SUSTAINABLE USES OF SOME MINOR FOREST PRODUCTS AT BAN THUNG SOONG COMMUNITY FOREST AND HOMESTEAD IN KRABI PROVINCE, THAILAND

INTRODUCTION

Minor Forest Products (MFPs), as defined in Thailand, refer to all forest products other than timber, charcoal and fuelwood. MFPs are essential to the livelihood and well-being of Thai rural communities. In the past, MFPs received only modest attention from the Royal Forest Department (RFD), and the quantity and diversity has decreased for four reasons: adverse impact of deforestation and environmental degradation, over-exploitation, use of traditional, unimproved methods in harvesting and lack of information and inadequate training. Now, the direct and indirect values of MFPs are more clearly recognized and receiving interest from the government of Thailand (Subansenee, 1994). In this study, the term of MFPs is used, however the definition is the similar as Non-Wood Forest Products (NWFPs) and Non-Timber Forest Products (NTFPs) that are used in different researches. Therefore, forest products other than wood have been classified as "Minor Forest Products".

The selection of Ban Thung Soong (BTS) as the study area was because BTS had good management of community forest and people were willing to conserve the sustainable resources of MFPs. BTS Community Forest is one of the good examples of community forest management in the Southern provinces of Thailand. People in BTS not only conserve their community forest but also sustain forest resources without destroying or disturbing the natural resources and at the same time plant MFPs around their homesteads. This study of MFPs was as indicators to determine the sustainable uses of forest products and resources in the natural habitat and homesteads and indicate which species of MFPs were important and under threat. Through Important Value Index study, the importance of plant species indicates the dominant species that exist in the forest. Some MFPs were chosen based on the species composition in BTS Community Forest and also including bamboo species in the homestead area. According to FAO (2002), bamboo is the most common MFPs in Asia. It supplies the necessities of life for a great part of the world's population. In Thailand, bamboo is one of the most socio-economically important plant species. The bamboo is used for many purposes, such as food, household construction, supporting poles, basketry and other handicraft making, fire wood and pulping (Ramyarangsi, 1985). It is well recognized that bamboos are multipurpose products that have served mankind for many generations. In Ban Thung Soong village, bamboo is also the main MFPs. People plant and harvest bamboos to get the shoots and culms for household consumption or sell the products in the local markets. People in BTS also planted bamboos in their oil palm, rubber and fruit tree plantations. There are six species of bamboo found in BTS: *Bambusa bambos* (L.) Voss, *Bambusa blumeana* Schult.f., *Dendrocalamus asper* (Roem. & Schult.), *Melocanna humilis* Kurz, *Cephalostachyum pergracile* Munro and *Bambusa tulda* Roxb.

The importances of MFPs are not only to accommodate rural peoples' daily livelihood, socio-economic, cultural and traditional needs but also for the forest conservation management. According to Mohamed *et al.*, 2004, MFPs have attracted considerable global interest in recent years because of increasing recognition of their contribution to household economies and food securities, to some national economies and to environmental objectives such as the conservation of biological diversity. About 80% of the populations of developing countries depended on MFPs for their primary health and nutritional needs (FAO, 1995). Many communities also acquire income from collecting, processing and marketing MFPs. Estimates of the number of people who depend on MFPs for at least part of their income range from 200 million world-wide to one million in Asia and the Pacific regions. Many of these activities are on a small scale and are not registered (Mittelman *et al.,* 1997). According to the Forest Management Division, there are about 9,500 villages with 862,500 families and 4.85 million residents living in the forest reserve areas in Thailand. People depend on forest resources to accommodate their socio-economy, and livelihood, and these requirements rapidly increase with advancement of technologies and intellectual capabilities. Recently, the significant environmental and economic roles of MFPs became main focuses for development. MFPs like bamboos, rattans, food products, animal food products, gum resins and latex are most important among people (Dennis, 1995).

The important and sustainable uses of natural resources can improve the development of forest resources management. To improve management of sustainable uses of MFPs, more knowledge is needed, especially about the MFPs resource and to understand the relationship between forest as a source and people as consumers. Sustainable development of MFPs uses through livelihood and socio-economic aspects to community management should be incorporated into the community forest management plans. Through this study, the importance of MFPs in the natural habitat and homestead will help to improve rural peoples' awareness to sustain the uses of MFPs. The effort to conserve forest resources through community forestry management will sustain the composition of MFPs in the natural habitat. The traditional knowedge of local parataxonomists is also important to ensure the sustainable uses of MFPs for the future generations and that research development is continuous and improved.

Objectives

To determine the sustainable uses of some MFPs in Ban Thung Soong Community Forest and homestead, the objectives this study will undertake were as follows:

1. To study Minor Forest Products (MFPs) that existed in natural habitats in Ban Thung Soong Community Forest and homestead.

2. To study MFPs that were used by the villagers for their livelihood.

3. To identify the priority of uses and needs of MFPs among the villagers.

LITERATURE REVIEWS

Community Forestry

Community forestry referred the relation of people and the forest and covers a range of livelihood and the forest resources management. It applies to local management of forest area, including protection and sustainable management of the area from intrusion. Community forestry has been promoted for rural development and forest conservation. It is the activity process of community management and organization for community forestry (Uchida, 1997). According to Siddique (1995) community forestry emerges in recognition of the potentials of people's participation in forestry activities not only to promote forest resources development but also to alleviate poverty of the local landless people.

In the last 25 years, Community Forestry (CF) has evolved from an emphasis on improving subsistence levels and reforestation activities, to looking at viable communities can generate income from the management and utilization of forest resources. It is now widely accepted that if local communities are involved in making decision regarding resources management and derive benefits from conservation activities, they are more needed to conserve forest resources. A range of collaboration activities from around the region has demonstrated that participation of local communities in the forest resources management assists in conservation as well as promotes rural development (Bornemeier *et al.,* 1994). There are many likely difficulties which have yet to be surmounted in seeking community consensus on forest management. There are few practical means of ensuring adherence to agreed forest conservation or management measures among village (Round and Hobart, 1995). The establishment of community forestry aims to reduce the land conflict between local people and authorities especially forestry department meanwhile to minimize the shifting activity and forest degradation.

In Southeast Asia, community forest area is increasing nowadays based on livelihood of rural people living in the forest because most of the rural people need forest as their source for supply their need and accommodation. According to Temu and Kowero (2001), local communities interact heavily with the forest, primarily for necessities of life (food, water, medicines, construction materials and wood fuel), but also as land banks to serve agricultural expansion, and for cultural and religious purposes.

Development of the Community Forestry in Thailand

Thailand is a country in the South-East Asian Region that surrounded by Burma on the North, North-West, Malaysia in the Southern and Laos on the North and North-East. Thailand has a total land area of 511,711 km^2 and a population of 61.97 million people in 2004 with an annual growth rate of 0.5% and about 32.66% (167,590 km^2) is under forest area. The regions of Thailand forests are divided into five regions including the Northern Region, the North-Eastern Region, the Eastern Region, the Western Region and Southern Region. The Southern Region of Thailand

running from the latitude 12^0 southward towards the Malay Peninsular. Government estimates that Thailand's forest cover declined from 53.3% of the total land area in 1961 to 25% in 1999. FAO (1999) estimates place forest cover at only 22.8% in 1995 about 320.7 million rai (51.312 ha) but in year 2000 the area decrease to 319.306 million rai (51.089 ha). In 1992, 130.64 million rai (41%) was classified under farm holding land, 85.44 million rai (27%) forest land and the rest unclassified land (JICA, 1995). Forest cover and its annual rate of change also vary widely. Table 1 shows that forest cover area of the Thailand.

Table 1 Basic data and forest cover of the Thailand

Total land area 2004 (km^2)	Population 2004 (million)	GDP per capita 2004 (US$)	Forest area, 2004	
			Total forest area (km^2)	% of land area
513 115	61.97	8 100	167 590	32.66

Source: RFD (2004)

Thailand's forest area decreased dramatically during the last 30 years. A total 'logging ban' issued in 1989 slowed down deforestation, but logging could not be stopped entirely. Thailand tries to find new ways of forest management to deal with the danger of forest loss and degradation. Community forests are one solution discussed very broadly in the Thai public as well as in Thai forestry. Participation of local people in the management of forest resources seems to be a promising way to conserve remaining forest areas. A growing number of villages claim their ability to manage forest land within the community as community forests. NGOs working in rural development and conservation, scientists and Royal Forest Department have been negotiating the draft of a community forestry bill. The recent change in government delayed the passing of the law, which leaves the community forests already existing without legal base for the time being (Keßler, 1998).

Community forestry in Thailand originates from two main roots. First; indigenous forest management has a long history in inherently diverse ethnic cultures. Most of them have been practiced for generations without any formal written rules and regulations, unnoticed and unrecognized by the state and the Thai public until a decade ago. The second root of Thai community forestry introduced by the United Nations Food and Agriculture Organization (FAO) to Kasetsart University as a social forestry curriculum in 1984, and then promoted by the state in the 1985 Thailand National Forestry Policy. This policy designates 25% of the country area to be in protected forest, and 15% to be in economic forest. It also encourages private reforestation on public land, plantation on marginal agricultural land, and woodlots for household consumption. Social Forestry programs have been designated for economic forests that are called "national reserve forests". Consequently, there has been an expansion of fast-growing trees, particularly *Eucalyptus camaldulensis,* encroaching upon private farmland and communal forests or community forest, causing waves of strong resistance from local farming communities, first by

northeastern farmers and followed later by northern farmers. Apart from this written document, oral histories and field investigation reveal different types of communal forest management including varieties of sacred forests, watershed forests and village woodlots (Ramitanond *et al.,* 1993; Ganachanaphan and Kaosa-ard, 1995). At present, this form of community forestry includes not only indigenous forest management of different ethnic groups, but also more recently developed community forests as responses to changing ecological and socio-economic conditions and emphasizes access to and control of forest resources.

Community forestry in Thailand is a highly politicized issue. It involves contesting discourses between centralized, professionally-oriented forest management, and a social movement of marginalized forest communities who advocate social justice and decentralization of resource management (Maneekul *et al.,* 2002; Hirsch, 1997; Gilmour and Fisher, 1997). For the time being, there is no legal basis for community forestry in Thailand. A draft bill has been drafted and redrafted several times. The drafts is based on the Analysis of the Thai Forest Sector Master Plan, the contributions of academic and NGO's and the result of a series of official Thai Government Public hearings finalized in 1997 (Kaosa-ard, 2000). During the past five years, several groups have been in conflict over the bill, especially the area permitted for establishing community forestry, the activities to be allowed on the land and the control of the area, including penalties for contravening the rules (Makarabhirom, 2000). On November, 7th 2001, the Council of State (the lower house) approved the Community Forest Bill proposed by the Cabinet, members of the council of state and the people who had right to election. It also states that any community which submits a request for the establishment of the community forestry must have at least five years experience in forestry protection, the community must prove that its way of living is in harmony with the forest and at least 50 adults who are over the age of 20 must sign the request, according to the resolution. The bill was then sent to the Senate for approval, on March 15th 2002, the Senate passed the bill after making amendments to three crucial articles 18, 29 and 31 of the draft bill (Table 2) (Maneekul *et al.,* 2002).

Currently the Royal Forestry Department (RFD) has procedures in place so that community forestry may be designated in National Reserve Forest (NRF) zones A and E. Community forests cannot be designated in NRF C zone and protected areas such as National parks, Wildlife Sanctuaries and Watershed Class 1A areas (RFD, Community Forestry Manual) (Maneekul *et al.,* 2002). Surveys of these community forests were made in various regions of the country. For example, Ramitanond *et al.* (1993) compiled 153 communal forests found in Upper Northern Thailand. According to Ayuthaya (1997) Community Forest Network in Mae Wang Watershed, Chiang Mai Province, there are three ethnic groups the Karen and Hmong in the highlands, and Khon Muang (Northern Thai) in the lowlands. All villages are located in Mae Wang watershed, a tributary of the Chao Phya River. Settled in the watershed for hundreds of years are the communities of three ethnic groups; the exemplary indigenous forest protection and management system of the Karen is inherent in their culture. However, the highland communities were threatened with eviction from the

protected forests. They began concerted efforts to strengthen community organization, negotiate with the state and support the community forestry bill.

Laungaramsi (1997) indicated that many of these are communities of marginalized ethnic hill peoples that confronted state infringement of customary land rights by the expansion of protected area system. As the network has been operating within the local watershed context, it has transformed the monolithic view and practice of community forestry as a type of forestry management in one individual community into the cooperation among villages whose livelihoods and resource use rely on the same watershed unit. Collaborative Temple Forest Management, Chiang Mai Province is one of several pilot projects designed to explore collaborative forest management between the RFD, temples and communities. To practices, flora and fauna in this space will not be killed or disturbed. Thus, many temple grounds become forests. As Buddhist temples and monks often play leading roles in many community activities, the RFD thus designed a form of community forestry that let the RFD work with temple and local people. The Taladkilek villagers campaigned for conservation of village forests since 1973, and in 1990, the Doi Chom Chaeng temple joined the pilot community forestry project (Ganjanapan, 1997).

In the case of the Wang Oo community forest in Ubon Ratachani, forest is managed by local communities in consultation with the Royal Forest Department. The 1,810 rai of the community forest is split into a 1,510 rai for conservation forest where no activities are permitted and 300 rai for multi-purpose forest where some harvesting activies are allowed, e.g. logging and hunting are banned while collection of dead fue wood is allowed through a permit system. As a result of the community activities, co-operation with government agencies has increased, there is greater harmony within the village, and the quality of the degraded forest has improved (Olsen *et al.,* 2001). Table 2 shows the draft of Community Forestry Bill and Amendments of Thailand.

The establishment of community forest in this case could benefit from several factors. There was a change in economic base of the village, lessening the need to exploit the resources in unsustainable manner. The village is a stable community with little social and no ethnical stratification. Community forestry can draw on experiences with common management of other resources like water (communal irrigation system tradition) and labor (traditional labor exchange system in agriculture). Local leaders have strong influence on village politics and strongly supported the idea of community forestry. The idea of managing forest on village level derived out of conflicts with other users, it was not brought into the village by outside agencies (Keßler, 1998). According to Royal Forest Department (1971), Community Forestry as a humanistic and humanizing orientation of forestry evolved from the concepts of forestry for the community. Community forestry is an emerging field to study still the process of seeking its own boundaries. It has been defined in too many depending on variation in the contexts in which is emerged. When the Forest Industry Organization took responsibility in supplementing the Royal Forest Department in he annual reforestation program from 1968 onward, the organization had set up the Forest Village System which in effect was a modification of the

Burmese Taungya method to meet its goals as follows (Royal Forest Department, 1971):

1. To collect and settle shifting cultivators in a certain place to prevent them from further land cleaning.

2. Making forest village as a source of labor for the reforestation, using the shifting cultivator's instinctive, yearly shifting habit as a means to improving the forest condition of the country.

3. To provide social development in the forms of a better standard of living, medical care and education to the rural inhabitants.

4. To slow down the flow of rural inhabitants into the urban area.

5. To encourage the people to growing agriculture crops to meet their need and for earning cash money.

6. To set up new community which is easy to administrate and basic needs can be provided.

In Ban Thung Soong (BTS) Community Forest, people developed the regulations of resources utilization for ecotourism. Villagers in BTS have protected, conserved and rehabilitated the community forest for ecotourism purpose and also for their peoples whether directly and indirectly. The villagers developed the regulations concerning BTS Community Forest for ecotourism (Bhumibhamon, 2006). Declarations of BTS Community Forest are:

1. BTS Community Forest is a common property and shall belong to all BTS villagers. They have protected and conserved forest resources and wildlife remaining in BTS Community Forest.

2. BTS villagers have set up BTS Community Forest Committee to manage the forest resources. They will make use of community forest to manage the forest. They will make use of community forest to cope well with the community needs. They will protect the forest from all illegal practices both from outside the villager as well as inside the village. They also help in rehabilitating the forest.

3. Logging is not allowed in the community forest except for the communal activities. In that case, it must be agreed upon with BTS Community Forest Committee.

4. BTS villagers can gather Minor Forest Products for their own uses and for the communal activities through sustainable management practices.

5. BTS villagers will help in transfer and exchange knowledge about forest resources conservation.

6. BTS villagers will cooperate with the authorities in forests and wildlife conservation for ecotourism.

7. BTS villagers will not set fire in the community forest and nearby area so as to prevent fire spreading into the forest.

8. Domestic animals are not allowed to feed in the BTS Community Forest.

9. People from outside can enjoy the BTS Community Forest only for ecotourism and recreation. They have to follow the regulations of BTS Community Forest.

10. BTS Community Forest should be developed bay based on the Master Plan. The establishment of trails and pavilion in BTS Community Forest should be simple and harmonize with the surrounding nature.

11. BTS villagers should cooperate with research agencies and education institutes so that the applications will be benefits for the society.

12. BTS villagers should cooperate with school in transferring the ecological knowledge of BTS Community Forest to the youth. This will help in transfering information to the new generation.

13. Establishment of foundation to conserve BTS Community Forest to sustainable benefits for forest management and BTS villagers.

14. BTS villagers are all involved in forest and wildlife conservation, particularly on the exploration, surveying and controlling the resources.

Penalty Charges:

1. A person who cut the trees in community forest illegally must be fined at least 1000 bath. The falled trees should be used for community activities.

2. A collecting of Minor Forest Products in BTS Community Forest for sell must be fined two times the market price of each item.

3. Any person who collects the medicinal plants from BTS Community Forest for sell must be fined 500 baht per species.

4. Any person who hunts wild animals must be fined. Weapons will be disposed and case will be taken legal action.

Table 2 The Draft of Community Forestry Bill and Amendments made by the Senate on 15th March, 2002.

