UTILIZATION AND CONSERVATION OF WILD PLANT DIVERSITY: A CASE STUDY OF TWO KARANG VILLAGES IN KAENG KRACHAN NATIONAL PARK.

ORAWAN BOONTUN

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE
(TECHNOLOGY OF ENVIRONMENTAL MANAGEMENT)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2010

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UTILIZATION AND CONSERVATION OF WILD PLANT DIVERSITY: A CASE STUDY OF TWO KARANG VILLAGES IN KAENG KRACHAN NATIONAL PARK.

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ABSTRACT

This research aimed to study the local knowledge in utilizing and conserving wild plant diversity and factors that influence Karang households' and communities' decision making in bringing plants to grow around their houses. This research was conducted employing questionnaire and in-depth interview as well as species list to study all 106 households at Baan Bang Kloi and Baan Pong Leuk, Kaeng Krachan National Park. Data collection in the study area covered the period of April to May 2009.

This study found 219 plant species in 76 families and 172 genuses grown at homestead agroforest. These plants were categorized into cropped plant species (109 species) and wild plant species (110 species). Of these plant species, 50% is being utilized as food, 28% medicinal, 14% household-use, 6% ornamental, 1% ritual and 1% toxic plant species. Of these, 74 species are herbs (34%), 63 species are trees (29%), 50 species are shrubs (23%) and 32 species are climbers (14%). Shannon Wiener Index, employed to indicate plant species diversity at homestead agroforest, showed the total plant diversity index value of 3.94, wild plant species diversity index value of 3.03 and cropped plant species diversity index value of 3.50. The total of 188 species were found at Baan Bang Kloi and 180 species found at Baan Pong Leuk. Of these, 151 species were found in both villages whereas 68 species were found in only one village. Thirty eight species were only found in Baan Bang Kloi whereas 30 species were specifically found in Baan Pong Leuk.

Multiple regression analysis was employed to analyze factors influencing household and community decision making to grow plant species in their homestead agroforest, and it was found that the factors of age of household head, major and minor occupation as farmers, debt status of household and villages in terms of different settlement duration and characteristic, could statistically significantly explain 25% variation in wild and cropped plant species diversity at homestead agroforest ($p<0.05$). Baan Bang Kloi had just migrated and their settlement areas were clustered, whereas their cultivation areas were separated from their residence. As a result, the homestead agroforest has statistically significantly high diversity than Baan Pong Leuk ($p< 0.05$). Due to the fact that both communities have local botanical knowledge in terms of utilization and conservation of plant species diversity, together with their livelihood as agriculture communities in forest area, they maintained local plant species diversity in their homestead agroforest. The promotion of sustainable utilization of plant species around homestead agroforest, thus, should pay attention to the importance of local knowledge to be set as a guideline or recommendation to promote the roles of local people and communities in decreasing the dependency on biodiversity as well as in conserving biodiversity in homestead agroforest.

KEY WORDS: HOMESTEAD AGROFOREST/ WILD PLANT CONSERVATION/ KARANG VILLAGE/ INDIGENOUS KNOWLEDGE/ KAENG KRACHAN NATIONAL PARK

208 pages

การใช้ประโยชน์และการอนุรักษ์ความหลากหลายของพันธุ์พืชป่า กรณีศึกษา ชนเผ่ากะหร่างในเขตอุทยานแห่งชาติแก่งกระจาน

UTILIZATION AND CONSERVATION OF WILD PLANT DIVERSITY: A CASE STUDY OF TWO KARANG VILLAGES IN KAENG KRACHAN NATIONAL PARK.

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บทคัดย่อ

งานวิจัยนี้เป็นการศึกษาองค์ความรู้ด้านการใช้ประโยชน์และการอนุรักษ์ความหลากหลายของชนิดพันธุ์พืช รวมถึงปัจจัยที่มีผลต่อการตัดสินใจของครัวเรือนและชุมชนชาวกะหร่างที่นำพืชมาปลูกรอบบ้าน โดยการใช้แบบสอบถาม การสัมภาษณ์เชิงลึกและสำรวจพันธุ์พืชที่พบในแต่ละครัวเรือนจำนวนทั้งสิ้น 106 ครัวเรือน ในหมู่บ้านบางกลอยและหมู่บ้านโป่งลึก ในเขตอุทยานแห่งชาติแก่งกระจาน โดยเก็บข้อมูลในพื้นที่ช่วงเดือนเมษายน-พฤษภาคม 2552

ผลการศึกษาพบพันธุ์พืชที่ชาวกะหร่างนำมาปลูกบริเวณรอบบ้าน 219 ชนิด ใน 76 วงศ์ 172 สกุล แบ่งเป็นพืชปลูกจำนวน 109 ชนิด พืชป่าจำนวน 110 ชนิด มีการปลูกพืชอาหารมากที่สุดคิดเป็น 50 % รองลงมาคือ พืชสมุนไพร 28 % พืชใช้สอย 14 % พืชประดับตกแต่ง 6 % พืชที่ใช้ในพิธีกรรมและพืชที่มีพิษ 1 % ตามลำดับ จำแนกเป็นไม้ล้มลุก 74 ชนิด คิดเป็น 34 % ไม้ต้น 63 ชนิด คิดเป็น 29 % ไม้พุ่ม 50 ชนิด คิดเป็น 23 % และไม้เลื้อย 32 ชนิด คิดเป็น 14 % เมื่อพิจารณาความหลากหลายของชนิดพันธุ์พืชที่ปลูกรอบบ้านด้วย Shannon Wiener Index พบค่าความหลากหลายเท่ากับ 3.94 เป็นค่าความหลากหลายของชนิดพันธุ์พืชป่าและชนิดพันธุ์พืชปลูก 3.03 และ 3.50 ตามลำดับ และจากชนิดพันธุ์พืชที่พบทั้งหมด มีจำนวน 188 ชนิดที่พบในหมู่บ้านบางกลอย และ 180 ชนิดที่พบในหมู่บ้านโป่งลึก เป็นชนิดพันธุ์พืชที่คล้ายคลึงกัน 150 ชนิดและเป็นชนิดพันธุ์พืชที่ต่างกันจำนวน 68 ชนิด โดยเป็นความต่างของชนิดพืชในหมู่บ้านบางกลอย 38 ชนิด ความต่างของชนิดพืชในหมู่บ้านโป่งลึก 30 ชนิด

จากการวิเคราะห์ปัจจัยที่มีผลต่อการตัดสินใจของครัวเรือนและชุมชนในการนำพันธุ์พืชมาปลูกโดยการวิเคราะห์ความถดถอยเชิงพหุพบว่าปัจจัยด้านอายุของหัวหน้าครัวเรือน อาชีพหลักและอาชีพรองทางด้านเกษตรกรรม การมีหนี้สินของครัวเรือน และปัจจัยหมู่บ้านซึ่งแตกต่างกันในเรื่องระยะเวลาและรูปแบบการตั้งถิ่นฐาน สามารถอธิบายความแตกต่างเรื่องความหลากหลายของจำนวนชนิดพันธุ์พืชป่าและพืชปลูกในสวนรอบบ้านได้ 25 %โดยเป็นความสัมพันธ์เชิงบวกอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) กับปัจจัยด้านการประกอบอาชีพหลักและอาชีพรองทางด้านเกษตรกรรม ปัจจัยด้านอายุของหัวหน้าครัวเรือน และปัจจัยการมีหนี้สินของครัวเรือน ส่วนปัจจัยหมู่บ้านพบว่า หมู่บ้านบางกลอยเพิ่งอพยพย้ายเข้ามาอยู่ทีหลังและมีรูปแบบการตั้งบ้านเรือนเรียงชิดติดกันเป็นกระจุก แต่มีพื้นที่ทำกินแยกส่วนกันกับการตั้งบ้านเรือน ส่งผลให้เกิดความหลากหลายของชนิดพันธุ์พืชที่นำมาปลูกรอบบ้านมากกว่าหมู่บ้านโป่งลึกอย่างมีนัยสำคัญทางสถิติ ($p<0.05$) ชุมชนทั้งสองมีองค์ความรู้ในการใช้ประโยชน์และอนุรักษ์ความหลากหลายของพันธุ์พืชและเป็นชุมชนเกษตรกรรมในเขตป่า ยังผลให้มีการรักษาความหลากหลายของพันธุ์พืชให้คงอยู่ในท้องถิ่น การส่งเสริมให้มีการใช้ประโยชน์พันธุ์พืชที่ปลูกรอบบ้านอย่างยั่งยืนจึงควรให้ความสำคัญต่อองค์ความรู้และการใช้ประโยชน์พันธุ์พืชป่าเพื่อสร้างความภาคภูมิใจในองค์ความรู้ที่มี และเพื่อเป็นแนวทางหรือข้อเสนอแนะเกี่ยวกับบทบาทของชาวบ้านและชุมชนในการลดภาระการพึ่งพิงรวมถึงการอนุรักษ์ความหลากหลายทางชีวภาพในสวนรอบบ้าน

208 หน้า

CONTENTS

		Page
ACKNOWLEDGEMENTS		**iii**
ABSTRACT (ENGLISH)		**iv**
ABSTRACT (THAI)		**v**
LIST OF TABLES		**xii**
LIST OF FIGURES		**xiv**
CHAPTER I	**INTRODUCTION**	**1**
1.1	Background and justification	1
1.2	Research questions	4
1.3	Objectives	4
1.4	Conceptual framework	5
1.5	Scope of study	6
1.6	Variables under study	7
1.7	Research hypotheses	9
1.8	Research definitions	10
1.9	Expected outcome	11
CHAPTER II	**LITERATURE REVIEW**	**12**
2.1	Biodiversity	12
	2.1.1 Definition of biodiversity	12
	2.1.2 The level of biodiversity	13
	2.1.3 The importance of biodiversity	18
	2.1.4 Plant biodiversity	18
	2.1.5 The relationship of cultural and biological diversity	20
	2.1.6 The government policy and plan for in-situ and on-farm conservation of biodiversity and the Convention on Biological Diversity	21
2.2	Agroforestry	23

CONTENTS (cont.)

		Page
	2.2.1 Components of agroforestry	23
	2.2.2 The role of local communities and farmers in biodiversity conservation on farms	24
2.3	Ethnobotany	25
	2.3.1 The definition of ethnobotany	25
	2.3.2 The utilization of ethnobotany	27
	2.3.3 The importance of ethnobotany	28
	2.3.4 The role of farmers towards biodiversity conservation	29
2.4	Study area	31
	2.4.1 Background of Baan Bang Kloi and Baan Pong Leuk	31
	2.4.2 Demographic characteristics	32
	2.4.3 Economic characteristics	32
	2.4.4 Social characteristics, belief, value and way of life	33
2.5	Related research	35
	2.5.1 Research concerning ethnobotany	35
	2.5.2 Research concerning biodiversity in homegarden	36
	2.5.3 Research concerning the study area	36
2.6	Research concerning variables under study	37
CHAPTER III	**RESEARCH METHODOLOGY**	**47**
3.1	Quantitative research	47
	3.1.1 Population sample	47
	3.1.2 The instrument for qualitative research	47
	3.1.3 Variable measurement	49
	3.1.4 The internal and external factors relating to different types of plant diversity	51
3.2	Qualitative research	52
3.3	Monitoring tool quality	53

CONTENTS (cont.)

		Page
3.4	Data collection	53
3.5	Data analysis	54
CHAPTER IV	**RESULS: COMMUNITY CONTEXT OF BAAN BANG KLOI AND BAAN PONG LEUK**	**55**
4.1	Background of Karang communities at Baan Bang Kloi and Baan Pong Leuk	55
4.2	Household demographic, economic, and social characteristics	60
4.3	Settlement and demographic characteristics	65
	4.3.1 Settlement	65
	4.3.2 Demographic characteristics and occupation	66
4.4	Socio-economic conditions	67
4.5	Culture, tradition and belief	72
	4.5.1 Culture	72
	4.5.2 Tradition and belief	74
4.6	Political characteristics and governance	80
4.7	Roles of agencies/ organizations in the area	82
	4.7.1 Organizations concerning natural resource conservation	83
	4.7.2 Organizations concerning national security	83
	4.7.3 Organizations concerning quality of life development	84
4.8	Community context: Baan Bang Kloi	86
	4.8.1 Population and household characteristics	86
	4.8.2 Occupation and household economic status	88
	4.8.3 Religion and belief	89
	4.8.4 Land Tenure	90
	4.8.5 Roles of conserving plant species diversity	90
4.9	Community context: Baan Pong Leuk	92
	4.9.1 Population and household characteristics	92

CONTENTS (cont.)

		Page
	4.9.2 Occupation and household economic status	93
	4.9.3 Religion and belief	95
	4.9.4 Land Tenure	96
	4.9.5 Roles of plant species diversity conservation	96
CHAPTER V	**RESULT: LOCAL KNOWLEDGE IN UTILIZATION AND CONSERVATION OF WILD PLANT SPECIES**	**98**
5.1	Wild plant species utilization	98
5.2	Distribution and abundance of plant species	103
5.3	Similarity and difference of plant types between 2 villages	110
5.4	Local knowledge of wild plant species	112
	5.4.1 Food plant species	141
	5.4.2 Medicinal plant species	143
	5.4.3 Plant species for household use and decoration	146
	5.4.4 Plant species for rituals and toxics	149
	5.4.5 Knowledge regarding planting and maintainting techniques	150
	5.4.6 The adaptation of Karang people to the current situation	151
5.5	The sustainable conservation approach and plant species utilization from homestead agroforest	153
	5.5.1 The traditional management of plant species	153
	5.5.2 Local wisdom for sustainable utilization of plant species	154
CHAPTER VI	**RESULT: WILD PLANT SPECIES CONSERVATION OF KARANG PEOPLE**	**156**
6.1	Maintaining plant diversity in homestead agroforests	156
	6.1.1 The number of wild plant species (Species richness)	159
	6.1.2 The plant species diversity	159

CONTENTS (cont.)

REFERENCES **191**

APPENDICES **198**

Appendix A 199

Appendix B 205

Appendix C 206

BIOGRAPHY **208**

LIST OF TABLES

Table		Page
1.1	Independent variables and expected relationship with dependent variables	8
3.1	External and internal variables and expected relationships with three dependent variables	51
3.2	The target group and key informants for in-depth interview	52
4.1	Descriptive statistics of household and community factors characteristics	63
4.2	Descriptive statistics of external and internal factors	69
4.3	Household characteristics of Baan Bang Kloi	86
4.4	Household income in Baan Bang Kloi	88
4.5	Household characteristics of Baan Pong Leuk	92
4.6	Household income in Baan Pong Leuk	94
5.1	The indigenous classification of plant species by the Karang according to utilization purpose	103
5.2	The difference in cultivating and utilizing plant types of 2 villages	112
5.3	Wild plant species in Karang homestead agroforests	114
5.4	Crop plant species in Karang homestead agroforests	129
6.1	Shannon-Wiener Index (H) of plant species diversity	157
6.2	The total plant species diversity of Karang homestead agroforest	158
6.3	The household demographic, social and economic characteristics of Baan Bang Kloi and Baan Pong Leuk	161
6.4	The multiple regression coefficients of independent variables for the number of plant species (species richness)	164
6.5	The multiple regression coefficients for the number of total plant species	162
6.6	The multiple regression coefficients for the number of wild plant species	168
6.7	The multiple regression coefficients for the number of crop plant species	169

LIST OF TABLES (cont.)

Table		Page
6.8	The multiple regression coefficients of independent variables for the diversity of plant species	171
6.9	The multiple regression coefficients of total plant species diversity	173
6.10	The multiple regression coefficients of wild plant species diversity	174
6.11	The multiple regression coefficients of crop plant species diversity	175

LIST OF FIGURES

Figures		Page
1.1	Conceptual frameworks	5
2.1	The map of study area in Kaeng Krachan National Park	34
4.1	Time line of community settlement	58
4.2	Map of land use of Baan Bang Kloi and Baan Pong Leuk	59
4.3	Population characteristic in Baan Bang Kloi	87
4.4	Main occupation in Baan Bang Kloi	89
4.5	Minor occupation in Baan Bang Kloi	89
4.6	Household income in Baan Bang Kloi	89
4.7	Population characteristic in Baan Pong Leuk	93
4.8	Main occupation in Baan Pong Leuk	95
4.9	Minor occupation in Baan Pong Leuk	95
4.10	Household income in Baan Pong Leuk	95
5.1	Plant classification by plant habits	99
5.2	Number of plant species by family	101
5.3	Plant classification by local usage	102
5.4	The distribution of plant species classified by habits	105
5.5	The distribution of plant species, classified by household utilization	105
5.6	The distribution of crop plant species, classified by household utilization	106
5.7	The distribution of wild plant species, classified by household utilization	106
5.8	The distribution and abundance of plant species in Karang homestead agroforets	108
5.9	The distribution and abundance of climber plant species	109
5.10	The distribution and abundance of herbaceous plant species	109
5.11	The distribution and abundance of shrub plant species	109

LIST OF FIGURES (cont.)

Figures	Page
5.12 The distribution and abundance of tree plant species	109
5.13 The beta diversity of plant species of 2 villages (total of 68 species)	112
5.14 Food plant species, classified by family	142
5.15 Food plant species, classified by plant habits	142
5.16 Medicinal plant species, classified by family	145
5.17 Medicinal plant species, classified by plant habits	145
5.18 Plant species for household use, classified by family	146
5.19 Plant species for household use, classified by plant habits	146
5.20 Bamboo used for building house	147
5.21 Lalang used for making a roof	147
5.22 Karang's house	147
5.23 "Round raft" used to travel to Baan Bang Kloi	147
5.24 "Tae Na" musical instrument of Karang	148
5.25 "Norae" used for honey collection	148
5.26 "Pa Lu" used for rice storage after harvesting	148
5.27 "Buea" used to catch fish	148
5.28 Ornamental plant species used as fences to demarcate household boundary	149
5.29 *Platycerium holttumii* de Jonch. & Hennipman fern for decoration	149
5.30 Growing plants in unusable containers	152

CHAPTER I
INTRODUCTION

The introduction chapter of the study of Utilization and Conservation of Wild Plant Diversity: A Case Study of Two Karang Villages in Kaeng Krachan National Park, comprises of background and justification, research questions, objectives, conceptual framework, scope of the study, variables, hypothesis, definition and expected outcomes, respectively as follows;

1.1 Background and justification

Societies in the world, at present, pay more attention to biodiversity conservation as can be seen that there are various biodiversity protection and preservation regulations. The World Conservation Union (IUCN) indicated that the conservation areas covered both land and marine areas through the management system based on the laws and the efficient applications; such as Forest Reserve Act 1964 and National Park Act 1961, which have both direct and indirect effect on people who live in or nearby this area. As a result, people call for their right and invade the conservation areas. The local people and the farmers who live in conservation areas, moreover, rarely receive information and participate in conservation activities; however, they have their own way to maintain and to utilize their ecosystem based on their local knowledge. Apichai Puntasen and Danai Srimora (1996) said that people, living in or nearby the conservation areas have the responsibility to maintain their forest. At the same time, their occupations must be suitable to conserve forest and are able to earn sufficient income for their family; thus, it is necessary to promote the occupation that could do for long term and sustain the environment like agroforestry activity, which is appropriate for tropical forest. In fact, the tropical forest with high biodiversity and production provides resources, both direct and indirect ways, such as foods, habitats, medicines and high ecological services to support human needs.

The population growth is one factor of overexploitation; therefore, the natural resource nowadays gradually deteriorates like Wisut Baimai (1995) said that rapid degradation of tropical rain forest was caused by human behavior and activities, especially people who directly employ forest products. As a result, people mostly believe that the biodiversity is affected by these groups of people who closely depend on natural resources. Collecting forest products, in fact, brings a certain extent of degradation to both social and ecological systems. However, if the plants provide the positive effects such as source of food and medicine or source of income on local people, these reflects the local knowledge of the communities in terms of controlling usage of natural resource because the community demand, indeed, is to sustainably use of the resources for long term benefits. Thus, studying the ways local people collect wild plant species to grow in their homestead agroforest needs the understanding of local knowledge and wisdom concerning plant and biodiversity conservation.

Environmental, forest and biodiversity degradations become the important issues which get many attentions from societies; however, the problem analysis and the recommendation to solve these problems are not obvious, especially the linkage between biodiversity and environmental problem and natural resources management due to the fact that the understanding is not based on the local knowledge and is lack of perspectives in human ecological aspect (Yos Santasombat, 1999). Although humans create many innovations, the application of knowledge to conserve and maintain biological resources is not precise. If the research integrate the scientific and local knowledge and wisdom towards biological resources conservation, the resources and the environmental quality would be secured in the right way.

Many tribes are staying in conservation areas, in Thailand, and living with the nature through harvesting and planting, both around the forest and around the communities, and apply their local wisdom by the way of seed selection for their food, medicine, auspiciousness, custom and culture (Aroon Thaewchatturat, 2000). Besides, the communities, which are located in protected areas, certainly depend on forest products because local people perceive that forest is the source of food and income due to the fact that their surrounding environment with unpredictable rainfall from variable seasons does not afford them to harvest agricultural products. Therefore, it is not easy not to allow local people to gather forest products because the forest

products are essential to them to survive. It is, thus, interesting to find out the ways to use forest products sustainably. Importantly there have been harvesting techniques or beliefs and local wisdoms to utilize forest benefits among local people for long terms.

The government allocated the areas around Baan Pong Lueng and Baan Bang Kloi, Tambon Huay Mae Preang, Amphoe Kaeng Krachan at Kaeng Krachan National Park, Phetchaburi Province to Karang people. Each family receives 7 rai for farming orchards; additionally, the national park promotes planting bamboos and some herbs for household consumption and for reducing local dependency on forest products.

Apart from agricultural farming, the local people also collect wild plant species to grow in their homestead agroforest around their houses. The ideas and methods including beliefs and local wisdom of Karang people for seed/seedling selection are interesting to learn because the study promotes the balance between natural resource utilization and human needs. All these actions and applications lead to the sustainable existence of the environment.

Therefore, growing plant species in homestead agroforest or practicing agroforestry among people around forest areas provides both direct and indirect benefits. The direct benefits include sources of foods, habitats, useable woods and medicinal plants which are the important fundamental for living especially people who live in the forest area and depend on these resources. In addition, the indirect benefits include forest around residence or agroforest which increases species abundance, soil fertility, high biodiversity, and reduces logging or collecting forest products due to the fact that they have already had products around their houses.

As of the benefits as mentioned above, farmers in many countries have the community economy as a driving force; for example, the farmers at Bangladesh (Giashuddin Miah and Jahangir Hussain, 2009) practiced homestead agroforestry by planting agricultural crops together with orchards, perennial trees or wild plant species around their houses. The productivity is regarded as "bank" which local people can earn money and use these products in various aspects. As a result, the farmers could collect these products whole year because of seasonal productivities. Therefore, they did not depend on forest resources; at the same time, the remaining products were able to sell to create income and enhance living standard. In other words, practicing

homestead agroforestry by growing various plant species around residence is another way of sustainable forest ecosystem conservation.

Therefore, this research studies the utilization and conservation of wild plant diversity, a case of two Karang villages at Kaeng Krachan National Park. The main focus is on growing wild plant species in their homestead agroforest together with their choices of plant species, the diversification of species, and the decreasing dependency on forest products. The study expects to make a recommendation to support the roles of local people and communities who live in forest areas towards plant diversity conservation in their settlement based on their local knowledge and wisdom to secure food and ecosystem.

1.2 Research questions

1.2.1 What is the local knowledge of the Karang people in collecting and diversifying plant species in their homestead agroforest?

1.2.2 What are the factors that influence households and communities on their decision to maintain plant diversity through collecting these plants from the forest to grow around their houses?

1.2.3 How can homestead agroforest of Karang people from both Baan Pong Leuk and Baan Bang Kloi increase the quantity and diversity of plant species and decrease local dependency on forest products?

1.3 Objectives

1.3.1 To study local knowledge of Karang people in utilizing and conserving plant species diversity in their homestead agroforest.

1.3.2 To analyze factors influencing households and communities to make decision to grow wild plant species.

1.3.3 To suggest local communities to reduce their dependency on forest resources including conserving biodiversity around their habitats.

1.4 Conceptual framework

After reviewing the related documents and research in order to determine variables under study about the biodiversity utilization and conservation among Karang people, the researcher designs the research with a conceptual framework having 2 levels of factors influencing local people's decision making to use and conserve wild plant species. These 2 levels of factors are household and community levels, which include gender, age, and level of education of household heads, number of household members, main and minor occupation of household heads, household income, household expense, debt, sources of plant species to collect to grow around their houses, distance from dwelling to forest areas, and community factor which are different in terms of the settlement duration and pattern of both communities. The linkage between factors and biodiversity conservation of Karang people is presented as followed:

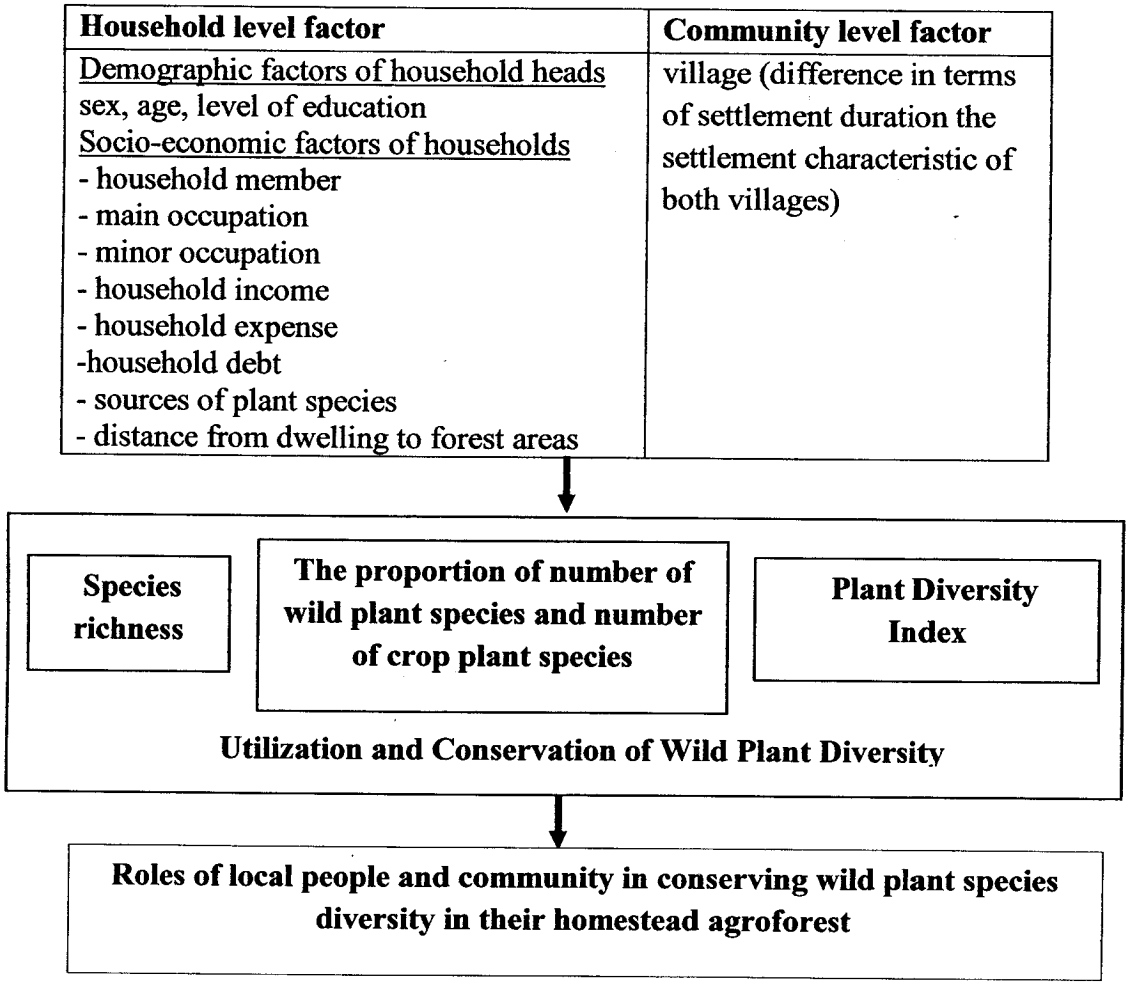


Figure 1.1 Conceptual frameworks

1.5 Scope of study

1.5.1 Scope of area under study -the population under study is households in Baan Pong Leuk 65 households and in Baan Bang Kloi 71 households (World Wide Fund for Nature, 2008) at Kaeng Krachan National Park, Tambon Huay Mae Preag, Amphoe Kaeng Krachan, Phetchaburi province. Heads of households are representatives to provide information regarding their decision making in practicing homestead agroforest.

1.5.2 Scope of content under study consisted of 3 main issues as followed:

1) Studying local knowledge in utilizing and conserving plant diversity of Karang people; for instance the utilization, properties, quantity, harvesting techniques time, and methods, parts of plants used, scientific name and local name.

2) Researching the influenced factors on household and communities decision to collect wild plant species to grow. These factors are composed of household level and community level factors.

Household level factors

Demographic factors of household heads such as sex, age and level of education

Socio-economic factors of households such as number of household workers, main occupation, minor occupation, household income, household expense, debt, source of plants, distance from resident to forest

Community level factors such as period of settlement

3) To examine the result of collecting wild plants to grow in their areas in terms of increasing volumes, plant breeding and decreasing dependence on forest resources.

The variables which indicate the households and communities' decision to collect wild plants to grow in their homestead agroforest include 3 variables as follows:

1. Species richness implied the number of wild plant species planted by Karang people. This variable, however, is not able to indicate plant species diversity well because collecting one species of wild plant to grow can increase only one species not augment the diversity of plant species.

2. The proportion of number of wild plant species and number of crop plant species is to find the proportion between number of wild plant species and number of crop plant species. This variable shows the variety between growing wild plants, agricultural plants and horticulture in homestead agroforests among Karang people.

3. Plant diversity index is to calculate the plant diversity between number of wild plant species and the number of wild plants grown by Karang people. This variable is able to express how much diversity of plant species in their homestead agroforest increases.

1.5.3 Scope of study duration

- This research has been conducted for 1 year
- Data collection was carried out at the protected area for 2 months, from April to May 2009

1.6 Variables under study

This research studies the local knowledge in utilizing and conserving wild plant species diversity grown by Karang people. The research aims to study wild plant species richness, the proportion of the number of wild plant species and number of species of crop plants (agricultural plants and horticulture) and diversity index. All of these are the dependent variables that researcher wants to examine their relationship with other independent factors influencing household and community decision for growing wild plants.

Table 1.1 Independent variables and expected relationship with dependent variables

Variable	Scale of measurement	Unit of measurement	Expected relationship
			Amount of wild plants
Demographic factor of household heads			
sex	Nominal	-	+
age	Ratio	Year	+
level of education	Ratio	Year	-
Socio-economic factors of household			
-number of household member	Ratio	Number	+
- main occupation	Nominal	-	
- minor occupation	Nominal	-	
- household income	Ratio	Baht	-
- household expense	Ratio	Baht	-
- household debt	Ratio	Baht	-
- source of collecting plants	Nominal	-	
- distance from dwelling to forest areas	Ratio	Meter	-
Community level factor			
-village (The difference of settlement duration and the settlement characteristic of both villages)	Nominal	-	+

1.7 Research hypotheses

1.7.1 Household level factor

1) Demographic factors of household heads to make decision to grow wild plant species diversity in their homestead agroforests.

1.1Heads of households who are male decide to maintain plant diversity through collecting these plants from the forest to grow around their houses more than females.

1.2 Heads of households who are aged grow wild plant species in their homestead agroforest more than young household heads.

1.3 Heads of households who have low level of education decide to grow wild plant species around their houses more than those who have high level of education.

2) Socio-economic factors of household to make decision to grow wild plant species diversity in their homestead agroforests.

2.1 The more number of household members, the more wild plant species are grown in their homestead agroforests.

2.2 Households whose main occupation is agriculture would grow wild plant species more than households whose main occupation is not agriculture.

2.3 Households whose minor occupation is agriculture would grow wild plant species more than households whose minor occupation is not agriculture.

2.4 The less income households earn, the more wild plant species are grown in their homestead agroforests.

2.5 The less expense households have, the more wild plant species are grown in their homestead agroforests.

2.6 The less debt households have, the more wild plant species are grown in their homestead agroforests.

2.7 The source of collecting plants species to grow in their homestead agroforest has significant influence on the diversity of wild plants around their homestead agroforests.

2.8 Households with shorter distance between dwelling and forest areas would grow more wild plant species in their homestead agroforests.

1.7.2 Community level factor

The village which has settlement duration for a long time and area is not clustered (Baan Pong Leuk) has higher wild plant species around their homestead agroforests.

1.8 Research definitions

Karang people means the local people who collect wild plant species to grow in their homestead agroforest around their houses in Baan Pong Leuk and Baan Bang Kloi at Kaeng Krachan National Park, Tambon Huay Mae Preang, Amphoe Kaeng Krachan, Phetchaburi province.

Wild plants mean plants that grow on natural habitats with no human interference or little help from humans and their seeds are growing in their natural state within their habitats. The Karang people from Baan Pong Leuk and Baan Bang Kloi have collected them to grow around their houses.

Crop plants mean agricultural and horticultural plants. They have commercial value and are important for daily life such as rice, corn, sugar cane, backyard garden, peas and flowers.

Ethnobotany means the study on the traditional knowledge and uses of plants by the ethnic people. The information covers their system of classification and the exploitation of plants for food, cloths, medicines, housing, symbols and spirit. These includes the process of preparation and the way it used. (Tem Samitinun and Weerachai Na Nakhorn, 2002)

Species richness implies the number of wild plant species that are planted by Karang people. Species richness is not able to indicate well the plant diversity because collecting one species of wild plant to grow can increase only one species not augment the diversity of plant species.

The proportion of wild plant species and crops plant species means the comparison between the number of wild plant species and number of crops plant species grown by Karang people at their houses.

Diversity index examines the plant species diversity between the number of individual in plant species and the total number of all individuals plants, which

were cultivated. The total plant species diversity of Karang people planted around their house was calculated by Shannon – Wiener Index (H)

1.9 Expected outcome

This researcher gathered the data on plant species and the utilization of plant species from the local knowledge of Karang people to collect wild plants to cultivate around their houses. The result, additionally, presents factors influencing Karang households' and communities' decision making in bringing plants to grow around their houses. The study expects to make a recommendation to support the roles of local people and communities who live in forest areas towards plant diversity conservation in their settlement based on their local knowledge and wisdom to secure food and ecosystem in homestead agroforest.

CHAPTER II
LITERATURE REVIEW

The case study of Karang group at the Kaeng Krachan National Park is to consider the utilization and species diversity conservation. The researcher studied the concepts, the theories, the documents and related researches, in order to determine the scope and the point of this study and to link to the objectives, which were categorized as follows;

2.1 Biodiversity

2.1.1 Definition of biodiversity

The root of "biodiversity" or "biological diversity" is from "biological" meant bio or organisms and "diversity" meant variety. After combining these 2 words, there are many definitions (Wisut Baimai, 1995) defined biodiversity as all creatures or organisms in this globe, including the internal part of each creature, among the same species or among the population which is same or different species as well as the environment both animate being and inanimate being in other words it can be summarized that the biodiversity means the variety in these 3 categories as follows;

1) Species diversity is all living organisms plus prokaryote, microorganisms, plants, animals and human being

2) Genetic diversity is the part of organisms which unite as a group of population

3) Ecological diversity depends on the habitats

Department of policy and environmental plan (1996) defined the biodiversity as the diversity of types and species in the ecosystem which is diverse and globally different in other words the various types of species, genetic and ecosystem.

The core of all living creatures is species diversity. The population of each species is able to evolution and to response the changeable environment through the natural selection depending on the genetic and the environment. The species variability causes the new species like plants, animals and microorganisms which altogether stay and adapt to the environment; at the same time, their function is commonly complicated becoming the ecological. Study of ecological diversity mainly specified the species which is the component of the habitats considering the number and the density of each species population.

