

# Ethnobotanical Study and Plant Dimension Classification in Kwan Phayao Community Areas, Phayao Province, Thailand

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This ethnobotanical study is conducted between June 2019 and March 2020 in Kwan Phayao community areas, Phayao Province. This study has been performed in five community markets around the Kwan Phayao market including, the Mae Sai, Ban Bua, Ban Tun, Ban Sang and San Bua Bok markets. The primary objectives of the study are to explore diversity and collect data of ethnobotanical in the communities around Kwan Phayao. The plant utilization is studied based on semi-structured interviews with three local herbalists as well as questionnaires from 25 people regarding usages of plants. The field surveys recorded 99 species and 78 genera of utilization plants form a total of 35 families. The family Fabaceae is the most used plant family representing 12.12% of all the plant species recorded by this study followed by Solanaceae Cucurbitaceae and Euphorbiaceae with 7.07%. The plants are classified as herbs (n=46), climbers (=19) shrubs (n=18), trees (n=12), scandents (n=3), and one fern. The plant utilization has been divided into two categories: 99 medical plants and 87 edible species. Leaves are most commonly (21%) followed by roots at 16%, shoots at 13%, flowers and fruits at 11%, stems at 9%, whole plants at 7%, seeds at 5%, bark and rhizome at 2%, and other 1%. A high cultural importance index (CI) is found in *Centella asiatica* (L.) Urb followed by *Cymbopogon citratus* Stapf, *Alpinia galanga* (L.) Willd., *Zingiber officinale* Roscoe and *Citrus hystrix* DC. with CI values of 1.42 1.32 1.24 1.22, and 1.22 respectively

**Key words:** Ethnobotany, Local plant, Phayao, Plant use, Utilization

## 1. INTRODUCTION

Phayao province is in the upper north region of Thailand and is approximately 6335 km<sup>2</sup> in terms of area size. The province consists of nine districts. Kwan Phayao is located at an altitude of 300–1550 m above the sea level with a mean annual rainfall of 1043.9 mm (Nguyen et al., 2020; Panprommin et al., 2019). The mean minimum and maximum temperatures are 10.8 °C in the cool season and 39.5 °C in the hot season. Kwan Phayao is the largest seminatural freshwater resource in northern Thailand and the fourth largest in the country stretching over an area of 6,335 km<sup>2</sup> (Butboonchoo et al., 2017; Laenoi et al., 2015)

The terrain is characterized by high mountains interspersed with plains. There is a difference in elevation above sea level (Hu et al., 2016). Changing climates at different times of the year cause each area to grow different plant species. This is why northern Thailand has high biodiversity (Panprommin et al., 2019; Pattanavibool et al., 2002). The plant species in these natural resources are valuable to conserve (Inta et al., 2013; Limmirankul et al., 2015). There are many areas that explorers are unable to access. Some of the existing plant species went extinct before further exploration (Pérez-Ortega et al., 2017; Senyolo et al., 2018). Some species have been utilized for the daily life of human beings. The number of plants in agriculture has changed due to the development of the country. Local plant surveys can provide an introduction to local flora and fauna (Inta et al., 2008; Junsongduang et al., 2014).

Surveying and collecting data on the utilization of local botany in communities around Kwan Phayao can lead to conservation and restoration of ethnobotanicals in food

and herbs. This can lead to further development and their sustainable use in the future.

## 2. MATERIALS AND METHODS

### 2.1 Study Area and Site Collection

Samples have been collected from five villages in and around Kwan Phayao i.e., Ban Mae Sai market, Ban Bua market, Ban Toon market, Ban Sang market, and Ban Sun Bua Bok market. (See Figure 1).