Draft Community Forestry Bill	Amendments
Article 18 The right to propose an area of community forest limited to groups of 50 or more persons aged over 18 years and from a traditional community native or indigenous to the area that has been active in forest preservation for at least the previous five years.	The number of proponents increased from 50 to 100 and community forest excluded in protected forest areas such as watersheds, wildlife sanctuaries and the time frame for forest conservation activity 'to at least five years before the bill takes effect.'
Article 29 Permits the community forestry group to request changes to the boundaries of the community forest areas for the improvement of its management plan, or for the revocation of the entire or part of a community forest provide valid and clear reasons are detailed to the Community Forestry Committee.	The expansion of designated community forest areas to be prohibited.
Article 31 Prohibits commercial-scale cutting of trees in all types of protected forest area. Trees to be cut only for subsistence and public utility, which should follow guidelines set by a relevant policy committee.	Locals cannot gather any forest products in the community forest except with permission from the Royal Forest Department.

Source: Bangkok Post, March 24th (2002).

Minor Forest Products (MFPs)

The broad terms "Minor Forest Products" (MFPs), "Non-Timber Forest Products" (NTFPs) or "Non-Timber Forest Resources" (NTFRs) refer to natural resources collected from forests apart from sawn timber (Secretariat of The Convention on Biological Diversity, 2001). Minor forest products (MFPs) are defined as all forest products besides that include medicinal plants, wild fruits and vegetables, herbs, essential oils, gums, resins, rattan, bamboo and animal products. According to Griffen (2001), MFPs are include plants used for medicines, foods, herbs, forest materials used for furniture, house-construction materialsm, household goods and crafts (including fibers, dyes, seeds for decoration, etc.). MFPs comprise all forest products other than timber and fuelwood and include medicinal plants, essential oils, spices, edible wild plants, gums, resins and oleoresins, fatty oils, tanning materials, natural organic coloring materials, fibers and flosses, insecticides and animal products such as lac, honey, hooves and ivory (Krishnamurty, 1993).

Asia is by far the world's largest producer and consumer of MFPs, not only because of its population size but also greater extent because of the traditional uses of a vast variety of products for food, shelter and cultural needs. MFPs have been vital to forest-dwellers and rural communities for centuries. Their collect, process and market bamboo, rattan, resins, fruits, bee-wax, mushrooms, gums, nuts, tubers, edible leaves, bush meats, lacs, oil seeds, essential oils, medicinal herbs and tanning materials. Both rural and increasingly urban communities (both affluent and poor, but for different products) draw upon forests for a variety of needs (FAO, 2002). Millions of rural people depend on forest for income and employment. For many, the money earned from collecting, selling or processing forest products provides an essential input to family income enabling them to buy food and invest in future food production (e.g. purchase of seeds, or tools) (FAO, 1989).

In recent years, MFPs have attracted considerable global interest. This is due to the increasing recognition that MFPs can provide important community needs for improved rural livelihood, contribute to household food securities and nutrition, help to generate additional employment and income, offer opportunities for processing enterprises, contribute to foreign exchange earnings and support biodiversity conservation and other environment objectives (FAO, 1995). The demands for MFPs in many areas primarily among rural people depending on markets, local traditions, alternatives raw materials of manufacturing, and the types of forest resources available in the area. Arnold and Ruiz Pérez (1998) noted that interest in MFPs that has built up over recent decades in conservation and development circles has its origins in a number of propositions:

1. MFPs much more than timber, contribute in important ways to the livelihoods and welfare of populations living in and adjacent to forests, providing them with foods, medicines, other material inputs and a source of employment and income, particularly in hard times.

2. Exploitation of MFPs is less ecologically destructive than timber harvesting and therefore provides a more basis for sustainable forest management.

3. Increased commercial harvest of MFPs should add to the perceived value of the tropical forest, at both the local and national levels, thereby increasing the incentives to retain the forest resources, rather than conversion of the land for use for agriculture or livestock.

Main Minor Forest Products in Thailand

Historically in Thailand, the government has paid little attention to Non-Timber Forest Products (NTFPs) until recently regarded as 'Minor Forest Products (MFPs) while the timber regarded as the major forest products. In the past this was the situations in Thailand and after the establishment of the Royal Forest Department (RFD) in 1896, the first laws to be passed, the Forest Protection Act and the Teak Protection Act of 1897 focused on valuable timber species. Sixteen years later in 1913 the forest Protection Act amended to include the control and harvesting of non-teak trees and MFPs (Chuntanapard and Wood, 1986). Later regulations concerning the collection of MFPs in protected forest areas were outlined in the National Reserve Forest Act B.E. 2507 (A.D. 1964) (Appendix 1.1). Before that, management of MFPs has its legal framework in the Forest Act B.E. 2484 (1941), the Royal Decree (1987) and the Forest Regulation (1989). According to Subansenee (1995) in Thailand, MFPs are defined as all products from the forest, excluding wood and other intangible products.

The potential important of MFPs in Thailand is indicated by the high level of biodiversity in the country. Thailand is the home range of more than 4,000 animal species with 10% of the world's known species and 15,000 species of vascular plants; altogether 187 species of animals and flowering plants are endemic to the country (GEC, 1996). Forest were largely perceived as sources of MFPs and over half of household within the village in Thailand collected common MFPs such as wild vegetables, bamboo shoots and mushrooms. The most important MFPs in Thailand are bamboo, rattan, lac, honey, gums and resins, spices and medicinal plants (Mohamed *et al.,* 2004; FAO, 2002). The importance of MFPs was mainly in their contribution to the non-cash household economy rather than the cash economy and there was a very slight tendency for MFPs to be proportionately more important to households with low cash incomes than those with high cash incomes. MFPs contributed on average 1/3 more to non-cash economy of landless households compares with access to land (Traynor *et al.,* 2002).

The main objective of MFPs collection was for household consumption especially for daily meals includes wild vegetables, mushrooms and bamboo shoots. The part of the plant such as flowers, fruits, leaves, stems and shoots consumed as food that primarily collected among rural people. According to Paisooksantivatana and Kako (1996), the number of species collected compares well with similar village studies, for example 81 plant species were documented by ethnic Karen elders in Western Thailand, 36 species were used as food and 46 species as medicinal plants.

Previous research concerning MFPs within Thailand has found that poorer families are more reliant upon MFPs than richer families and those villagers with less agricultural land to cultivate were more likely to harvest MFPs (Sharp *et al.,* 1999). Most of village people obtain something from the forest (Uchida, 1997). Within the village there are some householder that regularly collect MFPs and that these people have a substantial knowledge regarding recognizing MFPs and their habitats. These people who regularly collect MFPs have developed harvesting and management techniques for particular species that they consider encourage continues supply of the resource (Traynor *et al.,* 2001). Table 3 indicates the main MFPs groups in Thailand (Richardson, 1995; Subansenee, 1994, 1995; Chuntanaparb 1992; Chuntanaparb *et al.,* 1985; and Olsen *et al.,* 2001).

Bamboo is found throughout Thailand, mostly in mixed deciduous forests. It covers about 810,000 hectares (5.5% of the forest area). There are 13 genera with more than 60 species are found in Thailand including Bambusa, Cephalostachyum, Dendrocalamus, Dinochloa, Gigantochloa, Melocalamus, Melocanna, Neohouzeaua, Pseudosasa, Schizostachyum, Teinostachyum, Thyrsostachys and Vietnamosasa (Subansenee, 1994). According to Pattanavibool (2000), the important commercial bamboo in Thailand for construction work and supporting poles include pai liang (*Bambusa nana*), *Bambusa bambos, Bambusa blumeana, Dendrocalamus asper, Dendrocalamus strictus,* pai sangnuan *(Dendrocalamus membranaceus*), *Thyrsostachys oliveri* and pai phak *(Gigantochloa hasskarliana*); important species for basketry and handicrafts include *Bambusa nana, Bambusa blumeana, Dendrocalamus membranaceus, Thyrsostachys siamensis, Thyrsostachys oliveri, Gigantochloa hasskarliana,* pai kaolarm (*Cephalostachyum pergracile*) and pai hia (*Cephalostachyum virgatum*). Edible bamboo shoots are popular in both fresh and preserves food (Subansenee, 1994). There are some bamboo species that used for bamboo shoots production such as, pai tong (*Dendrocalamus asper*), pai bongyai (*Dendrocalamus brandisii*), pai sang (*Dendrocalamus strictus*), pai sisuk (*Bambusa blumeana*), pai pa (*Bambusa bambos*), pai ruak (*Thyrsostachys siamensis*), pai raakdam (*Thyrsostachys oliveri*) and pai rai (*Gigantochloa albociliata).*

Over 800 species of medicinal plants are described in Thai traditional recipes. About 400 species are available in traditional drug store and about 51 species are used in traditional medicines industry. Some medicines plants with commercial potential that are used in traditional medicines are *Rauvolfia serpentina*, *Gloriosa superba*, *Cassia angustifolia*, *Amomum krervanh*, *Dioscorea* spp., *Cartharanthus roscus*, *Strychnos nux-vomica, Diospyros mollis, Costus speciosus*, *Derris elliptica*, *Hydrocarpus anthelmintica, Calophyllum inophyllum* and *Stemona tuberosa* (Subansenee, 1995). Some other medicinal plants are faa thalai chone (*Andrographis paniculata*), *Carpinus viminea, Arcangelisia flava* and *Tinospora crispa* (FAO, 2002).

Table 3 Overview of main MFPs groups in Thailand

Major product group	Sub-grouping	Diversity and species	Examples of uses and products	Notes
Fibres	Bamboo	60 species in 13 genera (30 species are used)	House construction, scaffolding, ladders, fencing, fuel, pulp and paper making, baskets, handicrafts and wicker work.	Some species protected and require harvesting permit.
	Rattan	55 species in 6 genera	Handicraft, furniture, medicines, foods.	Permits required in reserve forests. Outside reserve (*C. caesius*) required a permit.
	Grasses	At least 20 species in use.	Paper making, fodder, mating, ropes, thatching, brooms and brushes.	Unprotected.
Foods	Plant foods	More than 500 species sold in local markets within Thailand	Fruits, nuts, leaves, shoots, tubers, flowers, seed pods, seedlings, mushrooms.	Some products have very high value.
	Animal foods	Unknown number (at least 33 insect species).	Honey (also wax, pollen, royal jelly, propolis and bee venom), insects	Honey unprotected.
Medicinal, spices and ornamental plants	Medicinal	Over 800 species (traditional recipes) 400 species (traditional drug stores); some 50 species (traditional medicine industry).	Used in both traditional and modern medicine	-

Table 3 (Continued)

Major product group	Sub-grouping	Diversity and species	Examples of uses and products	Notes
Medicinal, spices and ornamental plants	Spices	A unknown umber of species collected in the wild or cultivated	Flavours (food additives), stimulation of digestion.	-
	Ornamentals	More than 900 species. Unknown number used as ornamentals	Whole plant or part of stem, leaves, inflorescence used in decoration.	Protected. Cultivation for some species common.
Extractive products	Gums and resins	Some 27 species are used.	Gambodge, benzoin, gutta percha, gum dammar & agarwood.	Agarwood a protected products.
	Oleoresins (naval stores)	2 very important species (*Dipterocarpus alatus* and *Pinus merkusii*)	Used in industries producing paper, synthetic rubber, printing ink, paint and adhesive.	Protected. Minor amounts can be collected with permit (not available for *P. merkusii*).
	Lacquer	Tapped from *Gluta usitata*	Varnish for lacquer ware, wood work, cloth, etc.	Protected species. Minor amounts can be collected with permit. Min. DBH applied.
	Tans	An unknown number of species used, e.g (*Persea kurzii)*	*Pinus kurzii* used to produce kobuak powder used for making joss sticks.	Some species protected.

Table 3 (Continued)

Major product group	Sub-grouping	Diversity and species	Examples of uses and products	Notes
Extractive products	Dyes	An unknown number of species used.	Soft shades of colour used in traditional arts and in cottage industries.	-
	Essentials oils	From unknown number of trees and spices.	Incense	Some species protected.
Non-food animal products	Lac	Lac insect, most common is *(Laccifer lacca*) hosted by more than 40 species of trees and unknown number of shrubs.	Resinous protected secretion from insect. Used for medicinal purposes, as a resin and in dying silk, animal skins, soft drinks and food. Also used in colouring furniture.	Unprotected. Thailand second largest lac producing country (after India). Cultivation more important than natural sources.

In Thailand all rattans were brought under protected in 1987 because overexploitation had depleted the resources. Permits from the Royal Forest Department (RFD) are required for harvesting (Subansenee, 1995). There are more than 60 species of rattan in Thailand occurring in swamp, evergreen, dry evergreen and mixed deciduous forests at elevations up to 1,000 msl. The most important large stem rattans in Thailand used for furniture are kordam (*Calamus manan*), kampuan (*Calamus longisetus*), namphung (*Calamus* sp.), keesean (*Calamus rudentum*), nguay (*Calamus peregrinus*), takathong (*Calamus caesius*), keephung (*Calamus blumei*), lek (*Calamus javensis*), horm (*Calamus pandanosmus*) and keereh (*Calamus densiflorus*). Rattans also produce shoots for edible food. People primarily in rural area eat edible rattan shoots. People in northeast Thailand eat rattan fruits and shoots. The most popular species that produces edible shoots are waiyai (*Calamus siamensis*) and wai mon (*Calamus viminalis*) (FAO, 2002; Subansenee, 1995).

Categorization of Minor Forest Products (MFPs)

Minor Forest Products (MFPs) can be subdivided into various categories, making clear the large variety of products covered by the term MFPs; 1) By user purposes (for example for foods, medicines, roofing materials, etc), 2) By level of uses (self-supporting, commercial, etc) and 3) By type of MFPs harvested (for example leaf, fruit, stew, exudates and skin) (Rijsoort, 2000). In Thailand, MFPs are divided into two categories which are (Subansenee, 1994; 1995); protected and unprotected. Protected MFPs include wild orchids; aromatic wood (*Dracaena loureirei* Gaegnep), agarwood (*Aquilaria* sp.), drumm *(Mansonia gagei* J.R.Drumm. ex Prain) and sappan (*Caesalpinia sappan* Linn.); charcoal; yang oil (gurjan); some barks, including *Castanopsis* spp., *Walsura* spp., *Hopea* spp., *Cotylelobium melanoxylon* Pierre, *Persea* spp., *Litsea* spp., *Shorea* spp., *Artocarpus* spp., *Cinnamomum* spp., and *Platycerium* spp.; gums and resins, including gutta percha, *Pentace* spp., jelutong, lacquer resin, and oleoresins; some palm leaves and some ferns, including *Platycerium* spp. and *Osmunda* spp.*;* rattans*;* and talipot (*Corypha umbraculiferra*). Unprotected MFPs consists all other not specific from the protected MFPs groups.

According to de Beer and McDermott (1996) the categorization of MFPs are divided into five categories such as:

i. Edible plant products.

ii. Edible animal products.

iii. Medicinal products.

iv. Non-edible plant products.

v. Non-edible animal products.

1. Edible Plant Products.

Edible plant products are consisting of foods, edible oils, spices, fodder and etc. Many plants and plant products taken from forests are used as food for humans and animals. These include whole plants, leaves, roots, fruits, nuts and mushrooms (de Beer and McDermott, 1996).

In Thailand about 60% of rural people continue to rely on wild food for varying parts of their diet, especially the hill tribes and forest dwellers of about one million families who have traditionally depended on forest for their living (Chuntanaparb *et al.,* 1985). The food products of the forest come in many forms; people collect plant from roots, tubers, shoots, leaves, barks, flowers, buds, fruits, seeds, seedlings and etc. People eat edible plant such as *Adenanthera pavonina* L.*, Agaricus silvicola, Canarium subulatum* Guillaumin*, Caesalpinia mimosoides* Lam. and *Passiflora foetida* L.

People used spices for artificial flavoring to enhance taste and aroma, and to stimulate enzymes for digestion. There are some important spices from the forest such as *Amomum krevanh, Cinnamomum iners* and *Cinnamomum bejolghota.* Mushrooms also have become an important forest product in Thailand and have recently earned the country substantial money from exports. In Thailand, mushrooms are found in forest in all regions, especially during the rainy seasons. Some wild mushrooms such as *Termitomyces* spp. and *Russula delica* are delicacies and are sold in the market (Subansenee, 1994). Finally, forest plants supply food to people indirectly through the provision of feed for domestic animals (de Beer and McDermott, 1996).

2. Edible Animals Products

Edible animal products are included terrestrial animals, animal products (egg, bird's nests and honey), fishs, invertebrate water animals and etc. For many people in rural areas, forest animals are important sources of protein. Beside larger animals such as pigs, deers etc., and insects are also an important component of diet. Honey is a good example of an edible animal product that may be great significance both locally, regionally and internationally. Fresh-water fish, given that they form an integral part of the forest ecosystem, count as MFPs. Fish and invertebrates which are dependent for a large part of their life on mangrove forests can also be classified as MFPs (de Beer and McDermott, 1996).

Reis (1995) note that important component of MFPs resources is wildlife. Wildlife is now generally recognized as a renewable natural resource, but unfortunately it is rarely managed to this end. Certainly, conservation of endangered species is an essential part of wildlife management and where species have been over exploited. Sustainable management is particularly important in view of the role of wildlife resources as a source of food and income for rural people. Wildlife species have been protected under the Wildlife Preservation and Protection Act (B.E. 2535) A.D. 1992. Section 16 on this Act that 'no person shall hunt or attempt to hunt the preserves or protected wildlife' there are 15 species of preserves wildlife species are listed under the Ministerial Regulation Volume 14 (B.E. 2525) A.D. 1982. There are two types of protected wildlife species, type one and type two. Type one includes *Manis javanica* (Lin or Nim) and type two includes *Muntiacus muntjak* (Zimmermann), both these species are hunted by some villagers during the hot season. According to Traynor *et al.* (2001), most of animals that hunted by people as food such as *Tupala belageri* (Grratae), *Gallus gallus* (Gai Paa), *Rhisomys* sp. (Too) and *Varanus* sp. (Laen). Uchida (1997) notes that among the collectors of MFPs, young men of respondents (twenties or less) mostly collect birds or some other animals. Middle aged men (around forties) tend to collect birds and women scarcely hunt for animals but ordinarily collect the other products. According to Prasanay (2004), she studies on relationship between lands use type and wildlife biodiversity in Ban Thung Soong Village in Krabi Province and found that land use can influenced the amount of wildlife distribution (Tables 4 and 5).