The definition of biodiversity is wide and includes the species diversity as microorganisms, plants as well as human being. The element of each creature is composed of genetic diversity for the sake of harmonious habitat of ecological diversity.

2.1.2 The level of biodiversity consisted of 3 levels is;

1. Genetic diversity
2. Species diversity
3. Ecological diversity

1.Genetic diversity there are many scholars defined and gave the examples (Sumontha Promboon, 2002) defined genetic diversity as the gene of living organisms generally showed the genetic characteristic, both same species and different species, which is used to determine the relation of the living organisms in terms of evolution. The living organisms reproduced their descendents by asexual reproduction or the twin component, almost the same genetic on account of the copy of each other. The living organisms, moreover, inherited the same lineage having more similar genetic than different family; additionally, more different lineage is more different genetic until dissimilar living organisms, groups or kingdom, respectively. The biologist has several techniques to measure the genetic diversity but all methods employ genetic as an indicator in case the living creature has the same genetic which means that this living organisms does not have genetic diversity. The advantageous example of same species may have different genetic diversity; for instance thousand of rice species, potato or other plants as corn, potato and chili, which have several species but have less species diversity in agricultural hybrid.

The gene variation has a vast benefit to human due to the fact that breeder develops the plant species in order to increase production and to resist pest. The core factor of evolutional organisms process through natural selection is the component between genetic and the circumstance; in addition, the genetic diversity is the crucial importance for living organisms for the purpose of providing living organisms be efficient in changeable circumstance, including evading enemy or insist disease. Moreover, the dominant gene occurs from the natural selection as Charles Darwin (1895) noticed that the natural selection is the imbalance successful of reproduction through unequal ability of each living organisms to survive and to breed leding to population development towards environment.

UNEP/GEMS (2001) said that the living organisms settles in the large area and overall breeds same species therefore the ratio of genetic transferring is high but rarely indicate the local characteristic. On the other hand, the living organisms dwell at small area so the genetic transferring is low because of the environmental adaptation which clearly shows the local characteristic.

The reason of genetic diversity

The fundamental ecological diversity is genetic diversity which primarily changes of gene expression is called by geneticist as mutation. The mutation can naturally occur but the ratio is quite low. Each genetic has the different mutation ratio for example 1 to 100,000 per generation. However, it is possible to be 1 to 10,000 per generation. When it happens, it is able to transfer to the next generation (Sumontha Promboon, 2002) in fact, this error accidentally occurs in nature through the genetic fission or natural radio disturbance, either direct or indirect from human; for instance environmental pollution and radioactive cause high mutation. Even mutation is highly dangerous to living organisms, the mutation basically causes the genetic diversity. Furthermore, the cause of new species is from migration or from human activities such as sexual reproduction together with biotechnology such as transferring gene into cell via cell culture technique and molecular technology (Sumontha Promboon, 2002).

2 Species diversity

There are 2 aspects of species diversity that is species richness meant the number of type of living organisms per unit area and species evenness meant the proportion of living organisms. (Sumontha Promboon, 2002) This characteristic of

species diversity is able to measure by the amount of living organisms and the population of each species, including age structure and gender.

The cause of species diversity

The genetic component gradually develops generation by generation until the living organisms can adapt to the environment called speciation which means that the changeable circumstance is suitable for new species to reproduce only their group; thus, new species reproduction causes the species diversity at the same time maintains their characteristic. In general, the figure of new species is obviously probable difference from other species (Sumontha Promboon, 2002). The important factor caused the new species via natural selection is the system development and reproduce mechanism in their group which eliminates the homozygous recessive.

Biologist explained that the geography influences on creating new species due to the fact that natural features obstruct reproduce internal and external group; hence, the proportion and the genetic component change. Each species, additionally, has their way to develop via natural selection. In other words, the hybrid cannot happen anymore. Furthermore, human being selects species both plants and animals for their needs. This technique also follows the natural selection method but this new species adapts environment specified by human and cannot survive in nature so it is important for biologic diversity.

Another factor of new species by natural selection is small population random. The random tool accidentally gets rid of species that is suitable for the environment. In other words, the recessive species can survive and increases. The ecosystem is the main factor to determine durable species, neither natural selection technique nor random case. There are plenty of species and all these species adapt and have deeply relation when one species is disappeared consequently lose of living organisms (Sumontha Promboon, 2002).

3. Ecological diversity

The ecosystem is the shelter or habitat of all living organisms and both physical and biological effects on each species. Some species can survive in various types of ecosystem but some can survive only particular ecosystem. Ecological diversity depends on the number of species and population living in ecosystem. The living organisms, in the past, had its own evolution process and limitation to survive in

the changeable environmental condition. However, it depends on the genetic diversity within the population, the violence and irregular environment. If there are no genetic diversity and ecological diversity, the living organisms will have no choice to survive (Sumontha Promboon, 2002). To determine the variability of vast ecosystem UNEP/GEMS (2001) said that, in the environmental book series of Environmental Project of United Nations Environmental Program and Global Environment Monitoring System, it is difficult to measure because there is no ecosystem management which globally accepted; moreover, the territory is always changeable and difficultly verifies. At the same time, the ecosystem regularly changes. The area, where is high ecological diversity, is also high biological diversity but it is possible that the ecosystem, which has only local living organisms, is able to arise the biodiversity.

The biodiversity of ecosystem has 3 facets as follows;

1. The diversity of environmental area each habitat areas have different living organisms such as around canal has wild buffalo and in cave has bat. In fact, the habitat areas which naturally happen have high biodiversity.

2. The variety of replacement there are the plant replacement in forest which means that when the forest is destroyed in anyway such as forest fire and storm, plants as cogon grass grow up in these areas and if this areas are abandoned, there is pulpous growing, such as rubiaceae and sterculiaceace, then the secondary forest recovers.

3. Geography diversity many areas occur naturally such as canal, swamp, desert, valley, fieldstone and plant society. The grassland and deep forest are vastly abundant biodiversity unlike the cold areas which have only one species covering the area (Department of Environmental Quality Promotion, Ministry of Natural Resource and Environment).

The reason of ecological diversity

All living organisms is interdependent both indirect and direct way through energy chain which is the part of food chain. The ecosystem, having closely relationship or specific constrain in terms of habitat, is highly sensitive because this factor is able to affect the small part of ecosystem and to concern the whole part of ecosystem as well.

In general, the sustainable ecology has been developed for decade until both biological and physical mechanism can handle every changeable circumstance that is the ecosystem balance. The "Ecosystem Balance" in this case means the ecosystem can rehabilitate its condition; for instance, all forest types and water sources such as sea and lake. This ecosystem, therefore, is the source of sustainable biodiversity for human, flora, fauna and microorganisms. This system is the source of enormous genetic diversity towards the evolution and the change of geography for decade especially before birth of mankind. Even if human tries to imitate the environmental system, they cannot copy the whole system. However, this ecosystem should well preserve in order to be abundant genetic diversity (Sumontha Promboon, 2002).

In summarized, the biological diversity or biodiversity means species diversity dwells altogether in one ecosystem considering into 3 levels: genetic diversity, species diversity and ecosystem diversity. The dynamic of genetic change is the fundamental evolution leading to birth of new species caused biodiversity. In other words, the sustainable ecology is determined by ecosystem and although many living organisms are found and adapt to the environment, one species disappears that affects the whole part of ecosystem. Therefore, studying species is important because examining species makes mankind understanding the evolution and enactment the environmental protection. Hence, the researcher studied the definition of species diversity as well as species richness and species evenness which cause the new species in the ecosystem.

To examine plant diversity do not count and list the species only but also do consider the population. The plant diversity is related to the species richness that is the number of plant species and to species evenness that is the number of plant stem which means the proportion of each species in that society. The area, which is high diversity, reflects the environmental fluctuation so the area structure becomes more complicated. Siriwan Suksri (2003) said that there are many academics try to figure out the index which uses to estimate the plant diversity but they cannot conclude which one is the best technique. Shanon and Weavon (1949) suggested the method to estimate the plant diversity is Shanon – Wiener's Index of diversity (H). H value is higher when the number of each plant stem is equal and H value is equal 0 if there is

only one species (Utis Kutintara, 1998 reference in Siriwan Suksri, 2003). Therefore, the researcher applied Shanon – Wiener's Index of diversity (H) in order to find out the plant species diversity cultivated by Karang people in their areas because H value in this case covers both the species diversity and equal plant species planted by Karang people.

2.1.3 The importance of biodiversity

Forest diversity is essential for human because forest provides both direct and indirect benefits in relation to economic, social, politic, culture and ecosystem. Moreover, it supplies wood and forest products, including 4 basic needs such as habitat, food, clothes and medicine, which afford the basic needs of human being and raw material for industrial sector. The example of indirect benefit is that it causes rainfall on its season, is the headwater and dweller, prevents inundation, reduces air pollution, and maintains balance of natural resources; in addition, some forest areas become recreation and education center. The biodiversity and pristine ecosystem, moreover, have a positive effect on people who live in the forest because these groups mainly depend on it in terms of 4 basic needs, tradition and belief. Thus, it can be seen that the forest is valuable for Thailand especially for agricultural country in spite the fact that forest influences on cultivation. There is the linkage among forest water and air condition. If the forest areas have high humidity, it is cold and rains because trees emit humid and moisture into the air but if the forest is destroyed, it causes many negative effects such as dry climate and desertification.

2.1.4 Plant biodiversity

For the terrestrial ecosystem, "plant" is important for energy transfer. It uses energy from sun and other forms that other living organisms can eat. Then, sugar and starch are digested and burn for energy. Human being does not use the plant energy storage for survive but also employs plant for other purposes for instance energy from charcoal and biofuel from ancient plants (Taweesak Boonkerd and Torsak Reeranoon, 2002) for agriculatural activities, forest and medicine and pharmaceutics. Human, at the moment, tries to create new plant species for several purposes. Thus, studying plant diversity highly gets attention. Apichart Kaosa-ard et al

(1995) defined plant diversity as various plant species growing in general has either ecosystem diversity or habitat diversity such as forest condition or ecosystem, species diversity such as number of plant species in the area and genetic diversity as the differences of each plant species like rice species, longan, durian or teak; therefore, plant diversity is a part of biodiversity.

From researching and reviewing researches of biology and botany, it showed that tropical forest has the highest plant diversity especially in the tropical rain forest referring to Apichart Kaosa-ard ae al, (1995) estimated that Amazon has plant species more than 30,000 species from the overall plant species on earth altogether 250,000 species and Thailand is suitable for plant diversity due to the fact that it located at the joint of biogeography or floristic region among 3 regions: Indo-Burmese region in the north and in the west , Indo-Chinese region in the north and some area in the east and Malesian region in the south from Ranong province till the east point (Chantaburi province and Trat province), from these floristic region and the geo-physiography of Thailand (Apichart Kaosa-ard, 1995), it presented that Thailand has 16 sub forest types or sub-ecosystems or habitats altogether 16 types; consequently, the country has voluminous plant species. From the study of plant diversity, the species richness in the forest, in Thailand, found that 1 hectare (100×100 meters) of dry dipterocarp forest found 35-40 flora species, mixed deciduous forests found 14-21 species, pine/pine-dipterocarp forests found 22-34 species, dry evergreen forests found 57 species, montane forests found 56-70 species and tropical rain forests found 69-109 species. Because of plant diversity and its benefits, human utilizes their product both direct and indirect way such as food, utilization, medicine, recreation, industry. Each plant has gene which determines the special characteristic such as hedge tree, perennial or annual crops, producing toxic or tolerant insects. If this gene is transferred into the crops, the agricultural system will be more effective. However, there are some species without biochemical information which needs to research their advantage; hence, Sedjo (1992) suggested that people should conserve theses plant species in order to not extinct towards collecting information from folk healer who employs herbs as a tool to cure and whom their descendents transferred knowledge. Nonetheless, the factor for selecting a community or information provider is that community should have high biodiversity or people who live for many generations and

tradition plays an important role on the society related to transferring indigenous or local knowledge from generation to generation. This technique is applied for selected area and collecting information for the sake of the ethnobotany research benefit.

2.1.5 The relationship of cultural and biology diversity

Yos Santasombat (1999) said that there is the linkage between community and forest for a long time. The community is able to increase the forest biodiversity by planting various species, lighting in order to reduce some prominent species together with conservation and species development with the used limitation because it is risky to lose the biodiversity like headwater; as a result, biodiversity interconnects with cultural diversity. Ethnic groups and local communities have an important role to conserve biodiversity through their belief and their ritual as well as other natural management systems like Pritsana Promma and Montree Chantawong (1998) proposed the biodiversity management by community in the local and biodiversity management book series that the local communities, which has lived in the forest for a long time, have an advantage over and a good chance to accumulate their knowledge related to forest utilization for sustain and support their communities. The forest utilization of local communities is based on renewable energy for instance when local people collect wild yam or wild potato, they put its root and its young plants back. The outsider normally considers and understands that to conserve biodiversity should not use its benefits. The biodiversity management by local community has several factors as follows:

1. Belief and ritual the local communities manage their forest in line with their belief before having forest management system. Both belief and doctrine which is transferred generation by generation, is intervened by folk stories, songs and beliefs as holy law which has potentially influences on local people to manage their resources. This reflects many stories such as guardian spirit story, ritual forest or believing in using forest products. Each story has the same idea and proposes that are the system supports local residences manage natural resource in harmony with ecosystem.

2. Community knowledge based the communities living in forest for a long time have their own evolution and adaptation to the environment and transfer their knowledge which has several aspects for example;

3. Collecting herbs there are both techniques and belief in line with ethic, such as collecting technique: collecting clump has to leave shoot, whittling bark slices the stem, and using root gets only some part, concerned sufficiency economy. Though many herb species cannot reproduce at the residence, they rely on forest ecosystem to grow (plants nature) effect on to local people to strictly maintain.

4. Knowledge of logging tree for usage especially for building house, in the past bamboo was used for building house of Pakayo people because it is moveable easily. When they permanently located, their dwelling becomes more firmly. Using log for building a house is the rule of the community despite the fact that the local people need to have the permission from the community forest committee regarding the tree usage which is related between belief and tree species; additionally, if there is the animal nestle on the tree, the local people do not use that tree for the reason of destroying other people houses. The belief is not benefit only on quality of wood but also account for the belief in tree species.

2.1.6 The government policy and plan for in-situ and on-farm conservation of biodiversity and the Convention on Biological Diversity

Department of policy and environmental plan (1997) proposed the decreasing forest area information from forest department found that the forest area in 1993 was around 26.02 percent decreasing from 1961 around 53 percent of total land area. The main factor of reducing forest area is from the development of exporting agricultural policy, economic development, rapid population increased and lacked of potential organization and human resource towards biodiversity management. At the same time, the shifting cultivation in highland increases caused soil erosion and leaching which lead to flooding. Therefore, the government canceled the forest concession in 1992 as well as preceded the biodiversity protection policy and increased competency for effective sustainable use of natural resource such as declaration park area and wildlife sanctuary, classification water quality, categories area of resource usage and national preserved forest in order to protect and maintain ecosystem, the agricultural development together with maintain environmental and natural resource quality; for instance sustainable agriculture, flora and fauna species development or biotechnology for breeding and species selection. There are many

laws specify on conservation and biodiversity utilization in Thailand as can be seen on the 6^{th} ,7^{th} ,8^{th} of National Economic and Social Development Plan was about conserved ecosystem including greatly promote sustainable agriculture.

Furthermore, in Thailand, there were the policy, measurement and conservational plan and the sustainable biodiversity use in 1998-2002 by determine strategies of conservational policy and the sustainable biodiversity use as follows;

1. Enhance the organization and human resource ability in terms of biodiversity conservation
2. Increase capability of protected area to secure biodiversity in sustainable way
3. Increase the local motivation of biodiversity conservation
4. Conserve the diversity of species, populations and genetic and ecosystem/ habitats
5. Control, follow up and investigate the process or activities that are able to threaten the biodiversity
6. Promote biodiversity management in terms of environment, culture and tradition
7. Promote collaboration between institute and university, both national and international level, in conservation and sustainable biodiversity utilization

The policy, measurement or biodiversity convention is just a tool for maintain and natural resource and environmental promotion. If the government, organizations or resource users in every level considers and follows the policy and law, the biodiversity conservation will be more effective and provide beneficial sustainability.

In concluded, the diverse areas and systems provoke the biodiversity. The 4 basic needs, developed by knowledge and the local genetic, are acquired from both forest and agricultural area. The forest users maintain both process and consumption technique which concerned as method to preserve plant species diversity. Therefore, to study and to research the knowledge based of the communities living in forest is the one technique to find answer or support information. The local people is responsible for plant propagation and increase the diversity together with evaluate the effect of harvesting both in qualitative and quantitative in order to give guideline and recommendation about the role and responsibility of local people and local communities towards conserving plant species diversity at agricultural area and at

residence based on knowledge, local wisdom and local tradition for building food security and maintain ecosystem.

2.2 Agroforestry

2.2.1 Components of agroforestry

Agroforestry is the land use system for planting tree and doing agriculture at the same time by planting and herd. The tree in agroforestry system is hardwood or perennial plants, bush or bamboo and agricultural pattern is agronomy, horticulture, herd grass and fishery.

In short, the agroforestry uses the land for agriculture, both perennial and annual crops with feeding animal. The agricultural areas are composed of both big plants and long life, such as coconut, betel nut and bamboo, and short lived such as herbs, grass for feeding animal; in addition, feed animals in the same area, at the same or different period. This structure depends on each other for example the big tree provides shade for small tree and small plants become food of animals. Moreover, when dung and dry leaf are decomposed, they become nutrition for trees. The dependence between flora and fauna brings about the ecosystem balance. There are 3 systems of agroforestry as follows;

1. Agrisylvicultural system has high production and low competition

2. Sylvopastoral system plants for getting benefit in every parts of tree and growing grass as a supplement for livestock

3. Agrosylvopastoral system is the livestock. The advantages of livestock for the local people are meat, wool for making clothes, leather for making shoes or clothes, dung for making fertilizer. The benefits of trees are for consumption, residence, medicine and preventing disaster. Agriculture increases food for both human and animals. One area can apply all 3 systems or only one system; however, the local people have to consider the soil and environmental condition and way of life.

2.2.2 The role of local communities and farmers in biodiversity conservation on farms

Growing plants at the agricultural area is another tool for development and conserving environment or ecosystem of plant species to build the sustainability and fertility as Ratchaniwan Phimsirikul (2004) studied the Factors Relating to the Dependency on Forest Resource of the People Residing Adjacent to Pa Pun Don-Pa Ko National Reserved Forest, Amphoe Nong Saeng, Changwat Udon Thani in terms of the attitude of dependent forest resource found that from the interview local people, they believed that collecting forest product to plant in their area was more convenient than going to the forest; moreover, they can save money for buying food. The local people paid back to the environment was to conserve those plant species and to increase the number from planting and plant propagation which sometimes local people get new species or tolerant species from insect and disease.

At the same time, there was the research of Trinh L.N.et al (2003) said that planting plant around the house was another way for exploring and conserving biodiversity at agricultural area because garden around house promoted the production or diversity of plant species as well as collected scattered plant species. The farmers and local people had an important role for protecting plant species as can be seen in the research of Hodel Urs and Monika Gessler (1999) referent to Boster (1984) and Brush *et al.* (1981) regarded plant species management through selection system and classified plant species by local farmers. The local agriculture selected plant for growing by their experience, exchange knowledge or consult each other or observation from plant characteristics such as color, size, shape, taste and smell for being criteria to select good plant species for conserving and propagation. Therefore, the utilization plant species advantage of local people or the identity of local tradition is also important to maintain the plant diversity, both genetic and species, around their house.

To build homestead agroforest is liken to "genetic bank" which is responsible for conserving local plant species or local original plant species; moreover, for being food source and life security of plant utilization for medicine, usage including creating the relationship at family level and community level. The threaten of plant species at Bangladesh (Mohammed Shafiul Alam and Kazi Mohammad Masum, 2005) found that of these 60 species were threaten in 1994 and these species

increased up to 176 species in 1999. The forest management sector of Bangladesh had the policy related to promote the farmers to do homestead agroforest through platting perennial trees with the agriculture crops or livestock because not only create income but also maintain biodiversity which was inherited for many generations. Homestead agroforest at Bangladesh had the important role in maintain plant species along with food bank and source of income from selling agricultural productivity.

From these researches, to enlarge the forest area that local people gain benefits from agricultural area is agroforestry, which is another solution to reduce depending forest product at the same time to increase green area towards preserve biodiversity at agroforestry system and at garden.

2.3 Ethnobotany

2.3.1 The definition of Ethnobotany

The word "Ethnobotany" was defined by Dr. John W. Harshberger, the American botany from Pennsylvania University, in 1985 as "The study of plants used by primitive and aboriginal people". Many scientists defined ethnobotany quite similar, for example Tem Samitinun and Weerachai Na Nakhorn (2002) summarized the meaning of ethnobotany to be in line with Thai tradition as the study of usage of plant benefit transferred generation to generation, food, clothes, medicine, habitat as well as symbol and belief including local classification and the area preparation. Power (1874) reference in Tem Samitinun and Weerachai Na Nakhorn (2002) widely and thoroughly explained that ethnobotany is the way to use plants as medicine, food, fiber for weaving and for decoration.

Ethnobotany is a part of ethnobiology as Chayan Pichiansunthon (2002) explained that it is the multidisciplinary science similar with Martin (1995) defined ethnobotany is the part of ethnoecology which studies about the relationship between human and living organism not only flora and fauna, including the exploitation of land and forest. Moreover, Arthorn Riewpaiboon (1995) suggested the idea in terms of cultural and ecological dimension integrated 2 branches: botany about plant taxonomy

to study the plant evolution and to examine the plant species and anthropology about paleontology to research the plants which was useful in the past. Chonticha Tichachart (2004), moreover, proposed that ethnobotanist should have social knowledge in order to understand the different complex dynamic of each civilization; thus, ethnobotany is the study of relationship between human and plants from ancient humans using the plant benefits for surviving. Taweesak Boonkerd and Torsak Reeranoon (2002) similarly defined ethnobotany as the local plants used by ethic group in daily life were categorized by usages: herbs, food, food colorants, toxic plants and handicraft in the same way with Somsak Srisantisuk (1996) said that the study of ethnobotany was to know the linkage between local people and plant resources in terms of the use of plant advantages by trying, learning and knowledge transfer from generation to generation; likewise, Thawatchai Santisuk (2002) explained that the study of ethnobotany was the way of local people used local plants from the knowledge transferring from their ancestors and their friends till becoming the local plant identity. To study it, Arthorn Riewpaiboon (1995) grouped into 4 characteristics that is;

1. To study paleoethnobotany
2. To study herbarium search from dried plant documents
3. To study literature search such as documents of missionaries
4. To study field work through collecting the information from ethic groups

Besides, Tem Samitinun and Weerachai Na Nakhorn (2002) gathered the definition and related words such as

Ethno the inherit traditional and cultural inheritance

Botany study of plants

Traditional knowledge the knowledge transferred through tradition for a long time but unspecified

Ethnic people it covers the local groups in Thailand which have their own tradition and culture such as hill tribes and old people who have many experience and knowledge of plants used in daily life.

Folk classification means the local people classified plants from characteristic and their descendent knowledge including local name. It is not essential to accurate botany and plant taxonomy.

2.3.2 The utilization of ethnobotany

The advantage of plant classification provides various benefits to human. Tem Samitinun and Weerachai Na Nakhorn (2002) categorized plant utilization in daily life of local people into 5 facets that is;

1. Food plants means plants which human directly uses for food, processed food or being animal food. In terms of ethnobotany, Manosh Wamanong and Pennapa Subcharoen (1997) defined as the natural plants were collected for consumption. These plants can be found in forest, fields or agricultural areas emphatically collected plants from nature. Many wild plants are planted around paddy fields and around communities for daily consumption.

1.1 Plants foods for human nutrition

1.1.1 Cereal means overall gramineae that human uses for consumption. It is importance for human in daily life such as rice needed to grind to be powder or be piece. The important type is rice, oryza sative, zea mays, sorghum vulgare and coix lachrymal-jobi.

1.1.2 Vegetables are the vast groups of food for human including athyriaceae, algae, mushroom that inbreed and import from other places.

1.1.3 Fruit most of it can directly eat and is a sweet food like Bangana (Musa spp.) and mango (Mangifera indica).

1.2 Plants foods for animal nutrition has both fresh and dry such as morning glory (Ipomoea aqutica), water hyacinth (Eichornia crassipes) and rice straw (Oryza sativa)

1.3 Plants squeezed, extracted for food, food garnish and other purposes which are neither medicine nor toxic extracted plants get oil such as dipterocarpus (Dipterocarpus alatus), castor bean (ricinus communis), sesame (Sesamum indicum) and coconut (cocosnucifera)

1.4 Plant foods used as spices and garnish such as pepper (Piper nigrum), India long pepper (Piper chaba)

1.5 Beverage plants including other plants like glutinous rice, corn, millet, sugar cane and sugar

2. Habitats means processed plants for building house, residence, transportation, fence, windbreak, decoration, furniture, instrument, basketwork and weaving

2.1 Plants for building accommodation and transportation mostly is a hardwood which is strong, tolerant and easily polish such as teak (Tectona grandis), dipterocarpus (Dipterocarpus alatus), Craib (Afzelia xylocarpa) and Pterocarpus macrocarpus

2.2 Plants for making fence and windbreak such as Wrightia religiosa, Strebulus asper, and Leucaena leucocephala. Plants use for making partition and thatch such as vetiver grass (Vetiveria zizanioides) and nipah palm (Nypa fruticavs). Plants use for windbreak such as Bambusa blumeama and Thyrsostachys siamensis

2.3 Decoration plants such as orchids (Orchidaceae) and Caladium sp. Plants grown along footpath mostly are bush and flower such as white Champaka (Michelia alba), gardenia (Gardenia jasminoides) and jasmine (Jasminum sambac)

2.4 Plants for making furniture, instrument, basketwood and weaving such as Hibiscus canabinus and sugar palm (Borassus flabellifer)

2.5 Charcoal plants most trees can be firewood and charcoal but the quality is different such as Lagerstroemia spp. and Combretum quadrangulare as well as the tree is good for making charcoal such as Ceriops decandra, Rhizophora apiculate and R. mucronata

2.6 Clothes from plants for instance fiber plants like Gossypium barbadensis, Hibiscus canabinus, color of plants as Bixa orellana gives red color, Diospyros mollis gives black color and Aegle marmelos gives yellow color and plants for feeding insect

2.7 Medical plants the local people believed some plants properties for healing that directly use, mix with other plants or chemical or extract process

2.8 Plant symbol represented the belief, amulet or the symbol of wisdom and prestige

2.3.3 The importance of ethnobotany

There are various methods to study ethnobotany; for instance researching from documents or communities. The information mostly receives from gathering from traditional knowledge and being able to evaluate the community utilization of plant resource. This information causes the advantage to local community (Somsak Sukwong, 1996).

Siriwan Utta (2004) paid attention on the use of ethnobotany through sorting low quality herbs or toxic herbs. Moreover, the advantage of study ethnobotany related to ecology figured out the way of natural resource management in sustainable use by applying and developing local wisdom at risk areas. The biodiversity, furthermore, derives benefit from the study of ethnobotany as Siriwan Utta (2004) explained that to maintain the genetic diversity in form of study the use of advantage of plants from the past and the present for estimate the effect on resource extinction, natural resource degradation by human use (Tem Samitinun and Weerachai Na Nakhorn, 2002).

2.3.4 The role of farmer towards biodiversity conservation

The use of biodiversity, at the moment, gradually increases especially the part of each plant; for instance collecting bamboo shoot for selling and collecting forest products sometimes caused the environmental problem. People, additionally, get all these plants to grow around their house which called domestication is another way to conserve these plants in sustainable way and fully promotes the utilization plants as well as brings about the important economic and develops or adjusts plant species for increase the production (Pornchai Preechapanya and Chantana Suwanthada, 2007).

In several decades, many wild plants have influence on human living, not only the productivity but also wood. This product is increasingly rare due to the fact that the increased population and needs; in addition, the resource gradually decrease which is from many factors for example the technology limitation and lack of promoting information. Therefore, the local plant species are collected to systematically plant that is the key role to preserve biodiversity despite the fact that this technique develops and maintains the environmental or ecosystem condition of plant species. Food source, construct, wool (clothes) and local herbs exist in nature; for example from forest planted at orchard or rice field causing the suitable condition for utilization or harvesting the product instead of leaving it (Leaky and Simons, 1998: Midgley, 1996 referent in Pornchai Preechapanya and Chantana Suwanthada, 2007). The attempt of growing plants at the suitable human condition, including species development and plant system and management reflects human needs especially economic aspect. This principle and process called domestication or planted plants

nearby house (Pornchai Preechapanya and Chantana Suwanthada, 2007) that needs the participation of farmers and local people; for instance people have a chance to share their knowledge and wisdom in forest conservation, in the past, which was the subsistence agriculture system or descendent conservation based on belief, as well as the communities have a chance to participate in planning and working with staff or related organizations due to the fact that these people are stakeholders in use and natural resource conservation.

Chusri Trisonthi (1996) said in the botany conference that the study of plant utilization of local people is the real experience for survive. The Institute of Thai Traditional Medicine (1998) suggested that plant species used by local people interconnect every aspect: environment, social and culture particularly 4 basic needs and they truly understand the plant and vegetable nature. Tuanchai Nuchdamrong and Teerayut Sumton (2005) recommended that food and herbs from forest is vital basic of human; thus, human tries to learn and tries out to find the conservation technique and forest resource management for being source of food, medicine and equipment which is sufficiency for member and community. The knowledge of employing natural resources has descended many generations until becoming the local wisdom; nonetheless, this knowledge may be changed by time and environmental condition.

In short, ethnobotany is to study the type of plant species and classification of local plants by local technique from their experience without considering plant taxonomy or plant evolution as botanist system. The plants should be advantage for food, medicine, wool for weaving and for decoration. The study of ethnobotany is not only from local knowledge about plants through scientific name, local name, origin, advantage and disadvantage but also part of plants for usage with the purpose of environmental and biodiversity conservation and study the traditional herbal healing.

2.4 Study area

2.4.1 Background of Baan Kloi village and Baan Pong Leuk village

From the progress report number 1 of Kaeng Krachan National Park project about participation process through the presentation of department of forest resource management, World Wide Fund for Nature (2008), Baan Bang Kloi 1 and Baan Pong Leuk 2 was governed by Huay Mae Preang, Amphoe Kaeng Krachan, Pethchaburi province. These 2 villages are situated at Kaeng Krachan National Park area, protection unit of Kaeng Krachan National Park (Huai Mae Sareang).

The population of both villages is Karang people. Karang or Sarang used for calling group of people who is similar to Karen people. This word uses only at Phetchaburi province and Ratchaburi province becoming many people misunderstood that Karang people was originally from Phet headwater. In fact, Karang people called themselves as "Jakor" which Thai people pronounced as "Sakor" or "Charung" and some people called "Yankao" or "Yandoi" that mostly found in the north of Thailand down to Trat province. They preferable settle and live in the highland forest so they are very good at hunting, trail, and finding forest product. Karang people at Amphoe Kaeng Krachan have less number than Karen Pren which the majority group in the centre and even they are alike Karen and Karang people, they cannot communicate each other despite of language and different words (Department of quality control, 2003). For 100 years ago, Karang people emigrated from Tanowsri mountain range, Thailand and Union of Myanmar border, and Petchaburi province to hunt around salt lick that Karen people called "Praiprairo" before meant Phetchaburi canal where is abundant of wild animal and large area called Pong Luek. This group used to live upward Pong Luek called Huai Takraepado and Huai Pru then there was smallpox epidemic so they moved to settle down at Pok Luek area.

In 1993, the protection unit of Kaeng Krachan National Park 10 (Huai Mae Sareang) was established for initially teaching education for children in the village and was the collaboration to build temporary school building. The authority of Kaeng Krachan National Park and border patrol police division 144 administrated and were teacher.

In 1996, forest department (formerly) infantryman specific unit 19 Kaeng Krachan National Park and Phetchaburi province corporately set up educational project in order to solve the permanent headwater forest invasion of hill tribe in Kaeng Krachan National Park (sub-project). As the forest conservation project at upper La Au forest and Paneun Thung hill through Royal Initiative (little house in the big forest project) gathered the scatterable emigrative Thai Karen hill tribe along the border Thailand-Myanmar, around Baan Jai Pandin in front of Baan Pong Luek which is separated by Phetburi river, on 20-22 February 1996 was the first time and 6-20 April 1996 was the second time of relocated people altogether 57 families approximately 240 people and luggage by helicopter from infantryman specific unit 19. Moreover, 57 residences were built for the immigrant and providing 7 rai for each family and area for building house around 3 ngang (1250 sq.m.): 57 plots. The principle of land providing was the one who came first had the right to choose land and receiving the perennial seedling plant. The local people had to plant both annual crop and perennial plant. The right side of Phetchaburi River was set as Baan Bang Kloi Mu 1, Tambon Huai Mae Preng, Amphoe Kaeng Krachan, Phetchaburi province which was formerly set as Baan Pong Leuk Mu 2, Tambon Huai Mae Preng, Amphoe Kaeng Krachan, Phetchaburi province and officially opened the village on 13 May 1997.

2.4.2 Demographic characteristics

Baan Bang Kloi has 71 households (without census 10 households) and the number of population is 437 people. Each household, in average, has 6 people per household and the household which has the highest member is around 16 people per household

Baan Pong Luek has 65 household (without census 7 households) and the number of population is 345 people. Each household, in average, has 5 people per household and the household which has the highest member is around 15 people per household.

2.4.3 Economic characteristics

From the progress report of Kaeng Krachan National Park project about participation process found that the main occupation is agriculture. The 5 major plants

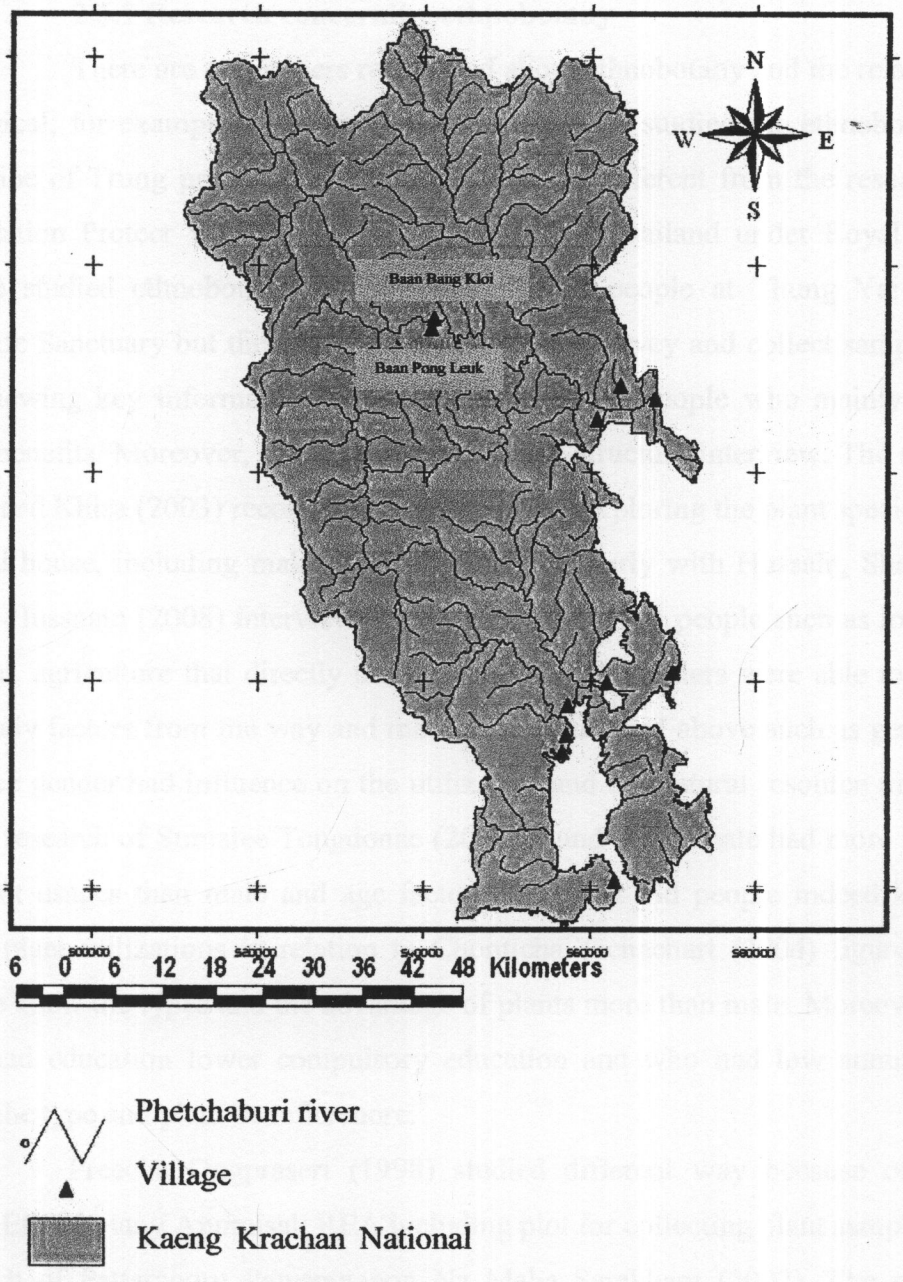
are rice, Banana, chili, tomato and kapok, respectively. The local people do integrated farming system and shifting agriculture and the livestock characteristic is household livestock such as chicken, pig, duck and fish.