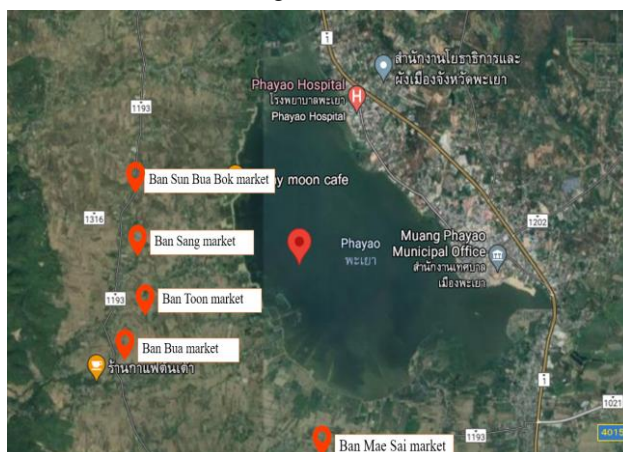


Figure 1. Study area in communities around Kwan Phayao, Phayao district, Phayao Province.

### 2.2 Key Informant Interview (KII)

Interviewed 25 local folk medicine experts with experience in local plants and herbs.

### 2.3 Survey and Collection Data

The author collected survey data and used questionnaires to perform interviews. The study particularly notes botanical characteristics, local name, plant utilization to food and herbs, and route of administration. To this end, 3 plant specimens per species are collected. The study seeks to collect and study samples with the most complete specimens including leaves, flowers, fruit, non-disease, or insect bite. It bears to note that each group of plants has different sampling methods.

### 2.4 Verification of the Identity of Plant Specimens

This study investigates plant species and describes their botanical features. It also seeks to verify the validity of scientific names and local names and identified plants in various aspects including methods of application and plant parts used. The study searches for information on the basis of expert inquiries. To this end, the author interviews a folk healer and compares plant specimens and plants in hibernation at Queen Sirikit Botanical Garden, Mae Ram Sub-district, Mae Rim District, Chiang Mai Province. Databases have been obtained from the Botanical Garden Organization Plants as well as books about local vegetables, e.g., Lanna Traditional Herbal Book, and Northern Local Vegetables.

### 2.5 Statistical Analysis

This study seeks to analyze data on the importance of use or cultural significance (CI). This is a value that calculates plant utilization in each area against the number of data user's indicative of use.

$$CI = \sum_{i=1}^{i=NU} \frac{UR_i}{N}$$

## 3. RESULTS AND DISCUSSIONS

### 3.1 Plant Utilization Data

Plant utilization from plants in the community is concentrated around Kwan Phayao including in community market areas around Kwan Phayao. These accounted for five markets; Ban Mai Sai Market, Ban Bua Market, Ban Toon Market, Ban Sang Market, and Ban San Bua Bok Market. Ethnobotany utilization questionnaires were conducted with 25 villagers who utilized plants spanning across 36 families, 78 genera, and 99 species (Table 1). The most common family is Fabaceae (Legumes family) consisting of 12 species (12.12%) followed by Solanaceae (Nightshade), Cucurbitaceae (Cucurbits family), and Euphorbiaceae (Spurges family). Each family consists of seven species (7.07%). The plants are categorized according to habits as annual plants accounting for 46 species (46.5%), climbing plants accounting for 19 species (19.2%), shrubs accounting for 18 species (18.2%), perennial plants accounting for 12 species (12.1%), scandent plants accounting for 3 species (3.03%), and one fern (1.01%) (see Figure 2). The plants

have been categorized according to utilization in two ways: medicinal plants, accounting for 99 species, and edible plants which are used for food and account for 86 species. The plant parts most common used are leaves, accounting for 72 species (20.45%). This is followed by root accounting for 56 species (15.91%), shoot apex accounting for 47 species (13.4%), fruits accounting for 39 species (11.08%), flowers accounting for 37 species (10.5%), stems accounting for 33 species (9.38%), the entire plant accounting for 24 species (6.82%), seeds accounting for 22 species (6.25%), shells accounting for seven species (1.99%), and finally bulbs, rhizomes, and others accounting for five species (1.42%) (see Figure 3).

