survey (QBS) Data collection

Identification and counting of large trees and sapling were the objectives of the QBS method.

1) Trees: Ten sampling plots (8 m x 8 m each) were set up at every 100 m distance along the 1 km transect. Trees with girth of 31 cm and above were identified for local and /or scientific names.
2) Saplings: Ten sampling plots (4 m x 4 m each) were set up at every 100 m distance along the 1 km transect. Plants with girth below 31 cm, but higher than 2 m in height were identified for local and /or scientific names. Numbers of all the saplings in each plot were counted.
3) If a plant (tree and sapling) could not be identified positively, collect its specimen for later identification.
4) Information about seed dispersal mechanism (e.g. wind, long range animals, and short range animals) was gathered from the local people and/ or literature.

Fig. 4 Study site in Mae Chaem, Chiang Mai, Thailand

Fig. 5 Sacred forest (top) at Ban Mae Hae Tai Karen village, Chiang Mai, Thailand

Fig. 6 Sacred forest at Ban Mae Hae Tai Karen village, Chiang Mai, Thailand

Findings (Result and discussion)

Trees diversity in two sacred forests

In the 2 villages, total numbers of trees species in the 2 sacred forests were similar (Table 3 and Figure 7). Twenty five tree species belonging to 22 genera and 16 families were recorded in the sacred forest of Ban Mae Hae Tai Karen village. The family with the highest species abundant was Lauraceae followed by Fagaceae and Moraceae, respectively, whereas 12 families were represented by only one species each (Figure 8). The genus *Litsea* had the highest total number of individuals and species.

In Ban Mude Lhong Lawa village, a total of 24 trees species belonging to 21 genera and 15 families were found in the area of 0.064-ha sacred forest. The family with the highest species abundant was Fagaceae followed by Lauraceae and Leguminosae, respectively, whereas 10 families were monospecific. The genus *Castanopsis* had the highest numbers of species than the other genera. Percent similarity was rather low (12%) when the trees species of the 2 sacred forests were compared.

Density and IVI (Important Value Index) values of the trees in the two sacred forests

Tree density was higher in Ban Mae Hae Tai (300 tree /ha) than that of Ban Mude Lhong (200 trees/ha). In Ban Mae Hae Tai, *Litsea monopetala* (Roxb.) Pers. had the highest IVI value followed by *Castanopsis tribuloides* (Sm.) A. DC., and *Heynea trijuga* Roxb. ex Sims, respectively (Table 4). These species together constituted approximately 33% of the total IVI of the trees in the forest. In Ban Mude Lhong, there were 41 individuals of the trees. *Schima wallichii* (DC.) Korth. had the highest IVI value followed by *Castanopsis tribuloides* (Sm.) A. DC. (Table 5). Together they constituted about 19% of the total IVI value.

Sapling diversity in the two sacred forests

The saplings in the sacred forest at the Karen village (Ban Mae Hae Tai) belonged to 26 species, 20 genera and 14 families (Table 3 and Figure 9). The families with the most species were Lauraceae followed by Sapindaceae and Euphorbiaceae, respectively, whereas 10 families were represented by only one species (Figure 10). The genera *Litsea* had the highest total number of individuals (Table 6). In Ban Mude Lhong, within a total area of 0.016 ha in the sacred forest, 37 sapling species belonging to 34 genera and 21 families were found (Table 3). The most species-abundant family was Rubiaceae followed by Lauraceae, Fagaceae and Leguminosae, respectively, whereas other 12 families were monospecific (Table 7).

Density and IVI values of the saplings in the two sacred forests

The sapling density was higher in the Karen community (Ban Mae Hae Tai) than in the Lawa village. There were 1200 individuals/ha in the former while there were 700 individuals/ha in the latter. In Ban Mae Hae Tai, 54 individuals of the saplings belonged to 26 species. *Litsea martabanica* (Kurz.) Hk.f. had the highest number of individuals followed by

Machilus gamblei King ex. Hk.f., and *Calophyllum polyanthum* Wall. ex Choisy, respectively. These species together constituted approximately 37% of the sapling density in the sacred forest.