Table 4 Groups of animals in Ban Thung Soong Village in Krabi Province

Group	Order	Families	Species	Total number of animals
Mammals	10	16	32	288
Birds	13	34	135	2,295
Reptiles	2	13	42	241
Amphibians	2	5	28	491

Source: Prasanay (2004)

Table 5 Land use of Ban Thung Soong Village

Land Use	Mammals			Birds			Reptile			Amphibians		
	Or.	Sp.	No.	Or.	Sp.	No.	Or.	Sp.	No.	Or.	Sp.	No.
Community Forest (CF)	10	23	80	22	68	421	7	26	96	4	22	258
Oil Palm	4	10	40	21	41	334	5	12	18	4	12	62
Rubber	6	11	31	20	46	296	6	16	59	4	10	21
Fruit	4	11	93	26	62	565	4	8	10	3	4	6
Village	4	8	20	25	55	420	7	13	40	4	12	105
Water Resource	4	12	34	21	57	259	8	8	18	5	19	42

Notes: Or. = Order, Sp. = Species and No. =Number.

Source: Prasanay (2004)

3. Medicinal Products

Medicinal products are included plant and animal products. This category is only mentioned separately because of the enormous number of products with medicinal properties. In practice, however it does not constitute as separate group since many plants with one or more medicinal properties are also used as food or as ornamental plants or are source of nuts, resins or tannins. Animal products may also have medicinal properties, for example honey or bear's gall (de Beer and McDermott, 1996).

For thousands of years, forest-gathered medicinal plants have been a key component of the traditional health systems of the humankind. The linkages between forestry medicine and nutrition are extremely important (FAO, 1989). Forests provide the only medicines available to a large proportion of the world's population. Many studies have catalogued the use of medicinal products gathered from the forests (Heinz and Maguire, 1974). The World Health Organization (WHO) has been changed to developed international standards and specifications of identity, purity and strength for the most widely used medicinal plants and their galenical preparations

and has also produced "Guidelines for the assessment of herbal medicines (Lintu, 1995).

Medicinal plants are important in the primary health care systems particularly in rural areas. The indigenous people have developed interesting and often sophisticated knowledge systems about use a vast variety of plants for medicinal purposes (FAO, 1995). It has been estimated that as many as 75 to 90% of the world rural people rely on herbal traditional medicine as their primary health care (Roy *et al.,* 1996). The medicines for internal use prepared in the traditional manner involve simple methods such as hot or cold water extraction expression of juice after crushing, powdering of dried materials, formulation of powder into pastes via such as vehicles of water, oil or honey and even fermentation after a sugar source (Silva and Atal, 1995).

People use plants for medicinal purpose like *Cassia* sp., *Diospyros* spp., *Tamarindus indica, Aquilaria malaccensis* and *Zingerber* spp. For example, *Acacia concinna* (Sompoi) fruit is using for stomachic, *Cassia siamea* (Khee lek) leaf and wood for laxative or cathartic and *Vitex pinnata* (Yah teen nok) for anti-leprous. According to Subansenee (1994), there are many kinds of medicinal plants in the Thailand forests; about 5,800 plant species are indigenous. About 1,900 species have already been studied for their medicinal value and over 800 species are described in Thai traditional recipes. About 400 species are available from traditional drug vendors and 50 species are used by traditional medicine manufacturers.

4. Non-Edible Plant Products

According to de Beer and McDermott (1996) non-edible plants products consisting of bamboo, rattan (also classified as an edible plant products), ornamental plants, chemical components (exudates and extracts), non-industrial timber, fibers and leaves. This is a large and varied category. Rattan and bamboo are among the most familiar and useful MFPs, especially in Asia. Besides their local value in "forest garden" and in traditional ceremonies, ornamental plants are of great value on the international market (botanical gardens and house plants). The chemical components of plants consist of a large group of exudates (resins, gums and latexs) and extracts (essential oils, tannins, paints and aromas). Non-industries timber means timber in the form of poles for local constructions, storage for crops, fencing, and etc. Fibers and leaves are used for clothing, baskets, mats, roofing materials, and etc.

Bamboo is found throughout Thailand mostly in Mixed Deciduous Forests. It covers about 810,000 hectares with 5.5% of the forest area. Bamboo has many uses. Their utilization varies according to size of culms, species and availability in each location (Chuntanapard *et al.,* 1985). The clumps are used for house construction, scaffolding, props, ladders, fencing, containers, pipes, toys, musical instruments, furniture, wicker work, partitions, house walls, fuel and raw material for pulp and paper making. Shoots are a popular food, used in fresh and preserves foods. Bamboo serves as fencing, windbreaks and to prevent river bank erosion (Subansenee, 1994).

The collection of rattan has been studied in a number of countries. Derives from a climbing palm (*Calamus* sp.), rattan provides a source of income for many South Asian people; both forest dwellers and settled agriculturalists (IDRC, 1980). There are 6 genera and 55 species of rattan in Thailand, the most important being Calamus, Korthalsia, Daemonorops, Plectocomia, Myrialepsis and Plectocomiopsis. Rattan has been used for centuries in Thailand for handicrafts such as rattan canes, hats, baskets, ropes and mats, furniture, medicines for treating rheumatism, asthma, diarrhea, snake bites and intestinal disorders and as are edible fruit and shoots (Subansenee, 1994).

Fuelwood is the main energy sources in most Third World rural communities. All cooking and most food processing are dependent on fuelwood. Fuelwood is also important for food processing often being used to smoke, dry and preserve foods. Food processing is of central importance for food security, as it serves to extend the supply of foods into non-productively over the year. Indirectly, therefore, fuelwood supplies affect the stability and quality of food supplies (FAO, 1989). According to Uchida (1997) many villagers utilize the community forest as a source of food provision rather than a source of fuelwood. He found that 92.8% of people in three villages in Northeast Thailand use fuelwood included charcoal and people who collected from the community forest received more trees than people from their own land.

Gums and resins have many uses in the food, paper, textile, printing, pharmaceutical, paint, varnish and ink industries are produced by many plant families. Plants species like Leguminosae, Anacardiaceae, Meliaceae, Dipterocarpaceae, Pinaceae and Caesalpiniaceae (Chuntanaparb *et al.,* 1985).

5. Non-Edible Animal Products

Non-edible animal products are included insects products (wax, lacquer and mainly collected), game products and living animals (pets, trophies, traditional ceremonies, clothing, often traded internationally) (de Beer and McDermott, 1996).

Thailand is dominate world trade in shellac, each exporting, on average, about 6 000 tons per annum. Shellac is an animal product. The basic material comes from the *Coccus lacca,* a scaly insect that feeds on certain trees. After feeding, the insect produces through its pores a gummy substance which hardens into a protective covering called lac. This lac is collected and then it is crushed, washed and dried. After further treatment, it is skillfully drawn into thin sheets of finished shellac (FAO, 1996).

Beeswax is used both at local and commercial level (cosmetics and batik). The “lacquer” exuded by aphids has a wide variety of uses, varying from high-quality varnish and lacquer to insulation for electricity cables. Animals are hunted not just for food and medicines, a large proportion are hunted to serve as pets, for ceremonies purposes, as trophies, for clothing and for trade with the city and at international level (for example parrots, butterflies and elephant ivory).

Minor Forest Products Plantation in Homestead

Minor Forest Products (MFPs) exploitation has recently emerged as a promising alternative to timber extraction in natural forest management. The domestication and the commercialization of these MFPs tend to emerge as an alternative strategy to their extraction from natural forests (Michon and Foresta (1996). In the tropics, `hortus' can be a swidden, an anthropogenic forest or a homegarden. ‘Ager' (literally the tilled or totally cleared field) conquered the forest and is the central platform for domestication and the `home' of domesticates. According to Arnold (1996), where the amount of arable land is the limiting resources, trees, as a land use that produces low returns per unit of area are generally restricted to homesteads, boundaries and other niches where they do not compete with the agricultural crops. Homegardens, with their vertically layered structure of trees, shrubs and ground cover crops making effective use of space above and below the soil surface, provide a notable example of this.

People want to commercialize the MFPs but they must grow the plant in their own garden. They plant different variety of medicinal plants in their home garden. According to FAO (1996), domestication and production of medicinal plants in home gardens is increasing rapidly. Income from MFPs activities helps a substantial proportion of rural households meet seasonal and other needs. The relevance of particular activities in different situations is often changing rapidly, and care needs to be taken to focus attention on those with continuing development potential. As forest-product processing may often be performed at or near home, women are often able to combine these income-earning activities with other household chores *(*e.g., child care). In addition, as women traditionally use forest products to meet some of their household's basic needs (e.g., fuelwood, medicines and foods); gathering of forest products for the market can often be accomplished in conjunction with other collecting activities (Falconer, 1990).

Homegarden means to villages betterment of quality of life and better products than from markets. Village people think that hey can save money because they do not have to buy food ingredients (for food before establishing the home garden 3000 baht and now 1000 baht). Home gardens play a very important role in providing families extra income, their own food and medicine (Mohamed *et al.,* 2004). In Thailand, keeping small bamboo plantation along fences and around homesteads for domestic uses has been a common practice for a long time, providing food and material for tools, handicrafts and housing. The main species planted includes *Thyrsostachys siamensis, Bambusa arundinaceae, Bambusa blumeana, Dendrocalamus asper* and *Dendrocalamus membranaceus* (Chuntanaparb *et al.,* 1985). Pipatwattanakul (2002) notes that very abundant tree species grown in homesteads were *Sandoricum koetjape* (Burm. f.) Merr. *Mangifera indica* L., *Cocos nucifera* and *Parkia speciosa* Hassk.

Sustainable Uses of MFPs

MFPs can prove to be an important key to the sustainable management of forest resources primarily on sustainable utilization on MFPs. The development of MFPs is challenging field, because it involves a fundamental change in the approach to ecological, socio-culturals, technologies, trade and institutional issues associated with forestry. Sustainable uses of MFPs become as method to approach the productivity and conservation to balance demands and MFPs consumption.

According to Browner (1992); Falconer (1996) and Fisher *et al.* (1997), the utilization of MFPs are assume that:

1. The management for MFPs is more likely to be more sustainable than traditional timber forestry (and other forms of land use such as shifting cultivation), in particular because it is less ecologically destructive.

2. Management for MFPs will benefit a large number of rural people (as opposed to traditional timber forestry).

3. Management for MFPs by local people is more likely to be wise and sustainable.

4. Therefore, management for MFPs can meet both conservation and development objectives.

5. MFPs are imperfect and can be improved to the benefit of rural collectors through government interventions.

Haeruman (1995) indicates that the term sustainability has different meaning for different people. In the context of forestry, sustainability means the ability of each generation to maintain and pass on to the next generation a stock of forest resources no less productive, protected and utilizable than what it inherited, including natural forests and other sensitive ecosystem. Just as sustainability of MFPs depends on the sustainability of forests, the sustainability of forests will depend on the way that MFPs are harvested. According to Bruenig (1996), the terms of sustainability are defined as the capacity of a system in its entirety to endure, last, persist and survive. The relation between sustainability and biodiversity is not simple, but complex and diverse. Sustainability is not equivalent to equilibrium.

Sustainable uses in this context indicate that consumption of forest products primarily MFPs whether come from wild and natural resources or cultivation should managed in proper way to maintain the productivity, population, biodiversity and also to support rural people livelihood. Most of MFPs originally come from wild and natural forest; so that forest is the main sources for accommodate MFPs. The importance to sustain MFPs resources not only for the uses, but also covered the ecology, socio-economy, food security, livelihood, and etc. Schreckenberg and Hadley (1991) notes that there is thus the sustainable production of goods, services,

and benefits, entailing the study and development of techniques and systems with special attention to maintaining environment, conservation benefits, yields of timber, and non-timber products, the generation of income, and productivity employment over several generations without serious degradation of the environment or its productivity capacity.

The potential for MFPs commercialization to be effective as a tool for biodiversity conservation is limited (Belcher *et al.,* 2003). According to Peters (1996) MFPs are biological resources derived from either managed or natural wooded areas. With the recent high rate of tropical deforestation, there is increasing interest in MFPs as a means of generating economic benefits from these forests, without compromising their conservation value (Counsell and Rice, 1992). However, whilst the ecological impacts of harvesting MFPs may be relatively slight, this is no guarantee that use of MFPs will always be sustainable, excessive or careless collection can have serious negative impacts on ecosystem (Hyman, 1996). For sustainability of MFPs collection to be assessed, social and economic aspects should be addressed in addition to environmental impacts as the concept of sustainability embraces all three components such as social, economics, and environmental aspects (Upton and Bass, 1995).

Bamboo as example, due to its fast growing, easy propagation, soil binding properties, and short rotation, is an ideal plant for use on afforestation, soil conservation, and community forestry programme (Jifan, 1985). According to Lekuthai *et al*. (2004), in utilizing of bamboo, one must have made approach to the considerations of their ecology and material properties of the respective bamboo. The role of bamboo as environment material will increase more and more in the future. In Thailand, the utilization of bamboo plays an important role from birth till death, and each piece of bamboo handicrafts reflects the aspiration and local culture (Lisuwan, 1994).

Development of MFPs Marketing and Trading

Minor Forest Products (MFPs) have attracted attention in recent years for their potential to generate income through added-value processing and innovative marketing. There is a need for a systematic approach to assessing MFPs as a basis for sustainable development (Belcher, 1998). A variety of approaches has been used for assessing forest product-based enterprise. These approaches vary in the extent to which they address conservation and development concerns, as well as income-generation effectiveness (Lecup *et al.,* 1998).

The important of MFPs lies mainly in contributions to the non-cash economy rather than the cash economy; however there was a slight tendency for MFPs to be proportionately more important to households with low cash incomes than those with high cash incomes. MFPs contributed on average 1/3 more to the non-cash economy of landless households compared to households with access to land. However, there were exceptions and 25% of landless households did not utilize MFPs. The actual inputs of MFPs to landless households were lower than in other land use types. These findings suggest that most landless households utilize MFPs to a lower degree than

households with access to land, but that they are more dependent upon the inputs for their subsistence (Traynor *et al.,* 2001).

Most failures of MFPs program result from inattentions to markets. With increasing pressure on forest resources, well-informed MFPs marketing strategies could be crucial for maintaining the resources. Producers need better information on the nature and volume of existing MFPs trades, markets and products standard. With the increase in green consumerism, knowledge of international market concerns and quality standards of products are needed. More rational and transport market transactions throughout the production or market chains are needed for producers to receive more equitable share of the product value. In general, a greater appreciation of marketing and market information are needed by producers, MFPs-programs planner, and NGOs (FAO, 1995). More rapid growth in market demand is usually associated with expansion of urban use of certain foods, medicinal products, building materials, furnitures, leaves and fibers packaging, and other forest products, which people continue to consume as they move to the towns. Most of such forest products are usually characterized as goods used primarily by low-income consumers.

MFPs give way to people to process and marketing their products as addition income. Most of the rural people process MFPs at home or in local shop-floors to earn the income in local market. Most of MFPs that traded in local market are certain food, wild vegetables (mushrooms, young leaves, bamboo shoots, and etc.), medicinal products, building materials, furnitures, and handicrafts. Arnold (1995) indicates that very large numbers of households also generate some of their income from selling forest products. MFPs are generally most extensively used to supplement household income during particular seasons in the year and to help meet dietary shortfalls (Arnold and Ruiz Pérez, 1998).

Many studies have indicates that, where people had relatively unrestricted access to forests, the income from forest foods and forest products is often particularly important for poorer groups within the community (FAO, 1996). In addition, some forest-product activities may be opportunistic, taking advantage of unexpected or periodic surges in availability of a product to generate additional income or savings (de Beer and McDermott 1989; Falconer, 1990). Poor households and indigenous communities tend to particularly depend on MFPs for subsistence and supplementary income. Even where they are involved in market-oriented production on MFPs, it is often undertaken as a part-time activity (FAO, 1995).

In sustainable forestry, the role of marketing is to help create better linkages among resources management, processing and the end-uses. Marketing can reinforce sustainable forest management by indicating the kind of products and raw materials required and by providing incentives through income distribution (FAO, 1995). MFPs programs need to resist the temptation to select products for focus largely or only on the basis of their having a market or adequate raw materials. Selection should income also simultaneous consideration of the availability of suitable entrepreneurial resources (Chipeta, 1995). According to Silva and Atal (1995), another major constrain in the industrial development of MFPs has been the lack of financial support

and incentives to the entrepreneurs as a result of the low priority that governments and banks have places on these forest industries. There are other problems associated with industries based on MFPs in developing countries such as:

1. Poor harvesting (indiscriminate) and post-harvest treatment practices.

2. Lack of research on development of high yielding varieties and domestication.

3. Inefficient processing techniques leading to low yields and poor quality products.

4. Poor quality control procedures.

5. Lack of R&D on product and process development.

6. Difficulties in marketing.

7. Lack of local market for primary processed products.

8. Lack of downstream processing facilities.

9. Lack of trained personnel and equipments.

10. Lack of facilities to fabricate equipment locally.

11. Lack of access to latest technologies and market information.

Each MFPs has a different production and marketing system. Essences, oils, flours, nuts, fruits, honey, resins and meats are all different. Each product has it own set of producers, processors, traders or marketers and end user (Clay, 1995). According to Nair and Merry (1995) markets for MFPs can be differentiated into two categories such as: the local markets and cottage industries and; the industrial or export markets. In many situations urban markets for most MFPs are still being supplied by mining natural stocks, with producers paying little if anything for the raw materials, so that the cost of the products delivered to the market consists mainly of labor and transport. In addition, in many countries supplies of some products come from state forests and plantations are sold at administered prices (FAO, 1996).

In general, returns to labor from MFPs sales are usually higher than the average local agricultural wages, with income usually higher for externally marketed products. Subsistence values are often also high, particularly for poorer rural households (Secretariat of the Convention on Biological Diversity, 2001). Pater (2000) indicates that some MFPs even play an important role in the national economy. International Trade in MFPs is estimated at US$ 11 billion. The European Union, the US and Japan together account for 60% of world-wide imports of MFPs. Besides their socio-economic importance, it is often stated that harvesting MFPs has no

influence on the structure and function of forests. This assumption is the basis for the belief that the use and management of MFPs in forests can potentially contribute to sustainable forest management and to combating poverty. In this context, combating poverty is also taken to mean improving capacity and control with respect to the management of natural resources ("empowerment"). Important Thai MFPs in the international market are shown in Table 6. These include rattan, bamboo, lac, honey, gum, resins and bark (Subansenee, 1994).

