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Plant Diversity and Utilization on Ethnobotany of Local People at Hmong Doi Pui Village in Doi Suthep-Pui National Park, Chiang Mai Province

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ABSTRACT

The study on plant diversity and utilization on ethnobotany of local people was conducted in montane forest adjacent to Hmong village at Doi Suthep-Pui National Park, Chiang Mai Province during January to December 2016. It aimed to compare plant biodiversity and utilization of ethonobotany of local people between natural montane forest (NMF) and forest edge adjacent to Hmong Village Doi Pui. The three sampling plots, 20 m x 50 m, were established in each site. All plants with diameter at breast height larger than 1 cm. were measured and identified. The information of plant utilization was being interviewed from ethnobotanists, herbal healers, and villagers.

The result showed the total, 53 families, 98 genera and 133 species of plants were found in the study areas. The 42 families, 72 genera and 90 species were existed in the NMF, while 39 families, 51 genera and 71 species in the forest edge. The similarity of families, genera and species were 30, 46, and 65 respectively in both sites. Trees distribution pattern based on diameter class in the two forest areas was found in a negative exponential growth form. Indicating they can be maintained their forest structure in the future. However, considering the distribution of sapling, DBH < 5 cm., the bell-shape form was found in the forest edge. Indicting the effected of ethnobotanical used on plant regeneration was detected. The highest ethnobotanical used was a food group (39 species), while the lowest was a dying color group (6 species). The most utilized species was *Castanopsis diversifolia, Dendrocalamus hamiltonii, and Diplazium escculentum*. Regarding sustainable used of the forest edge, the agroforestry should be promoted by planted the utilized species in their agricultural areas or used as a buffer zone between the forest and agricultural areas.

Keywords: Plant diversity, Ethonobotany, Hmong Doi Pui Village, Montane forest

INTRODUCTION

Historical and contemporary losses in forest cover of mountain ecosystems are significant component of the world's biodiversity and many of the food staples on which humans depend originated in mountain ecosystems. It was under threatened associated with human activities (Lamb *et al*., 2005; Schmidt-Vogt, 2001). Widespread poverty and an increase in the numbers of mountain inhabitants induce to land use changes where mostly converted to agricultural lands, especially shifting cultivation, and lead to deforestation, loss of biomass cover and other forms of environmental degradation (Barnaud *et al*., 2008; Fukushima *et al*., 2008). In Thailand, mountain ecosystem mostly distributed in the northern, presently, the forest areas were sharply decreased and faced to sensitive on soil erosion, landslide and rapid loss of habitat and genetic diversity. In fact, the continued capacity of mountain regions to provide goods and services to society is threatened by the impact of environmental changes on ecosystems (Becker and Bugmann, 2001).

Doi Suthep Pui, Chiang Mai province, was declared as the National Park in 1981 under the Royal Forest Department. The Doi Suthep-Pui National Park is also one of the important watersheds in northern Thailand, and also comprised of many endemic species. However, Hmong communities already settled down around B.C. 1950. They have long utilized on forest products, since they established from houses to communities. Most of utilized plants were collected from forest adjacent to the communities, and used for their basic needs. Nowadays, some natural forest products were over exploited regardless their renewable and would cause to local extinction. In addition, the converted forests into shifting cultivation areas had high influenced on biological diversity lost. Thus, the Royal Forest Department demarcated these communities and part of shifting cultivation's areas to be out of the national park (Sutthipibul, 2010). However, the communities still be needed to use forest products from adjacent forests or forest edged for various purposes such as food, fuel wood, dying color, and herbs, which known as ethnobotany. Many researches on biodiversity change and forest succession after abandoned or shifting cultivation areas in Doi Suthep-Pui have been extensively studied (Asanok *et al.*, 2002; Khamyong and Seramethakhun, 1998; Jingjai *et al.,* 2014). However, there is less concerned for utilization based on ethnobotany which can be considered as local wisdom. Thus, this knowledge may be useful to assess for self-subsistence and commercial purposed of local people in addition, contribute to ecological niche of utilized plant species (Martin, 1995).

Thus, these aimed to compare plant biodiversity and utilization on ethnobotany of local people between forest edged and natural montane forest in Ban Hmong Doi Pui at Doi Suthep-Pui National Park, Chaing Mai province.