Table 3 Trees and sapling of the sacred forests of Ban Mae Hae Tai Karen and Ban Mude Lhong Lawa villages, Chiang Mai, Thailand

Quantitative results/Village	Ban Mae Hae Tai	Ban Mude Lhong
Trees (in ten 8x8 m^2 or 0.064 ha)		
Number of species	25	24
Number of genera	22	21
Number of families	16	15
Number of trees	57	41
Tree density (m^{-2}) (mean ±S.D.)	0.03±0.03	0.02±0.01
Diversity index		
Shannon-Wiener's index	2.96	3.03
Shannon-Wiener's evenness	0.91	0.94
Simpson's index	0.93	0.94
Saplings (in ten 4x4 m^2 or 0.016 ha)		
Number of species	26	37
Number of genera	20	34
Number of families	14	21
Number of saplings	54	48
Sapling density (m^{-2}) (mean ± S.D.)	0.12±0.12	0.08±0.04
Diversity index		
Shannon-Wiener's index	2.98	3.50
Shannon-Wiener's evenness	0.90	0.96
Simpson's index	0.92	0.97

In Ban Mude Lhong, 48 individuals of the saplings belonging to 37 species were present in the area of 0.016 ha in the sacred forest. *Polyalthia simiarum* (Ham. ex Hk.f. & Th.) Bth. ex Hk.f. Th. had the highest number of individuals, followed by *Litsea monopetala* (Roxb.) Pers, and *Phyllanthus roseus* (Craib & Hutch.) Beille, respectively. Together they constituted about 21% of the stand density.

Discussion

This study was conducted in the two sacred groves of Karen and Lawa villages using the Rapid Agro-Biodiversity Appraisal or RABA or Quick biodiversity survey (Kuncoro et al, 2006). From the results, a total number of trees species in the two sacred forests were similar with 25 species, but the similarity percentage was only 12 % in term of species. This may be due to the difference in elevations of the Karen (1,340 m asl.) and Lawa (950 m asl.). The Shanon-weiner's diversity index in the Lawa forest was slightly higher than in the Karen forest. The villagers in Ban Mae Hae Tai leave their cattle to graze in the sacred forest, but there was no sign of cattle grazing in Ban Mude Lhong. Environmental heterogeneity alone did not control species diversity distribution, but species were affected by environmental filters at different stages in their life cycle, e.g. water proximity is significant for saplings and seedlings, but not for adults. Anthropogenic disturbances acted synergistically, e.g. trails played a key role in determining structure and tree diversity patterns (Williams-Linera and Lorea, 2009). Elevation has been identified in several studies of tropical and temperate forest communities as the most important environmental feature influencing woody plant composition and structure. Elevation was the single most important factor, though the independent effects of heat load, soil moisture, and soil type also play important roles in species' sorting patterns (Poulos et al., 2007).

For saplings, our study showed that species richness and sapling diversity of Lawa forest were higher than those of the Karen forest. Species composition in the sacred forest of Lawa village was largely composed of secondary forest species characteristic rather than primary forest species. We found many species that were typically species in fallow shifting cultivation such as *Schima wallichii* (DC.) Korth., *Phyllanthus roseus* (Craib & Hutch.) Beille, *Lithocarpus polystyus* (Wall. ex A. DC.) Rehd., *Leea indica* (Burm. F.) Merr. and *Wendlandia tinctoria* (Roxb.) DC. This was perhaps due to the fact that the sacred forest of Lawa villages was closer to the fallow fields than the Karen sacred forest (Figures 2 and 3).