Table 6 Minor Forest Products exports from Thailand during 1995-1999 (million baht)

MFPs	1995	1996	1997	1998	1999
Lac	158.85	132.75	187.20	132.75	193.50
Bamboo	1.35	0.45	0.90	0.45	2.25
Gum	9.45	9.45	34.65	16.20	42.30
Rattan (raw cane)	0.19	1.80	1.80	-	0.90
Rattan furniture	70.65	66.15	50.85	37.80	59.85
Natural honey	29.25	44.10	38.70	32.85	27.45
Resins	0.07	1.35	0.05	10.35	5.85
Spices	3.15	9.45	10.35	12.15	9.00
Total	273.15	265.50	324.45	242.55	341.10

Source: Royal Forestry Department (2000)

Sustainable Harvesting of MFPs

Bamboo harvesting is carried out by selective cutting. The one year old culms should not be harvested in order to maintain growth. Cutting is generally done by using a small axe, machete, bill hook or saw. Bamboo shoot harvesting is done from May to October primarily in the rainy seasons. Shoots can be collected from clumps daily or twice a week. In bamboo plantations, one to two year old stalks of *Dendrocalamus asper*, produce each yield about five or six shoots per year. Bamboo shoots can grow 90 to 120 centimeters per day under ideal conditions (Subansenee, 1994). In Indonesia, farmers cut the culms for bamboo construction at predetermined times. Farmer believe, by experience, that even the most durable bamboo species will be susceptible to borer attack if it is not cut in the proper month. Due to the times, the culms are resistant to borer attack since insects do not bore culms that have no food and therefore harvesting in that particular month is recommended (Yudodibroto, 1985).

For bamboo, the first harvest is between the third and fifth years of growth. There are up to five shoots from each culm in the first and second years. Mature culms are at the center of each clump and are surrounded by up to five new shoots each year. The two to three years old clumps are cut for bamboo stalks, poles, construction work and wicker work. The clumps should be cut at the bottom close to the ground. Quality decreases if over-aged clumps are left uncut. These clumps

become brittle while the immature ones are not durable. Cutting is easier from November through March. Studies have indicated that suitability of a three years cutting cycle for *Thysostachys siamensis* in natural forest conditions. Consecutive cuttings three years apart each yielded more than 10,000 culms per hectares with no reduction in stem quality (Royal Forestry Department, 1979). In Malaysia, harvesting of bamboo is usually done during the dry season when the starch content is lower and borer attacks are fewer. Bamboo must be processed within three days after harvesting as it is prone to discoloration (Yong, 1994).

In the past, all rattans except *Calamus ceasius* (Tahathong) were unprotected MFPs. People could collect without permits (except in reserved forests). In 1988, however, all rattan classified as protected MFPs because of over-exploitation. Permits are now required from the Forest Department for harvesting quantities exceeding 10 kilograms. The Ministry of Agriculture and Cooperatives has established temporary regulations for harvesting. The current regulations direct to collectors to cut only mature cane of at lest eight meter in length, leave half of the stems in the clumps, clear the area under the clumps after harvesting and follow a felling rotation of five years. Rattan canes are easily recognized as being mature when the leaf sheath has fallen. The best time for cutting rattan is from November to March (Subansenee, 1994).

According to Yong (1994), in Malaysia, forest medicinal plants including roots, barks, stems, leaves, fruits and flowers are usually collected by the aboriginal communities and sold to the traditional practitioners in fresh or dried form. The fresh or dried parts of medicinal plants are boiled and mixed with other forest plants. Olsen *et al.,* (2001) indicates that the involvement of the state in MFPs occurs at a variety of levels as follows:

1. Individual species may be protected according to the Forest Act B.E. 2484, e.g. this is the case for *Dracaena loureirel.*

2. The quantity of harvested products may be restricted on a per person basis, e.g. collection of rattan, gum, oleoresin and yang oils are limited to 10 kg per person.

3. Legislation that protects and areas may also protect the MFPs that occur within that area, e.g. harvest of all MFPs within National Parks is prohibited by the National Parks Act B.E. 2540.

4. A limited number of MFPs are subject to trading restrictions, e.g. export of raw rattan was banned in 1979.

5. In addition to national policy restrictions concerning MFPs harvesting, some products are require a collection licence from the Royal Forest Department, e.g. collection of rattan, pine resin and bamboo are regulated in certain geographical locations. These permits serve to allow the government to collect tax revenue rather than to limit the exploitation of natural supplies.

Status on Minor Forest Products Research in Thailand

Although the long-term potential of MFPs is well understand, concomitant efforts to develop them are still lacking. In Thailand, research into the past, present and potential role of MFPs in relation to rural livelihoods and development appears to have been very limited, there is an urgent need to quantify and qualify the importance of both subsistence and commercial MFPs (Olsen *et al.,* 2001). Most of the studies about 47% are focused on fibers and almost exclusively on bamboo and rattans. Some studies are also available on medicinal plants and food with 15% and 14% while few studies have focused on extractives and non-food animal products with 9% and 2% respectively. Figure 1 present the distribution of MFPs studies in Thailand according to the products categories (Jintana *et al.,* 2000).

Current researches are far from sufficient and spread too thinly over several items, topics and organizations (Nair, 1995). The recent studies on MFPs in Ban Thung Soong Village in Krabi Province were conducted by Mohamed *et al.* (2004). The most common MFPs for food supplements are mushrooms, *mamou*, bamboo shoots, durian fruits, guava, rose apple, mango tree, and parkia and for medicinal purpose include lemon grass, herbs, *katah*, *kamin*, and *dala*. BTS people collect MFPs from the forest when they use for their own consumptions and they majority of people in BTS are farmers and they have their own garden. In their garden there are more than 60 species for various purposes plants such as for food, medicinal plants, aromatics, and decorates. The herbalists or parataxonomist in BTS get the medicinal herbs from their homegarden and also collect some from the forest.

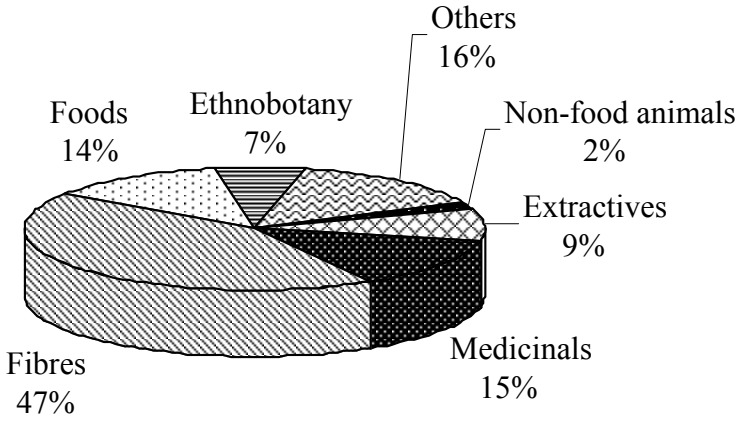

Figure 1 Distribution of MFPs studies in Thailand according to the product categories.

Traynor *et al.* (2001), study on forest products utilization and contribution to household economies in Tho Saman Village, Song Watershed, and Phrae Province, Northern Thailand. In this study, their found that majority of households collect the main MFPs such as wild vegetables, bamboo shoots, and mushrooms. The household, who collected MFPs regularly, had considerable knowledge concerning MFPs, their utilization and management. They found that approximately 25% of the Song

Watershed area are legally collected MFPs, but in the same locations from which villagers regularly collected MFPs did not coincide with these permissible areas. According to their study, approximately 65% of households collected wild vegetables, bamboo shoots and mushrooms and 17% purchased these products. Insects and their products were collected by 52% and purchased by 26% of households.

According to Uchida (1997) about 78.4% of respondents from 97 respondents obtain something from the forest. He study on constrains to tree growing in community forest in three village in Northeast Thailand. He found that mostly of respondent who collect MFPs are women and the majority of collectors are between 30 and 45 years old. MFPs that respondents obtain are mushrooms, young shoots or leaves, and some small animals, particularly birds and sometimes insects. Kantangkul (2002) found that the most of off-farm cash-income sources of Tho Saman Villagers came from three sources, 38% from employment in non-agricultural sectors, 56% from employment in neighboring farms and 46% from MFPs. The average cash income from MFPs was about 3,130 baht per household that collected MFPs and major non-cash income came from MFPs and timber. About 70% of the respondents collect MFPs with an average non-cash income of about 1,070 baht per household or 1,520 baht per household collected MFPs.

MATERIALS AND METHODS

Materials

In this study, materials used consist of hardwares and softwares for computerized analysis and equipments for plants specimen collections as follows:

1. Plants.
2. Global Positioning System (GPS) (eTrex).
3. Hand compass.
4. Measurement tape.
5. Diameter tape.
6. Calipers.
7. Haga hypsometer.
8. Altimeter.
9. Land use map.
10. ArcView GIS 3.2a program.
11. Statistical Package for Social Science (SPSS) program.
12. Personal computer.

Methods

1. Sampling Method and Data Collection

In this study the quantitative and qualitative measurements methods are used. Firstly collecting general information data including village, people and MFPs were conducted by questionnaires and interviews and secondly using Global Positioning System (GPS) equipements. The field data collected basic measurement of plants, plant distribution, and biomass study.

1.1 Community Forest

Field data collection was done in community forest determined from three elevation levels at 0-100 m with three stands (20x50 m^2/stand) of ten sample plots (10x10 m^2/plot), at 100-200 m altitude with four stands and at 200-300 m altitude with five stands. Totally there are 12 stands selected for survey the plant species vegetation distribution in community forest area. All plant species collected for this study include Minor Forest Products (MFPs) and bamboo species. All stands and all trees with DBH from 4.5 cm and height with 1.30 m above ground level in 20x50 m^2 (10 sample plots of 10x10 m^2) were collected and measured in each stand. Field data of each species were collected as follows: local and scientific names, plant characteristics habits, ecological habitats, uses, and diameter at breast height measured by using diameter tape and calipers, the height measured by using the haga hypsometer. Saplings with height over 1.30 m above ground level but DBH less than 4.5 cm were measured and recorded in 4x4 m^2 plot. For seedling collection, plants with height lower than 1.30 m from ground level were measured and recorded in each 1x1 m^2 (Figure 2). The distribution of bamboo species occurred in the 12 stands

(20x50 m^2) collected. The basic measurements such as diameter at breast height and height in addition; the characteristics bamboo culms such as local name, number of culms per clumps, and number of shoots were recorded.

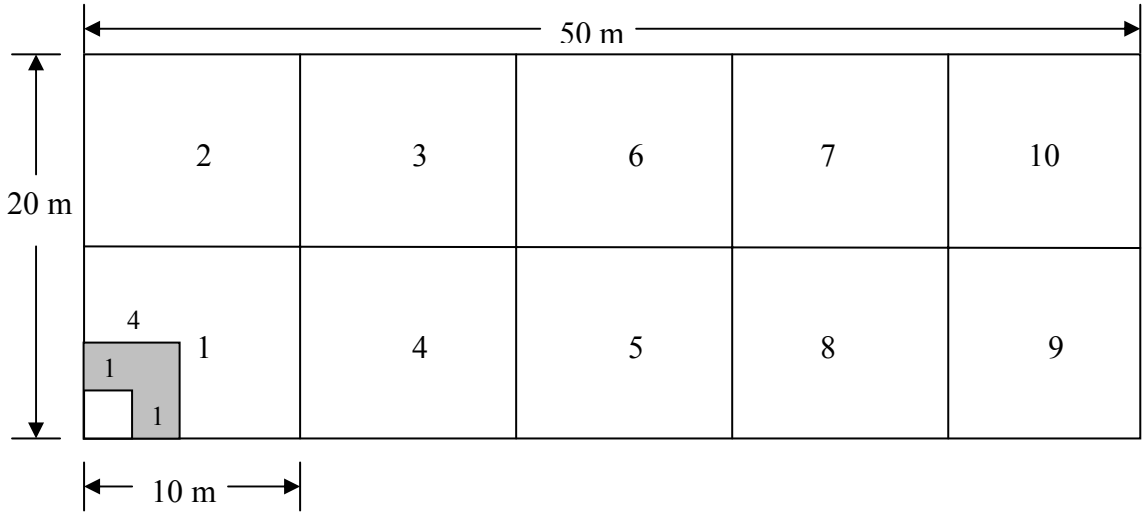

Figure 2 Stands of 20x50 m^2, numbering labels show the number of sample plots (10x10 m^2), all trees studied in all sample plots, saplings in each 4x4 m^2 and seedling in 1x1 m^2 in each 10x10 m^2.

1.2 Soil profile

In this study, soil profile of Ban Thung Soong Community Forest was taken. The basic information of soil profile such as soil location, date of collection, sample name, type of land use, topography, soil depth levels, slope character and position were recorded. Samping method for the soil profile was taken using simple random sampling covered three elevation levels of 0-100 m, 100-200 m and 200-300 m of BTS Community Forest. The soil sample was taken from 0-15 cm and 15-30 cm soil depth levels. Undisturbed soil sample was taken as sample by using soil core equipments. The positions of soil profile were recorded by using Global Positioning System (GPS) and mapping in BTS map. The soil samples were sended to soil laboratory for the basic soil anaysis such as soil texture, structure and colour, and etc.

1.3 Perception of Ban Thung Soong people

People perceptions regarding Minor Forest Products in Ban Thung Soong Community Forest and homestead were conducted through the questionnaires and interviews. The questionnaires conducted by using specific sampling method. According to the village committee there are 50 people in BTS are involve in MFPs collecting and uses. From the information 50 set of questionnaires were distributed to the 50 respondents that using MFPs. Questionnaires with semi-structures were conducted for interviews and inputs from the respondents and collected more than three times to collect necessary data. First visit conducted from 28th September to 3rd

October 2004 with 50 sets of questionnaires covered information about demographic, livelihood and MFPs in BTS Community Forest and homestead. Interviews with village committee include the Head of BTS village, parataxonomist and the other committees for collect information about BTS people and their village. Second questionnaire was covered information about bamboo species include bamboo collection in BTS Community Forest area, bamboo plantation, marketing, trade, information, and knowledge about bamboo cultivation and utilization.

1.4 Homestead

In homestead area some of MFPs were collected. The selection was undertaken based on the main MFPs that used by people in Ban Thung Soong such as bamboo etc. Whole areas of BTS village were randomly collected according to the distribution of bamboo species. Distribution and coordination of each species are recorded by using GPS including information regarding bamboo clumps. For measurement purposes, the height of bamboo were collected and each diameter of culms were measured from three segments (basal, middle and top) from four classes of bamboo culms development stage classes such as bamboo shoots, young culms (2 m and 5 m height) and mature bamboo (5-10 m, 10-15 m, 15-20 m height) according to the four parts of the crown with reference to East, West, North and South. Number of culms per clump and number of shoots per clump of bamboo species in BTS were recorded.

1.5 Study of main MFPs

The study on above-ground biomass of bamboo based on mature culms development stage classes which as follows: 0-5 m, 5-10 m, 10-15 m and 15-20 m height. Two samples from each component were taken as a sample which including culms, branches and leaves. Only mature culms from one sample clumps from each bamboo species were taken as test materials for aboveground biomass. All information about bamboo species such as local name, scientific name, length of culms, culms diameter, wall thickness, number of internodes and nodes, biomass study for fresh weight and dry weight for four components of bamboo such as bamboo culms, leaves, branches and shoots were taken. The branches, leaves and culms are cut and removed then separated for measuring the fresh weight. The culms were cut in three segments (basal, middle and top) of the same length, depending on total height and the diameter of each segment that measured. The 10 cm length culms of each segment are taken as a sample for dry weight measurement. For the fresh weight of branches and leaves, each sample of 200 g was taken. Every fresh weight of each component will be measured and dried to constant weight. All samples were dried at 85^{o}C for 48 hours and dry weight for the samples will be determined after the temperature decrease to room temperature.

2. Data Analysis

All information data and inputs from the questionnaires were analyzed by using Statistical Package for Social Science (SPSS) software and by Analysis of Variance (ANOVA). Calculation of the variables was based on sample plots means.

2.1 Global Positioning System

Data from field collection recorded by Global Positioning System (GPS) were analyzed by using ArcView GIS 3.2a software program for mapping the distribution of some Minor Forest Products (MFPs) in BTS homestead. Data from GPS could be displayed and analyzed based on X and Y geo-coordinates.

2.2 Important Value Index

In this study, quantitative ecological methods were used such as the Important Value Index (IVI) to show the number of dominant plant species in community forest. The IVI analysis used to determine the dominant and species composition in community forest as well as to indicate the sustainable uses status of MFPs among people in BTS. The Important Value Index (IVI) of all stands was determined as:

IVI = relative density (%) + relative frequency (%) + relative dominance (%)

Important Value Index (IVI) is the sum of relative frequency value (frequency of one species as a percentage of total frequency of all species), relative density value (percentage of the total number of stems contributed by a single species) and relative dominance value (percentage of total basal areas contributed by single species). The IVI indicates the figure of ecological importance of a plant species (Curtis and McIntosh, 1951; Risser and Rice, 1971). According to Sukwong (1982), IVI can be used to indicate the ecological succession of plant occupying the areas. The species that has high IVI is the dominant tree. It plays an important role in the community. Since each component value has a maximum value of 100, the IVI of any species in communities range between 0-300.

