

CHAPTER 2

LITERATURE REVIEW

2.1 Ethnobotany and evolution of the field

Study of plant utilization started when Christopher Columbus discovered the American continent “the New World” in 1492. After he came back to Europe, he reported on the beautiful landscapes of the continent and also the plants used by native Americans as an important part of their culture. More native uses of plants were subsequently recorded by immigrants arriving in the New World from both mainland Europe and the British Isles (Cotton, 1996). Since then, contemporary scientists became more alert and the study of plant utilization has become widespread and has continued to the present time. Yet there were no definition nor a specific term for studies related to the field even if there had been several attempts to assign a term (Wickens, 1990).

In 1873, the term *aboriginal botany* was first used by the American Stephan Powers in his description of plants used by the Neesheman Indians of the Bear River in California. The term was promptly recognized among North American fieldworkers who defined it as “the study of all forms of vegetation which aborigines used for commodities such as medicine, food, textiles and ornaments” (Powers, 1875 in Cotton, 1996). At about the same time the term *ethnographie botanique* was used by the French botanist Rochebrune (1879 in Wickens, 1990) to define the study of plants from archeological sites. However, neither term was universally accepted.

Subsequently, in 1895, the term *ethno-botany* was used by the American botanist, Dr. John W. Harshberger, in his lecture in Philadelphia to describe the field related to “the studies of plant used by primitive and aboriginal people” (Anonymous, 1895 in Wickens, 1990). He also used the term in his publication, Harshberger (1896). Since then, the term became popular and widely accepted. Since Harshberger (1896), considerable attention has focused not only on how plants are used but also how they are perceived and managed. The reciprocal relationship between human societies and plants on which they depend has also taken an interest (Cotton, 1996). As such, the

definition of *ethnobotany* has been refined, evolved and enlarged the scope of the field (Osawaru and Dania-Ogbe, 2010). Also, many new theoretical notions and methodologies were introduced into the study of ethnobotany.

Robbins *et al.* (1916) expanded the concept of the field and proposed that ethnobotany should be not only a matter of collecting plants, procure native names, and formulate a list of plants with some note regarding their uses. Instead he suggested that it should be more scientific and strike deep into understandings of plant life and plant relationships as perceived by the peoples studied. Also Robbins and his coworkers noted that the following important questions should be considered in ethnobotanical studies:

- (a) What are primitive ideas and conceptions of plant life?
- (b) What are the effects of a given plant environment on the lives, customs, religion, thoughts, and everyday practical affairs of the people studied?
- (c) What use do they make of the plants around them for food, for medicine, for material culture, and for ceremonial purposes?
- (d) What is the extent of their knowledge of the parts, functions, and activities of plants?
- (e) Into what categories are plant-names and words that deal with plants grouped in the language of the people studied, and what can be learned concerning the working of the folk mind by the study of these names?

Twenty-five years later, Jones (1941) agreed with Robbins *et al.* (1916) and other workers before him, when he published *The nature and scope of Ethnobotany* and stated that ethnobotany “is concerned exclusively with the interrelation of primitive man and plants and takes for its sole aim the illumination of this contact.” In addition, groundwork for the future evolution of ethnobotany should be “concerned not only with uses of plants, but with the entire range of relations between primitive man and plants.”

In 1978, Richard Ford modified Jones’s definition to accommodate the evolution of the field. He defined ethnobotany as “the study of the direct interrelations between humans and plants.” The term *direct* was added to acknowledge those who were in continual contact with plants permitting them to classify, in their own way, the plants and to generate cultural rules for manipulating the plants and their local

environments. Likewise, the term *primitive* was deleted to enlarge the scope of studies in this field. In addition to the definition, Ford also proposed a “new synthesis” of ethnobotany. Ethnobotanist of the new synthesis should be able to merge all methods and theories together (Ford, 1978). They “must be able to identify what plants are significant; to discover how the people of a culture classify, identify, and relate to them; and to examine how the perception of the plants world actually guides their action and concomitantly structures the floral environment.” In spite of these definitions of the term and even if it had been nearly a century since Harshberger, still, there have been many attempts in the following years to define the term and its scope by many workers, for example:

Wickens (1990): Ethnobotany is the study of useful plants prior to commercialization and eventual domestication;

Heiser (1985 in Wickens, 1990): Ethnobotany is the study of plants in relation to people;

Martin (1995): Ethnobotany is all studies concerning plants that describe local people’s interaction with the natural environment;

Turner (1988): Ethnobotany is the science of people’s interactions with plants;

Allem (2000 in Osawaru and Dania-Ogbe, 2010): Ethnobotany is the biological, economic, cultural interrelationship studies between people and plants in the environment in which they exist;

Schultes and Raffauf (2003 in Osawaru and Dania-Ogbe, 2010): Ethnobotany is human evaluation and manipulation of plant materials, substances and phenomena in societies;

Jain (2005 in Osawaru and Dania-Ogbe, 2010): Ethnobotany is the study of how people make use of plants;

Pushpangadan and Kumar (2005 in Osawaru and Dania-Ogbe, 2010): Ethnobotany is the entire realm of useful relationship between plant and man.

Obviously, ethnobotany is an interdisciplinary science that combines anthropology and botany (Gomez-Beloz, 2002). In the word itself, it encapsulates two major parts; *ethno*– the study of people, and *botany* – the study of plants (Davidson-Hunt, 2000). Ethnobotany therefore, in broad terms, is the study of the relationship

and interactions between plants and people (Balick and Cox, 1996) and since the deletion of the word *primitive* by Ford (1978), ethnobotany now includes the use of plants by both tribal and non-tribal communities without any implication of primitive or developed societies (Wickens, 1990). Researchers have argued that ethnobotanical knowledge emerges from the interaction of a given culture or society with a local biophysical environment, which implies that ethnobotanical knowledge is not restricted only to indigenous peoples nor only to developing countries (Reyes-García *et al.*, 2007).

“It is an anthropological approach to botanical science, and a science which brings cultural awareness of biological resource. It is particularly applied to tribal peoples. But it can be said that every group of people, no matter how technological, have their own botanical lore which can be subject to ethnobotanical study” (Given and Harris, 1994)

The real-life interactions of people with plants, however, often do not conform neatly to the ways that academic disciplines and related professional fields are organized. A comprehensive understanding of the constraints governing access and use of plant resources requires, in addition to botany and anthropology, knowledge from different fields such as sociology, economics as well as ecology (Hamilton *et al.*, 2003). Therefore, collaboration between many disciplines is necessary (Prance, 1991).

2.2 Ethnobotany and its related fields

Over the last decade in particular, ethnobotany has tended to become more analytical, quantitative, cross-disciplinary and multi-institutional (Hamilton *et al.*, 2003).

Attributed to the evolution of the field, ethnobotany has now been universally accepted as multidisciplinary science for holistic approach to people-plant relationship using not only botany and anthropology but also other fields of study (Gomez-Beloz, 2002; Osawaru and Dania-Ogbe, 2010). According to *Ethnobotany: A manual method*, the incorporation of the six basic fields of study can contribute to a systematic survey of the traditional botanical knowledge in a single community or region (Martin, 1995).

2.2.1. Botany

Collecting and identifying plants are the basic skills in ethnobotany. Plant collecting not only serves to produce voucher specimens that are the permanent records of the plants that are known and used by a particular community, but also allows the plant taxonomists to identify the plants used. In this context, the botanical knowledge related to:

- selecting a locality and populations of plants,
- collecting the specimens,
- recording the ethnobotanical information,
- composing and arranging the specimens,
- pressing the plants,
- drying the plants,
- labeling the specimens,
- distributing the specimens for identification,
- making a spirit collection,
- making living collection,
- identifying the plants

is important and contributes to a good quality herbarium specimens for plant identification and the completeness of the ethnobotanical data collected (Martin, 1995).

2.2.2. Anthropology

To study human-plants interaction, the central interests are to gather ethnobotanical information on folklore including the anthropological information of the population that is studied. The initial ways to gain this information are to talk with local people, to observe and participate in what they do in their daily activities. To yield the reliable data, various ethnographic methods, given names by anthropologists, have been incorporated into data collection in ethnobotany such as

- participant observation technique
- interviewing techniques which include the open-ended, semi-structured interviews and structured interviews.

2.2.3. Ecology

To study the way in which people manage their environments is also of interest in ethnobotany. Because local ethnobotanical knowledge is interrelated to perception of landforms, soils, climates, vegetation types, stages of ecological succession, land use and many other aspects of the natural environment, ecological methods help ethnobotanists to address how these aspects are classified by local people (Martin, 1995). In addition, integration of ecologically quantitative approaches helps ethnobotanists to choose an area for study, measure the diversity and abundance of plant resources including estimating the harvest of forest products. The incorporation of ecological method allows comparisons of the diversity of plant resource used by different groups of people (Begossi, 1996).

2.2.4. Economics

Because of the incorporation of economics into ethnobotanical study, some researchers refer to their work as *economic botany* which contributes to the discovery of plant resources that attain importance in global or regional or local markets. This may therefore possibly contribute to national and community development (Martin, 1995). Economics assist ethnobotanists in evaluating the value of forest product. As a consequence, economic botany has introduced many potentially economic plants into the manufacture line such as sugar cane, maize, cacao, *etc.* (de Macvean and Pöll, 2002)

2.2.5. Linguistics

Knowing the language of the studied group adds much depth to ethnobotanical research. As many ethnobotanists tend to conduct their work in traditional communities whose languages frequently are unwritten, it is suggested that ethnobotanists should consider taking an introductory course in linguistics on how to write and pronounce the various sounds that are found in the languages of the world (Martin, 1995). However, many ethnobotanists feel they do not have sufficient time or adequate skills to learn a language while carrying out fieldwork. The assistance of linguists as collaborators is therefore necessary in this context. Linguists can help

ethnobotanists to write and interpret key words and concepts encountered in the course of their research.

2.2.6. Ethnopharmacology and related fields

For potentially economic plants, in-depth experimental assessment of the benefits derived from them, both for subsistence and for commercial ends, may be needed. It is therefore necessary to collaborate with colleagues from a diverse range of academic fields such as pharmacognosy, ethnopharmacology, natural products chemistry and others (Martin, 1995).