The average income per household is 30,000 Bath/ year/ household and they require the person who is able to suggest about agricultural promotion, weaving, knitting, fertilizer, mechanism, jewelry, construction, livestock and hygienic.

2.4.4 Social characteristics, belief, value and way of life

The person whom people highly respects is His Majesty King Bhumibol Adulyadej and member of royal families; in addition, Mr. Krathong JeeBangg, parent of Mr. Roi JeeBangg, Mr. Niran Pongthep and monk are the persons whom people respect. Most of Karang people are Buddhism and their tradition is to make offering to the. ancestors, spirits or prediction which is mostly related to agricultural ritual, wedding and important day. Both male and female like to eat betal nut and to smoke tobacco (Lersakn Prachuabaree, 2008).

Figure 2.1 Map of study area in Kaeng Krachan National Park



2.5 Related researches

2.5.1 Research concerning ethnobotany

There are researchers researched about ethnobotany and the relationship of biological; for example Katesarin Maneenoon (2002) studied the ethnobotany of Sa Kai tribe of Trung province and Yala province is different from the research of the Foundation Protect Wildlife and Plant Species of Thailand under Royal Patronage (1998) studied ethnobotany knowledge of Karen people at Thung Yai NareSuan Wildlife Sanctuary but these 2 researches did both survey and collect sample through interviewing key informants that was tribes or local people who mainly employed plant benefits. Moreover, this research used semi-structure interview. The research of Alam and Khisa (2003) recorded the plant species, exploring the plant species growing around house, including making documentary similarly with Hussain, Shahazad and Zia-ul-Hussnain (2008) interviewed from knowledgeable people such as local doctor, women, agriculture that directly used plants. The researchers were able to determine the study factors from the way and method as mentioned above such as gender factor because gender had influence on the utilization and the natural resource management as the research of Sumalee Tongdonae (2003) found that female had more knowledge of plant usages than male and age factor found that old people indeed knew more about plant utilizations in relation to Chonticha Tichachart (2004) figured out that female knew the types and the advantage of plants more than male. Moreover, people, who had education lower compulsory education and who had low annual income, knew the type and plant benefits more.

Preecha Ongprasert (1998) studied different way because of applying Rapid Ethnobotany Appraisal: REA including plot for collecting plant samples like the research of Pattaraporn Pawaputanon Na Maha Sarakham (2002). The research of ethnobotany mostly studied about the characteristics of plant usage in various aspects such as plant foods, herbs, plants for making furniture, wood for construction, charcoal, and plants for ritual. Moreover, some plants have various advantages. Aroon Thaewchatturat (2000) and Siriwan Suksri (2003) found that the most benefits of plants to human was food, the second was herbal medicine and wood was for

construction; conversely, Siriwan Utta (2004) found that the most plant usage was construction, herbs and food, respectively.

2.5.2 Research concerning biodiversity in homegarden

There are the researchers studied the ecosystem management techniques for agriculture at home; for example Millat (2003) employed the semi-structure questionnaire with agriculture group to collect the information about the source, the plant origin planted around residence such as cutting, seeding, species selection criteria and other techniques such as.weeding, lopping, pruning, pollarding, manuring, and watering. Therefore, the researcher acquired that the area had association with household status. Rich household had more land tenure than poor household; therefore, the plants, both perennial plants, food plants, usable wood, and decoration wood, grown around their houses were also different. Female, furthermore, had responsibility to look after the garden because the female of Marma tribe, Bangladesh, had to take care of house, children and garden.

As the information above, the researcher applied the land tenure and gender factors into the research. This research also focused on the local management by planting cover crops and manuring which do not only increase the soil nutrition but also do prevent soil erosion especially around river Bangk. These techniques are in line with Belachew (2002) studied the advantage of garden at Daniio Gade in the south of Ethiopia by research and gathering plant species altogether with plant management at the garden around residence through note down the plant name, cultural method, part of plants for cultivation and utilization. Participatory Rural Appraisal: PRA and semi-structured interview were employed to evaluate the community condition. The information, in addition, obtained from telling, local song or utilization and plant management documented by local people

2.5.3 Research concerning the study area

For the study of ethnobotany of Karang people, there was research like Lersakn Prachuabaree (2008) studied the local herbs of Karang people, Baan Pong Luek, Amphoe Kaeng Krachan, Phetchaburi province. The objective of this study was to examine the local herbs and the knowledge of Karang people about using herbs.

The researcher interviewed knowledgeable people with experiences in using herbs, including collecting herbal samples to identify the plant species through taxonomy. As a result, Karang people used herbs for both human and animals and the usage classification as medicine, food, toxic plants in the same way with Oratai Neamsuvan (2003) used the questionnaire which asked about the useful of plants, usable way, Karang name and collecting sample for analyzing scientific name but this research added the Karang culture related to plant.

From study these researches, this secondary data about population and environment and herbal types of Karang people at study area was applied. Moreover, the research techniques were adapted for collecting primary data such as questionnaire and collecting dried plant sample for analyzing.

The study of ethnobotany mostly gathered data via questionnaire which is the tool of qualitative research through collecting the information from key informants such as community leader, teachers, old people or local people directly used of plants and surveying sample plots to collect plant species sample in order to categorize the advantage of plants for daily use such as food plants, herbal plants, plant utilization, plant construction, clothes and decoration together with plants used for ritual. These plants have various properties and are used in various aspects. The utilized botany of local people does not focus on only benefit but derives from observation, trial, and experiences from many generations becoming knowledge or local wisdom. Not only do use the questionnaire but also do analyze plant structure, such as plant frequency, plant density, plant dominant, important value index: IVI, and species diversity index. These methods are the procedure to evaluate effect from local used plants. Therefore, the study of ethnobotany is to examine the development and to amplify plant diversity as well as to sustainingly use and to conserve plants.

2.6 Research concerning variables under study

To study the influent factor on household and community decision in terms of plant utilization, the research determined factors and examined the

relationship of each factors to the plant diversity, which is collected by Karang people to plant around their area. The factors are composed as follows;

Individual factor

1. Gender

Patimaporn Phongsuksawat (2003) studied about the local participation in forest resource conservation and dependent community forest found that the difference of gender had connection with the forest resource conservation which means that male was more participation in forest conservation than female but for the management and decision making of plant selection, there is the research of Trinh et al (2003) considered the diversity conservation around residence at Vietnam found that the decision between male and female about planting was different. Male considered the industrial crop like rice, fruit and wood for constructing or for making furniture but female concerned to plant food plants. For the dependent community forest, Patimaporn Phongsuksawat (2003) found that gender connected to the dependency on community forest especially male highly depended on community forest than female because male, in fact, has more chance than female to access the forest product. Sompol Semsawat (2005) and Wisetsak Tongpradith (2000) studied that gender had different effect on dependent forest product. Male greatly depended on forest resource than female due to the fact that male is the leader of family and has to work outside or non-hunting area so they highly depend on forest resource than female. On the other hand, Chonticha Tichachart (2004) and Sumalee Tongdonae (2003) examined that female was more knowledgeable plant species and utilization than male.

Therefore, gender factor has effect on the conservation and the forest product utilization. Thus, the hypothesis of this research about gender is that the different gender influences on plant diversity planted by Karang people by male more cultivates wild plant and depends on forest product than female but knows about plant types and the utilization less than female.

2. Age

Sompol Semsawat (2005) researched the forest resource dependent of local people at non-hunting area of Somdet Phra Srinakarin Park, Kanchanaburi province found that the difference of age effected on their dependence on forest resource in different way. The old people depended on forest resource more because

old people in this case reflected on working age and having experience and recognizable forest area more than young people so that they highly depended on forest resource more; similarly with, Attapol Chariyapongphan (1999) studied the community depended on forest resource at Khao Ang Rue Wildlife Sanctuary found that the difference of age depended on forest product, particularly bamboo shoot, due to the fact that old people relied on bamboo shoot more; as well as, the research of Siriwan Utta (2004) researched the ethnobotany at Baan Don Pu Ta figured out the old people had more knowledge of plant resource use in order that the old people had many experiences and were necessary to use of plant resource in daily life more than young people who knew the processed food fruit or made toys more; for instance eating the ripe Annonaceaea as fruit and using Rhamnaceae as a catapult ball. People know more the useable way of plant resource such as food, herbs, construction, and creating appliance. In addition, Chonticha Tichachart (2004), Juthamanee Sangsawang (2000) and Sumalee Tongdonae (2003) found that the old people have more knowledge of plants and the usage than young people.

As many researches mentioned, the age is another factor of dependence on forest resource; therefore, the hypothesis is the difference of age has effect on wild plant species diversity which is collected by Karang people to plant around their area by old people have more collecting plants for cultivation and dependence on forest resource than young people.

3. Level of education

The research of Patimaporn Phongsuksawat (2003) was related to the local participation in forest conservation and community dependency on forest resource found that the difference of level of education effected on forest conservation. High level of education highly participated in forest resource conservation more than low level of education and for community dependency on forest resource, Patimaporn Phongsuksawat (2003) also mentioned that the level of education had the linkage with dependence on forest community which means that the people who had high level of education less dependent forest resource. It can be analyzed that the low level education less understood of conservation and unwell household economic condition so they highly relied on forest resource; likewise, Attapol Chariyapongphan (1999), Bunnaruk Shamethong (2000) and Juthamanee Sangsawang (2000) considered that the

different level of education brought out the dependence on different forest resource and vegetable. The low level of education more depended on wild vegetable despite the fact that the people who had low education had small land and low income; thus, they had to collect the forest product for their consumption. Udompian Wongchai (2004) added that these group mostly was farmer that greatly relied on forest resource; conversely, for the use of plant species, Chonticha Tichachart (2004) studied the ethnobotany of Mon hill tribe acquired that people who had low education deeply knew the use of plant species; as well as, Siriwan Utta (2004) studied the ethnobotany of Don Pu Ta found that the illiterate or low education people were more knowledgeable usage of plant resource than people with high education because most of high education people were new generation and prefered to go to modern medicine so the value of transferring knowledge in terms of plant utilization was lower than illiterate and low education people.

The difference of education level effects on the conservation, dependence and utilization of plants in various ways. Hence, the educational factor is also important to study plant species diversity. The hypothesis for the level of education is the difference of education level has an influence on the diversity of plant species collected by Karang people to plant at their area. Low educational level people highly collect the wild plants to cultivate at their areas and have the knowledge of plant usages more than high educational people.

Socio-economic factor

1. The household member

Patimaporn Phongsuksawat (2003) studied the local participation in forest conservation and community dependency on community forest found that the household member had relation to the dependent community forest. The household with fewer members, depended on forest resource within small amount but the household with many members had more chance to exploit forest resource for their consumption alike Sompol Semsawat (2005), Theerawut Kvansombut (2005) and Wisetsak Tongpradith (2000) said that many household members were necessary to use a large amount of resource; as a result, there are high dependency of many household members. Moreover, Attapol Chariyapongphan (1999) examined the

dependent forest product of people lived around Khao Ang Lo Wildlife Sanctuary figured out that the different of household member had an effect on the dependency of wild fruits and wild mushroom. The household with many members greatly relied on wild fruit and wild.

From this information, the exploitation of natural resource gradually increases due to the increased population. Therefore, another factor of plant diversity is the household number in utilization of natural resource which has influence on plant diversity. The researcher set up the hypothesis as the difference of household member effects on the plant diversity collected by Karang people to plant around their areas by many household members collect more plants to cultivate in the areas.

2. Main occupation

Sompol Semsawat (2005) studied the dependency of local people at Somdet Phra Srinakarin Wildlife Sanctuary, Karnchanaburi province on forest resource found that the different occupation affected on forest dependence, particularly the farmers, due to the fact that they converted forest areas to do agriculture and employed forest resource such as bamboo as tool for agriculture so that people, who had main occupation is agriculture, greatly relied on forest resource more than other occupations. Udompian Wongchai (2004) said that person whose main occupation was agriculture relied on the forest resource more than other occupations which were not related to agriculture. Due to the fact that the agriculture more depended on both forest areas and forest resource than the others as well as Kasinaj Limsawasdi (2000) also studied the participation of local people in forest conservation and dependency of community forest found that the different occupation had an effect on dependent forest product. For the use of plants, Chonticha Tichachart (2004) studied the ethnobotany of Thai Mon hill tribe found that the agriculture had more knowledge about the use of plant benefits.

As many researches mentioned above, the different main occupation had different effect on natural resource especially the agriculture mainly relied on forest resource. Therefore, the researcher set up the hypothesis as the different of main occupation has effect on wild plant diversity collected by Karang people to cultivate in various ways. People, whose main occupation is agriculture, plant wild plant in their areas more than other occupation.

3. Minor occupation

Theerawut Kvansombut (2005) studied the factor linked to the dependent forest resource found that people who had different minor occupation would have different use of forest resource because people whose minor occupation was agriculture, cultivation, livestock and worker. All these occupations relied on forest area for their living. Thus, people whose minor occupation was related to these fields depended on forest resource more than other occupations.

The research set the assumption as the different minor occupation has influence on wild plant diversity collected and planted by Karang people in different ways especially people whose minor occupation is agriculture plant wild plants around their areas more than other occupations.

4. Household income

The research of Patimaporn Phongsuksawat (2003) linked to the local participation in forest conservation and dependency on community forest found that the income had influenced on dependent forest resource. People with high income less relied on forest resource but people with low income more depended on forest resource because they could collect forest product for their consumption to reduce their expense similarly with Songpol Khanmuang (2007) examined the dependency of local people at Pa Wang Pleun-Muan Khom- Lam Narai National Park found that the household income had relationship with the dependent forest resource. The sample included both people with low income and people with high income. Their dependence was different particularly with people with low income more dependency on forest resource. Moreover, the household which had low income highly relied on forest products in order to decrease their household expense; for instance the research of Attapol Chariyapongphan (1999), Juthamanee Sangsawang (2000), Kasinaj Limsawasdi (2000) and Udompian Wongchai (2004) explained that the reason that people with high income concerned more about conservation was they have an alternative resource and it was unnecessary for them to collect the forest product. For the agricultural system, Sadudee Punpugdee (2003) studied the comparison of socio economic characteristic and the dependent forest conservation area of the community who did agroforestry and the community did monoculture at the Khao Ang Lo Wildlife Sanctuary found that the community did agroforestry had lower income than

the community did monoculture because of the soil adaptation to be suitable with the agricultural activities so the quality and production are lower than monoculture. (24) studied the ethnobotany of Thai Mon hill tribe found that the household with lower income had more knowledge about plant types and usage.

Therefore, the household income is also one of the factors of dependent forest resource. The household with low income is more dependence and more knowledge of plants including the utilization than household with high income. Thus, the researcher set up the hypothesis as the different household income influences on the wild plant diversity planted by Karang people. The household with low income collects more wild plants to cultivate at their areas and more knowledgeable of using plant than the household with high income.

5. Household expense

Sura Sastar (2000) studied the dependent forest resource of people living around the line of Huai Kha Khaeng Wildlife Sanctuary found that the difference of household expense effected on the dependent forest resource in different way. It is noticeable that the household with high expense less depended than the household with low income because the household with low income collected the forest products for their consumption to reduce their expense. Sadudee Punpugdee (2003) also studied the comparison about socio-economic characteristic and the dependent forest conservation area of community did agroforestry with the community did monoculture at Khao Ang Lo Wildlife Sanctuary found that the expense of farmers who did agroforestry less than the people who did monoculture because agroforestry was household consumption; thus, the expense for buying fertilizer or pesticide was less than the expense of people who did monoculture.

The difference of household expense affected on dependence on forest resource. The researcher set the assumption as the difference of household expense effects on the wild plant diversity collected by Karang people. The household with low expense collects more wild plants to cultivate in their area than household with high expense.

6. Household dept

Sadudee Punpugdee (2003) the comparison about socio-economic characteristic and the dependent forest conservation area of community did

agroforestry with the community did monoculture at Khao Ang Lo Wildlife Sanctuary found that the household with dept differently affected on dependent forest areas in particular the farmers who did the monoculture had more depth than doing agroforestry because the farmer, who did the monoculture, mainly focused on the productivity for making profit so they risked to lose money despite of market fluctuations. Moreover, depth is also the issue that makes people does monoculture; consequently, the increasing of dependent forest resource also rose. The researcher noticed that the difference of depth condition has influence on wild plant diversity planted by Karang people. The household with low depth plants wild plants in their area more than household with low income.

7. Land tenure

Attapol Chariyapongphan (1999) studied the forest resource of community around Khoa Ang Lo Wildlife Sanctuary found that the difference of land tenure relied on wild fruit and wild bamboo shoot The household with few land tenure depended on the wild fruit and wild bamboo more than household with many land tenure. Bunnaruk Shamethong (2000) studied the socio-economic factor had effected on dependent forest product and natural resource conservation participation expressed that household with less area more relied on the forest product than the household with big area; additionally, Sura Sastar (2000) explained that the difference of land tenure size differently influenced on the forest resource because the household with large area mostly spent time on cultivation so they did not have much time to harvest forest products. Moreover, they had the income from selling their products as a result they less depended on forest resource than the household with small land tenure which is similar idea with Udompian Wongchai (2004) and Wisetsak Tongpradith (2000) figured out that the household with less land tenure more relied on forest resource. There is the research about Agrobiodiversity conservation and development in Vietnamese home garden by Trinh comparing the number of plant species which was planted in the north area with in the south area of Vietnam found that the area influenced on the number of plant species which means that the big area is abundant plant species.

In summarized, land tenure links with the diversity and dependency of forest resource. Therefore, the researcher determined the hypothesis as the difference

of land tenure influences on the plant diversity which is planted by Karang people. The household with many land tenure collects more wild plants to cultivate in their areas than the household with less land tenure.

8. Source of collecting plants

unun Arunnopparat (2000) studied the socio-economic condition and the dependent community forest of the rehabilitation Kwai Rabom Si Yat national reserved forest project found that the sample group mostly used the old plant collection. Next, the local people bought the seed from the shop or from the distribution by government and from cousin, respectively.

In short, the agriculture has different source of species to cultivate causes the various plant species that is mostly from the plant collection in order to decrease the expense from buying seed; at the same time, keeping plant species is another way of species conservation. Hence, the researcher set up the assumption as the different source of plat seed impacts on the wild plant diversity planted by Karang people. The household that stores seeds plants these seeds at their area more than getting seeds from other sources.

9. The distance from dwelling to forest areas

Theerawut Kvansombut (2005) studied the factor linked the dependency of forest resource found that the distant from residence to the forest had different influence towards the dependent forest product. The people who lived nearby forest more relied on the forest resource than people who lived further due to the fact that the household nearby forest easily accessed and used the forest resource. Therefore, the household closed to the forest had more chance to rely on forest resource.

The researcher noticed that the distant from residence to forest area impacted on the dependent forest resource; thus, the hypothesis is the difference of household distance influences on the plant diversity planted by Karang people. The household closed to the forest more collects plant species to cultivate in their area than the household which is far from the forest.

10. Village

Sura Sastar (2000) studied the dependency of local people around Huai Kra Khaeng wildlife sanctuary found that the period of staying influenced on the dependent forest resource in various ways. The researchers analyzed and explained

that the household, settled down for a long period, significantly cherished their forest resource so they less depended on forest resource than the household just resided in line with Juthamanee Sangsawang (2000) studied the factor impacted on the natural resource use behavior of Pa Pru To Daeng found that the household stayed for a long time utilized the natural resource at Pa Pru To Daeng more sustainability according with the different staying period carried out the plant diversity. The hypothesis for this factor is the different time of settlement has an impact on the plant diversity planted by Karang people. The household staying for a long period collect more wild plant to cultivate in their area than the household just settlement.

As from the researches above, the researcher set the hypothesis as the different belief/ religion rituals has an influence on plant diversity which Karang people collect to cultivate especially Karang people, believed in evil spirit, collects more plant to cultivate in their area than other religions because descendent believe in evil spirit is consistent with the plant utilization more than the household believed in other religion.

CHAPTER III
RESEARCH METHODOLOGY

The case study of Karang tribe at Kaeng Krachan National Park showed the study of plant species diversity utilization and conservation which could be categorized into 2 aspects: [1] the quantitative research using questionnaire and species list including interview and [2] the qualitative research through employing in-depth interview as a tool for gathering information. The important research process was as followed:

3.1 Quantitative research

3.1.1 Population sample

The population under study is households in Baan Pong Leuk (65 households) and in Baan Bang Kloi (71 households) (World Wide Fund for Nature, 2008) at Kaeng Krachan National Park, Tambon Huay Mae Preag, Amphoe Kaeng Krachan, Phetchaburi province. Heads of households are representatives to provide data regarding their decision making in practicing homestead agroforest. The study employed census study despite the fact that the village has small amount of households and this study needs to compare 2 villages; hence, the researcher collected data in every household.

3.1.2 The instrument for quantitative research

The tool for this research, namely the questionnaire and species list, to cover all the scope of study was as followed:

Questionnaire was divided into 3 parts:

Part 1 the heads of household's data such as gender, age and level of education

Part 2 the socio-economic factors such as the number of household workers, the main and minor occupation of household heads, household income, household expense, dept, source of collecting plants and the distance from households to forest

Part 3 the community factor, which is village different in terms of settlement time of the communities and settlement characteristic

Species list

For plant species diversity, the researcher used botanical table and species list in order to note the plant name both in Thai and Karang language including the plant usage including advantage of plant part, properties together with taking a photo for analysis.

Similarity index compared the similarity of these 2 villages through studying the number of plant species in each village; moreover, it was able to compare the similarity within village but different time (Chaweewan Hutacharoen et al, 2004). This research studied the similarity of plant species between these 2 villages by Jaccard's similarity index which had the equation as following:

$$S=2C/(A+B)$$

When S = similarity index

A = the number of plant was found around A

B = the number of plant was found around B

C = the number of plant was found in both A and B (intersect)

The calculated value was between 0-1 and could explain the tendency of similarity value as

The value of almost 1 meant that the plant similarity was high.

The value of equal 1 meant that the plant species of 2 areas was the same.

The value of almost 0 meant the plant similarity was low.

3.1.3 Variable measurement

1. Independent variables were classified into 2 parts:

Part 1 Ratio scale, such as age and level of education, household member, household income, household expense, household dept, distance from dwelling to forest areas, and village (difference in terms of settlement duration the settlement characteristic of both villages)

Part 2 Nominal scale, such as sex, main occupation, minor occupation and sources of collecting plant species

2. Dependent variables of this study measured by ratio scale were consisted of:

The number of wild plant species (species richness) indicated the number of each wild plant species collected by Karang people to plant in their areas. But the number of species grown did not mean that areas were planted with species diversity because growing one plant species just increased the number of that plant species rather than increased the number of plant diversity. The significance of increasing was number of plant species.

The proportion of number of wild plant species to crop plant species implied the comparative amount of wild plant species versus crop plant species because some households collected more wild plants to grow in their homestead agroforests than crop plant but some households grew wild plant less than crop plants; therefore, it indicated the diversity between wild plants and crop plants which was explained as followed

(1) The value of less than 1 means that the number of wild plant species is less than the number of crop plant species.

(2) The value of 1 means that the number of wild plant species is equal the number of crop plant species.

(3) The value of more than 1 means that the number of wild plant species is more than the number of crop plant species.

The plant diversity index examined the plant species diversity between the number of individuals of each plant species and the number of total individuals of all plant species, which were grown. The total plant species diversity of Karang people planted around their house was calculated by Shannon – Wiener Index (H)

$$\mathbf{H = -\sum (Pi)(lnPi)}$$

When H = the plant diversity index

Pi = the fraction of individuals belonging to the i-th species

ni = the numbers of individuals in the i-th species

N = the total of overall individuals of all plant species

The plant community in tropical zone, in general, was between 1.5 and 3.5 Dachanee Emphandhu (2005). If the plant species diversity index is lowers than 1.5, it is considered that the plant community is impacted and it is necessary to conserve and rehabilitate.

3.1.4 The internal and external factors correlating with different types of plant diversity

Table 3-1 describes the household characteristics which are independent variables (external and internal factors of households) and three dependent variables in the study. They were categorized as follows:

Table 3.1 External and internal variables and expected relationships with three dependent variables

Variable types	Unit of measurement	Scale of measurement
Dependent variables		
Species richness	Number of plant species	Ratio
The proportion of number wild plant species to number of crop plant species		Ratio
Diversity index of plant species		Ratio
Independent variables		
Head of household factors		
Gender	Male=1 Female=0	Nominal
Age	Years	Ratio
Level of education	Years	Ratio
Socio-economic factors		
- household member	Number	Ratio
- main occupation		Nominal
- minor occupation		Nominal
- household income	Baht	Ratio
- household expense	Baht	Ratio
-debt	Baht	Ratio
- source of collecting plants		Nominal
- distance from dwelling to forest areas	Meter	Ratio
Community factor		
- *Village (difference in terms of the* settlement duration and the settlement characteristic)	*Bang Kloi = 0* Pong Leuk = 1	*Nominal*

3.2 Qualitative research

To collect all information, this research used in-depth questioning for interviewing the key informants. The target was divided into 2 groups such as the key informants from both Baan Pong Leuk and Baan Bang Kloi and the officers or national park staffs as shown in table 3-2

Table 3.2 the target group and key informants for in-depth interview

Target group	Key informants	Numbers (person)
The key informants from both Baan Pong Leuk and Baan Bang Kloi	1. Head of village from both villages	2
	2. Medicine man	2
The key informants from the national park staffs/ officers	1. Staff of Protection Unit Kaeng Krachan10 (Huai Mae Sa Reang)	1
	2. Staff of Protection Unit studying local herbs	1
	3. Border Petrol Police Unit 14	1
Total		**7**

Tools of qualitative research

In-depth interview applied for collecting information from 2 groups of key informants, such as key informants from Baan Pong Leuk and Baan Bang Kloi to provide local knowledge base management information about the utilization and diversity of wild plant species conservation and the officers/ national park staffs key informants to get the information about organization role/ national park management and conserved wild plant species diversity promotion as well as the role of Karang people towards the wild plant conservation. The guideline question and study points were as followed:

1. Key informants from Baan Pong Leuk and Baan Bang Kloi

1.1 Knowledge base, local wisdom, belief, technique and methods in terms of utilization and conservation of plant species diversity

1.2 Transferring knowledge from generation to generation

1.3Social mechanism (culture, belief and ritual) towards wild plant conservation

2. Officers/ national park staffs key informants

2.1 Roles of organization/ national park related to management and conserved wild plant diversity promotion

2.2 The factors supported Karang people to collect plant and to grow around their areas

2.3 The participation idea in terms of conserving wild plant species diversity of Karang people

3.3 Monitoring tool quality

To find the validity, the researcher consulted thesis committees in order to examine the context and wording as well as to ask for the recommendations for developing the questionnaire.

3.4 Data collection

The process of collecting data as followed:

3.4.1 Secondary data: the researcher reviewed documents, related researches and many theories including contact and asking the general information from Kaeng Krachan National Park, Department of National Park, Wildlife and Plant Conservation, Forest Resource Management, World Wildlife Fund Thailand, Specific Unit of Phaya Suan Army, 9th Field Artillery Regiment and Baan Pong Leuk Border Petrol Police School.

3.4.2 Primary data: the researcher collected data using questionnaire. The researcher interviewed each head of village from 2 villages as well as the in-depth interview was employed with the key informants. Wild plant species grown by Karang people around their dwelling, additionally, were examined through species list.

3.5 Data analysis was divided into 3 parts as followed:

3.5.1 Community context analysis: the researcher studied the history, socio-economic condition, culture, tradition, belief, politic together with the roles and responsibilities of organizations in terms of social structure towards forest resource management.

3.5.2 Knowledge base and wild plant species utilization of Karang people analysis: the plant was analyzed by categorized type, family and nature of plant species which referenced in Thai Plant Name by Tem Smitinand, 2001 as well as in the plant species examination report from Kaeng Krachan National Park's staffs. Furthermore, the descriptive analysis, such as percentage, mean, standard deviation, minimum and maximum, was applied for analyzing data.

3.5.3 To analyze the factors related to the diversity of wild plant species grown by Karang people

After checking all information from the questionnaire, the researcher verified the data by coding and using SPSS for Windows. The multiple regression was used to analyze the relationship between 1 dependent variable and multiple independent variables (more than 2 variables) at the significance level of 0.05. The independent variables were consisted of head of household factors, for instance, gender, age, and level of education; socio-economic factors, such as number of household worker, main occupation and minor occupation of household heads, household income, household expense, household dept condition, source of cultivated plants and distance from residence to forest; and community factors, such as villages which are different in terms of settlement duration and settlement characteristic. The multiple regression analysis was conducted to test the relationship of the independent and dependent variables, namely species richness, the proportion of wild plant species and crop plant species, and plant species diversity index.

CHAPTER IV
RESULT: COMMUNITY CONTEXT OF BAAN BANG KLOI AND BAAN PONG LEUK

The study of Utilization and Conservation of Wild Plant Diversity: A Case Study of Two Karang Villages in Kaeng Krachang National Park, of which this chapter provided the background of Karang people, including history, settlement, population, economic condition, social, tradition, belief, politic, role and responsibility of organization which was categorized into 9 parts as follows:

4.1 Background of Karang communities at Baan Bang Kloi and Baan Pong Leuk

"Karang" is the name some called Karen hill tribe at the central region around Petchaburi, Prachuapkhirikhan, Ratchaburi, Kanchanaburi provinces which have a little difference of costume and language from the Karen tribe in the north (Lersakn Prachuabaree, 2008 referred in the office of Secretary of the National Psychological Operation Committee 1975); additionally, Karang tribe has own unique tradition. Their settlement more than 100-200 years ago scattered and mostly lived nearby river basin around Tanowsri Mountain which is the border of Thailand and Myanmar. Afterward, they resettled in Marin province of Myanmar and Petchaburi province in Thailand for hunting at Din Pong before called "Prai Prai Lo" means Petchaburi River have abundant of wild animals and large area called "Pong Leuk". This tribe, originally, lived upper Pong Leuk called Huay Ta klae Pa du, Huay Ta Klae Po and Huay Pru. Then, there was epidemic caused displace to Pong Leuk which settled the village before 1935. The Chief of village was the oldest person who was accepted the most from people in the village and belonged to Amphoe Tha Yang until the government declared that this area was belonged to Kaeng Krachang National Park on January 9, 1981 therefore Pong Leuk village was held in national park area. The

local people initiated to provide education to the children in the village in 1993-1994 and collaborated to build temporary school building and Samnuan Chareunsuk was the mainstay for operation and the teachers as well, including the teachers from general staff of Border Patrol Police Division 14. Moreover, the staffs from Kaeng Krachang National Park helped the local people to build temporary school building 1 more building (4 classrooms) in order to support the increased numbers of student; meanwhile, 2 staffs of Kaeng Krachang National Park worked as National Guard Units KK 10 (Huai Mae Sa Reang) were sent to teach. Mr. Samnuan Chareunsuk, furthermore, worked as a teacher at Kaeng Krachang National Park.

In 1996, Department of Forestry (formerly), Department of Infantry Specific Units 29, Kaeng Krachang National Park and Petchaburi province set up the educational project for solving the permanent trespass of headwater forest problem from hill tribe at Kaeng Krachang National Park (sub-project) followed conserved forest project at upper La Au forest and Paneun Thung hill through Royal Initiative (little house in the big forest project) by gathering the scatterable emigrative Thai Kareng hill tribe along the border of Thailand-Myanmar around Baan Jai Pandin, Baan Bang Kloi (upper Bang Kloi) to Bang Pong Leuk located on the left side of Petchaburi River. Moreover, this project provided land for emigrative Karang people. Each household received 7 rai for constructing their house around 3 ngan (1,250 sq.m.) 57 plots. The principle of land providing was the one who came first had the right to choose land and received 7 perennial seedling plant species: coconut, jack fruit, stink bean, mango, santol and bamboo altogether 14,610 perennial seedling. However the Karang people have to do integrated farming (Kaeng Krachang National Park, 2007). There was officially set up the village at Baan Bang Kloi mu 1 and Baan Pong Leuk mu 2 in 1997 under administration of Huai Mae Preang, Amphoe Kaeng Krachang, Petchaburi province.