MATERIALS AND METHODS

Study area

The study area is in the Doi Suthep Pui National Park, Chiang Mai. It is located in

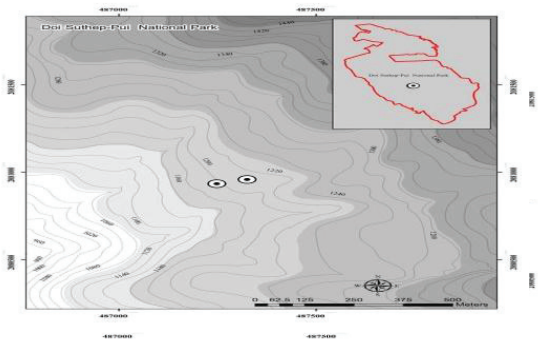
the mountainous areas of the Thanon Thong Chai Rage with latitude ranged from 330-1,685 m asl., the average annual rainfall and temperature ranged from 1,350-2,500 mm. and 2-23ºC respectively. Four forest types were found; 1) deciduous dipterocarp forest occupied on the ridge with altitude ranged from 330-900 m asl., and dominant species comprised with *Shorea obtusa, Dipterocarpus tuberculatus, D. obtusifolius, Quercus kerrii, and Gluta glabra,* 2) mixed deciduous forest scattered in the area ranged from 330-600 m asl., and dominant species comprised with *Pterocarpus macrocarpus*, *Xylia xylocarpa*, and *Terminalia mucronata*, while bamboos dominated in middle canopy, 3) dry everygreen forest mostly occupied in the valley with ranged from at 400-1,000 m asl., and dominant species comprised with *Dipterocarpus baudii, Mangifera caloneura,* and *Cratoxylum cochinchinese,* and 4) lower montane forest mostly found at above 1,000 m asl., and comprised with *Castanopsis tribuloides, C. acuminatissima, Magnolia garretti, Anneslea fragrans, and Schima wallichii* (Aksornkaoe and Bonyawat, 1977)

The communities located in the Doi Suthep Pui National Park which divided into two groups, northern Thai community situated in the area in front of Pra That Doi Suthep temple, the members of this community moved in around 1942 during the construction of the road to the temple, and settled down here after the construction was completed. The Hmong at Doi Pui and Khun Chang Khian communities migrated from China, practicing shifting cultivation along the way before permanently settled in the Doi Pui area around 1950 (Department of Tourism, 2015). Presently, the Hmong Doi Pui village consists of 212 households, practicing permanent mono-cropping for instant lychee, longan, tomato, and temperate fruits. In addition, the community members also sell the forest minor products to local market.

Data collection

Two study areas, forest edged (FE) and natural montane forest (NMF) were selected (Figure 1). Three sampling plots, 20 m x 50 m, were established in each site, and sub-plots of 10 m x 10 m were divided (Figure 2). All plants with diameter at breast height, DBH, larger than 1 cm. were measured and identified in every sub-plot. The specimens of unidentified species were collected to identify based on type specimens at the Office of the Forest Herbarium, Department of National Parks, Wildlife, and Plant Conservation.

In addition, the information of plant utilization on ethnobotany was also carried out based on interviewed from ethnobotanists, herbal healers, and villagers of Hmong Doi Pui village. The utilized plant purpose was divided into seven groups followed Trisonthi (1991) and Smitinand and Nanakorn (1991); 1) for foods, 2) for herbs, 3) for dying and threads, 4) for timbers and fuel wood, 5) for traditional culture, 6) for poisons, and 7) for general uses.



A

Figure 1 Study areas A for sample plot at Doi Suthep-Pui National Park, Chiang Mai province.

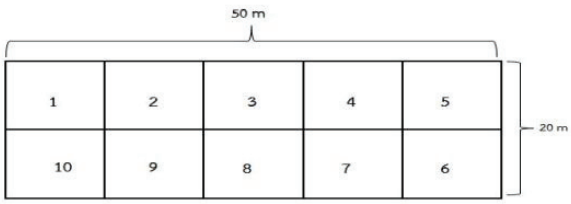


Figure 2 Sample plot, 20 m × 50 m was divided into subplots 10 m × 10 m.

Data analysis

1. Importance value index (IVI) was derived from the summation of relative density (RD), relative dominance (RDo), and relative frequency (RF), which were computed based on basal area (Ba), density (D), dominance (Do), and frequency (F) (Marod and Kutintara, 2009)

2. Plant diversity was computed using the Shannon-Weiner index (Kent, 2012)

$$H' = -\sum_{i=1}^{s} (p_i)_i \ln(p_i)$$

H' = Shannon-Weiner diversity index

p_i = proportion of individual number of species i, (n_i), and the total individual number of all species of total cover (N)i

or $p_i = \frac{n_i}{N}$ when, i = species 1, species 2, to species s

S = total number of found species

3. Index of similarity, IS (Sorensen, 1948)

$$IS\ (\%) = \frac{2W}{A+B} \times 100$$

W = found species both in A and B

A = total species in A community

B = total species in B community

4. Descriptive statistical analysis perform on data concerning ages and genders of Hmong community members who used plants from the forest.