Apart from these subjects, many other subjects have also been integrated into the field of ethnobotany. In recent decades, ethnobotanists are much more engaged with questions of conservation, sustainable development, cultural affirmation, and the intellectual property rights of local and indigenous people (Hamilton *et al.*, 2003). As a part of this, multi-institutional projects such as *People and Plants* had developed the interdisciplinary subject *Applied Ethnobotany* which is ethnobotany applied to conservation, sustainable development and many other disciplines as shown in Figure 1.

Ethnobotanical studies are now in progress throughout the world and the scope of ethnobotany has become broad and its studentship diverse (Cotton, 1996). A number of ethnobotanical works have been published during the past few decades, not only in journals that are specifically dedicated to ethnobiological research (*e.g.*, *Journal of Ethnobiology*, *Journal of Ethnopharmacology*, *Ethnobotany Research & Applications*) (Cotton, 1996; Reyes-García *et al.*, 2007) but also in a whole range of publications dedicated to different academic disciplines including anthropology, botany, archaeology, palaeobotany, phytochemistry and conservation biology (Cotton, 1996). Despite the worldwide and increasing number of studies of the field, Reyes-García *et al.* (2007) pointed to the uneven distribution across geographical areas of the ethnobotanical studies and indicated that, during the last two decades (1986–2005), ethnobotanical research were still mainly conducted by biologists and anthropologists and focusing on indigenous people of developing countries especially in Latin America. As such, Reyes-García and her colleagues suggested that research should

also be conducted among group of population or in regions that have been scarcely studied (e.g., Europe) because those populations might show variation of ethnobotanical knowledge that can provide new insight in cross-cultural research.

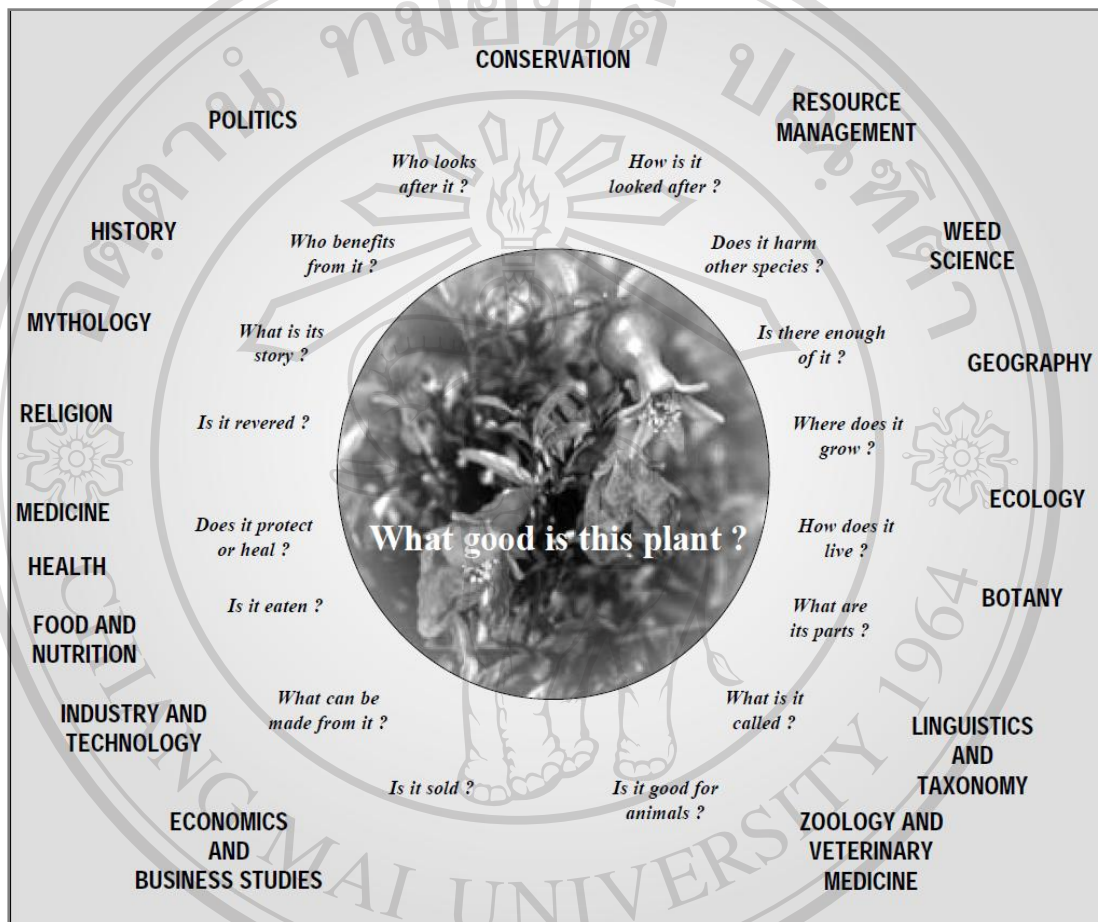


Figure1. Some key questions and disciplines relevant to applied ethnobotany (Hamilton *et al.*, 2003)

2.3 Importance of ethnobotany

In the present situation in which social, environmental and cultural transformation have led to changes in traditional lifestyle including feeding/healing practices in many indigenous communities, as a result, the intellectual and cultural heritage accumulated over many centuries is gradually disappearing. The main objective of ethnobotany is to record and conserve the knowledge that different societies have about the plants present in their own environment and, at the same

time, to study the particular way in which groups interact with their environment. It is therefore accepted that ethnobotanical research is a form of cultural rescue (Caballero, 1986 in Hamilton *et al.*, 2003; Martin, 1995). The rescue and documentation of traditional knowledge can contribute to the strengthening of indigenous cultures. Ethnobotany is a subject of great practical value; its applications can result in the demonstration of the value of cultural diversity within the context of the processes of globalization, modernization and integration of indigenous peoples into national societies (Hamilton *et al.*, 2003)

Apart from its theoretical significances, ethnobotany can contribute to:

- 1) Elucidation of “cultural position of the tribes who used the plants for food, shelter or clothing” (Harshberger, 1896)
- 2) Retrieval of past distribution of plants (Harshberger, 1896)
- 3) Retrieval of ancient trade routes (Harshberger, 1896)
- 4) Identification and development of new economic products from plants, for instance, crafts, foods, herbal medicines and horticultural plants (Given and Harris, 1994; Hamilton *et al.*, 2003), and new lines of manufacture by suggesting plants with potential economic importance (Harshberger, 1896).
- 5) Assessments of the conservation status of a single plant species- including varieties of crops - and other forms of biological diversity such as plant families and forest type.
- 6) Sustainability in the exploitation of plant resources including non-timber forest products (NTFPs) (Hamilton *et al.*, 2003).
- 7) New drug development, ethnobotanical studies provide a valuable shortcut for locating biologically active compounds (Prance, 1991; Heinrich, 2000; Lentini, 2000; Hamilton *et al.*, 2003; Bletter, 2007; Lundh, 2007).
- 8) Enhanced food security, nutrition and healthcare (Hamilton *et al.*, 2003); scientist have found that the nutritional status of the rural poor people can be improved by native plants (de Macvean and Pöll, 2002).

2.4 Field techniques for gathering ethnobotanical information

There are many ways to gain ethnobotanical information such as:

2.4.1 Participant observation

This technique refers to observation of human-plant interactions. Ethnobotanists may live in a community, take part in everyday activities of the local people, and share with them many facets of their life, from subsistence activities such as cooking, farming or gathering firewood, to ritual occasion such as marriage, religious celebrations or initiation rites (Martin, 1995). The most important tools are curiosity, a willingness to learn from other people and an ability to adapt to their rhythm and lifestyle. This method helps reducing researchers' subjectivity and intrusiveness and allows the ethnobotanists to see how people put their knowledge into practice and observe the changes that come with each season (Martin, 1995; Hoffman and Gallaher, 2007).

2.4.2 Interview

Interview is the most common way used by ethnobotanists to collect ethnobotanical data. There are many forms of interviews such as (Martin, 1995; Gerique, 2006):

2.4.2.1 Ethnobotanical inventory or field interview

This technique refers to walking in the field or in the forest with the presence of one or more informants, asking them about the use of plants and collecting the plant specimens including taking pictures of such plants. Even if this technique is considered very time-consuming, it allows informants to see the plants in their natural state, which minimizes the risk of misidentification and offers an excellent context for interview.

2.4.2.2 Plant interview

This technique refers to bringing plants collected in the field back to the village and showing them to the informants. In case that there are no fresh specimens available, pressed plant specimens or pictures of the plant can also be used in this way. The minimum data required in plant use interviews involves three deceptively

simple questions: *Do you know this plant? Do you know a name for this plant (and if so, what is it)? And Do you use this plant (and if so, how do you use it)?* (Hoffman and Gallaher, 2007). This method is very helpful for preliminary or short studies or in order to reconfirm the collected data.

2.4.2.3 Artefact interview

This technique refers to asking the informants about all of the species associated with the manufacture or preparation of particular items; for example, plants used for making tools, baskets, *etc.* As it helps familiarizing the local community with the researcher, it is very helpful especially at the beginning of an ethnobotanical study.

2.4.2.4 Checklist interview

This technique refers to when ethnobotanists prepare a list of plants beforehand and show it to the informants. It is often used when time in the field is limited (Gomez-Beloz, 2002). As the plants names may vary among cultures (or sometime, individuals), to avoid the errors caused by the variation of plant names, plant pressed specimens or pictures may be used as complementary aids during the interview (Martin, 1995).

2.4.2.5 Group interview

This technique refers to when ethnobotanists conduct simultaneous interviews with several informants. The advantage of this technique is that when all informants are willing to share their knowledge in a group environment, group discussion can produce a wealth of data and lead to the discovery of new topics and questions.

However, it may be that some informants are reluctant to disclose their knowledge in a group environment (Gerique, 2006).

In any form of interview, the setting of the interview and the degree to which questions are predetermined as well as the questions asked are crucial to the degree of control of the interview (Gerique, 2006). Based on the approaches of the study, qualitative or quantitative, types of interview listed below can be applied to each form

of interviews described above. The open-ended and semi-structured interviews are usually used in qualitative data collection, while structured interviews and questionnaires may be used for quantitative analyses.

2.4.3 Open-ended interview

This kind of interview refers to the casual conversations that can reveal the detail of the interested subjects (Cotton, 1996). Questions relevant to the subject of interest will naturally arise during the course of conversation and the researcher simply makes notes. The first open-ended interview helps researchers to develop a sense of what needs to be asked in more structured interviews (Martin, 1995).