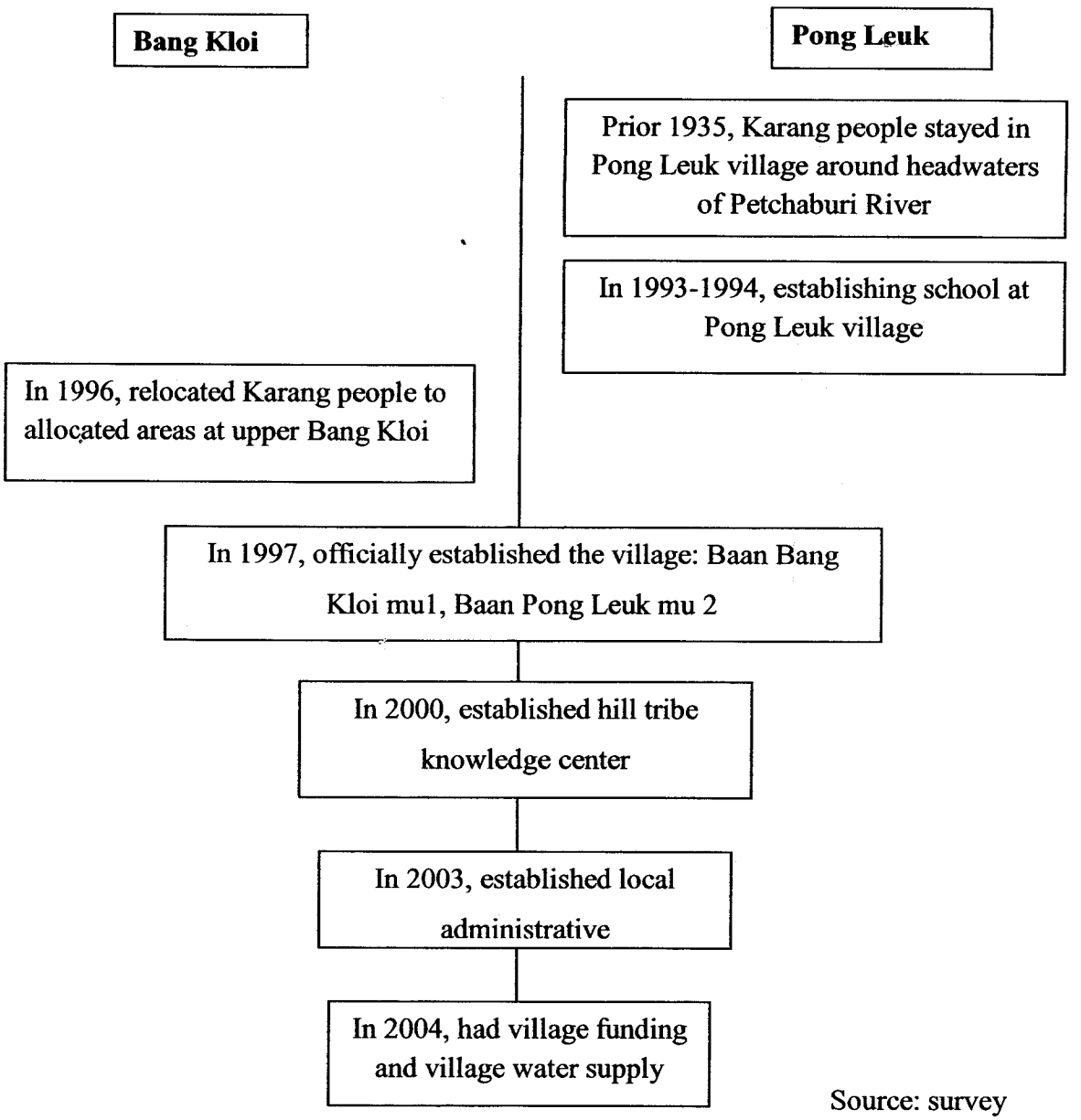
Her Majesty Queen Sirikit ordered 1st Army and the provincial governor of Petchaburi province to be the HRH Queen Sirikit representative in order to grant the royal items and money 500,000 Baht for establishing rice Bangk, fishery and promoting job at Baan Pong Leuk on June 28, 1997. In the same year, Cholera plagued both villages despite of no toilet and unwell sanitation; thus, the public health supported by providing toilet and hygiene knowledge. The local people, however, did

not pay attention to this much due to the fact that building toilet need money to buy equipments, it is difficult for transportation and they are familiar with going to forest rather than to toilet.

Deputy provincial governor of Petchaburi province was represented of provincial governor on July 5, 2000 establishment the hill tribe knowledge center "Mae Pha Luang". The local administration was established the following year by 2 representatives of each village being member and there was SML and village fund, in 2004, at the village including the village water supply system supported by Specific Unit of Phraya Suan Army.

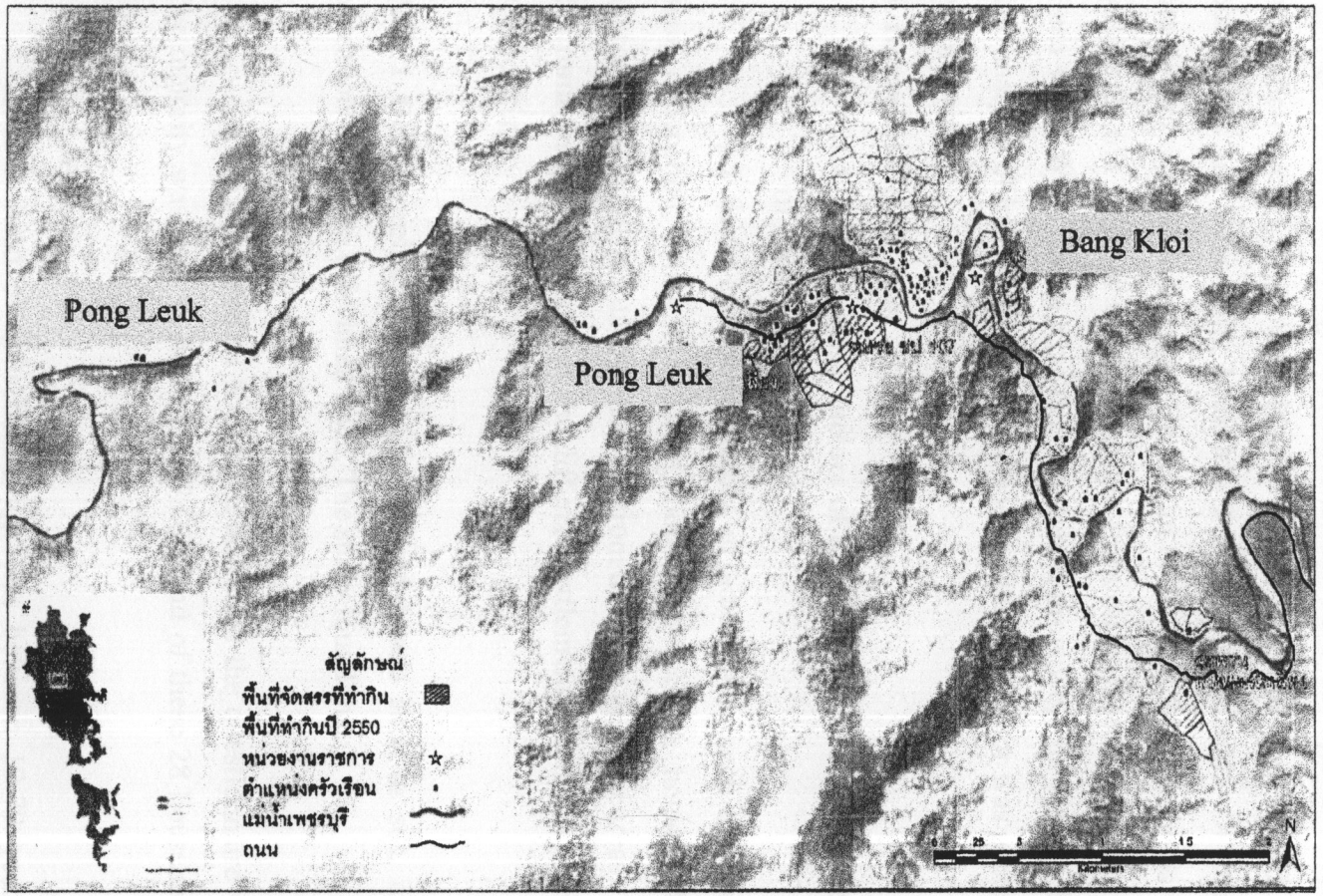
In short, the duration of settlement of these 2 villages was different. The Karang people at Baan Pong Leuk stayed from their origin and their settlement was scattered along the village road. The houses including pillar and floor were built by wood and rose up. On the other hand, the Karang people at Baan Bang Kloi emigrated from upper Bang Kloi in 1996. The government allocated the land. The houses were built by bamboo and lined in the same area; moreover, the floors were rose up. Both villages had the small garden around their house for household consumption and around their land. The Karang people from Baan Pong Leuk have their land nearby or same area of their residence; conversely, the land of Karang people from Baan Bang Kloi. The nearest land of Karang people from Baan Bang Kloi was around 2 km. from the village. (Figure 4-2)

Figure 4.1 Time line of community settlement



Source: survey

Figure 4.2 Map of land use of Baan Bang Kloi and Baan Pong Leuk



Source: World Wide Fund for Nature, 2008

4.2 Household demographic, economic and social characteristics

The study of utilization and wild plant species diversity a case study two Karang villages in Kaeng Krachan National Park through interviewing the sample population overall 106 households was categorized into Baan Bang Kloi Mu 1 was 52 households and Baan Pong Leuk Mu 2 was 54 households. Of these 72 household mostly immigrated from upper Baan Kloi 67.9% and 24 households were born at the village 22.6% together with emigration from other places 10 households 9.5% from Baan Wang Won, Kaeng Krachan, Ratchaburi province, Pha Teng and Pha Laau.

The analysis of individual factor and socio-economic factor was presented into 3 parts as following

1. Household level factor

1.1 Demographic factors of household heads such as sex, age and level of education

1.2 Socio-economic factors of households such as household member, main occupation, minor occupation, household income, household expense, debt, source of collecting plants and distance from dwelling to forest areas.

2. Community level factor is the different settlement duration and village settlement characteristic

Part 1 Demographic factors of household heads such as sex, age and level of education which are individual level. The study found that:

Sex

The total head of household answered the questionnaire was 106 people. The majority was men 78 households73.6% and of these 28 households were female 26.4%.

Age

The head of household's age was between 19-79 years old. The age average was 43.43 years old. The rank from 31-42 years old was 34 households 32.1%; the rank from 43-54 years old was 29 households 27.4%; the rank from 19-30 years old was 22 households 20.8%; the rank from 55-66 years old was 15 households 14.2%; and the age from 67 years old up was 6 households 5.7%, respectively.

Level of education

The level of education of household head mostly was illiterate 80 households (75.5%); 11 households graduated high school (10.4%); 7 households graduated grade 4 (6.6%); 4 households graduated grade 9 (3.8%); 3 households graduated grade 6 (2.8%) and 1 household graduated grade 3 (0.9%) respectively.

Part 2 Socio-economic factors of household such as number of household member, main occupation, minor occupation, household income, household expense, debt, source of collecting plants and distance from dwelling to forest areas, the study was as followed:

Number of household member

This study found that the total population was 106 households. The household member could work 1-12 people/ household. The majorities of the number member was 2 people having 41 households (38.7); the number of household member was 3 people having 29 households (27.4%); the number of household member was 1 person having 11 households (10.4%); the number of household member was 4 people having 9 households (8.5%); the number of household member was 5 people having 7 households (6.6%); the number of household member was 6 people having 4 households (3.8%); the number of household member between 7-8 people was 2 households (1.9%) and the number of household member 12 people was 1 households (0.9%) respectively.

The main occupation of head of household

The main occupation of head of household mostly was agriculture 66 households (62.3%); 20 households worked as labor (18.9%); 8 households were the staffs of Kaeng Krachan National Park (7.5%); 5 households did craft/ embroidery fabric (4.7%) and other occupations were 7 households (6.6%).

The minor occupation of head of household

There were 68 households that the head of household did not have minor occupation 64.2%. The head of household vastly was labor 23 households (21.7%); the agriculture as minor occupation was 11 households (10.4%) and other minor occupations were 4 households (3.8%).

Household income

The household income per year found that it was around 3,600-275,520 Baht/ year. The average household income was 64,274.34 Baht/ year and it was able to categorized as household having low income which meant the income was less than 35,819 Baht/ year was 34 households (32.1%) and household having high income which meant the income was higher 35,819 Baht/ year was 72 households (67.9%).

Household expense

This study found that the expense per year was around 2,308-90,000 Baht/ year. The household expense average was 25,325.40 Baht/ year. The household expense was classified into 2 groups: (1) the household expense less than 16,471 Baht/ year was 39 households from 106 households and (2) 67 households had the expense more than 16,471 Baht/ year (63.2 %).

The household debt condition

More than a half of household, 73 households, were not in debt (68.9%) and only 33 households had debt (31.1%). This study categorized debt condition into 2 groups: (1) the household having debt less than 4,158 baht was only 18 households from 33 household who were in debt and (2) the household having debt more than 4,158 baht was 15 households (14.1%).

Source of collecting plants

Karang people mostly collected cultivate plants by themselves 53 households (50.0%); 20 households bought plant species from other places 18.9%; 9 household got from relative or neighbors (8.5%) and 24 households did not plant any plant species (22.6%).

Distance from dwelling to forest areas

The distance from dwelling to forest area was 0-25 Km. The average distance was 19.0 Km. and the most area was upper Baan Bang Kloi which had the total distance 25 Km. that had to spend around 24 hours. This study found that there were 76 households (71.7%) always went to upper Baan Bang Kloi. Moreover, the researcher grouped the household into 2 groups: the distance from dwelling to forest areas less than 14 Km was 27 households (25.5%) and (2) the distance from dwelling to forest areas more than 14 Km. was 79 household (74.5%).

Part 3 Community level factor is villages which are different in terms of community settlement duration and settlement characteristic of village.

As the interviewed head of households in both villages, this research found that the settlement of Karang people from Baan Pong Leuk has been settled before 1935. At the beginning, there were 8 villages and the leaders were the oldest people and the most accepted from the villages. The leaders depended on Tha Yang district; then, the chief of villages were appointed in 1964 which was the background of village election and Baan Bang Kloi mu 1 and Baan Pong Leuk mu2 were officially set up at Huai Mae Preang Kaeng Krachan district, Petchaburi province.

Table 4.1 Descriptive statistics of household and community factors characteristics

Data		Observation	Percentage
Villages			
	Baan Bang Kloi Mu 1	52	49.1
	Baan Pong Leuk Mu 2	54	50.9
Sex			
	male	78	73.6
	female	28	26.4
Age			
	19-30 years	22	0.8
	31-42 years	34	32.1
	43-54 years	29	27.4
	55-66 years	15	14.2
	≥ 67	6	5.7
Level of education			
	No	80	75.5
	Grade.3	1	0.9
	Grade.4	7	6.6
	Grade.6	3	2.8
	Grade.9	4	3.8
	Grade.12	11	10.4
Main occupation			
	Agriculture	66	62.3
	Handicraft	5	4.7
	Work as employee	20	18.9
	Staff's National Park	8	7.5
	Other	7	6.6
Minor occupation			
	No	68	64.2
	Agriculture	11	10.4
	Work as employee	23	21.7
	Other	4	3.8

Table 4.1 Descriptive statistics of household and community factors characteristics (Cont.)

	Data	Observation	Percentage
Household Member			
	1 people	11	10.4
	2 people	41	38.7
	3 people	29	27.4
	4 people	9	8.5
	5 people	7	6.6
	6 people	4	3.8
	7 people	2	1.9
	8 people	2	1.9
	12 people	1	0.9
Household income	< 20,000 Baht/year	25	23.5
	20,000-40,000 Baht/year	17	16.0
	40,000-60,000 Baht/year	26	24.5
	60,000-80,000 Baht/year	9	8.5
	80,000-100,000 Baht/year	13	12.3
	≥100,000 Baht/year	16	15.1
Household expense			
	< 20,000 Baht/year	50	47.1
	20,000-40,000 Baht/year	39	36.8
	40,000-60,000 Baht/year	13	12.3
	60,000-80,000 Baht/year	2	1.9
	80,000-100,000 Baht/year	2	1.9
Debt of household		debt	33
		-	73
Debt			
	0-4,000 Baht/year	18	54.5
	4,001-8,000 Baht/year	1	3.0
	8,001-12,000 Baht/year	2	6.1
	12.001-16,000 Baht/year	2	6.1
	16,001-20,000 Baht/year	10	30.3
source of collecting plants			
	no	24	22.6
	kept by Karang people	53	50.0
	bought	20	18.9
	relatives/neighbor	9	8.5
distance from dwelling to forest areas			
	0-5 Km.	25	23.6
	6-10 Km.	2	1.9
	11-15 Km.	1	0.9
	21-25 Km.	78	73.6

4.3 Settlement and demographic characteristics

4.3.1 Settlement

There were 52 households in Baan Bang Kloi and 54 households in Baan Pong Leuk, altogether 106 households. The Karang people mostly settled nearby river that is Petchaburi River which is the important source for consumption. The forest type around the village was dry evergreen forest and the important species were rubber, takhian, baing, *blchia siamesis* Gapnep, bamboo, reang, mak lek mak noi (Kaeng Krachang National Park, 2007) and it can be seen that the Karang people from Baan Pong Leuk normally built their house not so close each other and had more land tenure despite the fact that they settled and stayed for many generations. Therefore, the workplace was the same area or different but it was closed to their residences. In contrary, the house characteristic of Baan Bang Kloi built close each other and had the small garden at the back of their houses that planted papaya, mango, pomelo, jack fruit, tobacco, and other plants. Most houses rose up the floor and the materials for building the house was bamboo (hit the bamboo until flat) to make the wall, the partition and the floor. As interviewed Karang people, *Hasskarliana* (Kurz) Bacher ex K. Heyne was popular among them for building their house because it is the big tree, has no thorn, mostly grows at sparse wood and at river so it is easy for transportation; furthermore, *Hasskarliana* (Kurz) Bacher ex K. Heyne was abundant around the headwater of Petchaburi River and upper Bang Kloi. *Imperata cylindrical* Beauv was used for making roof but some household used galvanized iron. They normally had the kitchen inside the house and their stove was built by the rock and used charcoal. They built the wooden pedestal upper the strove in order to store the seed and food.

Karang's settlement characteristic

4.3.2 Demographic characteristics and occupation

Both communities called themselves as "Karang" received Thai nationality and census in 1990-1991. There were male 341 people and female 315 people so the total population was 656 people. The average member in one household was 6 people. The minimum number of household was 1 people and the maximum number of household was 17 people. The male as the head of household was 78 households (74%) and the female as the head of household was 28 households (26%). The age was from 19-79 years old and the average age was 43 years old. The most average age was between 31 to 42 years old, 34 households (32%). To classify the head of household age into 2 groups was (1) age over 45 years old had 42 households (40%) and (2) age lower 45 years old had 64 households (60%). The majority of household head was illiterate around 75% of the total head of household as the table 4-1

The living characteristic of Karang people was to stay together like family, to help each other and did not obviously separate the class. They respected the old people in their family and in their village. The worker was the member of each family and they, sometimes, exchanged the workers among family and relative. As surveyed, the number of household member was around 1-12 people/household. The number of household member mostly was 2 people. The researcher categorized the number of household member into 2 groups: (1) the household having member more than 4 people had 25 households (24%) and the household having member lower than 4 people had 81 households (76%). Moreover, more than a half of head of household mainly did agriculture (62%) of the total main occupation. The average of land tenure was about 7 rai. The highest land tenure was 1 household that had 40 rai and the household did not have land tenure 31 households. It can be said that 75 households had land tenure around 7 rai. Therefore, the household having land more than 11 rai had 13 households (12%) and the household had land lower than 11 rai had 93 household (88%). They mostly planted rice with chili and tomato at their land and planted rambutan, durian, Banana, papaya, gourd, pumpkin, ginger, and galangal for household consumption. The Karang people normally kept the seed or shoot on the wooden pedestal upper the strove due to the fact that they believed the smoke made this seed grow well, no fungus and insect. Moreover, they got the seed from other places such as buying from the market, from their cousin or relative. It is not essential

for Karang people to buy vegetable because they planted some vegetable species around their house such as Paco and Ceylon spinach or they caught fish from the river. The minor occupation of some household was worker around 22% of the total minor occupation. Nonetheless, the head of household mostly did not have minor occupation despite the fact that the farming, especially rice, and cattle was for consumption as the table 4-1

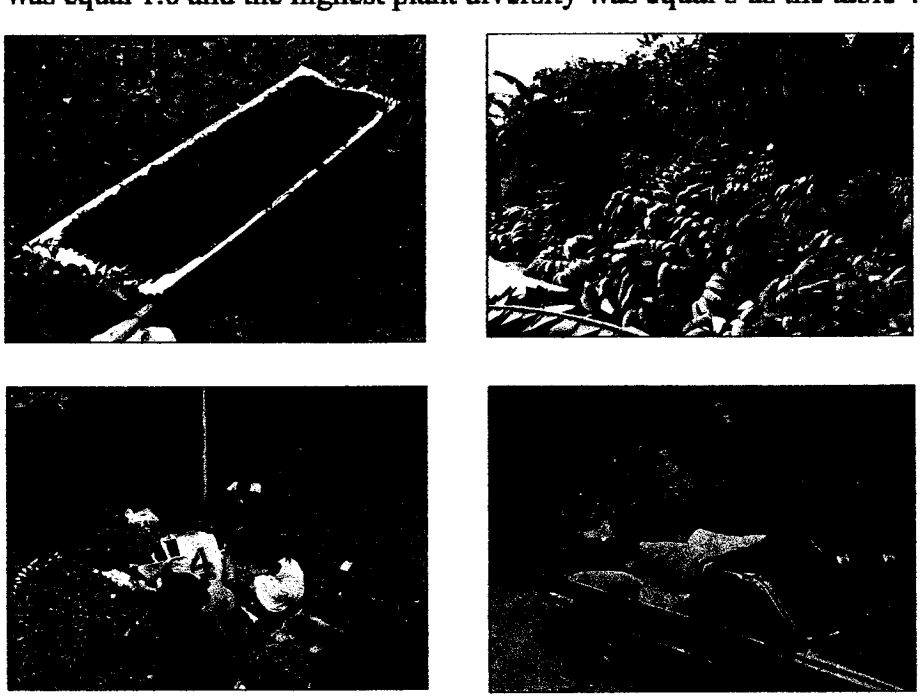
4.4 Socio-economic conditions

The economic condition of Karang people, in general, was self sufficiency. The production was for household consumption level which mainly came from agriculture. The main crops was rice, then chili, tomato, corn, taro and other plants were cultivated around their houses for household consumption; therefore, their income was not stable. The households having many occupations would have high income. The net income was around 3,600-275,520 Baht/ year. The average income per household was approximately 60,000 Baht/ year. The households having income lower 35,819 Baht/ year found 34 households (32%); conversely, the households having income higher 35,819 Baht/year had 72 households (68%). The expense mainly was for consumption such as rice, ketchup, and tobacco. This research found that the expense of household per year was around 2,308-90,000 Baht/year. The expense average was approximately 25,315.40 Baht/year. To categorize household expense into 2 groups was (1) the household having expense lower 16,471 Baht/year was 39 households (37%) and (2) the household having expense higher 16,471 Baht/year was 67 households (63%). Even most of Karang people spent a lot; this study found that only 33 households had dept and the households within this number having dept lower 4,158 Baht was 18 households.

In fact, these 2 villages were located in the national park area so logging was controlled as well as conserved forest and wildlife were promoted. However, the staffs did not truly prohibit local people to collect forest product, especially perennial tress for building their house because the local people had to depend on the environment to survive. The distance from residence to forest was around 0-25 km. so the average distance was about 19 km. Most of the forest area was in upper Bang Kloi

around 25 km. It took around 24 hours for travel. This research found that there were 72 households (72%) that often used the forest product at upper Bang Kloi and it can be grouped the households into 2 categories: (1) the household located near forest area means the distance from household to forest was not lower 14 km. that had 27 households and (2) the distance from household to forest was higher 14 km. that had 79 households.

The external factors at the individual level were arrest, punishment from selling or buying illegal forest product due to the conserved areas. The strict of national park officers caused the Karang people less smuggled the forest product or did not happen. Moreover, there were the government organizations, such as Specific Unit of Phraya Suan Army, 9th Field Artillery Regiment, and Border Patrol Police Section 1444, attend this area. Therefore, there was not any arrest or punishment for collecting, consumption and selling forest product but it found that the Karang people collected the various seeds from both in the forest and in land for planting around their house. From the survey each household, it found that the maximum number of wild plant species was 26 species and some household did not have any wild plant species. Thus, the average wild plant species was equal 10 species. Considering the portion of number of wild plant species with the number of planted species found that the highest portion was equal 1.6 and the highest plant diversity was equal 5 as the table 4-1



The production of household consumption came from agriculture

Table 4.2 Descriptive statistics of external and internal factors

Variables	Categories of variables	Observation	Percentage	Mean	S.D.	Minimum	Maximum
Dependent variables							
species richness		106		10	5.6	0	26
the proportion of number of wild plant species to number of crop plant species		106		0.5	0.2	0	1.6
plant diversity index		106		3.4	0.7	0.6	5
Independent variables							
Demographic factors of household heads							
sex[1]	Male	78	74				
	Female	28	26				
age (year)[1]		106		43	13.2	19	79
	≥45 year	42	40				
	≤ 45 year	64	60				
level of education(year)[1]		106		2	4	0	12
Socio-economic factors of household							
household member (number)[1]		106		3	2	1	12
	≥4 people	25	24				
	≤4 people	81	76				

[1] The multiple regression was used to analyze the relationship between each dependent variable and independent variables

Table 4.2 Descriptive statistics of external and internal factors (cont.)

Variables	Categories of variables	Observation	Percentage	Mean	S.D.	Minimum	Maximum
Independent variables							
Socio-economic factors of households							
main occupation	agriculture [1]	66	62				
	handicraft	5	5				
	work as employee	20	19				
	staff's national park	8	8				
	other	7	6				
minor occupation	no	68	64				
	agriculture [1]	11	10				
	work as employee	23	22				
household income (Baht)[1]		106		64,274	56,910	3,600	275,520
	≥ 35,819 Baht/year	72	68				
	≤ 35,819 Baht/year	34	32				
household expense (Baht)[1]		106		25,325	17,709	2,308	90,000
	≥ 16,471 Baht/year	67	63				
	≤16,471 Baht/year	39	37				

[1] The multiple regression was used to analyze the relationship between each dependent variable and independent variables

Table 4.2 Descriptive statistics of external and internal factors (cont.)

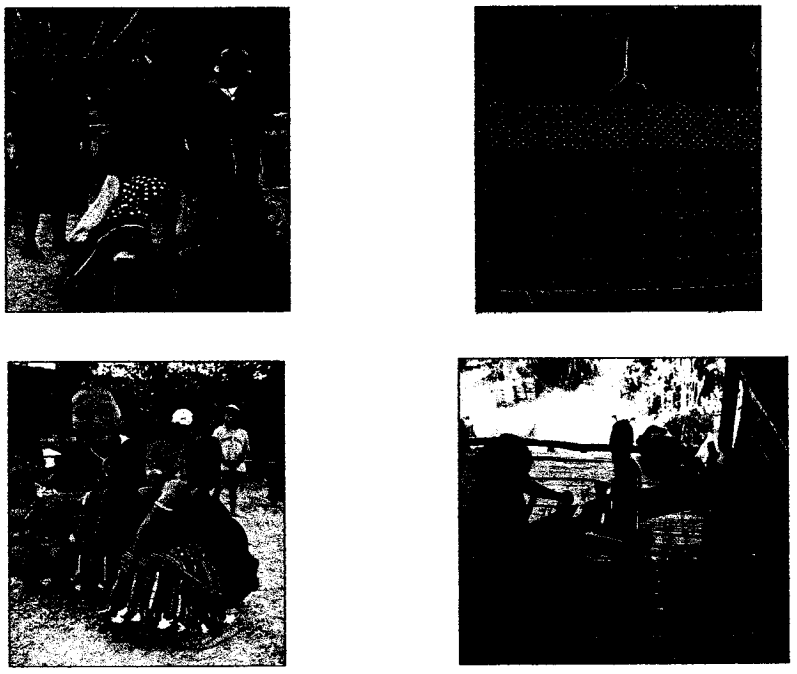
Variables	Categories of variables	Observation	Percentage	Mean	S.D.	Minimum	Maximum
Independent variables							
Socio-economic factors of households							
debt (Baht)[1]	With debt	33	31	8,440	8,564	200	20,000
	≥ 4,158 Baht	18	17				
	≤ 4,158 Baht	15	14				
debt (Baht)[1]	Without debt	73	69				
saving deposit (Baht)	saving	26	25	1,335	1,017	60	4,000
	not save	80	75				
source of collecting plant	at home[1]	53	50				
	market	20	19				
	relative or neighbor	9	8				
	not	24	23				
distance from dwelling to forest areas (km.)[1]		106		19	10	0	25
	≤ 14 Km.	27	26				
	≥14 Km.	79	74				

[1] The multiple regression was used to analyze the relationship between each dependent variable and independent variables

4.5 Culture, tradition and belief

4.5.1 Culture

The costume of Karang people, normally, was not different from the people in the flat area or people in general like wearing t-shirt, for female wearing sarong and for male wearing pants. When there was the special occasion or ceremony such as wedding ceremony, Ka-Ron Kuan or Bu Por, the Karang people would wear their traditional suite called "Chi-bu". In the past, they weaved cotton and added design to make their cloth more beautiful by putting the seed "Bu" (Karang language) (*Coix sp.*) which looks like white bead. The suite called "Si Po To Kui" was also the Karang costume but had less Bu seed as the picture 4-6. They, at the moment, wanted to wear like the people in the flat area because it is easy and convenient to buy as well as the Chi-Bu dress spent for a long time and needed finely skill. Moreover, the man went to farm and woman stayed at home so they had time for weaving but the present time, they needed to help each other to earn their living as a result they did not have time to make Karang suite as well as their suite was not convenient for working. To wear "Chi-bu" rarely saw in general.



The Karang people would wear their traditional suite called "Chi-bu".

Karang language was used to communicate within the village but the Karang people at Bang Pong Leuk village were able to speak Thai language clearer than the Karang people at Baan Bang Kloi due to the fact that Karang people at Bang Pong Leuk village stayed in this longer than the Karang people at Baan Bang Kloi and they had more chance to communicate and to deal with people outside the village. At the moment the children had chance to study Thai language thus the new generation of Karang people used more Thai language.

The transportation, in the past, went by foot or floated rafting. The distance from Amphoe Kaeng Krachang to the village totally was 54 km. which was very difficult because the road was very rough, slop and steep as the valley as well as to entrance the village had to cross many rivers. There was the flood during the rainy season so they could not cross the river. Nevertheless, the Karang people uses, at the present time, motorcycle for transportation to buy stuffs, medicine or to go to work outside the village. Most household had their own motorcycle and some household having a car is a shop buying the agricultural product from the local people in order to sell at the market in Amphoe Ta Yang. They did not have the electricity so they use solar cell which was provided by the government, in 2001-2002. However, some Karang people had solar cell more than 1 panel but some household did not have solar cell so they had to use lamp or candle. Furthermore, both male and female liked to eat betel nut and the old people especially man liked to smoke tobacco.

Karang's transportation

4.5.2 Tradition and belief

"In the previous time, people said that Karen people took care of forest that was not them but it was their tradition that looked after the forest. They had to follow their ancestor." This was the reflection of Karen Thung Yai through the book "Building Knowledge by listening" of Opart Panya and Solot Sirisai (2007) that emphasized the thinking system and belief of group or ethic group connecting with the nature. They made themselves as a part of nature, looked at the nature as the one who gave their life, their shelter, their food and maintain their species including determining their belief because Karang people respected ghost and holy thing, supernatural particular holy thing protected land, soil, water and forest. Therefore, there was the ritual to present the kindness and guarded which implied the concept of natural resource management and building balance to the ecosystem through employing advantage of plant species to be the represent or the symbol of rewarding the nature through this ritual as followed:

Rituals of livelihood

1. The ritual for choosing farm: Prior 1935, the Karang people settled at the headwater of Petchaburi River. Many old people confirmed that their ancestors lived here for many generations. The farming characteristic was rotation farm which rotated the farm every year and the most of farming areas were in the forest where Karang people believed holy place. They, therefore, had to ask the permission from the spirit before choosing the land in order to get a high productivity. Karang people did the cast lots by using the paddy seed which prepared for cultivation. Karang people called this ritual "Ka" was to put the paddy seed around 10-20 seeds line on the land then covered by coconut shell and made a wish "If this area is suitable for agriculture and high productivity, I wish these seeds would not be scatter." The next day, Karang people opened the coconut shell again and if these seeds are still the same, it means that the guardian spirit allows them to do agriculture at this area. On the other hand, if the seeds scatter or disappear from the coconut shell, it means that this area is not suitable for farming and low productivity. Another criterion for choosing the land is that area should not have bamboo shoot because this ceremony occurs in dry season in January-March. In general, there is no bamboo shoot at this time and if there is the bamboo shoot, it is uncommon. Moreover, these ceremony also uses for choosing land

to build a house but this time used rice; nevertheless, when this area was the Kaeng Krachang national park in 1981, they had to do farming in their area and could not rotate to other places anymore. As a result, these ceremonies, choosing land for farming and building house (Ka) did not carry out but they adapted these ceremonies by doing at their area through separating plot and each plot cultivated for 2-3 years to let the soil naturally rehabilitation. The area, before, planted potato, taro, sugar cane and Banana when they could choose the plot, they would choose the day for dropping rice through grab some rice and make it in pair. If it left only one, it means that day was not good for dropping rice. When they got the plot and day, they dropped only 7 holes first because they believed when they planted in the remaining whole, their plants would be strong, had no pest and got high productivity. There were 2 popular rice species that Karang people cultivated at the moment was "Buku" grows very well at the upper Bang Kloi and "Waju" grows very well aroud Pong Leuk-Bang Kloi. Rice species "Buku" took around 5 months but rice species "Waju" spent for 4 months. There are 2 sticky rice species was "Piitpor" is yellow-white sticky rice and "Piitku" is black sticky rice. At the moment, the Karang people cultivate these 4 species for surviving and for ceremony.

2. Harvesting and threshing: Karang people liked to harvest in the afternoon till evening around 10-20 binds. They do not eat the remaining food from the previous day on the harvesting day but they cook the new food and eat before harvesting in the afternoon until evening. They believed if they eat the new food, they will have more energy. There is only 1 person harvesting on the first day and their relatives and neighbors will help them to harvest in the following days. Karang people called sickle as "Take". They are threshing and harvesting at the same time. There is a mat made from 5-10 bamboos bound together to catch rice when threshing so there is no rice fall to the floor. At the present time, they likely use a plank put in 135 degree slop and thresh on it.

3. Kalong rice ritual: Karang people dropped rice during August-September until it is ready to harvest in November-December. They have the ceremony for harvesting and keep it in a barn. If they collect lower 100 than of rice in that year, they will keep it in sack or container made from bamboo called "Palu" but if they can collect rice more than 100 than, they will have the Kalong rice ritual called "Bupor" that is keep the rice

in "Bupor" located around their house because their land is further than their residences. After they finished and kept the entire thing, the local people helped each other handling rice to "Keu" and put at the back during the ceremony. Upper the stack of rice is a branch (mostly bamboo branch) stick in the middle of rice stack, next to the branch is a small basket for putting betel nut and betel. 7 packs 1 rice bunch (1bunch has 7 packs) and 7 candles bound altogether with flower such as cockscomb or marigolds. There are 3 rounds for handling rice into "Keu", the first third rounds, only 1 person carries "keu" walking with the person who carries the basket with flower bound with betel nut, betel, rice and candles and walk the clockwise of rice 3 rounds to call the mysterious principle of rice in the barn. They put the flower and sacrifice on the corner of "Bupor" in the final round. After finished the Kalong rice ritual, they Bangquet the people who come to help them together with tied wrist (kijeu) of household member and other people by using the remaining straw from harvesting. Grandfather and grandmother tie niece and nephew or wife for husband before tying other people. Karang people moved to the national park area, the productivity is low or some year cannot get any yield as a result Kalong rice ritual rarely does in the village because this ceremony should get rice around 200-300 thang. Nevertheless, there are only 2-3 households at Pong Leuk village do this ceremony every year despite the fact that the soil quality of Pong Leuk village has more quality and it is nearby the river as well as Karang people at Pong Leuk village have more land than Baan Bang Kloi.

Life cycle ceremony

New born ritual: A father used sharpen bamboo sheet to cut the new born baby's navel after delivered and put it in the bamboo tube called "budebo" the bamboo tube, then, placed near tree. If this tree was logged, the spirit of baby floated away caused sick or misfortune. After the father already placed it, he broke branch around 1 wa to make the clothes line for new member. However, the delivery way in the villages followed the medication as a result this ceremony rarely happens.

Ceremony about tying hand to call spirit before eating packed food (Aung-mee-thong): Karang people have this ceremony after dropped rice through gathering all the family and descendents using salacca and Bangana leaf to eat with sauce made from coconut mixed with sugar cane. This ceremony, moreover, gets together among cousin, relative and expresses the respect to the old people.

Loi Kra Thong ceremony: Karang people called "tutui" by bound the bamboo as a raft in order to put all kinds of rice such as rice, sticky rice, roasted rice, and cooked rice together with boiled vegetable. They believed this is the way for asking forgiveness through floating the bad thing in the river. This ceremony does after harvesting around January-February and they prepare the land for cultivation in the next year.

Trekking: Karang people, in fact, depend on the forest for many generations for hunting, collecting herbs or choosing land. They did the cast lots each by binding chicken bone in pair and randomly choose 1 pair for scrolling by the throne of livistona and speciosa. After scrolling both left and right side of chicken bone, this means they can get meat or herbs but if each side does not fully scroll, it means that day is not suitable to go to the forest. Karangnd people brought "Posu" and black turmeric (*Curcuma aeruginosa* Roxb.) each journey for protecting themselves.

