THESIS APPROVAL

GRADUATE SCHOOL, KASETSART UNIVERSITY

Master of Science (Tropical Forestry)
DEGREE

Tropical Forestry
FIELD

Interdisciplinary Graduate Program
PROGRAM

TITLE: Greening and Homegarden Development: A Case Study at Ban Thung Soong Village, Ao Luek District, Krabi Province, Thailand

NAME: Md. Sayedul Islam

THIS THESIS HAS BEEN ACCEPTED BY

D. Pipatwattanakul
(Assistant Professor Damrong Pipatwattanakul, D.Sc.) **THESIS ADVISOR**

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Vinai Artkongharn
(Associate Professor Vinai Artkongharn, M.A.) **DEAN**

THESIS

GREENING AND HOMEGARDEN DEVELOPMENT: A CASE STUDY AT BAN THUNG SOONG VILLAGE, AO LUEK DISTRICT, KRABI PROVINCE, THAILAND

MD. SAYEDUL ISLAM

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
Master of Science (Tropical Forestry)
Graduate School, Kasetsart University
2006

ISBN 974-16-1785-2

Md. Sayedul Islam 2006: Greening and Homegarden Development: A Case Study at Ban Thung Soong Village, Ao Luek District, Krabi Province, Thailand. Master of Science (Tropical Forestry), Major Field: Tropical Forestry, Interdisciplinary Graduate Program. Thesis Advisor: Assistant Professor Damrong Pipatwattanakul, D.Sc. 110 pages.
ISBN 974-16-1785-2

The study was aimed to obtain basic information related floristic composition of homegarden, species richness, species similarity, species density, indigenous management technique, uses of medicinal plant, and dependency on homegarden at Ban Thung Soong Village, Krabi Province, Southern Thailand.

The total of 132 perennial species was identified from the set of 10 homegardens surveyed throughout the village. Where 58 species were tree, 29 species were shrubby tree, 12 species were shrub, 5 species were under shrub, 17 species were herb, 4 species were palm and 7 species were climber. Species density declined with increasing homegarden size. Within each of the homegarden, food and fruit producing species were dominated and followed by the timber and medicinal plant, respectively. People were more conscious about environment and beautification. They used a lot of species for its aromatic attributes and planting with respective to wind direction. Similarity of species in each group of homegarden, namely fruit group, timber group, and medicinal plant group, the species similarity was found 58% in fruit species, 47% in timber species, and 37% in medicinal plant species.

The average size of homegarden was 2.18 Rai (0.35 ha) and its mixed pattern was demonstrated. The planting materials used in the homegarden were seedling from seed and vegetative propagation due to the availability and quality. The sources of planting material were from own homegarden, homegardens of neighbors', private nursery, and Royal Forest Department. To collect the quality seed and/or mother tree selection, the local people employed their indigenous knowledge. Planting season was mostly done in the rainy season. Weeding, pruning, pollarding, and fertilizing were identified as cultural operations practiced in the village using by their indigenous knowledge. Farmer's views about home garden farming system in Ban Thung Soong Village was that farmers are mostly satisfied with fruit species, followed by the timber species, agricultural crop, vegetables, fuel wood, and fodder respectively. The most of fruit species were multipurpose species of which not only producing fruit but also provided fuel wood, fodder, timber and cash income. Farmers mostly maintain timber species for their home consumption. 55 species were recorded as medicinal plants in the homegardens of the village. These species were used frequently for tonic, antimalarial, antidiarrheal, blood circulation antipyretic, antidiabetic, typhoid, paralysis, hypertension, carminative, hematinic and for snake bite, etc by their indigenous knowledge. In addition to the tangible benefit, people were agreed that the plant species have spiritual and ritual values such as the *Ficus religiosa*, *Hopea odorata*, *Phyllanthus acidus*, *Artocarpus heterophylla*, *Plumerdia longifolia*, *Polyanthia longifolia*, *Carica papaya*, and *Aegle marmelos*. Farmers in Ban Thung Soong were mostly depended on their homegarden.

Student's signature

Thesis Advisor's signature

15 / 05 / 06

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Mr. Osman Gani Chief Conservator of Forests, Bangladesh Forest Department for financing my MS course in Tropical Forestry, Kasetsart University, Bangkok, Thailand.

I am highly grateful to my Course Leader Dr. Suree Bhumibhamon, Associate Professor MS in Tropical Forestry Course, Faculty of Forestry, Kasetsart University , for his valuable guidance and suggestions during this study from June 2004 to May 2006. His encouragement and constant supervision helped me to bring this thesis to a successful conclusion.

I am indeed grateful to my adviser Dr. Damrong Pipatwattanakul, Assistant Professor, Faculty of Forestry, Kasetsart University, for his enthusiastic support and unwavering encouragement which made me highly facilitated by providing SPSS training course, and supplying relevant materials. His keen interest and extended help ensure maximum institutional support; specially in preparing and furnishing this thesis paper, which deserves special mention.

I would like to express my special gratitude to my close friend Dr. Millat-e-Mustafa, Professor, Institute of Forestry and Environmental Sciences Chittagong University .to encourage me to take this field of study and time to time providing his important ideas and views related to my study.

I am very grateful to Mr. Prin Kalasee, Ms. Pen, Mr. Mac. Mr. Jakrapong Bualka, Mr. Ake, Ms. Koi, Ms. Tukta and Mr. Md. Sadrul Islam for their enormous help in field data collection, entry and species identification.

My special thanks to Mr. Chakrit Na Takuathung (Tong), Ph.D. student, Dr.Ms. Supattra Thueksathit (Nui), Ms. Suwimon Uthairatsamee (Joy), Ph.D. student for their continuous help in solving computer problems and formatting according to the Graduate School which bring this thesis into existence.

My heart-felt thanks go to my beloved son Mr. Md. Shahriyar Tahseen Chowdhury and daughter Ms. Maliha Tahmeen Chowdhury for their immense help in computer typing and providing me more time to study.

My sincere thanks to all Faculty members and Ban Thung Soong villagers for their cooperation, friendship and hospitality during my study and stay in Thailand.

Finally I must express my thankfulness to my respected mother Mrs. Sharifunnessa Khanam and my wife Mrs. Rahima Khanam Chowdhury (Lucky) for their endless support, inspiration and prayers.

Md. Sayedul Islam
Bangkok, Thailand
15 May, 2006

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INTRODUCTION

Thailand is an agricultural country with about two-thirds of the population living in the rural areas.They are practicing homegarden since long ago with their own culture, long tradition and indigenous knowledge. Northern and southern part of this country is mountainous or hilly area. People of this area also maintain their homegarden with their tradition. But these mountainous area also under shifting cultivation zone.

There are almost 700,000 shifting cultivators in the highlands (Preechapanya 1996). As a result the hill evergreen forest has been widely destroyed by shifting cultivation. The farmers have cut and burnt the forest with slash and burn systems to grow annual crops without using soil and water conservation methods. In the past some farmers grew poppy for opium as a cash crop, but now most of them grow alternative cash crops, such and cabbage and maize, Most of the farmers have grown upland rice and other vegetables as subsistence crops and maize for fodder. This practice has caused deforestation and destruction of the ecosystem of catchments areas and decreased biodiversity in the hill evergreen forest. The direct consequence has been a very sudden rise in surface run-off and a high amount of sediment transport in the rainy season. This has resulted in a rapid decrease in soil fertility in the lowland cultivated areas and homegarden of the highland region It has also caused farmers to move on the cut and burn the forest in other areas. As a result, there is now a large area of wasteland on the mountains face problem lack of water in the summer, and floods, land slides occurring in the rainy season. Preechapanya (1996), working in Doi Suthep watershed west of Chiang Mai, found that there was twice the amount of surface water run-off from areas under shifting cultivation as compared to hill evergreen forest; 14 mm yr^{-1} and 29 mm yr^{-1} for the natural hill evergreen forest and shifting cultivation respectively. Government programmers now focus on halting shifting cultivation, substituting commercial sedentary agriculture, and increasing areas under permanent forest cover.

Before 1961 the people of study area used to shifting cultivation and practiced slash and burn system on their community forest After that they stopped it and start to conserve their community forest. Simultaneously they gave the attention to their homegarden. Now the homegarden of this area became a model homegarden in the south. Presently there are 253 families living in the community. From the history it was known that a devastating storm and wind in 1961 caused severe damage to the forest *Dipterocarpus alatus* was the main species of the forest. The size of the trees were so bigger that 1961 to 1962 two years required for removing the broken and uprooted trees from the forest. Some influential group of people prompted the loss of forest resources and biodiversity causing disrupt and unbalanced ecosystem. The villagers realized the matter seriously and organized themselves strongly to protect and conserved the forest from the damage. Beyond their effectiveness, they have

coordinated with different sectors ranging from their own members of 253 families, local government agencies, private sectors and NGOs. So this effect to keep the forest healthy and productive state heading towards a flourishing economy of the villagers (Sawatdee, 2002). In 1998 they got official declaration from the government as a community forest and have given more emphasis on it in respect to protection ,conservation and preservation of biodiversity.

Homegarden also a part and parcel of the community. Villagers are more conscious about their homegarden, farming system and proper management system. Homegardens preserve much of the local cultural history and reveal information about plant management decisions by individual holders. Homegarden may contribute to the conservation of native species and selected exotic germplasms.

The main goals of the Ninth National Economic and Social Development Plan (2002-2006) is “Poverty Alleviation” and Recovery with Sustainability and Stability Forest resources over 40 percent of the nation’s total protection and production area were to be preserved. Homegarden can play an important role to reached the goal of Ninth National Economic and Social Development plan by alleviate poverty and recovery with sustainability and stability. By horizontal expansion, homegarden can increased tree cover of the country. Which assists to increase tree cover of the country. By providing proper land tenure homegarden can controlled shifting cultivation in the high land of the country. In this situation how the lowland people maintain their homegardens by using their indigenous ecological knowledge and management techniques is a main interest to study. Species composition and structure as well as plant form, its uses, diversity, and similarity would be discussed. Homegardens may be varied greatly, related to the number of individual plants present, or species richness. The findings of the study may be useful for policy formulation and planning for more efficient land use and sustainable development of the community and for the nation.

Objectives

The present study was carried out to achieve the following objectives:

1. Overall Objectives

To obtain basic information related floristic composition of homegarden, species richness, species similarity, species density, indigenous management techniques, uses of medicinal plants, and dependency on homegarden at Ban Thung Soong Village, Krabi Province, Southern Thailand.

2. Specific Objectives

2.1 To assess the existing patterns of floristic composition, species richness, species density and species similarity, through a vegetation survey.

2.2 To evaluate indigenous management techniques practiced by the farmers to maintain their traditional homegardens, and uses of medicinal plants in the study area.

2.3 To assess the dependency of the farmers on their homegarden by a detail social survey.

LITERATURE REVIEW

Definition of Agroforestry

The definition of agroforestry as adopted by ICRAF, and now being' almost unanimously accepted is as follows:

Agroforestry is a collective name for land-use systems and technologies where woody perennials are deliberately used on the same land-management units as agricultural crops and /or animals, in either a spatial arrangement or a temporal sequence, there being both ecological and economical interactions between the different components (Lundgren and Raintree, 1983).

This definition implies that:

i) agroforestry normally involves two or more species of plants (or plant and animals), at least one of which is a woody perennial (trees, shrubs, palms, bamboos, etc.);

ii) an agroforestry system always has two or more outputs;

iii) the cycle of an agrofarestry system is always more than one year; and even the most simple agroforestry system is more complex, ecologically (structurally and functionally) and economically, than a monocropping system (ICRAF 2006).

Agroforestry is any sustainable land - use system that maintains or increases total yields by combining food crops (annuals) with tree crops (perennials) and/or livestock on the same unit of land, either alternately or at the same time, using management practices that suit the social and cultural characteristics of the local people and the economic and ecological conditions of the area.

World Agroforestry Center define agroforestry as a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production. Our interest derives from the (potential) social, economic and environmental benefits for all land users.

Agroforestry combines agriculture and forestry technologies to create more integrated, diverse, productive, profitable, healthy and sustainable land-use systems.

Agroforestry is an important livelihood for millions of men, women and their children throughout the Asia-Pacific region. Agroforestry practices and systems are diverse and complex, and reflect the cumulative innovations, experimentation, and knowledge that farmers have evolved over centuries and millennia. Good agroforestry practices functions to farm households. Sound agroforestry system contribute to ecological sustainability and support the overall environmental strategies of UNCED and national governments.

Farmers integrated agriculture crops, trees and livestock in their farming system to meet their needs for food, fodder, fuel fiber, medicine, and cash. This integration has resulted in a wide diversity of traditional agroforestry systems. Most of these systems are well-suited to the local agroecological and environmental conditions, the specific subsistence and cash needs of farmers, and their social and cultural context. There are a large numbers of agroforestry system managed by farmers in the Asia-pacific region. These may be indigenous systems developed by farmers over the years, or technologies introduced through research or extension, or, increasingly, a combination of traditional and introduced elements. Agroforestry often emerges as a suitable livelihood alternative for smallholder households.

One of the most promising alternatives to the conventional approaches to increase agricultural productivity is agroforestry. In agroforestry, farmers choose to grow trees and shrubs with their crops or livestock because they provide additional important benefits the farmers need. Agroforestry can improve soil fertility, provide animal fodder, create a favorable micro-climate for crops and livestock, produce tree fruits, expand fuel wood supplies, and produce a variety of wood products for farmers' home use. Well-known examples of agroforestry include windbreaks, hedgerows, and mixed home gardens.

Agroforestry is rapidly evolving as a science and a practice. It is increasingly seen as an approach to improve the livelihood of the rural poor and to protect the natural resource base by growing trees on farms. Agroforestry is the deliberate growth and management of trees, along with agricultural crops and/or livestock, in system that aim to be ecologically, socially and economically sustainable. Or more simply, agroforestry is the use of trees in farming system.

Benefits from Agroforestry

1. Environmental Benefits

Combining trees with food crops on cropland farms yield certain important environmental benefits, both general ecological benefits and specific on site benefits. The general ecological benefits include:

-Reduction of pressure on forest.
-More efficient recycling of nutrients by deep – rooted trees on the site.
-Better protection of ecological systems.
-Reduction of surface run-off , nutrient leaching and soil erosion through impeding effect of tree roots and stems on these processes.
-Improvement of microclimate, such as lowering of soil surface temperatur and reduction of evaporation of soil moisture through a combination of mulching and shading.
-Increment in soil nutrients through addition and decomposition of litter-fall.
-Improvement of soil structure through the constant addition of organic matter from decomposed litter.
-Protection and improvement of soils (especially when legumes are included) and of water sources.

-Increased efficiency in use of land.
-Medium and long-term production of fruits.
-Long term production of fuel and timber.
-Increase of total production to eat or to sell.
-Furnishing of shade for vegetables or other crops that require it or tolerate it.

2. Economic Benefits

Agroforestry systems on croplands/farmlands bring significant economic benefits to the farmer, the community, the region or the nation. Such benefits may include:

-Increment in an maintenance of outputs of food, fuelwood, fodder, fertilizer and timber.
-Reduction in incidence of total crop failure, common to single-cropping or monoculture systems; and
-Increase in levels of farm incomes due to improved and sustained productivity.
-Improved year-round production of food and of useful and palable products.
-Short term food production offsetting cost of establishment of trees.
-Improved year-round use of labour and resources.

3. Social Benefits

Besides the economic benefits, social benefits occur from increases in crop and tree product yields and in the sustainability of these products. These benefits include:

-Improvement in rural living standards from sustained employment and higher incomes,
-Improvement in nutrition and health due to increased quality and diversity of food outputs; and
-Stabilization and improvement of upland communities through elimination of the need to shift sites of farm activities.

Definition of Homegarden

Homegardens as an Agroforestry System Although the word 'homegarden' has been used rather loosely to describe such diverse practices as growing vegetables behind houses to complex multistoreyed systems, the word is used here to refer to "land-use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses, the whole crop-tree--animal unit being intensively managed by family labour". It can therefore be seen that the homegardens display many agroforestry concepts: the intimate mix of diversified agricultural crops and multipurpose trees fulfils most of the fundamental needs of the local populations and their multistoreyed configuration and high species diversity avoid the environmental deterioration commonly associated with monocultural

production systems. Moreover, they have been producing sustained yields for centuries in a most resource-efficient way. Thus homegardens are economically efficient, ecologically sound and biologically sustainable agroforestry systems.

Tropical homegardens are characterized by the deliberate management of trees in intimate association with annual and perennial agricultural crop and small livestock within house compounds. The whole tree-crop-animal unit is intensively manaqge by family labour. Known by a varity of names, these agroforestry systems are commonly found throughout the tropics and especially in areas with high population densities (Fernandes and Nair 1986).

Homegarden is a land-use form on private lands surrounding individual houses with a definite fence, in which several tree species are cultivated together with annual and perennial crops; often with the inclusion of small livestock. There are many forms of such gardens varying in how intensively they are cultivated and their location with regard to the home, for example, village forest gardens, 'compound gardens', 'kitchen gardens'.

Quite a lot has been written about the so-called "homegardens". Most of these are qualitative descriptions of traditional land use practices around homesteads. Numerous terms have been used by various authors to denote these practices These include, for example, mixed-garden horticulture (Terra, 1954), mixed garden or house garden (Stoler, 1975), home-garden (Ramsay and Wiersum, 1976), Javanese homegarden (Soemarwoto *et al*., 1976), compound farm (Lagemann, 1977), kitchen garden (Brierley, 1985), household garden (Vasey, 1985), and so on. Various forms of Javanese homegardens dominate in most of the writings on the topic so that the Javanese words "pekarangan" and "Talun-kebun" are often used interchangeably with the word homegarden (ICRAF,2006).

A homestead (or homegarden) is an operational farm unit in which a number of tree species are raised along with livestock, poultry and/ or fish mainly for the purpose of satisfying the fanner's basic needs. Such a farming system is traditional to the eastern and southern parts of the Indian subcontinent. Homestead agroforestry practices have been described by Khaleque (1987) from Bangladesh, Nair and Sreedharan (1986) from Kerala, India, and Liyanage *et al.* (1985) from Sri Lanka. A typical homestead with a multitude of crops presents a multi-tier canopy configuration. The leaf canopies of the components are arranged in such a way that they occupy different vertical layers with the tallest component having foliage tolerant of strong light and high evaporation demand and shorter components having foliage requiring or tolerating shade and high humidity. The major portion of the upper canopy goes to coconut, which is followed by other crops such as black pepper, cacao and tree species. The lower storey of the harvesting plane is occupied by banana and cassava and other tuber crops. At the floor level, pineapple, vegetables and other herbaceous crops are grown.

A common interpretation of homegardens is that it is a system for the production of subsistence crops for the gardener and his family. It may or may not have the additional role of production of cash crops. It can be immediately surrounding the home or slightly further away, but still near the residential area. The Indonesian term *pekarangan* is derived from the .word *karang*, meaning a place of residence (Poerwadarminta, 1976) and, hence, *pekarangan* specifically refers to a garden on the residential site (ICRAF 2006**)**.

Homegardens have usefully been defined as "a small scale supplementary food production system by and for household members that mimics the natural, multi-layered ecosystem" (Hoogerbrugge and Fresco 1993). Homegardens appear to have developed independently in the Indian subcontinent, Indonesia and other parts of Southeast Asia, the tropical Pacific islands, the Caribbean, and various parts of tropical Latin America and Africa (Brownrigg 1985, Landauer and Brazil 1990), and "can be found in almost all tropical and subtropical ecozones where subsistence land-use systems predominate" (Nair 1993: 86). Temperate climate homegardens were important for many years in the USSR and continue to provide an important safety net for families in the successor nations of the region (ICRAF,2006).

The global inventory of agroforestry systems being undertaken by ICRAF since 1982 (Agroforestry Systems, :(3),-269-272, 1982) has gathered and synthesized quite a substantial body of information on several types of traditional land-use systems that can collectively be called "homegardens (ICRAF, 2006).

According to the classification of agroforestry systems based on the nature and type of components {Nair, 1985), most homegardens are agrosilvopastoral systems consisting of herbaceious crops, woody perennials and animals; some are agrisilvicultural systems consisting of the first two groups of these components only.

Homegardens represent land-use systems involving' deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops: and invariably livestock within the compounds of individual houses, the whole crop-tree-animaI unit being intensively managed by family labour. Known by different names in various places, these agroforestry systems are common in all ecological regions of the tropica and subtropics, especially in humid lowlands with high population density (ICRAF, 2006).

Brownrigg (1985) defines the term as ‘a supplementary food production system by and for members of group of people with rights to the land, who eat meals together regularly’. Fernandes and Nair (1986) state that the term Homegarden can mean anything from growing vegetables behind housed to complex multistoried systems. They defined the term as ‘land-use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably, livestock, within the compounds of individual houses, the whole crop-tree-animal unit being intensively managed by family labor’.

Homegardens are traditional land use systems found mostly in the moist tropical world, although some are present in semi-arid or arid lands or on steep slopes (Mergen, 1987). On the other hand FAO(1986) stated that homegardens are one of the most elaborate systems of indigenous agro forestry, found most often in tropical and sub-tropical areas where subsistence land use systems predominate. They are found in traditional communities all over the world and are one of the more intensively cultivated parts of an overall farm.

Homegardens are important agro-eco systems and are a source of subsistence and cash resources. These traditional systems are characterized by intensive integration of numerous multipurpose trees and shrubs with food crops and animals all on the same unit of land and at the same time (Margen, 1987). Homestead containing land, ponds, houses, plants and animals arranged in a continuous setting and in continuous interaction with the farmer and his family for fulfilling some of his daily household needs, plays a very vital role in the household economy (Alam *et al,* 1990) and it is considered as the unique source of income generation of landless and marginal farmers (Miah *et al*, 1990).

The multistorey, multispecies crop mixes around the homesteads form a typical land use system in most parts of thickly- populated regions, especially in Southeast and South Asia. Prominent among these include the homegardens of Java (Indonesia), the 'Kandy gardens' of Sri Lanka (Bavappa and Jacob, 1982), coconut-based systems of India and Sri Lanka (Nair, 1979; 1983c; Liyanage et a1. 1984), compound farms of West Africa'(Okafor, 1981), the 'Chagga' homegardens of Mt. Kilimanjaro, Tanzania (Fernandes, *et al.*,1984) and the traditional crop combinations of Latin America (Wilken, 1977).

The homegarden has a multistoried canopy structure, composed of a large number of plants ranging from those; creeping on the surface (e.g. sweet potato) to tall trees reaching 20 m or more (e.g. coconut palm), with about 2-3 intermediate layers consisting of shrubs like guava '(Psidium guajava) and climbers, (e.g. bitter melon - Momordica charantia).

Homegardening has a long tradition in many tropical countries. Tropical homegardens consist of an assemblage of plants, which may include trees, shrubs, vines, and herbaceous plants, growing in or adjacent to a homestead or home compound. These gardens are planted and maintained by members of the household and their products are intended primarily for household consumption; the gardens also have considerable ornamental value, and they provide shade to people and animals. The word "homegarden" has been used rather loosely to describe diverse practices, from growing vegetables behind houses to complex multistoried systems. It is used here to refer to intimate association of multipurpose trees and shrubs with annual and perennial crops and, invariably livestock within the compounds of individual houses, with the whole crop-tree-animal unit being managed by family labor (Fernandes and Nair, 1986).

Homegardens are characterized by a mixture of annual or perennial species grown in association by a multistoried structure (Mergen, 1987) as a tangle houses and disorderly, luxurious vegetation amids rice fields (Michon, 1983) Homegardens function like natural forest ecosystem (Mergen, 1987) Their multistoried structure and the high diversity of their cultivated species evoke configuration of tropical forest ecosystems (Michon, 1983). There is great diversity in the type of tree, shrubs, vegetable and crop species as well as in the spatial arrangement of these components (Mergen, 1987). They have been producing with sustained yields for centuries without causing environmental deterioration, they are both ecologically and economically viable and efficient agro-ecosystems, they are sustainable (Michon, 1983). The layered structure of the garden vegetation creates a gradient of light and humidity that plants have to exploit according to their ecological and phytosociological requirements (Michon, 1983).