2.4.4 Semi-structured interview

This kind of interview is based on a checklist of topics or questions that researchers have beforehand prepared as a guide. During the conversation, some other questions may arise naturally and some of prepared questions may be omitted and fall to the wayside or left for a future discussion (Martin, 1995; Cotton, 1996).

2.4.5 Structured interview

Whenever quantitative data are required for analytical purposes, structured interviews are a helpful tool (Cotton, 1996). By this type of interview, a group of selected informants are requested to answer the same set of questions or to perform the same test. The interview can either be conducted by asking the questions orally or by writing it down in a questionnaire if the participants are literate. The verbatim answers yielded from this type of interview are comparative and can be analyzed using various statistical methods (Martin, 1995).

2.5 Quantitative Ethnobotany

In the past, the research objective of most ethnobotanical studies only focused on documenting vernacular names and traditional uses of plant species with little emphasis on scientific methods (Höft *et al.*, 1999; Gomez-Beloz, 2002; Collins *et al.*, 2006). For this reason, ethnobotany was criticized and seen as ‘weak science’ (Albuquerque, 2009). However, ethnobotanists have perceived and responded to the

need for research based upon scientific method. As a result, a fundamental step in the development of research in ethnobotany has been moved from a descriptive to a more analytical quantitative approach including the testing of hypothesis, reproducible methods, and statistical measure of variation.

The hallmark in scientific method in ethnobotanical research began during the late 1980s and has increased dramatically in the past two decades as a consequence of the adoption of quantitative methods in ethnobotany. For the first time, the term quantitative ethnobotany appeared in an article published in a Brazilian journal (Balée, 1987 in Albuquerque, 2009) and was relatively broadly defined as “the application of quantitative technique to direct analysis of contemporary plant use data” (Philips and Gentry, 1993a). A primary challenge in this quantitative trend is how to produce values that are reliable and comparable measures of less tangible qualitative data (Hoffman and Gallaher, 2007). The advantages of the quantitative techniques are not only that they allow analysis of patterns of plant use knowledge but they also allow the researcher to check the credibility of the data collected, increasing the methodological scientific rigor of the research (Gerique, 2006).

The application of quantitative techniques to data analysis associated to the refinement of methodologies for data collection (Höft *et al.*, 1999) and the incorporation of proper quantitative method into ethnobotanical studies enhances the value of the research and the interpretation of the results (Williams *et al.*, 2007).

Prance and collaborators (1987) first introduced the quantitative method into the ethnobotanical study. Since the method of Prance and collaborators (1987) and Phillips and Gentry (1993a) were introduced, the interest in quantitative ethnobotany has grown and a number of quantitative methods have been developed by many authors and applied to ethnobotanical data to test different hypotheses about the relation between plant species and humans (Reyes-García *et al.*, 2006). The development and application of ecological and ethnobotanical indices can provide data amenable to hypothesis-testing, statistical validation, and comparative analysis (Begossi, 1996; Hoffman and Gallaher, 2007). The central concerns in quantitative ethnobotany were the measure of ‘importance’ of plants and vegetation to people (Hoffman and Gallaher, 2007), including individual variation in ethnobotanical knowledge (Reyes-García *et al.*, 2007). The ‘importance’ of plant taxa can result from

the estimation of their ‘quality of use’, ‘intensity of use’ and ‘exclusivity of use’ (Turner, 1988; Tardío and Pardo-de-Santayana, 2008). A common tool to quantify otherwise qualitative data in the biological and social sciences is an index. Mostly, the ethnobotanical indices are based on the pattern that “informant *i* mentions the use of the species *s* in the use-category *u*.” (Hoffman and Gallaher, 2007).

In the last few decades, there have been different indices in ethnobotany formulated by researchers. These indices have been applied to ethnobotanical data gathered from structured interviews or questionnaires in order to evaluate cultural preferences and capture the relative importance of the different plant species to societies, for example (Hoffman and Gallaher, 2007):

2.5.1 Frequency of Citation (FC)

This index, which does not consider the variable *u* (use-category), is also sometimes known as *Frequency of quotation*. It is one of the simplest and most widely used indices to evaluate the relative importance of the species based on the number of informants that mention a given species as useful.

2.5.2 Relative Frequency of Citation (RFC)

This index is a simple and widely used index (Ladio and Lozada 2001; Lozada *et al.* 2006; Tardío and Pardo-de-Santayana, 2008) which does not take the variable *u* (use-category) into account and is obtained by dividing the frequency of citation (FC) of a given plant species by the total number of informants (*N*). The formula for RFC, therefore, can be seen as;

$$RFC = \frac{FC}{N}$$

2.5.3 Informant Consensus Factor (ICF; Trotter and Logan, 1986; Heinrich *et al.*, 1998)

The degree of agreement among the various informants is the most used among the ethnobotanical indices (Albuquerque *et al.*, 2006). Trotter and Logan (1986) initially developed a method based on *informant consensus* to determine potentially effective medicinal plants. This index is originally called *informant agreement ratio* (Trotter and Logan, 1986) but Heinrich (1998) has subsequently

renamed it *informant consensus factor* (ICF). This index has been widely used for assessing the importance of medicinal plants used for particular ailments or use-categories by many authors (*e.g.*, Canales *et al.*, 2005; Akerreta *et al.*, 2007; Ugulu *et al.*, 2009; Upadhyah *et al.*, 2011, *etc.*) and can be calculated using the formula;

$$ICF = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

in which N_{ur} refers to the number of use-reports for a particular use category and N_t refers to the number of taxa used for a particular use category by all informants. The value of informant consensus factor can also reflect the homogeneity of knowledge. ICF values are low (near 0) if plants are chosen randomly or if there is no exchange of information about their use among informants, and approach one (1) when there is a well-defined selection criterion in the community and/or if information is exchanged between informants (Gazzaneo *et al.*, 2005).

2.5.4 Use Value (UV; Phillips and Gentry, 1993a)

The Use Value index is an index originally developed by Prance and collaborators (1987), independent of informant consensus, and in contrast based only on the diversity of plant uses. Regardless of informant variation, this index was initially defined as a sum of uses for a given plant species, using a value of 1.0 for ‘major’ uses, 0.5 for ‘minor’ uses and 0 for ‘no use’. Afterwards, for a more objective index, Phillips and Gentry (1993a) modified the index of Prance and collaborators (1987) by taking the number of informants mentioning uses of a given plant into account. The Use values index, thus, is calculated by the formula

$$UV = \sum \frac{U_i}{N}$$

where U_i is the number of use-reports cited by each informant for a given species and N refers to the total number of informants. Use values are high when there are many use-reports for a plant, implying that the plant is important, and approach zero (0) when there are few reports related to its use. Thus, plants mentioned with more frequency were assigned more use value than plants mentioned with less frequency (Reyes-García *et al.*, 2006). The use value, however, does not distinguish whether a plant is used for single or multiple purposes; for example, a rarely used plant with two

cited uses would be more 'important' than a very popular plant with only one use (Kvist *et al.*, 1995).

2.5.5 Cultural Importance index (CI; Tardío and Pardo-de-Santayana, 2008)

This index could be regarded as a simplification of the cultural value of Reyes-García and collaborators (2006) and as a redefinition of the Use Value developed by Phillips and Gentry (1993a). It was developed by Tardío and Pardo-de-Santayana (2008) because they were not totally convinced with the indices developed by other researchers. The cultural importance index was defined by the following formula;

$$CI = \sum_{u=1}^{NC} \sum_{i=1}^N \frac{UR_{ui}}{N}$$

where UR_{ui} is the total number of use-report for each use category of a given species, N is the total number of the informants and NC refers to the total number of the use-categories. Hence, the CI index is the sum of the proportion of informants that mention each of the use-categories for a given species. The maximum value of the index equals the total number of different use-categories (NC), which would occur if all informants would mention the use of a species in all use-categories.

Nevertheless, compared to the Use Value (UV), the same events (use reports) were added to the formula but the CI is defined in different ways. In the case of the CI index, Use reports (URs) were grouped by use-categories (the sum of the informants who cited each use-categories) and then sum all these URs together whereas in the case of the UV index, the URs were grouped largely based on the informants (the sum of the uses cited by each informant) and then sum all these data. This is to say the CI index is the sum of the proportions of informants cognizant of each use-category but the UV index is the average number of use-categories for a certain plant per informant. The result gained from both indices is the same (Tardío and Pardo-de-Santayana, 2008).

Based on the way plant uses are grouped, the CI index correspond with an interest in whether it is a given plant for a particular use-category or a more diversified one whereas the UV index better suits a study for comparing individual knowledge variation among the informants. In other word, the CI index better reflects

and highlights the cultural aspect of plant utilization. The CI index can also be used as efficient tool to compare the plant knowledge among different cultures or subgroups of the identical cultures (Tardío and Pardo-de-Santayana, 2008).

2.5.6 Fidelity level (Friedman *et al.*, 1986)

In the same way as the Cultural Importance index correspond with an interest in whether it is a given plant for a particular use-category, the Fidelity Level index has been used by many authors (Estomba *et al.*, 2006; Teklehaymanot and Giday, 2007; Ugulu *et al.*, 2009; Cheikhoussef *et al.*, 2011; Musa *et al.*, 2011) to determine the most preferred species used in treatment of particular ailment because many plant species may be used in the same use-category. The fidelity of a given plant can be calculated by the formula;

$$FL (\%) = \frac{N_p}{N} \times 100$$

where N_p is the number of use-reports cited for a given species for a particular ailment and N is the total number of use-reports cited for any given species. High FL value (near 100%) are obtained for plants for which almost all use reports refer to the same way of using it, whereas low FLs are obtained for plants that are used for many different purposes.

In addition to the use of ethnobotanical indices, the following analytical tools can also be used in quantification of a species' local significance and data verification.

These tools are often combined with interview techniques such as:

2.5.7 Free-listing

This tool refers to asking member of a given community to list all plants that might be used for a particular purpose. The importance of plant species is based on the principle that those plants that are more significant are likely to be mentioned by several informants and are likely to be mentioned earlier in each list (Cotton, 1996).

2.5.8 Preference ranking

This tool refers to asking each participant to order a group of plants according to given criteria such as personal preference or perceived importance. A numerical value for each plant is then assigned according to its personal preference (Cotton, 1996). For example, when the participants are asked to arrange the medicinal plants based on their personal preference of efficacy, the medicinal plants that are believed to be the most effective will be given the highest value and the lowest value will be given to the least effective one (Teklehaymanot and Giday, 2007). Overall ranking value can be determined based on the total score of each plant species (Cotton, 1996). Based on the overall ranking, the most effective medicinal plants or the most preferred species for given purpose can be determined (Teklehaymanot and Giday, 2007).