RESULTS AND DISCUSSION

1. Species composition

In total, 53 families, 98 genera, and 133 species of plants were found with tree density and basal area (with DBH > 4.5 cm.) 1,210 individual ha^{-1}, and 33.87$m^2.ha^{-1}$, respectively.

Considering to plant species existed in the forest edge and NMF can be described as follows.

1.1 Natural montane evergreen forest (NMF): In total, 42 families, 72 genera, and 90 species of plants were found with density and basal area of 1,325 individual. Ha^{-1}, and 33.77 $m^2.ha^{-1}$, respectively. The dominance species based on the IVI (%) was *Castanopsis acuminatissima* (57.91%), *Litsea martabarnica* (22.07%), *Schima wallichii* (19.72%), *Eriobotrya bengalensis* (11.76%), *Castanopsis tribuloides* (9.82%), *Olea salicifolia* (9.63%), *Persea gamblei* (7.25%), *Myrsine seguinii* (6.81%), *Lithocarpus dealbatus* (6.74%), and *Symplocos sulcata* (6.70%). In addition plant diversity bay Shannon-Weiner index was 3.36

1.2 Utilization forest edge: in total, 39 families, 51 genera, and 71 species of plants were found with density and basal area of 1,075 individual.ha^{-1}, and 34.15 $m^2.ha^{-1}$, respectively. The dominance species based on the IVI (%) was *Glochidion lanceolarium* (37.48%), *Litsea beusekomii* (20.89%), *Schima wallichii* (15.85%), *Erythrina stricta* (14.57%), *Macaranga indica* (12.98%), *Turpinia cochinchinensis* (11.86%), *Croton persimilis* (11.77%), *Pinus kesiya* (11.15%), *Litsea martabarnica* (9.15%), and *Clausena excavate* (8.13%). In addition plant diversity bay Shannon-Weiner index was 3.60

Regarding tree density and basal areas existing in the two forest areas, it was observed that the NMF had higher density and basal areas than in the forest edge. This is because the latter was high disturbed areas by over cut for local utilization. Consequently, large vacant space was created and faced to microclimate changes. Then, many pioneer species rapidly occupied and supported to higher diversity of Shannon-Weiner index than in NMF. Indicating, pioneer species can be distributed and scattered in Doi Suthep-Pui national park where disturbance occurred (Marod *et al.,* 2014)

Considering on forest regeneration based on diameter class distribution of plant (DBH > 1 cm), a negative exponential growth form or L-shape was found in both forest edge and NMF. Indicating both areas can be maintaining their forest structure which the small trees can be replaced to big trees in the (Bunyavejchewin *et al*., 2001). However, at the distribution pattern of sapling stage which was high sensitive on disturbances, a bell-shape was detected only in the forest edge. Indicating the regeneration of sapling stage was not good when compared to NMF. Most of sapling stage was the pioneer species which short life-span, for instant, *Erythrina stricta*, *Macaranga indica*, *Litsea monopetala* and *Croton persimilis*, etc.