The homegardens provide the fundamental requirements of the family (Mergen, 1987) such as staple foods, various fruits and vegetables, spices and flavorings, source of raw materials for building and handicrafts and of fuel wood, source of edible, medicinal and other useful plants industrial crops such as coffee, clove, pepper or cacao are a source of cash (Michon, 1983). The farmers obtain benefits out of the trees in the form of fruits, timber, fuel and fodder (Alam *et. al.*, 1990). Homegardens are a highly efficient form of land use, incorporating a variety of crops with different growth habits (Millat-e-Mustafa, 1997). Regarding tree raising, homesteads are more reliable than crop lands both from physical and socio-economic standpoints. Unlike the crop fields, homesteads are less vulnerable to flood hazards and thus more suitable for raising trees (Abedin *et. al*., 1990). Trees have an important role in the risk management mechanism of the household economy. They provide cash during ceremonies, economic hardships and many other occasions such as marriages, school expenses of children and buying land and other assets (Abedin *et. al.*, 1988). Though these gardens represent an ecologically sustainable land-use system, their productivity is relatively low (Mergen, 1987). The ratio of income from homestead did not vary significantly due to farm size or homestead size. However, income generated from homestead is slightly higher in the smaller farm than in larger one, indicating the possibilities of more cash income from the later farm category (Miah *et. al*., 1990). For want of sufficient cropland, the landless and marginal farmers depend heavily on the homestead land to meet various needs of the family, including food, fuel and fodder (Abedin *et. al*, 1990), post harvest processing of crops and various crafts and cottage industries. Therefore, the homestead is not only the seat of the family but also a production system, very important especially for the poor farmers (Abedin *et. al.*, 1990).

In almost all farm categories, the major part of the homestead is occupied with trees and bushes. The rest is occupied by vegetables and spices production. The distribution of species is influenced by macro and micro environmental factors of the homestead and the need and choice of the family. A homestead is used as dwelling and as a production unit for plants, animals, fish under integrated farming system in which continuous interaction takes place among men, trees, livestock, soil, water, etc. It also refers to the immediate are surrounding the dwelling unit (Abedin *et. al.*, 1988).

Homegardens represent land use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and, invariably, livestock, within the compounds of individual houses, the whole crop-tree-animal unit being intensively managed by family labor. Known by different names in various places, these agroforestry systems are common in all ecological regions of the tropics and subtropics, especially in humid lowlands with high population density.

An analysis of the structural and functional aspects of ten selected homegarden systems from different ecological and geographical regions shows that the average size of the homegarden units is less than 0·5 ha; yet they are composed of a large number of woody and herbaceous species, carefully structured to form 3–5 vertical canopy strata, with each component having a specific place, as well as function.

Food production is the primary function of most homegardens, the vast majority of them being subsistence production systems. While there is a remarkable similarity among the different homegardens with respect to the type and nature of the herbaceous crops, the nature of woody perennials varies, depending on environmental and ecological factors. In general, most woody components produce fruits or other types of food in addition to other outputs such as fuel wood, timber, etc. These various food products provide a substantial proportion of nutritive and energy requirements of the local diet. Moreover, the species diversity and varying production cycles of the different components ensure continuous production throughout the year from the homegarden unit.

Little or no research has been done to improve homegarden systems. Structural complexity, species diversity, multiple output nature, tremendous variability from farm to farm, etc., are some of the main characteristics that make the homegardens extremely difficult models to work with according to the currently available research procedures.

Juma (1987) reported on domestication of plants by using indigenous knowledge in Kenya. According to him, people is western Kenya group plant according to their uses and one functional name may then fit several species. Several wild vegetables have already been brought into cultivation and it is likely that all the wild vegetables in regular use have now been domesticated. However, new domestication of fruit species are still being made, one example bearing what looks like grapefruit, but with the smell of bananas and the taste of passion-fruit. In order to domesticate plants, people make trips into the mountains (usually on the Uganda side of the border to evade Kenya's strict forest laws and) bring back plants and seeds to try on their own land. They first grow the plants in similar conditions to those obtaining where they found them. After producing seed, farmer would plant them in conditions closer to those normally found on their land. The plants that survive and producer seeds then have their offspring grown under normal farm conditions. The survivors from the second generation have thus been selected as a variety appropriate to ordinary farm or homestead environment (Juma, 1987).

Samanta and Prasad (1995) observed an indigenous post-harvest technology in India. They stated that farmers have a wealth of knowledge pertaining to their own environment and developed specific skills designed to make the best use of that environment. According to them for the storage of grains in the basket, bin or can, the quantity of neem leaves used for a particular quantity of grains. It has been reported that in the first 2 to 3 months, the grains stored together with neem leaves are not affected by pests of any kind. If the baskets are kept completely airtight, the occurrence of pests in the grains is reduced virtually to nil.

Kruijf *et.al*., (1995) have discussed the Indigenous Knowledge systems for plant protection on the basis of 13lh International Plant Protection Congress held from 2-7 July, 1995 in the Hague. They analyzed the global plant protection issues and cited examples of several authors from different part of the world. As for example, from Latin America they quoted the paper "Indigenous pest management systems among Latin American farmers" by Dr. Altieri in which the author explained that traditional farmers in Latin America have inherited and develop complex farming systems based on diversified cropping patterns, animal integration and low-input management. The ecological interactions and biological synergism which result from such complexity provide mechanisms by which these farming systems can "sponsor" their own soil fertility, productivity and crop protection. The knowledge which farmers have soils, plants, bio-indicators and animals is likewise complex, and in some cases this knowledge has formed the basis for the development of innovative and effective pest management tactics which differ quite markedly from 'modern' techniques. Another paper from Brazil by Dr. Suzuki also has been discussed, kruijf et.al., (1995) again discussed the examples from Africa and Asia. From Africa they cited Dr. Ngwasiri (Cameroon) who talked about indigenous plant protection in his country where farmers have developed a wide variety of plat-protection techniques which have proved not only effective but also affordable and sustainable. Some indigenous plant protection methods in Cameroon are - the use of fast growing and many branching varieties to control weeds; time harvesting and the use of early-maturing or tolerant varieties to control root rot; the use of wood ash to control ants, which are commonly associated with the incidence of root, mealy bug, and burying crab shells in the soil in the Zoetele region; surface planting and burning of certain varieties in order to control termites etc. From Asian part, they highlighted Dr. M.G. Chandrakanth's (India) report, who quoted the India's ancient texts. According to him-combining various cattle products, such as urine, milk and dung can be quite effective in the control of certain widespread diseases.

Hunter (1996) reported from Maldives about the traditional pest control practices which rely on local knowledge and materials have traditionally been a vital component of farming systems on Moldavian atolls. Vertebrates such as rats, fruit bats and to a lesser extent birds cause the major pest problems in the Maldives. The isolation of the country has tended to minimize the problems caused by insects and plant diseases, although occasional outbreaks have occurred. To combat attacks by major crop pests, a variety of resourceful traditional pest control practices were employed. For examples, rats cause serious losses in coconuts and cereals. To prevent rats gaining access to coconuts, barriers were placed around the trunks of the trees. One practice was to split a large palm leaf along its midrib, one set of leaflets was

then wrapped around the trunk below the crown, and the other set was wrapped in the opposite direction, and form in an effective barrier to climbing rats. Another approach to control rats is "tin banding" which consists of wrapping sheets of tin -Completely around the trunk. The idea behind it is that it prevents the rat from getting a foothold. In the past, rats were caught by means of stone or stick traps. Stone trap are made using a large flat piece of corai stone levered over a bait of dried fish or coconut. The trap is triggered using a tripwire made from the fiber and wood of the sea hibiscus (*Hibiscus liliaceous*). Stick traps are similarly constructed using wood instead of stones. Hunter (1996) further explained the fruit pests control process and reported that fruit bats, house crows and water hens are considered pests on the island of Maldives because they damage scarce and thus valuable fruits. Tin clangers and other hand-operated scaring devices and fixed in the top of the trees. These are activated by periodically pulling the strings during the night. Ripen fruits are protected by covering them with individual cloth or polythene bags, tins or coconut shells. Oil lamps and human effigies are often placed in trees, while fishing nets are hung over fruit trees to prevent access to the fruit. The practice of burning in the home garden system helps to drive off harmful insects where smoke fires are constructed under fruit trees. Parrish (1996) reported from Egypt about the indigenous knowledge dealing with the post-harvest pests control and traditional storage technologies. Munyanziza and Wiersum (1999) reported from Tanzania about the indigenous knowledge of miombo trees in Morogoro and Zussed the regeneration technique of 5 indigenous species with along their utility.

Several authors (e.g. Bompard *et. al*, 1980 from Java, Fernandes *et. al*., 1984 from Chagga homegardens; Nair and Sreedharan, 1986 and Dadhwall *et. al*.. 1989 from India; Hossain *et. al*., 1988, Alam *et. al*., 1990 and Miah *et. al*., 1990 from Bangladesh and Thaman, 1990 from the Pacific region) report that the farmers generally use farm yard manure and organic manure/compost for the soil fertility management of their homegardens and application of chemical fertilizer is very rare and to valuable species only during early stage of development and / or during fruiting (Millat-e-Mustafa, 1997).

Homegardens particularly preserve much of the cultural history, as they are the site where many useful plant species have been subjected to intense management regimes over extended periods. Throughout the years, farmers have cultivated and selected the plant species they desired, and in this way, homegardens are reservoirs of current and potential resources The plant diversity in homegardens is characterized by a large variety of mostly multi-purpose plants in various vegetation layers, which allow a good utilization of environmental factors like water, nutrients and sunlight.

Research Work on Homegarden

A study carried out by Millat-e-Mustafa *et al.* (1996) on "Homegarden productivity of Bangladesh" found that there were 92 perennial species in the set of 80 homegardens surveyed in four physiographic regions (20 from each region) of Bangladesh. The common trees and shrubs found are Coconut, Betel nut, Mango, Jackfruit, Lichi, Guava, Lemon, Jujube, Papaya, Banana, Koroi, Rain tree, Mahogany, Neem, Kadam and Banjo. Millat-e, Mustafa provided a useful general summary of strata for typical homegarden vegetation (these strata are dynamic and there is constant recruitment from one stratum to another).

less than 1m: Vegetables, spices, tubers, roots, pineapple
1-3m: Food plants e.g. lemon, banana, papaya, guava
3-5m: Saplings of fruit/timber trees all growing taller
5-7m: Fruit/timber trees, some growing taller
7-9m: A few fruit/timber trees
>9m: Timber trees, Bamboo

From the physical and socio economic points of view, homegardens were found more reliable than crops fields for growing trees and vegetables and important sources of income for the farmers of Bangladesh. It was observed that farmers tended to sell cropland to fight against pauperization, but retain their homegardens unless absolutely unavoidable: Even functionally landless farmers had their own homegardens, where they grew the essential commodities for subsistence. During the last 40 years the relative importance had shifted from the traditional forestry (in the government managed forests) to homegardens in such a way that today about 55% of requirement of timber, fuel wood and bamboo were met from the homegarden sources. An estimate showed home gardens with a growth rate of 5 percent while the rate of removal stood at 10 per cent per annum. However, the productivity in homestead forests in Bangladesh 7 to 8 times higher than in government owned forests.

Another study conducted in Gazipur district (former greater Dhaka district) of Central Bangladesh focused on the species composition of homegardens, species richness, species density, relative prevalence, species diversity index, purpose of growing trees and number of trees in homestead showed that the most prevalent horticultural species was jackfruit (*Artocarpus heterophyllus*, relative prevalence, RP = 26.3), followed by mango (*Mangifera indica*, RP = 22.5), mahagoni *(Swietenia mahagoni*, RP = 10.3), coconut (*Cocos nucifera*, RP = 9.9), teak (*Tectona grandis*, RP = 9.7), guava (*Psidium guajava*, RP = 8.2) and litchi (*Litchi chinensis*, RP = 5.7), while low prevalence species were minjiri (*Senna siamea*, RP = 0.03), ghora neem (*Azadirach indica*, RP = 0.18), tamarind (*Tamarindus indica*, RP = 0.19) and shimul (*Bombox ceiba*, RP = 0.21). The number of trees per 100 m2 homesteads decreased gradually from landless farms (3.5 trees/100 m2) to large farms (1.85 trees/100 m2). Least number of trees was found in the group of above 25 years of age. However, the larger farm categories had more old trees (> 25 years) than the smaller farm categories. Most of the farmers prefer fruit trees over fuel/timber species and species diversity was higher for fruit trees (7.3) than for timber trees (4.8). Jackfruit was

identified as an important cash generating crop in the study area. The study concluded that in the future, the homegarden would be a viable alternative to mono-cropped field agriculture and a highly valuable source of genetic diversity.

Based on the results of a research work on plant genetic resources in homegardens conducted by The German Federal Ministry for Economic Cooperation and Development (BMZ) and GTZ, (Deutsche Gesellschaft für Technische Zusammenarbeit) in partnership with national plant genetic resources programmes in five countries, Ghana, Vietnam, Guatemala, Cuba and Venezuela, a framework for including homegardens as a distinct and important component of *in situ* conservation of agro biodiversity was developed.. The case studies also began to establish a clear link between homegarden diversity and household livelihoods and food security.

A research was conducted on the topic Plant Biodiversity in the Homesteads of Saline Area of Southeastern Bangladesh by Uddin, *et. al* 2002 and they found sixty-two useful plant species were identified during the study period. Among them 30.9% fruit trees, 29.09% timber tree species, 34.54% vegetables and 5.45% were spices species. Number of vegetable species was found the highest (19 spp.) followed by fruit species (17 spp.), timber species (16 spp.) and spices (3 spp.). Only 17 fruit species, 13 timber species, 17 vegetable species and 2 spices species were found in all region. Coconut, Karai and chilli were found the most prevalent. Inter species diversity was highest (0.879) in the vegetable species. Coconut was found 98.63% in homestead followed by mango (96.72%), banana (91.6%) and betel nut (93.44%).

A survey conducted in the homegarden of San Rafael Coxcatlán, a rural village in the semi-arid valley of Tehuacán-Cuicatlán, Mexico Blanckaert, *et. al*., (2003) revealed that among two hundred and thirty three different plant species collected from 30 studied homegarden 65.7% were found ornamental species, 29.6% edible species and 8.6% were medicinal species. Sixty eight percent of the plants were cultivated, while 22% were spared and 10% protected. The results confirmed that homegarden were rich in biodiversity and an interesting area for ethno botanical research. Another study on structure and floristic composition of homegardens in a dry forest region in the municipality of Alagoinha, Pernambuco, Northeastern Brazil found that 54 woody species were found to be used for numerous purposes, especially as food sources. *Prosopis juliflora* is the principal tree species in local homegardens.This species is thoroughly disseminated throughout Brazilian Northeast, and constitutes the majority of the total population of homegarden trees in the region. It was observed that the size of the homegardens varied greatly, but was related only to the number of individual plants present, not species richness. The floristic structure of homegardens is also very variable, but there is a core group of very frequent species, with significant representation of the local flora. This suggests that the homegardens may contribute to the conservation of native species.

An analysis of the structural and functional aspects of ten selected homegarden systems from different ecological and geographical regions of the tropics and subtropics, especially in humid lowlands with high population density Fernandes, *et. al*, 2003, showed that the average size of the homegarden units was less than 0·5

ha; yet they were composed of a large number of woody and herbaceous species, carefully structured to form 3–5 vertical canopy strata, with each component having a specific place, as well as function. While there was a remarkable similarity among the different homegardens with respect to the type and nature of the herbaceous crops, the nature of woody perennials varied, depending on environmental and ecological factors. Most woody components generally produced fruits or other types of food in addition to other outputs such as fuel wood, timber, etc. These various food products provide a substantial proportion of nutritive and energy requirements of the local diet. Moreover, the species diversity and varying production cycles of the different components ensure continuous production throughout the year from the homegarden unit. It was also stated that though there were little or no research to improve homegarden systems; structural complexity, species diversity, multiple output nature, tremendous variability from farm to farm, etc., were some of the main characteristics that make the homegardens extremely difficult models to work with according to the currently available research procedures.

The cropping pattern of banana-based farming systems in Bukoba district, Tanzania, Baijukya, *et. al.*, (2004) found changed from a predominance of banana/coffee/beans to a complex mixed cropping of banana/coffee/beans/maize and root crops in the homegarden and increased cultivation of maize and root crops in pure stands. Farmers stopped cultivating sorghum and finger millet. Increasing population density, coupled with an unequal distribution of resources among households, land tenure, economic policies and poor crop markets were identified as major causal factors of the above changes. It was also stated that though there were little or no research to improve homegarden systems; structural complexity, species diversity, multiple output nature, tremendous variability from farm to farm, etc., were some of the main characteristics that make the homegardens extremely difficult models to work with according to the currently available research procedures.

Another previous study conducted by Baijukya *et. al*. (1998) in Bukoba district, northwest Tanzania. Previous studies as well as farmer interviews indicate that soil fertility is the major constraint in the banana based land use systems. Nutrient fluxes in these systems were not well documented. In the study presented here data were collected to calculate nutrient balances for different agro-ecological zones. Emphasis was given to homegarden productivity the role of cattle and quantification of nutrient loss from leaching. Households with different soil fertility management levels were included in the studies. Results showed that nutrient balances were negative in all agro-ecological zones for households without cattle. Major sources of nutrient loss were harvest of crops residues, especially beans, leaching and denitrification. Nutrient balances were less negative in agro-ecological zones with less rainfall and lower population densities. The results from this study emphasize the importance of cattle in maintaining soil fertility, but few households have access to this source. Other sources of nutrient input besides cattle must be considered to involve low resource households in the improvement of their soil nutrient balances. Recommendations made are, amongst others, introduction of slow-release industrial fertilizers and split applications, on-farm coffee de-hulling, introduction of green manures and improvement of small ruminant management.

Indigenous Knowledge Regarding Management of Homegarden

Indigenous Knowledge (IK) is the knowledge that is unique to a given community or society and is adapted to the local culture and environment; it is generally transmitted by word of mouth and forms the basis of people,' decision making (Mathias, 1994). Quddus *et.al*., (1998) synthesized IK as the common knowledge, i.e. held by most people in a community, shared knowledge, i.e. held by many but not all, or specialized knowledge, i.e. held by a few people who may have undergone some special training or apprenticeship in the field. They also argued indigenous knowledge system in dynamic and changes over time, and IK includes not only the information that local people know but also the practices or technologies they develop on the basis of their knowledge and informal experiments.

IK is the local knowledge unique to a society, community or culture. For generations, the village farmers and natural resources users have accumulated knowledge very patient to their environment and society through practical experience and have passed it down to their descendants orally or through practice and demonstration. (BARCIK, 1998)

Local people have a wide knowledge of the ecosystem they live in and ways to ensure that natural resources are used sustain ably. Therefore, indigenous knowledge which has been accumulated over centuries has potential value for sustainable development. It can help other people learn how to live in harmony with nature and the environment in a sustainable fashion (Ulluwishewa, 1993). Farmers have a wealth of knowledge pertaining to heir own environment and they have developed specific skills designed to make the best use of that environment . There are farmers who are always experimenting and involved in informal research and development activities (Biggs, 1990; Rajasekaran *et.al*., 1993). Roling and Engel (1992) warned that to look at farmers only as users neglects the important fact that farmers are experimenters and that farmers have developed most the technology used on the farm today.

A study was conducted in the upland areas on the sustainable participatory watershed management based on the IK of local people by Sharma (1998). He observed that several indigenous methods are prevailing in the upland areas for watershed management actively practiced by the local people. In this regard, he described IK as indigenous or traditional efforts as these are based on ancient rituals and cultures of local people. These efforts are long lasting, structured around human development in harmony with nature and their cosmic world.

Emadi (1998) reported from Iran that historically indigenous peoples of Iran have gained knowledge which has a much better chance of producing the desired qualitative results. He also stated, IK is not limited to the technical skills of traditional procedures, it is gained through experience and passed down from one generation to the next. The content of this knowledge is the local environment, in all its culture, social, economic and physical aspects.

Boonto (1993) reported on the natural resource management system of the Karen hilltribe in Northern Thailand. Three key features characterize the resource management system of the Karen such as:

1. The indigenous social organization that controls the natural resources within the community;

2. Customary norms, rules and procedures for control, acquisition, maintenance and transfer of natural resources; and

3. Indigenous techniques for using resources that also conserve and preserve them. The IK, values and effectiveness of the forest management system of Karen societies. Have considerable potential for the sustainable use of natural resources.

Homegardens in Thailand

Agroforestry system in Thailand have long been developed, especially by farmers, as can be seen from existing evidence such as the planting of durian trees in homegardens of the southern region. In some places, these trees are more than 100 years old (Mellink *et al*, 1991). Similarly, lansat trees were planted in homegardens of Lablae District, Uttaradit Province since the late Ayuthaya period (more than 200 years ago) and at present, they are still alive. The only officially recorded agroforestry system developed and practice by the government was the establishment of government forest plantation by farmers. They planted upland rice between rows of teak trees in 1956.

Land pressure due to population increase, change of environment, socio-economic development and new technologies, has caused the decline of indigenous agroforestry systems. However, these practices are still existing (Mellink *et al*, 1991).

Homegarden in which, trees and crops are planted together, comprise often 3-5 layer like in an Evergreen Forest.(FAO, 1991) The trees in the upper layer provide wood for construction and fruits for food such as wild durian trees coconut and areca palm and stink bean (*Parkia speciosa*). Those in the lower tier are medium-sized fruit trees such as mango, rambutan, mangosteen. Those in the next layers are Papaya, Sesbania and small fruit trees. Those in the lowest layer need high humidity and tolerate shade well, such as pepper, some kinds of herbs, spice plants and kitchen-garden crops. In some areas, livestock, mostly fowls, are also raised. This system is stable and has been practiced for a long time in communities situated in the lowlands and on the bank of rivers or canals.

In the northern region examples of these systems can be found in Lablae District, Uttaradit Province. The upper layers are indigenous trees. Those in the next layers are fruit trees such as lansat (*Aglaia domestica),* mangosteen, durian rambutan and areca palm. The lowest layer consists of robusta coffee, cocoa,pepper, etc. In the central region, this system is practiced mostly in the provinces around Bangkok such as Nonthaburi, and Pathumthani. They plant big fruit trees such as durian, coral *(Erythrina* spp.), areca palm, etc as upper layer trees. Those in the lower layers are oranges, rambutan, lemon, etc. The provinces in the southern region practicing this system are Langsuan District, Chumphon Province, and further down south

In southern region rice and bean are interplanted when they start planting fast growing trees such as *Acacia auriculiformis*, riang *(Parkia timoriana*), Tungfa (*Alstonia macrophylla*), Eucalyptus *(Eucalyptus camaldulensis*), *Azedarachta indica*, etc. When the trees have grown taller, cattle is raised. It is also commonly practised to plant coffee, cacao and fruit trees such as jackfruit. Most of the agroforestry activities, mainly interplanting of rubber, coconut and fruit trees, are practised on small pieces of land of less than 1.6 hectare. (Mellink *et al*, 1991).

"Homegarden" or "multistory tree-crop gardens" can be recognized as a traditional agroforestry practice. Generally, homegardens are dominated by a wide variety of fruit trees, situated in three to five horizontal layers. The main feature of

this practice is the combination of fruit trees with field crops and/or vegetables (Koppelman, *et al.,* 1996). Trees in the upper layer provide fruit and construction wood, while the lowest stratum is comprised of shade-tolerant species which need high humidity. Pepper, certain herbs, spices, and kitchen – garden crops can be found on the ground. This system is stable and has been practiced for centuries by communities situated in the lowlands and on the banks of rivers or canals. Homegardens have also been a common feature of upland areas to many generations, especially among the Karen and Lua ethnic groups (IIRR and FAO, 1995) In the north, homegardens are mostly located in communities in the foothills. Becauselandholdings in the central region of the country tend to be small, home gardens in that part of the country are also small.

The "homegarden" is not mentioned as an agroforestry land use by Thai scientists (Bhumibhamon 1988, Petmak 1990, FAO 1992), though Boonkird *et. al*. (1984) recognize "homegardens dominated by a wide variety of fruit trees". Bhumibhamon, 1988 (FAO, 1992) on the other hand mentions that farmers have been encouraged to grow *Areca catechu, Mangifera indica, Cocos nucifera, Tamarindus indica* and *Corypha umbraculifera* for a long time. In the central plain region, growing of *Caesalpinia pulcherrima* and *Plumeria acuminata* in farm areas is considered to bring misfortune; *Phyllanthus emblica* is planted in front of the home. And *Artocarpus heterophyllus* in the backyard (Bhirom 1972). Bhumibhamon (1988) also mentions farming areas being behind the house, followed by bush forest and beyond that the natural forest. However, no description of home garden as such is available.

Petmak (1990) recognize "multistory planted forest" in the floodplains of large rivers. The main feature of this practice is "the combination of fruit crops with trees or vegetables". Apparently coconut is treated as a fruit crop. Under the shade of coconut or durian trees, farmers may grow coffee, cacao, pepper, lemon and other shade-tolerant species. Sometimes farmers may include fish or shrimp culture in their fruit tree farms.The publication "Agroforestry initiatives by farmers of Thailand" describes homegardens and silvofisheries, and documents the agroforestry practices of 50 farmers throughout Thailand (FAO 1989).