The data processing techniques in quantitative ethnobotany may also include complex computational techniques of multivariate analysis such as classification and ordination. Multivariate and statistical methods have been applied to ethnobotanical data for many purposes based on the objective of the researchers such as (Höft *et al.*, 1999):

- knowledge and uses of plants by different ethnic, social or gender groups,
- size class distribution of woody plant species,
- quantitative impact of human uses on growth and regeneration patterns,
- quantitative impact of environmental factors on certain plant traits,
- quantitative impact of agricultural or horticultural techniques on certain plant traits,
- quantitative plant morphological and pharmacological characteristics of useful plants

2.6 Comparative Ethnobotany

Because the concept of plant uses differ among different people, ethnobotany will become a more important subject when it has progressed to a point where results can be studied comparatively (Robbins *et al.*, 1916). The ethnobotany of one ethnic group should be compared with similar studies. Comparative ethnobotany is

important avenue to study effects of ecological and cultural constraints on plant use patterns among the culturally identical or distinct groups. The quantitative approaches also allow the comparisons on the use of plants by different populations in different environments (Begossi, 1996; Hoffman and Gallaher, 2007). Some important questions in understanding the evolution of plant resource utilization are whether people's interaction and use of the natural resources in their surroundings is culturally bound or whether it is a reflection of the ecological conditions under which they live (Inta *et al.*, 2008). An important starting point for quantitative cross-cultural comparison of ethnobotanical knowledge was the study of Boom (1990). He determined the percentage of plants used by Panare indigenous informants within a 1 hectare forest plot in Venezuela and compared plant knowledge inter-culturally. Afterwards, Heinrich *et al.* (1998) examined and compared the use of medicinal plants in four different indigenous groups by using the informant consensus factor (ICF). Since then, comparative ethnobotany has been increasingly studied by a number of ethnobotanist (*e.g.*, Ladio *et al.*, 2007; Paniagua Zambrana *et al.*, 2007; Inta *et al.*, 2008; de la Torre *et al.*, 2009; Ladio and Lozada, 2009; Molaes and Ladio, 2009) and fundamental anthropological questions such as what factor affect plant use pattern of a community or whether there is the similarity in plant use pattern among people has been raised as central interest of the field.

Frequently, a specific domain (*e.g.*, useful plants, medicinal plants, wild plants, crop plants, *etc.*) and dimension (*e.g.*, theoretical knowledge, practical knowledge [skills]) of plants use were raised as the subject of comparative studies (Reyes-García *et al.*, 2007). A general assumption has been made, when comparisons are made intra-culturally, that plant uses patterns can be influenced by two possible factors; ecological or cultural constraints (Inta *et al.*, 2008). The cultural constraint is the social force to maintain ethnic integrity and uniformity through common cultural practices concerning the plants (Terashima and Ichikawa, 2003; Kent, 2006). In case that plant use patterns are culturally bound, little difference in plants uses would be expected among the culturally identical groups of people living geographically separated and it would be implied that traditional knowledge of plant uses evolved and has been maintained by cultural coherence. On the other hand, the ecological constraint is the adaptability of the plant's material attributes to the use (Terashima

and Ichikawa, 2003; Kent, 2006). This is to say, if plant use pattern is determined by ecological factor, differences in plant uses would be larger between culturally identical groups who live geographically separated and this would imply that traditional knowledge of plant uses evolved and has been maintained by ecological divergence (Inta *et al.*, 2008).

Reciprocally, similarity in plant use pattern could also be found between culturally different groups. The possible explanation for any two or more different cultures using similar or the same plants, especially for medicinal uses, could be that the two cultures have independently discovered that the plants can be used effectively for a particular purpose and have not communicated these uses to each other. For less related cultural groups with decreasing distance between them, the probability that they have communicated to each other about the use of plants for particular purpose via the media moving from one group to another such as literature, immigration, *etc.* (Bletter, 2007).

Comparative ethnobotany has always been an essential avenue contributing to the understanding of plant use patterns and factors that affect the use of plants among different populations inhabiting different environments (Ladio *et al.*, 2007). During the last decade, there have been a number of comparative ethnobotanical studies stretching out from many regions over the world.

In Congo, comparative ethnobotany allowed the comparison of plant use patterns among different cultural groups, the Mbuti and the Efe, who inhabited the same environment. Despite the cultural diversity and inter-group difference in the knowledge of plants, they shared a similar overall use pattern and the knowledge of certain important species (Terashima and Ichikawa, 2003).

In Argentina, selection patterns of wild plant were evaluated to understand whether it is influenced by environmental constraints in the two Mapuche communities sharing the same traditions and beliefs but inhabiting different environments. Similarities and differences in the use patterns of wild medicinal and edible plants were analyzed by means of the Jaccard's similarity index and statistical tests. Even if habitat and environment is a driving factor that influences which plant species are used, similar patterns were found with respect to plant families, ways of

utilization, plant parts and life form used irrespective of where the communities are settled (Ladio *et al.*, 2007).

Recently, in Thailand, Inta and collaborators (2008) studied the effect of geographic separation of ethnic groups on local knowledge of medicinal plants used by Akha people in Thailand and China, who were separated 100–120 years ago, to see how different the two geographically separated but culturally similar groups were in this respect. The results were similar to those found in the Mapuche communities in Argentina (Ladio *et al.*, 2007) in that the use patterns of Akha people living in Thailand and China were quite similar with respect to which plant families and plant growth forms were used and also in terms of in which habitats the Akha found their medicinal plants and they concluded that the moving to a different site has forced the Akha to find a new set of species, but that when using these new species they maintained their traditions relating to medicinal plants.

In addition to the purpose of comparing and determining the factors that influence plant uses pattern of groups of people who are culturally identical or share the same habitat environment, comparison of plants used by distantly related cultures with the aim of searching for potential plant, especially medicinal plants, is also of interest in comparative ethnobotany.

The preliminary comparative analysis of approximately 250 medicinal plants used in traditional medicine of Bulgaria and Italy showed that the two countries share more than 80% of the plants which are employed in identical or similar kinds of ailments with their preparation also being remarkably similar (Leporatti and Ivancheva, 2003). These authors also suggested that the findings should be exploited to provide new, useful and important knowledge.

Bletter (2007) compared medicinal plants species used by distantly related cultures, the Malinké of Mali and the Asháninka of Peru. In his study, plants used to treat similar diseases by both cultural groups were considered potentially efficient based on the hypothesis that closely related plants used to treat closely related disease in distantly related cultures have a higher probability of being effective than other plants that may be used for the same disease in only one culture because the discoveries of the effectiveness of the plant by each group are more likely to be independent.

Despite a number of comparative studies that have been conducted, there has been a limitation to making cross-studies comparisons of ethnobotanical knowledge distribution owing to the differences in methods and concepts (domains and dimensions) used by different researchers. To allow comparability across studies, making it possible to draw generalizations about what it is that shapes ethnobotanical knowledge distribution, a research on ethnobotany must overcome two major burdens: conceptual inconsistency and the lack of methodology that provides data comparable at cross-cultural level (Reyes-García *et al.*, 2007).

2.7 Ecological methods used in ethnobotany

Ecological methods have proven useful in ethnobotanical studies. Within the same domain and dimension of ethnobotanical study, the incorporation of statistical and ecological method allows intra and inter-cultural comparisons (Begossi, 1996).

Diversity indices are quantitative tools used by ecologists in most studies at the community level and have been applied to ethnobotanical study to evaluate the intensity of resources used by human populations. Diversity indices also allow comparisons among different populations in different environments and are very helpful in answering at least the following questions (Begossi, 1996);

a) Does the diversity of plant use represent the diversity of plants available?

Use of diversity indices allow comparisons between the richness of available and used species such as in the study that showed that 30% of the species were used by the Panare Indians from Venezuela (Boom,1990). Likewise, Prance and collaborators (1987) showed that 77%, 61%, 49% and 79% of species were used by the Ka'apor, Tembe, Pan-are and Chacobo from the Amazonia. Generally, the assumption that there is a positive relationship between the number of plant species used by a human community and the number of plant species present in the surrounding ecosystem has been made in ethnobotanical studies; the significant results from the recent study of meta-analysis of plant use pattern in Ecuador has strongly supported such hypothesis (de la Torre *et al.*, 2012).

b) Are the same plants used by most individuals?

To answer this question, the calculation of the evenness may be helpful. A low evenness infers to a high dominance in the use of a few species.

c) Are there any differences in the diversity of plant uses per category (*e.g.*, gender, age)?

Use of diversity indices allows comparison between subject categories; for instance, in a community in the Atlantic coastal forest in Brazil women and older people were more knowledgeable and tended to cite higher diversity of plant uses than the men and young individuals did (Figueiredo *et al.*, 1993 in Begossi, 1996).

In this study, two ecological indices were employed:

2.7.1 Shannon-Weiner Diversity Index

The Shannon-Wiener index is widely used in ecology to compare diversity between habitat samples. The index can be calculated by the formula:

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

where, in the context of used species diversity, p_i refers to the proportion of species i in a given study site; s equals total number of species present in the same study site. Likewise, in context of uses diversity, “ p_i ” is the proportion between the number of citations for each species and the total number of citations (Begossi, 1996)

2.7.2 Jaccard's Similarity Index

Jaccard's similarity index (JSI) is an index widely used for measuring the similarity between two sample sets. In this regard, the two sample sets refer to any pair of two communities of identical/distinct ethnic groups. Similarity in used plants composition from any two study sites will be calculated by the formula;

$$JSI = C/A+B-C$$

where A equals the number of plant species mentioned as useful by people in community A, B equals the number of plant species mentioned as useful by people in community B, and C equals the number of plant species mentioned as useful by people in both communities; A and B.