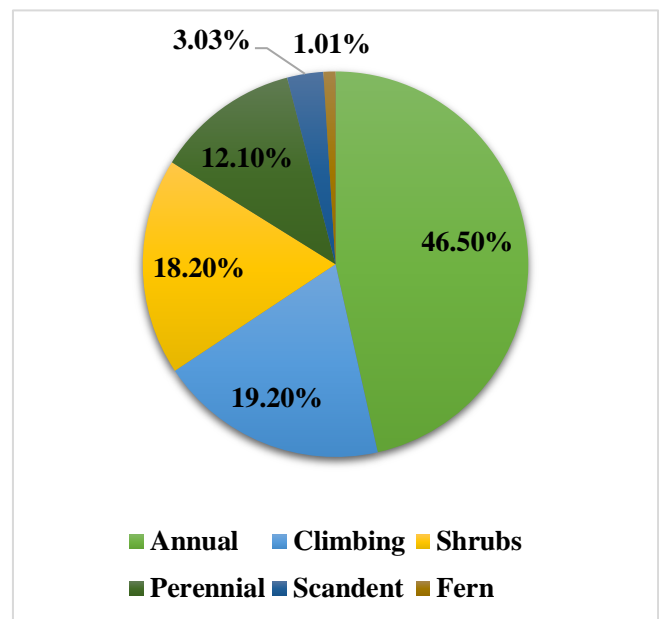


Figure 2. Plant types.

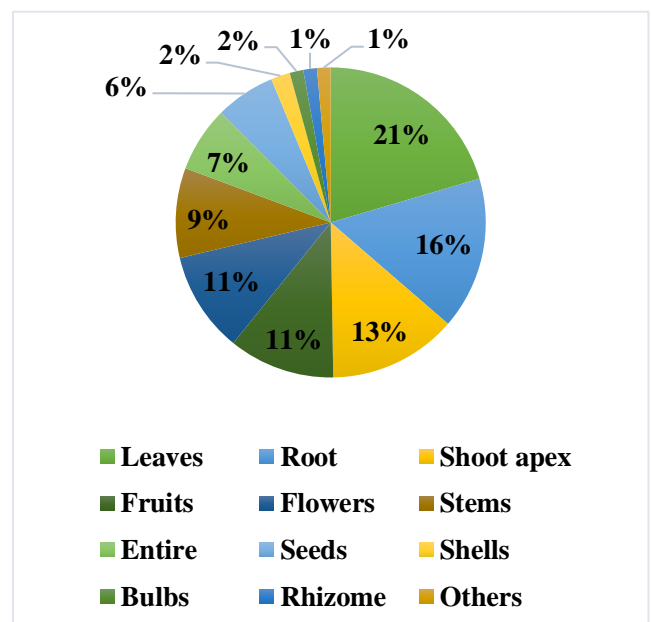


Figure 3. Plant parts based on primary utilization.

**Table 1. Number of Species and Family of Plants Utilized**

| No. | Family         | Species | %     |
|-----|----------------|---------|-------|
| 1   | Fabaceae       | 12      | 12.12 |
| 2   | Solanaceae     | 7       | 7.07  |
| 3   | Cucurbitaceae  | 7       | 7.07  |
| 4   | Euphorbiaceae  | 7       | 7.07  |
| 5   | Lamiaceae      | 5       | 5.05  |
| 6   | Asteraceae     | 5       | 5.05  |
| 7   | Amaranthaceae  | 5       | 5.05  |
| 8   | Apiaceae       | 4       | 4.04  |
| 9   | Convolvulaceae | 4       | 4.04  |
| 10  | Piperaceae     | 4       | 4.04  |
| 11  | Acanthaceae    | 4       | 4.04  |
| 12  | Zingiberaceae  | 3       | 3.03  |
| 13  | Brassicaceae   | 3       | 3.03  |
| 14  | Rutaceae       | 3       | 3.03  |
| 15  | Apocynaceae    | 2       | 2.02  |
| 16  | Phyllanthaceae | 2       | 2.02  |
| 17  | Molluginaceae  | 2       | 2.02  |
| 18  | Poaceae        | 2       | 2.02  |
| 19  | Cyperaceae     | 1       | 1.01  |
| 20  | Meliaceae      | 1       | 1.01  |
| 21  | Oleaceae       | 1       | 1.01  |
| 22  | Oxalidaceae    | 1       | 1.01  |
| 23  | Rubiaceae      | 1       | 1.01  |