Erythrina spp. and banana are common tree species providing shade for crops and vegetables. *Moringa oleifera* and *Sesbania grandiflora* are commnly planted as multipurpose trees. In the south, big trees such as wild durian (*Durio* spp) yang trees *(Dipterocarpus* spp). *Parkia speciosa,* and *Artocarpus integer* dominate the top story of the gardens. *Syzygium aromaticum* is commonly mixed with fruit trees to provide cash income (Koppelman, *et al,* 1996).

Farmers have long been encouraged to grow *Mangifera indica, Tamarindus indica, Cocos nucifera, Areca catechu,* and *Corypha umbraculifera,* in combination with other crops. For example, farmers may grow coffee, cacao, pepper, lemon, and other shade – tolerant species under the shade of coconut or durian trees (APAN,1996).

Raintree (1979) pointed out that there are three criteria for designing a suitable agroforestry system, namely: 1) productivity, 2) sustainability, and 3) adoptability. According to those criteria, a research (Lakhaviwattanakul, 1994) was carried out to analyze what agroforestry systems were and were not suitable for highland by using questionnaires. Data were analyzed by using a scoring system, as shown below:

Table 1 shows the analysis of various agroforestry systems and different tree-crop combinations practiced in the highlands of northern Thailand. Considering the total score, the systems can be divided into three groups.

Group I: Agroforestry system suitable for high land:

This group (total score:7–9) includes homegarden system, system of agroforestry in multiple-purpose forestry, system of crop integration on forest land, and other system that combine with coffee *(Coffea arabica*). These systems have structures that are similar to those of a natural forest. They are sustainable because nutrients and energy lost from the systems are very little. It is expected that these systems can help improve the economy of highland communities with minimum effect on the environment.

Table 1 Potential of different agroforestry systems in the highland

No.	Agroforestry system	Sustaina-bility	Adopta-bility	Produc-tivity	Total
1	Homegarden	3	2	3	8
2	Multiple purpose forestry	3	2	3	8
3	Crop integration in forestland	3	2	3	8
4	*Coffea arabica* & *Erythina subumorans*	3	1	3	7
5	*C. arabica* & *Acacia formosana*	3	1	3	7
6	*C. arabica*, *Ricinus communis*, & *Calliandra callothythyras*	3	1	3	7
7	*C. arabica* with *Toona ciliata*	3	1	3	7
8	*C. arabica* with *Betula alnoides*	3	1	3	7
9	*C. arabica* with Hill Evergreen Forest	3	1	3	7
10	*Camallia sinensis* with Hill Evergreen Forest	3	3	1	7
11	Agroforestry system by *Leucaena leucocephala*	3	3	1	7
12	Medicinal plants with Dry Mixed Deciduous Forest	3	2	2	7
13	*C. arabica* with *Gmelina arborea*	2	1	3	6

Table 1 (cont'd)

No.	Agroforestry system	Sustaina-bility	Adopta-bility	Produc-tivity	Total
14	*Passiflora foetida* with Mixed Deciduous Forest	3	1	2	6
15	*C. arabica*, *Bisconoria javanica* and *Gmelina arborea*	2	1	3	6
16	*Brassica oleracea* and *Pinus kesyva*	0	3	3	6
17	*Citrus anrantifolia* with *Acacia auriculiformis, Cunninghamia laveolata, and Liguidawbar tarnosona*	3	0	2	5
18	Maize, ginger, peanut and *Eucaliptus*	0	3	2	5
19	Maize and *Leucaena leucocephala*	0	3	2	5
20	*Oryza sativa*, *Erythina subumbrans*, and *Eucalyptus*	0	2	3	5
21	*C. arabica* and *Pinus kesiya*	1	1	2	4

Remark: Total score 0-3 = Not suitable for high land
Total score 4-6 = Suitable but need to have conservation measures
Total score 7-9 = Suitable for highland

Source: Asia - Pacific Agroforestry Network, APAN Report No. 12, 1994.

Group II: Agroforestry systems suitable for highland but soil and water conservation measures are needed.

This group (total score: 4-6) can be divided into two subgroups.

1. Systems accepted by farmers but not very sustainable.
2. Systems are sustainable but not widely accepted by farmers.

Group III: System not suitable for highland (total score: 0-3)

From this research it is obvious that homegarden, multiple purpose forestry and crop integration in forestland obtained the highest score which indicate that homegarden is highly accepted by the Thai Farmers.

Thailand National Forestry Policy

Cabinet Resolution on 3 December 1985 to achieve a long term and coordinated national forest administration and development and for better understanding between state and private sectors, it is hereby declared as a national forestry policy that:

1. Long term guidelines for forest management and development shall be established to maximize national social and economic benefits and national security, with sufficient measures provided for environmental protection. Emphasis shall be placed and harmonized utilization of forest resources and other natural resources.

2. Role and responsibility sharing among various government agencies and the private sector in forest management and development shall be promoted.

3. National forest administration shall be reorganized in line with the changing quality and quantity of forest resources and environment.

4. Forty percent of the country area shall be kept under forests. The forest area shall be divided as follows:

4.1 Protected forest : 25% of the country area shall be kept as protection forests for nature conservation, recreation and environmental quality protection.

4.2 Production forest : 15% of the country are shall be designate as production forest of produce timber and other forest products.

5. Public and private sectors together shall develop and manage the forest are to achieve the objective of providing perpetual direct and indirect benefits to the country.

6. Science and technology to increase the efficiency of agricultural production shall be enhanced to reduce to risk of the forest being destroyed to increase agricultural land.

7. The State shall establish a forest development plan as part of the natural resources development plan in the National Economic and Social Development plan to harmonize a mutual utilization action between forest resources and other natural resources.

8. Efficiency in timber production shall be increased through appropriate forest management techniques using both Selection and Clear Cutting System. In the Clear Cutting System, the cleared area shall be replanted immediately.

9. To conserve and protect natural environment, the State shall accelerate the city planning process and designate specific area for forest, residential, rural and agricultural areas in each province to prevent forest land encroachment.

10. National Forest Policy Committee shall be established under the Forest Acts for policy formulation, supervision and management of national forest resources.

11. The State shall undertake extension programs to create public awareness, instill positive attitude, and proper skills on the wise use, as apposite to the negative effects of forest destruction and wasteful use, of forest resources.

12. The State shall promote reforestation by the public and private sectors for domestic industrial consumption. Export of wood and wood products shall be encouraged. Community forestry such as reforestation on public land by private sector, tree planting on marginal agricultural land and establishment of forest woodlot for household consumption shall also be promoted.

13. The State shall encourage integrated wood using and pulp and paper industries to realize the whole-tree utilization concept.

14. Amendment of forest acts shall be made to support efficient forest resources conservation and utilization.

15. Wood energy as a substitute of fossil energy shall be promoted through farm woodlots.

16. Any land with the slope of 35% or more on an average shall be designated as forest land. No title deed, or land use certificate under the Land Acts shall be issued for the land of this category.

17. Explicit guidelines shall be established to deal with various forest degradation problems e.g. shifting agriculture, forest fires, forest clearing by the hill tribe minorities, etc. Measures on enforcement of law and penalty codes shall be specified and respective due processes shall be established Regional Forestry Law Enforcement Center shall be established. Measures shall also be devised to penalize corrupted government official and influential person.

18. Incentive systems shall be established to promote reforestation by the private sector.

19. Human resources and rural settlement planning must be in conformity with national natural resources management and conservation plans.

MATERIALS AND METHODS

Study Area

1. Location and geological landform

Ban Thung Soong was the one of 5 villages in Tambon Khao Yai, Amphoe Ao Luek. Krabi is one of the 14 provinces in the southern region of Thailand The village is located between latitudes 8°27′ and 8°30′ North, longitude 98°30′ North, longitude 98°42′ and 98°45′ East, about 64 km northeast of Krabi. The map of study area the village Ban Thung Soong is given in Figure 1.

The general, the topographical feature of village area could be classified as flat and hill terrain with the ground surface in the 30-350 m MSL. The hill landform was lied on the north, northeast and northwest boundary of village, namely Khao Mai Gaew-Khaun Ying Wua, Yai and Lang Tang Hills, respectively. The total area of the village was approximately 16,336 rai or 2613.76 ha.(26.14 km^2). The land use type of village was comprised the forest 7,300 rai, rubber plantation 1,866 rai, oil palm farm 5,600 rai and settlement land, homegarden and the other land use 820 rai (Sawatdee, 2002). Khao Mai Gaew-Khaun Ying Wau reserved forest was converted to the BTS community forest because the Ban Thung Soong conserved and protected this forest during the last 50 years. The total household of the community is 253 out of which 251 families are Buddhist and 2 families are Christian. The total population is 1056 (Ban Thung Soong Community Office, 2004).

2. Climate

The climate classified by Koppen's system in Ban Thung Soong Community Forest was characteristic of tropical monsoon climate. The area was influenced mainly by the two monsoons, namely south-west and north-east monsoons, and by the cyclone and depression storms occasionally. Thus the climate in this area was different from the others regions and within the southwest region. There were 2 seasons in the area, as follow:

2.1 Rainy season occurred during the late of April to December approximately 8 months. This season has two peaks as influenced by north-east monsoon (April-September) and south-west monsoon (October-December). As BTS village locate in the scattered limestone mountains. So the rain was prevented by Nakorn Sri Thammarat and Phuket mountain ranges. However, Panom Benja mountain the highest peak in Krabi is also prevent some rain in the area.

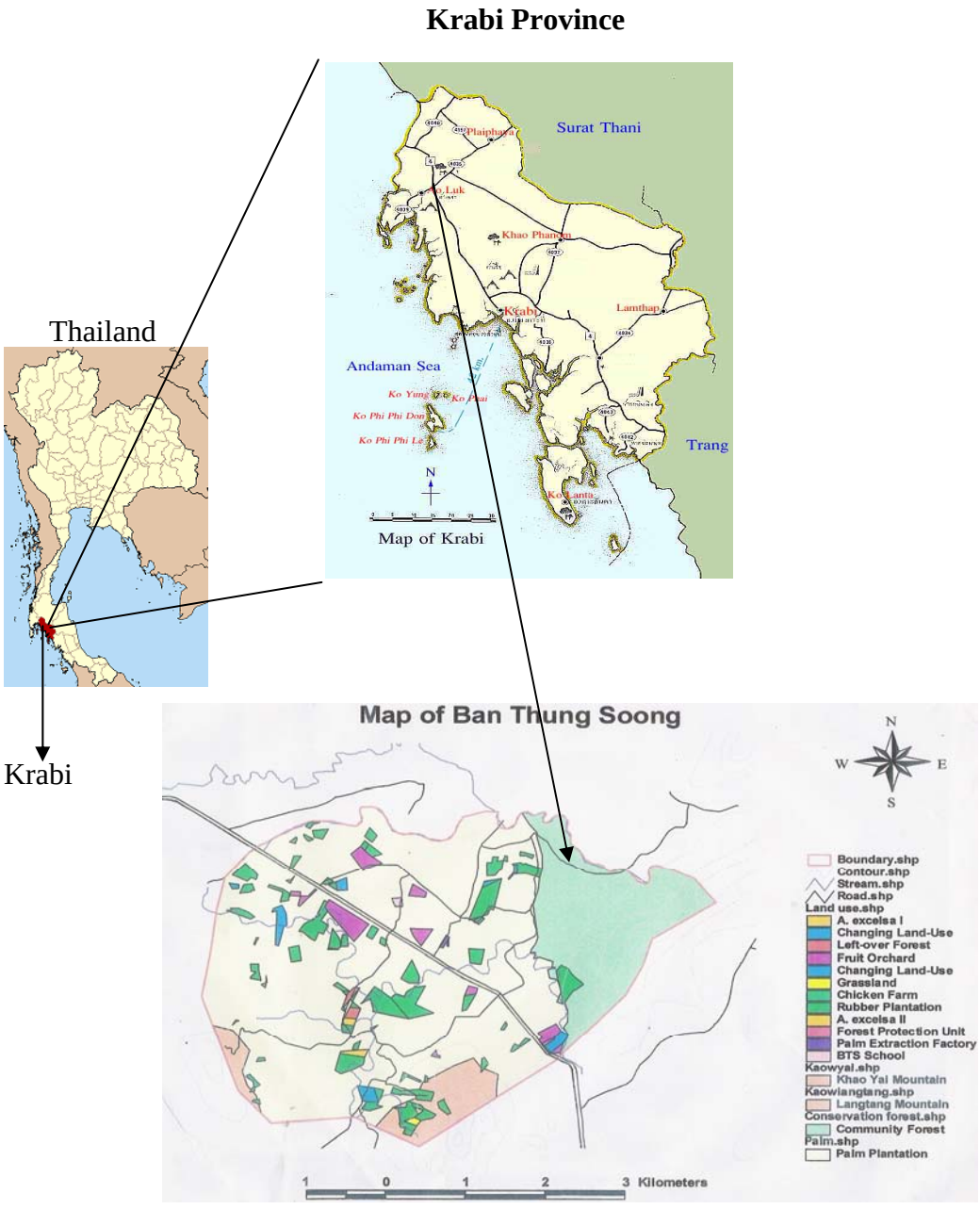

Figure 1 Map of study area, The Village of Ban Thung Soong, Krabi Province, Thailand.

2.2 Dry season occurred during January to April. Occasional rain occurred irregularly.

Last ten years (1996-2005) the average climate of the study area was recorded shown in the Table 2. From the Table, it was found that average monthly rainfall ranges from 33.9 mm to 384.7 mm while average rainfall was 202.36 mm. The minimum rainfall occurred during February (33.9 mm) and maximum occurred in August (384.7 mm). The maximum temperature was found in April (29.12°C) and

lowest in November (26.97°C) while average air temperature was 28.08°C. The highest average relative humidity occurred same both in October (87.2%) and November (87.2%) and the lowest occurred in February (76.7%) while the average relative humidity was 82.67%.

Table 2 Average rainfall, air temperature and relative humidity at the study area during 1996-2005

Month	Average of			
	Rainfall (mm)	Rainy days (day)	Temperature (°C)	Relative humidity (%)
January	51.6	3.1	27.72	78.2
February	33.9	2.2	28.23	76.7
March	83.8	5.8	28.76	79.1
April	100.3	7.6	29.12	81.2
May	179.3	10.0	28.9	82.9
June	312.7	12.1	28.37	84.8
July	342.2	13.0	28.34	83.7
August	384.7	12.5	28.23	84.4
September	350.4	14.0	27.6	86.4
October	320.1	14.2	27.28	87.2
November	180.8	9.5	26.97	87.2
December	88.5	6.3	27.54	82.3
Total	202.36	110.3	28.08	82.67

Source: The Meteorological Department, Ministry of Transport and Communications (2006).

3. Vegetation

Ban Thung Soong has comprised 3 hills, Khao Mai Gaew-Kuan Ying Wua, Khao Yai and Khao Lang Tang. There are covered by moist Tropical Forest, which slightly different in structure and species composition. Kuan Ying Wua and Khao Lang Tang hill was the secondary forest that succeeded from logging and from setting telecommunication station, respectively. The home garden is situated foot hill or the low land of the 3 hills. Forest areas were dominated by *Dipterocarpus atatus, Hopea odorata, Alstonia scholaris, Memecylon sp., Eugenia sp., Ficus sp.*, etc.and the homegarden dominated by *Durio zibethinus Aglaia domestica, Garcinia mangostana, Artocarpus heterophyllus, Cocos nucifera , Areca catechu , Parkia speciosa* etc.

4. Soil Characteristics

In fact, soil characteristics were directly controlled by relief, parent materials, climate, timing and organism, Soil texture origins by decomposition of parent material of Ban Thung Soong was mainly silt, silty clay and silty sand in topsoil and

clay in subsoil. Soil colors was brown, yellow and red. So there are well drainage and moderate to low fertility. Soil pH was approximately 4.5-5.5 (Sawatdee, 2002).

Materials

A systematic vegetation survey was done including taking position of all plants present in the each homegarden, location of house and boundary of the homegarden at Ban Thung Soong Village. An exploratory survey of the indigenous management technique, a semi structured interview regarding uses of medicinal plants in homegarden, detailed social survey on homegarden production system and their dependency on homegarden by questionnaires were carried out over a period of one year since from April 2005 to April 2006.

Methods

1. Reconnaissance Survey

Before the actual study started, a reconnaissance survey was done in the study area. The objectives of this survey were to identify homegardens, respondents, pre test of questionnaire and rapport building with the local leaders and the people of the study area.

2. Selection of the study Plot

For the detailed survey in Ban Thung Soong village 10 (Ten) homegardens randomly selected as sample plots. Ten homegardens again divided into 3 (Three) groups by selecting the homegarden randomly.

Group A-4 homegardens (Fruit group) homegarden number $hg_1+hg_5+hg_8+hg_9$.

Group B-3 homegardens (Timber group) homegarden number $hg_2+hg_4+hg_{10}$.

Group C-3 homegardens (Medicinal plant group) the homegarden number $hg_3+hg_6+hg_7$.

3. Collecting Secondary Data

Secondary data and information were collected from published and unpublished works, in order to get an initial understanding of the planting system, climate, and topography on the site. This data were collected from various organization, like; Royal Forest Department, Regional Community Forestry Tranning Center (RECOFTC), ICRAF Office Chiang Mai, FAO RAPA Office in Bangkok, and other related government offices.

4. Collecting Field Data:

4.1 Vegetation Survey:

A detail vegetation survey was done in the study area including number of trees, shrubs, herbs, and medicinal plants to study plant composition, species richness, similarity of species etc.

4.2 Mapping the study Plot:

All plants in each homegarden, house and boundary of the homegarden of ten sample plot were taken for mapping and showing the pattern of species composition of the homegardens at Ban Thung Soong Village. Data were collecting by using Global Positioning System (GPS).

4.3 Semi Structured Interview with Farmers about Indigenous Knowledge:

The farmers of the Ban Thung Soong Village were gathered at Village Community Centre and they were interviewed by asking questions for collecting data about indigenous management techniques they followed in their homegardens.

4.4 Semi Structured Interview with Parataxonomist about Uses of Medicinal Plants

Parataxonomists of the village were gathered at same Community center and interviewed for collecting information and indigenous knowledge about uses of medicinal plants present in their homegardens.

4.5 Questionnaire for detailed social survey

Using questionnaire for collecting data of the whole village about homegarden condition, characteristics, farming system, people dependency on homegarden etc. The representative (men and women) from the selected households were considered as sample for interview. The total number of samples were determined by the “Yamane’s formula (1973)”

$$n = \frac{N}{1 + Ne^2}$$

Where, n = Sample size
N = Population Size
e = Desire margin of reeor

As a result the total number of population in the study area were 253. By using this formula with a margin of error 5%, the sample size were computed 155 respondents. Stratified random sampling were used for selecting the households.

5. Data Compilation and Analysis

5.1 Composition of species

To ascertain the floristic composition, the plants were firstly categorized into trees, shrubby trees, shrubs, under shrub, herbs, climber and palm. Species composition was also shown in terms of their functions, e.g. food and fruit producing species, timber and fuel wood species, medicinal species etc.

5.2 Species Density

Density is an absolute measure of the abundance of a plant. It is usually expressed as the ratio of the total number of individuals of species present in a plot and the area sampled. (Millat-e-Mustafa 1996), Thus-

$$\text{Density} = \frac{\text{Total number of species}}{\text{Area of the plot}}$$

Density was measured for individual species per hectare basis.

5.3 Similarity of species

To find out the similarity of species in the homegardens within each group Similarity Index (SI) values were calculated using the formula:

$$SI = \frac{2c}{a+b} \times 100$$

Where,
a = Number of species present in community X
b = Number of species present in community Y
c = Number of species common to both communities X & Y

The value derived is called the “Sorensen’s index of similarity” according to Muller-Dombis and Ellenberg, (1974) and it expresses the actually measure coinciding species occurrence against the theoretically possible one. To find out the similarity index of species, here the community refers to each homegarden.

5.4 Species Richness

Species richness of ten homegarden were caculated by “Menhinic Index” using following formula.

Menhinic Index:

$$N_{mn} = \frac{S}{\sqrt{N}}$$

Where, S = Number of species
N = Number of individuals.

6. Statistical package used to analysis the data

The position of all species in each homegarden which collected by using Global Positioning System (GPS) were entered into the Microsoft Excel and GPS software program for showing the pattern of species composition of respective homegarden at Ban Thung Soong Village. Data which collected through social survey using questionnaire also entered into statistical package software “SPSS” program for detailed analysis. Wherever applicable percentage, mean and regression were carried out.

RESULTS AND DISCUSSIONS

Part 1: Social Survey

A socio-economic survey of Ban Thung Soong village was undertaken using a pre-tested questionnaire. There were altogether 155 respondents. Important socio-economic attributes of the respondents are presented below.

1. Age of the Respondent to the Socio-economic Survey

Age of the respondents varies from 19 years to 84 years as shown in Table 3. More than three-quarters of the respondents belong to 31-70 age group. The wider range of ages of the respondents indicates that people from all age groups are involved in homegarden management system. It also signifies that a traditional channel of transferring indigenous knowledge on homegarden farming system from one generation to another prevails in the study area.

Table 3 Age of respondents

(n=155)

Age Classes	Number	Percentages
19-30	10	6
31-40	34	22
41-50	53	34
51-60	24	16
61-70	24	16
71-84	10	6
Total	155	100

2. Residency Status of the Respondents

Residency status of the respondents are shown in Table 4. Only 11% of the respondents migrated to this village. Rest 89% of them have been living in this village as a permanent resident. So they have inherited homegarden farming system from their ancestors. It also indicate that their attitude, culture, tradition norms and values were the same, very strong and deep rooted.

Table 4 Permanent resident of respondents

(n=155)

Resident	Number	Percentage
Permanent residents	138	89
Non permanent residents	17	11
Total	155	100

3. Duration of Living of Respondents at Present Location

From the Table 5 it observed that total 93.6 % people were live in the village more than 20 years and only 87.8 % people live in more than 30 years. So most of the people were involved homegarden more than three decades.

Table 5 Duration of living of respondents at present location

(n=155)

Years	Number	Percentages
1-10 yr	1	0.6
11-20 yr	9	5.8
21-30 yr	9	5.8
Above 30 yr	136	87.8
Total	155	100

4. Occupation of the Respondents

Occupation of the respondents is presented in Table 6. Here 91% of the respondents are farmers. Only very small fraction (3%) of the respondents are involved in government or private jobs. The result indicated that farming is the main occupation of the respondents in the study area and they have deep rooted relationships with this activities. Thus the respondents devoted most of their time in homegarden and / or farming system where they grow fruit tree species, timber species, vegetables, for their daily subsistence needs and cash income.

Table 6 Occupation of respondents at Ban Thung Soong Village, Krabi

(n=155)

Occupations	Number	Percentage
Farmer	141	91
Government job	3	2
Private job	2	1
Others	9	6
Total	155	100

5. Total Land Area Occupied by the Respondents

The terrain of the Ban Thung Soong village is mostly undulating although some flat lands are also available for making dwelling house and cattle sheds. From Table 7, it is clear that almost half of the respondents posses 11- 25 Rai (46.5%) and more than one-third of the respondent (35.5%) posses 1-10 rai.15.5 % have 26-50 Rai and 2.5% have 51-100 Rai. So it indicate that farmers have own land and they have scope to maintain a homegarden within their own land. to mitigate their daily needs and cash crops.

Table 7 Total area of land posses by the respondents at present

(n=155)

Area of Land	Number	Percentages
1-10 Rai	55	35.5
11-25 Rai	72	46.5
26-50 Rai	24	15.5
51-100 Rai	4.0	2.5
Total	155	100

6. Land Tenure

Land tenure is very important factor for any farming system as the sustainability, cropping pattern, management objectives, management techniques etc. are completely dependent on it. People are reluctant to grow permanent crops (plants) if the lands do not belong to them. From Table 8 it is revealed that 96% respondents possessed their own land. Only few 3% posses leased and 1% posses rented land. Land tenure security gives them the choice to grow diversified species in their home gardens with varied phenological cycles and rotations.As a result, species diversity are relatively riched in Ban thung Soong Village It is a common characteristics of most of the tropical home gardens where people grow variety of species having different phenological cycles to ensure their regular harvest from the homegarden on a sustain basis.

Table 8 The land ownership of the respondents at Ban Thung Soong Village

(n=155)

Land Ownership	Number	Percentages
Private	149	96
Leased	4	3
Other	2	1
Total	155	100

7. Respondents Posses of Homegarden

From the Table 9 it revealed that almost all (98%) respondented have a homegarden. In the study area. Only 2% respondent have no homegaarden It represent that all household in the study area were involved with homegarden for theie daily home consumption, for nutrition and for their livelihood.