2.8 Ethnobotanical studies in Thailand

In Thailand, ethnobotany first became recognized academic subject in 1990 (Trisonthi and Trisonthi, 2002) and it was defined as *Preugsasartpuenbaan* (พฤกษศาสตร์พื้นบ้าน) by the experts in this field, Professor Dr. Tem Smitinand, Dr. Weerachai Nanakorn, Dr. Dietrich Schmidt-Vogt, Dr. Ardith A. Eudey and Dr. Hans T. Beck, in the national seminar regarding ethnobotany in 1991 (Smitinand and Nanakorn, 2002). *Preugsasartpuenbaan* is the study of plant utilization inherited in each ethnic group since ancestral time as sources of food, clothing, shelter, fuel, medicine and ritual symbol including local classification methods together with the preparation of those plants for use and also the ways to use them (Smitinand and Nanakorn, 2002). In 1991, Dr. Chusie Trisonthi firstly proposed the direction in ethnobotanical study and research in Thailand and also in 2002 established the first programme at PhD level that included ethnobotany as a major element at Chiang Mai University. The programme was entitled *Biodiversity and Ethnobiology* (Trisonthi and Trisonthi, 2002). Later, many biology students of the university followed this field of research in many parts of the country, especially in the north.

2.9 Nan province

Nan is a province located in a remote valley of the Nan river in the upper eastern northern Thailand and the province covers 11,472 km² (Department of provincial administration, 2010). Most areas in Nan are high mountains from which lots of waterways originate and a number of national parks were established. Nan, therefore, is an important biodiversity hotspot in Thailand. The western boundary of Nan is adjacent to the Phrae, Phayao, and Chiang Rai provinces; the south of the province is adjacent to Phrae and Uttaradit provinces, while the north and east borders the Lao People's Democratic Republic. Nan is divided into 15 districts, 99 sub-

districts, and 886 villages. The population in Nan was over 470,000 people in 2010. Of those, 10.5 % belong to the hill tribes (Department of provincial administration, 2010).

2.10 Ethnic minorities in Nan province

As most of the province borders Lao PDR, a number of ethnic minorities have migrated from southern China and Laos and settled there in highland habitats since ancestral time. Those ethnic groups include;

2.10.1 Hmong

2.10.1.1 Origin and migrations

The Hmong (also known as Meo) form a sub-group of the Miao ethnic group and their name means ‘free man’ and they have been seeking their freedom and independence throughout their history (Fass, 1991; Lundh, 2007). Originally from southern China in the regions that are now the Sichuan, Guizhou, Guangxi and Yunnan provinces (Siriphon, 2006), they were migratory and self-sufficient farmers in highland habitats (Lee, 1986). In the latter half of the nineteenth century, forced by population pressure and political control exerted by the Han Chinese over centuries, the Hmong migrated south to other parts of Asia (Michaud, 1997; Perve, 2006; Siriphon, 2006; Lee, 2007). Apart from political conflicts, search for fertile farmland may have contributed to the Hmong migration (Michaud, 1997; Siriphon, 2006). Subsequent migrations of the Hmong in southeastern Asia have been attributed to the spread of communists’ regime in the Indochina peninsula.

During the Vietnam War and the Secret War in Laos, some of the Hmong allied with the United States Central Intelligence Agency (CIA) to fight against the North Vietnamese forces and the communist Pathet Lao. At the end of the Vietnam War, after the victory of the communist, their assistance to the CIA had severe consequences for the Hmong and their way of life. A number of Laotian Hmong were persecuted and those who were targeted by the communist conquerors fled to refugee camps in Thailand and some eventually immigrated to the United States and other western countries such as Canada, Australia, France and French Guyana (Lee, 1986; Johnson, 2002; Perve, 2006; Siriphon, 2006; Lee, 2007; Lundh, 2007). Nowadays, the

Hmong have a total population of 4–5 millions (Lemoine, 2005) with the largest groups living in southern China, northern Laos, Vietnam, Thailand and the United States.

The Hmong probably arrived in Thailand around 1880 (Michaud, 1997; Perve, 2006) where they settled in highland habitats in what is now the provinces of Nan, Chiang Rai, Phayao, Chiang Mai, Phrae, Tak, Mae Hong Son, Lampang, Pitsanulok, Phetchabun and Loei. Following the Karen, the Hmong form the second largest ethnic group and have spread over a larger area than any other tribes in Thailand. The most recent count in 2003 indicated that there were over 150,000 Hmong in Thailand at the time (Perve, 2006).

2.10.1.2 Language and subgroups

Hmong spoken language belongs to the Hmong-Mien language group of the Sino-Tibetan family (Ovensen, 2004 in Lundh, 2007). Originally, the Hmong did not have their own writing system. Nowadays, they have a writing system, invented by a group of French-American missionary-linguists in the early 1950s, using the Roman alphabets (Bliatout *et al.* 1988). Hmong populations are divided into two groups; the green Hmong (sometimes called the Blue Hmong) and the white Hmong. The two groups differ by their traditional costume (Figure 72A-D) and dialect but still they can understand each other. Hmong women traditionally make clothing for their families from cotton or hemp (Figure 83). Their clothing is richly decorated with magnificent embroidery and silver jewellery. Blue Hmong women wear beautiful pleated batik skirts with bands of red, blue and white intricately embroidered (Figure 72E-H). White Hmong do not practice batik, and therefore tend to wear less elaborate clothes, their skirts contain plain white bands of hemp on which they embroider (Eliot and Bickersteth, 2003).

2.10.1.3 Society

Hmong society is patrilineal. Their basic social units are the lineage and the clan, and names are passed down from father to son. Marriages are arranged between members of different clans. Each household is made up of an extended family.

Polygamy is accepted and practiced among the Hmong and is seen as a sign of wealth and prestige (Perve, 2006).

Respect for age and seniority is very important in the Hmong community. The oldest man in the family has supreme authority over its members and is responsible for their well being and family affairs (Eliot and Bickersteth, 2003; Perve, 2006). Gender roles are pronounced in the traditional Hmong family. Hmong women's roles and status are inferior and subordinate to men's (Symond, 2004). In every household, women are responsible for domestic works such as cleaning, feeding animals, cooking and taking care of children. The Hmong believe that "maleness is Hmong" and "men are more important" as the men make up the structure of their society on which everything else is built and even that if every Hmong women died or ran away, the patriline would continue because Hmong men would be able to marry women from other groups, and those women would then become Hmong and produce Hmong descendants for them (Symond, 2004). Also, Hmong men are considered to have power to make formal and final decisions in most areas of Hmong society. Hmong woman conform very well to this view and give less prestige to themselves than to the men (Symond, 2004; Lundh, 2007).

2.10.1.4 Religious beliefs

Hmong religion is a mixture of animism and shamanism. They are also spirit worshippers. They believe that spirits are present in all places and can touch every aspect of life (Perve, 2006). A spirit can be benevolent or mischievous, protecting or bringing harm to men, beasts and crops. They also strongly worship the ancestor's spirits and believe in reincarnation. In each house there are tutelary spirits that protect the family and its animals (*e.g.*, the spirit of central house post, hearth, door, bedroom, *etc.*). In a house, the spirit of the door is of particular importance as it guards the entry to the house and allows the dead to leave for the next life (Perve, 2006). Every household has an altar (Figure 71C), where protection of the household is sought, elaborate rituals and sacrifices are made. Each village has a number of shamans, both men and women, who are responsible to contact with the spirits using dramatic methods. The Hmong are faithful animists; so far there have been few Hmong converts to Christianity or Buddhism.

2.10.1.5 Village, houses and ways of life

Both the location of the village and houses within a village are chosen with great care, as it is important that the site must meet with the approval of the ancestors (Perve, 2006; Lundh, 2007). Like their ancestors, the Hmong descendants prefer to establish their villages away from other hill tribes at high altitudes, usually between 1000 m and 1500 m elevation (Figure 70), where the weather is cool and good for practicing agriculture (Anderson, 1993; Perve, 2006). In the past, the Hmong used to move their villages at regular intervals to find new farmland for practicing swidden agriculture and growing opium (Eliot and Bickersteth, 2003). For a long time the Hmong have supported themselves by the cultivation of opium. Now, as the result of the complete prohibition of opium growing in Thailand, the Hmong in Thailand practice shifting ‘slash and burn’ cultivation with upland rice and sweet corn (Michaud, 1997; Perve, 2006; Siriphon, 2006). They also raise black pigs and poultry for food and scarified animal in ritual ceremonies. Some of the Hmong have turned to market their exquisite needlework in order to supplement their income.

The traditional Hmong houses have a rectangular shape and are always built directly onto the ground and there is no fence around the house. The walls are made of the planks of wood or bamboo, without windows, and the roofs are tiled or thatched with *Imperata cylindrica* (Figure 71A-B). The space inside a house has a main living area and the rest is partitioned into bedrooms, usually used as bedrooms for couples. The spirit altar is installed high on the wall facing the front door (Figure 71C).

2.10.2 Mien (Yao)

2.10.2.1 Origin and migrations

The Mien (sometimes called “Yao”), an ethnic group with a population of over seven million (Long and Li, 2004). In Mien mythology, they believe that they came from ‘across the sea’ during the 14th century (Eliot and Bickersteth, 2003), though it is generally accepted that the roots of their ancestor may have been in southwestern China in what are now the Yunnan, Guangxi and Guangdong provinces (Jonsson, 2001; Perve, 2006). Their southwards migration began in the mid-nineteenth century as result of the invasion and the political pressure exerted on them

by the Chinese government together with the expansion of the opium trade. Subsequent migrations of some Mien populations in southeastern Asia was attributed to the same reason causing the Hmong's migration to the U.S. as consequence of their alliance to the American CIA to fight against the communist regime in the Indochina peninsula during the Secret war. When Laos fell to the Communists in 1975 a number of Mien became refugees. Therefore, in addition to the main concentration of Mien in southern China and Southeast Asia, the Mien are also scattered in western countries such as France and the United States (Long and Li 2004).

It is believed that the Mien entered Thailand from Laos at the beginning of the 20th century and settled in the highlands, in what are now the provinces of Nan, Chiang Rai, Chiang Mai, Phayao, Lampang, Phitsanulok and Kamphaeng Pet. The Mien population in Thailand was 45,571 in 2003 (Perve, 2006).

2.10.2.2 Language and subgroups

The Mien language is related to the Hmong as it belongs to Hmong-Mien language group of the Sino-Tibetan family. The Mien in Thailand are remarkably homogeneous in style of dressing, dialect and traditions (Figure 74-75). The Mien do not have their own writing, but hand down the liturgical language of their religion from their origin using Chinese characters (Figure 75C), and this makes them unique among all the hill-tribes (Eliot and Bickersteth, 2003).