2.2.1 Species Density

Density refers to the quantity or number of a plant species per unit area or per unit volumes (Wongkhaluang, 1983). According to Kershaws (1973) it is usual to count the number of individuals within a series of randomly distributed quadrats, calculating the average number of individuals related to the size quadrat used, from the sample. Vegetation density can be calculated by method of Greig-Smith, 1964 and Cottam, 1949. The relative density will be determined from all standing tree of DBH larger than 4.5 cm in each stands of 20x50 m^2.

$$\text{Density} = \frac{\text{Total number of species i}}{\text{Quadrate size}}$$

Relative density is used to explain of vegetation in the area that can be calculated by:

$$\text{Relative Density} = \frac{\text{Total number of species i}}{\text{Total number of all species}} \times 100 \quad \text{or}$$

$$\text{Relative Density (\%)} = \frac{\text{Density of species i}}{\text{Total plant density}} \times 100$$

2.2.2 Species Frequency

Frequency is an index to indicate the scatter of plant species. Frequency always shows in percentage of density (Sukwong, 1982). The measure is obtained very simple whether a species is present or not in a series of randomly placed quadrates (Kershaw, 1973). This is more rapid than counting the number of each tree or to measure the cover of plants in the area (Mueller-Dombois and Ellenberg, 1974). The frequency can be calculated by:

$$\text{Frequency} = \frac{\text{Number of quadrate that species i occurred}}{\text{Number of all quadrate}}$$

Relative frequency is used for the number of a species occurred in a given number of repeatly placed small sample plots. The relative frequency will be determined for 10 sample plots of 10x10 m^2, which set by regularly subdividing from stand 20x50 m^2. This value is useful for searching the ecological importance of each species in community that can be calculated as follows:

$$\text{Relative Frequency (\%)} = \frac{\text{Frequency of species i}}{\text{Total frequency of all species}} \times 100$$

2.2.3 Species Dominance

Dominant defined as the class representing the most abundant species, means that species exerts the most influence on the other species of the community (Kershaw, 1973). Dominance value always shows in percentage of quadrate areas and measurements or estimate the pattern of plant covering the area. Basal area of stem is the most commonly employed measure for this purpose (basal area refers to the cross-sectional area of plant at breast height). For relative dominance, the basal area at breast height will be computing as $\pi D^2/4$, of each tree species in whole plots. The vegetation dominance can be calculated as follows:

$$\text{Relative Dominance (\%)} = \frac{\text{Total basal area of species i}}{\text{Total basal area of all species}} \times 100$$

2.3 Above-ground biomass

For biomass study for some species mostly in grass group, for instances bamboo, the data were analyzed by biomass formula. Only above-ground biomass is taken which included culms, leaves and branches as samples. Conversion of the total fresh weight to total dry-weight calculated based on the methods used for moisture content determination. The total dry weight can determine the total aboveground biomass of bamboo. Biomass is the total quantity of organic matter per unit area present in an ecosystem at a given time and may relate to a particular species (a) group of species of a community as a whole (Shanmughavel and Francis, 2001). According to Hunter and Junqi (2002), productivity of bamboo is generally within the range of woody biomass in the same environment with the exception that bamboo culms biomass never seems to reach the very high values attainable by tree stem biomass in favaourable situations. According to Jayaraman (2000), weight is the standard measure in the case of MFPs as well. Hence biomass is usually expressed in terms of dry weight of components part of plants such as stems, branches and leaves. For bamboo biomass, the aboveground components such the leaves, culms and branches with its weight from each culm are taken. The total dry weights of each components of bamboo are presented for total biomass. The biomass can be calculated as follows (Jayaraman, 2000):

$$\text{Total dry weight} = \frac{\text{Dry weight of the sample}}{\text{Fresh weight of sample}} \times \text{Total fresh weight}$$

2.4 Soil analysis

The collected soil samples from BTS Communtiy Forest were brought back to laboratory and analyzed in Forest soil laboratory, Faculty of Forestry, Kasetsart University. The soil texture, bulk density, particle density, porosity and soil component including solids, moisture and gases were analyzed.

STUDY AREA

The study conducted in Ban Thung Soong (BTS) Community Forest and homestead in Krabi province. Krabi is one of the Southern Province (*Changwat*) of Thailand and located the along Andaman Sea shore. Krabi area is approximately 4,708.5 km^2 (2,942 820 rai) with about 336,210 people and population density is 71 in/km^2. Krabi is located 814 kilometers from Bangkok and between latitude $7^0$30' and $8^0$30' North and $98^0$30' and longitude $99^0$30' East with altitude about 6 m above sea level on land (Figure 3). The province consists of mountains, hills (solitary limestone hills, plains and mangrove forest, Rain Evergreen Forest, Dry Everegreen Forest, Beach Forest and Fresh Water Swamp Forest including more than 130 large and small islands. Natural forest mostly consists of mangrove and trees. Krabi's sandy clay soil conditions are perfect for a variety of agricultural products, including: rubber trees, oil palms, oranges, coconuts, fruit trees especially mangosteen and coffee. Krabi was bordered as follow;

To the North: Lies Phang-Nga and Surat Thani Provinces
To the South: Lies Trang Province and the Andaman Sea
To the East: Lies Trang and Nakhon Si Thammarat provinces
To the West: Lies Phang-Nga Province and the Andaman Sea

Krabi is subdivided into eight districts (*Amphoe*) and divided into 53 subdistricts (*Tambon*) with 374 villages (*Mubaan*). The eights districts are located in various subdistrcits including Muang Krabi, Khao Phanom, Ko Lanta, Khlong Thom, Ao Luek**,** Plai Phraya, Lam Thap and Nuea Khlong. Recently, there are 66 Community Forest (CF) areas in Krabi Province, which are Muang Krabi (17 CF), Khao Phanom (11 CF), Ko Lanta (8 CF), Khlong Thom (7 CF), Ao Luek (12 CF), Plai Phraya (1 CF), Lam Thap (2 CF) and Nuea Khlong (8 CF).

BTS is one of the five villages in Khao Yai Subdistricts and part of Ao Luek Districts. BTS village was located between latitudes $8^0$27' and $8^0$30' North, longitude $98^0$42' and $98^0$45' East. BTS village are classified as a flat and hill terrain with the ground surface at the 30 to 350 m above Mean Sea Level (MSL). There are three hills that bordered BTS landform which are, on the north, northeast and northwest village area, namely Kuan Ying Wua Hill, Khao Yai Hill and Kho Lang Tang Hill. Kuan Ying Wua Forest was BTS community forest. People in BTS village were conserved and protected Kuan Ying Wua Forest for 50 years. Barrebo (2004) previously reported that the village has 236 families (approximately 1,053 people) living in BTS. According to Sawatdee (2002), total area of the village was approximately 16,336 rai (26.14 km2) and total protected forest area of 7,300 rai (1,168 hectares). The land use type of village were comprised the forest, rubber plantation 1,866 rai, oil palm plantation 5,600 rai and other land use 820 rai. Figure 3 shows the location map of Ban Thung Soong in Krabi Province.

The study collected from two areas which include BTS Community Forest area for plant vegetation study and homestead area for bamboo species. Figure 4 shows the distribution of stands (20x50 m^2) in BTS community forest are divided into

three elevation levels of 0-100 m, 100-200 m and 200-300 m. There are 12 stands (20x50 m^2/10 stands) were established for study the plant species vegetation. The forest type of BTS Community Forest (Kuan Ying Wua Hill) is Tropical Moist Forest or Evergreen Forest. For the homestead study, whole areas of BTS village locating bamboo clumps distribution are mapping in the BTS map.

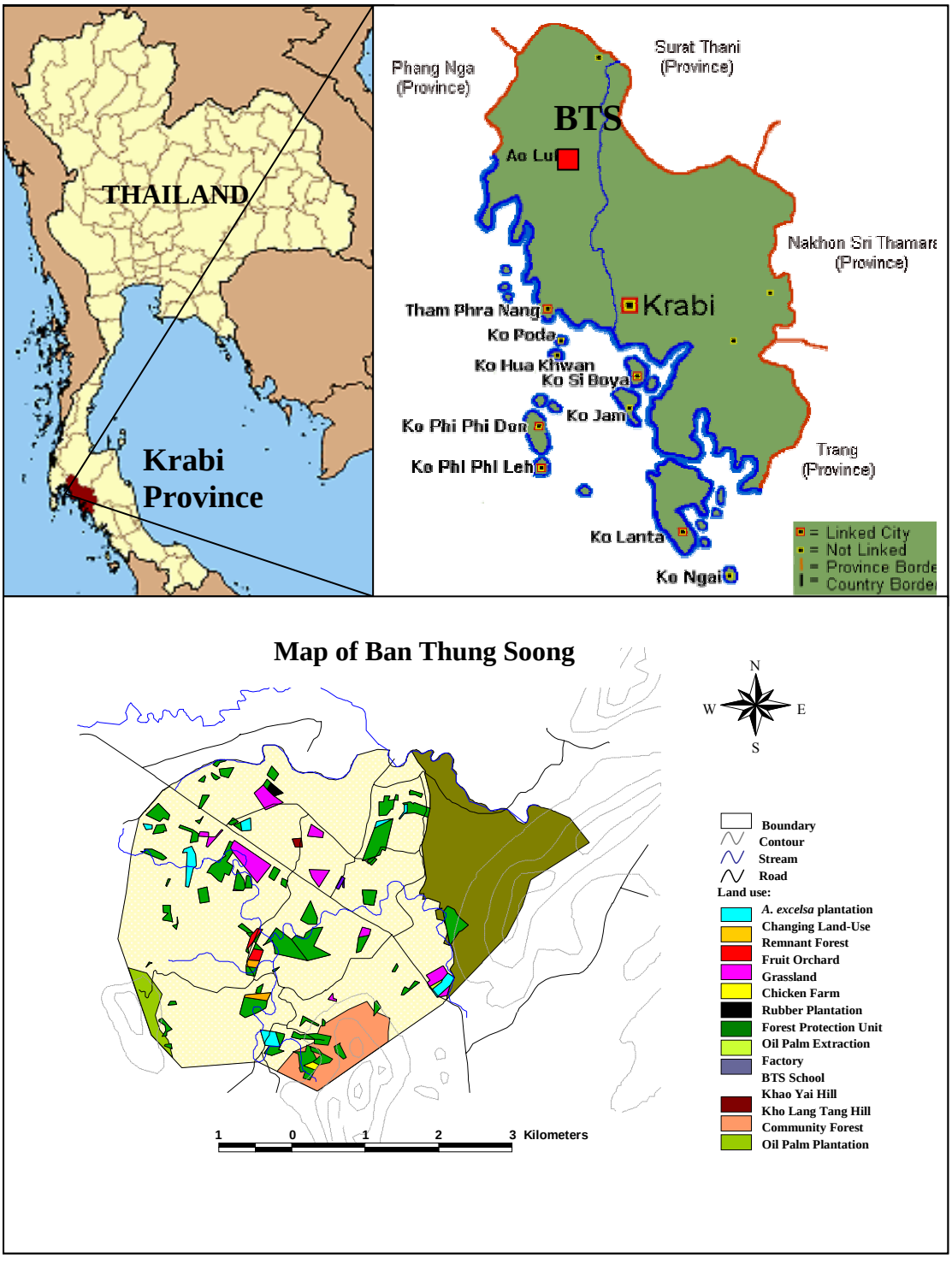

Figure 3 Map of Ban Thung Soong Village in Krabi Province in Thailand

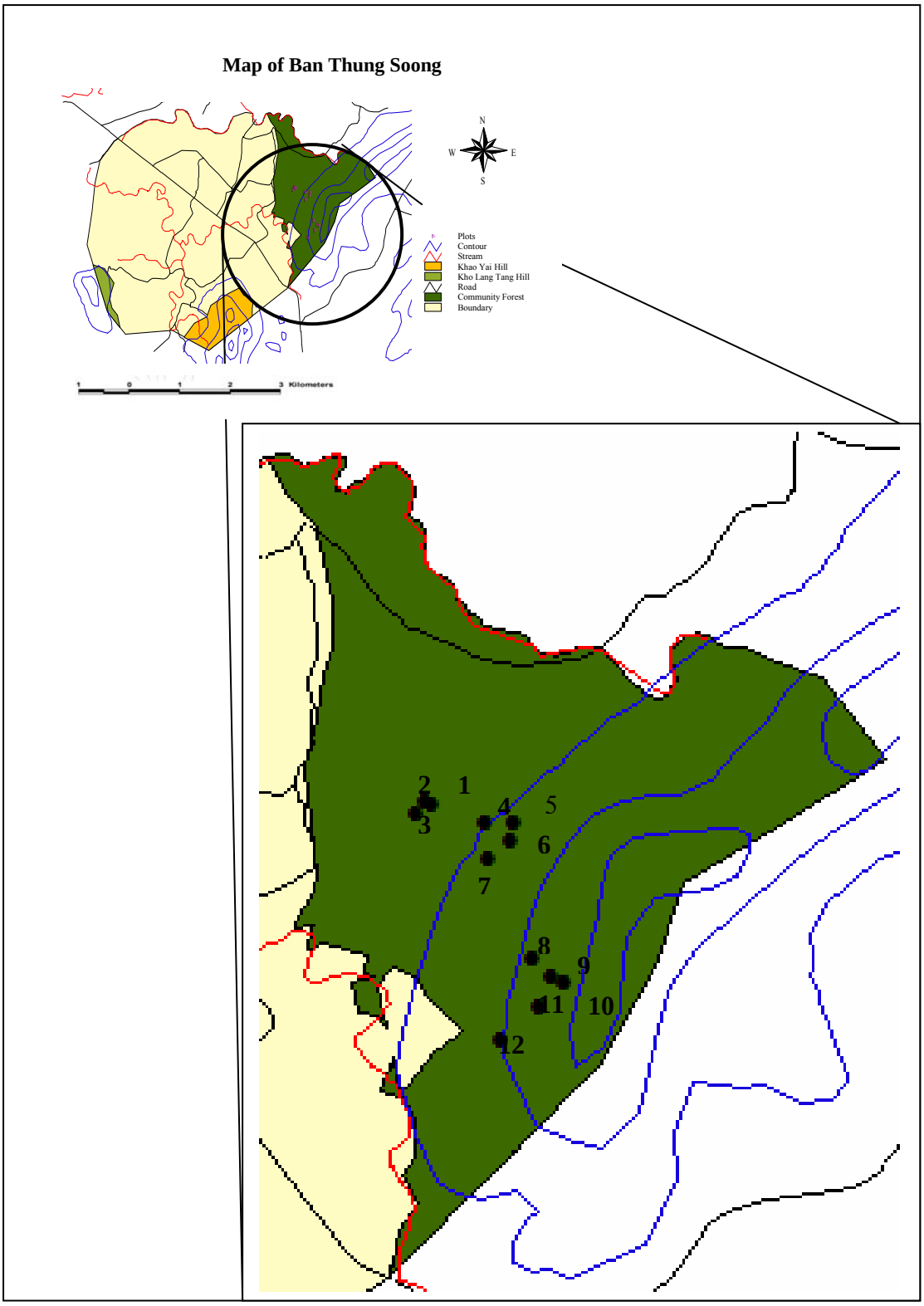

Figure 4 Map of stand (20x50 m^2/10 plots) distribution in Ban Thung Soong Community Forest

1. Climate

Climate and weather in Krabi Province and Ban Thung soong (BTS) village typically characteristic of tropical monsoon climate (AM) and were influenced mainly by three monsoons which are southwest, northwest, northeast monsoon and also by cyclone and depression storms. There are two seasons that occurr in this area such as (Sawatdee, 2002):

1. Rainy season will be occurred during late April to December, approximately 9 months. Any kind of monsoon wind, which change according to season, blow from the southeast, the southwest, and the northeast. There was divided into two periods. The first period during the late April to the late September, the rain fall continuously and monthly about 200 to 300 mm, because of the southwest monsoon, the air mass moved from the Indian Ocean and brought rain. Second period starting from December to January that influenced from the northeast monsoon, the air mass moved from the Gulf of Thailand and brought few rainfalls because of the topographic prevention of the Khao Phanom Benja Mountain Range and Khao Luang Mountain Range on Nakhon Si Thammarat Province.

2. Dry season from January to April. This season influence from southeast monsoon; the air mass moved from the high pressure in the South China Sea and brought slight rain. The average monthly rainfall ranged from 3.2 mm to 412.8 mm (annual rainfall 2,224.5 mm). The minimum rainfall occurred during January influenced from the northeast monsoon. The maximum rainfall normally occurred in September due to the southwest monsoon from the Indian Ocean.

2. Temperature

The annual temperature of the area is shown in Table 7. The average annual temperatures range between 16.9 and 37.3 degrees Celsius; average annual rainfall with 2,586.5 mm (Figures 5 and 6). The highest temperature of 36.6^0C recorded in February and May (mean maximum temperature 32.3^0C). The lowest temperature of 19.5^0C occurred during December (mean minimum temperature 23.6^0C).

3. Vegetation

BTS has comprised three hills namely Kuan Ying Wua, Khao Yai and Kho Lang Tang. There are covered by tropical moist forest, which slightly different in structure and species composition. The Moist and Dry Forest in Kuan Ying Wua and Khao Lang Tang hills was the secondary forest that success from logging and from setting telecommunication station, respectively. Forest type of Khao Yai was the Tropical Moist Forest and in the top of forest is the limestone mountain. These forest areas were dominated by *Dipterocarp* sp., *Hopea* sp., *Alstonia* sp., *Memecylon* sp., *Syzygium* sp., *Ficus* sp., and etc (Sawatdee, 2002)

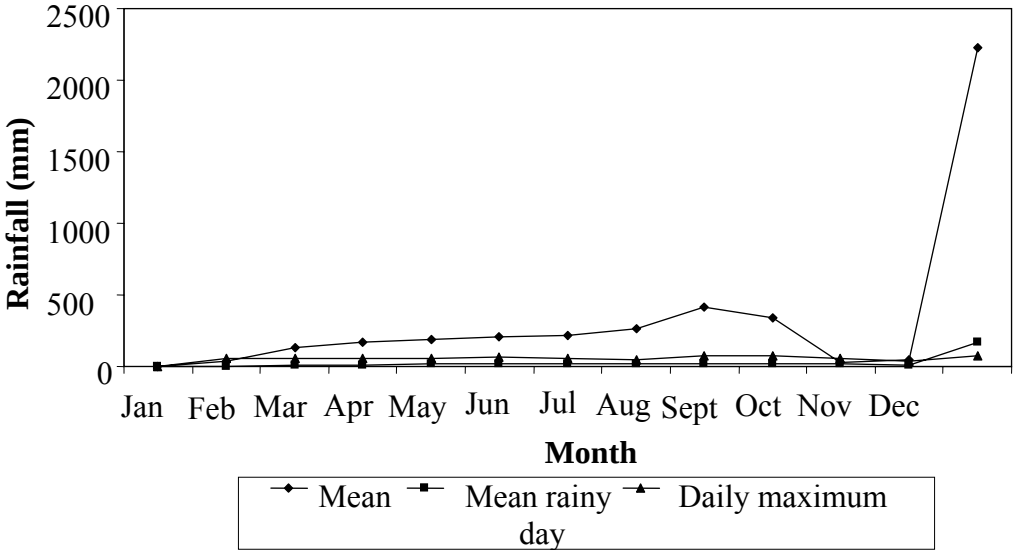

Figure 5 The average monthly rainfall at Ao Luek District (9 km from BTS Community Forest).