Choosing land for building house: This ceremony is the same with the ceremony for choosing agricultural area (Ka). Karang people from both villages, in fact, cannot relocate especially for choosing the new area for building house; hence, Ka ceremony was for casting lots to move house pillar or to expand house area.

Make a merit for sending spirit (Mabu): When the member of family passed away, Karang people likely graved but nowadays they like to bury within 1-2 years or depending on the readiness of the family member. They chose a land which is not suitable for cultivation, building house, having small tree, and being similar with grove wood called "Kana" means bad place for the purpose of building hut for ceremony through dig the dead body to put at "Kana"; furthermore, the family and descendents had to stay until finish. This ceremony takes 3 or 7 days depending on the host. Each day has the fete so the local people can visit and have dinner until the last day of ceremony where has playing bird because they believed that "bird" is a representative of sending the spirit to heaven. This game is separated into 2 teams in order to bargain the price. The host buys the bird from neighbor. This bird made from softwood such as capoc or betel nut trees. When finished bargain the price, the host buys the bird through using breakfast and whisky as money, afterward, they put the betel nut, betel, dead bone at the back of bird together with set up the bamboo pillar that height is around 1-2 m. for send the spirit.

Buddhism ceremony: The researcher interviewed 106 households found that all of Karang people are Buddhism because there was the monk from Kaeng Krachang temple disseminated Buddhism and donated within villages. The researcher, furthermore, collected data in April-May 2009 noticed that male, from childhood to old people, more than a half ordained for His Majesty the king as well as the temple set up the activities, donation or Lagpacha ritual in the village but there is no temple or monk at the village despite of the national park.

As interviewed, Karang people did not know the traditional and important day of Buddhism such as Makha Bucha Day, Visakha Bucha Day and Buddhist End of Buddhist Lent Day but there is moon cake festival on the full moon day (15 Kumg). On this day, Karang people did not do farming or any works for 1 day and after they moved to Baan Bang Kloi in national park, they received the culture and tradition from outside such as New Year or Songkran festival. School and Border Patrol Police Baan Pong were the central arrangement activities for both villages. However, the Karang people still believed the spirit and supernatural for many generations, the traditions or rituals became the expression of asking permission, notification and gratitude for the sake of represent the gratitude to the spirit or other holy spirits through eating chicken ritual, feeding guardian spirit ritual, and full moon festival for protecting their yield being more abundant and themselves from danger. These rituals were changed by their wife that means when male gets married, they have to move to stay with their wife before making their own family. If the man respects eating chicken ritual before getting married, they have to change their respect following their wife for example if the wife respects moon cake festival, the man has to change to respect moon cake festival. Besides, they teach their descendents to respect the natural resource and to use sustainability. Karang people have the rules, traditions, or prohibitions of belief on controlling their habit of local people in order to use natural resource sustainability as followed.

Belief of tree: Karang people mainly depend on forest for household consumption. Therefore, there is the tree which cannot be logged or used because they are afraid the bad things happen. These belief and restrictions are as their strategy to enhance the chance for plant species to balance the ecosystem. These are the tree characteristic that Karang people do not cut down as followed:

1. Tree with tear (rubber) comes out from the tree
2. Tree has molehill
3. Tree has creeping plant
4. Tree has 2 branches leaning closely which is unnaturally and if using this tree for building house is like crocodile mouth caused bad events
5. Tree has 3 branches means the angel chair
6. Tree has the split end or torn into pieces at the top of tree
7. There 3 trees: Bangyan tree, Bohd tree and dipterocarpaceae, are not logged down for building house or household consumption because these trees have holy spirit or guardian spirit and considering ecosystem point, Bangyan tree and bohd tree are the big tree and the source of food for wildlife, bird, and bat

Therefore, if there are more rules, there are more chances for the trees to survive

Belief about building house: Karang people do not build their house turning in the same direction with the sunrise-sunset because they believed that people who live in that house will get sick or have bad thing happen inside the house and they will not turn their head direct to the river.

Belief of feeding animal: Particularly duck and chicken cannot raise inside the house because they believed that tiger comes to eat chicken inside the house and may hurt people in that house as well. When Karang people moved to settle at Pong Leuk-Bang Kloi Nai, it is noticeable that these 2 villages do not raise animal due to the fact that this area is the national park which is located at the central of national park that are the source of wild animals. If they raise the animals in the village, it causes the transmission between wildlife and domestic animal; moreover, this area is classified as the important upstream and if there are animals in the village caused releasing sewage to the river that causes the negative effect on flat people. There are only few pig, and chicken.

Belief about the animal sounds in the forest: For instance if there is the gibbon sound in the early morning (03.00-04.00 am.) and around 08.00 am or there is the sound of barking deer, loris, palm civet and red-billed blue magpie be the signal that this day is not good to go outside and if they go to the farm, work, or hunting, they will not be successful and ill since these villages are not the wildlife area and not the deep forest. Therefore, if there is the sound or the errant wildlife, it is the abnormal

situation for the Karang people but when they were relocated to the national park, the animal sounds seldom happen. This area, in addition, is a dry evergreen forest that local people do the farming and use its benefit for consumption, including there is the light from the electricity and the sound from the engine caused the wild animal gradually disappear from this area.

The thinking and the belief of Karang people implied that they are always connected with the nature. Although some people excused that their rituals followed their ancestors, Karang people continuously act until now. Their rituals or ceremonies are related to the natural influence on their faith. It can be noticed from their rituals having popped rice, flower and other plant species are the representative or symbol of respect and gratitude to the holy spirit and guardian spirit. If these rituals and beliefs still remain, flowers and other plants using in this ceremonies are preserved; in other words, these rituals and ceremonies protect and balance the nature.

4.6 Political characteristics and governance

In 1935, the oldest people in the village was accepted and respected by people in the community become the administrator of the village and community and there was the officially election in Baan Pong Leuk village, in 1964, under administrator Amphoe Tha Yang, Petchaburi province, and the local administration was set up in 2003; additionally, each villages has to send 2 people to be the member of local administration. After the village was formally established in 1997, the villages of Karang people were located under Huai Mae Preang district, Amphoe Kaeng Krachang, Petchaburi province by set up Bang Kloi village as mu1 and Baan Pong Leuk as mu2. The administrator elected by the local people was the oldest people in the village and was able to communicate with the outsider. The administration form has both tradition and government official.

Formal political characteristics

After established Kaeng Krachang National Park in 1981 in the purpose of critically protection and maintain natural resource, there was the problem around upper Petchaburi River and at the Pong Leuk village, trespass the forest for agriculture

including hunting that had been the big problem in this area. Although the Border Patrol Police Division 1444 already based, these threats also happened from the local people and the outsider who smuggled into the national park. The national park enforced the forest protection project through Royal Initiative around upper La Au-Pha Nern Thung Mountain by emigration the scatterable Thai Karen hill tribe along the border Thailand-Myanmar and around upper Bang Kloi to Baan Pong Leuk (the left side of Petchaburi River) in 1995. The villages were, at that time, registered and the sheriff Sannga Santhan announced Bang Kloi was mu 1 that had the village headman in 1964. Head Yong was the first village headman as well as Baan Pong Leuk was mu 2 that head Yim was the first village headman afterwards head Pud being the village headman was appointed by the district and was voted by the local community because people in the village respected him and he could speak Thai language and knew many people. Head Pud had been the village headman until he retired after that head Loi. Both villages had the administrative assistant and security affair section (in 2002) each section had 2 members but in 2004, the administrative section had only 2 members and security affair section left only 1 member. There was the local administrative around 2002-2003 that both villages were the member and each villages had 2 members for administration and budget allocation in terms of public health, economic development, social and tradition.

Traditional political characteristics

The traditional administration through the seniority system, they were generally from "Jee Bangg" family. The head of village, at first, was the oldest man whom the local people respected. There was the first village headman in 1982 that was village headman Yim and since Karang people believed in the spirit so there was a shaman in the village. They really paid respect to the shaman because he was able to protect them from evil. If the local people are ill and they cannot treat by themselves, they go to consult the herbal doctor, who is a good person, has ethics; consequently, his treatment will be work, at the same time, he has to know about diseases especially the herbal doctor at Pong Leuk village was highly respected by the local people because of not only healing the local people but also being midwife and Karang people are Buddhism so they respect the monk who practices the dharma, donates stuffs and

worship. To administrator in household level, Karang people respected the seniority of the family and they categorized the important level of wife's mother because the man got married has to move to the woman's house and changes to believe in ghost. Therefore, the administration from woman side is more influence on relative than the man side. The seniority, particularly grandfather, grandmother, father and mother, respectively, highly takes action in the relative administration level for teaching their children about the rules and regulations, the prohibitions and the traditions.

The informal leaders influences on Karang people for a long time because their way of living depends on their belief especially the holy things and this leader is a public consultant for example the village headman can consult them about the tradition or the difficult things to make a decision. Thus, the traditional leaders have been the spiritual supporter of Karang people from the past until now.

Karang people regarded both the elected leader and traditional leader due to the fact that both leaders were adorable by local people according to their tradition; in addition, the administration system, both formal and informal, overlaps in terms of rules or restriction which control the local people's behavior in using the advantages of natural resource. Their goal is to maintain the diversity of both flora and fauna as well as the government rules as logging, hunting or farming, are in line with their traditions. It can be said that the rules, restriction or election in both administration dimensions are as a cog of the community to use the forest without against their culture, tradition and belief together with the government policy.

4.7 Roles of agencies/ organizations in the area

After declared Kaeng Krachang National Park in 1981, the coming of organizations effected and changed Karang way of living. The target of these organizations is to develop the quality of life, security and national security together with protecting and conserved national resource around the central national park where is the headwater feeding all the living organisms. The way of living of Karang people was changed by the organizations as followed:

4.7.1 Organizations concerning natural resource conservation

The national park officers provided the sprouts to Karang people after established the villages in 1997. The perennial plants were provided to the local people for planting around their house for the sake of household consumption. Each household received 7 sprouts/1 species. The distributed species was betel nut, Lychee, Parkia speciosa and *P.timoriana* Merr.The Protection Unit of Kaeng Krachang 10 (Huai Mae Sareang), in 2006, promoted Karang people to cultivate the perennial plants such as Livistona speciosa, chilli, and prang which are the household plant. The earlier stage, however, was not successful despite the fact that their thinking and belief of these plants already had for a long time so this project was cancelled in 2006. Moreover, the Protection Unit of Kaeng Krachang 10 (Huai Mae Sareang), at the moment, plants the seedling such as Soap Nut Tree, takhian and wild bamboo and Dracontomelon dao (Blanco) Merr. & Rolfe to plant more in the national park and to distribute to Karang people who are interested to plant in their area around 5-10 stems per species which is on process. Besides, there is the agricultural organization promote Karang people to cultivate industrial crops for instance mango, durian, rambuton and maprag. Karang people more plant both perennial trees and industrial crops.

The role of Karang people originate from their parents or the head of household, additionally, was to increase the green areas at their residences. Karang kids were a part of increasing the diversities in their houses because the Pong Leuk Border Patrol Police School has the herbal project, which provided the benefits to local community, to encourage the students to plant these plants as well as to let them know the plants and its value in their community and which one can be used.

4.7.2 Organizations concerning national security

In November 1992, the Border Patrol Police Section of Border Patrol Police Troop 144 was set by the Border Patrol Police 14 around Baan Pong Leuk for secure the situation along border. Specific Unit of Phraya Suan Army, moreover, prevented the trespass national park because Kaeng Krachang National Park, in fact, connects to Myanmar and it is a pristine evergreen forest. The minority people escape from Myanmar during dry season every year and do logging or farming and building house including illegal planting marijuana; therefore, the Specific Unit of Phraya Suan

Army is an important force for surveillance every year. They do not do only inspect but also do safeguard the villages plus primary medical care to the local people.

The administration pattern, village headman and local administration, regularly follows the government rules and regulations and it is a good chance for Karang people to meet people from outsider because Karang people have the activities with other villages more and more such as village meetings, sport competition or participation in important days. The roles of local administrative not only make peace in the village but also cooperate with external agencies to support or allocate the budget for developments in terms of economic, social and local tradition.

4.7.3 Organizations concerning quality of life development there are many agencies aiding and supporting the living quality such as education, public health and occupation promotion as followed:

1. Education section: the education system of both villages is operated by the government process which is categorized into formal education system and non-formal education system:

The formal education system there is a small kindergarten before the school age is located at Baan Pong Leuk. The age of kid is from 2-5 years old and a teacher is from their village because it is easy to communicate and prepare the readiness before going to school especially language. The teacher mainly uses Thai language for communication because these kids generally speak Karang language with their parents, their cousins and their relatives more than speak Thai language but when they go to school; they have to speak Thai so they need the Karang teacher to teach them Thai language. The Border Patrol Police Unit 14 supported the areas around Baan Pong Leuk and changed the name "Baan Pong Leuk Study Center" to "Baan Pong Leuk Border Patrol Police School (Baan Huai Sok Border Patrol Naresuan Police School) for the primary school followed the Border Patrol Police policy in 2003 and if the students are interested to study secondary school, the school supports them to study at Suksasongkor Petchaburi School without any expense. However, there are some student's move to study other places. As interviewed the teacher from Baan Pong Leuk Border Patrol Police School, this study found that none of students continuously study university.

Non-formal education system plays important roles because many Karang people, both illiterate and interested in study, have chance to study and use their knowledge earn for living or adjust the educational qualification. The community educational center "Mea Pha Luang" was established on July 5, 2003. Most students are the village headman, local leadership and teacher more than local people. In fact, these occupations need the educational qualification.

2. Health care section: Karang people hardly go to services such as hospital or health care because of the difficulty of transportation but if they are really seriously ill, they likely go to Kaeng Krachang hospital. The distance from the village to Kaeng Krachang hospital is approximately 60 km. and the distance from the villages to Huai Mae Preang public health that is responsible for medical care is around 50 km due to the fact that this distance is very far and difficult as a result they do not like to go to the hospital together their way of living does not pay much attention on sanitation, living, medical care, food, drinking water and toilet; additionally, when they give birth, they prefer give birth with midwife to hospital because the expense is very high and the route is uncomfortable. The contraception is not famous among Karang people because they are afraid to be insane or like to have many children to help the household works. Therefore, Karang people like to cure by themselves or ask the primary medical care from Specific Unit of Phraya Suan Army and Border Patrol Police School. Moreover, the village areas are surrounded by the forest so Malaria can be found thus Malaria Clinic Center Pong Leuk-Bang Kloi was established by the villages in order to check blood and cure the initial systems before sending to the Kaeng Krachang hospital. The person who wants to cure people in the village has to be trained because they have to examine symptom.

3. Occupation promotion: Bang Kloi-Pong Leuk Arts and Crafts Center was established by Kaeng Krachang district and H.M. Queen Sirikit commanded to help both 2 villages including granted 500,000 Baht for operation. The objective is to create job and income, especially for women after finishing their household works and farming, through practicing woven silk, cotton and silk lace. The center trained a group leader first then the group leader transferred this knowledge to Karang people who are interested in. The income from weaving is 80 Baht/day and from lace fabric is 60 Baht/day but they have to work at the center because of counting member. If they

want to weave at home, they cannot get the daily wage; in other words, they can get only money for weaving. Therefore, this center can create income to family and reduce unemployed rate or immigrant workers.

4.8 Community context: Baan Bang Kloi mu 1

The household settlement characteristic of Karang people is closed to each other but it is out of order due to the fact that the areas were allocated by the government section on the purpose of emigration scatter able Karang people along the Thailand and Myanmar border to stayed altogether at the left side of Petchaburi river (in front of Pong Leuk Village); consequently, the households need to expand particular the new generations have to build their household in the limited area. Some households have 3 houses in the same area or some household has only 1 house but has 2 census registrations. The local people gave the reason of separated census was to get solar cell that make the census does not match with the house at table 4-2

Table 4.3 Household characteristics of Baan Bang Kloi

Baan Bang Kloi mu 1	
Household settlement characteristic	**Number of household**
Only 1 household in the area with house registration number	37
Only 1 household in the area without house registration number	4
Only 1 household in the area with 2 house registration number	7
2 households in one area without house registration number	2
2 households in one area but only 1 household with house registration number	1
3 households in one area with house registration number	1
Total	**52**

Source: surveying

4.8.1 Population and household characteristics

As from surveying the household information, this research found that Karang people from Bang Kloi mu 1 totally had 335 people, 176 male and 159 female,

and had 52 households. The population structure between male and female had similar proportion of every age ranks: adults (25-44 years old) have plenty both male and female so it indicated that there would be only the elderly people at the village in the future (Figure 4-3).

The survey of the number of household member considerably found that Karang people at Bang Kloi village had members around 5-7 people and the household having fewest member was 2 persons but maximum members were 17 people. The household head was male around 39 households, adversely; the household head was female around 13 households whose ages were 19-72 years old: the age average was equal 44 years old. The majority of local people emigrated from upper Bang Kloi around 48 households and 2 households were born in the village as well as 2 households moved from Kaeng Krachang district. The illiterate household head was 86%, the household head studied grade 6 was about 4%, and studied grade 9 was 2% and studies grade 12 was 8% respectively.

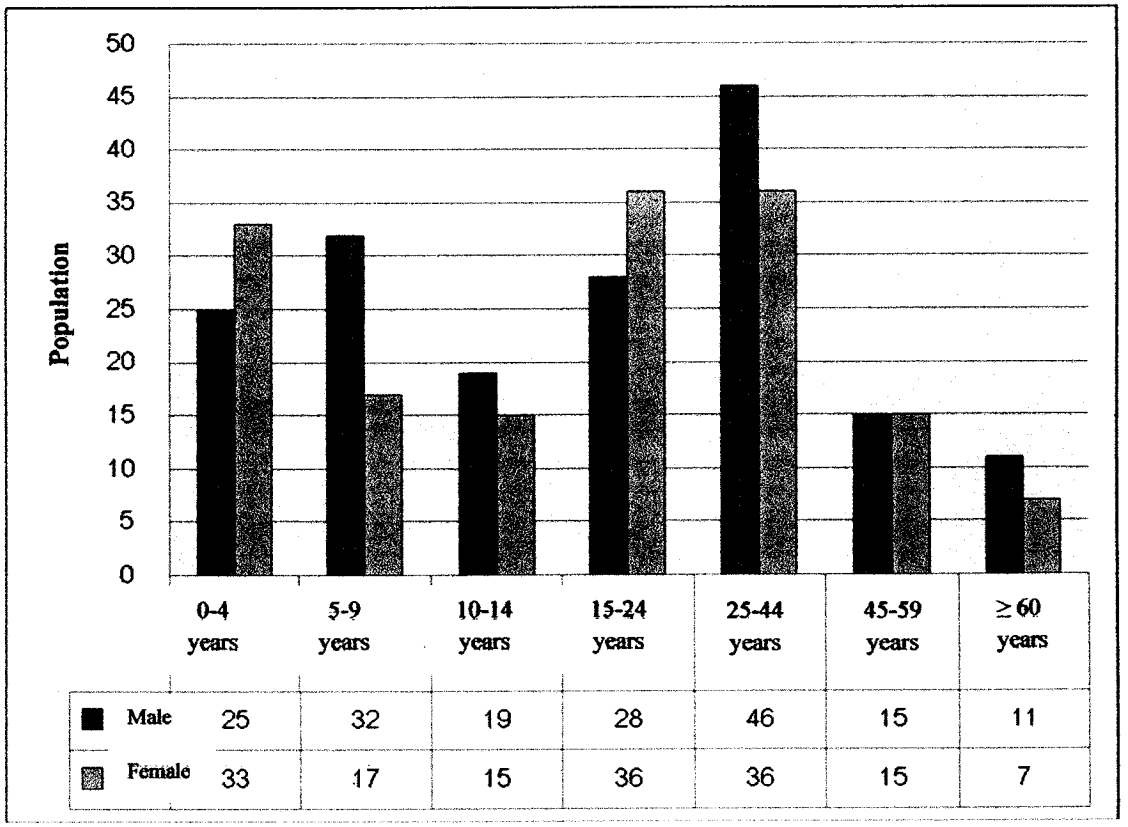


Figure 4.3 Population characteristic in Ban Kloi(May, 2009)

4.8.2 Occupation and household economic status

The main occupation is agriculture (58%), worker (21%), crafts or silk lace (8%), national park officer (6%) and other occupations (7%), respectively. The majority does not have sub-occupation but the household heads likely have the sub-occupation due to the fact that the members who can work are around 1-12 people/household and the most households have 2 worker/household. Therefore, the household income is directly from both main occupation and sub-occupation. The economic status of Karang people at Baan Bang Kloi largely was around 60,000-100,000 Baht/ year about 21 households (41%), moderate level was around 20,000-60,000 Baht/year 18 households (34%) and poor level was their income lower than 20,000 Baht/year 13households (25%) as table 4-3

Table 4.4 Household income in Bang Kloi

Income (Baht/year)	Member of household	Percent
≤ 20,000 Baht/year	13	25
20,000-40,000 Baht/year	9	17
40,000-60,000 Baht/year	9	17
60,000-80,000 Baht/year	6	12
80,000-100,000 Baht/year	8	15
≥100,000 Baht/year	7	14
Total	**52**	**100**

The total annual expense of Karang people at Bang Kloi village was around 2,308-90,000 Baht/ year. Most people had the expense around 20,001-30,000 Baht/ year (32.7%). The household having dept was 15 households and the rest 37 households had no dept. The household had dept mostly not over 15,000 Baht/ household and there were just on 5 households having dept around 20,000 Baht. Moreover, only 10 households of Bang Kloi village had saving money which was around 60-3,000 Baht.

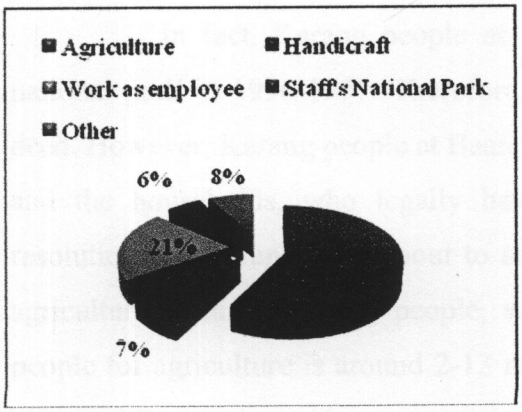


Figure 4.4 Main occupation

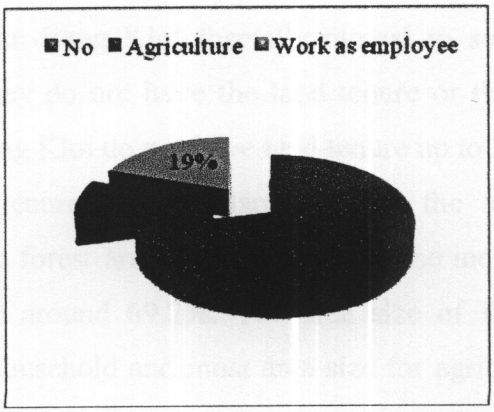


Figure 4.5 Minor occupation

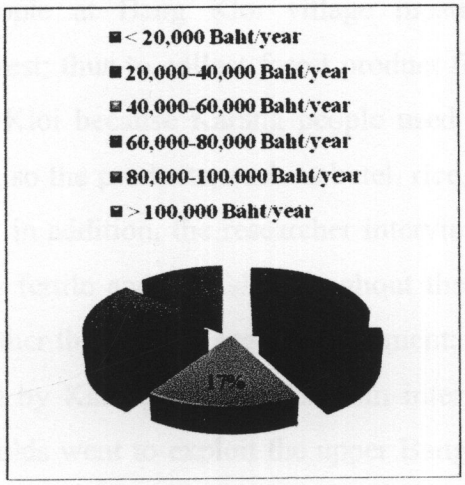


Figure 4.6 Household income in Bang Kloi

4.8.3 Religion and belief

The household heads, including household members, are Buddhists and still believe in spirits and supernatural that protects agricultural productivity. Interviewing local leadership was about the rituals and beliefs, starting from the cultivation season till harvesting to Karang people barn called "Palu" which is circle or "Bupor" which is square. Moreover, there are the beliefs about protected members from danger such as eating chicken rituals or tying wrist.

4.8.4 Land tenure

In fact, Karang people at Baan Bang Kloi formally moved to settle at national park in 1996-1997. Therefore, they do not have the land tenure or the title deed. However, Karang people at Baan Bang Kloi do not have land tenure up to 30.8% and the households, who legally have tenure on their land through the cabinet resolution on 30 June 1998 about to solve forest area problem in this case including agricultural area of Karang people, were around 69.2%. The area size of Karang people for agriculture is around 2-13 rai/household and most area size for agriculture is around 7 rai/household.

4.8.5. Roles of conserving plant species diversity

Karang people at Bang Kloi village mostly rely on vegetable and equipment from the forest; thus to collect forest product for household consumptions is around upper Bang Kloi because Karang people used to stay in this area before moved to national park so the products, such as betel, rice, chili, capoc, eggplant, and bamboo, can be found; in addition, the researcher interviewed the local people found that this area was very fertile and rainfall throughout the year so there was enough water for agriculture rather than their place at the moment; hence, the upper Bang Kloi was frequently utilized by Karang people. As from interviewed household head 52 households, 37 households went to exploit the upper Bang Kloi area and the distance from their residence to the upper Bang Kloi was around 25 km but the route was very dense so they had to take for 1-2 days and the forest products were sent back to their village by float rafting.

Because of many difficulties as route and times, the specialist and expertise are necessary because this area is dry evergreen and evergreen forest (Academic section of Kaeng Krachang National Park) and there is, sometimes, the disease during the journey. At the moment, the plants from both forest and market are planted around the Karang people's houses. This research found that more than a half of Karang people collected plant species to cultivate up to 53.8% and buying plants from other places was around 17.3% and receiving from their cousins and their relatives was around 5.8% respectively.

To plant the wild plants or crop plants, such as capoc, chili, Bangana, castor bean and lemon, in their agricultural area was not only for household consumption but also selling, in case of a lot of product left after household consumption, at the shop in the village. The income from these plants was around 750-12,000 Baht/year.

For conserved wild plant species information, most of Karang at Baan Bang Kloi used to receive the conserved wild plant information up to 86.5% and only 13.5% never received the information. The local people, in addition, said that they hardly stayed in the village because they had to work outside the village for a long time. The household head used to receive this information from the community radio 78.8%, next was from their cousins and neighbors 42.3%, and from the national park officers 3.8% together with radio 1.9% respectively.

Regarding the diversity of plant species, both wild and crop plants that were cultivated around the house and used by Karang people found that there were 100 crop plant species and 88 wild plant species altogether 188 species. The proportion of number of wild plant species to crop plant species was equal 0.5 and there was only 1 household that had the amount of wild plants more than crop plants.

(1) The number value of less than 1 means that the number of wild plant species is less than the number of crop plant species.

(2) The number value of equal 1 means that the number of wild plant species is equal the number of crop plant species.

(3) The number value of more than 1 means that the number of wild plant species is more than the number of crop plant species.

Shannon-Weiner Index (H) was employed to find the value of plant species diversity at Baan Bang Kloi. The value of plant species diversity was 3.77 which was the high value or no/low impact value because the tropical plant community was around 1.5-3.5 (Kent and Coker, 1996 referenced in Dachanee Emphandhu, 2005). Therefore, if the value of plant species diversity was lower than 1.5 which means the plant society was disturbed and it is essential to conserve and rehabilitate.

4.9 Community context: Baan Pong Leuk mu 2

The settlement characteristic of Baan Pong Leuk, in general, was separated and scattered along Petchaburi River and they mostly had a census because the census was used for asking solar cell as a result some households had more than 1 census but the household without census was because of expansion or separation from their parent's house; therefore, the number of household and the number of census do not match similar with Bang Kloi village as table 4-4

Table 4.5 Household characteristics of Karang people in Baan Pong Leuk

Baan Pong Leuk mu 2	
Household characteristic	**Number of household**
Only 1 household in the area with house registration number	33
Only 1 household in the area without house registration number	5
Only 1 household in the area with 2 house registration number	11
Only 1 household in one area with 3 house registration number	1
Only 1 household in one area with 4 house registration number	1
2 households in one area and with house registration number	2
2 households in one area and with only 1 house registration number	1
Total	**54**

Source: survey

4.9.1 Population and household characteristics

As from surveyed the general information, this research found that there are 321 people: 165 male and 156 female, and the total number of households is 54 households. The population structure between male and female had similar proportion in every age ranks: adults population (25-44 years old) is noticeably that the number of male is more than female (Figure 4-7).

To recognize the number of household member found that the Karang people at Baan Pong Leuk had the member around 4-6 people: the household having the fewest members was 1 person and the household having plentiful members was 14 people. The head of household was male 39 households and the head of household

was female was 15 household whose age was around 20-79 years old so the average age was equal 43 years old. There were 24 households emigrated from upper Bang Kloi and 22 households were born in the village and the household moved from Wan Won village was 2 household and from Baan Pa Teng was 2 households. The household moved from Kaeng Krachang, Ratchaburi, Pa La Au Sarahed was 1 household from each village. The illiterate head of household was 65% and the head of household studied grade 3 was 2%, studied grade 4 was 13%, studied grade 6 was 2%, studied grade 9 was 5% and studied grade 12 was 13%.

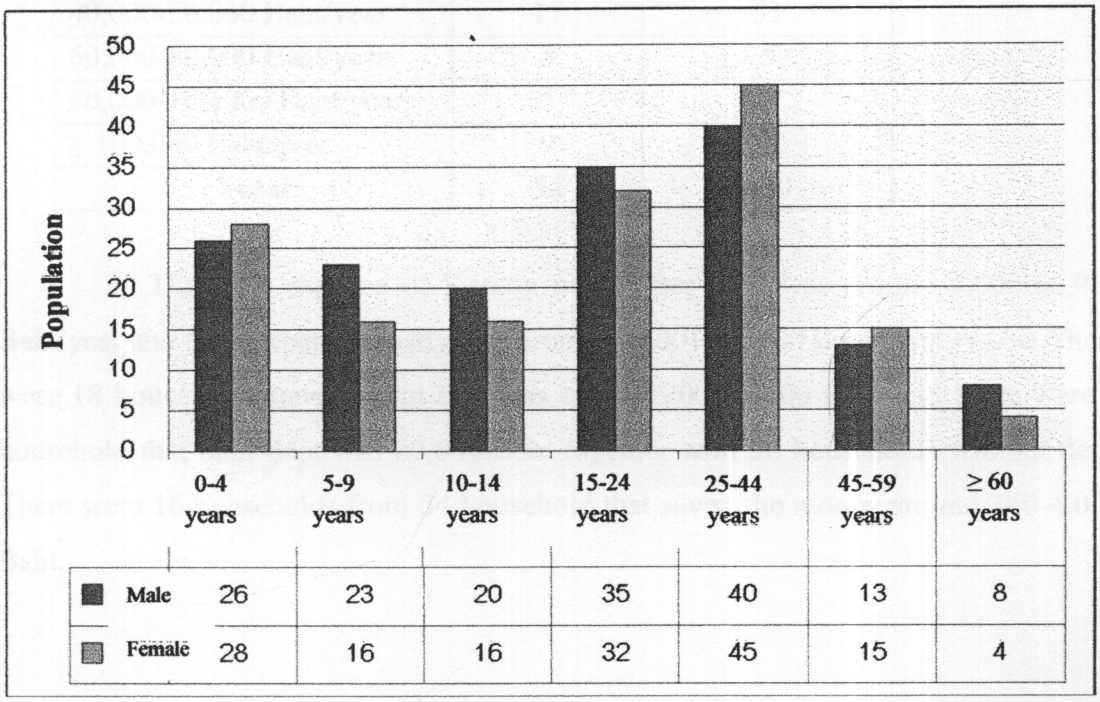


Figure 4.7 Population characteristic in Pong Leuk (May, 2009)

4.9.2 Occupation and household economic status

The main occupation was agriculture (67%), worker (17%), national park officer(9%), crafts and silk lace (2%) and other occupations (5%) respectively and most of them did not have sub-occupation but the sub-occupation of household head mainly was worker because the number of household worker was around 1-7 people/household. The number of worker generally was around 2 persons/household; therefore, some household had income from both main occupation and sub-occupation. The economic status of Karang people in Baan Pong Leuk regularly was in moderate level which means the income around 20,000-60,000 Baht/ household

had 25 households 46%. Next, the rich household having income around 60,000-100,000 Baht/year had 17 households 32% and only 12 household were poor which means their income was lower than 20,000 Baht/year 22% as table 4-5.

Table 4.6 Household income in Pong Leuk

Income (Baht/year)	Member of household	Percent
≤20,000 Baht/year	12	22
20,000-40,000 Baht/year	8	15
40,000-60,000 Baht/year	17	31
60,000-80,000 Baht/year	3	6
80,000-100,000 Baht/year	5	9
≥ 100,000 Baht/year	9	17
Total	**54**	**100**

The total expense of Karang people per year was around 3,600-66,000 Baht/year and their expense mostly was around 10,001-20,000 Baht/year 37.0%. There were 18 households having dept that was around 200-20,000 Baht and there were 5 household that their dept was 20,000 Baht together with 36 households without dept. There were 16 households from 54 household that saved the money around 360-4,000 Baht.

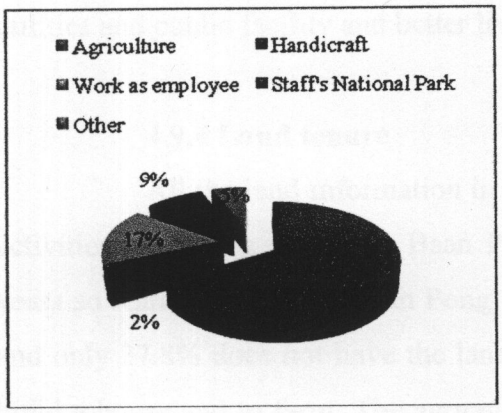


Figure 4.8 Main occupation

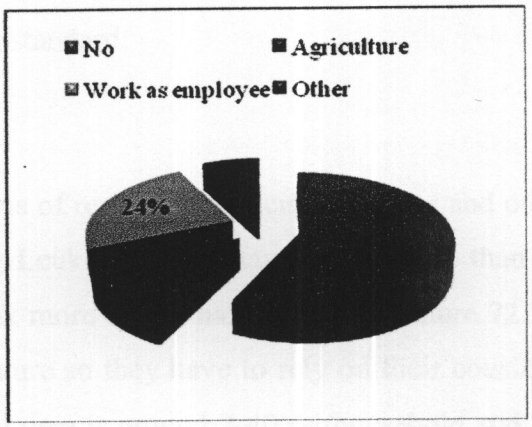


Figure 4.9 Minor occupation

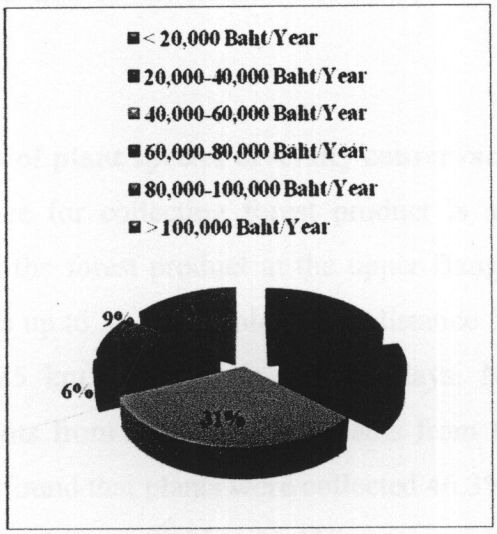


Figure 4.10 Household income in Pong Leuk

4.9.3 Religion and beliefs

Every household head and member is Buddhists and still has the beliefs or rituals about cultivation including a ritual about spirits similar with Karang people from Baan Bang Kloi. It is noticeable that their rituals almost disappear because during eating chicken ritual (December-April), some households did not do this ritual. Moreover, the local people said that this ritual is complicated and waste money as well as their children study and working outside the village and if their children have to come back home for join this ritual, it is difficult and inconvenient. Another reason is Karang people have been moved to stay at this area before Karang people at Baan

Bang Kloi and they highly accept the modernization like urBang society such public utilities and public facility and better living standard.