2.10.2.3 Society

Like the Hmong, the basic social unit of the Mien is the extended family, which can be more than twenty people living together, and the patrilineal clan. In Mien families men have special status and respect for age and seniority is very important in the Mien community. Elderly have privileged knowledge about many things in life including rituals, thus, young Mien pay particular respect to them. Marriage of the Mien is usually monogamous (Perve, 2006). In a family, the women are subordinate to their husbands and bound to household duties such as cooking, washing and cleaning to which the men contribute every little. Owing to the need for working labor in the fields, adoption of non-Mien children is therefore a general practice among the Mien (Chanan, 1987).

2.10.2.4 Religious beliefs

Mien religion is influenced by two major systems; animism and Taoism. On the one hand, they follow Taoism as it was practiced in China in the 13th and 14th centuries. On the other hand, they strongly believe in ancestral spirits of their own lineage (Eliot and Bickersteth, 2003; Perve, 2006). In addition to ancestor's spirit, they worship the spirits of the natural world (*e.g.*, the spirit of the stream, fields, Earth, *etc.*). They believe that the various events that affect their lives are attributed to the spirits. For example, prosperity and good luck are thought to come to those who make offering to their ancestors whereas sickness, tragedies or poor harvests are caused by the influence of discontented spirits (Perve, 2006). In every house, there is the spirit's altar which is built to be easily seen from the main door signifying that the spirits, which are believed to pass through the main door, are welcome and do not have a hard time reaching their altar (Figure 73G). Usually, the list of names of their deceased ancestors is placed on the altar (Figure 73F). For rituals, there is the spirit's priest whose task is being the mediator to contact with the spirit (Figure 75A-B). The Mien has their own sacred Taoism-written scripture as a guide for rituals and ceremonies (Figure 75C). Literacy in Chinese therefore seems to be the qualification of their spirit's priest since he must be able to know how to chant the sacred scripts that are all written in Chinese. Nowadays, in Thailand, it would seem a challenge for the spirit's priests to find his successor since the new generation Mien has a very slim chance to learn Chinese. As the Taoist rituals are expensive, the Mien appear to spend a great deal of their lives struggling to save enough money to afford the various ceremonies, such as wedding, merit-making and death ceremonies (Eliot and Bickersteth, 2003).

2.10.2.5 Village, houses and ways of life

Mien villages are often located on slopes at altitudes over 1,000 m and the site must not be a village belonging to another hill tribe higher up the same mountain (Anderson, 1993; Perve, 2006). Mien farmers practice slash-and-burn agriculture. In the past some Mien grew opium. In the same way as the Hmong, the Mien traveled to search for fertile farmland so as to increase the productivity (Perve, 2006). The traditional Mien house is also built directly on the ground and the walls are made of

bamboo or wooden planks, the roof is tiled or sometimes thatched with *Imperata cylindrica* or leaves of *Livistona speciosa* (Figure 73C-D). The house needs to be orientated appropriately, so that the spirits are not disturbed. Usually, Mien houses are large so that they can accommodate an extended family of sometimes 20 or more members living together. The house has one large living area and four or more bedrooms (Figure 73E). In the centre of the house, opposite to the main door, the spirit altar is installed (Figure 73F-G).

The economy of the Mien is based on shifting cultivation with upland rice, sweet corn and various cash crops. A little garden can be seen in their cultivated fields to supply their daily needs. They also raise black pigs and poultry for food and for providing animals to be sacrificed in ritual ceremonies (Perve, 2006). This helps them avoid having to purchase costly sacrificed animals and to have them ready anytime that rituals and ceremonies are performed. Mien women are usually the gatherer of NTFPs such as edible plants, wild fruits, root crops and mushrooms whereas men are hunters who provide wild meat. When eating the Mien use chopsticks like the Chinese, which also reflects their Chinese origin.

2.10.3 Khamu

2.10.3.1 Origin and migrations

The Khamu (also as Khmu/Kammu) are the small ethnic group subdivided from the greater Khmuic people who are aboriginals to Laos and surrounding areas. In addition to “Khamu” — which means ‘human being’ — there are other terms that refer to the Khamu, for example in Laos and Vietnam they are called *Kha* and *Tmooy* respectively (Chanan, 1987; Leitner, 2007). According to the mythology well known among several group of Tai in the Thai-Yunnan periphery, the Kha was the first-born man together with the other four races. While the couple of the remaining four races took their first bath in the sacred stream to clean their bodies and clear their minds, the Kha couple (which were believed to be ancestors of the Khamu) were afraid of the cold water so they did not bath and all the Kha have remained black until now...therefore they owned no country (Satyawadhna, 1990). It has been accepted by historians that the Khamu are the earliest inhabitants in the area which is now northern Laos of mainland Southeast Asia prior to the south-westward migrations of

Tai-speaking peoples who took over the land (Satyawadhna, 1990; Leitner, 2007). Their origin is believed to be in the regions that are now Luang Prabang and Xieng Khoung districts in northern Laos (Eliot and Bickersteth, 2003). However, there is another hypothesis concerning their origin, which says that they are Austro-Asiatic people who moved northward from the area of Indonesia in prehistoric times. Several groups of Khamu were studied by scholars from many disciplines (Satyawadhna, 1990).

Like the Hmong and Mien, during the Secret war in Laos, a small number of Khamu supported the Royal Lao Government and the American CIA (Leitner, 2007). As a consequence, after the communists came to power in 1975, many Khamu fled as refugees and finally settled in western countries, mostly in the United States. A census in 2010 estimated that there are more than 800,000 Khamu around the world; they are mainly concentrated in northern Laos where 700,000 Khamu were reported and they form the second largest ethnic group to the Lao population (Eliot and Bickersteth, 2003). The rest of them live in scattered villages in mountainous areas in northern Vietnam (approximately 50,000 people), northern Thailand (15,000), southern China (7,000), and in western countries including France (1,500) and USA (8,000). In Thailand, it is estimated that they first migrated as labor and worked either in the teak forest or similarly isolated employment (Eliot and Bickersteth, 2003). Presently they live along the Thai-Laos borders in the northern provinces of Nan, Chiang Rai, and Lampang and as far as Kanchanburi in the west of the country (Suwilai, 1998; Eliot and Bickersteth, 2003).

2.10.3.2 Language and subgroups

Their language belongs to the Khmuic language group, which is a branch of the Mon-Khmer of the Austro-Asiatic language family (Lewis, 2009; Diffloth and Zide, 1992). The Khamu language is so diverse that in some regions every village has its own dialect (Leitner, 2007). Based on the variations in their language dialect and customs, the Khamu can be sub-divided into subgroups (Leitner, 2007). They use the word *tmôoy*, which can be translated as ‘guest’ or ‘visitor’, for those who are clearly Khamu but are not personally known to the speakers in order to recognize diversity of their subgroups (Leitner, 2007; Suwilai, 1998). *Tmôoy* is in this way the generic term

for a sub-grouping of the Khamu used in combination with the name of a specific subgroup (Leitner, 2007). The Khamu did not have writing system for their own language, at least not until Christian missionaries began working among them (Brown and Ganguly, 2003). However, the differences of their dialects have obstructed the creation of one system which represents all the dialects equally well.

2.10.3.3 Society

The basic social unit of the Khamu is the monogamous couple and it is both patrilineal and patrilocal (Eliot and Bickersteth, 2003; Suwilai, 1998). It appears that in Khamu society, men have high status and significant role (Suwilai, 1998). In Khamu villages, the elders are considered the most important people and responsible for resolving all village disputes (Tayanin, 1994). In each family, the oldest man will be treated with great respect and so does the father-in-law. In a village, regardless of the size, there is a priest (the *Ikuun* in Khamu language) who inherited the priesthood from generation to generation in family lineage. One of the most important tasks of the *Ikuun* is to hold the village ceremony. They believe that the *Ikuun* has a special relation to the spirits of village and the spirits would not accept and take part at the sacrifices to them if somebody else should try to make that instead of the priest (Tayanin, 1994). The village's leaders include the shaman who is knowledgeable in spirit ritual, the medicine man that is knowledgeable in herbal medicine, the priest and the village headman who is elected by the villagers as a response to the modern time government (Wildflowers Institute, 1999).

2.10.3.4 Religious beliefs

Like many of the other ethnic groups in northern Thailand, the Khamu are animists. The main features of the Khamu animism are beliefs in spirits of the living and dead. They also strongly believe that their house, village, and its surroundings are linked to the tutelary spirits; for this reason they consider houses and villages as holy or ritualized spaces (Wildflowers Institute, 1999). Traditional Khamu animistic practices places emphasis on the reverence around the spirit called *Hrooy*. Among those, the one called *Hrooygaan*, which is the house spirit that protect the family and believed to dwell at the hearth in a house, and *Hrooyhoo*, which is one of the most

powerful of the jungle spirits, are of particular importance (Leitner, 2007; Suwilai, 1998). In addition to these spirit, they also believe there are hundreds of different spirits in the jungle such as spirit of mountain, rock, water, sun and one particularly identified with shamans (Lebar, 1964 in Leitner, 2007) many of which can be harmful but some of which are helpful. To plead to the spirits, they install the spirit altar in each household and build the spirit gates on the approach to the village and offer them food and sacrifice chickens (Eliot and Bickersteth, 2003). They also put emphasis on the concept of taboos because they strongly believe that the violation of taboo can result in the vengeance of the spirits. The taboos include many forbidden activities such as touching the altar or the amulets representing the house's spirit, birth ceremonies for children born feet-first, and entering a house without permission. Whenever there is an important ceremony, the village will be sealed off and the entrance or the exit from the village becomes taboo for varying periods of time (Lebar, 1964 in Leitner, 2007). They will put a special sign made of strips of bamboo on the approach to the village referring to the taboo and preventing evil spirits from coming around the village (Suwilai, 1998). The animism also influences their cultural perception of illness, as result of living far from health centers and access to modern medicine, the Khamu often attribute illness to evil spirits and call on a shaman to exorcise them and bring back the soul of the patient.

In the past, the Khamu were renowned for their uses of magic and control of the spirits and therefore they were considered the most powerful magic practitioners. There were the old records that the Khamu played a significant role in conducting the spirit rituals in the court of Luang Phrabang and in Buddhist ceremonies involving the spirits as well as in the ancient Kingdom of Nan in Thailand (Chanan, 1987; Leitner, 2007). Nowadays, some of the Khamu villages have adopted Buddhism and incorporated it into their traditional animistic beliefs whereas some, particularly those who migrated to western countries have become Christians (Eliot and Bickersteth, 2003; Leitner, 2007).