Table 9 Respondents posses of homegarden

(n=155)

The present of homestead	Number	Percentage
Yes	152	98
No	3	2
Total	155	100

8. Size of the Homegarden of Ban Thung Soong Village

An analysis of the size of 152 homegarden (three farmers had no homegarden) from different places of the village (Table 10) shows that the average size of the homegarden units was 2.18 Rai (0.35 ha); yet minimum was 0.5 Rai (0.08 ha) and maximum was 25 Rai (4 ha) It indicated that various type of homegarden were present in the village. According to the size of the homegarden people produce the product on the basis of their desire, chose, need, and availability of planting materials. As a result the farming system was continuous round the year as sustainable basis.

Table 10 Size of the respondent's homegarden

(n=155)

The size of the Homegarden (Rai)	Number	Total (%)
0.5 – 1	46	30
2 - 3.5	60	39
4 – 5	31	20
6 – 10	7	5
11 – 15	4	3
16 – 25	4	3
Total	152	100

9. Species Grown in the Homegardens

A tropical homegarden is characterized by a mixture of diversified species which makes the system sustainable from production, management and environmental point of view. The homegardens in the study area are not exceptions. Most of the farmers grow a mixture of timber, fruit, fuel wood, fodder, vegetables, bamboo and medicinal plant species in their home gardens. These varieties of species meet their daily demand of food, fruit, timber, fuel wood, fodder and herbal medicine to a considerable scale. (Table 11).

Table 11 Choice of species grown in the homegarden

(n=155)

Choice of Plants	Number	Percent
Timber species	152	98
Fruit species	152	98
Fuel wood species	71	46
Fodder species	71	46
Medicinal plants	64	41
Bamboo	120	77
Vegetables	134	86
Others	42	27

10. Satisfaction Level of Homegarden Product

Agroforestry system in Thailand have long been developed, especially by farmers, as can be from existing evidence such as the planting of durian trees in home garden of the southern region (FAO, 1991). Although it is very difficult to assess farmer's satisfaction level about homegarden production system in quantitative terms, farmers were given a choice of five satisfaction level (from most satisfied to not satisfied) and their satisfaction level were assessed based on this scale. The findings were finally converted into percentage figures as shown in Table 12. In most satisfied level fruit species (87.09%), timber species (84.52%), and in satisfied level Bamboo (82.6%), Vegetables (81.3%), Agricultural crop (78.7%), Medicimal plant (74.19%), Fodder (72.9%), and Fuel wood (70.3%), respectively.The findings can be explained by the fact that farmers were satisfied with their homegarden product and most of the fruit species are multipurpose species. Besides producing fruit, it also gives fuel wood, fodder, timber and generate additional cash income.

Table 12 Respondents satisfaction level related to the products from homegarden

(n=155)

Products Items	Number(%)				
	Most Satisfied	More Satisfied	Satisfied	Less Satisfied	Not Satisfied
Fruit	135 (87)	12 (8)	8 (5)	-	-
Timber	131 (85)	14 (9)	10 (7)	-	-
Bamboo	3 (2)	6 (4)	128 (83)	11 (7)	3 (2)
Vegetables	2 (1)	7 (5)	126 (81)	10 (7)	5 (3)
Agricultural crop	6 (4)	18 (12)	122 (79)	5 (3)	1 (0.6)
Medicinal plant	7 (5)	27 (17)	115 (74)	6 (4)	-
Fodder	7 (5)	23 (15)	113 (73)	8 (5)	1 (0.6)
Fuel wood	11 (7)	27 (17)	109 (70)	5 (3)	-

11. Present Supply Condition from Homegarden

Present supply condition from homegarden in the study area was increasing (Table 13). In fact there is no other alternative land use system available to them in the study area.So they were able to provide more time to their homegarden and manage this production system more intensely. It is the homegarden which provides them places to live, rear their cattle, grow their own food to sustain their livelihood.

Table 13 Present supply condition of homegarden products

(n=155)

Production	Number	Percent
Increasing	151	97
No reply	4.0	3
Total	155	100

12. Choice of Species

For homegarden development programme in the future, it was imperative to learn about farmers' preferences of species. Table 14 shows farmer's preferences of species. Most of the farmers preferred more than one species and preference ranking for fruit (98%), timber (95%), vegetables (70%), Medicinal plant (42%), and fodder (20%). It reflects farmer's individual choice, tradition of the village, local needs, indigenous knowledge about the species and uses of the species.

Table 14 The type of species respondents like more to plant at homegarden

(n=155)

Type of Species	Number	Percent
Fruit	152	98
Timber	148	95
Vegetables	109	70
Medicinal plant	65	42
Fodder	31	20

13. Problems Faced by the Farmers in the Study Area Relating to Their Homegarden

From the previous discussion it is very clear that farmers of the study area are almost completely dependent on the homegarden farming system. So any development initiatives of government or NGOs should be focused on homegarden development. Farmers were asked to mention their problems with homegarden production system. (Table 15). There is no acute problem in Ban Thung Soong village at all Though shortage of animal manure is one of the present problem mentioned by most (74%) of the respondents. People should solve this problem by using green manuring.

Table 15 Respondents facing problem related to homegarden

(n=155)

Kind of Problem	Support Number	Percent
Shortage of animal manure	114	74
Shortage of technology	16	10
Shortage of equipment	13	8
Shortage of water	12	8
Total	155	100

14. Homegarden Development

Tropical farmers have indigenous knowledge about traditional farming system, such as homegarden, has been acknowledged by different researchers elsewhere. Homegarden is not only a production system for the farmers in the study area, but it is also a part of their culture and heritage. It is the system which they have inherited from their fore fathers. For the development of their homegarden they know better than any outsiders. Farmers were asked to mention the possible ways of improving their existing homegarden production system through species selection. Most of them viewed introduction of more fruit species (92%) in the homegarden as a means of improving the production followed by the timber (83%), agricultural crops (70%) and medicinal plant (48%), (Table 16). From their tradition and knowledge they have seen that fruit trees grow well in the area. Moreover fruit trees are multi-purpose which not only provide them food to eat, but they can also earn money by selling the fruits. They can also get fodder and timber from the fruit trees. Thus the

multiple use of this species made it their first choice. Homegarden of Ban Thung Soong can be developed by introduce community based ecotourism and planting more species of non-wood forest product.

Table 16 Possible way of development of homegarden

(n=155)

Items	Number	Percent
To increase fruit trees	143	92
To increase timber trees	129	83
To increase agricultural crops	109	70
To increase medicinal plants	75	48

15. Expectation from the Homegarden Besides Home Consumptiom

The people of Ban Thung Soong Village were more conscious about biodiversity conservation irrespective to homegarden and community forest, environmental aspect and esthetic value. It came from respondents answer that they did not maintain their homegarden only for their home consumption and want to generate more income (98%) as well as preserve the environment from pollution (91%) and increase esthetic value (66%). (Table 17). Each of the rural house had a beautiful flower garden in front of the house.Sometimes they attached orchids to their homegarden plants also.So besides home consumption income,environment and esthetic value all were related to their expectations from the homegarden.

Table 17 Expectation from the homegarden

(n=155)

Expectation	Number	Percent
More income	152	98
Environmental aspect	141	91
Increase aesthetic value	102	66

16. Agricultural Crop within Homegarden

A lot of agricultural crops (Table 18) they produce in their homegarden It was their daily home consumption commodity and produce high in quantity such as Long bean (89%), Chilli (88%), Garlic (87%), Onion (86%), Papaya (83%), Ginger (81%), Bean (79%), Turmeric (76%), Egg plant (76%), Banana (72%), Pepper (67%). Other commodities they produce low in quantity like Cheese tree (45%), Taro (40%), Gnetum (28%), Amaranth (24%), and Corn (3%). It indicated that they were going to be established a “Self- reliant Community” properly followed His majesty of King’s Nation Famous Recommendation..

Table 18 Kind of agricultural crops grown in the respondent homegarden

(n=155)

Agricultural Crop Species	Number	Percent
Long bean	138	89
Chilli	137	88
Garlic	135	87
Onion	134	86
Papaya	128	83
Ginger	125	81
Bean	122	79
Turmeric	118	76
Egg plant	118	76
Banana	111	72
Pepper	103	67
Cheese tree	69	45
Taro	62	40
Gnetum	43	28
Amaranth	37	24
Corn	05	3

17. Fertility Condition of Homegarden

It was essential to know what was the fertility condition of the homegarden of Ban Thung Soong Village What kind of manure people used in the study area.The result came out that Ban Thung Soong Village people used both organic manure and chemical fertilization in their honegarden (Table 19).

Table 19 Respondents used any manure to the homegarden.

(n=155)

Respondent's Reply	Number	Percentage
Positive reply	152	98
Negative reply	3	2
Total	155	100

18. Kind of Manure Used in Homegarden

The people of Ban Thung Soong Village used chemical fertilizer 84%, Organic fertilizer 52% and animal dung 20% (Table 20) .These organic and animal manure were Bat's dung collected from the hill caves and the livestock raised in the village. The figure of domestic animals raised in the village at present Bull and Cows 45; Buffalo 6; Chiken 13,000; Duck 150 and Pig 120. Earlier when there was no restriction to cattle rearing , the people used a lot of organic matter and dung.

As the manure is at present shortage in the village, Agricultural Technology Center and Village Committee can help in connecting with the available source of supply since it is difficult to raise more livestock in the village. On the other hand "Green manure" program should be developed by the government's assistance.

Table 20 The kind of manure respondents used

(n=155)

Kind of manure	Number	Percentage
Chemical fertilizer	131	84
Organic fertilizer	80	52
Animal manure	31	20

19. Local Knowledge about Spiritual,Ritual and Aromatic Value of the Species

Most people of the Ban Thung Soong Village agreed that a lot of tree species have spiritual and ritual values (Table 21). To Some species they pay respect from religious or ritual point of view and some other species they also respect from afraid or spiritual point of view. On the other hand they have long tradition and deep rooted culture that some species they plant in front of the house and some are back side of the house. All of these could be described as follows:

19.1 *Ficus religiosa* is a species that related to their religion. They believed that Lord Buddha found the "Truth" (Buddhism) beneath that tree. They respect the tree so much that from the ritual thinking they believed this species never be planted in home garden. It's appropriate place is the sacred place like Temple. Some times this species could be allowed to plant in School Campus taking in the mind that all the students pay their respect when they pass through the tree

19.2 They believed that some species have spiritual value so they are afraid about it. Such kind of trees they try to avoid to planted in their home garden .Such as Takian thong (*Hopea odorata*) they believe it as "Nang Takien" (Lady Ghost). On the other hand some *Ficus* species they also afraid about it because they believe these species related to the Spirit. From the fierceness they respect all of these kind of species in a perfect way.

19.3 When people go to the forest and found a biggest tree in front of them (mainly *Ficus* spp), they believed it is "Deparaksa" and pay respect to it. The Thai word "Deparaksa" means "The God of the Forest". If they want to take any things from the forest or they want to take a rest in the forest before done these they pay worship and pray for seeking permition from it.

19.4 There was a saying that "if you want to be a popular in the society, you plant Mayom"in front of your house. The name of the species Mayom (*Phyllanthus acidus.)* in Thai way of thinking which means "to be popular". So the Thai people plants this species in the front entrance of their houses. In rural areas it found almost every house.

19.5 Some species they believe "Supporting their lives from the back" so they plant this trees in the back side of their houses. Such species named as Khanun (*Artocarpus hrterophylla*). Not only that they also believe that it provide support from all sectors like protect them from storm, cyclone etc.

19.6 Some species they believe it related to “Sadness”. So they avoid to plant these kind of species in their home garden. One of these species is *Plumerdia longifolia* (Lantom). This species was found in a Church yard in Latin America. Mr. Plumeria discovered it when he was walking in front of the Church in full moon night. The smell of flower of the tree was very attractive to every body. But the meaning of the word “Lantom” in Thai is “Sad” so, people never plant it in their home garden. Although present princess Sirindhorn change its name as “Lilawadi” meaning “Charming lady” to encourage the people to plant it.

Another species *Polyanthia longifolia* also not planted in people’s home garden Because the meaning of this species is “Sadness”. Sometimes it can be seen in the temples, religious center and also in school yards.

19.7 In the old days people want to avoid to plant “Papaya (*Carica papaya*) because they believed that like its flower all the members of the house / family will be go out and became scattered . Now a days people in Ban Thung Soong village grow in their homegarden mainly for food.

19.8 Matoom is a tree that is also related to their religion. Though the farmers plant it in their homegarden yet, it is commonly found in many Buddhist temples as it’s dried and sliced fruit boiled with water and used as a popular drink for monks.

19.9. Farmers of Ban Thung Soong Village were more conscious about their environment and beautification. They used a lot of species for it’s aromatic attributes. Such as *Michelia champaca* (Champa), *Michelia alba* (Champi), *Alyxia reinwardtii* (Cha-lood), *Cananga odorata* (Kra-Dang Nga), *Cananga fruticosa* (Kra-Dang Nga Songkhla), *Mimusops elengi* (Phikun), *Artabotrys siamensis* (Kara wek), *Anaxagorea javanica* (Cham-Pun), *Tetracera loureiri* (Ros-su-khon), *Plumeria longifolia* (Lan-tom), etc they like more to plant for their attractive fragrant. Besides *Anaxagorea javanica*, all other species they planted in the north-east direction of the house in such a way that the fragrant air can easily blow to their living rooms. Only *Anaxagorea javanica* they planted near the well where more water is available.

Table 21 Spiritual, ritual and aromatic value of the species

(n=155)

Respondent’s Reply	Number	Percentage
Positive reply	155	100
Negative reply	0	0
Total	155	100

20. Regular Work in Homegarden

From the Table 22, it found that peoples of the study area gives more time to their homegarden. It means that homegarden activity was more active in that area. People gave more emphasized on homegarden as they also benefited from the activity. It was a positive side of the area. It also indicate that the people of Ban Thunh Soong Village are more dependent on their homegarden.

Table 22 Respondents given the time to work at homegarden

(n=155)

Respondent's reply	Number	Percentage
Positive reply	130	84
Negative reply	25	16
Total	155	100

21. Productive Situation of Homegarden

Ban Thung Soong village people was more unite to protect their community forest, more active and laborious to their farm land When asked the question about the condition of productivity of their homegarden almost all (94 %) of the farmers replied positive (Table 23). It indicated that they were more depended on their homegarden and as a result they maintain their homegarden in such a way that they controlled the loss of productivity of their homegarden.

Villager informed in the interview that they want the community forest to be restorated so most need is foods and minor forest products have to be developed in the homegarden instead.

Table 23 Present productive conditions of homegarden at Ban Thung Soong village

(n=155)

Respondent's Reply	Number	Percentage
Positive reply	145	94
Negative reply	10	6
Total	155	100

22. Domestic Requirements Fulfilling by the Timber, Pole, Fuelwood and Fodder from the Homegarden

Farmers at Ban Thung Soong Village smoothly maintain their homegarden more than three decades with their rich indigenous knowledge without losing any productivity .They were also satisfied with their homegarden products. When they were asked whether the homegarden product fulfil their domestic requirement with timber, pole, fuelwood and fodder their reply was shown in Table 24.For timber 94%, for pole 91%, for fuel lwood 82% and for fodder 79% people had given their opinion in positive direction. It indicated that in the study area people's domistic requirement of timber or timber related products were fulfilled by their homegarden.

Table 24 Meet respondents domestic requirements of timber, pole, fueiwood and fodder from homegarden

(n=155)

Products of Homegarden	Number Fully	Percent
Timber	145	94
Pole	141	91
Fuel wood	127	82
Fodder	122	79

23. Meeting Domestic Demand of Agricultural Crop and Fruits

When farmers were asked about their domestic requirement of fruits and agricultural crops were fulfilled by the homegarden, they replied in various degrees i.e for .fruit 88% and for agricultural crop 84% (Table 25). It indcated that most of people in the study area agreed that their domestic demand of fruits and agricultural crops mitigate by their homegarden. From the result it showed the picture that the homegarden condition of Ban Thung Soong Village was progressive, able to mitigate the domestic requirements of the farmer, assists in generating income ,uplift their livelihood , helped them to became self relient and also play a vital role in socio-economic development of the community.

Table 25 Meet respondents domestic requirements of fruits and agricultural crops from homegarden

(n=155)

Homegarden Product Fruits & Agricultural Crop	Number	Percent
Fruits	136	88
Agricultural crop	130	84

Discussion

Fropm the above discussion it is obvious that people of the study area are more active and conscious about their hiome garden. Most of the people living in this village more than three decades.So their tradition and culture is same and deep rooted. Most of the people involve with homegarden production system. They have no agricultural land in their undulating hill tarrian. So they can provide more time to the homegarden and homegarden also provide them a lot of goods and services .Homegarden production is increasing and they are able to maintain their homegarden in such a way that they can controlled the loss of productivity of their homegarden by proper manuring and management. Homegarden fulfilled their daily deman of their home consumption and help in generating income. They aer fully satisfied about their homegarden products. So the people of Ban Thung Soong Village are more dependent on their homegarden and homegarden provides tangible and intangible benefit in a sustainable basis

Homegardens are fundamentals to the farmers' life throughout the village. Wide ranges of products are available from the homegardens. The multipurpose tree crops provide fuelwood, fruit, timber, poles, medicines, shade, living fences, fodder, protection against pests, cash crops, and even simply ornament. The great diversity of species and their different phenological behaviors ensure year round production of different products thus ensuring something for daily harvest. Many authors from all the three continents make similar observations (e.g. Michon, 1983 in Java; Okafor and Fernandes, 1987 in Nigeria and Buylla Roces *et al.,* 1989 in Mexico, Millat-e-Mustafa, 1996 in Bangladesh).

Part 2: Vegetation Survey

1. Plant Composition

The inventory data in the homegardens revealed that a great variety of plant species were managed in the homegardens of the study area. From the 10 sample homegardens, a total of 132 perennial species (including medicinal plants) were recorded. According to Thai classification out of 132 species, 58 species were recorded as tree, 29 species as shrubby tree, 12 species as shrub, 5 species under shrub, 7 species as climber, 4 species as palm, and 17 species as herb. Annual crops e.g. vegetables, spices etc were excluded from the inventory. If these could be included, the number of species would be much higher. Species recorded in the inventory with their family name, local name, common name, scientific name,plant form, functional grouping or utilization of species, and availability in the ten homegarden were presented in Appendix B_4.

2. Species Richness

The variation in species richess was found in the homegardens of different groups (Table 26) and within ten homegardens (Table 27). In groups it was observed that species richness was more high in medicinal group (4.41) followed by fruits (2.08) and timber (1.84) group. Individual group shown in Appendix B_1-B_3.

Table 26 Species richness within groups

Group Number	Number of Species	Number of Individuals	Species Richness
1 Group A	69	1105	2.08
2 Group B	70	1449	1.84
3 Group C	91	426	4.41

Within 10 homegardens the highest richness was found in homegarden no 7 (3.90), next Hg 3 (3.62), and Hg 6 (3.62), both were same in condition. All these three homegarden were medicinal species oriented homegarden. Next, Hg 4 (3.37), Hg 9 (3.00), Hg 8 (2.92), Hg 5 (2.04), Hg 10 (1.90), Hg 1 (1.59), and Hg 2 (1 31), respectively.

Table 27 Species richness within ten houses

Homegarden Number	Number of Species	Number of Individuals	Species Richness
Hg-1	36	510	1.59
Hg-2	40	932	1.31
Hg-3	51	199	3.62
Hg-4	43	163	3.37
Hg-5	28	188	2.04
Hg-6	40	122	3.62
Hg-7	40	105	3.90
Hg-8	36	152	2.92
Hg-9	48	255	3.00
Hg-10	36	354	1.90

3. Species density

Species density of ten homegarden was calculated and shown in Table 28.

Table 28 Species Density of ten Homegardens

Homegarden Number	Size of homegarden (ha)	Total Species	Density Species / ha
Hg-1	1.87	36	19
Hg-2	3.1	40	13
Hg-3	0.42	51	121
Hg-4	1.93	43	22
Hg-5	1.09	28	26
Hg-6	0.85	40	47
Hg-7	0.19	40	211
Hg-8	0.36	36	100
Hg-9	1.05	48	46
Hg-10	0.46	36	78

While density of species per hectare for each homegarden was plotted against the size of the respective homegardens a general trend was observed for species density to decline with increasing home garden size (Figure 2). In this figure the exponential curve was shown the value of $R^{2\,(0.824)}$ was closer to 1.which indicate that “Homegarden Size” and “Species Density” closely related to each other in a positive way.

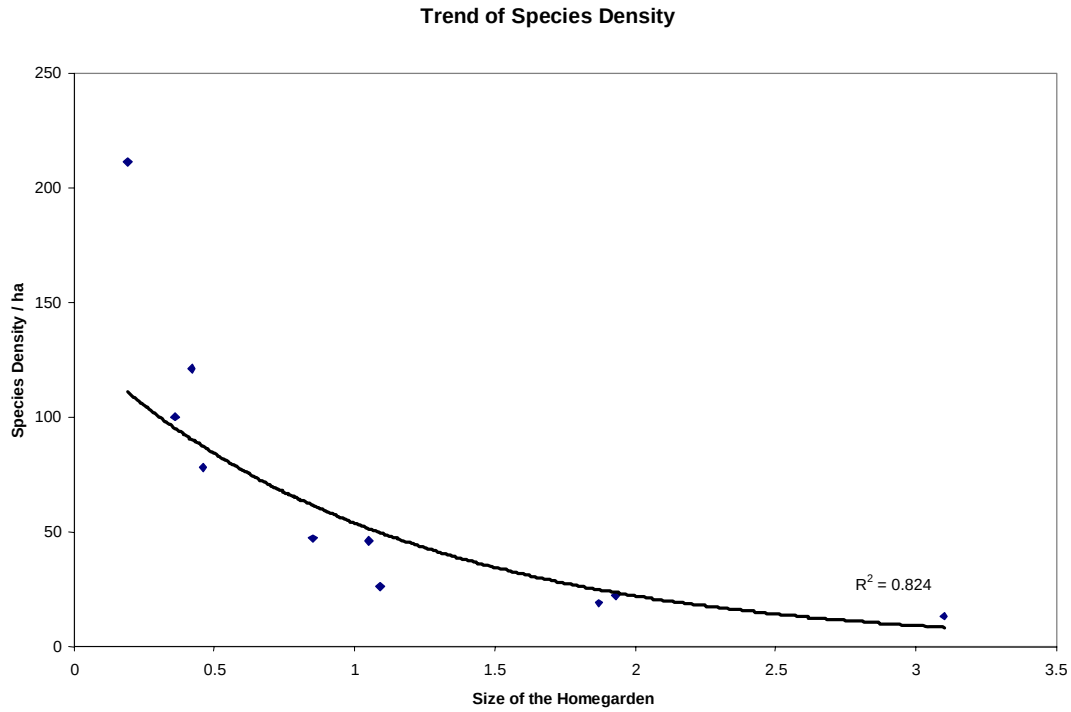

Figure 2 Trend of species density with homegarden size in the Ban Thung Soong Village.

Statistical analysis (Regression) for "Homegarden Size" (independent variable) against "Species Density" per hectare (dependent variable) also showed a strong positive relationship in all the homegardens in Ban Thung Soong Village (Table 29).

Table 29 The regression analysis of homegarden size against species density / ha

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	18589.536	1	18589.536	9.282	.016
Residual	16022.564	8	2002.820		
Total	34612.100	9			

4. Species similarity

Species similarity caculated between the individual homegarden within each group.Presented in the Table 30. For Group A-fruit and food species, similarity ranges from 52% to 63% and average 58%. For Group B-timber species similarity ranges from 46% to 48% and average 47 %. For Group C- medicinal plant species it ranges from 30 % to 44 % and average 37%. It indicate that average 58% of fruit species, 47% of timber species, and 37% of medicinal species were common in each group of homegarden at Ban Thung Soong Village. It revealed that within three groups only fruit species were very high common species in homegardens with respect to timber trees and medicinal plants.

Table 30 Species similarity within the group

Name of the Groups	Number of Homegarden and Similarity (%)	Number of Homegarden and Similarity (%)	Number of Homegarden and Similarity (%)	Number of Homegarden and Similarity (%)	Average Percentage of Similarity
Similarity for fruits species within Group A	Hg_1 & Hg_5 63	Hg_5 & Hg_8 59	Hg_8 & Hg_9 57	Hg_9 & Hg_1 52	58
Similarity for timber species within Group B	Hg_2 & Hg_4 46	Hg_4 & Hg_{10} 48	Hg_{10} & Hg_2 47	-	47
Similarity for medicinal plant species within Group C	Hg_3 & Hg_6 37	Hg_6 & Hg_7 30	Hg_7& Hg_3 44	-	37

Discussion

The information presented here was the results of a vegetation inventory of the traditional homegardens of Ban Thung Soong village, Krabi province, Thailand. The proportion of trees was more than herbs, shrubs and others in the study areas. This is an indication of the long-term perpetuity of the homegardens.