4.9.4 Land tenure

All the land information in terms of residence, agricultural areas and other activities of Karang people in Baan Pong Leuk has been stayed here more than 30 years so Karang people in Baan Pong Leuk more than a haft have land tenure 72.2% and only 27.8% does not have the land tenure so they have to rely on their cousin to build a house and to farm. The agricultural area is around 2-40 rai/household and the majority has the agricultural area around 7 rai/household. There is only 1 household which has the total land area 40 rai; on the other hand, the least land area is 2 rai have only 1 household.

4.9.5 Roles of plant species diversity conservation

The distance for collecting forest product is approximately 0.5-25 km. They mostly collected the forest product at the upper Bang Kloi like Karang people from Bang Kloi village up to 39 households. This distance from their houses to upper Bang Kloi is about 25 km. and spends for 1-2 days. Nonetheless, they start to cultivate, the wild plants from the forest and plants from the flat area, around their workplace. This study found that plants were collected 46.3%, were bought from other places 20.4% and received from neighbor 11.1%.

The plant species cultivated by Karang people at Pong Leuk village is the plant for household consumption like rice, chili, tomato, lemon, and corn and the plant for sell is capoc and castor bean. The income for selling this plants is around 500-36,000 Baht/year.

For the information about wild plant species diversity conservation, this study found that Karang people used to receive this information were more than half up to 92.6% and it was just only 7.4% that had never known about this information. The source of this information mostly came from the community radio 74.1%. Next is from cousin and relative or neighbor 38.9%, from national park officer 37.0%, from official document or government 18.5%, from television 5.6% and from radio 3.7%.

To consider the plant species diversity both wild plants and crop plants found that there were 98 wild crop species and 82 wild plant species altogether 180 species. The proportion of number of wild plants to the number of crop plants was equal 0.4. It had only 1 household that had number of wild plants more than the number of crop plants as can be explained as followed:

(1) The number value of less than 1 means that the number of wild plant species is less than the number of crop plant species.

(2) The number value of equal 1 means that the number of wild plant species is equal the number of crop plant species.

(3) The number value of more than 1 means that the number of wild plant species is more than the number of crop plant species.

Shannon-Weiner Index (H) was employed to estimate the value of plant species diversity that was 3.79 which means that the diversity is high or no/ low impact like the value of plant species diversity in Baan Bang Kloi.

In conclusion, this research found that the village head of both villages were male at the age from 19-79 years old and mostly were illiterate. The emigration from upper Bang Kloi was highly in Baan Bang Kloi. The main occupation of both villages was agriculture and some households had sub-occupation as worker. The household members were around 4-7 people and the number of household worker generally was 2 person and the fewest household worker was 1 person/household and the highest household worker was 12 people/household. The highest income was 35,000 Baht/year and their expense was higher than 15,000 Baht/year. The perspective income and expense of Baan Bang Kloi was higher than Pong Leuk and most of Karang people in Baan Pong Leuk did not have dept and had saving money. The land tenure of both villages was around 7 rai. The Karang people collected the plant species by themselves for cultivation and they spent 1-2 days for travel around 25 km in order to collect forest product at upper Bang Kloi. There is no crime about collecting forest product and they used to receive the information about plant species diversity conservation as well as it found that the plant species diversity was equal 3.94 which means the diversity is high and no/low impact.

CHAPTER V
RESULT:
LOCAL KNOWLEDGE IN UTILIZATION AND CONSERVATION OF WILD PLANT SPECIES

The study of local knowledge in utilization and conservation of wild plant species diversity was conducted in Baan Bang Kloi and Baan Pong Leuk from April to May 2009. The study found that the transferring of local knowledge of plant species usage could be categorized as follows:

5.1 Wild plant species utilization

This research discovered that the cultivated plants of the Karang people from Baan Bang Kloi and Baan Pong Leuk planted around their house for usage overall were 219 species and only 207 species were identifiable with specific scientific names and 12 species from 72 families 171 genus were unable to be identified and grouped into 2 main types: crop plants of 109 species and wild plants of 110 species. These plant species were 110 species were categorized into 4 types of plant habits: climber (32 species), herbaceous (74 species), shrub (50 species) and tree (63 species) as figure 5-1. Zingiberaceae species were found most, 12 species; then the plants in Gramineae family 11 species, the plant in Euphorbiaceae 10 species and other families as in figure 5-2.

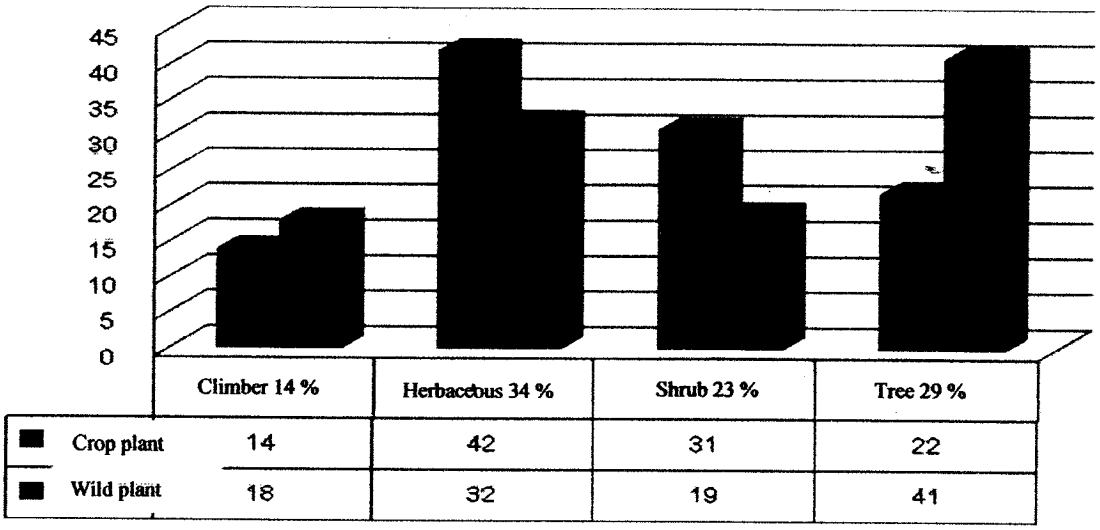


Figure 5.1 Plant classification by plant habits

To consider the distribution of plant characteristics, figure 5-1 showed that 32 species are climbers with 2,006 individuals accounting for 14 % of total plant species, 74 species are herbaceous plants with 37,532 individual plants accounting for 34 %, 50 species are shrubs with 6,057 individual accounting for 23 %, 63 species are trees with 5,970 individual stems accounting for 29 %. The plant species found most were herbaceous plants, perennial trees, shrubs and climbers respectively due to the fact that Karang people planted herbaceous plants for consumption as a result these plants could be seen almost in every household such as zerumbet ginger, sago, banana and pieapple. Most of the trees were fruit orchard which were for consumption and usage such as mango, coconut, rose apple, jackfruit and Karang people let shrubs and climber growing around their fences and herbaceous vegetables were for household consumption.

The high number of herbaceous plants were widely grown because the herbaceous plants were small and took a short time for planting and harvesting. Moreover, the Karang explained that some species could not be planted around their houses. For example, the old people in the village believed that the bamboo which was long and used to carry things should not be planted because it is a curse or betel nuts for making a bird in funeral ceremony or wood having the same size as the coffin could not be planted around their houses. It means bringing bad luck into their houses.

However, Bunmun, a Karang from Baan Pong Leuk noticed that "as they get old, they have no energy to go to the forest to collecting forest products such as bamboo which provided an edible bamboo shoots and to build a house so if they planted around their house, when they are old, it is easy for them to get these products as well as these products were not only for them but also for their descendents. Even they cultivate these plants around their houses; they still teach their children to go to the forest to gather the forest products in order to survive".

The beliefs of planting those plants have been altered as time change and inevitable making for a living as well as every households needed to use these plants like betel nuts or nuts. In addition, the government organizations namely the national park, encouraged people to plant the perennial trees especially the economic crops around their workplaces like Brucea amarissima Desv., Takhian, wild bamboo and Dracontomelon dao (Blanco) Merr&Rolfe which were provided by the national park staffs for distributing to Karang people to plant around their houses. This, consequently, caused the plant diversity.

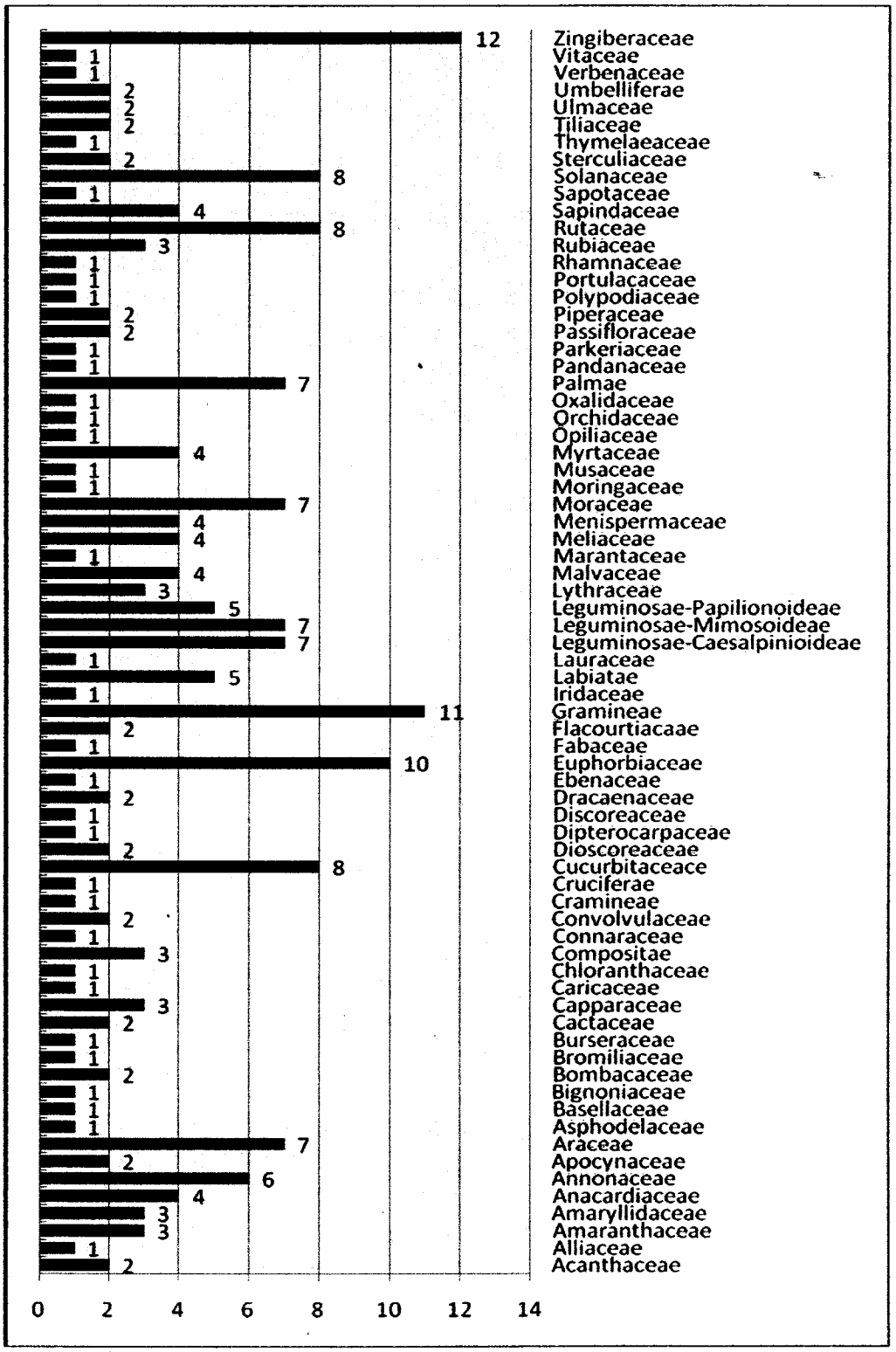


Figure 5.2 Number of plant species by family

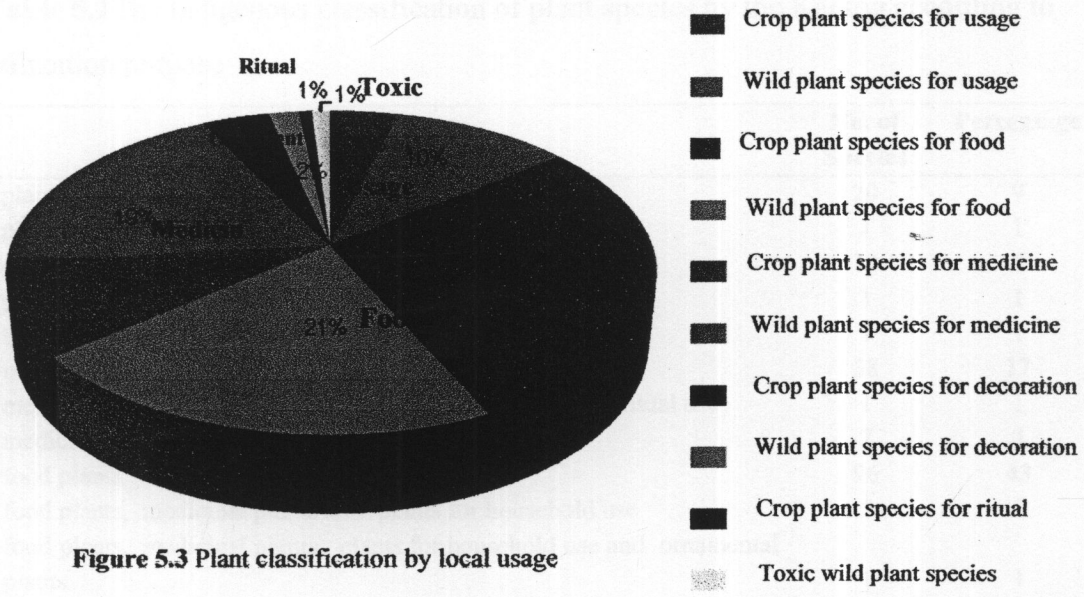


Figure 5.3 Plant classification by local usage

The plants around Karang people's residences, Baan Bang Kloi and Baan Pong Leuk, were classified according to their usage characteristic into 6 types such as medicinal plants, plants for household use, food plants, toxic plants and plants for rituals. Some plants had more than 1 property as illustrated in table 5-1. The plant utilization of Karang people from both villages were for food (50% of overall usage); followed by usage for healing purposes (28%), household consumption (14%), for decoration (6%), and for ritual and being toxic plant around (1 % each).

The study of how the wild and crop plants were utilized found that the vast number of food plant, both from wild and crop plants, were grown around the houses but the wild plants used for healing were grown more than the crop plants. At the same time, the ornamental plants and the plants for rituals or prosperity plants mostly were crop plants which had the same proportion with the wild toxic plants as show in figure 5-3.

Table 5.1 The indigenous classification of plant species by the Karang according to utilization purpose

Usage	No. of Species	Percentage
plants for household use	20	9
plants for household use and ornamental plants	1	1
ornamental plants	12	5
plants for ritual use	1	1
toxic plants	1	1
medicinal plants	38	17
medicinal plants, plants for household use and plants for ritual use	1	1
medicinal plants and plants for household use	7	3
food plants	96	43
food plants, medicinal plants and plants for household use	5	2
food plants, medicinal plants, plants for household use and ornamental plants	1	1
food plants and plants for household use	5	2
food plants and ornamental plants	2	1
food plants and toxic plants	2	1
food plants and medicinal plants	27	12
Total	**219**	**100**

5.2 Distribution and abundance of plant species in the community

The distribution and the abundance of plant species among households which grew those plants as illustrated in figure 5-4 showed that 169 plant species, were grown in 20 households and the majority of those plants were herbaceous plants such as garden spurge (*Euphorbia hirta* L.(Euphoribiaceace)), luuk tai bai (*Phyllanthus amarus* Schumach. & Thonn), bamboo grass (*Thysanolaena mixima* Kuntze), (*Clausena* sp). and (*Micromelum* sp.). Some plants like the tu and to no ae (Karang language), were planted only by the medicine man.

The plant species, which were grown in more than 50 households, largely were herbaceous (8 species). These species are classified as 6 species of crop plants. *Zingiber cassumunar* Roxb, lemon grass (*Cymbopogon citratus* Stapf), roselle (*Hibiscus sabdariffa* (L.)), turmeric (*Curcuma longa* (L.)), banana (*Musa* sp. and *Ananus bracteatus* Schult.f.) and 2 species of wild plant: bamboo (*Thyrsostachys siamensis* Gamble.) and zerumbet ginger (*Zingiber zerumber* (L.) Sm.) six species of trees that were crop plant were betel nut (Areca catechu), jackfruit (*Artocarpus*

heterophyllus Lam),white silk (*Ceiba pentandra* (L.) Gaertn.), coconut (*Cocos nucifera* L.), and tamarind (Mangifera indica (L.)) and mango (*Mangifera indica* (L.)). Moreover, there were 5 shrub species: castor bean (*Ricinus communis* L.), basil (*Ocimum sanctum* (L.)), guava (*Psidium guajava* L.), papaya (Carica papaya L.) and cockroach berry (Solanum aculeatissimum Jacq.) as well as there was only 1 wild climber plant species: white yam (Dioscorea alata L.). Therefore, most plants found in more than 50 households were food plants (18 species), medicinal plants (7 species) and usable plants (2 species) and some species like guava, papaya and zerumbet ginger were use as medicine.

From figure 5-5 to figure 5-7; it could be seen that Karang people likely grew few food and wild plant species which have medicinal compounds due to the fact that cultivating medicinal plants require knowledge and expertise to use each parts. Every household, in fact, grew food plants for consumption and getting from flat area, buying from market or receiving from officers; in addition, Karang people needed to go to the forest to collect medicinal plants. Regarding to the distribution of plant species to the number of household found that Karang people favored planting mango (Mangifera indica (L.)), pie apple (Ananus bracteatus Schult.f), banana (Musa sp.), tamarind (Tamarindus indica L.) and cockroach berry (Solanum aculeatissimum Jacq.) which mostly were for food and some of them had the property as medicine: *Zingiber cassumunar* Roxb., guava (*Psidium guajava* L.), papaya (Carica papaya L.) and betel nut (Areca catechu).

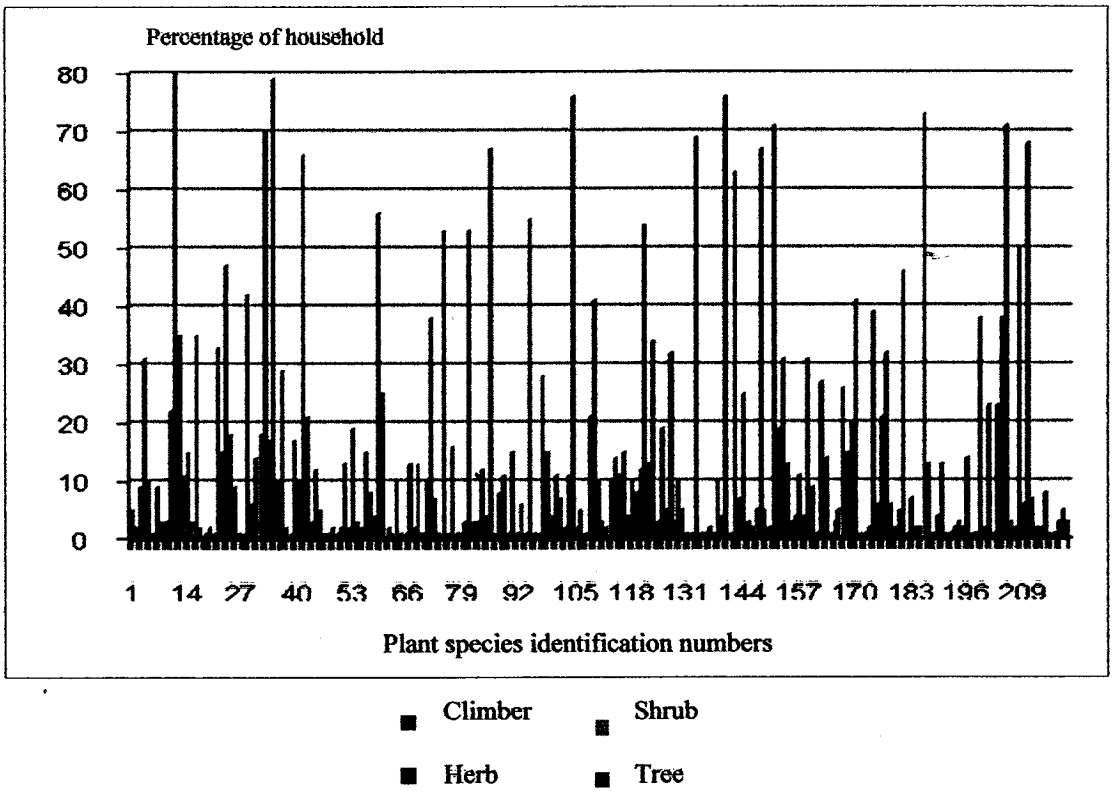


Figure 5.4 The distribution of plant species, classified by habits

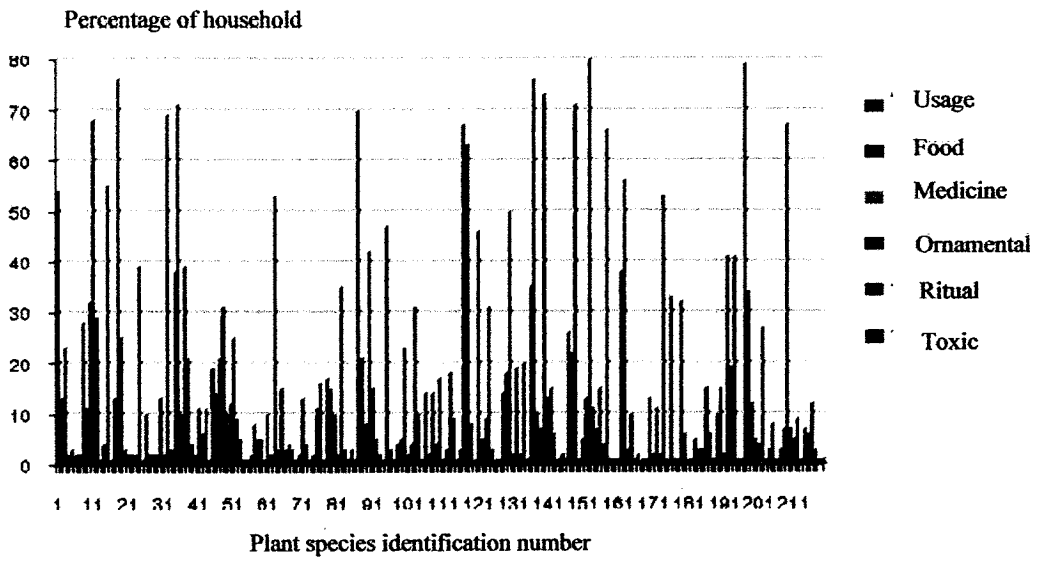


Figure 5.5 The distribution of plant species, classified by household utilization

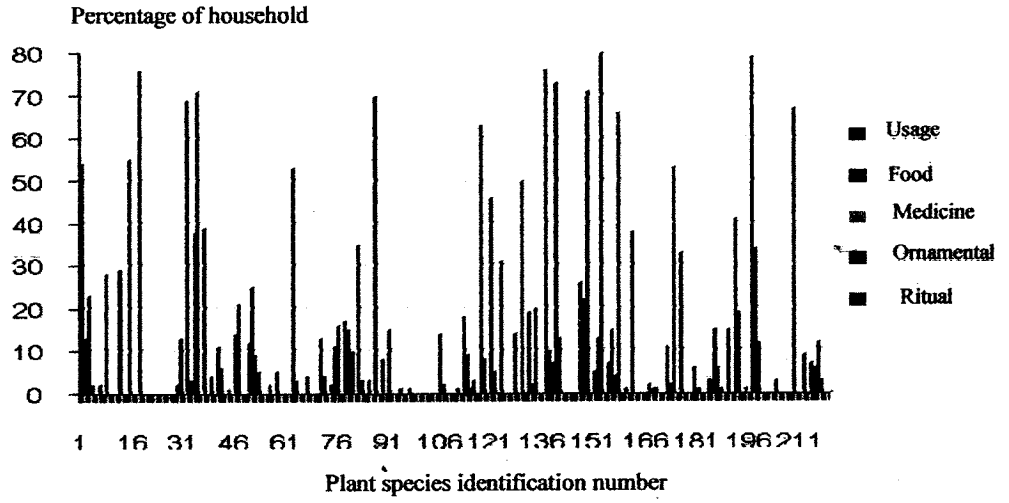


Figure 5.6 The distribution of crop plant species, classified by household utilization

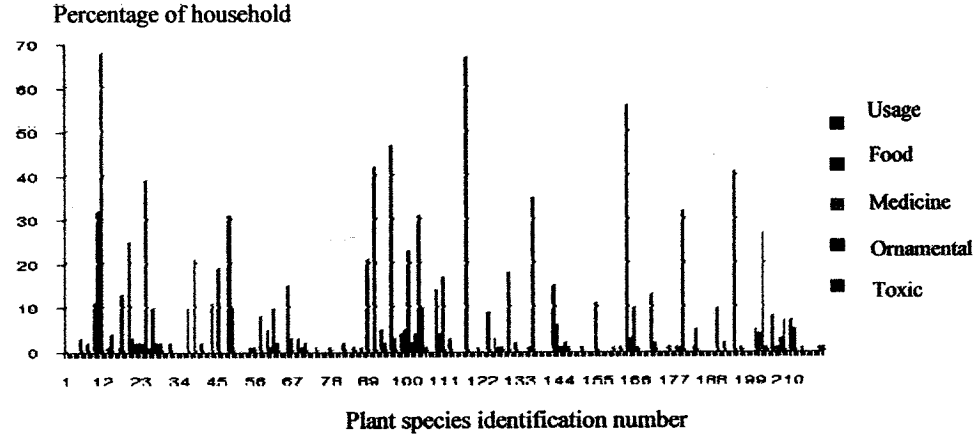


Figure 5.7 The distribution wild plant species, classified by household utilization

The plant species that were collected to plant in primal 10 households included many wild plants for consumption such as *Zingiber cassumunar* Roxb., white yam (Dioscorea alata L.) and elephant foot yam (Amorphophallus paeoniifolius (Dennst.) Nicolson); for medicine such as (Zanthoxylum limonella (Dennst.)), hog plum (Spondias pinnata (L.f.)), Talinum fruticosum (L.) Juss., and for usage such as bamboo (Thyrsostachys siamensis Gamble), djenkol tree (Archidendron jiringa (Jack) I.C.Nielsen) and slender lady palm (Rhapis siamensis Hodel).

The number of cultivated trees presented at figure 5-8 showed that Karang people collected crop plants and alien species, which was food plants, grown around their houses. Mango (Mangifera indica (L.)) was widely planted up to 80 households

but the plant species less cultivated among Karang people was the wild plants which were medicinal plants in house use and useable plants such as garden spurge (Euphorbia hirta L. (Euphoribiaceae)), bamboo grass (Thysanolaena maxima Kuntze), luuk tai bai (Phyllanthus amarus Schumach. & Thonn.), ka bok klud (*Hydnocarpus Ilicifolia King*), (Clausena sp.), ma had (Artocarpus lacucha Roxb. Ex Buch-ham), and sandal wood tree (Adenanthera pavonina L.) was planted in only 1 household.

The abundant plant species distribution information from figure 5-9 to 5-12 showed that most of climber and tree species were wild plant species but the herbaceous and shrub mainly were crop plants. All of these 4 characteristics were for food more than for other aspects. Karang people, moreover, planted climber trees for food as (*Cissus hastate* Miq.), (*Discorea esculenta* (Lour.) Burkill), the tu (Karang language) and haw si na (Karang language) but they likely used the food plants which can be medicine to plant around their house such as Asiatic bitter yam (*Dioscorea hispida* Dennst. var. hispida), Ceylon spinach (*Basella rubra*), betal vine (*Piper bettle* L.), bitter cucumber (*Momordica charantia* (L.)) and (*Dioscorea alata* L.).

The herbaceous plant, which rarely planted, was medicinal plants as luuk tai bai (*Phyllanthus amarus Schumach.&* Thonn), tomatillo(*Physalis angulata* L.), silver staghorn (*Platycerium holttumi* de Jonch & hennipman), to no ae (Karang language), por wee woo (Karang language); on the other hand, the herbaceous largely cultivated for food were kra thue (*Zingiber zerumber* (L.) Sm.), turmaric (*Curcuma longa* (L.)), galangal (*Alpinia galangal* (L.) Willd), cha plu (*Piper sarmentosum* Roxb.), garden parsley (*Petroselinum crispum* (Mill.) A.W. Hill).

The shrub, which less planted, was: (*Polyalthia suberosa* (Roxb.) Thwaites), (*Clausena* sp.), Andaman satin wood (*Murraya paniculata* (L.) Jack), (*Flacourtia indica* (Burm.f.) Merr.),and (*Micromelum* sp.) but they used the some shrub plants as a food as well; for instance, basil (*Ocimum sanctum* (L.)), lemon (*Citrus aurantifolia* (Christm.) Swingle), papaya (*Carica papaya* L.), cassava (*Manihot esculenta* Crantz) and castor bean (*Ricinus communis* L.).

Tree species that were medicinal plants and plants in household use were less cultivated including ka bhok klad (*Hydnocarpus ilicifolia* King), iron wood (*Hopea odorata* Roxb.), (*Cyathocalyx* sp.), cinnamon (*cinnamomum* sp.) and sandal wood tree (*Adenanthera pavonina* L.) and tree species used as food were jackfruit

(*Artocarpus heterophyllus* Lam), Thailand lady palm (*Rhapis siamensis* Hodel), white silk (*Ceiba pentandra* (L.) Gaertn.), mango (Mangifera indica (L.)) and betel nut (*Areca catechu*).

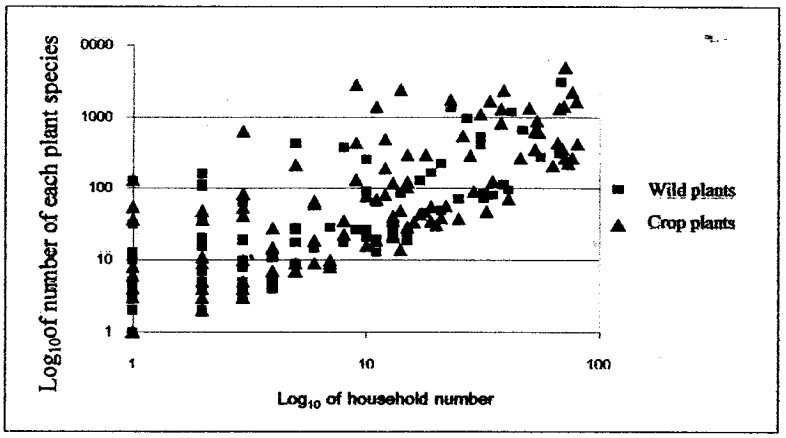


Figure 5.8 The distribution and abundance of plant species in Karang homestead agroforests

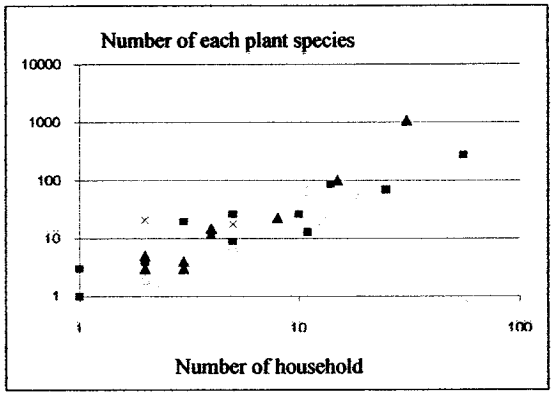


Figure 5.9 The distribution and abundance of climber plant species

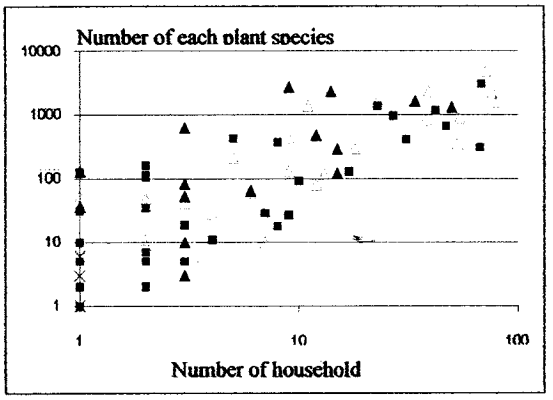


Figure 5.10 the distribution and the abundance of herbaceous plant species

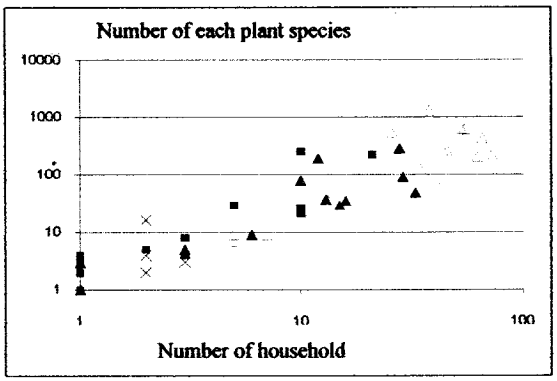


Figure 5.11 the distribution and abundance of herb plant species

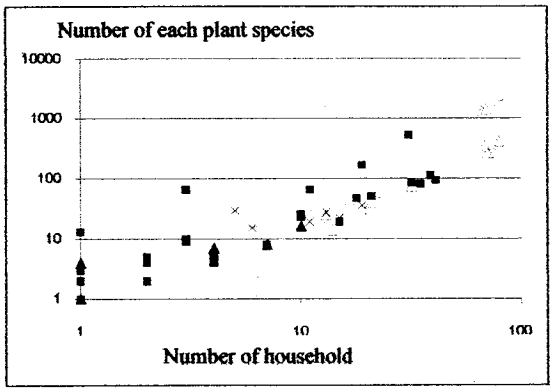
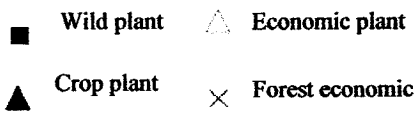


Figure 5.12 the distribution and abundance of tree species



As regards to plant species in homestead agroforests, the most popularly cultivated plant species were food crop plants, conversely, the medicinal plant species were rarely planted. Some species were not endangered plants or rare but it was the endemic plants such as haw si na (Karang language), platycerium, cardamom, bamboo grass, garden spurge, kare karon and goldenberry which can be found in the forest.

The distribution of plant species categorized into 4 plant habits (from figure 5-9 to figure 5-12) showed that Karang people generally cultivated the economic plants more and more in homestead agroforests but they less cultivated wild plants which have economic value. However, those wild plants can be used as medicine and food such as babbler's bill leaf (Thunbergia laurifolia Lindi), (Tinospora crispa (L.) Miers ex Hook.f. & Thomson), siam cardamom (Amomum testaceum

Ridl.), eagle wood moonseed (Aquilaria malaccensis), takhia (Hopea odorata Roxb.), cinnamon (Cinnamomum sp.), ma hat (Artocarpus lacucha Roxb. Ex Buch.-ham), soap erry (Sapindus trifoliatus DC.), queen flower (Afzelia xylocarpa (Kurz) Craib), teak (Tectona grandis L.f.), and lian (Melia azedarach L.). If the local people continuously grew crop plants, the biodiversity around their paddy field and around their garden would be replaced by these new plant species which are from other places. As a result, the endemic plants or wild plants decreased or became extinct.