2.10.3.5 Village, houses and ways of life

The Khamu villages are traditionally located on a hilltop or halfway up the mountain (Figure 76A-B). The main criteria for choosing location of a village are that

the area must be near a river and that there are large areas for growing sticky rice (Suwilai, 1998). Also the land must be satisfactory to the spirits of the village, and in the past they used to organize an animistic ceremony to ensure this. The Khamu village is usually surrounded by a belt of jungle that separates it from cultivated fields and serves to protect the village from storms and from fire when the fields are burned off. Because they practice rotation cultivation, the Khamu do not move their villages much but there are still some events that may lead to the move; for example, if there is a village crisis that is attributed to the action of spirits who live in the area or when their fields are depleted (Leitner, 2007). Khamu houses are built close together in the village and usually built on piles. The floors and walls are usually made of bamboo matting or wood planks and the roof can be thatched or covered with wooden tiles (Figure 76C). The space underneath the house is used for firewood storage or for raising pigs and poultry (Tayanin, 1994; Suwilai, 1998; Leitner, 2007).

The Khamu practice subsistence agriculture as the main source of food. They grow a variety of glutinous rice as the staple food. To the Khamu, “rice is considered not just to feed the stomach of the people or animals, but also to feed the invisible soul” (Leitner, 2007). Also, to them, rice insufficiency is seen as poverty because “eating rice is **everything**, if there is not enough rice one doesn’t have enough of **anything**, to eat rice therefore means to be alive whereas to not eat rice means death” (Simana and Preisig, 1997 in Leitner, 2007).

Besides the rice, other kinds of crops include corn, bananas, sugar cane, gourds, pumpkins, chilies and a wide variety of vegetables that are grown in their fields. Living close to the forest, hunting, fishing, trapping and gathering of NTFPs are easy supplements to their food (Chanan, 1987; Eliot and Bickersteth, 2003). The Khamu are very active NTFPs gatherers and they have earned cash income from selling NTFPs for a long time (Chanan, 1987; Satoshi, 2004). Some Khamu raise domestic animals such as pigs and cattle but these animals are used for sacrifices to please the spirits in ceremonial occasions rather than for their food.

In Khamu society, they live mutually. In case there is work to do, during the harvest season for example, they give mutual help to each other without asking for payment (Tayanin, 1994; Leitner, 2007). Because of the decreasing jungle areas together with the falling of agricultural productivity, lately, the young Khamu men

often leave their village and engage in non-farm occupations, such as construction work, to get money for a bride price and turn back to village to help their parents in the field during growing season (Eliot and Bickersteth, 2003).

2.10.4 Lua

2.10.4.1 Origin and migration

The Lua is a sub-group of the Lawa people. They mostly live on the mountains along the Thai-Laos border, particular in the Nan province. A census in 1987 indicated that there were 28,516 Lua people who lived in 146 villages in Nan province, representing 51.7% of the highlanders which makes them the largest hill-tribe in the Nan province (Satyawadhana, 1987; 2003). Unlike the Hmong, Mien, Lisu, and Lahu ethnic groups who migrated from China, it is believed that the Lua are native inhabitants and originate in the areas of Thai-Laos border where they live now (Phattiya and Suriya, 1998). Some minor migrations around these areas have been attributed to epidemics and warfare (Suwilai, 1988). Some anthropologists (*e.g.*, Srisavasdi, 1963; Dessiant, 1981) believe that the Lua in Thailand had migrated from Laos. There are many speculations about the timing of their first arrival in Nan province in northern Thailand. Srisavasdi (1963) believe that the Lua arrived in Thailand in 1826 and they are the earliest inhabitants in the area prior to the move of other groups into the area whereas Dessaint (1981) speculated that their move to and from the Thai-Laos border happened regularly and they had first entered Thailand in 1876. Likewise, Phubeth (1985 in Phattiya and Suriya, 1998) thought that the migration of the Lua from Laos to Nan province was to escape from political pressure on them in Laos in 1876 and that they escaped from communist suppression in 1974–1975.

However, in the same area where the Lua live, there is a population that calls themselves *H'tin* whose language is quite different from the Lua's but sometimes mutually comprehensible. Also, their religious beliefs and social structure is similar to those of the Lua. The Anthropologist therefore believe that both groups are anthropologically identical and the word *H'tin* is applied as official ethnonym for both subgroups by the government, means 'local' people (Phattiya and Suriya, 1998;

Suwilai, 1988). However, to them, the word *H'tin* appears to sound pejorative and they prefer being called *Lua* (Phattiya and Suriya, 1998)

Likewise, there have been contradictions about the identity of the Lua in Nan province as there have been misapprehension that they are identical to another subgroup of the Lawa or *Laveue* people in Chiang Mai and Mae Hong Son province who also being called *Lua* and share a common cultural heritage and whose language belong to the same family with those of the Lua in Nan (Satyawadhana, 1987; Phattiya and Suriya, 1998). However, Fillbeck (1978) classified these two groups as different groups as each have their own unique language that is not mutually comprehensible. Food culture is also used in the classification, the Lua of Nan eat sticky rice whereas the Lua of Mae Hong Son and Chiang Mai eat the non-sticky variety of the same species (Satyawadhna, 1990). The recent comparative molecular study, using mitochondrial DNA and Y-chromosomal microsatellites as markers, significantly revealed that the genetic structure of the Lua in Nan was genetically related to those of the H'tin and differed from those of the ancient Lua in Mae Hong Son and Chiang Mai. It was therefore concluded on that the Lua of Nan and the ancient Lua living in Mae Hong Son and Chiang Mai are not the same ethnic group (Kutanan and Kangwanpong, 2010). Like the Hmong and Mien, apart from inhabiting northern Laos and Thailand in Nan province, they also live in the US, as consequence of the civil war in Laos during 1970s and 1980s (Lewis and Tayanin, 1992). A recent census in 2003 indicated that there were more than 48,000 H'tin people in Thailand (Perve, 2006).

2.10.4.2 Language and subgroups

Like the Khamu, Lua languages belong to the Khmuic language group, which is a branch of the Mon-Khmer of the Austro-Asiatic language family (Lewis, 2009; Diffloth and Zide, 1992). Based on the language dialect, H'tin people can be divided into two subgroups (Fillbeck, 1978); the Mal and Phrai. The Mal speaks *Mal* and the Phrai speaks *Phrai* (Lewis, 2009). As the Lua are identical and sub-grouped to the H'tin. The ethnonym *Lua* is therefore used as prefix ethnonym combined with the two specific sub-groups; *Lua Mal* or *Lua Phrai* (Phattiya and Suriya, 1998).

2.10.4.3 Society

The Lua is the monogamous social group. It appears in Lua society that women have high status and significant roles. The dominant system in Lua society is therefore considered matrilineal and matricentric (Satyawadhna, 1990). Mostly, their basic social unit is the single family but sometimes extended family; which consists of a family of couple and wife's parents, can be found due to Lua marriage tradition as a man has to move to live with a woman's family (Phattiya and Suriya, 1998).

The matrilineal structure is one criterion used for distinguishing the Lua of Nan from the Lua of Mae Hong Son and Chiang Mai whose structure is patrilineal and patricentric. As Satyawadhana (1987) assumed in her previous book that the Lua of Nan and those of Mae Hong Son and Chiang Mai could be the same ethnic group but subsequently described in her later work (Satyawadhna, 1990) about the *Laveue* which referred to the Lua of Mae Hong Son and Chiang Mai that "...in their patrilineal structure and patricentricity, the Laveue of northern Thailand are very different from the Lua of Nan, though they share a common cultural heritage in almost every other respect..."

According to Satyawadhana (2003) when there was the communist insurrection in Thailand in the early 1960s, some Lua people who formerly resided in the 'red areas' and allied with the communist had given up their matrilineal spirit cults. However, these practices are still found among some other Lua who live in 'pink areas'.

Most ethnographic studies of the Lua of Nan before 1986 (e.g., Filbeck 1971; Dessaint, 1981) stated that the Lua had neither clan nor lineages. However, from intensive study among the Lua, Satyawadhna (1990) put the objection to those scholars and confirmed that the Lua do have clans and lineages and that it had been shown in form of the privilege among certain groups of particular rank in the Lua hierarchy. Such privileges are handed down from generation to generation. It may be seen either in the way of the right over resources; *i.e.*, water resource, or in the way of the right for choosing lands for cultivation. These ancestral rights over resources or lands usually belonged to major clan whose senior member had rank or were persons of authority in a village or among a number of inter-related village, *i.e.*, the chieftain and ritual leader. Nowadays, this operation of clan and lineage can still be observed in

their society as it happens that the clan of the chieftain that is usually the biggest clan of the village has the prior right to choose land for their swidden (Satyawadhna, 1990; 2003).

The privileged member of the Lua community may be ranked as follows (Satyawadhna, 1990):

1. The big clan, usually an extended family, that owned more than one rice-field and more than ten gourds. The clan had privileges of fish and water resources, but they had to work on the fields of the chieftain under a corvée system;
2. The ritual leader's clan which had privileges over fish and water resources;
3. The super clan, usually the clan of the chieftain, which had the most privileges of choice of land, fish, and water resources, including labor corvée from all adult members of every clan living in the community.

2.10.4.4 Religious beliefs

Like many other ethnic groups, the Lua of Nan are animists; they worship spirits (Figure 79A-B), the term for *spirit* of the Phrai and Mal are *Prong* and *Soi/Pyong*, respectively. Four spirits that are important to the subsistence of the Lua are (Phattiya and Suriya, 1998):

1. Spirit of the house

In each household, every member worships the house-spirits, which was also the spirit of the family's ancestors. To the Lua, the 'spirit of the house' is the most important and protective, the strong spirit that can protect the members of the household from the actions of other spirits. However, it is also the spirit that is responsible for the various events that affect their lives, such as sickness, if anyone breaks the taboo of the family lineage. It is therefore that the Lua seldom invite outsiders or strangers to their house because they are afraid those people may do something inappropriately and lead to the dissatisfaction of the spirits (Tangtragoon, 1998).

2. Spirit of the village

In each village, there is an original house *Hüan kaw*, where the spirit of the village is believed to dwell. The spirit of the village is the spirit of the house of *Hüan kaw* and has the same name as the clan name of all members who actually live in *Hüan kaw*. There has been ambiguity about the gender of the spirit of the village. However, membership of the spirit of the village descends through the female line, that is, from (supposedly) the first generation to her daughter of the second generation, then to her daughter in the third, and similarly to the fourth generation and her eldest daughter in the fifth. Once a man marries a woman, he has to move to live with the side of his wife and from then on belongs to his wife's spirit line and his membership to his own spirit line was lost as soon as he was married (Satyawadhna, 1990). Annually, there has been the offering made to plead the spirit of village so that all members of the village can live happily and peacefully (Tangtragoon, 1998).