The total 132 perennial species was identified from the study area. Smaller homegardens had more species density than the larger one. This may be attributed to the fact that farmers with smaller homegardens who are also economically insolvent attempt to exploit the garden for all their domestic needs of tree products. Similar observation is made by Southern (1994) for the kandy homegardens of Sri Lanka.

Higher proportion of fruit and food producing species followed by the timber. The studies of Barrau (1961) in the Pacific, Mc. Connell and Dharmapala (1973) in Sri Lanka, Sommers (1978) in Philippines, Michon et al. (1983) in Java, Boonkird et. al. (1984) in Thailand, Millat-e-Mustafa *et. al.*,(1996) in Bangladesh have

acknowledged the predominance of fruit and food producing species in the homegardens of the respective countries.

More than half of the fruit species (58%), near half of the timber species (47%) and more than one third (37%) of the medicinal plant species were common in the homegardens while compared ten homegarden in each group.

Part 3: Pattern of Floristic Composition of Homegardens

The existing pattern of the species composition in ten homegardens at Ban Thung Soong Village shown in this part from Figure 5 to Figure 15 by taking position of all species present in each homegarden. The pattern of the species composition in homegarden revealed the farmers indigenous knowledge, their tradition and culture.

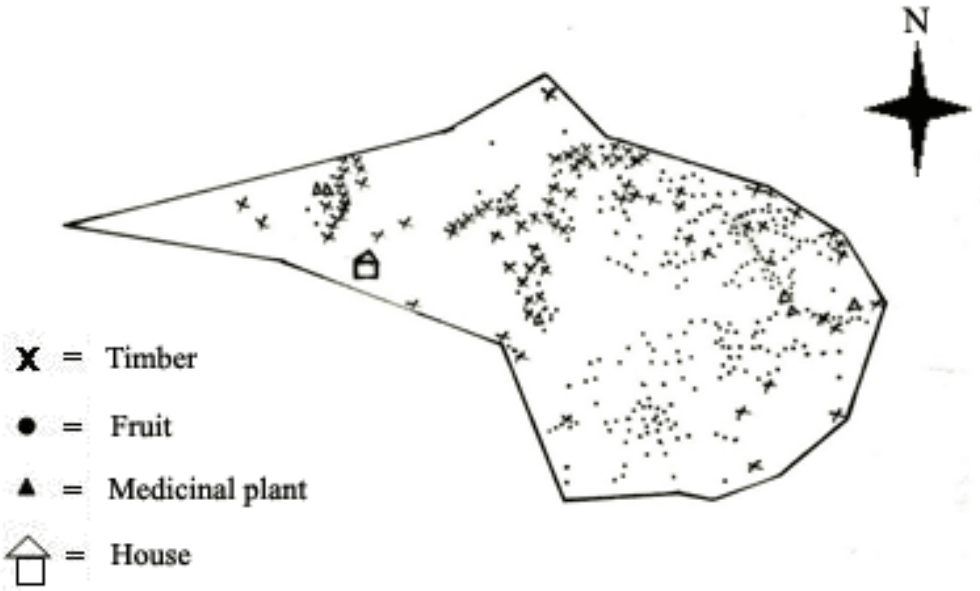

Figure 3 Map of Homegarden No.1.

Figure 3 shown that all timber trees, fruit trees, medicinal plant, boundary of the homegarden and the location of house of homegarden owner (Mr. Montri Kawsa Art). The figure also shown that the pattern of the species composition was mixed in condition.But plenty of fruit species, few timber species and very few medicinal plant in the homegarden. The area of the homegarden obtained from the GPS was 11.68 Rai. Or 1.87 ha. (6.25 Rai = 1 ha). Total 510 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species were recorded 36.

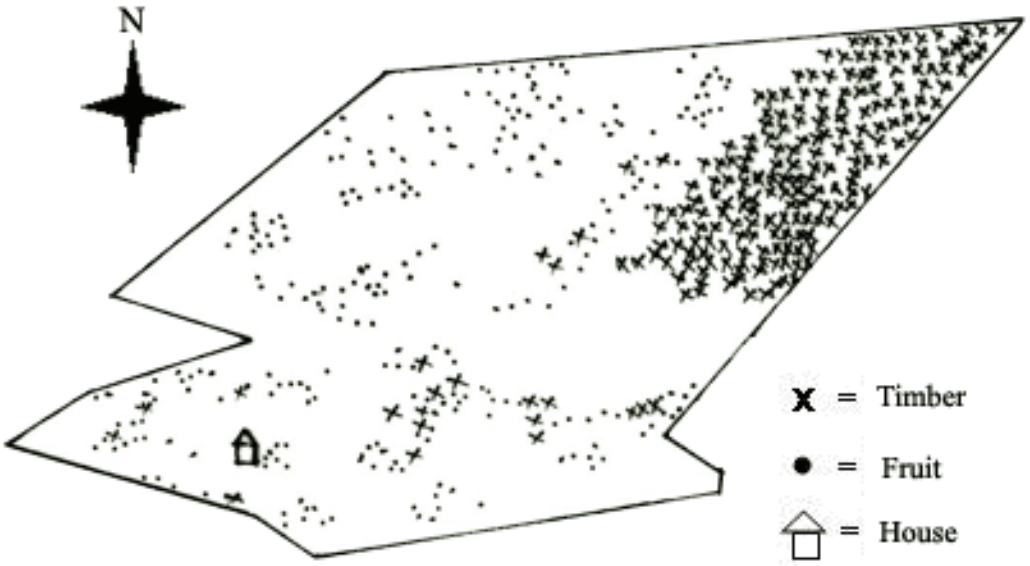

Figure 4 Map of Homegarden No 2.

It shown in the figure 4 that, all the fruit trees, timber trees, homegarden boundary and the location of owner's house (Mr. Kuakul Patanasingh). There was no medicinal plant in this homegarden. The position of all fruit trees were scatteredly distributed throughout the whole homegarden. But variety of fruit species represent the homegarden as a mixed in condition. On the other hand though all timber trees planted in a specific block, yet it was not a monoculture in composition. Variety of timber species planted in the wood lot. So it was also a mixed pattern of species composition. Some timber species were also found in mixed condition with fruit species.Ultimately it was revealed that the owner established a mixed pattern of species composition in his homegarden where timber species and fruit species were separated from each other.The area of the homegarden was 19.40 Rai. Or 3.1 ha. Total 932 number of plants including timber & fruit species. total number of species were recorded 40.

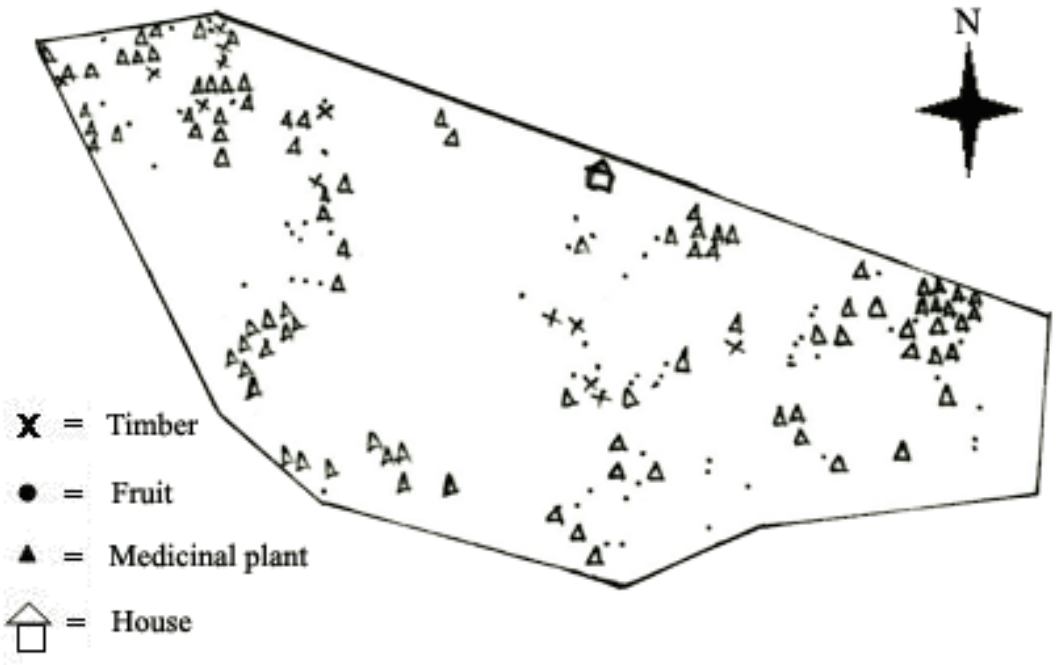

Figure 5 Map of Homegarden No 3.

The figure 5 has shown the position of timber, fruit, medicinal plants, boundary of the homegarden and the location of the owner's (Mr. Sakorn Pridapol) house.The figure was also shown that maximum number of medicinal plants in this homegarden. Very few fruit trees and timber trees were present mixed in condition. The area of the homegarden was 2.65 Rai.or 0.42 ha. Total 199 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species were recorded 51.

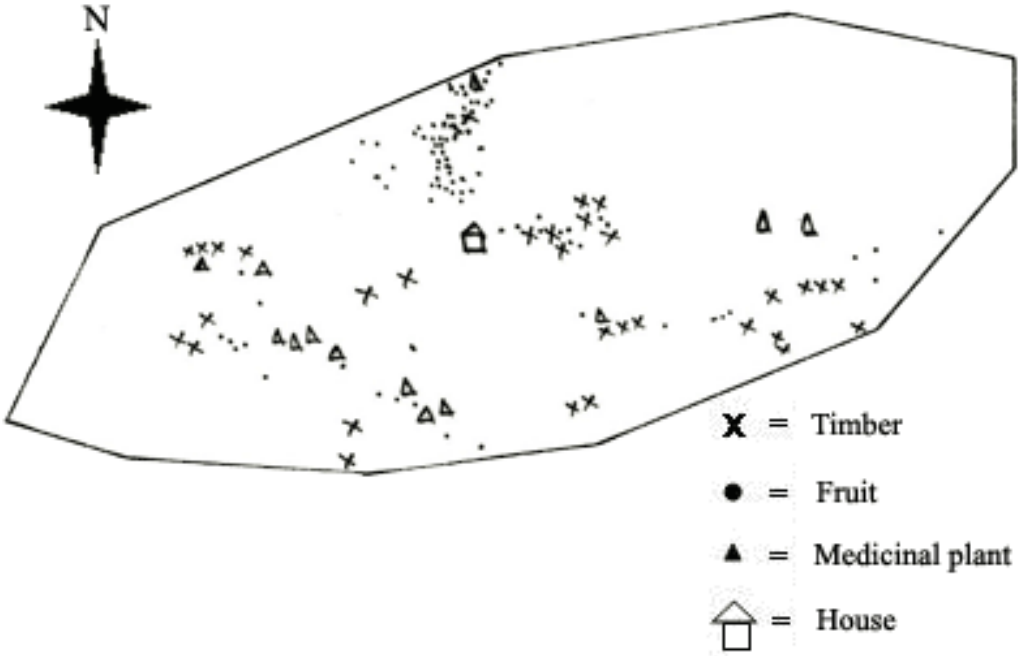

Figure 6 Map of Homegarden No 4.

From the figure 6, it was shown that the location of the owner's (Mr. Pramote Pridapol) house was almost in the middle. All timber trees, fruit trees and medicinal plants were mixed in condition and situated around the house. The area of the homegarden was 12.06 Rai. Or 1.93 ha. Total 163 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species were recorded 43.

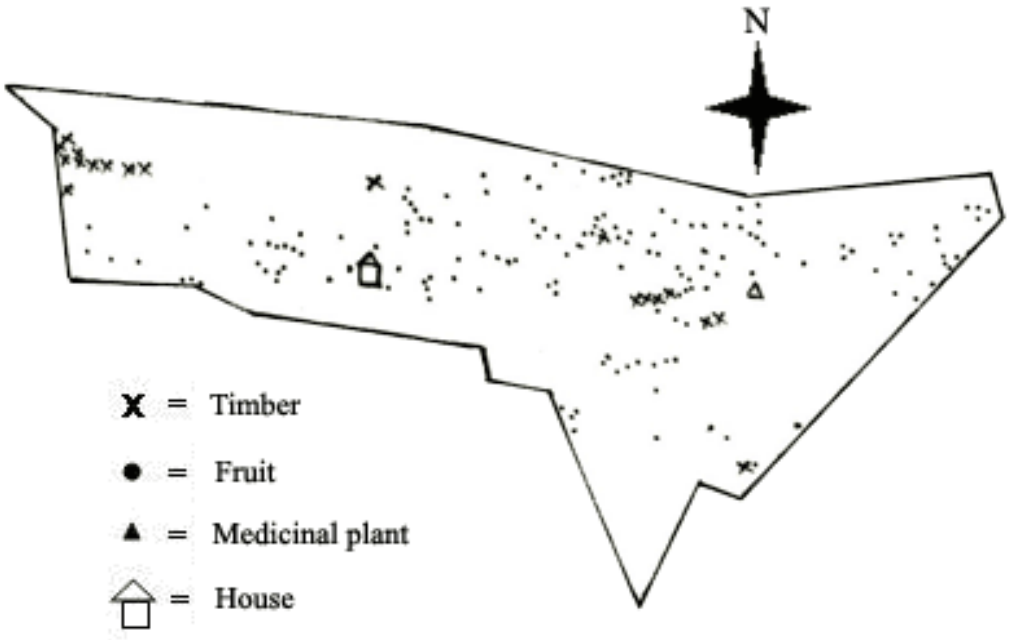

Figure 7 Map of Home garden No 5.

Figure 7 shown all fruit species, boundary of the homegarden amd the location of the house of the homegarden owner (Mrs.Yindee Nouanlong). It shown that all the fruit species were mostly located around the house and these species were mixed in condition. The area of the homegarden was 6.80 Rai or 1.09 ha. Total 188 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species were recorded 28.

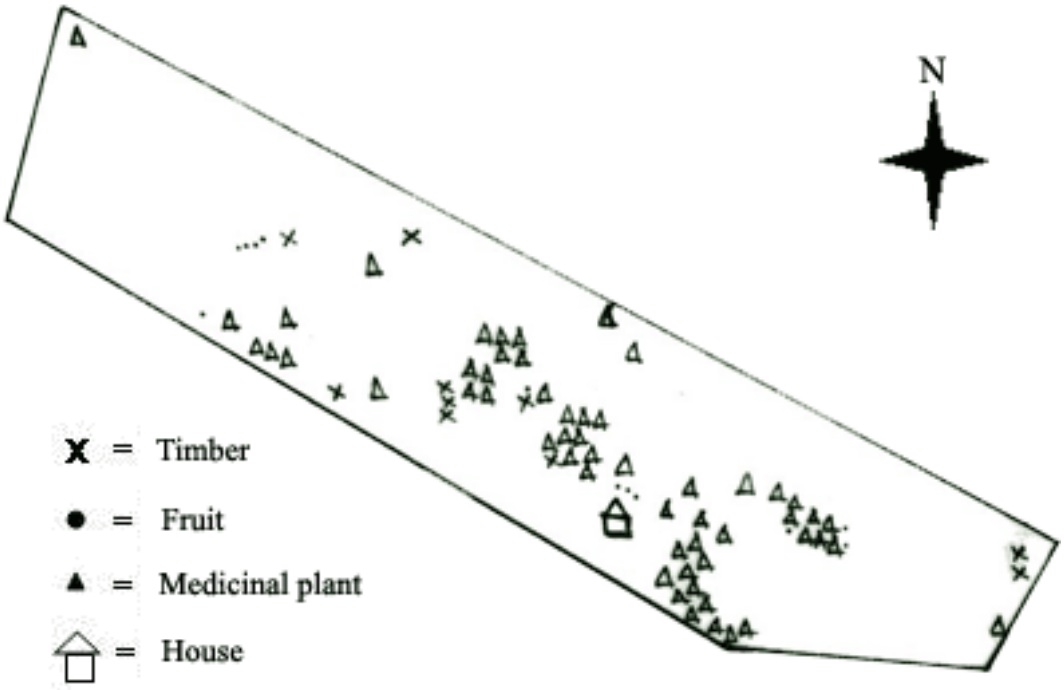

Figure 8 Map of Homegarden No 6.

Figure 8 shown that all the timber trees, fruit trees, medicinal plants, house point and boundary of the homegarden. It also shown that plenty of medicinal plant in the homegarden and all were near the house. Fruit and timber trees were very few and far away from the house. Species were scatteredly distributed and pattern of species composition was mixed. The homegarden area was obtained from the GPS 5.32 Rai or 0.85 ha. Total 122 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species recorded were 40.

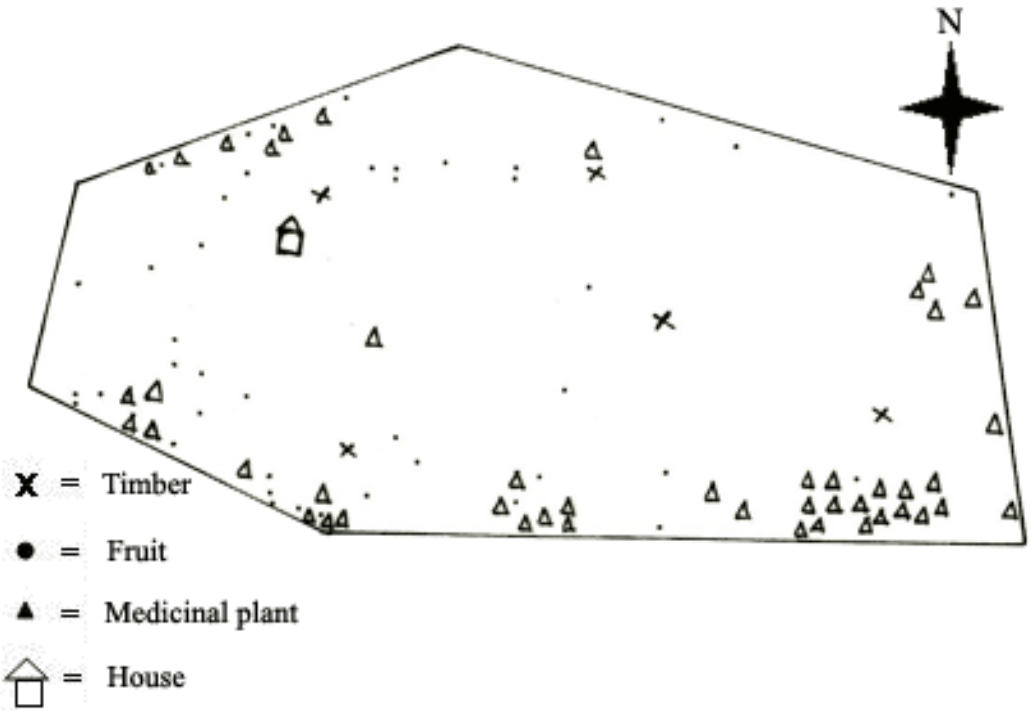

Figure 9 Map of Homegarden No 7.

The figure 11 shown that total area of the homegarden, position of the total timber trees, fruit trees and medicinal plant, position of woner's (Mr Somboon Kawsawang) house. The figure shown that it was a mixed pattern of species composition where maximum medicinal plants were clustered in condition and near the boubdary. The area of the homegarden was 1.21 Rai or 0.19 ha. Total 105 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species were recorded 40.

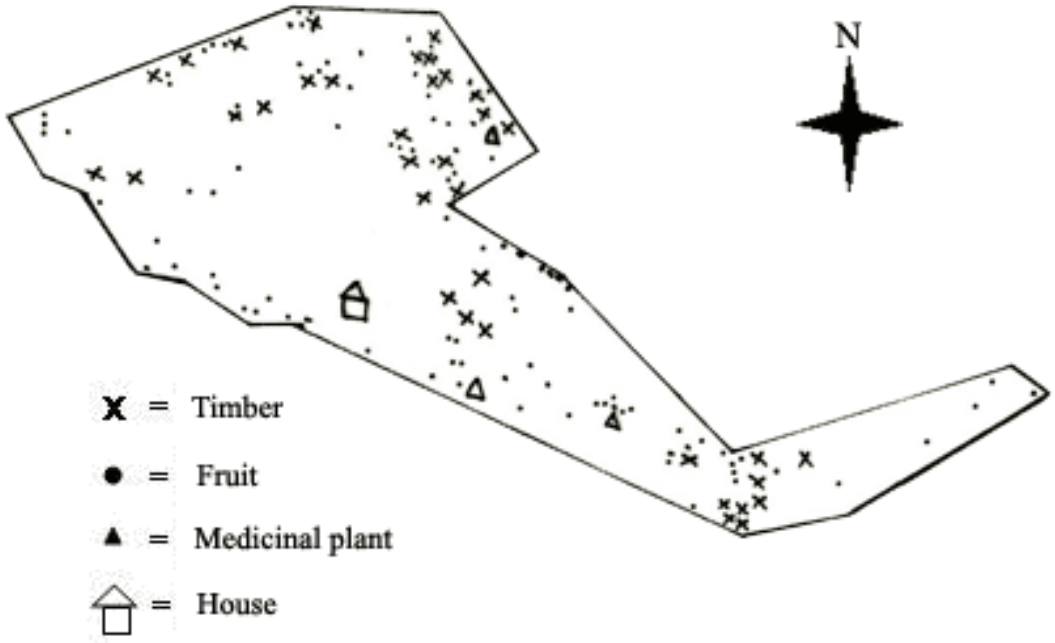

Figure 10 Map of Homegarden No 8.

The figure 10 shown the the position of timber trees, fruit trees, medicinal plants, boundary and position of homegarden owner's (Mrs. Jiam Srithep) house. It was also a mixed pattern of species composition where all the trees were planted around the living house scatteredly. The area of the homegarden was 2.23 Rai or 0.36 ha. Total 152 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species recorded were 36.

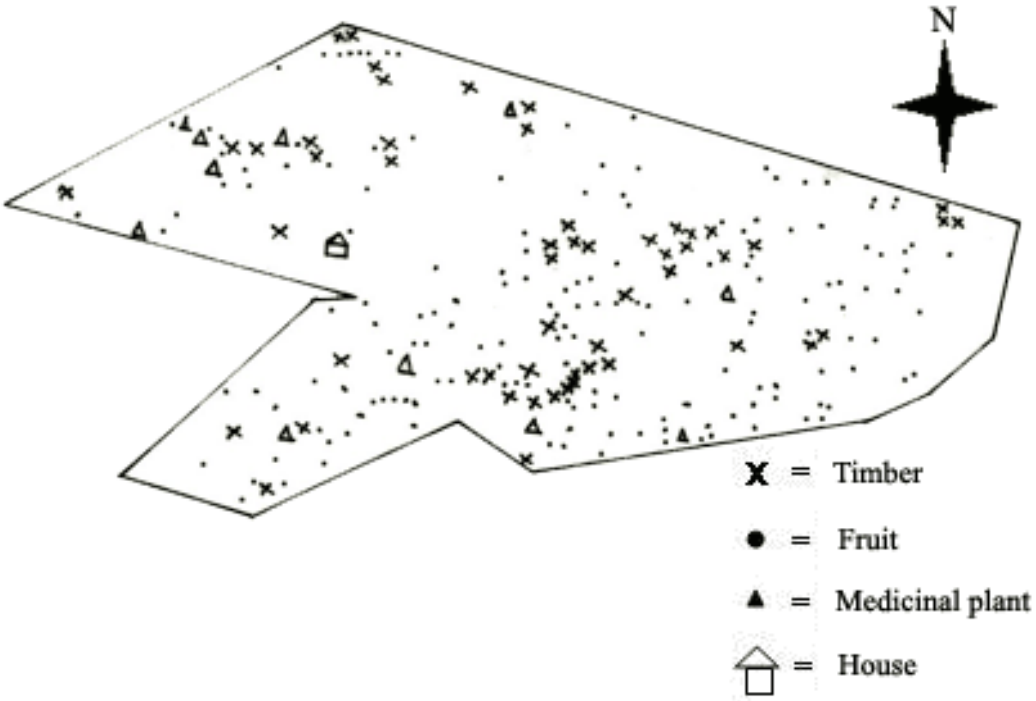

Figure 11 Map of the Homegarden No 9.

The figure 11 shown the position of all timber trees, fruit trees, medicinal plant, boundary of the homegarden and the location of the owner's (Mr. Bandit Luanloy) house. All plants distributed more or less equally throughout the whole area of the homegarden. But mixed in condition. The area of the homegarden obtained from the GPS was 6.56 Rai. Or 1.05 ha.Total 255 number of plants including tree, shrub and herb were taken position in this homegarden and total number of species were recorded 48.