**Table 2. Number of Species and Family of Plants Utilized (Cont.)**

| No.   | Family         | Species | %      |
|-------|----------------|---------|--------|
| 24    | Pedaliaceae    | 1       | 1.01   |
| 25    | Plumbaginaceae | 1       | 1.01   |
| 26    | Malvaceae      | 1       | 1.01   |
| 27    | Plantaginaceae | 1       | 1.01   |
| 28    | Liliaceae      | 1       | 1.01   |
| 29    | Araceae        | 1       | 1.01   |
| 30    | Menispermaceae | 1       | 1.01   |
| 31    | Athyriaceae    | 1       | 1.01   |
| 32    | Saururaceae    | 1       | 1.01   |
| 33    | Basellaceae    | 1       | 1.01   |
| 34    | Polygonaceae   | 1       | 1.01   |
| 35    | Amaryllidaceae | 1       | 1.01   |
| 36    | Caricaceae     | 1       | 1.01   |
| Total | 36             | 99      | 100.00 |

### 3.2 Local Plants Utilization

#### 3.2.1 Studying and Categorizing Plants with Tourism Potentials Beauty and Natural Dimensions

*Tagetes erecta* L. is a species of the family Asteraceae and more commonly known in English as "African marigold" and a local name, "Kham Poo Joo (Chiang Mai)". They tend to be weeds in cultivation. The shoot tip is used as a vegetable and is eaten with chili sauces. Their fresh flowers can be put in an omelet or coated with a batter and deep fried. For medicinal utilization, the entire plant is used as carminative (medicine for stomach pain). The leaf tastes cool, luscious and has a strong smell. It can be applied to elcosis. Squeezing juice from the leaf can be

done to create a drink to relieve earache. The flower can be used to cure hemorrhoids. Marigolds can be used as a blood-purifying medicine, to cure eye pain, as a carminative, and as a mucomyst. It can cure dizziness, whooping cough, mastitis, mumps, and bronchitis. This plant is a tourist attraction. Propagation of the wild type is seen in garden arrangements, farms, and marigold fields; it can grow in every soil condition. Healers and merchants from ten local regions of Morelos State recommend *T. erecta* flowers as an infusion or as a tincture for several culture-bound syndromes associated with CNS, among others. Anxiolytic and sedative-like activities of the *T. erecta* aqueous and organic polar extracts are corroborated in these models and linked to a participation of rutin (Laosinwattana et al., 2018; Pérez-Ortega et al., 2017).

*Basella rubra* L. scientific name (Phakplang-local name) is family Basellaceae with the common English name *Basella rubra* L. Utilized parts are shoot tips, leaves, and flowers. Shoot tips and flowers are parboiled and dipped with chili sauces or put into a sour soup made of tamarind paste as well as a curry called Kaeng Kae. It can cure abscess toxicity, urine retention, and constipation with its antipyretic activity. Northern midwives use fresh leaves by crushing them finely and then extract them to get mucilage. This mucilage is applied to the vagina to facilitate childbirth. *Basella rubra* L. is an important green leafy vegetable vine and is known for its health benefits in traditional medicine. Light is a basic physical factor essential for the development and bioactive secondary metabolite production in vitro callus cultures. The present study researches into the impact of different photoperiods on biomass, bioactive compounds, and antioxidant activity in callus cultures of *B. rubra* (Kumar et al., 2020).

#### 3.2.2 Culture and Belief Dimension

*Acacia concinna* is locally known as Som Poi and belongs to the Fabaceae family. *Acacia concinna* is used to manufacture products related to religious beliefs and rituals in the form of souvenirs. Local believe that houses should have *Acacia concinna* to prevent misfortune. They also believe that when pods are soaked in the water, the water becomes sacred and keeps evil away. The most cited plants as known, used and found were *Acacia concinna*, *Clitoria ternetea*, *Oryza sativa* and *Citrus hystrix*. Biometric analyses advise that knowledge of detergent plant utilisation is well preserved at all age ranges and does not vary with gender (Poomanee et al., 2017; Wisetkomolmat et al., 2021).