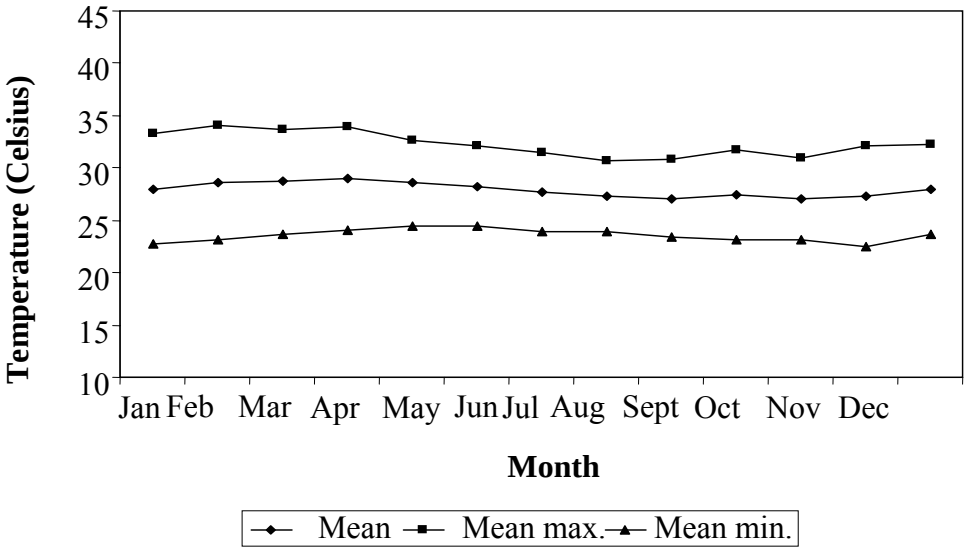

Figure 6 The average monthly temperature at Ao Luek District (9 km from BTS Community Forest).

Table 7 Total rainfall, air temperature and wind at Krabi Station during 1994-1995.

Item	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Rainfall (mm)													
Mean	3.2	33.8	136.6	172.7	191.2	203.2	214.2	264.2	412.8	338.3	26.4	47.9	2224.5
Mean rainy day	1.5	2.5	12.0	14.0	17.0	15.5	20.5	21.0	21.0	20.0	20.5	7.0	172.5
Daily maximum	3.8	60.1	60.1	57.7	54.9	65.4	54.2	44.7	75.5	75.9	56.5	35.9	75.9
Temperature (Celsius)													
Mean	28.0	28.6	28.7	29.0	28.6	28.2	27.7	27.3	27.1	27.4	27.0	27.3	28.0
Mean max.	33.3	34.1	33.7	34.0	32.7	32.1	31.5	30.7	30.8	31.7	30.9	32.1	32.3
Mean min.	22.7	23.2	23.7	24.1	24.5	24.4	23.9	23.9	23.4	23.1	23.2	22.5	23.6
Ext. max.	34.9	36.3	35.5	36.3	36.6	34.6	33.9	33.4	32.6	34.0	33.8	33.6	33.6
Ext. min	20.2	21.5	22.5	22.7	23.0	22.2	22.1	21.8	22.0	21.7	22.1	19.5	19.5
Wind (Knot)													
Mean wind speed	-	-	-	-	-	-	-	-	-	-	-	-	-
Prevailing wind	NE	NE	NE	W	W	W	W	W	W	W	NE	NE	-
Max. windspeed	20	30	25	28	22	30	42	26	26	43	25	33	43

RESULTS AND DISCUSSION

Community Forest

1. Community structure

1.1 Species composition

The number of tree species and number of plants in the previous research and present in BTS Community Forest which include saplings and seedlings in stands (20x50 m^2) are shown in Table 8. In the previous research by Sawatdee (2002), there are 61 species of trees, 30 saplings and 31 seedlings and as comparison to the present study, the number of trees, saplings and seedlings are 65; 59 and 32 respectively were found in BTS Community Forest. The different between previous and present research are using different stands. In the previous research the stands were used 40x40 m^2 and the present research with 20x50 m^2. This study shows the differing from Sawatdee (2002) because the size and number of stands, and number of species are different. Compare to the others Moist Evergreen Forest in the Southern such as at Khao Chong, Trang and Khao Pra Taew, Phuket had 150$\pm$22 species per ha respectively (Kiratiprayoon, 1986). According to Glumphabutr (2004), the number of plant species in the Moist Evergreen Forest and Dry Evergreen Forest are 135 and 138 species respectively showed sightly higher than in the Hill Evergreen Forest with 129 species. The study also indicates that the number of species at high elevation at 200-300 m attitude was higher than at lower elevation (0-100 m altitude). From this study, the composition of species from the 12 stands (20x50 m^2) indicates that at 0-100 m altitude, the number of trees about 338 trees with 3 stands, at 100-200 m altitude comprise 478 trees with 4 stands and at level 200-300 m were consisted about 593 trees with 5 stands. The compositions of trees from the three altitude levels are not much different. The number of trees, saplings and seedlings per ha in BTS Community Forest are 4,697; 119,166 and 252,500 of trees ha^{-1} respectively. Sawatdee (2002) indicates that the density of trees, saplings and seedlings per ha in BTS Community Forest are 1,638 trees, 18,906 saplings and 141,251 seedlings.

According to Gardner *et al.,* 2000, the common emergent trees in Tropical Moist Evergreen Forest are *Atrocarpus fraxinifolius, Hopea odorata* Roxb., *Dipterocarpus alatus* Roxb. ex G.Don, *Ficus* spp. and *Tetrameles nudiflora* R.Br. In BTS Community Forest the emergent trees are including *Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen, *Homalium undulatum* King, *Mangifera caloneura* Kurz, *Lithocarpus collettii* A. Camus, *Vatica stapfiana* (King) Slooten, and *Eurya acuminata* DC. var. *acuminata.* Glumpahabutr (2004) indicates that the dominant trees in Moist Evergreen Forest in Chantaburi Province consist of *Dipterocarpus alatus* Roxb. ex. G.Don, *Anisoptera costata* Korth, *Sterculiaceae campanulata* Wal, *Hopea odorata* Roxb., *Irvingia malayana* Oliv. ex A. W.enn. and etc.

Table 8 Quantitative characteristics of trees, saplings and seedlings in Ban Thung Soong Community Forest

	Previous study (Sawatdee, 2002)			Present in BTSCF		
Quantitative characteristics	T	S	Se	T	S	Se
Number of species	61	30	31	65	50	49
Number of trees (per plot)	524	121	113	1,413	572	303
Density of trees (per ha)	1,638	18,906	141,251	4,697	119,166	252,500
Basal area (per plot)	8.56			36.45		
Percentage of basal area (%)	0.0856			0.3645		
Average DBH (cm) (per plot)				14.53		
Average height (m) (per plot)	12.5	4.06	4.01	13.75	3.43	0.24

Note: T = Trees, S = Saplings, Se = Seedlings

The list of plants in BTS Community Forest is shown in Table 9. There are 36 families and 65 species are comprise in BTS Community Forest. The compositions of species are influenced by forest type in BTS which are Tropical Moist Evergreen Forest and some plants are native of Southern of Thailand, for example *Bouea oppositifolia* (Roxb.) Meisn., *Canarium denticulatum* Blume, *Prismatomeris* sp., *Bhesa indica* (Bedd.) Ding Hou, *Diospyros cauliflora* Blume, *Fagraea racemosa* Jack and *Cryptocarya ferea* Blume. The result shows that the BTS Community Forest consist plant species about 42 species, 9 species of shrub/trees, 7 species of shrub/shrubby trees and shrubs with 7 species. The highest number of trees found in Euphorbiaceae which consist of 5 species, 4 species of Dipterocarpaceae, 4 species of Moraceae, 3 species of Rubiaceae, Lauraceae, Leguminosae-Mimosoideae and Myrtaceae respectively.

Table 9 List of plants in Ban Thung Soong Community Forest

No.	Family name	Scientific name	Vernacular name	Habitat
1.	Anacardiaceae	*Bouea oppositifolia* (Roxb.) Meisn.	Ma pring	T
2.	Anacardiaceae	*Mangifera caloneura* Kurz	Mamuang pa	T
3.	Annonaceae	*Polyalthia* sp.	Lang kong	T
4.	Apocynaceae	*Alstonia scholaris* (L.) R.Br.	Tin pet	T
5.	Burseraceae	*Canarium denticulatum* Blume	Laen ban	T
6.	Celastraceae	*Bhesa indica* (Bedd.) Ding Hou	Hu yan	T
7.	Celastraceae	*Euonymus javanicus* Blume	Khao kwang	S/T
8.	Crypteroniaceae	*Crypteronia paniculata* Blume	Som	T
9.	Dilleniaceae	*Dillenia obovata* (Blume) Hoogland	San	T
10.	Dipterocarpaceae	*Dipterocarpus grandiflorus* (Blanco) Blanco	Yung	T
11.	Dipterocarpaceae	*Hopea griffithii* Kurz	Ta khian	T
12.	Dipterocarpaceae	*Shorea* roxburghii G.Don	Phayom	T
13.	Dipterocarpaceae	*Vatica stapfiana* (King) Slooten	Sak	T
14.	Ebenaceae	*Diospyros cauliflora* Blume	Thao saen pom	S/T
15.	Ebenaceae	*Diospyrod undulata* Wall. ex. G.Don var. *undulata*	Duk chang	S
16.	Euphorbiaceae	*Aporosa villosa* (Wall. ex Lindl.) Baill.	Krom	S/T
17.	Euphorbiaceae	*Baccaurea parviflora* (Müll.Arg.) Müll.Arg.	Mafai ka	T
18.	Euphorbiaceae	*Baliospermum solanifolium* (Burm.) Suresh	Tong taek	S

Table 9 (Continued)

No.	Family name	Scientific name	Vernacular name	Habitat
19.	Euphorbiaceae	*Cleidion spiciflorum* (Burm.f.) Merr.	Din mi	T
20.	Euphorbiaceae	*Cleisthanthus polyphallus* F.N. Williams	Nok non	S
21.	Fagaceae	*Lithocarpus collettii* A.Camus	Ko	T
22.	Fagaceae	*Lithocarpus grandifolius* (D.Don) Bigwood	Ko mu	T
23.	Flacourtiaceae	*Homalium caryophyllaceum* (Zoll. & Moritzi) Benth.	Naeng	T
24.	Flacourtiaceae	*Homalium undulatum* King	Daeng khao	T
25.	Gnetaceae	*Gnetum gnemon* L. var. *tenerum*	Phak miang	S/T
26.	Guttiferae	*Calophyllum polyanthum* Wall. ex Choisy	Tang hon	T
27.	Guttiferae	*Garcinia cowa* Roxb. ex DC.	Cha muang	S/T
28.	Guttiferae	*Cratoxylum maingayi* Dyer	Taeo	T
29.	Ixonanthaceae	*Ixonanthes reticulata* Jack	Khi klak	T
30.	Labiatae	*Vitex glabrata* R.Br.	Khainao	T
31.	Labiatae	*Vitex pinnata* L.	Non	T
32.	Lauraceae	*Cinnamomum iners* Reinw. ex Blume	Chiat	T
33.	Lauraceae	*Cryptocarya ferea* Blume	Thang bai lek	T
34.	Lauraceae	*Phoebe paniculata* (Nees) Nees	Chan thip	T
35.	Leguminosae-Caesalpinioideae	*Cynometra iripa* Kostel.	Mang kha	S/T
36.	Leguminosae-Mimosoideae	*Archidendron clypearia* (Jack) I.C.Nielsen	Namwa	T
37.	Leguminosae-Mimosoideae	*Parkia speciosa* Hassk.	Sato	T

Table 9 (Continued)

No.	Family name	Scientific name	Vernacular name	Habitat
38.	Leguminosae-Mimosoideae	*Xylia xylocarpa* (Roxb.) Taub. var. *kerii* (Craib & Hutch.) I.C.Nielsen	Daeng	T
39.	Loganiaceae	*Fagraea racemosa* Jack	Wa nam	S/ST
40.	Lythraceae	*Lagerstroemia* sp.	Salao	T
41.	Melastomataceae	*Memecylon garcinioides* Blume	Plong	S/T
42.	Meliaceae	*Aglaia odoratissima* Blume	Sang khriat lang khao	S/ST
43.	Meliaceae	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	Sadao	T
44.	Moraceae	*Artocarpus lacucha* Roxb.	Hat	T
45.	Moraceae	*Artocarpus* sp.	Kradang	T
46.	Moraceae	*Ficus chartacea* Wall. ex King var. *torulosa* Wall.	Duea nok	T
47.	Moraceae	*Ficus hispida* L.f.	Duea plong	S/T
48.	Myristicaceae	*Gymnacranthera eugeniifolia* (A. DC.) J.Sinclair	Lueat kwai bai lek	S/T
49.	Myristicaceae	*Knema globularia* (Lam.) Warb.	Han	T
50.	Myrsinaceae	*Ardisia ionantha* K.Larsen & C.M.Hu	Philang kasa	T
51.	Myrtaceae	*Rhodamnia cinerea* Jack var. *cinerea*	Phae	S
52.	Myrtaceae	*Syzygium diospyrifolium* (Wall. ex Duthie) S.N.Mitra	Chomphu nam	S
53.	Myrtaceae	*Syzygium* sp.	Wa	T
54.	Rhizophoraceae	*Carallia brachiata* (Lour.) Merr.	Ko heng	T
55.	Rubiaceae	*Prismatomeris* sp.	Duk kai	S
56.	Rubiaceae	*Psychotria* sp.	Kha nang	S
57.	Rubiaceae	*Morinda elliptica* Ridl.	Yo pa	S/ST

Table 9 (Continued)

No.	Family name	Scientific name	Vernacular name	Habitat
58.	Rutaceae	*Acronychia pendulata* (L.) Miq.	Yom pha ranap	S/ST
59.	Sapindaceae	*Zollingeria dongnaiensis* Pierre	Khi non	T
60.	Sapotaceae	*Madhuca kerrii* H.R.Fletcher	Dueai kai	T
61.	Simaroubaceae	*Eurycoma longifolia* Jack	Lai phueak	S/ST
62.	Symplocaceae	*Symplocos cochinchinensis* (Lour.) S.Moore subsp. *cochinchinensis*	Lot	S/ST
63.	Theaceae	*Eurya acuminata* DC. var. *acuminata*	Plai san	S/ST
64.	Theaceae	*Schima wallichii* (DC.) Korth.	Mangtan	T
65.	Tiliaceae	*Pentace triptera* Mast.	Lueat nok	T

Note: T: Tree; S: Shrub; S/ST: Shrub/Shrubby Tree; S/T: Shrub/Tree

Table 10 shows the list of MFPs found in BTS Community Forest. The MFPs are divided into categories namely as edible plants, medicinal plants and non-edible plants. There are 28 families with 49 species from 65 species which founded in BTS Community Forest are categories as MFPs. The highest MFPs families are Moraceae with 5 species, 3 species of Euphorbiaceae, Rubiaceae and Myrtaceae respectively. The medicinal plants show the highest composition with 23 families and 32 species were found in BTS Community Forest. The medicinal plants are including *Bouea oppositifolia* (Roxb.) Meisn. *Mangifera caloneura* Kurz, *Diospyros cauliflora* Blume, *Cinnamomum iners* Reinw. ex Blume, *Schima wallichii* (DC.) Korth., and *Eurya acuminata* DC. var. *acuminata.* The result also indicates that there are 10 families and 13 species of MFPs are edible plants which can be use as food. The species such as *Bouea oppositifolia* (Roxb.) Meisn., *Cratoxylum maingayi* Dyer, *Azadirachta indica* A.Juss. var. *siamensis* Valeton, *Ficus hispida* L.f. and *Eurya acuminata* DC. var. *acuminata* are edible plants. Most of people use leaves, fruits, seeds, flowers, young shoots and sprouts as food. According to de Padua *et al.* (1999), *Ficus hispida* L.f. can be used as medicinal plants and edible plants. The leaves also taken to treat fever, diarrhoea and to relieve painful urination and the fruits are also eaten in curries and ripe fruits are made into a jam. The bamboo species is categories as non-edible plants and edible plants. There are only one species of bamboo is found in the stands (20x50 m^2). The *Bambusa bambos* (L.) Voss is the dominant bamboo species in BTS Community Forest.

The non-edible plants consist of ornamental plants, chemical components (exudates and extracts), non-industrial timber, fibers and leaves. There are 18 families and 22 species of non-edible plants namely *Diospyros cauliflora* Blume, *Diospyros undulata* Wall. ex G.Don var. *undulata, Aporosa villosa* (Wall. ex Lindl.) Baill., *Homalium undulatum* King, *Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen, *Memecylon garcinioides* Blume, *Artocarpus* sp., *Cryptocarya ferea* Blume, *Vitex pinnata* L. and *Ixonanthes reticulata* Jack. The uses of wood from MFPs are defined only for non-industrial timber and own uses such as pole, house flooring, household tools, and etc. People in BTS use wood from *Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen as pole, house flooring, and etc. According to Lemmens *et al.* (1995), the timber of *Vitex pinnata* L. is not important for commercial timber industries because it is usually not available in larger composition and locally favoured for construction, boats and implements as well as for medicinal purposes. The leaves and bark of *Vitex pinnata* L. are used in local medicines to against stomach-ache, as febrifuge and to heal wounds.