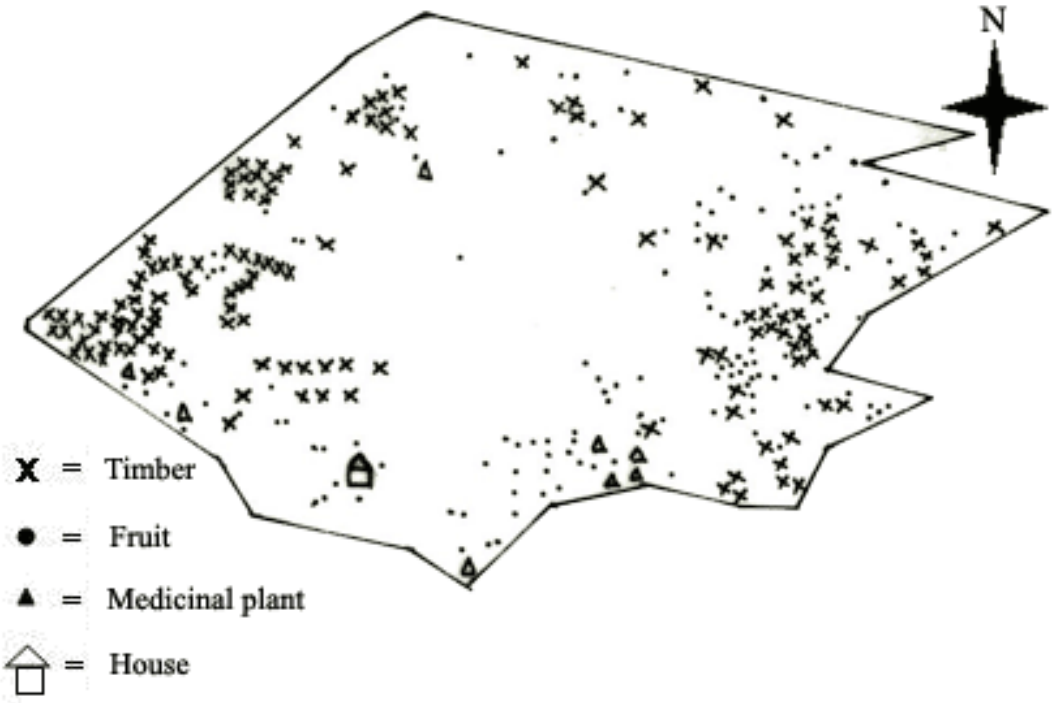

Figure 12 Map of the Homegarden No 10.

The figure 12 shown the total timber trees, fruit trees, medicinal plants, boundary of the homegarden and the location of the owner's (Mr. Charun Tonchon) house.The figure also show that maximum fruit trees located at the east side of the house and almost all the timber trees located in the west side of the house. Medicinal plants were also mixed both in the timber and fruit trees. It also indicate mixed pattern of species composition. The area of the homegarden obtained from the GPS was 2.86 Rai or 0.46 ha. Total 36 species were recorded in the homegarden including tree, shrub and herb and total number of plants taken position were 354.

Part 4: Indigenous Management Technique of Homegarden

1. Planting materials used

Farmers in the study areas used planting materials such as seeds, seedlings, and vegetative propagules to regenerate their homegarden plants (Table 31). There are some similarities as well as very few differences in using a particular type of planting material observed in the village. For example, *Cocos nucifera* is always regenerated by seedling in whole the village. Similarly for rambutan (*Nephelium lappaceum)* and mangosteen (*Garcinia mangostana)* grafting method followed as a planting materials by the farmers.

Table 31 Planting materials used by the farmers at Ban Thung Soong Village

Planting materials	Name of the reported specie
Seed	*Leucaena leucocephala*
	Areca catechu
	Mangifera foetida
Seedling	*Parkia speciosa*
	Cocos nucifera
	Dipterocarpus alatus
	Azadirachta excelsa
	Hopea odorata
Both seed and seedling	*Swietenia macrophylla*
	Dipterocarpus alatus
	Alstonia macrophylla
	Shorea roxbuerghii
Vegetative propagation	*Psidium guajava*
	Citrus hystrix
	Mangifera indica
	Garcinia mangostana
	Durio zibethinus
	Lansium domesticum
	Artocarpus heterophyllus
Seed, Seeedling, & Vegetative propagation	*Psidium guajava*
	Zyzyphus mauritiana

2. Reasons for Using Different Types of Planting Materials

Farmers used different types of planting materials (Table 32) to regenerate their homegarden plants. Reasons were identified:

(i) ease of availability,
(ii) best quality,
(iii) more survival rate and
(iv) convenient size

Table 32 Reasons for using different type of planting materials in the homegarden at Ban Thung Soong Village

Planting Materials	Reasons	Reported species
Seed	Quality planting materials can be ensured	*Areca catechu* *Mangifera foetida*
	Easily available in the homegarden	*Areca catechu* *Leucaena leucocephala* *Azadiracta indica siamensis* *Baccautea* spp.
Seedling	More survival rate	*Cocos nucifera* *Areca catechu*
	Quality planting materials can be ensured	*Swietenia macrophylla* *Cocos nucifera*
Seed and Seedling	Easy to grow from both seed and seedling	*Swietenia macrophylla* *Artocarpus heterophyllus* *Alstonia scholaris*
Vegetative	Improve variety can be introduce	*Nephelium lappaceum* *Phyllanthus acidus* *Mangifera indica* *Garcinia mangostana* *Durio zibethinus* *Lansium domesticum* *Artocarpus heterophyllus* *Psidium guajava* *Citrus hystrix*

3. Sources of Planting Materials

Four major sources (Table 33) of planting materials were identified. These were:

(i) own homegarden,
(ii) neighbors and relatives homegarden,
(iii) private nursery and
(iv) Royal Forest Department Nursery

Throughout the village a tradition of giving planting materials as gift to the neighbors and relatives was observed. Exchange of quality planting materials of desired variety of homegarden origin was also common. Farmers also encouraged naturally growing seedlings when it was valuable. Planting materials also available in the private nursery from where people can buy their desire species. Mainly high genetic quality grafting materials were available in the private nursery. Farmers collected the planting materials mainly timber species from the Royal forest department nursery.

Table 33 Source of Planting materials in the homegarden at Ban Thung Soong Village.

Sources	Name of reported species
Own Homegarden	*Cocos nucifera*
	Areca catechu
	Bamboo
Neighbour / relatives homegarden	*Carica papaya*
	Punica granatum
	Lansium domesticum
	Phyllanthus acidus
	Parkia speciosa
Private nursery	*Nephelium lappaceum*
	Mangifera indica
	Garcinia mangostana
	Durio zibethinus
	Lansium domesticum
	Artocarpus heterophyllus
	Psidium guajava
	Artocarpus integer
	Phyllanthus acidus
The Royal Forest Department Nursery	*Tectona grandis*
	Dipterocarpus alatus
	Azadirachta excelsa
	Swietenia macrophylla
	Hopea odorata
	Alstonia macrophylla
	Shorea roxbuerghii

4. Mother Tree Selection

Farmers of the village collect their planting materials from good mother trees. For tree straight bole, uniform crown development, free from any defects, middle aged, able to produce viable seeds and vigor in nature were the criteria attributed by all farmers of the village. In case of fruit trees, for prepare grafting materials more branching habit (for more fruit production), able to produce good quality (e.g. sweet, insect/disease free etc.) big sized fruits, uniform shape of the fruits, more fruit

production were the criteria identified. If sweetness found higher then other criteria such as shape and size considered more by the farmers. (Table 34)

Table 34 List of species for which mother trees are selected in the homegarden at Ban Thung Soong Village.

Plant	Name of the Species
Fruit	*Durio zibethinus*
	Nephelium lappaceum
	Areca catechu
	Punica granatum
	Lansium domesticum
	Cocos nucifera
	Garcinia mangostana
	Syzygium cumini
Timber	*Eucalyptus* spp.
	Dipterocarpus alatus
	Swietenia macrophylla
	Hopea odorata
	Parkia timoriana
	Alstonia macrophylla
	Acacia auriculiformis

5. Location and spacing of planting

Three specific locations were identified:

(i) homegarden boundary close to the living house,
(ii) homegarden boundary away from the living house and
(iii) inside the homegarden (Table 35)

Trees in the homegarden boundary acted as a living fence, area marker and wind break. Trees which caste more shade, requires less care, big in size, big branches causes any damage to the living house by falling any time in storm or its greater root system causes damage to the living house were usually placed away from the living quarter. Species which require intense care and supervision (e.g. fruit trees needs to be safe from theft) were usually planted nearby the living house. Ornamental trees, important medicinal plants, small size fruit trees they planted in front of the house. Agricultural crops like pepper, chilli, egg plant, turmeric they planted beneath the other trees near the houses and vegetables they planted in kitchen garden behind the living house.

No definite spacing pattern could be detected for the homegarden plants. Though all the farmers were well aware about the positive effects of wider spacing. Farmers of the village reported that plants were spaced in a wider gap in the early stages of homegarden development. But gradually it could not be possible to maintain since seeds after eating often scattered here and there without due consideration of

spacing and when they found new variety they collect and also planted in their homegarden.

Table 35 Location of the species selected for the homegarden at Ban Thung Soong Village.

Location	Name of the species
Homegarden boundary close to the house	*Cocos nucifera*
	Michelia champaca
	Annona squamosa
	Caryota bacsonensis
	Cassia fistula
	Ocimum tenniflorum
	Aloe vera
	Curcuma mangga
	Curcuma zedoaria
	Belamcanda chinensis
	Curcuma xanthorrhiza
	Psidium phyllanthus
	Leucaena leucocephala
	Senna siamensis
Homegarden boundary away from the living house	*Mangifera foetida*
	Areca catechu
	Eucalyptus spp
	Tectona grandis
	Dipterocarpus alatus
	Swietenia macrophylla
	Hopea odorata
	Parkia speciosa
	Parkia timoriana
	Durio zibethinus
	Azadirachta exelsa
	Citrus hystrix
	Bamboo spp
Inside the homegarden	*Punica granatum*
	Cocos nucifera
	Garcinia mangostana
	Mangifera indica
	Artocarpus integer
	Artocarpus heterophyllus
	Lansium domesticum
	Leucaena leucocephala

6. Planting season

Planting activities are usually done during the eight months long rainy season (April - December). Here rainy season divided into two parts. One north-east monsoon (April - August) and another one south-west monsoon (September - December). Farmers of the village reported that whole the year they could plant trees. But they prefer rainy season and north-east monsoon part (April - August) was more acceptable for their planting. Transplanting is also done during that time. The only reason reported by all farmers for planting during rainy season was that the survival rate was higher during this season due to availability of soil moisture which requires for new root development.

7. Cultural operations

Weeding, pruning, pollarding and fertilizing were the cultural practices done by the farmers of the village. The farmers have an idea that weeding controlled insect for their homegarden and avoiding from snake bite. As a result most farmers in the village reported that they carried out weeding operation (clean the whole homegarden) 2 – 3 times a year.

Pruning also performed for the rambhutan (*Nephelium lappaceum)* every year after fruiting (Table 36). Some other fruit species they pruned occationally. However, the intensity of pruning varied considerably from farmers to farmers and species to species. Farmers pruned *Krathin (Leucaena leucocephala)* every year for young leaf and fruits. But other some species they do whenever it needed.

The reasons of pruning varied from species to species. All the farmers reported that pruning was done for timber species to get straight, long and clean bole, for fuelwood and fodder. Farmers pruned the fruit trees to encourage more fruiting in the next year. Some fruit trees very sensitive to pruning which not only reduced fruit production but also heavy pruning might cause death to the trees. *Areca catechu, Artocarpus heterophyllus,* and *Psidium guajava* were the species identified by all the farmers as pruning sensitive species.

Table 36 Pruning operations practiced for the homegarden plants at Ban Thung Soong Village.

Pruning intensity	Reasons of pruning	Reported species
Regular	For young leaf and fruit	*Leucaena leucocephala*
	More fruit production	*Nephelium lappaceum*
	Fuelwood production	All timber and fruit species
Occasional	Encourage fruiting in the next year of pruning	*Psidium guajava*
		Artocarpus heterophyllus
	Timber species	*Dipterocarpus* spp.
		Swietenia macrophylla

Pollarding was practiced some time for *Krathin (Leucaena leucocephala)*. It was also reported that pollarding done for more branching,more young leaf and more young seed. Reduce tallness was another idea for pollarding.

Watering was not need at all because eight months long rainy season has provided enough for watering of the trees. But in dry period if any time needed, watering done only for fruit trees.

Organic fertilizer such as bat dung, cattle dung, kitchen waste, dung and rice husk from poultry farm and pig farm, etc used by the farmers for homegarden plants. Farmers also reported that they used complete (NPK) fertilizer for planting seedlings and trees.

Discussions

The variety of planting materials by which farmers regenerated their homegarden plants indicates that farmers have intimate knowledge about different regeneration techniques. Four reasons of using different planting materials were identified: ease of availability, quality, more survival rate and convenient size,. When more than one type of planting materials could regenerate a species, compromises are often made on the availability, quality and the prices of the planting materials which makes the regeneration techniques more flexible, Millat-e-Mustafa (1996), and Abedin and Quddus (1990) also observed a similar situation in Bangladesh homegardens.

Four major sources of seedlings were mentioned. Homegarden itself was the major source in the village. Though Royal Forest Department nursery as a source of seedling materials, yet government has taken “His majesty Kings Project” named “Self-reliance Project” to distribute quality seedlings to the farmers throughout the country, but it has been still in primary condition. In homegarden management collection of planting materials from good mother trees is one of the most important aspect for sustainable productivity. Farmers are reported certain criteria of mother trees. Thus by selecting the planting materials from good mother trees, farmers are maintaining the genetic potentiality of their homegarden plants through generations.

Although three different locations were recorded as being used by farmers for tree planting in their homegardens, there was a consistency in the choice made by farmers about where to put particular types of trees in his / her garden. When asked if there were any particular reasons for planting a particular type of tree on specific location, distinct explanations were given by the farmers. The patterns that emerge, in terms of tree locations, may be explained according to their primary use, farmers' perceived needs, their perception of the value of different tree species and convenience in terms of management and use. There was unanimous agreement among farmers that they would not wish to take the risk of damaging their living quarter from branch falling or whole tree falling in storm or any natural calamities. and as such they prefer the far part of the homegardens away from the living houses for growing timber species. Similar observations is reported by Millat-e-Mustafa (1996) from Bangladesh, Thapa (1994) from Nepal, Fernandes and Nair (1986) from

the Pacific, Nair and Krishnankutty (1984) from the Kerala homegardens of India, and Wickramasinghe, (1992) from the Kandy homegardens of Sri Lanka.

The homegardens are intensively planted. Once it is established, the garden is largely self-sustaining although some interventions, such as weeding, pruning, and pollarding prevent the homegardens from becoming overgrown during periods of rapid plant growth. Jacob and Alles (1987), and Southern (1994) from the Kandy homegardens of Sri Lanka, Millat-e-Mustafa (1996), and Leuchner and Khaleque (1987) from Bangladesh, Nair and Sreedharan (1986) from Kerala, India reported similar types of situation in the homegardens of the respective countries.

From the above discussion it would appear that the farmer of the study area have an intimate knowledge about different management aspects of homegardens which is sufficient to maintain the homegardens in a manner which provides more services to the farmers from diverse community of plants.

Part 5: Uses of Homegarden Medicinal Plants

Farmers in the study areas led their every day life along with some innovative and inherited indigenous knowledge. The blessing of modern science now constitute the modern rural life of Ban Thung Soong Village which is slightly modified and advanced rather than the old one. But still now the farmers of the village using medicinal plants for various diseases. There were some parataxonomist in the village and they were very expert about uses of medicinal plamts. Maximum medicinal plants were found parataxonomist's homegardens. All parataxonomists were found knowledgeable and they help their neighbors in collecting medicinal plants either from their own homegarden or from neighbors' homegarden whenever necessary.

Medicinal plants in the homegarden area were used frequently for tonic, antipyretic, antidiarrheal, carminative, antidiabetic, antimalarial, hematinic, typhoid, blood circulation, muscle sprain, and for snake bite etc. Some species were found to use for curing more than one disease. Similarly many species used for curing single disease. Sometimes for aparticular disease a single species was used while in many cases a mixture of species with different proportions were also used. A total 55 species were recorded in the homegarden of the study area during the vegetation survey which farmers used as a medicinal plants.Some fruit species and timber species farmer also used as a medicinal plant.Recorded 55 species were described below in the Table 37.

Table 37 Medicinal plants of homegarden frequently used at Ban Thung Soong Village.

Botanical name	Thai name	Part used	Medicinal use	Application
ANCISTROCLAD-ACEAE *Ancistrocladus tectorius* (Lour.) Merr.	Lin kwang	leaf	antipruritic	decoction and bath
Alstonia macrophylla Wall.ex G.Don	Thungfa	stem, root	tonic	alcoholic extract/drink
EUPHORBIACEAE *Claoxylon longifolium* (Blume) Engl. ex Hassk.	Phak wan chang	root	for snake bite	crush with rice water/apply locally
Sauropus androgynus (L.) Merr.	Phak wan ban	Leaf	antipyretic	crush/poultice or decoction/drink
LAURACEAE *Flemingia macrophylla* (Willd.) Prain subsp. heterocarpon	Khamin nang	Leaf	for abscess in for animal	grounded with food

Table 37 (Cont'd)

Botanical name	Thai name	Part used	Medicinal use	Application
ANACARDIACEAE *Mangifera foetida* Lour.	Mamut	kernel root	Antidia- rrheal, for snake bite, hematinic	decoction/drink decoction/drink
Mangifera indica L.	Mamuang	leaf stem bark	for hyperten-sion, antidiarrheal detoxicant	decoction/drink decoction/drink
ANNONACEAE *Anaxagorea javanica* Blume	Chumpun	stem	Antiinfla-matory	decoction/drink
Annona squamosa L.	Noina	leaf	to kill lice	crush with vegetable oil/poultice on head
	Noina	leaf	shampoo	With water
ARALIACEAE *Polyscias fruticosa* (L.) Harms	Lepkhut	leaf	for snake bite	decoction with other plants/drink
BIGNONIACEAE *Oroxylum indicum* (L.) Kurz	Pheka	stem bark leaf	antipyretic for Herpes zoster	decoction/drink decoction/drink
	Pheka	bark	Anti fever	Drink with water
CARICACEAE *Carica papaya* L.	Malako	resin	for warts	apply locally
RUTACEAE *Clausena excavate* Burm. f.	Mui	Whole plant	Increase strength	Bath with boil water
GUTTIFERAE *Carcinia mangostana* L.	Mang Khut	dried pericarp	antidiarrheal, for abcess	decoction/drink crush with water/apply locally
Orthosiphon aristatus (Blume) Miq.	Ya nuat moeo	leaf	diuretic	decoction/drink
Tamarindus indica L.	Ma Kham	seed pericarp	anthelmintic laxative	roasted and infused/drink
LEGUMINOSAE-MIMOSOIDEAE *Parkia speciosa* Hassk	Sator	seed	Antidiabetic and fat reducing	roasted and infused/drink

Table 37 (Cont'd)

Botanical name	Thai name	Part used	Medicinal use	Application
LEGUMINOSAE-PAPILIONOIDEAE *Clitoria ternatea* L.	Anchan	whole plant	antipyretic	decoction/drink
	Anchan	Root	Snake bite	Smear
MAGNOLIACEAE *Michelia champaca* L.	Champa	stem bark flower	for stimulating blood flow for paralysis	decoction/drink decoction/drink
MORACEAE *Artocarpus heterophyllus* Lam	Khanun	wood	anthelmintic, hematinic	decoction/drink
	khanun	Sapwood	Blood circulation	Drink with boil water
Ficus hispida L.f.	Ma duea plong	root	for typhoid	decoction/drink
Streblus asper Lour.	Khoi	fruit stem bark	tonic for nasal polyp	decoction with other plants/drink
BOMBACACEAE *Ceiba pentandra* (L.) Gaertn	Nun	leaf	Small pox	Smear
MYRTACEAE *Psidium guajava* L.	Farang	Leaf root	antidiarrheal tonic	decoction/drink decoction/drink
Palmae *Areca catechu* L.	Mak	root	antipyretic	decoction with other plants/drink
		Young fruit	Diarrhea	With boil water
ZINGIBERCEAE *Alpinia officinanarum* Hance	Kha lek	Young shoot	Release gas	eating
PLUMBAGINACEAE *Plumbago indica* L.	Chetta mun phloeng daeng	Root	For abnormal mensruation	decoction/drink
Plumbago zeylanica L.	Chetta mun phloeng khao	root	carminative	decoction/drink
PUNICACEAE *Punica granatum* L. var. granatum	Thap thim	leaf	antidiarrheal	decoction/drink
Mitragyna speciosa (Roxb.) Korth.	Krathom	leaf	For toothache	chew

Table 37 (Cont'd)

Botanical name	Thai name	Part used	Medicinal use	Application
Morinda tomentosa Heyne ex Roth	Yo pa	Stem bark	antimalarial	decoction/drink
RUTACEAE *Citrus aurantifolia* (Christm.) Swingle	Manao	Fruit juice	For sorethroat	Pill with other plants/orally
EUPHORBIACEAE *Phyllanthus acidus* (l.) Skeels.	Mayom	Leaf	High blood pressure	Drink with boil water
Citrus hystrix DC.	Makrut	pericarp	carinative	decoction/drink
	Makrut	leaf	Stomach problem	Boil water
ZINGIBERACEAE *Alpinia galanga* (L.) Willd.	Kha	rhizome	Carminative, for ring worm, Stomach problem	decoction/drink crush/apply locally
Boesenbergia rotunda (L.) Mansf	Kra chai	rhizome	Tonic, Belly pain	decoction/drink
Curcuma comosa Roxb.	Wan chak motluk	rhizome	For muscle sprain,	decoction/drink
Curcuma longa L.	Khamin	rhizome	for peptic ulcer	decoction/drink /pill/orally
*Zingiber montanum (*Koenig) Link ex Dietr.	Phai	rhizome	antiinflammatory	crush/apply locally
LABIATAE *Ocimum tennuflorum* Linn	Kaphrao		Stomach problem	Boil water
Zingiber officinale Roscoe	Khing	rhizome	carminative	decoction/drink
Zingiber zerumbet (L.) Sm.	Kra thue	Rhizome	antipyretic	crush/bath
	Kra thue	Rhizom with green betel nut	High blood pressure	Drink,boil water,
DIOSCOREACEAE *Dioscorea hispida* Dennst.	Kloi	Bark juice	Stopping blood from gum	Gargle

Table 37 (Cont'd)

Botanical name	Thai name	Part used	Medicinal use	Application
GUTTIFERAE *Garcinia atroviridis* Griff ex T. Anderson	Som khak	Green fruit	Anty malaria	Boil water
APOCYNACEAE *Alstonia scholaris* (L.) R Br.	Tin pet	Stem	Paralyzed	Boil water
SAPINDACEAE *Lepisanthes rubiginosa* (Roxb.) Leenh	Mahuat	Root	High fever, Headache	Boil water
CELASTRACEAE *Euonymus javanicus* Blume	Kra duk khai	Root & leaf	Wash lower part, sexual disease	Boil water
GUTTIFERAE *Garcinia mangostana* Linn.	Mangkhut	Bark smash	Itching	smear
SIMAROUBACEAE *Eurycoma longifolia* Jack	Pla lai phueak	Root	Antimala-rial, tonic	alcoholic extract/drink
TILIACEAE *Microcos tomentosa* Sm.	Phalapphl a	Leaf	for animal dermatitis	crush with food/eat
ZINGIBERACEAE *Stephania suberosa* Forman	Bora phet phung chang	Whole plant	tonic	alcoholic extract/drink
Curcuma longa L.	Kamin chan	Rhizom e with other ingredie nt	Increase blood & strength	Pregnant lady,drink
Morinda coreia Ham.	Yo pa	Whole plant	tonic	alcoholic extract/drink

Discussion

In ancient times plants, herbs and shrubs were used only as medicinal agents for the treatment of diseases and healing of wounds. According to the world health organization (WHO) more than 80% of people, mostly in less developed countries, depend on traditional herbal medicine for their primary health care needs (Zuberi, 1998). Siddik (1994) reported from Indonesia about the current status of jamu, which is an Indonesian term for indigenous medicine usually prepared from herbal materials. Even where modern medicine is readily available, a large portion of the population still depends heavily on jamu. It is estimated that 70-80% of Indonesian people

traditionally maintain their health by regularly drinking jamu (Afdhal and Welsch, 1991; Soedibyo, 1990). Abbink, (1995) from south- western Ethiopia also reported similar observations. According to him, plants have not only nutritional value but also in the eyes of the local people - medicinal and rituals or magical value.