#### 3.2.3 Dimensions of Food, Restaurants, Souvenirs and Plant Products

Pak Kowtong (local name) is scientifically known as, *Houttuynia cordata* Thunb. This plant belongs to the Saururaceae family. It has a strong taste and smell, and it is occasionally used for its fresh leaves which can be used in desserts to reduce the smell and bitter taste. It has anticancer activities and can inhibit cancer cells. *Houttuynia cordata* Thunb. It is also a traditionally used

medicinal plant for the treatment of pneumonia. Flavonoids are one of the major bioactive constituents of *Houttuynia cordata* (Ling et al., 2020).

### 3.2.4 Categorizing Plants with Health Potentials

Prickly-leaved elephant's foot (English common name) goes by the scientific name, *Elephantopus scaber* L. and is part of the Asteraceae family. Its root can be boiled to be used for cough-remedy, nourishment, boosting libido, treating mouth sores, and quenching thirst as well as an antipyretic. Its root can be boiled or fermented in liquor for drinking together with *Strychnos axillaris* and *Ficus foveolate* Wall as a way to nourish the body and relieve body aches and pains. The root, stem, leaves, and fruits can be boiled for drinking to treat gastritis or as a cough remedy. This agrees with a study that parts of *Elephantopus scaber* L. can be used for treatment and nourishment (Christina et al., 2020; Phumthum et al., 2018).

The laurel clock vine or blue trumpet vine is known locally in Thailand as Rang jeud. Its scientific name is *Thunbergia laurifolia* Lindl and it belongs to Acanthaceae family. The rang jeud leaf can be sliced finely and air-dried and the remnant can then be combined with water to make tea. It is aromatic, helps detoxifying poison and has antioxidant properties. Rang jeud herb can also be processed in capsule form of rang jeud for the purpose of easy and convenient use. Drinking water boiled with rang jeud is traditionally believed to remove voodoo, potions, or black magic. The rang jeud leaf can be dried and mixed in fodder such as pig food, chicken food, etc. to enhance immunity and help animals survive disease (My et al., 2020; Phumthum et al., 2018).

## 3.3 Pattern of Using Local Plants in the Community around Kwan Phayao,

### 3.3.1 Medicinal Plants

Medicinal plants are mostly in the family Fabaceae (Legumes) followed by Solanaceae (Nightshade), Cucurbitaceae (Cucurbits), and Euphorbiaceae (Spurges). They can be categorized based on their medicinal properties. Strengthening, and pain and ache relief was associated with *Cucurbita moschata* Duchesne. This is boiled or crushed into powder and dissolved in hot water. Its poultice helps heal bruises and can be used as an anti-inflammatory drug (Armesto et al., 2020).

Cough and fever suppressant activity is associated with *Sesbania grandiflora* (L.) It can be extracted for use as an antipyretic, antitussive, and to cure colds. It is an antipyretic when the season changes when it can reduce the symptoms of fever. *Diplazium esculentum* (Retz.) Sw. can be boiled with water to be antipyretic, to counteract poisons and inflammation, and to reduce cholesterol levels. Medicines for treating bones and teeth come from *Acmella oleracea* (L.) R.K. Jansen. Its leaves and flowers have Spilanthal with anesthetic activity. It is used to fill teeth and cure toothaches. The raw and processed jambu may be a good alternative for conventional vegetables, even after nutrients being lost during the process of boiling

(Neves et al., 2019).