Table 10 Minor Forest Products in Ban Thung Soong Community Forest

No.	Plant categories	Family name	Scientific name	Vernacular name
1.	Edible plants	Anacardiaceae	*Bouea oppositifolia* (Roxb.) Meisn.	Ma pring
2.		Gnetaceae	*Gnetum gnemon* L. var. *tenerum*	Phak miang
3.		Guttiferae	*Garcinia cowa* Roxb. ex DC.	Cha muang
4.		Guttiferae	*Cratoxylum maingayi* Dyer	Taeo
5.		Labiatae	*Vitex glabrata* R.Br.	Khainao
6.		Leguminosae-Mimosoideae	*Parkia speciosa* Hassk.	Sato
7.		Meliaceae	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	Sadao
8.		Moraceae	*Artocarpus* sp.	Kradang
9.		Moraceae	*Ficus hispida* L.f.	Duea plong
10.		Myrtaceae	*Syzygium diospyrifolium* (Wall. ex Duthie) S.N.Mitra	Chomphu nam
11.		Myrtaceae	*Syzygium* sp.	Wa
12.		Rubiaceae	*Morinda elliptica* Ridl.	Yo pa
13.		Theaceae	*Eurya acuminata* DC. var. *acuminata*	Plai san

Table 10 (Continued)

No.	Plant categories	Family name	Scientific name	Vernacular name
14.	Edible plants	Anacardiaceae	*Mangifera caloneura* Kurz	Mamuang pa
15.	Medicinal plants	Anacardiaceae	*Bouea oppositifolia* (Roxb.) Meisn.	Ma pring
16.		Apocynaceae	*Alstonia scholaris* (L.) R.Br.	Tin pet
17.		Burseraceae	*Canarium denticulatum* Blume	Laen ban
18.		Celastraceae	*Bhesa indica* (Bedd.) Ding Hou	Hu yan
20.		Dilleniaceae	*Dillenia obovata* (Blume) Hoogland	San
21.		Ebenaceae	*Diospyros cauliflora* Blume	Thao saen pom
22.		Euphorbiaceae	*Baliospermum solanifolium* (Burm.) Suresh	Tong taek
23.		Gnetaceae	*Gnetum gnemon* L. var. *tenerum*	Phak miang
24.		Guttiferae	*Garcinia cowa* Roxb. ex DC.	Cha muang
25.		Guttiferae	*Cratoxylum maingayi* Dyer	Taeo
26.		Labiatae	*Vitex pinnata* L.	Non
27.		Lauraceae	*Cinnamomum iners* Reinw. ex Blume	Chiat
28.		Leguminosae-Mimosoideae	*Parkia speciosa* Hassk.	Sato
29.		Meliaceae	*Aglaia odoratissima* Blume	Sang khriat lang khao
30.		Meliaceae	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	Sadao
31.		Moraceae	*Artocarpus lacucha* Roxb.	Hat
32.		Moraceae	*Ficus hispida* L.f.	Duea plong
33.		Myristicaceae	*Knema globularia* (Lam.) Warb.	Han

Table 10 (Continued)

No.	Plant categories	Family name	Scientific name	Vernacular name
34.	Medicinal plants	Myristicaceae	*Gymnacranthera eugeniifolia* (A. DC.) J.Sinclair	Lueat kwai bai lek
35.		Myrsinaceae	*Ardisia ionantha* K.Larsen & C.M.Hu	Philang kasa
36.		Myrtaceae	*Syzygium diospyrifolium* (Wall. ex Duthie) S.N.Mitra	Chomphu nam
37.		Myrtaceae	*Syzygium* sp.	Wa
38.		Rhizophoraceae	*Carallia brachiata* (Lour.) Merr.	Ko heng
39.		Rubiaceae	*Ixora lobbii* King & Gamble	Kem
40.		Rubiaceae	*Morinda elliptica* Ridl.	Yo pa
41.		Rubiaceae	*Prismatomeris* sp.	Duk kai
42.		Sapindaceae	*Zollingeria dongnaiensis* Pierre	Khi non
43.		Simaroubaceae	*Eurycoma longifolia* Jack	Lai phueak
44.		Theaceae	*Eurya acuminata* DC. var. *acuminata*	Plai san
45.		Theaceae	*Schima wallichii* (DC.) Korth.	Mangtan
46.		Tiliaceae	*Pentace triptera* Mast.	Lueat nok
47.	Non-edible plants	Anacardiaceae	*Mangifera caloneura* Kurz	Mamuang pa
48.		Celastraceae	*Bhesa indica* (Bedd.) Ding Hou	Hu yan
49.		Ebenaceae	*Diospyros cauliflora* Blume	Thao saen pom
50.		Ebenaceae	*Diospyros undulata* Wall. ex G.Don var. *undulata*	Duk chang
51.		Euphorbiaceae	*Aporosa villosa* (Wall. ex Lindl.) Baill.	Krom

Table 10 (Continued)

No.	Plant categories	Family name	Scientific name	Vernacular name
52.	Non-edible plants	Euphorbiaceae	*Cleisthanthus polyphallus* F.N. Williams	Nok non
53.		Flacourtiaceae	*Homalium undulatum* King	Daeng khao
54.		Ixonanthaceae	*Ixonanthes reticulata* Jack	Khi klak
55.		Labiatae	*Vitex pinnata* L.	Non
56.		Lauraceae	*Cryptocarya ferea* Blume	Thang bai lek
57.		Leguminosae-Caesalpinioideae	*Cynometra iripa* Kostel.	Mang kha
58.		Lythraceae	*Lagerstroemia* sp.	Salao
59.		Melastomataceae	*Memecylon garcinioides* Blume	Plong
60.		Meliaceae	*Aglaia odoratissima* Blume	Sang khriat lang khao
61.		Moraceae	*Artocarpus* sp.	Kradang
62.		Moraceae	*Ficus chartacea* Wall. ex King var. *torulosa* Wall.	Duea din
63.		Moraceae	*Ficus* sp.	Pho
64.		Myrsinaceae	*Ardisia virens* Kurz	Ta pet ta kai
65.		Myrtaceae	*Rhodamnia cinerea* Jack var. *cinerea*	Phae
66.		Proteaceae	*Heliciopsis terminalis* (Kurz) Sleumer	Khot
67.		Sapindaceae	*Zollingeria dongnaiensis* Pierre	Khi non
68.		Theaceae	*Schima wallichii* (DC.) Korth.	Mangtan
69.	Bamboo	Gramineae	*Bambusa bambos*	Phai pa

1.2 Species density

The density of species which including trees with DBH≥4.5 cm, saplings and seedlings are shown in Table 8. The result shows that density of tree ha^{-1} with DBH≥4.5 cm in BTS Community Forest are 4,697 trees ha^{-1} with 65 species found in BTS Community Forest. The density of saplings is 119,166 sapings ha^{-1} with 50 species and seedlings were consisted 252,500 seedlings ha^{-1} with 49 species. According to the research in BTS Community Forest by Sawatdee (2002), the species density of trees with DBH≥4.5 cm, saplings and seedlings are about 1,638 trees ha^{-1}, 18,906 saplings ha^{-1} and 141,251 seedlings ha^{-1} respectively. As comparison, the density of trees in Moist Evergreen Forest and Dry Evergreen Forest in Chantaburi Province consist about 1,510 trees ha^{-1} and 1,355 trees ha^{-1} respectively which lower than in the Hill Evergreen Forest with 2,513 trees ha^{-1} (Glumphabutr, 2004). The result shows that the density of trees with DBH≥4.5 cm in BTS Community Forest are higher than the Hill Evergreen Forest in Chantaburi Province. The density of trees is higher because of the composition of the small trees. The mean DBH for Hill Evergreen Forest trees is lower with 10.8 cm than Moist Evergreen Forest and Dry Evergreen Forest about 13.7 cm and 13.1 cm respectively. The average DBH for trees in BTS is 14.53 cm. The average diameter at breast height determines the size of trees will influence the composition of species in the plot area.

1.3 Diameter at breast height and basal area

The average DBH for trees with diameter more than 4.5 cm are shown in Tables 11, 12 and 13. The distribution of tree species were categorized to three elevation levels from 0-100 m, 100-200 m and 200-300 m in Ban Thung Soong Community Forest. The DBH ranges from 4.5 cm to 84.5 cm. Table 11 shows the diameter at breast height classes for trees with DBH≥4.5 cm at 0-100 m altitude. The result shows that at level 0-100 m altitude, the diameter classes from 4.5 cm to 9.5 cm comprise the highest number of trees with 204 trees. The *Homalium undulatum* King consist the highest number of trees with 30 trees at DBH 4.5 to 9.5 cm. The DBH for trees at 100-200 m altitude is shown in Table 12. The result shows that in this level, the diameter classes from 4.5 to 9.5 cm comprise the highest number of trees with 221 trees. In this altitude, the tree of *Homalium undulatum* King shows the highest number of trees with 39 trees at DBH classes 4.5 to 9.5 cm. Table 13 shows the DBH of trees at 200-300 m altitude. The diameter classes from 4.5 to 9.5 cm comprise the highest number of trees with 294 trees, but the others diameter classes such as 9.5 to 54.5 cm also comprise moderate quantity of trees from 9 to 87 trees. In this level the *Mangifera caloneura* Kurz consist the highest number of trees with 32 trees which followed by *Vatica stapfiana* (King) Slooten with 31 trees and 27 trees of *Madhuca kerrii* H.R.Fletcher at DBH classes 4.5 to 9.5 cm respectively. The diameter classes from each altitude levels according to the highest total number of trees in BTS Community Forest are shown in Figures 7, 8 and 9.

Table 11 DBH distribution classes of trees with DBH≥4.5 cm at 0-100 m altitude in Ban Thung Soong Community Forest

Local name	Scientific name	DBH classes (cm)											Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	
Chiat	*Cinnamomum iners* Reinw. ex Blume	1											1
Daeng	*Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen	16	4		2		1	1	2				26
Daeng khao	*Homalium undulatum* King	30	7	1	3	2	1						44
Din mi	*Cleidion spiciflorum* (Burm.f.) Merr.	2											2
Duea nok	*Ficus chartacea* Wall. ex King var. *torulosa* Wall.		1										1
Duea plong	*Ficus hispida* L.f.	5						1					6
Duk chang	*Diospyros undulata* Wall. ex G.Don var. *undulata*	1	2		1								4
Duk kai	*Prismatomeris* sp.	3											3
Khainao	*Vitex glabrata* R.Br.	1	1	2									4
Khao kwang	*Euonymus javanicus* Blume	16	2		1								19
Khi non	*Zollingeria dongnaiensis* Pierre	2	1		1		1						5
Ko	*Lithocarpus collettii* A.Camus	7											7
Ko heng	*Carallia brachiata* (Lour.) Merr.	1	5	3	2	1		1					13

Table 11 (Continued)

Local name	Scientific name	DBH classes (cm)											Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	
Ko mu	*Lithocarpus grandifolius* (D.Don) Bigwood	1											1
Kradang	*Artocarpus* sp.		1	1									2
Krom	*Aporosa villosa* (Wall. ex Lindl.) Baill.	6	1	1	1			1					10
Laen ban	*Canarium denticulatum* Blume									1	1		2
Lang kong	*Polyalthia* sp.	3			1		1						5
Lueat nok	*Pentace triptera* Mast.	1											1
Mafai ka	*Baccaurea parviflora* (Müll.Arg.) Müll.Arg.	2	1										3
Mamuang pa	*Mangifera caloneura* Kurz	2	2	1	1								6
Mangtan	*Schima wallichii* (DC.) Korth.	29	4	6	3	1		1					44
Namwa	*Archidendron clypearia* (Jack) I.C.Nielsen	1											1
Non	*Vitex pinnata* L.	2	2	2		1							7
Phae	*Rhodamnia cinerea* Jack var. *cinerea*	3	2	3									8
Philang kasa	*Ardisia ionantha* K.Larsen & C.M.Hu	11	3										14
Plai san	*Eurya acuminata* DC. var. *acuminata*	13	4	1									18
Plong	*Memecylon garcinioides* Blume	11	5	1									17

Table 11 (Continued)

Local name	Scientific name	DBH classes (cm)											Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	
Sadao	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	3	1										4
Salao	*Lagerstroemia* sp.	2											2
San	*Dillenia obovata* (Blume) Hoogland	3	5		1								9
Som	*Crypteronia paniculata* Blume	2	2	1		1		1					7
Taeo	*Cratoxylum maingayi* Dyer	7	1	1									9
Tang hon	*Calophyllum polyanthum* Wall. ex Choisy	14	6	2		1	1		1				25
Thang bai lek	*Cryptocarya ferea* Blume		2	1									3
Wa nam	*Fagraea racemosa* Jack	1											1
Yo pa	*Morinda elliptica* Ridl.	1	2			1							4
Total		204	67	27	17	8	5	6	3	1	1	0	338

Table 12 DBH distribution classes of trees with DBH≥4.5 cm at 100-200 m altitude in Ban Thung Soong Community Forest

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Cha muang	*Garcinia cowa* Roxb. ex DC.		1															1
Chan thip	*Phoebe paniculata* (Nees) Nees		1															1
Chiat	*Cinnamomum iners* Reinw. ex Blume	3		1														4
Chomphu nam	*Syzygium diospyrifolium* (Wall. ex Duthie) S.N.Mitra					1												1
Daeng	*Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen	14	6		2	2	2					1		1				28
Daeng khao	*Homalium undulatum* King	39	8	3	2	1		1			2							56

Table 12 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Din mi	*Cleidion spiciflorum* (Burm.f.) Merr.	1																1
Duea nok	*Ficus chartacea* Wall. ex King var. *torulosa* Wall.	3	1															4
Dueai kai	*Madhuca kerrii* H.R.Fletcher	9	2	2			1											14
Duk chang	*Diospyros undulata* Wall. ex G.Don var. *undulata*							1								1		2
Duk kai	*Prismatomeris* sp.	5			1													6
Han	*Knema globularia* (Lam.) Warb.	1																1
Kha nang	*Psychotria* sp.	2																2
Khao kwang	*Euonymus javanicus* Blume	10	1															11

Table 12 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Khi klak	*Ixonanthes reticulata* Jack	4		3	2			1										10
Ko	*Lithocarpus collettii* A.Camus	3	1		1			1										6
Ko heng	*Carallia brachiata* (Lour.) Merr.	3		1	2		1			4				1				12
Kradang	*Artocarpus* sp.				1		1		2									4
Krom	*Aporosa villosa* (Wall. ex Lindl.) Baill.	5	10	4		1	2			1								23
Lang kong	*Polyalthia* sp.	6	2	1	2							1						12
Lot	*Symplocos cochinchinensis* (Lour.) S.Moore subsp. *cochinchinensis*			1														1

Table 12 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Lueat kwai bai lek	*Gymnacranthera eugeniifolia* (A. DC.) J.Sinclair	1																1
Lueat nok	*Pentace triptera* Mast.	7										1						8
Mafai ka	*Baccaurea parviflora* (Müll.Arg.) Müll.Arg.	1				1												2
Mamuang pa	*Mangifera caloneura* Kurz	14		4	3	2	1	1		2								27
Mangtan	*Schima wallichii* (DC.) Korth.	7	3	1		1	1		1									14
Namwa	*Archidendron clypearia* (Jack) I.C.Nielsen	1		1	1	1	1	1										6

Table 12 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Nok non	*Cleisthanthus polyphallus* F.N. Williams	2			1													3
Non	*Vitex pinnata* L.		4	2	4		3				1							14
Phae	*Rhodamnia cinerea* Jack var. *cinerea*	5		2		1		2										10
Phayom	*Shorea* roxburghii G.Don				2													2
Philang kasa	*Ardisia ionantha* K.Larsen & C.M.Hu	6																6
Plai san	*Eurya acuminata* DC. var. *acuminata*	11	2	3	4	3	6	1	1									31
Plong	*Memecylon garcinioides* Blume	9	3	3	5	3	2											25

Table 12 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Sadao	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	3	1	1		1	1											7
Sak	*Vatica stapfiana* (King) Slooten	4				1												5
Salao	*Lagerstroemia* sp.	2	1	2														5
San	*Dillenia obovata* (Blume) Hoogland	4	5				1											10
Som	*Crypteronia paniculata* Blume	2		5	5	6	1		3		1							23
Ta khian	*Hopea griffithii* Kurz	2								1							1	4
Taeo	*Cratoxylum maingayi* Dyer	8		5	5	4			1		1							24
Tang hon	*Calophyllum polyanthum* Wall. ex Choisy	13	3	5	1	1					1							24
Thang bai lek	*Cryptocarya ferea* Blume	1				1	2											4

Table 12 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Thao saen pom	*Diospyros cauliflora* Blume			1														1
Tin pet	*Alstonia scholaris* (L.) R.Br.	1																
Tong taek	*Baliospermum solanifolium* (Burm.) Suresh	3		1		1												5
Wa	*Syzygium* sp.	2				1												3
Yom pha ranap	*Acronychia pendulata* (L.) Miq.	6	2			2		1		1								12
Yung	*Dipterocarpus grandiflorus* (Blanco) Blanco		1															1
Total		221	58	52	45	35	26	10	9	9	6	3	0	2	0	1	1	478

Table 13 DBH distribution classes of trees with DBH≥4.5 cm at 200-300 m altitude in Ban Thung Soong Community Forest

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Cha muang	*Garcinia cowa* Roxb. ex DC.	10	1	3	1	1		1										17
Chan thip	*Phoebe paniculata* (Nees) Nees	3	1	1														5
Chiat	*Cinnamomum iners* Reinw. ex Blume	6	4		1				1									12
Chomphu nam	*Syzygium diospyrifolium* (Wall. ex Duthie) S.N.Mitra	1																1
Daeng	*Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen	17	6	5	2	1				1	3						1	36
Daeng khao	*Homalium undulatum* King	4		2	1													7
Din mi	*Cleidion spiciflorum* (Burm.f.) Merr.	9	2	3		1												15