From the results, prediction can be made that para taxonomist group of the study area possess a rich herbal medicinal knowledge for health care in their everyday life as their tradition and heritage.

CONCLUSION

The present study highlights composition, richness, density, and similarity of species of the homegarden of Ban Thung Soong Village. A vegetation inventory ascertained the above information. The information was subsequently used as a basis for exploring indigenous management techniques of homegardens employed by farmers in the study area and to acknowledge farmers' indigenous knowledge of homegarden medicinal plants as well as explore farmers' dependency on homegarden. Based on the present study, following conclusions are:

A total of 132 perennial species were identified, including 58 species of tree, 29 species of shrubby tree, 12 species of shrub, 5 species of under shrub, 7 species of climber, 4 species of palm, and 17 species of herb. Species richness obserbed high in medicinal plant oriented homegardens followed by fruit and timber oriented homegardens. Species density declined with increasing homegarden size in the study area. It found that average 58% of fruit species, 47% of timber species, and 37% of medicinal species were found commonly in homegardens. Mixed pattern of species composition was found. Farmers used the planting materials such as seed, seedling, and vegetative propagation in their homegarden. The people were choosing planting materials based on availability, quality, better survival rate, suitable size. Four major sources of planting materials were own homegarden; homegardens of neighbour and relatives; private nursery; and Royal Forest Department nursery. Farmers had considerable knowledge about mother tree selection and generally tried to apply this to collect / exchanging planting materials within the village. The pattern of planting in the homegarden were homegarden boundary close to the living house, homegarden boundary away from the living house, and homegarden interior. Planting in the homegarden were genegally done during the rainy season. Weeding, pruning, pollarding, and fertilizing were identified as cultural operations practiced although the intensity and species might varied from person to person. 55 species were recorded as medicinal plants in the homegardens of Ban Thung Soong Village.These species were used frequently for tonic, antipyretic, typhoid, antidiabetic, antidiarrheal, carminative, antimalarial, hematinic, blood circulation, muscle sprain, Itching, hypertension, paralysis and for snake bite etc. For using these medicine farmer apply their indigenous knowledge and technique for prepare it.

About 89 % of households were a permanent resident and very few were migrated (11%). On the other hand 93.6 % people were live in the village more than 20 years and mass population i.e. 87.8 % people lived in the village more than 30 years. More than 90% of the respondents were farmer. Almost all (96.1%) respondents possessed their own land. Almost all (98.1%) respondented have a homegaeden. There were various size of homegarden available in the study area.The average size of the homegarden units was 2.18 Rai (0.35 ha). Most of the farmers preferred more than one species and preference ranking for fruit (98%), timber (95%), vegetables (70%), Medicinal plant (42%), and fodder (20%). It reflects farmer's individual choice, tradition of the village, local needs, indigenous knowledge about the species and uses of the species. There was a shortage of animal manure. The products gained from homegarden were used for their daily home consumption

commodity of which some produced high in quantity such as Long bean, Chilli, Garlic, Onion, Ginger, Bean, Turmeric, Egg plant, Banana, Pepper. Other commodities they produce low in quantity like Cheese tree, Taro, Gnetum, Garlic, Amaranth and Corn. It again proved that they are more dependend on their homegarden.

The local people agreed that a lot of tree species have spiritual, ritual and aromatic values. Some species they paid respect from religious or ritual point of view. These species they never plant to their homegarden. They belives that its perfect place were temple, school or college yard. Some species they afraided for some spiritual meaning. They belived that *Hopea odorata* was the residence of the “Lady Ghost”. The Mayom (*Phyllanthus acidus*) should be planted in front of the house to became popular. Jackfruit (*Artocarpus heterofhyllus)* they plant in the back side of the house because they belived this tree would support and help them from the back side. They planted a lot of aromatic species around their houses in north-east direction for continuous blow of fragrant air to their rooms.

Farmers in Ban Thung Soong were mostly depended on their homegarden. Because they obtain more goods and services from their homegarden, including fruit, food, medicinal plant, fodder, fuelwood, timber, pole, and cash which uplifted their livelihood in a sustainable basis.

RECOMMENDATIONS

Based on the present study following recommendations are:

The present study has provided the useful information about the evolution of homestead planting system in the western part of southern peninsula. Ban Thung Soonh village has given the positive trend in developing the potential supply system of wood and wood products, food and food products as well as non wood forest products. Knowledge of these five cases of planting systems in Ban Thung Soong village can be used in technology transfer to the rest of the Ban Thung Soong village, nearby villages, and to the villages in the Andaman region. It is recommended to expand Ban Thung Soong function from the Technology Transfer Center in Agriculture to cover more areas of forest resources and ecotourism activities

Royal Forest Department should take some initiative to ensure quality planting materials to the farmers, especially the fruit species.

It is also recommended that the Ban Thung Soong Primary School should developed the teaching materials to ensure the recognition of people wisdom in homestead tree planting and wise management. Information from parataxonomists will help in improving the documents. More program on socio-economic aspects of homestead trees need to be more activated and increase more in depth studies.

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APPENDIX

Appendix A

Questionnaire

แบบสอบถาม

Questionnaires

1. ชื่อ (Name): ----------นามสกุล (Family name)----------

2. ที่อยู่ (Address):----------

3. อายุ (Age): ---------- ปี (years)

4. ท่านหรือบรรพบุรุษได้ตั้งหลักแหล่งถาวรในบ้านทุ่งสูง

Are you or your fore fathers are permanent resident in Ban Tung Soong ?

ใช่ Yes □ ไม่ใช่ No □

5. ถ้าไม่ใช่ ท่านได้ตั้งหลักแหล่งอยู่ในที่อยู่ปัจจุบันมานานเท่าใด

How long you have been living at present location?

1-10 ปี (years)	11-20 ปี (year)	21-30 ปี (year)	มากกว่า Above 30 ปี (years)

6. อาชีพในปัจจุบันคืออะไร?

What is your present occupation?

ว่างงาน Unemployed	เกษตรกร Farmer	นักธุรกิจ Businessman	รับราชการ Govt.Service	ทำงานภาคเอกชน Private service	อื่นๆ Others

7. ท่านมีพื้นที่ถือครองมากน้อยเพียงใด?

How much land you posses now ?

1-10 ไร่ Rai	11-25 ไร่ Rai	26-50 ไร่ Rai	51-100 ไร่ Rai	มากกว่า Above 100 ไร่ rai

8. ประเภทของพื้นดินถือครอง โปรดกา (/) ลงในช่องที่เหมาะสม
What type of land you posses? Please tick ( ) here.

ที่ส่วนตัว Private	ที่ใช้ประโยชน์ Leased	ที่เช่า On Rent	พื้นที่ป่าบุกรุก Encroached Forest Land	อื่นๆ Others

9. ท่านมีพื้นที่สวนครัวหรือไม่ ?
Have you any home garden?

มีYes □ ไม่มี No □

10. ขนาดของพื้นที่สวนครัว ---------- ไร่
How much the area of your home garden----------Rai

11. ท่านปลูกพืชชนิดใดในสวนครัวของท่าน โปรดระบุ
What you grow in your home garden- Please tick.

ไม้ยืนต้น Timber Trees	ไม้ฟืน Fuelwood Trees	พืชอาหารสัตว์ Fodder Trees	ไม้ผล Fruit Trees	พืชสมุนไพร Medicinal Plant	พืชผัก Vegetable	ไผ่ Bamboo	อื่นๆ Others

12. ท่านพอใจกับผลผลิตจากสวนครัวของท่าน กรุณาระบุในช่องที่เหมาะสม
Are you satisfied with your products come from home garden-Please Tick in appropriate space?

ประเด็น Items	พอใจมากที่สุด Most satisfied	พอใจมาก More satisfied	พอใจ Satisfied	พอใจน้อย Less satisfied	ไม่พอใจ Not satisfied
1. มีไม้จากสวนครัวเพียงพอกับความต้องการ Full the timber demand from home garden					
2.มีไม้ฟืนจากสวนครัวเพียงพอกับความต้องการ Full the fuel wood demand from home garden					

3.มีไม้ผลจากสวนครัวเพียงพอกับความต้องการ Full the fruit demand from home garden					
4.มีพืชอาหารสัตว์จากสวนครัวเพียงพอกับความต้องการ Full the fodder demand from home garden					
5.มีพืชเกษตรจากสวนครัวที่เพียงพอกับความต้องการ Full the agricultural crops demand from home garden					
6.มีพืชสมุนไพรที่ผลิตในสวนครัว Assistance for medicinal plant from home garden					
7. ผลิตปาล์มน้ำมันได้เต็มที่ Full the demand of oil palm					
8. ผลิตยางพาราได้เต็มที่ Full the demand of rubber					
9. ผลิตไม้ไผ่ได้อย่างเพียงพอ Full the demand of bamboo					
10. ผลิตพืชผักได้อย่างพอเพียง Full the demand of vegetables from home garden					
11. ผลิตเห็ดได้อย่างพอดพียง Full the demand of mushroom from home garden					

13. สถานภาพการผลิตจากสวนครัวของท่าน

What is the condition of supply of products from your home garden?

เพิ่มขึ้น Increasing □ ลดลง Decreasing □

14. พืชชนิดใดที่ท่านจะปลูกมากขึ้นในสวนครัว
Which type of species you like more to plant in your home garden?

ชนิดพืช Species	โปรดระบุ Tick
1. ชนิดไม้ยืนต้น Timber species	
2. ชนิดไม้ผล Fruit trees	
3. ชนิดของพืชอาหารสัตว์ Fodder	
4. ชนิดของพืชผัก Vegetables	
5. ชนิดของพืชสมุนไพร Medicinal plant	

15. ท่านมีรายได้จากพืชที่ปลูก เป็นสัดส่วนเท่าใดเมื่อคิดเป็นร้อยละ
What is the way of living based on the crop come from your land as a percentage?

ชนิดของพืช Crops	ร้อยละ Percentage (%)
1. ไม้ยืนต้น Timber species	
2. ไม้ผล Fruit trees	
3. พืชสมุนไพร Fodder	
4. พืชผัก Vegetables	
5. พืชสมุนไพร Medicinal plant	
6. ปาล์มน้ำมัน Oil palm	
7. ยางพารา Rubber	
8. อื่นๆ Others	

16. ท่านได้รับปัญหาอะไรบ้าง จากการปลูกต่างๆในสวนครัว
What is problem you face in your home garden activities?

ขาดน้ำ Shortage of water	ขาดปุ๋ย Shortage of animal manure	ขาดเครื่องมือ Shortage of equipment	ขาดเทคโนโลยี Shortage of technology	อื่นๆ Others

17. อะไรคือเป้าหมายที่ต้องการในการปลูกพืชสวนครัว โปรดระบุในช่องที่เห็นด้วย
What is the possibility to develop the home garden-please tick what you prefer?

เพิ่มไม้ใช้สอย To increase timber trees	เพิ่มพืชสมุนไพร To increase Medicinal plant	เพิ่มไม้ผล To increase Fruit trees	เพิ่มพืชเกษตร To increase Agricultural crops	อื่นๆ Others

18. อะไรคือความคาดหวังจากการปลูกพืชสวนครัว โปรดระบุ
Besides home consumption what is your expectation from home garden -please tick.

มีรายได้เพิ่มขึ้น More income	เพิ่มคุณค่าความเพลิดเพลินใจ Increase aesthetic value	ประเด็นสิ่งแวดล้อม Environmental aspects	อื่นๆ Others

19. พืชเกษตรที่ท่านจะปลูกในสวนครัว
Which kind of agricultural crops you grow in your home garden?

ถั่ว Bean	ถั่วฝักยาว Long bean	พริก Chilly	ขิง Ginger	กระเทียม Garlic	หอมใหญ่ Onion	ขมิ้น Turmeric	กล้วย Banana	มะละกอ Papaya

ข้าวโพด Corn	เผือก Taro	มะเขือ Egg plant	พริกไทย Pepper	มันปู Cheese tree)	เหรียง (Gnetum)	ผักเสี้ยน (Amaranth),	อื่นๆ (others)

20. ท่านใส่ปุ๋ยใสนสวนครัวหรือไท่
Do your manure in your home garden?

ใส่ Yes □ ไม่ใส่ No □

21. Kind of manure
ถ้าท่านใส่ปุ๋ย ท่านใส่ปุ๋ยชน

(1) ปุ๋ยอินทรียOrganic fertilizer (2) ปุ๋ยเคมี (Chemical fertilizer)
(3) ปุ๋ยคอก Animal manure (4) อื่นๆ (Others)

22. ท่านได้ปลูกพืชศักดิ์สิทธิ์หรือมีคุณค่าทางจิตใจหรือไม่
Any species in your home garden have spiritual, ritual and aromatic value ?

ปลูก Yes □ ไม่ปลูก No □

23. ถ้าท่านปลูก ท่านปลูกพืชชนิดใด โปรดระบุ
If yes name the species and reason .

24. What are the main source of income

Salary form job	Agriculture	Livestock	Poultry	Home gender	Sale of oil palm & rubber	Others

25. Do you work in your home garden regularly ?

Yes	Not

26. Do you think your home garden is productive ?

Yes	Not

27. If not why

Inefficient model	Less fertility	Lack of technical assistance	Insufficient fund	Others

28. Can you meet your domestic requirement for following products from your home garden:

Product	Fully	Partly	Little
Timber			
Pole			
Fuel wood			
Fodder			

29. Can you meet your domestic requirement of fruits and agricultural crop from . . home garden:

Item	Fully	Partly	Little
Agricultural crop			
Fruits			

Appendix B

List of species in homegardens

Appendix Table B1 List of species in homegardens Group "A"

No	Thai Name	Common Name	Scientific Name	Function
1	Malako	Papaya	*Carica papaya* Linn.	Fo,Fr
2	Longkong	Long kong	*Aglaia duccoo* Griff.	Fr
3	Mak	Betel Nut	*Areca catechu* Linn	Fr,T
4	Sator	Stink bean	*Parkia speciosa* Hassk	Fr,Fo,T
5	Lian	Persian lilac	*Melia azedarach* L.	T, Or
6	Khanun	Jackfruit	*Artocarpus heterophyllus* Lamk.	Fr,Fo,T
7	Krathon	Santol	*Sandaricum koetjape* Merr	Fr,Fo,T
8	Maphrao	Coconut	*Cocos nucifera* Linn	Fr,Fo,T
9	Mangkhut	Mangosteen	*Garcinia mangostana* Linn.	Fr,M
10	Thurian	Durian	*Durio zibethinus* Murr.	Fr,T
11	Som O	Pomelo	*Citrus maxima* Merr.	Fr,Fo
12	Mamuang	Mango	*Mangifera indica* Linn.	Fr,Fo,T
13	Phe Ka	-	*Oroxylum indicum* Vent	Fo
14	Makrut	Leech lime	*Citrus hystrix* DC	Fo,M
15	Manao	Common lime	*Citrus aurantifolia* Swingle	Fo,M
16	Man Chang	-	*Eriosema chinense* Vogel	M
17	Thang bai cho	-	*Nothaphoebe umbelliflora* Blume	M
18	Champada	Champadek	*Artocarpus integer* Merr.	Fr,Fo
19	Yang daeng	Dipterocarp	*Dipterocarpus turbinatus* CF.	T,MFP
20	Makham	Tamarind	*Tamarindus indica* Linn.	Fr,Fo,T
21	Pam Nam Man	Oil Palm	*Elaeis guineensis* Jacq.	Fo,MFP
22	Krathin	Leucaena	*Leucaena leucocephala* (Lam .)	Fo,T
23	Mafai	Baccaurea	*Baccaurea ramiflora* Lour	Fr
24	Champi	-	*Michelia alba* DC.	T,M
25	Yang	White Depterocarp	*Dipterocarpus alatus* Roxb.	T,MFP
26	Sak	Teak	*Tectona grandis Linn.* F. .	T

Appendix Table B1 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
27	Sadao Thai	Thai Neem	*Azadirachta indica siamensis* Juss	Fo,M
28	Sadao theum	-	*Azadirachta exelsa*(Jack) Jacobs	Fo,T
29	Riang	Timor stink bean	*Parkia timoriana* Merr.	Fo,T
30	Tang hon	-	*Calophyllum calaba* L.	T
31	Niang	Jiringa	*Archidendron jiringa*(Jack) I.C.Nielsen	Fo
32	Phak wan ban	Phak wan	*Sauropus androgynus* (L) Merr	Fo
33	Khi lek	Cassod tree	*Senna siamea* Lamk.	Fo,Or
34	Mayom	Star gooseberry	*Phyllanthus acidus* Skeels	Fr,M
35	Lamyai	Longan	*Dimocarpus longan* Lour	Fr
36	Ngo	Rambutan	*Nephelium lappaceum* L.	Fr,Fo
37	Ta khian tong	Iron wood	*Hopea odorata* Roxb.	T
38	Lamut	Sapodilla	*Manilkara zapota* (L).	Fr
39	Mamut	Horse mango	*Mangifera foetida* Lour	Fr,Fo
40	Ma prang	Plum mango	*Bouea macrophylla* griff	Fr,M
41	Farang	Guava	*Psidium guajava* Linn	Fr,M
42	Noina	Custard apple	*Annona squamosa* L.	Fr,M
43	Chompu	Rose apple	*Syzygium malaccense* (L) Merr.	Fr
44	Yi Kheng	Crape myrle	*Legerstroemia indica* L.	Or
45	Kratom	-	*Mitragyna speciosa* (Roxb.)	T
46	Man pu	-	*Glochidion littorale* Blume	Fo
47	Takhop Farang	Jam tree	*Muntingia calabura* L.	Fr
48	Chamuang	-	*Garcinia cowa* Roxb ex DC.	Fo
49	Cha Om	-	*Acacia pennata* Willd	Fo
50	Langsat	Langsat	*Lansium domesticum* Correa.	Fr
51	Som Chit	Calamodin	*Citrus madurensis* Lour	Fr

Appendix Table B1 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
52	Mamuang him maphan	Cashew nut	*Anacardium occidentale* Linn	F
53	Chomphu	Java apple	*Syzygium samarangense* (Blume) Merr L.M. Perry	Fr
54	Yom hin	-	*Chukrasia tabularis* A.Juss.	T
55	Phak wan pa	-	*Champereia manillana* Merr.	Fo,M
56	Tao rang	Wine palm	*Caryota bacsonensis* Magalon	Or
57	Yang bai	-	*Dipterocarpus costatus* CF.	Fo,MFP
58	Kra thin narong	Wattle	*Acacia auriculaeformis* A. Cunn.	T,Or
59	Phutsa	Jujube	*Zizyphus mauritiana* Lamk.	Fr
60	Khun	Yellow flamboyant	*Cassia fistula* Linn	T,Or,M
61	Takhop pa	-	*Flacourtia indica* (Burm.f.) Merr.	Fr
62	Mafuang	Carambola	*Averrhoa carambola* L.	Fr,M
63	Phlai	-	*Zingiber montanum* Link	M,Fo
64	Makok	Hog plum	*Spondias pinnata* (Lf.) Kurz	M
65	Nom maew	Nom maeo	*Melodorum siamense* (Scheff) Ban	M,Or
66	Kafae	Coffee	*Coffea robusta* L.	Fr,M
67	Thammang	-	*Dehaasia condolleana* (Meisn)	Fo
68	Lin kwang	-	*Ancistrocladus tectotius* (Lour) Merr.	M
69	Som kung	-	*Ampelocissus martini* Planch	M

Appendix Table B2 List of species in homegardens Group "B"

No	Thai Name	Common Name	Scientific Name	Function
1	Ngo	Rambutan	*Nephelium lappaceum* L.	F
2	Sadao theum	Azadirachta	*Azadirachta exelsa* (Jack) Jacobs	Fo,T
3	Mangkhut	Mangosteen	*Garcinia mangostana* Linn.	Fr,M
4	Mamuang	Mango	*Mangifera indica* Linn.	Fr,Fo,T
5	Sator	Stink bean	*Parkia speciosa* Hassk	Fr,Fo,T
6	Lamut	Sapodilla	*Manilkara zapota* (L).	Fr
7	Makham	Tamarind	*Tamarindus indica* Linn.	Fr,Fo,T,
8	Taling Pling	Bilimbi	*Averrhoa bilimbi* Linn	F
9	Longkong	Long kong	*Aglaia duccoo* Griff.	Fr
10	Thurian	Durian	*Durio zibethinus* Murr.	Fr,T
11	Som O	Pomelo	*Citrus maxima* Merr.	Fo,Fr
12	Mak	Betel Nut	*Areca catechu* Linn	Fr,T
13	Maphrao	Coconut	*Cocos nucifera* Linn	Fr,Fo,T
14	Sak	Teak	*Tectona grandis* Linn. F. .	T
15	Phe Ka	-	*Oroxylum indicum* Vent	Fo
16	Manao	Common lime	*Citrus aurantifolia* Swingle	Fr,M
17	Riang	Timor stink bean	*Parkia timoriana* Merr.	Fo,T
18	Krathon	Santol	*Sandaricum koetjape* Merr	Fr,Fo,T
19	Champada	Champedek	*Artocarpus integer* Merr.	F
20	Makrut	Leech lime	*Citrus hystrix* DC	Fr,M
21	Chomphu	Java Apple	*Syzygium samarangense* Merr.	Fr
22	Krathin	Leucaena	*Leucaena leucocephala* (Lam .)	Fo,T
23	Khanun	Jackfruit	*Artocarpus heterophyllus* Lamk.	Fr,Fo,T
24	Mayom	Star gooseberry	*Phyllanthus acidus* Skeels	Fr,M
25	Noina	Custard Apple	*Annona squamosa* Linn.	Fr,M
26	Thapthim	Pomegranate	*Punica granatum* Linn.	Fr,M

Appendix Table B2 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
27	Thungfa	-	*Alstonia macrophylla* Wall	T,M
28	Farang	Guava	*Psidium guajava* Linn	Fr,M
29	Champi	-	*Michelia alba* DC	T,M
30	Lamyai	Longan	*Dimocarpus longan* Lour	Fr
31	Thang bai cho	-	*Nothaphoebe umbelliflora* Blume	M
32	Phayom	Shorea	*Shorea roxburghii* G. Don	T
33	Mahokkani bai lek	Mahogany	*Swietenia mahogani* Jacq.	T
34	Mahokkani bai Yai	Mahogany	*Swietenia macrophylla* King	T
35	Ta khian Tong	Iron wood	*Hopea odorata* Roxb.	T
36	Kra thin te pha	Brown Salwood	*Acacia mangium* Willd.	T
37	Kra thin narong	Wattle	*Acacia auriculaeformis* A. Cunn.	T
38	Yang Na	White Depterocarp	*Dipterocarpus alatus* Roxb.	T,MFP
39	Mamut	Horse mango	*Mangifera foetida* Lour	Fr,Fo
40	Mamuang him maphan	Cashew nut	*Anacardium occidentale* Linn (Roxb) Mull.Arg	Fr,Fo
41	Mafai	-	*Baccaurea sapida*	Fr
42	Som	Mandarin	*Citrus reticulata* Blanco	Fr
43	Man Sampalang	Cassava	*Manihot esculenta* Crantz	Fo
44	Mafuang	Carambola	*Averrhoa carambola* L.	Fr
45	Wan chak motluk	-	*Curcuma xanthorrhiza* Roxb.	M
46	Kamin chan	Turmeric	*Curcuma longa* L.	M
47	Phlai	-	*Zingiber montanum* (Koeniq) Link ex Dietr.	M,Fo
48	Kaphrao	Holy basil	*Ocimum tenniflorum* Linn	M
49	Chompu	Rose apple	*Syzygium malaccense* (L) Merr. L.M. Perry	Fr
50	Khi lek	Cassod tree	*Senna siamea* (Lamk) Irwin &Barnety	Fo,Or