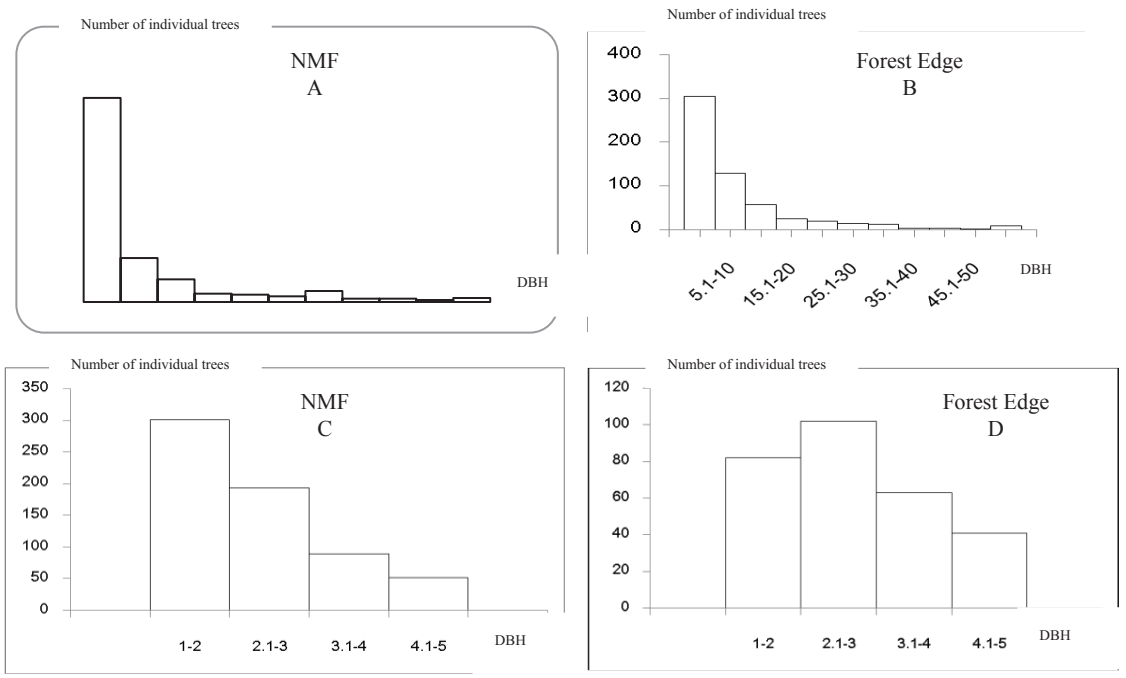


Figure 3 Diameter class distribution of tree in natural montane evergreen forest, NMF and forest edge at Doi Suthep Pui national park.

2. Ethnobotany in Hmong Doi Pui village

Based on interview data, it was found that the members of Hmong Doi Pui Village collected forest minor products at least once a week (90% of total interviewers). Most of them participating in this activity were at the age of 40 or above (or 96.7% of total interviewers). The utilized plants were mainly found during the rainy season. These plants can be classified into 21 families, 71 genera, and 86 species. They can also be grouped into ethonobotany as follows:

2.1 Food group: there were 39 species with two main groups a) wild fruits such as *Baccaurea ramiflora, Mangifera caloneura, Phyllanthus emblica, Protium serratum*, etc., and b) local vegetative such as *Diplazium esculentum, Ficus fistulosa, Flemingia lineate,* and *Lasia spinosa,* etc. These plants could be collected from the beginning to mid of the rainy season. The Hmong also grew various wild plants in their lychee orchards and/or the community's agricultural areas: for instance, *Dendocalamus hamiltonii, Diplazium esculentum* and Family of Zingeberaceae.

2.2 Herb group: there were 16 species most of which were boiled and liquid from the boiling process was used as traditional medicine for pain relief and restorative. The plants can be further classified into various utilized such as for restorative (e.g. *Betula alnoides, Cryptolepis dubia, Globba nisbetiana,* and *Neuropeltis racemosa*), for fever relief (e.g. *Thunbergia laurifolia* and *Tithonia diversfolia*), and for healing and body anti-infective (e.g. Adiantum erylliae, Chromolaena odorata, and *Ricinus communis*). Those with knowledge in this regard were mostly herbal healers who

collected the plants concerned to treat the community members.

2.3 Dying and thread group: six species were found. The community members grew these plants in the community areas or at the buffer zones between the forest and agricultural areas. The utilized plant species for thread were family of *Malvaceae* (e.g. *Sterculia macrophylla, S. urena,* and *S. Villosa*). The bark of them was removed and made as rope for agricultural or religious purposes, e.g. while, three plant species were used for dying; *Tephrosia purpurea* for blue color, and heartwood of *Artocarpus chama* and *A. lacucha* for yello to brown color.

Nowadays, local wisdom on dying based on natural resource capitals is disappearing from the community as its members increasingly use modern clothing, while chemical dyes are readily available and inexpensive. At the same time, those with knowledge on traditional dying and weaving almost disappeared with no contribute to young generation.

2.4 Tradition group: there were nine species which were mostly used in rituals by families practicing ancestor worship. For example, *Pavetta indica* was always used in rituals of suspicious ceremony to 'inform' they ancestors, while shoot of *Bambax anceps* was placed on the ear of a person who fell ill with unknown causes. Flowers from the *Rubiaceae* family (*lxora* sp. and *Rothmannia sootepensis*) were also related to ancestor worship as they were used during burial ceremony. In the past, large trees, especially family of Magniliaceae (e.g. *Magnolia baillonii* and *M. garrettii*) were cut to make coffin, as it was believed as suspicious trees which the ancestors' spirits would help their descendant to be prosperous.