Table 13 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Duea plong	*Ficus hispida* L.f.	2																2
Dueai kai	*Madhuca kerrii* H.R.Fletcher	27	6	4	1	2	1											41
Duk chang	*Diospyros undulata* Wall. ex G.Don var. *undulata*	3	1	1														5
Han	*Knema globularia* (Lam.) Warb.	3		1			1											5
Hat	*Artocarpus lacucha* Roxb.		3	1	2													6
Hu yan	*Bhesa indica* (Bedd.) Ding Hou	2																2
Khainao	*Vitex glabrata* R.Br.			1														1
Khao kwang	*Euonymus javanicus* Blume	4	4		1													9

Table 13 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Khi klak	*Ixonanthes reticulata* Jack	1																1
Ko	*Lithocarpus collettii* A.Camus	7	3	3	5	2	1	2	4	2	2	1						32
Ko heng	*Carallia brachiata* (Lour.) Merr.	1																1
Ko mu	*Lithocarpus grandifolius* (D.Don) Bigwood	6																6
Laen ban	*Canarium denticulatum* Blume	8			1				1	1	1					1		13
Lai phueak	*Eurycoma longifolia* Jack	1																1
Lueat kwai bai lek	*Gymnacranthera eugeniifolia* (A. DC.) J.Sinclair	1																1

Table 13 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Lueat nok	*Pentace triptera* Mast.	1			1													2
Ma pring	*Bouea oppositifolia* (Roxb.) Meisn.	10	6	1	1	1				1								20
Mafai ka	*Baccaurea parviflora* (Müll.Arg.) Müll.Arg.	3		1				1										5
Mamuang pa	*Mangifera caloneura* Kurz	32	6	5	4		1				1							49
Mang kha	*Cynometra iripa* Kostel.	2	1						1					1				5
Mangtan	*Schima wallichii* (DC.) Korth.	1					1											2
Naeng	*Homalium caryophyllaceum* (Zoll. & Moritzi) Benth.	1		1														2

Table 13 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Namwa	*Archidendron clypearia* (Jack) I.C.Nielsen				1													1
Nok non	*Cleisthanthus polyphallus* F.N. Williams		1															1
Non	*Vitex pinnata* L.		4															4
Phae	*Rhodamnia cinerea* Jack var. *cinerea*	11	3	8	1	2	1											26
Phak miang	*Gnetum gnemon* L. var. *tenerum*							1										1
Phayom	*Shorea* roxburghii G.Don	6	5	3	1	1												16
Plai san	*Eurya acuminata* DC. var. *acuminata*	16	1	1	1		2											21

Table 13 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Plong	*Memecylon garcinioides* Blume	8	2	2	1	2			1									16
Sadao	*Azadirachta indica* A.Juss. var. *siamensis* Valeton	4	1	2	2	1												10
Sak	*Vatica stapfiana* (King) Slooten	31	9	4	5	7	4		3	1	2							66
Salao	*Lagerstroemia* sp.	2																2
San	*Dillenia obovata* (Blume) Hoogland		1				1	1			1							4
Sang khriat lang khao	*Aglaia odoratissima* Blume	8	1	2														11
Sato	*Parkia speciosa* Hassk.						1											1

Table 13 (Continued)

Local name	Scientific name	DBH classes (cm)																Total
		4-5 - 9.5	9.5 - 14.5	14.5 - 19.5	19.5 - 24.5	24.5 - 29.5	29.5 - 34.5	34.5 - 39.5	39.5 - 44.5	44.5 - 49.5	49.5- 54.5	54.5 - 59.5	59.5 – 64.5	64.5 – 69.5	69.5 – 74.5	74.5 – 79.5	79.5 – 84.5	
Taeo	*Cratoxylum maingayi* Dyer	20	4	4	6	2	2	1	5		2	2		1				49
Ta khian	*Hopea griffithii* Kurz	1	2		1								1					5
Tang hon	*Calophyllum polyanthum* Wall. ex Choisy	1	1	2	1	1	1	1										8
Thang bai lek	*Cryptocarya ferea* Blume				1													1
Thao saen pom	*Diospyros cauliflora* Blume	12	2	4	2	2												22
Tin pet	*Alstonia scholaris* (L.) R.Br.		1		1													2
Wa	*Syzygium* sp.	3	1				1	1	1			1	1					9
Yung	*Dipterocarpus grandiflorus* (Blanco) Blanco	5	4				1					1			1			13
	Total	294	87	65	45	26	19	9	17	6	12	5	2	2	1	1	1	593

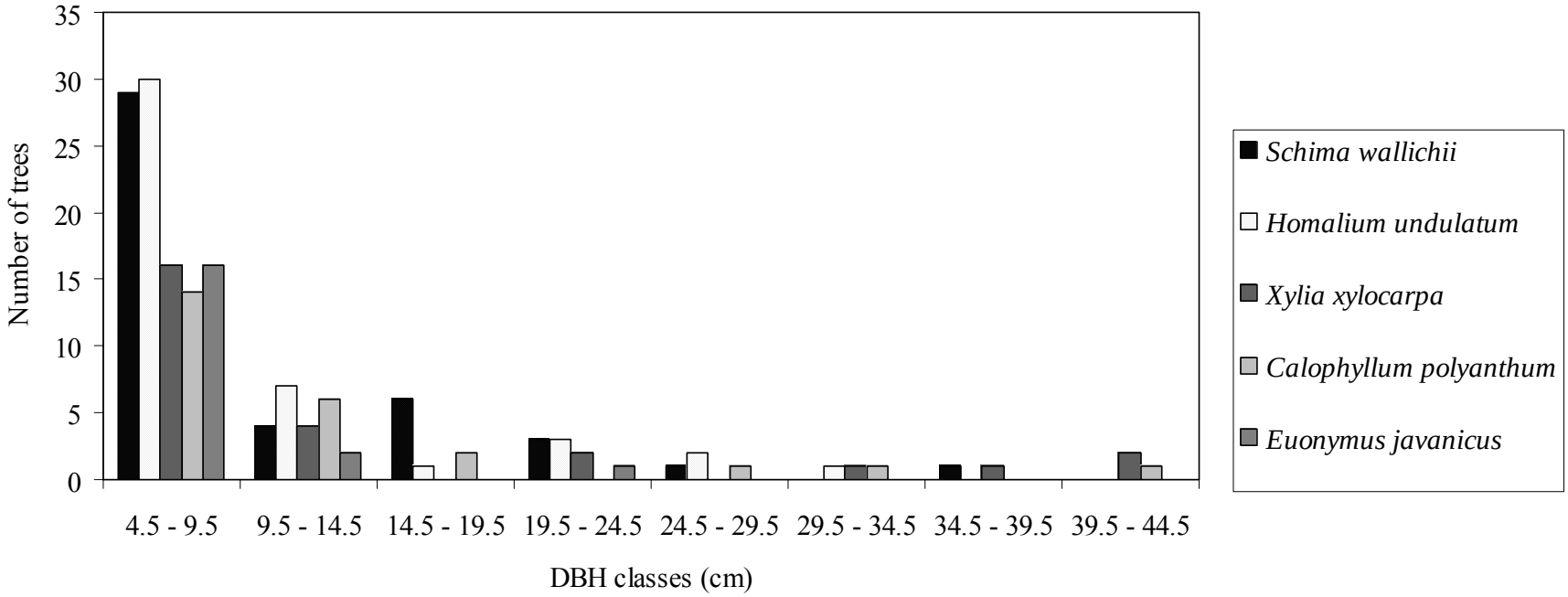

Figure 7 The diameter classes of 5 main species with the highest number of individual trees at 0-100 m altitude

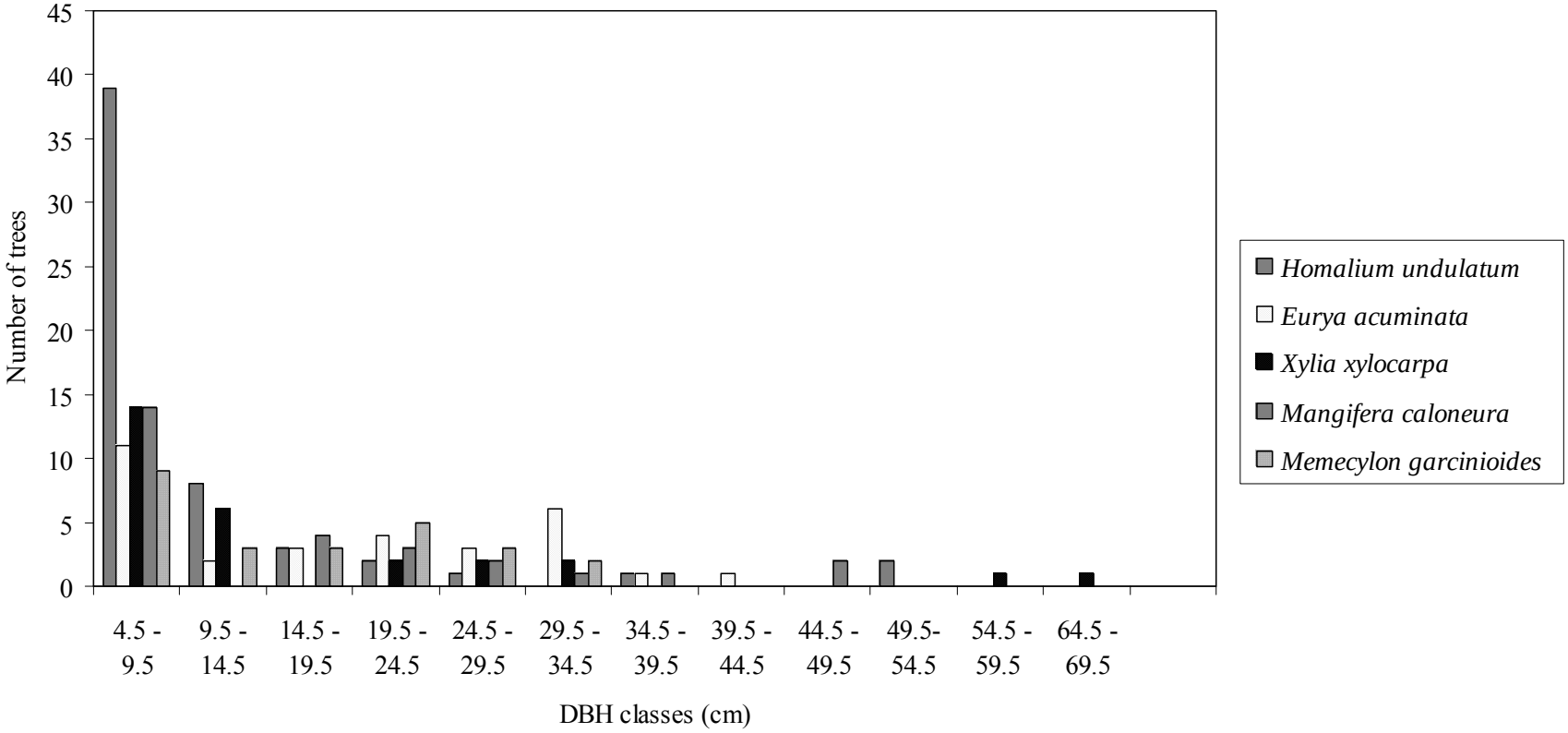

Figure 8 The diameter classes of 5 main species with the highest number of individual trees at 100-200 m altitude.

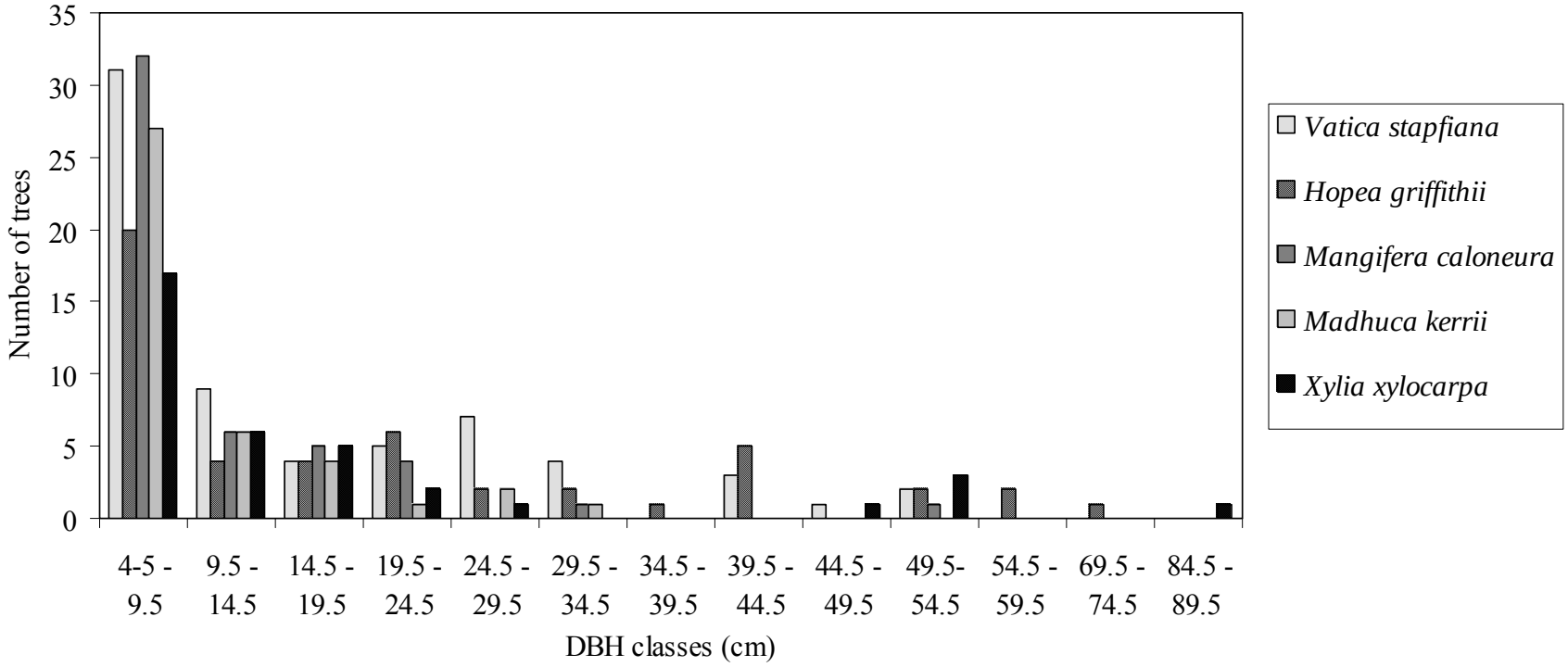

Figure 9 The diameter classes of 5 main species with the highest number of individual trees at 200-300 m altitude.

Table 14 shows the total basal area and number of individual trees with DBH≥4.5 cm in BTS Community Forest. The result indicates that at 0-100 m altitude, *Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen and *Homalium undulatum* King comprise the highest total basal area with 0.6174 and 0.5147 m^2 respectively. The highest numbers of individual trees are *Homalium undulatum* King and *Schima wallichii* (DC.) Korth. with 44 trees respectively. At 100-200 m altitude, *Cratoxyllum maingayi* Dyer and *Crypteronia paniculata* Blume indicates the highest total basal area about 1.3780 and 1.3474 m^2 with number of individual trees were 24 and 23 trees respectively. At 200-300 m altitude, the highest total basal area was found in *Lithocarpus collettii* A.Camus with 2.7500 m^2 had 32 trees and 1.8701 m^2 and 2.5524 m^2 for *Syzygium* sp. had 66 trees. The average basal area per plot from altitude levels at 0-100 m, 100-200 m and 200-300 m are 4.3707, 8.24805 and 8.6869 m^2 respectively. The result indicates that, the average of basal area of trees at altitude 200-300 m is higher than the other levels because consist high number of larger trees. At altitude 0-100 m, most of trees are smaller and the number of trees is low with 338 trees.

Figure 10 shows the total basal area of the individual trees with DBH≥4.5 cm according to three altitudes from 0-100 m, 100-200 m and 200-300 m in BTS Community Forest. The result also shows that at 200-300 m altitude, the total basal area of trees is higher than the other levels about 19.4781 m^2. The total basal area and number of individual trees from three alttitude levels are 38.8462 m^2 with 1,413 trees. The average basal area at altitude 0-100 m is lower than the other levels because the lowland area consist high number of saplings and seedlings. In the previous period, the lowland area is the secondary forest and people in BTS manage the lowland area with rehabilitation and restoration. According to Shimwell (1971), basal area is related to crown size, the vegetation that have much basal area will have high dominance value. Most of the trees which comprise high total basal area are found in *Homalium undulatum* King with 106 trees, 90 trees for *Xylia xylocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) I.C.Nielsen and 71 trees of *Vatica stapfiana* (King) Slooten are the dominant species in BTS Community Forest.

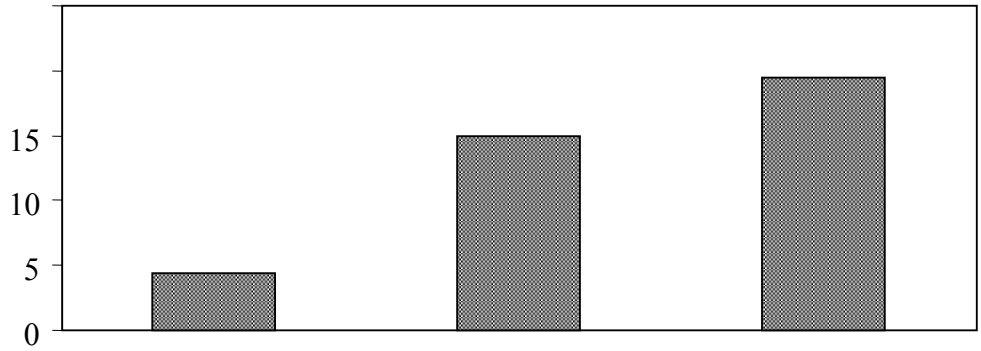

Figure 10 Total basal area of trees according to three level of elevation in BTS Community Forest