Therefore, if there is the promotion of planting and conserving wild plant species, the number of plant species gradually increases in terms of both number of tree volume and plant species which considering increase the various productivity at their areas for food, usage, herbaceous, ornament and ceremony. The utilization objective led to increase biodiversity so the encouragement of planting wild species enlarges the species diversity remaining in the area and reduces the dependence on collecting forest products.

5.3 Similarity and difference of plant types between 2 villages

The gamma diversity in these 2 villages was 219 species. As for alpha diversity, Baan Bang Kloi had 188 species and Baan Pong Leuk had 180 species. The difference among 2 villages or beta diversity were found with 68 species. The similarity analysis of plant species between 2 villages was found with 151 species (69%) which had Jaccard's similar index equal 0.82 or 82% that was almost 1 which meant the plant types were high similarity (Chaweewan Hutacharoen et al, 2010) due to the fact that both villages had similar cultural background which led to the similar growing plants. The finding corresponded with the research of Kamolned Sritee (2010) which studied the comparison of plant components at the home gardens of Mon tribe, Nan province emphasized on group of people which had similar cultural background and found that the cultural background was the influenced factor on the component of home gardens. Moreover, the individual plant type favoring of Mon tribe influenced on the component of home gardens as well. In other words, these 151 similar species could be regarded as cultural plant species which were identity of both villages.

The different settlement duration of these 2 villages as Baan Pong Leuk had immigrated 60 years before Baan Bang Kloi the reason that the culture of Karang people at Baan Pong Leuk were close to Thai people which could notice from their crops such as corn, white silk, mango, maprang, rose apple and jackfruit; at the same time, Karang people from Baan Bang Kloi collected wild plant species for their homestead agroforests such as ho si na (Karang Language), *Stephania venosa* (BP.) Spreng., *Zanthoxylum rhetsa* (Roxb.) DC., RUTACEAE and *Livistona speciosa.* Therefore, these 2 villages were different in plant species diversity (beta diversity) of 68 species. Out of the different plant species of both villages (Beta diversity) of 68 species, 38 species was only found at Baan Bang Kloi and 30 species at Baan Pong Leuk. Baan Pong Leuk had the economic plants more than Baan Bang Kloi while Baan Bang Kloi had plants for food, for medicine and for decoration more than Baan Pong Leuk as showed in graph 5-13.

Regarding the different cultivating plant type of 2 villages found that Karang people at Baan Bang Kloi grew higher numbers of plant species with all 4 plant habit than Baan Pong Leuk. They normally grew plants for food and medicine. The Karang people at Baan Bang Kloi normally used wild plant species for food, household use herbal healing (Table 5-2). They perceived that having vegetables and medicinal plants were better because they did not need to go to the forest and were able to collect anytime; thus, the plant species both crop and wild plants were for utilization as food, medicines and decoration at Baan Bang Kloi more than Baan Pong Leuk as table 5-2.

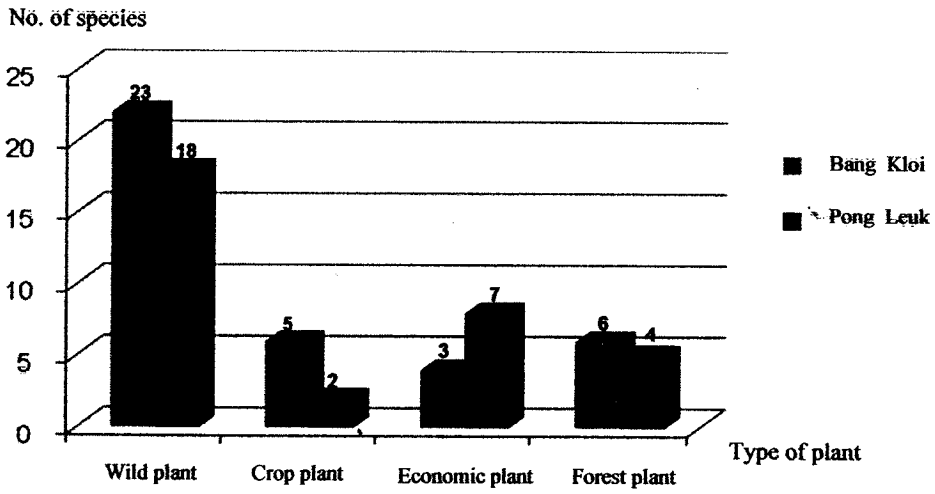


Figure 5.13 The beta diversity of plant species of 2 villages (total of 68 species)

Table 5.2 The difference in cultivating and utilizing plant type of 2 villages

Habit plant	Bang Kloi					Pong Leuk				
Usage	Climber	Herbaceous	Shrub	Tree	Total	Climber	Herbaceous	Shrub	Tree	Total
Food	4	5	2	3	**14**	2	5	3	2	**12**
Medicine	1	7	1	3	**12**	0	4	4	1	**9**
Usage	0	1	0	7	**8**	1	2	1	4	**8**
Ornamental	0	2	1	0	**3**	0	1	0	0	**1**
Toxic	0	0	1	0	**1**	0	0	0	0	**0**
Total	**5**	**15**	**5**	**13**	**38**	**3**	**12**	**8**	**7**	**30**

5.4 Local knowledge of wild plant species

The plants that Karang people from these 2 villages cultivated around their houses for utilization were found around 219 species, of which 207 identified and 12 unidentified species. These species were grouped into 72 families and 171 genuses. The crop plants, moreover, were found 109 and wild plants were found 110 species. Table 5-3 and table 5-4 presented the plant name in both common name and Karang name. Furthermore, the researcher differentiated the benefit from plant parts into 6 types: medicinal plant, useable plant, ornamental plant, food plant, toxic plant and ritual plant that used plants which concerned as the knowledge base and local wisdom of Karang people in terms of protecting biodiversity. This knowledge was passed and

transferred for many generations. The researcher mentioned all these knowledge based in detail as followed: the food plant, medicinal plant, usage and decoration, ritual and toxic plant, planting and protecting knowledge including the adaptation of utilization the plant benefit at the current state.

Table 5.3 Wild plant species in Karang homestead agroforests

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
1	*Barleria lupulina* Lindl.	Acanthaceae	-	Photachue	Shrub	Leaf	Externally used as poultice or plaster on snake bite
2	*Thunbergia laurifolia* Lindl	Acanthaceae	-	Chonadidue	Climber	Climber / leaf	Climber take to sub-lingua, leaf use to detoxication
3	*Amaranthus lividus* (L.)	Amaranthaceae	-	Metalohwo	Herbaceous	Whole plant	Food plant
4	*Amaranthus* sp.	Amaranthaceae	-	Metalomi	Herbaceous	Whole plant	Food plant
5	*Amaranthus spinosus* L.	Amaranthaceae	Spiny amaranth, Spiny pigweed	-	Herbaceous	Whole plant	Food plant
6	*Crinum* sp.	Amaryllidaceae	Crinum lily, Cape lily, Asiatic poison bulb	-	Herbaceous	Flower	Ornamental plant
7	*Spondias pinnata* (L.f.) Kurz	Anacardiaceae	Hog plum	Taphi	Tree	Fruit/ shoot/ root	Fruit and shoot are food plant, root used as tonic
8	*Anacardium occidentale* L.	Anacardiaceae	Cashew nut tree	Takhorori	Shrub	Nut	Food plant

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
9	*Cyathocalyx* sp.	Annonaceae	-	Sikwuatu	Tree	Fruit/ wood	Ripe fruit is food, wood used for fuel
10	*Polyalthia suberosa* (Roxb.) Thwaites	Annonaceae	-	Klephoti	Shrub	Fruit	Food plant
11	*Alstonia scholaris* (L.) R.Br.	Apocynaceae	Devil tree, White cheese wood, Blackboard tree, Devil's bark	-	Tree	Bark	Bark is febrifuge
12	*Amorphophallus paeoniifolius* (Dennst.) Nicolson	Araceae	-		Herbaceous	Storage root	Food plant
13	*Typhonium trilobatum* (L.) Schott	Araceae	-	Blisukhua	Tree	Root	Used in scorpion sting and relieve pains
14		Araceae	-		Herbaceous	Stem/ leaf	Food plant

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
15	*Basella rubra* L.	Basellaceae	Malabar nightshade, Ceylon spinach, East Indian spinach	Hnomito	Climber	Whole plant	Enriching the blood as tonic
16	*Oroxylum indicum* (L.)Kurz.	Bignoniaceae	Broken bones, Indian trumpet flower	Doka	Tree	Nine tops pagoda/, shoot/ bark	Pod and shoot used for food, bark used for shingles
17	*Garuga pinnata* Roxb.	Burseraceae	-	Phithodi	Tree	Trunk	Plant for household use
18	*Capparis micracantha* DC.	Capparaceae	-	Kakara	Shrub	Fruit	Food plant
19	*Cleome gynandra* L.	Capparaceae	Wild spider flower	Hokala	Herbaceous	Shoot	Food plant
20	*Crateva magna* (Lour.) DC.	Capparaceae	-	Hokapi	Tree	Shoot/ bark	shoot used for food, bark used as rice brown spot disease

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
21	*Chloranthus erectus* (Buch-Ham.) Verdc.	Chloranthaceae	-	Talasuay	Shrub	Leaf/ stem	Used for chickenpox
22	*Blumea balsamifera* (L.) DC.	Compositae	Camphor tree	Phopuea	Shrub	Leaf/ root/ stem	Hot press post-partum
23	*Cnestis palala* (Lour.) Merr.	Connaraceae	-	Phomi	Climber	Shoot	Food plant
24	*Brassica* sp.	Cruciferae	-	-	Herbaceous	Whole plant	Food plant
25	*Momordica cochinchinensis* (Lou.) Spren	Cucurbitaceae	-	Phiphowa	Climber	Flower/ shoot/ fruit/ vine	Flower, shoot and fruit used for food, vine used as chickenpox
26	*Dioscorea alata* L.	Dioscoreaceae	Greater yam, Winged yam	Hnuaiho	Climber	Tuber	Food plant
27	*Dioscorea hispida Dennst.*var.hispida	Dioscoreaceae	-	Khri	Climber	Storage root	used in snake sting and food plant
28	*Hopea odorata* Roxb.	Dipterocarpaceae	Iron wood	Suhwe	Tree	Bark	Add pure alcohol
29	*Discorea esculenta* (Lour.) Burkill	Discoreaceae	Lesser yam	Hnuaitakhu	Climber	Tuber	Food plant

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
30	*Dracaena loureiri* Gagnep.	Dracaenaceae	-	Datakuy	Shrub	Leaf/ heartwood	Leaf used for rope, heartwood used for apthous ulcer
31	*Diospyros areolata King* & Gamble	Ebenaceae	-	Talamo	Tree	Fruit/bark	Ripen fruit used for food and used as natural dye clothing and mesh, bark used in diarrhea
32	*Cleistanthus sumatranus* (Miq.) Mull. Arg.	Euphorbiaceae	-	-	Tree	Trunk	Plant for household use
33	*Euphorbia hirta* L.	Euphorbiaceae	Hairy Spurge, Asthma weed	Nocheyo	Herbaceous	Whole plant	Plant is emetic, stimulate milk maternity, malaria and against itch
34	*Jatropha gossypifolia* L.	Euphorbiaceae	-	-	Shrub	Resin	Juice is used in malnutrition
35	*Phyllanthus amarus Schumach.* & Thonn.	Euphorbiaceae	-	Khomi	Herbaceous	Whole plant	Malaria and hypertension

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
36	*Hydnocarpus ilicifolia King*	Flacourtiacaae	-	-	Tree	Trunk/ seed	Trunk used in household, Seed used for anthelmintic
37	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae	-	-	Shrub	Fruit	Food plant
38	*Thyrsostachys siamensis* Gamble.	Gramineae	-	Wabo	Herbaceous	Trunk	Used to building
39	*Thysanolaena maxima* Kuntze	Gramineae	-	Paau	Herbaceous	Root	Used in colic
40	*Vetiveria zizanioides* (L.) Nash ex Small	Gramineae	-		Herbaceous	Whole plant	Protect to soil erosion
41	*Tectona grandis* L.f.	Labiatae	Teak		Tree	Trunk	Used to building
42	*Cinnamomum* sp.	Lauraceae	-	Kadahra	Tree	Tab root/ bark	Used to abate giddy
43	*Afzelia xylocarpa* (Kurz) Craib	Legumjnosae-caesalpinioideae	-	Siboko	Tree	Leaf/ seed	Food plant
44	*Caesalpinia mimosoides* Lam.	Leguminosae-caesalpinioideae	-	Sitayoi	Climber	Shoot	Food plant
45	*Senna timoriensis* (DC.) Irwin & Barneby	Leguminosae-caesalpinioideae	-	Pitakhabolue	Tree	Bark/ trunk	Used for wasting disease

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
46	*Acacia concinna* (Willd) DC.	Legumjnosae-caesalpinioideae	-	Phueachi	Shrub	Stem/ shoot	Stem is febrifuge, enriching the blood as tonic, shoot used as aperient
47	*Adenanthera pavonina* L.	Leguminosae-Mimosoideae	Red Sandalwood Tree, Coralwood Treem, Sandalwood Treem Bead	Kahlihwo	Tree	Trunk/ seed	Trunk used in household, Seed used for decorations
48	*Archidendron jiringa* (Jack) I.C. Nielsen	Leguminosae-mimosoideae	-	Tahne	Tree	Fruit/leaf/ bark	Fruit used for eating, leaf used in fevers, bark used as rice brown spot disease
49	*Parkia speciosa* Hassk.	Leguminosae-mimosoideae	Petai	Tape	Tree	Lomentum	Food plant
50	*Millettia brandisiana* Kurz	Leguminosae-papilionoideae	-	-	Tree	Trunk	Plant for household use

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
51	*Lagerstroemia cuspidata* Wall	Lythraceae	-	Sokhwa	Tree	Bark/ trunk	Bark used for diarrhea, trunk used for building
52	*Lagerstroemia tomentosa* C.Presl	Lythraceae	-	Kamusui	Tree	Trunk	Used to building
53	Aglaia sp.	Meliaceae	-		Tree	Trunk	Used for building
54	*Melia azedarach* L.	Meliaceae	Persian lilac, Indian lilac, Bastard cedar, China berry, Pride of Indian, Bead tree	Siphoke	Tree	Trunk	Used to building
55	*Sandoricum koetjape* (Burm.f.) Merr.	Meliaceae	Sentul, Santol, Red santol, Yellow santol	Kradue	Tree	Fruit	Food plant
56	*Stephania venosa* (Blume) Spreng.	Menispermaceae	-	Kachise	Climber	Tab root/ leaf	root used for spleen disorder, leaf used for food

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
57	*Tiliacora triandra* (Colebr.) Diels	Menispermaceae	-	Naekopha	Climber	Leaf/ vine	leaf used as food, diabetes, Vine used for rope
58	*Tinospora crispa* (L.) Miers ex Hook.f. & Thomson.	Menispermaceae	Andawali	Tuetomue	Climber	Climber	Used in fever, wasting disease and malaria
59		Menispermaceae		Hosina	Climber	Leaf/ vine	Food plant
60	*Artocarpus lacucha* Roxb. Ex Buch.-ham	Moraceae	-	Kapoekha	Tree	Bark/ trunk	Bark used in dressing ulcer, trunk used to building
61	*Ficus* sp.	Moraceae	-		Tree	Fruit	Food plant
62	*Ficus hispida* L.f.	Moraceae	-	Ngaauenahwoei	Tree	Fruit	Heaving loss due to over dose
63	*Ficus racemosa* L.	Moraceae	Country fig tree	Woeingapawa	Tree	Root coat/ fruit	Externally used as poultice or plaster on swelling, ripe fruit is food plant

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
64	*Strebles ilicifolius* (Vidal) Corner	Moraceae		Sipahne	Shrub	Leaf/ bark	Lowers fever
65	*Syzygium cumini* (L.) Skeels	Myrtaceae	Black Poum.	Tahme	Tree	Fruit	Food plant
66	*Champereia manillana* (Blume) Merr.	Opiliaceae	-	Sipuchue	Tree	Leaf	Food plant
67	*Cymbidium* sp.	Orchidaceae	-	Tharodhi	Herbaceous	Leaf	used for tinnitus
68	*Calamus* sp.	Palmae	-	Likha	Climber	Shoot /stem	Shoot used for food, stem used for handicraft
69	*Caryota mitis* L.	Palmae	Jaggery palm, Toddy palm, Wine palm	Mopo	Tree	Fruit/ shoot	Fruit used takes to finish a mouthful of betels and areca nuts, shoot used for food
70	*Livistona speciosa* Kurz	Palmae	-	Lu	Tree	Leaf	Leaf used for thatching, spine used for toothache
71	*Rhapis siamensis* Hodel	Palmae	-	Mochi	Tree	Tab root/ stem/ fruit	Root used for carminative, steam used for handicraft
72	*Salacca wallichiana* C.Mart.	Palmae	-	Takho	Tree	Root/ fruit	Root have a morning sickness, fruit used for food

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
73	*Pandanus unicornutus* H.St. John	Pandanaceae	-		Shrub	Leaf	Used as mat and rope
74	*Ceratopteris thalictroides* (L.) Brongn.	Parkeriaceae	-	Wasipo	Herbaceous	Shoot	Food plant
75	*Passiflora foetida* L.	Passifloraceae	Wild Water Lemon, Love-in-a-mist	Nothiso	Climber	Leaf/fruit/ shoot	Food plant
76	*Platycerium holttumii* de Jonch. & Hennipman.	Polypodiaceae	Holttum's staghorn fern	Nochidakhu	Herbaceous	Whole plant	Ornamental plant
77	*Talinum fruticosum* (L.) Juss.	Portulacaceae	Surinum Purslane, Ceylon Spinach, Waterleaf	Bli	Herbaceous	Whole plant	Recover uterus in maternal, Anemia, Diabetes and mellitus
78	Morinda citrifolia	Rubiaceae	Noni, Great Morinda	Khu	Shrub	Leaf/fruit	Used as food, diabetes
79	*Paederia linearis* Hook. f.	Rubiaceae	-	Naenoaue	Climber	Leaf/root/ shoot	Leaf and root used for stomachic and shoot used for carminative

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
80	*Clausena* sp.	Rutaceae	-	Nomaa	Shrub	Tab root	Used for tonic
81	*Micromelum* sp.	Rutaceae	-	Tichoi	Shrub	Shoot/ leaf	Used in fever
82	*Murraya paniculata* (L.) Jack	Rutaceae	China box tree, Orange jusmine, Adaman satin wood	Phaekae	Shrub	Flower	Ornamental plant
83	*Zanthoxylum limonella* (Dennst.) Alston	Rutaceae	-	Hokocho	Tree	Tab root/ fruit	Root used for carminative, fruit used for spice
84	*Paranephelium longifoliolatum* Lec.	Sapindaceae	-	Lochopha	Tree	Fruit	Food plant
85	*Sapindus trifoliatus* DC.	sapindaceae	-	Maproe	Tree	Fruit/ trunk	Plant for household use
86	*Datura metel* L.var.metel	Solanaceae	Angel's Trumpet		Shrub	Leaf/ flower	Toxic, induce mental disorder and poison with the dog
87	Physalis minima	Solanaceae	Bladder Cherry	Chodipulu	Herbaceous	Fruit/ shoot	Food plant (sour)

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
88	*Byttneria andamanensis* Kurz	Sterculiaceae	-	Tayomue	Climber	Vine	Shampoo, Mix lime juice while menstruation for contraception
89	*Sterculia pexa* Pierre	Sterculiaceae	-	Chopulu	Tree	Bark/ follicle /root	Bark used to rope, fruit used for food, root used for tonic
90	*Aquilaria malaccensis*	Thymelaeaceae	Agarwood, Aloe wood, Calambac, Eagle wood tree, Lignum aloes	Sinumu	Tree	Heart wood/ bark	Heartwood used for malaria, bark used as rope
91	*Grewia laevigata* Vahl	Tiliaceae	-	Choprikhu	Shrub	Trunk	Used to building
92	*Microcos paniculata* L.	Tiliaceae	-	Topra	Tree	Heart wood/ leaf	Heartwood used to relieve asthma, leaf used for anthelmintic, ripe fruit for food
93	*Celtis timorensis* Span.	Ulmaceae	-	Sikwachi	Tree	Fruit	food plant
94	*Holoptelea integrifolia* Planch.	Ulmaceae	Indian Elm	Kapuekha	Tree	Trunk	Plant for household use
95	*Centella asiatica* (L.)	Umbelliferae	Asiatic pennywort	Nowome	Herbaceous	Leaf	Food plant

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
96	*Stachytarpheta jamaicensis* (L.) Vahl	Verbenaceae	-		Shrub		Medicine
97	*Cissus hastata* Miq.	Vitaceae	-	Soprachi	Climber	Leaf/ vine	Food plant (sour)
98	*Alpinia mutica* Roxb.	Zingiberaceae	-	Pokhue	Herbaceous	Rhizome/ flower/ stem	food plant
99	*Amomum dealbatum* Roxb.	Zingiberaceae		Poao	Herbaceous	Stem/ rhizome/ flower	Food plant
100	*Amomum testaceum* Ridl.	Zingiberaceae	Siam Cardamom, Camphor Seed	Pokawa	Herbaceous	Rhizome	Carminative and relieve toothache
101	*Zingiber zerumber* (L.) Sm.	Zingiberaceae	-	Kamoeydue	Herbaceous	Stem/ rhizome	Food plant and carminative
102			-	Nomaa	Herbaceous	rhizome	Drink with alcohol or mixed with honey milk used to back pain
103				Kamaka	Herbaceous	Root	Increase maternal milk

Table 5.3 Wild plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
104				Kopoithi	Herbaceous	Whole plant	Food plant
105				Sikapotasumae	Herbaceous	Seed	Used in centipede sting
106				Toethu	Climber	Leaf/shoot	Food plant
107				Tonoae	Herbaceous	Root	Enriching the blood as tonic
108				Bokochi	Herbaceous	Rhizome	Enriching the blood as tonic
109				Pothakho	Herbaceous	Whole plant	Food plant
110				Phowiwo	Herbaceous	Whole plant	Press for head, use to good blood flow, Usually menstruation

Table 5.4 Crop plant species in Karang homestead agroforests

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
1	*Allium ascalonicum* L.	Alliaceae	Shallot	Paklue	Herbaceous	Bulb	Food plant
2	*Eucharis grandiflora* Planch.	Amaryllidaceae	Amazon lily, Star of Bethlehem		Herbaceous	Whole plant	Ornamental plant
3	*Hippeastrum johnsonii*	Amaryllidaceae	Star lily	Phokochi	Herbaceous	Bulb	Hernia disease
4	*Bouea macrophylla* Griff.	Anacardiaceae	Plum mango	Takhochi	Tree	Fruit	Food plant
5	*Mangifera indica* (L.)	Anacardiaceae	Mango tree	Takho	Tree	Fruit/leaf/ flower	Food plant
6	*Annona muricata* (L.)	Annonaceae	Sour sop, GuanaBanga, Durian belanda	Aocha	Shrub	Fruit	Food plant
7	*Annona reticulata* (L.)	Annonaceae	Custard apple, Bullock's heart	Siphotorui	Shrub	Fruit	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
8	*Annona squamosa* L.	Annonaceae	Custard apple, Sugar apple, Sweet sop	Noyhna	Shrub	Fruit/leaf	Fruit used to relieve pains, less bloating breast and eat, leaf used for head louse removal
9	*Artabotrys* sp.	Annonaceae	-	Yopa	Climber	Flower	Ornamental plant
10	*Plumeria* sp.	Apocynaceae	Frangipani	Phorudi	Shrub	Flower	Ornamental plant
11	*Alocasia macrorrhizos* (L.) G.Don	Araceae	-	Katu	Herbaceous	Stem/leaf	Food plant
12	*Colocasia esculenta* (L.) Schott	Araceae	Elephant's Ear, Wild Taro, Yam	Katru	Herbaceous	Corm	Food plant
13	*Colocasia* sp.	Araceae	-		Herbaceous	Corm	Food plant
14	*Colocasia* sp.	Araceae	-	Khuenoemu	Herbaceous	Corm	Food plant
15	*Aloe vera* (L.) Burm.f.	Asphodelaceae	Star cactus,	Potamamae	Herbaceous	Leaf	Used in swelling and burns
16	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae	White silk cotton tree	Bekhu	Tree	Shoot/ flower /seed pod	Shoot and flower is food, cotton inside used for household

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
17	*Durio zibethinus* (L.)	Bombacaceae	Durian	Turuy	Tree	Fruit	Food plant
18	*Ananus bracteatus* Schult.f.	Bromiliaceae	Pineapple	Hne	Herbaceous	Fruit	Food plant
19	*Cereus hexagonus* Mill	Cactaceae	Torch thistle	Khokachuela	Shrub	Phylloclade	Food plant and ornamental plant
20	*Schlumbergera truncata* (Haw.) Moran	Cactaceae	-		Herbaceous	Fruit	food plant
21	*Carica papaya* L.	Caricaceae	Papaya, Pawpaw, Tree melon	Kuchi	Shrub	Fruit/ root	Fruit used for food, root used as alcohol component
22	*Chromolaena odoratum* (L.) R.M.King &H.Rob.	Compositae	-	Chophukui	Herbaceous	Leaf	Stop bleeding
23	*Tagetes erecta* L.	Compositae	-	-	Herbaceous	Flower	Ornamental plant
24	*Ipomoea batatas* (L.) Lam.	Convolvulaceae	Sweet potato	-	Herbaceous	Tuber	Food plant
25	*Ipomoea reptans Poir.*, syn. I. aquatica Forsk.	Convolvulaceae	-	-	Herbaceous	Stolon/ leaf	Food plant
26	*Coix sp.*	Cramineae	-	Blue	Herbaceous	Caryopsis	Ornamental plant
27	*Cucumis sativus* (L.)	Cucurbitaceace	Common cucumber	Dichi	Climber	Fruit	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
28	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceae	-	Lu	Climber	Fruit	Food plant
29	*Cucurbita pepo* L.	Cucurbitaceae	Pumpkin, Cushaw, Winter squash	Lukhe	Climber	Shoot/ flower / fruit	Food plant
30	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae	Bottle gourd	Da	Climber	Fruit/ shoot	Food plant
31	*Momordica charantia* (L.)	Cucurbitaceae	Bitter Gourd, Bitter Melon, Balsam Pear	Khokha	Climber	Fruit/ leaf	Fruit used for food, leaf used as contagious disease
32	*Trichosanthes anguina* (L.)	Cucurbitaceae	Snake cucumber, Snake gourd	Taleke	Climber	Gourd	Food plant
33	*Zehneria indica* (Lour.) Keraudren	Cucurbitaceae	-	Klini	Climber	Leaf	Food plant
34	*Sansevieria trifasciata* Prain var. trifasciata	Dracaenaceae	Mother-in-law's Tongue, Snake Plant	Khlipri	Herbaceous	Whole plant	Ornamental plant
35	*Baccaurea ramiflora* Lour.	Euphorbiaceae	-	Sapachue	Tree	Fruit	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
36	*Codiaeum variegatum* Blume.	Euphorbiaceae	Croton	-	Shrub	Leaf	food plant and ornamental plant
37	*Manihot esculenta* Crantz	Euphorbiaceae	Cassava, Manioc, Tapioca plant	Hnuaikabo	Shrub	Tuber	Food plant
38	*Phyllanthus acidus* (L.) Skeels.	Euphorbiaceae	Star gooseberry		Shrub	Fruit	Food plant
39	*Ricinus communis* L.	Euphorbiaceae	Castor bean, Castor-oil plant, Palma Christi	Mato	Shrub	Stem/ shoot	Stem used as earache, shoot used for food
40	*Sauropus androgynus* (L.) Merr.	Euphorbiaceae	Sweet Leaf Bush, Star Gooseberry		Shrub	Shoot	Food plant
41	*Cajanus cajan* (L.) Millsp.	Fabaceae	Angola pea, Congo pea, Pipeon pea	Klabu	Shrub	Root/ pod	Root used to relieve flatulence, pod used for food
42	*Bambusa ventricosa* McClure.	Gramineae	-	Wabo	Herbaceous	Trunk	Used to building
43	*Cymbopogon citratus* Stapf	Gramineae	Lemon Grass	Hwebue	Herbaceous	Rhizome	Used for spice

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
44	*Cymbopogon nardus* Rendle	Gramineae	Citronella grass	Hnoemu	Herbaceous	Leaf	Used for eradicate pest
45	*Imperata cylindrical* (L.) P.Beauv.	Gramineae	-	Kadi	Herbaceous	Whole plant	Leaf used for thatching
46	*Saccharum officinarum* (L.)	Gramineae	Sugar cane	Tipo	Herbaceous	Trunk	Food plant
47	*Setaria italica* (L.) P.Beauv.	Gramineae	Millet, Italian millet	Suy	Herbaceous	Caryopsis	food plant
48	*Zea mays* L.	Gramineae	Pop-corn, Field-corn, Sweet-corn	Buekhe	Herbaceous	Caryopsis	food plant
49	-	Gramineae	-	-	Herbaceous	Trunk	Plant for household use
50	*Eleutherine americana* (Aubl.) Merr.	Iridaceae	-	Pochosui	Herbaceous	Bulb	Used to feed, tonic and used for ritual
51	*Mentha cordifolia* Opiz.	Labiatae	Kitchen mint	Charahne	Herbaceous	Whole plant	Food plant, toothache
52	*Ocimum basilicum* (L.)	Labiatae	Common Basil, Sweet Basil	Photasua	Shrub	Leaf	Food plant
53	*Ocimum gratissimum* L.	Labiatae	-		Shrub	Flower	Ornamental plant
54	*Ocimum sanctum* (L.)	Labiatae	Holy basil, Sacred basil	Krapho	Shrub	Leaf	Food plant and deodorize

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
55	*Leucaena leucocephala* de wit	Leguminosae	Lead Tree, Jumbay, White Popinac	Phopi	Shrub	Root	Use in centipede sting
56	*Cassia fistula* L.	Leguminosae-caesalpinioideae	Golden Shower Tree/ Purging Cassia		Tree	Lomentum heartwood	Lomentum used as laxative
57	*Delonix regia* (Bojer ex Hook.) Rafin	Leguminosae-Caesalpinioideae	Flame Tree, Flamboyant, Royal Poinciana	Phodonoyong	Tree	Lomentum	Food plant
58	*Senna alata* (L.) Roxb.	Leguminosae-caesalpinioideae	Ringworm bush, Candelabra bush	Khasipho	Shrub	Leaf/ flower/ fruit	Leaf used for ringworm, flower and fruit used for purgative
59	*Tamarindus indica* L.	Leguminosae-caesalpinioideae	Tamarind	Sabokle	Tree	Fruit/ wood	Fruit used for food, bark used as emollient
60	*Acacia pennata* (L.) Willd.subsp.insuavis (Lace) I.C.Nielsen	Leguminosae	-	Prada	Climber	Shoot	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
61	*Pithecellobium dulce* (Roxb.) Benth.	Leguminosae-mimosoideae	Madras thorn, Manila tamarind		Tree	Fruit	Food plant
62	*Clitoria ternaten* L.	Leguminosae-papilionoideae	Blue pea, Butterfly pea	Sona	Climber	Flower	Used as a hair restorer
63	*Lablab purpureus* (L.) Sweet, syn. Dolichos lablab (L.)	Leguminosae	Bonavista bean	Kribue	Climber	Legume	Food plant
64	*SesBangia grandiflora* (L.) Poir.	Leguminosae-papilionoideae	Vegetable humming bird, SesBang, Agasta	-	Shrub	Flower/ shoot/ bark	Flower and shoot used for food, bark used in diarrhea
65	*Vigna unguiculata* (L.) Walp.	Leguminosae-papilionoideae	Cow pea	Patho	Climber	Legume	Food plant
66	*Lawsonia inermis* (L.)	Lythraceae	-	-	Shrub	Whole plant	Ornamental plant
67	*Gossypium herbaceousaceum* (L.)	Malvaceae	Cotton plant	Bae	Shrub	Seed pod	Used in ringworm, cotton wool used for clothing
68	*Hibiscus rosa-sinensis* L.	Malvaceae	Shoe flower		Shrub	Flower	Ornamental plant
69	*Hibiscus sabdariffa* (L.)	Malvaceae	Rozelle (Jamaica), Sorrel, Red sorrel	Baechi	Herbaceous	Pod/ flower	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
70	*Abelmoschus esculentus*	Malvaceae	Hibiscus esculentus	Bluebi	Herbaceous	Pod/ flower	Food plant
71	*Maranta arundinacea* L. var arundinacea	Marantaeae	West Indian arrow root	Aeruru	Herbaceous	Rhizome	Food plant
72	*Azadirachta indica* A. Juss., var. siamensis Valenton	Meliaceae	Neem tree	Kamakha	Tree	Shoot/leaf	Shoot used for food,leaf used for eradicate pest
73	*Artocarpus heterophyllus* Lam	Moraceae	Jack-fruit tree	Pahnuay	Tree	Shoot/ fruit	food plant
74	*Broussonetia papyrifera* (L.) Vent.	Moraceae	Paper mulberry	Thiduyo	Tree	Leaf	Used to feed
75	*Moringa oleifera* Lam.	Moringaceae	Horse redish tree, Ben oil tree, Drumstick Tree	-	Tree	Lomentum/ shoot	Food plant
76	*Musa* sp.	Musaceae	Bangana	Takuy	Herbaceous	Fruit	Food plant
77	*Eucalyptus* sp.	Myrtaceae	-		Tree	Trunk	Used to building
78	*Psidium guajava* L.	Myrtaceae	Guava	Naka	Shrub	Bark/leaf/ fruit	Bark and leaf astringent in diarrhea, fruit used for food

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
79	*Syzygium jambos* (L.) Alston	Myrtaceae	Rose apple	Nopo	Shrub	Flower	Food plant
80	*Averrhoa carambola* L.	Oxalidaceae	Carambola	Thimoto	Shrub	Fruit	Food plant
81	*Areca catechu*	Palmae	Areca palm, Areca-nut palm, Betel nut palm	Se	Tree	Fruit	White crust tongue
82	*Cocos nucifera* L.	Palmae	Coconut	Takho	Tree	Nut	Food plant
83	*Passiflora quadrangularis* L.	Passifloraceae	Giant granadilla	Diprewa	Climber	Fruit/ shoot	Food plant
84	*Piper bettle* L.	Piperaceae	Betel vine	Tablue	Climber	Leaf	Leaf in cough, urticaria, stop the bleeding and
85	*Piper sarmentosum* Roxb.	Piperaceae	-	Thakhotabrue	Herbaceous	Whole plant	Used for asthma, leaf used for food
86	*Ziziphus oenoplia* (L.) Mill	Rhamnaceae	-	Lekhomi	Tree	Fruit	Food plant
87	*Cinchona* sp.	Rubiaceae	Quinine	Troso	Tree	Tab root	Used for Malaria
88	*Citrus aurantifolia* (Christm.) Swingle	Rutaceae	Lime, Common lime		Shrub	Fruit	Food plant
89	*Citrus aurantitum* (L.)	Rutaceae	Bigarade, Bitter orange, Sour orange,	Panochue	Shrub	Fruit	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
90	*Citrus hystrix* DC.	Rutaceae	Leech lime, Mauritius papeda	Maklo	Tree	Fruit	Juice is used in stomachic and used as eating
91	*Citrus maxima* (Burm. F.) Merr.	Rutaceae	Pummelo, Shaddock	Soao	Shrub	Fruit	Food plant
92	*Litchi chinensis* Sonn.	Sapindaceae	Litchi	Siyapla	Tree	Fruit	Food plant
93	*Nephelium lappaceum* (L.)	Sapindaceae	Rambutan	Sakabue	Tree	Fruit	Food plant
94	*Manilkara achras* (Mill.) Fosberg	Sapotaceae	Sapodilla plum	Takhoeisitol aewa	Tree	Fruit	Food plant
95	*Capsicum annuum* L.	Solanaceae	-	Maehasapo	Shrub	Seed	Food plant
96	*Capsicum annuum* L. var. acuminatum Fingerh	Solanaceae			Shrub	Seed	Food plant
97	*Lycopersicon esculentum* Mill.	Solanaceae	Wild tomato, Love apple	Dubo	Herbaceous	Fruit	Food plant
98	*Nicotiana tabacum* L.	Solanaceae	-	Yaso	Herbaceous	Leaf/ root	Leaf used for roll tobacco, root used as alcohol component
99	*Solanum aculeatissimum* Jacq.	Solanaceae	-	Tako	Shrub	Fruit	Food plant
100	*Solanum torvum* Sw.	Solanaceae	Turkeyberry, Thai Pea Eggplant	Kothodi	Shrub	Fruit	Food plant

Table 5.4 Crop plant species in Karang homestead agroforests (cont.)