*Solanum melongena* L. has flowers can be burned to ashes and then crushed finely and used as a medicine for toothache etc. Medicines to treat diseases affecting women include *Citrus hystrix* DC. Its fruits and leaves are aromatic and have an unpleasant acidic taste. It can cure menstrual problems, purify blood during menstruation, and facilitate the expulsion of gas from the intestines. *Lactuca sativa* L. has extracted juice that can be prepared to be a tonic, suppress period cramps, and help increase breast milk after delivery. Antidotes such as *Clinacanthus nutans* (Burm.f.) Lindau should use dried leaves, shells, and roots. These are crushed and mixed with grilled scorpions as a medicine against snake venom. It can also be boiled as a drink for its analeptic effects (Pongmuangmul et al., 2016). Antibiotics include *Piper betle* L. Its crushed leaves are used as a paste and can be used to relieve pains from bruises, kill germs in pus, and cure rhinitis, pharyngitis, and ringworm. *Ipomoea batatas* (L.) Lam. has juice extracted from the bulb which is topically applied to kill germs and bacteria. Tai Yai people use this plant to cure high blood pressure, lumbago, blisters, kidney diseases, kidney stone diseases, hemorrhoids, flatulence, and malaria. Mouth disease-curing medicine includes *Cyperus alternifolius* L. (Bhat et al., 2014; Khuankaew et al., 2014). Its boiled flowers are used with water for a drink. It can be held in the mouth and gargled as a medicine to cure mouth diseases, stomatitis, canker sores, and mouth paleness. *Momordica charantia* Linn. juice is extracted from the fruit and can cure stomatitis; the mouth becomes flaky and nourishes menstruation etc. The current research studies the effect of geographic separation of ethnic groups on local knowledge of medicinal plants used by Akha people in Thailand and China. From a total of 95 medicinal plants registered in the five villages, only 16 were shared between China and Thailand. In all other ways, the use patterns are found to be quite similar with respect to which plant families and plant growth forms are used and also in terms of in which habitats the Akha found their medicinal plants (Inta et al., 2008)

### 3.3.2 Plants Used for Food

The most common food plants are found to be from the family Fabaceae (Legumes family). This was followed by the family Solanaceae (Nightshade family), Euphorbiaceae (Spurges family), and Asteraceae (sunflower family). These families have a variety of species and can be found commonly in the study area. The most popular plant parts used for eating are shoot tips followed by fruits, leaves, and flowers (Kichu et al., 2015; Naidu et al., 2021; Ripen et al., 2016). People usually eat food plants such as fresh vegetables or parboiled vegetables dipped with chili sauces, spicy minced meat, and papaya salad, e.g., Vietnamese coriander. *Polygonum odoratum* Lour. is usually boiled or eaten as a fresh vegetable with minced meat. It is used to season spicy minced meat and in Koi (spicy salad dish) (Pei et al., 2009). *Azadirachta indica* A. Juss. is usually cooked as a curry, steamed, eaten as a fresh vegetable, or parboiled and dipped with chili sauce. In particular, it is used in making

minced meat, papaya salad, Koi, and Jaew (sauce) (Mahomoodally et al., 2019). *Sauropus androgynus* (L.) Merr. is usually cooked as curry, boiled, steamed, stir-fried, eaten as a fresh vegetable, and dipped in chili sauce (Khuankaew et al., 2014; Kichu et al., 2015).

### 3.4 Cultural Importance of Plants (CI)

The index of cultural importance value of plants describes the frequency and varieties of plant utilization according to informants, including utilization of food and utilization of medicinal plants. When the CI of plants around Kwan Phayao is analyzed, it is found that plants accounting for 42 species had a CI over one, and the plant with the highest CI is *Centella asiatica* (L.) Urb. The whole plant is eaten as a fresh vegetable with spicy minced meat or parboiled as a vegetable eaten with chili sauce; it can be extracted to get the juice for a drink (Sengupta et al., 2021). It also has medicinal properties whereby it can be boiled with water to make a drink to treat aphthous ulcer, exhaustion, and bruises; moreover, it can also reduce inflammation and be made into a skin cream or antibiotic. The plant with the second highest CI is *Cymbopogon citratus* Stapf. Its stem is used as a component of food such as Tom Yum (hot and sour soup) and Kaeng Oom. The whole plant is used to treat stomach ache/asthma, to increase the flow of urine, to treat kidney stones, to suppress fishy smell, and to increase appetite (Aumeeruddy et al., 2020). Its stem is used as a carminative to treat gastrointestinal diseases, nourish the fire element, expel air in the intestine, and treat shy bladder syndrome. It can be used to treat thick saliva, colic, abnormal menstruation, and menstruation; it can also help remove phlegm from the throat and expel air in the intestine. The CI values are 1.22 - 1.42. The main species (in order of number of reports) are *Allium sativum* L., followed by *Olea europaea* L., *Allium cepa* L., *Annona muricata* L., *Persea americana* Mill., *Citrus aurantiifolia* (Christm.) Swingle, *Catharanthus roseus* (L.) G. Don, *Moringa oleifera* Lam., *Cymbopogon citratus* (DC.) Stapf, and *Carica papaya* L. Pakistan (Family:81; Species:246) reports the highest number of plant species followed by Mexico, Nigeria, India, Algeria, Morocco, Thailand, Suriname, Benin, and Iran. Leaf (35%), fruit (12%), and root (10%) are found to be the most preferred plant parts while the main methods of preparation are decoction (50%) and infusion (22%) (Aumeeruddy et al., 2020).