2.5 Poisonous group: there were seven species utilized by the community. For instance, the resin of *Antiaris toxicaria* was applied on a dart used for hunting; however, this plant was rarely found in the forest edge Some plants were used as poison; for example, the vine of *Mucuna macrocarpa* was chopped and filled into the river to kill fish. This poison however, has no effect on human. Some species, *Mallotus barbatus* and *Dendrocnide sp.*, had high irritated for human by their poisonous covered on leaves or branches.

2.6 Timber and fuel wood group: there were 25 species; most of which were found in the NMF adjacent to the village. For instant, *Castanopsis diversifolia, C.* acuminatissima, and *Schima* wallichii were common used for construction, however, there were low strength of wood. Instead of these species, the local people preferred to use deciduous tree species, i.e. *Protium serratum, Canarium euphyllum,* and *C. subulatum* for house construction because it had high strength and beautiful color of wood. In addition, some species also used for agricultural tools, including *Memecylon plebejum*, and *Tristaniopsis burmanica.* Regarding fuel wood, *Gluta glabra*, and *Semecarpus cochinchinensis* were used for charcoal production as the resulting charcoal was of high quality and normally utilized in the forge. Currently, fuel wood was still in high demand; the community members had to collect fallen trees or cut the trees from the natural forest for cooking and curing tea. However, some species still be lived after used, for instant, the people chopped the bark

of tree pine,*Pinus kesiya*, for their fuel or sell in the Hmong's local market.

2.7 Other utilized purposes: there were 15 species that do not fit in the groups mentioned above, but the community members also used them in for various purposes. For instance, *Musa acuminata* was used as food and also animal feeds – banana stem was for pigs, while its leave were used to wrap foods or to make a floating basket for various ceremonies. Some bamboos, including *Dendrocalamus hamiltonii*, *Thyrsostachys siamensis*, and *Bambusa* sp. were utilized for foods (i.e. bamboo shoots) and crutches (e.g. the structure frame for agricultural vines, and stilt pole for branches of lychee during flowering), In addition, *Cyperus iria* and *Brachiaria distachya* were used to animal feeds.

Forest use continues to be part of the Hmong's everyday life; this use is now under control and direction from the Doi Suthep-Pui National Park. At the same time, the Hmong community also manages forest resources using a village committee to oversee the utilization of forests surrounding the community, while forest areas are clearly demarcated and specified for particular use, e.g. forest edge and burial area. The management protocol was initiated by the participatory of local people and the National Park. However, the carrying capacity of forest edge areas is still being under estimated from Hmong village. Then, the community members still have to find and collect utilized plants from natural forest, leading to conflicts with the national park officers. These conflicts more or less have impacts on co-management such as the patrol on illegal cutting or collecting the forest minor products by the outsiders, and forest fire prevention. Unlike the Hmong community, the northern Thai community faced fewer problems regarding forest utilization and disturbance. This may be because the northern Thais have different occupations and ways of life. Similarly, Noitana *et al*. (2013) reported that the Hmong in Na Noi District, Nan Province, relied on nearby forest, especially for food and bamboo, and converted preservation forest into agricultural areas. In contrast, Khamfachuea *et al*. (2010) found that the Karen community, Pa Pa Ka Yor tribe, in the Mae Chaem Preservation Forest, Chiang Mai Province, could create their community regulation with less controlled by government. Resulting less conflicts occurred between the community and officials as the latter helped to promote agroforestry in the community's agricultural areas.

CONCLUSION

The Hmong Doi Pui community utilized the plants from 21 families, 71 genera, and 86 species for ethnobotany. These plants were highest used for foods (39 species), followed by timber and fuel woods (25 species), herbs (16 species), tradition (9 species), poisons (7 species), and dying and thread (6 species). The most common utilized species were from family of Fagaceae, *Pinus kesiya* and bamboos in the community forest and adjacent areas. Regarding local wisdom on ethnobotany, it was declined due to less knowledge transfer from the old to new generation. Then, recently the community members faced on situation of low efficiency used on natural resource capital. Resulting the illegal utilized still be

found in the Doi Pui National Park because less conservation was done in the forest edge. To maintain the natural resource capital for human living, agroforestry should be promoted in Hmong village by the government. This can be achieved by induced the utilized plant species from the natural forest into the forest edge. Some native induce species may be planted in the agricultural areas mixed with other crops, or as a buffer zone between the forest and agricultural areas. With this, the community would be enabled to suitably manage its land use, while utilization from the natural forest and forest degradation could be reduced in the long run. In addition, the local wisdom of ethnobotany and the community's culture could also be preserved. To realize the above mentioned, however, the public agencies responsible, particularly the Doi Suthep-Pui National Park.

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