3. Spirit of cultivated fields

It is believed that each cultivated field has a landlord spirit that take care of the field and its plants and the falling or increasing of agricultural productivity are attributed to this spirit. Also, the dissatisfaction of this spirit can attribute to sickness. As such, during the growing season, it is very important to farmers to bring sacrifices to the spirit (Tangtragoon, 1998).

4. Spirit of landlord

This spirit of the land is the spirit who dwells in the land where a village is located prior to the time it was established. At the initial time after a village was established, the villagers offer the spirit house to the spirit as new dwelling. Like other spirits, offering must be made annually to plead the spirit and ask them for protection of the village (Tangtragoon, 1998).

Nowadays, some Lua villages have adopted Buddhism but, simultaneously, most of the Lua still hold their animistic practices (Phattiya and Suriya, 1998).

Religious conversion mostly takes place among those who move to the lowland and come into contact with lowland Tai settlements (Eliot and Bickersteth, 2003)

2.10.4.5 Village, houses and ways of life

The Lua prefer to establish their village on sloping mountain ridge between the elevations of 600 m and 1,000 m above sea level (Suwilai, 1988; Figure 78A-B). As the life of Lua is closely attached to water resources (Satyawadhna, 1990), most Lua villages are located not far from the rivers (Phattiya and Suriya, 1998; Suwilai, 1988). A village usually consists of many clumps of households of different clans (Phattiya and Suriya, 1998). It can often be found that, in some villages, the majority of the people belong to the same clan with only a few people coming from a different clan or from a different village because they moved to the village due to marriage. Like the Khamu, Lua villages are usually permanent. One of the reasons that may lead to their move could be the depletion of their farming lands, epidemics, or the interference of the communists (Tangtragoon, 1998).

Traditional Lua houses are usually built on stilts above the ground. The floors and walls are made of bamboo, split in half, and the roofs are covered with thatch made of the leaves of *Imperata cylindrica* or *Livistona speciosa* (Figure 78C-D). Either of four sides of the house is usually roofed to the ground and the space under the roof is used for storage of fuel woods or installation of the traditional rice mortar (Figure 78F). Also, the underneath space of the house is usually modified into the stables for raising poultry, cattle or pigs (Chanan, 1987; Phattiya and Suriya, 1998).

Traditionally, the Lua are subsistence agriculturalists. They practice slash and burn farming, they grow and eat sticky upland rice as staple food together with some crops such as beans, sesame and large variety of other vegetables. Most households also own a tea garden. In addition to the subsistence agriculture, gathering of NTFPs such as rattan, bamboo shoots, bamboo worms, mushrooms, and broom grass are supplementary sources of food and cash income for the Lua. Because of the subsistence agriculture system, like the Khamu, rice is considered the most important food to the Lua. Therefore, there are rice-associated ceremonies held annually. As for the Mal-subgroup, they hold the ceremony called *Sa-Lode* (Figure 79C-F) that is usually held around September–October after rice was grown in order to sacrifice to

the spirit of rice fields and plead for the high rice yield and protection from insects and pathogens. The Phrai-subgroup hold the ceremony called *Kin Dok Dang* (Phattiya and Suriya, 1998) to show respect and thank spirits for looking after the rice fields. The timing of performing this ceremony is very strict and it has been the rule that the ceremony can be performed only when all rice yielded from a growing season were relocated to the household's barn as they believe that performing the ceremony while some rice yields is still left in the field may lead to rice insufficiency in their household (Tangtragoon, 1998).

2.11 Ethnobotanical studies in Nan province

During the two last decades, several ethnobotanical studies have been conducted in Nan province. Tovanonte (1998) studied ethnobotany of the Tai Lue, the Hmong and the Yao in three villages and documented a total of 273 plant species in 221 genera and 98 families used by these ethnic groups as food, medicines, crop plants and miscellaneous uses. Of those plants, an endemic species — *Maesa glomerata* — was recorded. Tangtragoon (1998) studied ethnobotany of the Khamu, Lua and H'tin in three villages and documented 232 plant species belonging to 199 genera, 85 families used in five categories: medicinal plants, edible plants, housing plants, economic plants and plants of miscellaneous uses. Yaso (2000) studied ethnobotany of the Lua and H'tin in Bo Kleua district and registered 255 plant species, of which some were used in similar ways among the two groups. Pantarod (2002) studied ethnobotany of medicinal plants used by Lua people in Na Kwang village in Bo Kleua district. As results, uses of 216 medicinal plants were recorded for eight use categories. Of those, compared to medicinal plants documented in Thai medicinal books, 35 plant species were used similarly, 88 species were recorded but used differently, and 93 species have never been recorded in Thai literature before. In the research project on gathering of highland traditional biodiversity-and ethnobiology-based knowledge, Trisonthi *et al.* (2007a) found that more than 200 species of plants were used by the Hmong, Mien, and “Khon muang”. Trisonthi *et al.* (2007b) studied plant diversity and ethnobotany of the H'tin and Lua in Doi Phuka National Park and documented 174 plant species used for satisfying their basic needs.

Of those plants, the important crops were upland rice and mixed crops in the land rotational of 5–7 years system. In another ethnobotanical study of the Lua and H'tin, 391 plant species were used traditionally for their subsistence, most of which are native species (Trisonthi and Trisonthi, 2011). Supawimolpan (2011) studied ethnobotany of the Khamu and reported 64 plant species used for food, herbal medicine, ritual ceremonies and miscellaneous uses. Of those, the use of some plants such as *Pedaeria linearis* and *Homonoia riparia* reflected the ethnobotanical intellectual and identity of plant uses of the Khamu. Most of these studies focused on qualitative ethnobotany of which the documentation of vernacular names and traditional uses of plants are the center of attention. The study of Inta (2008) was the beginning point of quantitative and comparative ethnobotany in Nan province. In her study, the ethnobotany of the Tai Lue in Nan was quantitatively studied and compared to ethnobotanical data extracted from the Tai Lue in Chiang Rai province and Yunnan province, southern China.

The current study presents the quantitative and comparative ethnobotany of the four ethnic groups in Nan province, apart from the Tai Lue, which are the Hmong, Mien (Yao), Khamu, and Lua.

2.12 Homegardens

2.12.1 What is homegarden

Homegardens are small gardens adjacent to people's residence (Vogl and Vogl-Lukasser, 2003; Vogl *et al.*, 2004) that function as multi-story, multi-use, small scale, land-use system for satisfying immediate needs of household members (Bennett-Lartey *et al.*, 2002). Within homegardens, combinations of plants provide critical complements to food, medicines and many other human needs including plants used for aesthetic purposes, as witnessed by the variety of ornamental plants (Rico-Gray *et al.*, 1990; Caballero, 1992; Agelet *et al.*, 2000; Eichemberg *et al.*, 2009).

2.12.2 Importance of homegardens

In addition to being sites for growing subsistence crops and generating secondary sources of income (Caballero, 1992; Méndez *et al.*, 2001; Kumar and Nair,

2004), homegardens have also been important sites used for the experimentation with and domestication of useful plants — especially medicinal and food plants — from the wild, and this is an important contribution to the conservation of rare, endangered, or overexploited species (Gautam *et al.*, 2009; Huber *et al.*, 2010). Homegardens are, therefore, repositories for a large diversity of crop plants and their genetic resources.

Furthermore, homegardens also reflect the cultural history of ethnic groups because they involve management of many useful plant species over prolonged periods of time. Plants grown in homegardens can, therefore, be seen as cultural markers (Blanckaert *et al.*, 2004).

2.12.3 Factors that affect diversity and floristic composition in homegardens

The diversity and floristic composition in homegardens are influenced by a variety of factors such as geographic location, cultural background and socioeconomic conditions (Kumar and Nair, 2004; Wiersum, 2006; Eichemberg *et al.*, 2009; Huai and Hamilton, 2009; Galluzzi *et al.*, 2010;), influence of modernization and economic development (Rico-Gray *et al.*, 1990; Vogl *et al.*, 2000), gender of homegarden owners (Reyes-García *et al.*, 2010), distance to urban market and the availability of local market, as well as the influence of tourism (Lamont *et al.*, 1999).

In Java (Indonesia), for instance, homegardens are smaller and their diversity of plants is lower as altitude increases, and, at lower altitude, coconut (*Cocos nucifera* L.) and fruit trees are prominent whereas vegetables are prominent at higher altitudes (Soemarwoto and Conway, 1991).

In Nepal, tropical species such as mango (*Mangifera indica* L.), papaya (*Carica papaya* L.) and coconut are common in lowland homegardens while sub-tropical to temperate species, such as peach (*Prunus persica* (L.) Batsch) and chayote (*Sechium edule* (Jacq.) Schwartz) are common in highland homegardens. Also, in homegardens in market-accessible regions, seasonal commercial vegetables such as cauliflower (*Brassica oleracea* L. var. *botrytis* L.), cabbage (*Brassica oleracea* L. var. *capitata* L.), radish (*Raphanus sativus* L.) and bean (*Phaseolus* spp.) are more common while in traditional homegardens, perennial vegetables dominate. Besides, ethnicity and food culture are also reflected in the choice of plant species in Nepali homegardens (Shrestha *et al.*, 2002).

In northeastern Peru, high plant diversity is found in homegardens of wealthy families that have larger landholdings (Coomes and Ban, 2004) and there was lower diversity of fruit tree species and increased numbers of craft species in villages with tourist activities (Lamont *et al.*, 1999).

In Yucatecan Maya communities (Mexico), the uniqueness of each homegarden depends on the cultural background and history of the owner and homegardens in villages located in the outskirts of cities have more ornamental species and commercial fruit plants than those in isolated village as a response to the modernization process and economic development (Rico-Gray *et al.*, 1990).

However, spatial and temporal variation in floristic composition in homegardens is not determined by one factor alone, but rather by a complex combination of agro-ecological, socio-economic, cultural and political factors (Kehlenbeck, 2007).

Home garden system is an interaction between ecology and culture. The existence of plants and other elements in homegarden is influenced by humans, especially the owner of the land as the manager (Gómez-Pompa, 1996). Therefore, homegardens become an important study object for ethnobotanist (Vikova *et al.*, 2011).