## 4. SUMMARY AND DISCUSSION OF EXPERIMENT RESULTS

This paper studies plant utilization patterns of plants in the community around Kwan Phayao, including in community market areas around Kwan Phayao, all in all accounting for five markets i.e. Ban Mai Sai Market, Ban Bua Market, Ban Toon Market, Ban Sang Market, and Ban San Bua Bok Market. The work reflects the trends observed from July 2019 to February 2020 and uses semi-structured interviews with 25 local healers and ethnobotany utilization questionnaires with 50 villagers accounting for 18 males and 32 females. These cover 99 different species, 78 genera, and 36 plant families. The most common family

was Fabaceae (Legumes family) consisting of 12 species (12.12%). This was followed by Solanaceae (Nightshade), Cucurbitaceae (Cucurbits family), and Euphorbiaceae (Spurges family). Each family consists of seven species (7.07%). The family Fabaceae (Legumes family) has been studied previously, and villagers in Phayao province utilized indigenous plants. This is in line with a past study on ethnobotany of indigenous plants utilization in the Phayao province. The family Fabaceae (Legumes family) has the most members and is ranked third for flowering plants as its distribution is quite extensive.

A previous study focusing on ethnobotany utilization in Phayao province shows that the use of indigenous vegetables is seen in 104 species, 85 genera, and 44 families. They were categorized as follows: dicotyledons accounting for 85 species, monocotyledon accounting for 16 species, and fern and fern allies accounting for 3 species. They mostly belonged to the family Fabaceae (Legumes family) accounting for 12 species. Indigenous vegetables are unique foods for Phayao province and include *Cissampelos pareira* (L.) and *Brassica juncea* (L.) Czern. Indigenous vegetables that are economic vegetables with market demand are *Senegalia pennata* (L.) Willd. subsp. *insuavis* (Lace) I. C. Nielsen, and *Champereia manillane* (Blume) Merr. The most commonly found plants belong to the Fabaceae family (Legumes family).

The plants are categorized based into two groups based on utilization: Medicinal plants account for 99 species and plants used for food account for 86 species. This is in line with the study on ethnobotany in the area around Mae Fa Luang University whereby the area that the Lanna people use is surveyed by collecting data from interviews with knowledgeable people in the village in terms of local names, methods of use, and benefits. The total utilization accounts for 196 species: 77 for food, 133 for medicine, five economic plants, and 10 miscellaneous. Ethnobotany studies of the black Muser people in Ban Huayplalod, Dan Maelamoo sub-district and Mae Sod district in Tak province indicate that people use plants for their different characteristics. This is studied through rapid botanical appraisal where the inhabitants are able to select various flora for a total of 193 species and 79 families. Utilization was categorized into 6 types: plants used for food account for 60 species, 37 families; medicinal plants account for 103 species, 53 families; plants used for construction accounts for 14 species, 12 families; firewood accounts for 6 species, 6 families; plants used in other forms account for 19 species, 15 families; and plants grown for restoring the environment account for 4 species, 4 families.

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