Appendix Table B2 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
51	Sor	-	*Gmelina arborea* Roxb	T
52	Wa	Black plum	*Syzyginm cumini* (L) Skeels.	Fr,T
53	Non	-	*Vitex pinnata* L.	T
54	Ma prang	Plum mango	*Bouea macrophylla* griff	Fr,M
55	Taeo	-	*Cratoxylum maingayi* Dyer	Fo
56	Khrop	East Indian Plum	*Flacourtia jangomas* (Lour)	Fr
57	Phutsa	Jujube	*Zizyphus mauritiana* Lamk.	Fr
58	Thammang	-	*Dehaasia candolleana* (Meisn) Kosterm.	T
59	Makham thet	Manila tamarind	*Pithecellobium dulce* Benth	Fr
60	Tang hon	-	*Calophyllum calaba* L.	T
61	Phikun	Bullet wood	*Mimusops elengi* L.	M,Or
62	Phak wan ban	-	*Sauropus androgynus* (L) Merr	Fo,M
63	Takhop pa	-	*Flacourtia indica* Merr	Fr
64	Pam Nam Man	Oil Palm	*Elaeis guineensis* Jacq.	Fo,MFP
65	Phak wan pa	-	*Champereia manillana* Merr.	Fo,M
66	Sadao Thai	Thai Neem	*Azadirachta indica siamensis* A. Juss.	Fo, M
67	Lian	Bastard cedar	*Melia azedarach* Linn.	T,Or
68	Sarapee dok yai	-	*Mammea harmandii* Kosterm	T
69	Niang	-	*Archidendron jiringa*(Jack) I.C.Nielsen	Fo
70	Kratom	-	*Mitragyna speciosa* (Roxb.)	T

Appendix Table B3 List of species in homegarden Group "C"

No	Thai Name	Common Name	Scientific Name	Function
1	Mamuang him maphan	Cashew nut	*Anacardium occidentale* Linn	Fr,Fo
2	Thang bai cho	-	*Nothaphoebe umbelliflora* Blume	M
3	Phak wan ban	-	*Sauropus androgynus* (L) Merr	Fo,M
4	Bora phet phung chang	-	*Stephania suberosa* Forman	M
5	Mak	Betel Nut	*Areca catechu* Linn	Fr,T
6	Mamuang	Mango	*Mangifera indica* Linn.	Fr,Fo,T
7	Khanun	Jackfruit	*Artocarpus heterophyllus* Lamk.	Fr,Fo,T
8	Kra thin te pha	Brown Salwood	*Acacia mangium* Willd.	T
9	Sator	Stink bean	*Parkia speciosa* Hassk	Fr,Fo,T
10	Lamut	Sapodilla	*Manilkara zapota* (L).	Fr
11	Farang	Guava	*Psidium guajava* Linn	Fr,M
12	Kamcham (Mahuat)	-	*Lepisanthes rubiginosa* (Roxb.) Leenh.	F
13	Kathue	-	*Zingiber zerumbet* Smith.	M
14	Plai san	-	*Eurya acuminata acuminata*	M
15	Som O	Pomelo	*Citrus maxima* Merr.	Fo,Fr
16	Mangkhut	Mangosteen	*Garcinia mangostana* Linn.	Fr,M
17	Phutsa	Jujube	*Zizyphus mauritiana* Lamk.	Fr
18	Pla lai Phueak	-	*Eurycoma longifolia* Jack	M
19	Kamin Khao	-	*Curcuma mangga* Veleton	M
20	Kamin Oi	Zedoary	*Curcuma zedoaria* Roscoe	M
21	Champada	Champadek	*Artocarpus integer* Merr.	Fo,Fr
22	Krathon	Santol	*Sandaricum koetjape* Merr	Fr,Fo,T
23	Kaphrao	Holy basil	*Ocimum tenniflorum* Linn	M
24	Wan hang chang	Leopard lily	*Belamcanda chinensis* (L.) DC	M
25	Wan chak motluk	-	*Curcuma xanthorrhiza* Roxb.	M

Appendix Table B3 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
26	Anchan	-	*Clitorea ternatea*L.	M
27	Matoom	Beal fruit	*Aegle marmelos* (L)	Fr,M
28	Maphrao	Coconut	*Cocos nucifera* Linn	Fr,Fo,T
29	Thurian	Durian	*Durio zibethinus* Murr.	Fr,T
30	Manao	Common lime	*Citrus aurantifolia* Swingle	Fr,M
31	Makham	Tamarind	*Tamarindus indica* Linn.	Fr,Fo,T
32	Krachai	-	*Boesenbergia rotunda* (L) Mansf.	M
33	Akhi	-	*Clerodendrum serratum* (L) Moon	M
34	Eucalyptus	Eucalypt	*Eucalyptus deglupta*	T
35	Khi lek	Copper pod tree	*Senna siamea* Lamk.	Fo,Or
36	Khoi	Tooth brush tree	*Streblus asper* Lour	M
37	Champi	-	*Michelia alba* DC.	T,M
38	Yo ban	-	*Morinda citrifolia* L.	Fr,Fo
39	Chomphu	Java Apple	*Syzygium samarangense* Merr.	Fr
40	Lep khrut	-	*Polyscias fruticosa* Harms	Fo
41	Phlapphla	-	*Microcos tomemtosa* SM.	Fod, M
42	Ma prang	Plum mango	*Bouea macrophylla* Griff	Fr,M
43	Tin pet	Devil tree	*Alstonia scholaris* R. Br.	T
44	Kha	Galanga	*Alpinia galanga* (L) Willd	M
45	Cha Om	-	*Acacia pennata* Willd	Fo
46	Siao dok khao	-	*Bauhinia acuminate* L.	M,Fo
47	Kamin chang	Turmeric	*Curcuma longa* L.	M
48	Khing	Ginger	*Zingiber officinale* Roscoe	M,Fo
49	Chamuang	-	*Garcinia cowa* Roxb	Fo
50	Yo pa	-	*Morinda tomentosa* Heyne ex. Roth	M

Appendix Table B3 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
51	Hora pha	Sweet basil	*Ocimum basilicum* L.	M
52	Krathin	Leucaena	*Leucaena leucocephala* (Lam)	Fo,T
53	Wan nga chang	-	*Sansevieria cylindrica* Bojer	Fo,M
54	Mayom	Star gooseberry	*Phyllanthus acidus* Skeels	Fr,M
55	Mamut	Horse mango	*Mangifera foetida* Lour	Fr, Fo
56	Hang Chora Khe	Aloe	*Aloe vera* (L) Burm f.	M
57	Riang	Timor stink bean	*Parkia timoriana* Merr.	Fo,T
58	Taeo	-	*Cratoxylum maingayi* Dyer	Fo
59	Sadao theum	-	*Azadirachta exelsa* (Jack) Jacobs	Fo,T
60	Nat	-	*Pluchea polygonata* (DC) Gagnep	M
61	Nun	-	*Ceiba pentandra* Gaertn.	M
62	Phlai	-	*Zingiber montanum* Link	M
63	Yang	White Depterocarp	*Dipterocarpus alatus* Roxb.	T,MFP
64	Man pu	-	*Glochidion littorale* Blume	Fo
65	Ngo	Rambutan	*Nephelium lappaceum* L.	Fr,Fo
66	Niang	Jiringa	*Archidendron jiringa*(Jack) I.C.Nielsen	Fo
67	Mao khai pla		*Antidesma ghaesembilla* Gaertn	M
68	Malako	Papaya	*Carica papaya* Linn.	Fr,Fo
69	Phe Ka	-	*Oroxylum indicum* Vent	Fo
70	Man Sampalang	Cassava	*Manihot esculenta* Crantz	Fo
71	Champu	Rose apple	*Syzygium malaccense* (L) Merr.	Fr
72	Thapthim	Pomegranate	*Punica granatum* Linn.	Fr
73	Hon Kai	-	*Cnestis pelata* (Lour) Merr.	M
74	Tao yeay mom	-	*Clerodendrum petasites* (Lour) S. Moore.	M
75	Kha lek	-	*Alpinia officinarum* Hance	M

Appendix Table B3 (cont'd)

No	Thai Name	Common Name	Scientific Name	Function
76	Noina	Custard apple	*Annona squamosa* L.	Fr, M
77	Mui	-	*Clausena excavate* Burm.f.	M
78	Som Khak	-	*Garcinia cowa* Roxb. ex.DC.	Fo,M
79	Madua plong	-	*Ficus fistulosa* Reinw ex Blume	M,Fo
80	Pak Kad Nok Kao	-	*Emilia sonchifolia* (L.) DC.	M
81	Wan kai chon	-	*Aeschynanthus speciosus* Hook.	M
82	Ta khai	-	*Ardissia oxyphylla* Wall.ex	M
83	Kradook Kai	-	*Euonymus javanicus* Blume	M
84	Deang	-	*Xylia xylocarpa kerrii* (Craib&Hutch)IC Nielsen	M
85	Khon thi so	-	*Vitex trifolia* L.	M
86	Kloy	-	*Dioscorea hispida* Dennst var. hispida DC	M
87	Kamin chan	-	*Curcuma longa* L.	M
88	Pak wan chang	-	*Claoxylon longifolium* (Blume) Endl. Ex. Hassk.	M
89	Ya nuat moeo	-	Orthosiphon aristatus (Blume) Miq.	M
90	Chetta mun Phloeng daeng	-	*Plumbago indica* L.	M
91	Chetta mun Phloeng khao	-	*Plumbago zeylanica* L.	M

Remarks : Fr = Fruits Species

Fo = Food Species

T = Timber Species

M = Medicinal Plant Species

Or = Ornamental Species

MFP = Minor Forest Products

Fod = Fodder species

Appendix Table B4 List of species in ten homegardens at Ban Thung Soong Village, surveyed in 2005-2006

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization							Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
1	Anacardiaceae	Mamuang	Mango	*Mangifera indica* Linn.	T	/	/		/				/	/	/	/	/	/	/	/	/	/
2		Mamut	Horse mango	*Mangifera foetida* Lour.	T	/	/							/	/		/	/	/		/	
3		Ma prang	Plum mango	*Bouea macrophylla* griff	T	/				/					/	/	/				/	/
4		Makok	Hog plum	*Spondias pinnata* (L.f.) Kurz	T	/				/											/	
5		Mamuang him maphan	Cashew nut tree	*Anacardium occidentale* Linn	ST	/	/								/	/			/		/	/
6	Ancistrocladaceae	Lin kwang	-	*Ancistrocladus tectorius* (Lour.) Merr.	C					/			/									
7	Annonaceae	Nom maeo	-	*Melodorum siamense*(Scheff.) Ban	C					/	/										/	
8		Noina	Custard apple	*Annona squamosa* L.	S	/				/				/		/			/	/		
9	Apocynaceae	Tin pet	Devil tree	*Alstonia scholaris* (L.) R. Br.	T				/	/					/				/			
10		Thungfa	-	*Alstonia macrophylla* Wall ex. G. Don.	T				/	/				/								
11	Araliaceae	Lep khrut	-	*Polyscias fruticosa* (L.) Harms	S		/								/							
12	Asphodelaceae	Wan hang chora khe	Aloe	*Aloe vera* (L) Burm f.	H		/			/								/				
13	Bignoniaceae	Phaka	-	*Oroxylum indicum* (L.) Kurz	ST		/						/	/			/		/			
14	Bombacaceae	Thurian	Durian	*Durio zibethinus* Merr.	T	/			/				/	/	/	/	/	/	/	/	/	/
15		Nun	White silk cotton tree	*Ceiba pentandra* (L.) Gaertn.	T							/						/				

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization							Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
16	Caricaceae	Malakor	Papaya	*Carica papaya* Linn.	ST	/	/						/						/	/	/	
17	Celastraceae	Kra duk kai	-	*Euonymus javanicus* Blume	ST					/									/			
18	Compositae	Pak Kard Nok Kao	-	*Emilia sonchifolia* (L.) DC.	H					/									/			
19	Cucurbitaceae	Mauk	-	*Solena stramonifolium* Jacq.	H		/			/									/			
20	Dioscoreaceae	Kloi	-	*Dioscorea hispida* Dennst.	C		/			/								/				
21	Dipterocarpaceae	Yang	White Dipterocarp	*Dipterocarpus alatus* Roxb.ex G.Don	T				/			/	/	/			/	/				/
22		Yang bai	-	*Dipterocarpus costatus* C.F.Gaertn.	T				/			/									/	
23		Yang daeng	Dipterocarp	*Dipterocarpus turbinatus* C.F.Gaertn.	T				/			/	/									
24		Ta khian Thong	Iron wood	*Hopea odorata* Roxb.	T				/					/		/	/				/	
25		Phayom	Shorea	*Shorea roxburghii* G. Don	T				/					/								
26	Dracaenaceae	Wan nga chang	-	*Sansevieria cylindrica* Bojer	H					/					/			/				
27	Euphorbiaceae	Mafai	Baccaurea	*Baccaurea ramiflora* Lour	T	/							/			/					/	/
28		Man pu	-	*Glochidion littorale* Blume	ST		/											/		/		
29		Mayom	Star gooseberry	*Phyllanthus acidus* (L.) Skeels	ST	/				/				/	/	/	/	/	/	/	/	
30		Phak wan ban	Phak wan	*Sauropus androgynus* (L.) Merr.	ST		/			/			/		/	/		/	/	/	/	/

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization						Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
31		Mao khai pla	-	*Antidesma ghaesembilla* Gaertn	S/ST	/				/									/			
32		Phak wan chang	-	*Claoxylon longifolium* (Blume) Endl.ex.Hassk.	S		/			/					/							
33		Man Sampalang	Cassava	*Manihot esculenta* Crantz	S		/									/			/			
34	Flacourtiaceae	Ta khop pa	-	*Flacourtia indica* (Burm.f.) Merr.	S	/															/	/
35		Khrop	East Indian Plum	*Flacourtia jangomas* (Lour.)Rausch	T	/										/						
36	Guttiferae	Taeo	-	*Cratoxylum maingayi* Dyer	T		/									/		/				
37		Som Khak	-	*Garcinia atroviridis* Griff ex T. Anderson	T		/			/									/			
38		Tang hon	-	*Calophyllum calaba* L.	T				/				/			/	/					
39		Mang khut	Mangosteen	*Garcinia mangostana* Linn.	T	/				/			/	/	/	/	/		/	/	/	/
40		Cha muang	-	*Garcinia cowa* Roxb.ex DC.	ST		/								/					/	/	
41		Sarapec bai yai	Saraphi	*Mammea harmandii* Kosterm	T					/	/											/
42	Iridaceae	Wan hang chang	Leopard lily	*Belamcanda chinensis* (L.) DC	H					/					/							
43	Labiatae	Sak	Teak	*Tectona grandis* Linn. f.	T				/				/	/			/					
44		Kaphrao	Holy basil	*Ocimum tennuflorum* Linn	US		/			/					/	/		/				
45		Sor	-	*Gmelina arborea* Roxb.	T				/													/
46		Non	-	*Vitex pinnata* L.	T				/							/						

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization						Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
47		Akkhi	-	*Clerodendrum serratum* Wallichii C.B. Clarke	S					/					/			/				
48		Ya nuat maeo	-	*Orthosiphon aristatus* (Blume) Miq.	H					/					/			/				
49		Hora pha	Common basil	*Ocimum basilicum* L.	US		/			/					/							
50		Khon thi so	-	*Vitex trifolia* L.	S					/					/			/				
51	Lauraceae	Thammang	-	*Dehaasia candolleana* (Meisn) Kosterm.	T		/						/			/						/
52		Thang bai cho	-	*Nothaphoebe umbelliflora* Blume	T					/			/	/	/	/						/
53	Leguminosae-caesalpinioideae	Siao dok khao	-	*Bauhinia saccocalyx* Pierre	ST		/											/				
54		Makham	Tamarind	*Tamarindus indica* Linn.	T	/	/		/	/			/	/	/	/			/	/	/	/
55		Khi lek	Cassod Tree	*Senna siamea* (Lam.) Irwin & Barneby	T		/				/		/		/					/	/	/
56		Khun	Golden shower tree	*Cassia fistula* Linn	T				/	/	/										/	
57	Leguminosae-Mimosoideae	Sator	Stink bean	*Parkia speciosa* Hassk	T	/	/		/	/			/	/	/	/	/	/			/	/
58		Krathin	Leucaena	*Leucaena leucocephala* (Lam .) de Wit	S		/		/				/	/	/	/	/			/	/	/
59		Riang	Timor stink bean	*Parkia timoriana* Merr.	T		/		/				/	/			/	/		/	/	/
60		Niang	Jiringa	*Archidendron jiringa* (Jack) I.C. Nielsen	T		/						/	/				/	/	/		/
61		Kra thin narong	Wattle	*Acacia auriculaeformis* A. Cunn.	T				/		/			/							/	

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization							Availability in Homegarden								
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
62		Cha Om	-	*Acacia pennata insuavis* (Lace).I.C.Nielsen	C/H		/								/				/	/		
63		Kra thin te pha	Brown Salwood	*Acacia mangium* Willd.	T				/					/	/							
64		Makham thet	Manila tamarind	*Pithecellobium dulce* (Roxb.)Benth	T	/										/						
65		Deang		*Xylia xylocarpa kerrii* (Craib&Hutch) I.C. Nielsen	T	/												/				
66	Leguminosae-Papilionoideae	Anchan	Butterfly Pea	*Clitorea ternatea*	C					/								/	/			
67		Man Chang	-	*Eriosema chinense* vogel	US					/			/		/							
68	Lythraceae	Yi Kheng	Crape myrtle	*Lagerstroemia indica* L.	ST						/									/		
69	Magnoliaceae	Champi	-	*Michelia alba* D.C.	T				/	/			/	/	/		/			/		
70	Meliaceae	Longkong	Long kong	*Aglaia duccoo* Griff.	T	/							/	/		/	/			/	/	/
71		Lian	Persian Lilac	*Melia azedarach* L.	T				/		/		/				/			/	/	/
72		Kra thon	Santol	*Sandoricum koetjape*(Burm.f.) Merr.	T	/	/		/				/	/	/	/	/			/	/	/
73		Mahokkani bai lek	West Indian Mahogany	*Swietenia mahogani* (L.) Jacq.	T				/					/								
74		Mahokkani bai Yai	Baywood	*Swietenia macrophylla* King	T				/	/				/								

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization							Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
75		Sadao Thai	Thai Neem	*Azadirachta indica siamensis* Valeton	T		/			/			/				/			/	/	/
76		Sadao thiam	-	*Azadirachta excelsa* (Jack) Jacobs	T		/		/				/	/			/	/	/	/	/	/
77		Langsat	Langsat	*Lansium domesticum* Correa.	T	/														/		
78		Yom hin	-	*Chukrasia tabularis* A. Juss.	T				/												/	
79	Menispermaceae	Bora phet phung chang	-	*Stephania suberosa* Forman	C					/					/			/				
80	Moraceae	Champada	Champedak	*Artocarpus integer* (Thunb.) Merr.	T	/	/						/	/	/	/					/	/
81		Khanun	Jackfruit	*Artocarpus heterophyllus* Lam.	T	/	/	/	/	/			/	/	/	/		/	/	/	/	/
82		Khoi	Tooth brush tree	*Streblus asper* Lour.	T					/					/							
83		Ma duea plong	-	*Ficus hispida* L.f.	ST		/											/				
84	Myrsinaceae	Ta khai	-	*Ardisia oxyphylla* Wall.ex A.DC.	S/ST					/									/			
85	Myrtaceae	Farang	Guava	*Psidium guajava* Linn	ST	/				/				/	/	/			/	/	/	/
86		Chompu	Rose apple	*Syzygium malaccense* (L.) Merr.&L.M.Perry	ST	/										/			/	/		
87		Chomphu	Java apple	*Syzygium samarangense* (Blume)Merr.&L.M.Perry	T	/								/	/						/	/
88		Wa	Black plum	*Syzyginm cumini* (L.) Skeels.	T	/			/							/						
89		Eucalyptus	Eucalypt	*Eucalyptus deglupta*	T				/						/							

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization							Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
90	Opiliaceae	Phak wan pa	-	*Champereia manillana* (Blume) Merr.	ST		/														/	/
91	Oxalidaceae	Ma fueang	Carambola	*Averrhoa carambola* L.	ST	/				/						/					/	
92		Taling Pling	Bilimbi	*Averrhoa bilimbi* Linn	ST	/				/				/								
93	Palmae	Mak	Betel Nut	*Areca catechu* Linn	P	/			/	/			/	/	/	/	/		/	/	/	/
94		Maphrao	Coconut	*Cocos nucifera* Linn	P	/	/		/	/			/	/	/	/	/		/	/	/	/
95		Pam nam man	Oil Palm	*Elaeis guineensis* Jacq.	P		/		/				/							/	/	/
96		Tao rang	Wine palm	*Caryota bacsonensis* Magalon	P						/										/	
97	Plumbaginaceae	Chetta mun phloeng daeng		*Plumbago indica* L.	US					/								/				
98		Chetta mun phloeng khao		*Plumbago zeylanica* L.	US					/								/				
99	Punicaceae	Thapthim	Pomegranate	*Punica granatum* I.	S	/				/				/					/			
100	Rhamnaceae	Phutsa	Jujube	*Zizyphus mauritiana* Lam.	ST	/									/	/					/	
101	Rubiaceae	Yo pa		*Morinda tomentosa* Heyne ex Roth	ST		/			/								/				
102		Kratom	-	*Mitragyna speciosa* (Roxb.)Korth	T					/										/	/	/
103		Kafae	Coffee	*Coffea robusta* L.	S		/			/											/	
104		Yo ban	-	*Morinda citrifolia* L.	ST	/	/								/							

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization					Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg1	Hg2	Hg3	Hg4	Hg5	HG6	HG7	HG8	HG9	Hg10
105	Rutaceae	Som	Mandarin orange	*Citrus reticulata* Blanco	ST	/				/						/						/
106		Som Chit	Calamodin	*Citrus madurensis* Lour.	ST	/														/		
107		Som O	Pomelo	*Citrus maxima* (Burm.f.) Merr.	ST	/	/						/	/	/	/	/	/	/		/	/
108		Makrut	Leech lime	*Citrus hystrix* DC.	ST		/			/			/	/						/	/	
109		Manao	Common lime	*Citrus aurantifolia* Swingle	ST		/			/			/	/	/	/	/	/	/	/		
110		Matoom	Beal fruit tree	*Aegle marmelos* (L) Correa.ex.Roxb.	T	/				/					/				/			
111		Mui	-	*Clausena excavate* Burm.f.	S/ST		/			/									/			
112	Sapindaceae	Mahuat	-	*Lepisanthes rubiginosa* (Roxb.) Leenh	ST	/									/							
113		Lamyai	Longan	*Dimocarpus longan* Lour	T	/								/			/				/	
114		Ngo	Rambutan	*Nephelium lappaceum* L.	T	/	/							/		/	/	/		/	/	/
115	Sapotaceae	Phikun	Bullet wood	*Mimusops elengi* L.	T					/	/					/						
116		Lamut	Sapodilla	*Manilkara zapota* (L.) P.Royen	T	/								/	/	/	/		/	/	/	
117	Simaroubaceae	Pla lai Phueak	-	*Eurycoma longifolia* Jack	S					/					/			/				
118	Theaceae	Plai san	-	*Eurya acuminata* DC.	S					/								/				
119	Tiliaceae	Takhop Farang	Jam tree	*Muntingia calabura* L.	ST	/														/		
120		Phlapphla	-	*Microcos paniculata* L.	T		/			/								/				
121	Vitaceae	Som kung	-	*Ampelocissus martinii* Planch	C		/			/			/									

Appendix Table B4 (cont'd)

No	Family	Thai Name	Common Name	Scientific Name	Plant form	Utilization					Availability in Homegarden									
						Fr	Fo	Fod	T	M	Or	MFP	Hg 1	Hg 2	Hg 3	Hg 4	Hg 5	HG 6	HG 7	HG 8	HG 9	Hg 10
122	Zingiberaceae	Kha	Galanga	*Alpinia galanga* (L) Willd	H		/			/								/	/			
123		Pro pa	-	*Kaempferia pulchra* (Ridl.) Ridl.	H					/						/						
124		Phlai	-	*Zingiber montanum* (Koenig) Link ex Dietr	H		/			/									/		/	
125		Wan chak motluk	-	*Curcuma xanthorrhiza* Roxb.	H					/					/	/			/			
126		Kra-thue	-	*Zingiber zerumbet* (L.) Smith.	H		/			/					/			/	/			
127		Khing	Ginger	*Zingiber officinale* Roscoe	H		/			/								/				
128		Kha lek	Galangal minor	*Alpinia officinarum* Hance	H		/			/									/			
129		Khamin chan	Turmeric	*Curcuma longa* L.	H		/			/					/	/		/				
130		Khamin Oi	Zedoary	*Curcuma zedoaria* (Berg) Roscoe	H		/			/					/			/				
131		Kamin Khao	-	*Curcuma mangga* Veleton & Zijp	H		/			/					/							
132		Kra chai	-	*Boesenbergia rotunda* (L.) Mansf.	H		/			/								/				

Remarks: T = Tree ST = Shrubby Tree S = Shrub
US = Under Shrub H = Herb P = Palm
C = Climber Fr = Fruit Fo = Food
Fod = Fodder Ti = Timber M = Medicinal Plant
Or = Ornamental Plant MFP = Minor Forest Product Hg = Homegarden