Fig. 7 Trees in the sacred forests of Ban Mae Hae Tai (Karen) and Ban Mude Lhong (Lawa) villages, Chiang Mai, Thailand

Fig. 8 Trees families in the sacred forests of Ban Mae Hae Tai (Karen) and Ban Mude Lhong (Lawa) villages, Chiang Mai, Thailand

Fig. 9 Saplings in the sacred forests of Ban Mae Hae Tai (Karen) and Ban Mude Lhong (Lawa) villages, Chiang Mai, Thailand

Fig. 10 Sapling families in the sacred forests of Ban Mae Hae Tai (Karen) and Ban Mude Lhong (Lawa) villages, Chiang Mai, Thailand

We assumed that a sacred forest could act as habitat and conservation sources for plant species movement. Several studies revealed that tropical tree species varied in their ability to disperse seeds. Limited dispersal was known to cause spatial among seeds and seedlings of pioneer trees (Seilder and Plotkin, 2006). Estimates of routine maximum dispersal distance for various plant-vector combination range from < 10 km to > 10 km. Routine maximum dispersal of > 1 km required an animal vector such as fruit bats, large canopy birds, carnivores including civets, martens, bears and most terrestrial herbivores. For routine maximum dispersal of > 10 km also required an animal vector that had a large home range for example fruit pigeons, large fruit bats, elephants rhinoceroses and people (Corlett, 2009). From the distance information between sacred forest and surrounding areas (Tables 1 and 2) and the data collection on the eater of many plant species in the two sacred forest, The majority of eaters were vertebrates such as birds, wide pig, bats, squirrel and man. From this information, we suggested that the two sacred forests can be act as habitat and sources for plant species movement to the surrounding areas at the studied sites. Additional data on seed-dispersal mechanisms are provided in Table 8.

Conclusion and recommendation

The Karen and Lawa communities still have sacred or spirit forests. Spirit forest or worship forest is used for religion purpose as the place to celebrate the god of forest, god of mountain, whom Karen and Lawa people believe that will bring luck to the community. Those forests are strictly protected, and receive full respect from the local people. Species richness and valuable species such as *Lithocarpus echinops* Hjelmq. (Santisuk et al, 2006) that was found in the sacred forests can be explained that these forest have a potential for biodiversity conservation. Sacred forests can be found in many hill-tribe areas in northern Thailand. If appropriate managements can be applied, spirit forest would significantly contribute to safeguard biodiversity values. Currently, these forests are encroached upon. Forestry and land administration sectors should address this issue in their policy formulation. Spirit forests also play certain spiritual and cultural roles and are important in environmental education for younger generation in the mountainous area.

Table 8 Seed dispersal information

Species	Family	Primary Seed Dispersal Mechanism	Reference
Adinandra integerrima T.Anderson *ex* Dyer	Theaceae	Animal	Wangpakapatanawong and Elliott (2008)
Alstonia rostrata C.E.C.Fisch.	Apocynaceae	Wind	
Castanopsis diversifolia (Kruz) King	Fagaceae	Animal	
Castanopsis tribuloides (Sm.) A. DC.	Fagaceae	Animal	
Betula alnoides Buch.-Ham. *ex* G.Don	Betulaceae	Wind	
Chionanthus ramiflorus Roxb.	Oleaceae	Animal	
Dalbergia cultatra Grah. ex Bth.	Leguminosae	wind	
Engelhardtia serrata Blume var. *serrata*	Juglandaceae	Animal	
Eurya acuminata DC. var. *wallichiana* Dyer	Theaceae	Animal	
Heynea trijuga Roxb. ex Sims	Meliaceae	Animal	
Styrax benzoides Craib	Styracaceae	Animal	
Turpinia pomifera (Roxb.) DC.	Staphyleaceae	Animal	
Celtis tetrandra Roxb.		Birds	Stiles (1980)
Sambucus javanica Reinw. ex Bl. ssp. *javanica*	Caprifoliaceae	Birds	
Sapindus rarak DC.	Sapindaceae	Birds	
Vibrunum cylindricum Ham. Ex D.Don	Caprifoliaceae	Birds	
Beilschmiedia intermedia Allen	Lauraceae	bird	Ingle (2003)
Polyalthia simiarum (Ham. ex Hk.f. & Th.) Bth. ex Hk.f. Th.	Annonaceae	bird	
Saurauia roxburghii Wall.	Saurauiaceae	Animal	
Sterculia balanghas L.	Sterculiaceae	bird	
Litsea spp.	Lauraceae	bird	Sri-Ngernyuang et al. (2007)

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Appendix (data and pictures documentation)

Fig. 11 *Alangium kurzii* Craib. var. *kurzii* Nielsen. Bl.

Fig. 12 *Archidendron clypearia* (Jack) Nielsen.

Fig. 13 *Artocarpus nitidus* Trec.

Fig. 14 *Carallia brachita* (Lour.) Merr. King ex Hook.f.

Fig. 15 *Caseania grewiilfolia* Vent. var. *grewiilfolia*

Fig. 16 *Celtis tetrandra* Roxb.

Fig. 17 *Castanopsis diversifolia* (Kurz) King ex Hook.f.

Fig. 18 *Castanopsis tribuloides* (Sm.) A. DC.

Fig. 19 *Cinnamomum iners* Reinw. ex Bl.

Fig. 20 *Dalbergia cultatra* Grah. ex Bth.

Fig. 21 *Diospyros glandulosa* Lace. Bth.

Fig. 22 *Engelhardia serrata* Bl.

Fig. 23 *Eurya acuminata* DC. King ex Hook. f.

Fig. 24 *Flaucautia indica* (Burm. f.) Merr. Bl.

Fig. *25 Ficus semicordata* B.-H. ex J.E. Sm Bl.

Fig. 26 *Homalium ceylanicum* (Gard.) Bth.

Fig. 27 *Lithocarpus polystyus* (Wall. ex A. DC.) Rehd. DC.

Fig. 28 *Litsea cubeba* (Lour.) Pers var. *cubeba*

Fig. 29 *Litsea martabanica* (Kurz.) Hk.f.

Fig. 30 *Litsea monopetala* (Roxb.) Pers.

Fig. 31 *Machilus gamblei* King ex Hk.f. Bl.

Fig. 32 *Mallotus philippensis* (Lmk.) M.-A. Bl.

Fig. 33 *Phoebe lanceolata* (Ness) Ness

Fig. 34 *Phylanthus roseus* (Craib & Hutch.) Beille

Fig. 35 *Rauvolfia verticillata* (Lour.) Baill.

Fig. 36 *Schima wallichii* (DC.) Korth.

Fig. 37 *Scleropyllum pantandrum* (Denn.) Mabb. Bl.

Fig. 38 *Sterculia balanghas* L.

Fig. 39

Fig. 40 *Turpinia pomifera* (Roxb.) Wall ex DC. var. *pomifera* DC.

Fig. 41 *Vitex peduncularis* Wall. ex Schauer

Fig. 42 *Wendlandia tinctoria* (Roxb.) DC. ssp. *tinctoria* Bl.

Fig. 43 *Xerospermum noronhianum* (Bl.) Bl.

Fig. 44 The sacred forest of the Karen community

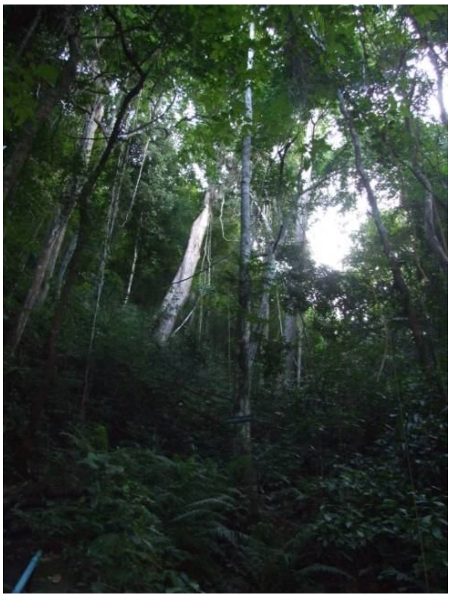

Fig. 45 The sacred forest of Lawa community

Fig. 46 Sampling plot in the sacred forest of the Karen community

Fig. 47 Sampling plot in the sacred forest of Lawa community

Fig. 48 Tree measuring

Fig. 49 Plant identification for local name and plant eater (s)