No	Botanical Name	Family	Common Name	Vernacular Name	Plant Habit	Part used	Used
101	*Petroselinum crispum* (Mill.) A.W. Hill	Umbelliferae	Garden parsley	Tapahnoe	Herbaceous	Whole plant	Food plant
102	*Alpinia galanga* (L.) Willd	Zingiberaceae	Greater Galangal	Aeche	Herbaceous	Rhizome	Used for spice
103	*Boesenbergia pandurata* Holtt	Zingiberaceae	Chinese key, Kunchi (Indonesia)	Ponue	Herbaceous	Rhizome	Used for spice plant
104	*Curcuma aeruginosa* Roxb.	Zingiberaceae	-	Posu	Herbaceous	Rhizome	plant for ritual use
105	*Curcuma longa* (L.)	Zingiberaceae	Turmeric	Tayo	Herbaceous	Rhizome	food plant
106	*Curcuma mangga Valeton* & Zijp	Zingiberaceae	-	Metru	Herbaceous	Rhizome	food plant
107	*Kaempferia parviflora* Wall.ex Baker	Zingiberaceae	-	Maelasu	Herbaceous	Rhizome	Used in ulcer
108	*Zingiber cassumunar* Roxb.	Zingiberaceae	-	Metalo	Herbaceous	Rhizome	Used for giddy, poultice or plaster on inflammation
109	*Zingiber officinale* Roscoe	Zingiberaceae	Ginger	Taae	Herbaceous	Rhizome/ leaf	Used for colic

5.4.1 Food plant species

The food plant species around Karang people's residences overall found 138 species (there are 4 plants that cannot indicate the scientific name), 52 families. The plants mostly were in Cucurbitaceae family around 8 species, in Zingiberaceae family 7 species and other species as figure 5-14. In addition, it was classified into 4 types of plant habit such as tree (30%), herbaceous (28%), shrub (23%) and climber (19%) respectively (Figure 5-15). The majority of these plants was from the flat area or cropped plant 80 species but the endemic plants or wild plants found only 58 species. The reason of Karang people planted different kind of plants was from their experience of food usage as well as many organizations promoted for example Kaeng Krachan National Park or agricultural district provided the perennial sprout to Karang people for household consumption; consequently, most plants were perennial trees. However, the plant diversity caused food security; in other words, the local people were not necessary to use only one plant species. They had seasonal plants for food; at the same time, the food security did not depend on only various types of food plants but also plant species diversity or knowledge in relation to part of plant for medicinal medicine as stem, root, leaf, bloom and fruit which have different cooking ways, such as boil, preserve, grill, and pound, and healing methods, such as drinking, eating, bathing and streaming that can cure many diseases. Besides, one symptom can use many plants for treatment. Each part of food plant that Karang people likely used was leaf, top, pod, fruit, shoot, stem, head, and climber which is able to cook in various ways such as boil, curry, grill, mingle or eating with chili. Some plants can eat fresh or make desert, be a fruit or eat instead of rice as Asiatic bitter yam, sweet potato, white yam and spiny yam.

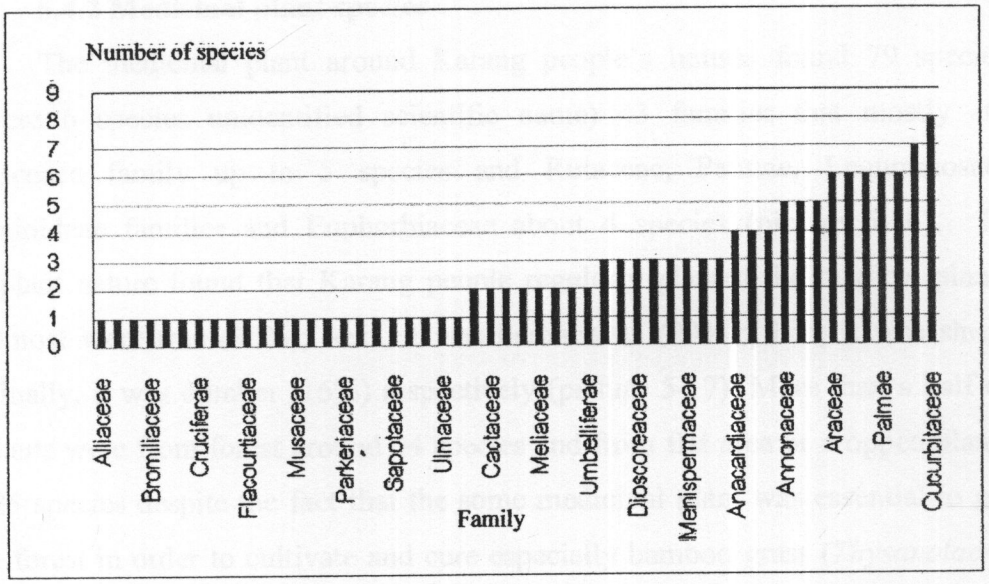


Figure 5.14 Food plant species, classified by family

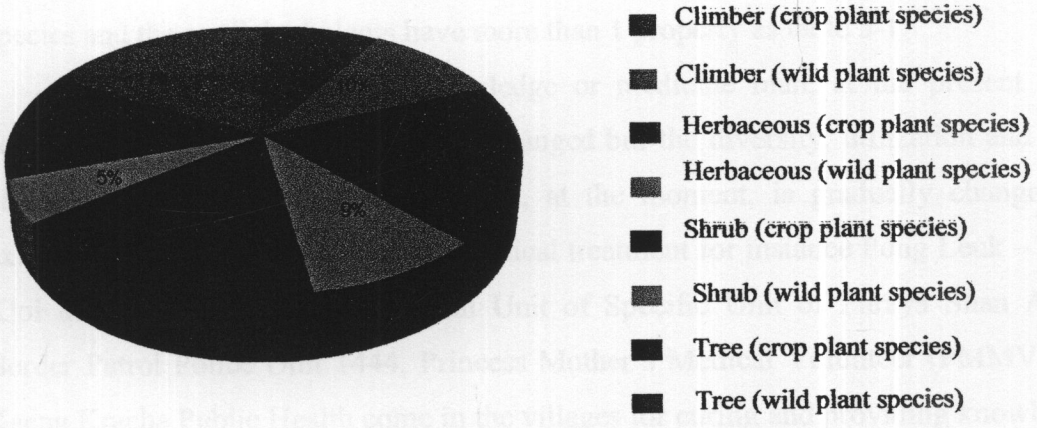


Figure 5.15 Food plant species, classified by plant habits

5.4.2 Medicinal plant species

The medicinal plant around Karang people's houses found 79 species (there were 6 species unidentified scientific name) 43 families that mostly are Zingiberaceace family up to 5 species and Rutaceae, Palmae, Leguminosae-Caesalpinioideae families and Euphorbiaceae about 4 species (picture 5-16). To classify plant nature found that Karang people regularly planted the medical plants which almost were tree (30%); next, it was herbaceous (29%); then, it was shrub (25%); finally, it was climber (16%) respectively (picture 5-17). More than a half of theses plants were from forest around 54 species and from flat area or cropped plants around 25 species despite the fact that the some medicinal plant was essential to get from the forest in order to cultivate and cure especially bamboo grass (*Thysanolaena maxima* Kuntze), (*Clausena* sp.), kamaka, sikapotasumae, tonoae, bowkowsi, porweewoo; therefore, the wild medicinal plant species greatly found 79 species: their property was medicine around 38 species, the food plants have the property as medicine around 27 species, the medicinal plants are for food and usage around 5 species and the medicinal plants have more than 1 property as table 5-1.

The local treatment knowledge or medicine man, at the present time, continuously adapted because of time changed but the diversity, utilization and local pharmacy still remained. The treatment, at the moment, is gradually changed by external factors, particularly current medical treatment for instance Pong Leuk – Bang Kloi Malaria Clinic Center, Medical Unit of Specific Unit of Phraya Suan Army, Border Patrol Police Unit 1444, Princess Mother's Medical Volunteer (PMMV) and Kaeng Kracha Public Health come in the villages for curing and providing knowledge, basic hygiene training so the current medical treatment wildly used together with the medicinal medicine cannot cure some disease. Even it could treat in the past, it was not effective at the moment; thus, Karang people treated the current medical treatment more and more. It can be seen from the local healing doctor information, using luuk tai bai (*Phyllanthus amarus Schumach.* & Thonn), before, was used for curing Malaria disease but this herbaceous is not effective at the moment because the virus develops to insist this medicinal medicine. However, the current medical treatment cannot cure some disease like the medicinal treatment such as chicken pox. Karang people believed that if boil ka kai (*Chloranthus erectus* (Buch-Ham.) Verdc.) for bathing

every morning and evening can treat the chicken pox disease better than go to hospital. Karang people, nowadays, integrate their local treatment and current medical treatment. If the symptom cannot be cured by medical treatment, they will treat by using herbaceous or ritual because the healing knowledge does not know only the medicine man but also everybody in the community like aspirin, analeptic or the medicine for woman who just delivered baby. Hence, to plant the herbaceouss around residences is like the household remedy which is like the indicator of transferring knowledge based and maintaining local wisdom.

The transferring knowledge of medicine man mainly transferred to the communities especially the household member but for the medicine required many herbaceouss or the herbaceouss having special property or toxic herbaceouss, this knowledge transferred to their children or the communicator chose the closest, trusted, and moral person. It takes time to find the person who has all these qualification and the doctor sometimes already passes away before transferring this knowledge to their children. In some case, the doctors do not dare to transfer their knowledge because they are afraid that they will give the wrong procedure or use inappropriate way together with their children have an education, have scientific knowledge and are cured by the current medical treatment as a result they less pay attention to conserved local wisdom in terms of medicinal healing caused the number of medicine man reducing.

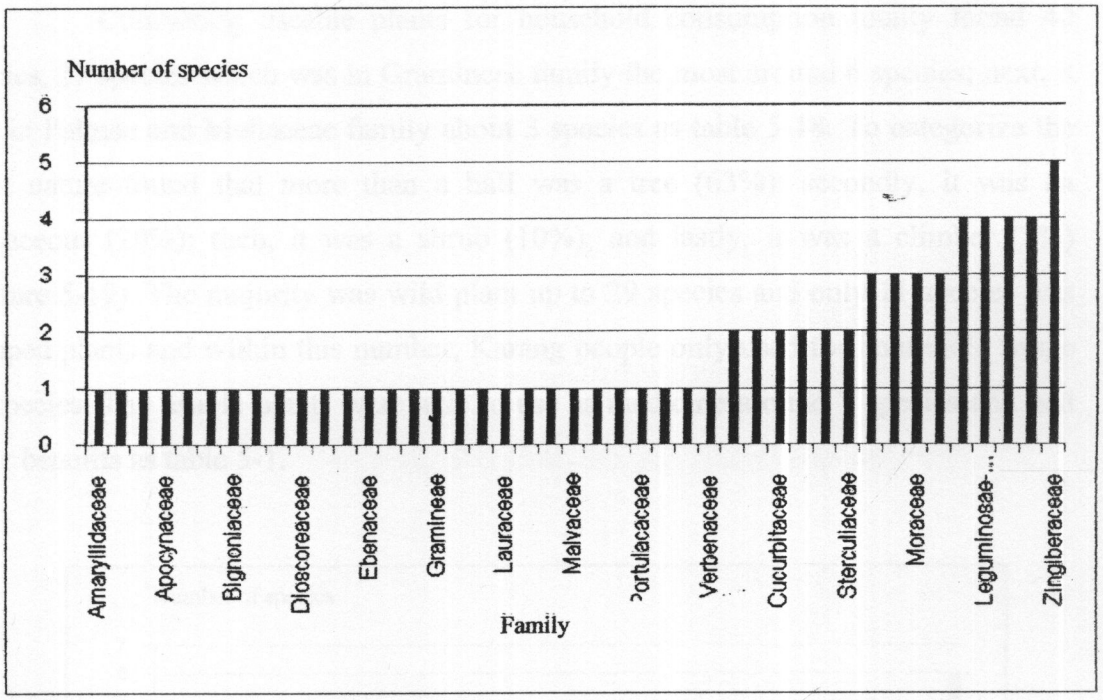


Figure 5.16 Medicinal plant species, classified by family

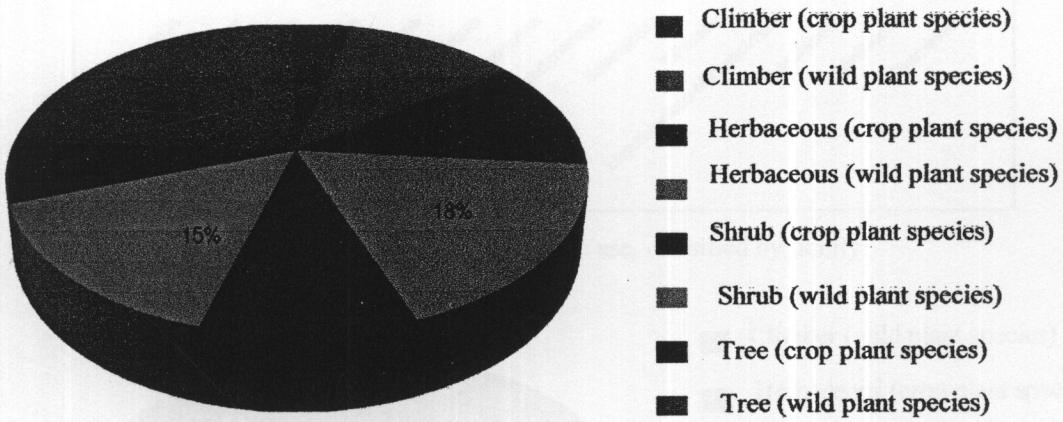


Figure 5.17 Medicinal plant species, classified by plant habits

5.4.3 Plant species for household use and decoration

Cultivating useable plants for household consumption totally found 40 species, 27 species which was in Gramineae family the most around 6 species; next, it was in Palmae and Meliaceae family about 3 species as table 5-18. To categorize the plant nature found that more than a half was a tree (63%); secondly, it was an herbaceous (20%); then, it was a shrub (10%); and lastly, it was a climber (7%) (Picture 5-19). The majority was wild plant up to 29 species and only 11 species was cropped plants and within this number, Karang people only used for household usage 20 species. The usable plants were able to use as medicine around 7 species and had other benefits as table 5-1.

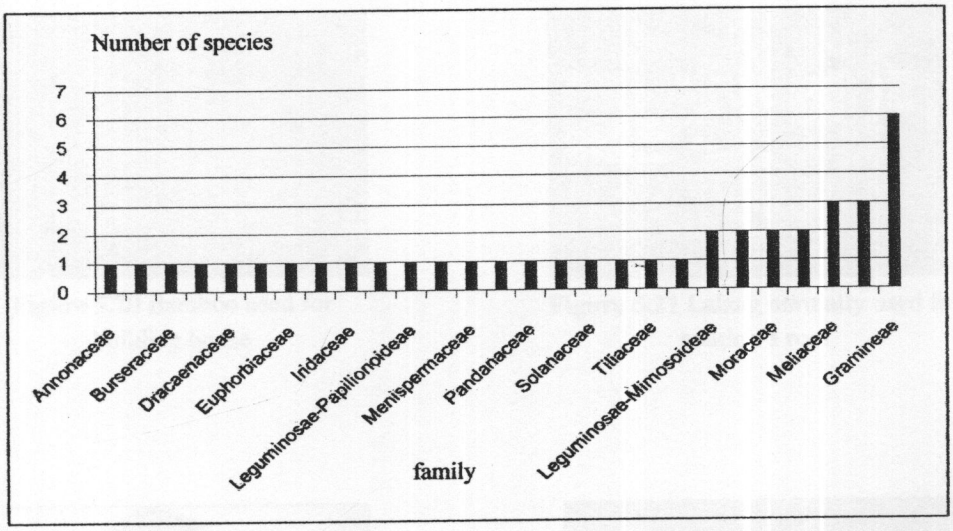


Figure 5.18 Plant species for house use, classified by family

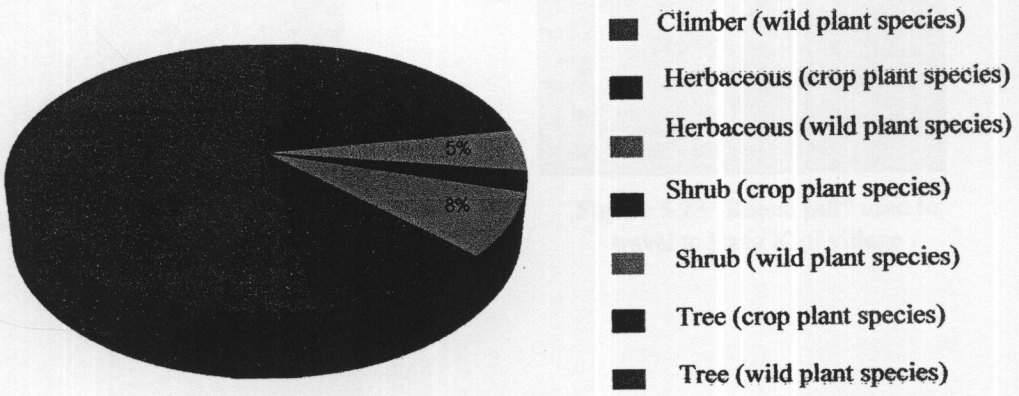


Figure 5.19 Plant species for household use, classified by plant habits

Besides, Karang people planted the plant from upper Bang Kloi or from forest nearby for building and renovation their houses especially bamboo considering is important for them due to the fact that the bamboo was used for building house by employing phai phak (*Hasskarliana* (Kurz) Backer ex K. Heyne) as a main component of building house because the characteristic of this tree has high stem, has no throne and generally grows sparse forest and near river; thus, it is convenient and easy for transportation. This bamboo vastly grows at Petchaburi River and upper Bang Kloi. Bai ko and lalang normally are used for making a roof but some household use galvanized iron for making roof.

Figure 5.20 Bamboo used for building house

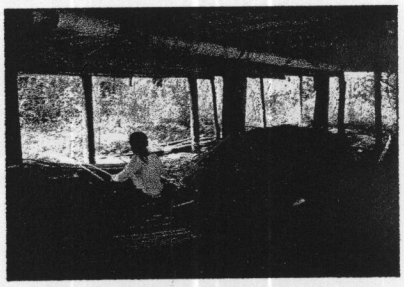


Figure 5.21 Lalang normally used for making a roof

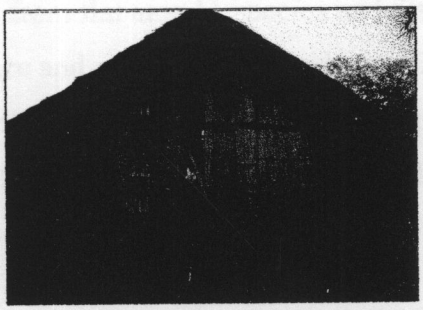


Figure 5.22 Karang's house

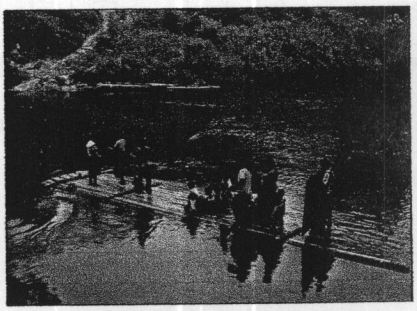


Figure 5.23 "Round raft" used to travel to Bang Kloi village

Figure 5.24 "Tae Na" musical instrument of Karang

Figure 5.25 "Norae" used for honey collection

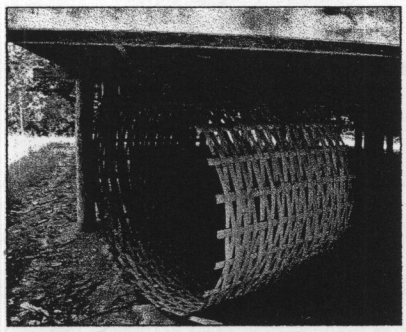


Figure 5.26 "Pa Lu" used for rice storage after harvesting

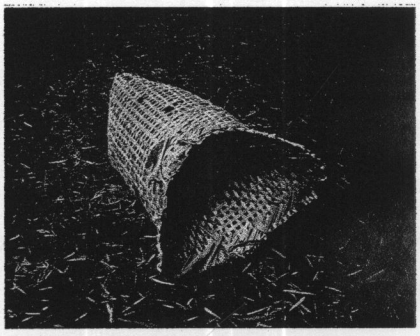


Figure 5.27 "Buea" used to catch fish

Ornamental plant

Sixteen species were found in 14 families. A large number of shrubs were found following by herbaceous and climber respectively as well as these plants mostly were from flat area 11 species and 5 species of wild plant. They planted these plants as a fence and some species can be medicine such as slender lady palm (*Rhapis siamensis* Hodel). Moreover, these ornament plants were not only for decoration but also for healing like their root can reduce flatulence plus with there were many advantages from these ornament plants as table 5-1.

Figure 5.28 Ornamental plant species used as fences to demarcate household boundary

Figure 5.29 *Platycerium holttumii* de Jonch. & Hennipman fern for decoration

5.4.4 Plant species for rituals and toxics

Yos Santasombat (1999) mentioned in the book "Ecological Ethnicity, Bioresourses and Community Rights in terms of local knowledge towards natural resource management of ethic groups who used their belief and their tradition to manage resources". The belief about holy power especially in the forest created forest and natural resources usage tradition including raise the forest value awareness as this research found that Karang people put the umbilical cord of new born baby in the bamboo tube called "bu de bo" and graved it at the big tree having vertical stem and without climber. They believed that "Kwan" of the new born baby is at the tree if the tree is very strong and vertical and its stem is big, the baby will have a good health; therefore, no one can log this tree. This belief is another measurement for maintain the forest and cultivates the awareness of conserved forest as well as it is the connection between human and forest for many generations.

The main plant for ceremony of Karang people was betel nut (*Areca catechu*) and betel (*Piper bettle* L.) and Karang people likely used marigold (*Tagetes erecta* L.) and cockscomb (*Cnestis palala* (Lour.) Merr.) as a flower for offering. Moreover, they have the ritual which uses rice especially sticky rice as a main component of ceremony. The prosperity plant or the plants for preventing evil mostly are in Iridaceae family such as wan hon daen (*Eleutherine Americana* (Aubi.) Merr.) and turmeric (*Curcuma aeruginosa* Roxb.). They plant these plants same direction with head of bed or bring it during going to forest in order to protect them from danger.

Furthermore, there are 3 species of toxic plants: lumpongpa (*Datura metel* L.var.metel), maduea plong (*Ficus hispida* L.f.), haw si na (Karang language). If people eat these plants too much, it can harm their life; for example if people eat lumpongpa too much, it can cause insane, if people eat a lot of maduea plong, it can cause deaf and in case of haw si na, people r fainting if they eat haw si na, their symptom will be more severe.

From the context of Karang communities, both communities have culture, tradition base on thinking and belief supernatural which is mechanical to control behavior and way of living of people in the communities and to maintain natural resource which is the basic needs for their dutiful and respectful living through their ritual. Karang people used the plants which they eat and use be the symbol or representative for offering the spirit particularly betel nut, betel, and rice that concerned as the main plants of every rituals. If these rituals still carry on, the plants, which use for these ceremonies, will be with Karang people. It can be said that the belief and rituals are not always ridiculous if it is a part of local wisdom to use natural resource in a sustainable way.

5.4.5 Knowledge regarding planting and maintaining techniques

In terms of knowledge base development related to utilization and conserved plant species of Karang people presented that the reaction between human and nature, not only the consumption but also choosing plants which have both advantage and disadvantage (toxic) including breeding technique development and household consumption by base on experience, observation and trial; for instance, to plant climber, Karang people believed that if they directly put the plant into soil, the water inside stem will come out all and it will die; on the other hand, if they plant by rise up both side of climber in bend shape as upside down bell which the water is around the curve so the root can grow very easily. The plants cultivated like this was castor-oil plant (*Byttneria andamanensis* Kurz), bamboo grass (*Tiliacora triandra* (Colebr.) Diels), betel (*Piper Bettle* L.),som kaw(*Cissus hastate* Miq.), and Malabar spinach (*Basella rubra* L.. Another knowledge base development of Karang people was plant propagation Karang people believed that the tree has soft bark which is easier to do plant propagation than hard bard or resin. The tree which is easy for do

plant propagation was such as rambutan (*Nephelium lappaceum* L.) and lemon (*Citrus aurantifolia* (Christm.) Swingle). It is noticeable that Karang people received the experience from plant characteristic; for example, to separate taro from elephant ear by leaf and stick is that the taro has a dark spot at the middle of leaf and leaf stalk is white color but the elephant ear has no spot and green leaf stalk.

The agricultural system, such as paddy rice system, plants various types of plants in paddy field; for instance corn (*Zea mays* L.), chili (*Capsicum annuum* L. var. acuminatum Fingerh.), cockroach berry (*Solanum aculeatissimum* Jacq.), yard long bean (Vigna unguiculata (L.) Walp.), pumpkin (*Cucurbita pepo* L.) and bottle gourd (*Lagenaria siceraria* (Molina) Standl.), which can cause high risk of disease spread and pest because each species have different capability to resist disease, and insect. However, this technique is the most useful because the growing period and harvesting time of each plant are different. Thus, during waiting for harvest one species can harvest another plant products, this method reduces risk in terms of food security and gathers the genetic resource. Ratchaburi Rice Research Center and Ratchaburi Rice Seed Center, Rice Department cooperating with life quality development committee centre in order to promoted rice cultivation development at Baan Bang Kloi-Baan Pong Leuk on 11 June 2008 for enhancing the rice quality.

5.4.6 The adaptation of Karang people to the current situation

From the survey of the 210 plant species in Karang homestead agroforests, the number of economic plant species was found of 88 species, accounting for 40% of the total plants around the houses. Those were regarded as the important economic plant species related to horticulture, crops, vegetables and flowering plants (Surachai Matchacheep, 1992) of 67 species and the forest economic species (Crops Operation Center, Department of National Plants, Wildlife and Plant Conservation) of 21 species. The reason of planting economic plants was the economic pressure from outside. This research also found that Karang people planted white silk, corn, chili and banana more than the plants provided by the national park staffs because these plants have a good price and cultivated rice is not effective because they have to wait for rainfall. Therefore, Karang people mainly planted the economic plants for their income.

The adaptation and protection biodiversity of Karang people have various characteristics due to the land and resource control by government; for example the medicine man planted some herbaceouss which often use around their house due to save time and the local people planted the food plants around their houses unlike the previous time that they had to go to the forest. They highly keep the plant species and species conservation for seasonal crops; for instance collecting rice species, chili species, corn species or vegetable species to plant around their house such as turmeric, galangal, krachai, lemon grass and shrubs at the open space as well as the climbers like red fruit passionflower, Malabar spinach and betel which generally planted around fences. Some plant species put in pot or some unusable containers then place it at terrace to prevent duck and chicken and to be easy for collecting onion.

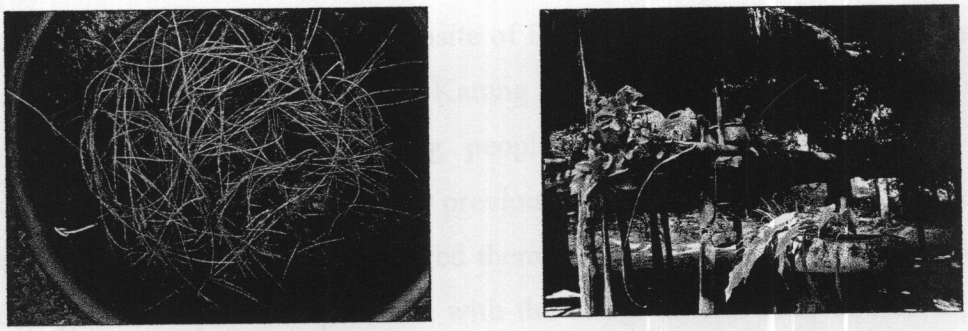


Figure 5.30 Growing plants in unusable containers

The wisdom passed for many generations until it became tradition which presented the dynamic knowledge system development and the adaptation to the circumstance in order to have food security and to survive by base on their indigenous knowledge and modern technique to create the diversity and retain the plant species.

5.5 The sustainable conservation approach and plant species utilization from homestead agroforest

The study of plant species diversity of Karang people which grew at homestead agroforest found that the diversity was in low/no impact but the cultivated plant species diversity was gradually changed because of many organizations namely Kaeng Krachan National Park promoted Karang people to grow perennial trees after set up the village in 1997 or Kaeng Krachan district agricultural organization also supported the perennial trees along with the market system that greatly demanded agricultural product. This was another factor that made Karang people increasingly grew the industrial crops and the different settlement duration. Baan Pong Leung reserved the land for agriculture before it was declared as national park in 1996. Furthermore, the scattered Karang people at Petchaburi head water were immigrated to the left side of Petchaburi River (opposite of Baan Pong Leung) and the national park allocated the permanent land for the Karang people who immigrated to this area in order to prevent migration. Karang people greatly brought some wild plants particularly medicinal plant from their previous residence to new place. Besides, they still believed supernatural that protected them from danger so they had the ritual for expressing their respect and gratitude with the things around their houses especially betel and betel nut or popped rice and flower which was the symbol of respectiveness. When there was the permanent relocation, the way of living of Karang people still depended on ritual plant for their rituals. The form of ritual was a part of forest management and the sustainable way of Karang people.

5.5.1 The traditional management of plant species

1) The utilization of plant species for ritual concerned as conserving these plant species at their homestead agroforest in order to be convenient for usage such as betel, betel nut, cockscomb flowers or marigold which was used in Kalong Kaow or weaving thin wood bird for sending spirit that considered as increasing the plant species diversity.

2) The utilization of plant species for cast lots such as using rice for selecting paddy field or for building house. After declared national park, Karang people had to do farming at the allocated land so the land casting lots ritual was adapted by casting lots

at their area. Karang people separated their land into plot, each plot was rotated in every 2-3 years in order to naturally restore.

3) The utilization of auspicious trees for protecting such as planting turmeric at the same direction with head because this plant was able to protect their descendents from danger through bringing it with them when they went to the forest. This belief conserved plant species in another way.

4) The selecting plant species strategy for forest conservation such as keeping the new born's navel in bamboo tube and placing it at the big tree which was the trunk straight and strength. They believed that child spirit was in the tree if there was anybody cut down this tree, the child's spirit would castaway or the kid would get sick. Therefore, they had the strategy for logging down the trees which regarded as conserving trees together with increasing the chance of ramifying and balancing forest ecosystem.

5.5.2 Local wisdom for sustainable utilization of plant species

There was the knowledge of plant species utilization without the rituals for example

1) The knowledge of sustainable collecting food plant by harvesting only the roots or the stem in the ground such as potatoes, wild yam, Karen sago, and ginger or galangal oil through digging in round shape and far from the stem around 5-10cm. because if they dug near the plant, it would make the plant die or torn it. They dug down around 30-50 cm. and found the roots; then, they slowly dug or broke up which may come up around 3-5 heads. They selected only the big one and retuned the small one in the hole.

2) The knowledge of sustainable utilization especially bamboo which considered as the important wood for building house. The bamboo (*Hasskarliana* (Kurz) Backer ex K. Heyne) was vastly used that was collected from upper Baan Kloi and the upstream of Petchaburi River. They used the imperfect stem which was in line with the Office of Economic Research and Forest Products, Royal Forest Department in 2004 mentioned that cutting the small stem increased the number of bamboo shoot rather than un-cutting and even the Karang people did not replant, their method was the appropriated sustainable bamboo utilization.

The transferring knowledge based and thinking of Karang people in terms of biodiversity management did not record or note down but it was transferred by their

think process and the cultural performance of community through their belief and local wisdom; moreover, the most important was the study through their agriculture system as seen from every agricultural producing process of Karang people had delicacy in their culture and belief that linked between human and natural resources, human and animal or the holy spirit that was the owner of nature. Even anybody could not find the reason of their ancestor ritual, they still abided because these rituals and knowledge based became their culture to maintain and truly balance the forest.

CHAPTER VI
RESULT:
WILD PLANT SPECIES CONSERVATION OF KARANG PEOPLE

The wild plant species conservation role of Karang people in this case means cultivating wild plants around their houses for utilization in various aspects such as consumption, herbal, utilization, decoration and ritual. If there is no planting or breeding, these plant species will die or become extinct. Therefore, to maintain plant diversity in households is related to the demographic characteristic, economic and social condition as follows.

6.1 Maintaining plant diversity in homestead groforests

The study of wild plant species diversity in Karang people' homestead agroforests is useful in various aspects. The influenced factors on increasing biodiversity were economic and social characteristics at household and community level. Therefore, the study found out factors influencing households and communities' decision to collect wild plant species for planting in their homestead agroforests. The household demographic, economic and social characteristics were tested in relation to conserving plant species diversity in households. The household and community decision on planting wild species was set as dependent variables, including 3 variables:

1. The number of wild plant species (species richness) indicated the number of each wild plant species collected by Karang people to plant in their areas. But the number of species grown did not mean that areas were planted with species diversity because growing one plant species just increased the number of that plant species rather than increased the number of plant diversity. The significance of increasing was number of plant species.

2. The proportion of number of wild plant species to crop plant species implied the comparative amount of wild plant species versus crop plant species because some households collected more wild plants to grow in their homestead agroforests than crop plants but some households grew wild plant less than crop plants; therefore, it indicated the diversity between wild plants and cropped plants which was explained as followed

(1) The number value of less than 1 means that the number of wild plant species is less than the number of crop plant species.

(2) The number value of equal 1 means that the number of wild plant species is equal the number of crop plant species.

(3) The number value of more than 1 means that the number of wild plant species is more than the number of crop plant species.

3. The plant diversity index examined the plant species diversity between the number of individuals of each plant species and the number of total individuals of all plant species, which were grown. The total plant species diversity of Karang people planted around their house was calculated by Shannon – Wiener Index (H)

$$\mathbf{H = -\sum (Pi)(lnPi)}$$

When H = the plant diversity index

Pi = the fraction of individuals belonging to the i-th species

ni = the numbers of individuals in the i-th species

N = the total of overall individuals of all plant species

The plant community in tropical zone, in general, was between 1.5 and 3.5 Dachanee Emphandhu (2005). If the plant species diversity index is lowers than 1.5, it is considered that the plant community is impacted and it is necessary to conserve and rehabilitate.

Table 6.1 Shannon – Wiener Index (H) of plant species diversity

Level of Impact	Standard value
No/ low impact	> 3.5
Medium impact	1.51-3.50
High impact	<1.51

The plant diversity index result was compared with the impact level criteria of plant diversity by Shannon – Wiener Index (H) as illustrated in table 6-1. The result can indicate how much the plant cultivation of Karang people at their homestead agroforests increased plant species diversity.

Table 6.2 The total plant species diversity in Karang homestead agroforest

	Mean	**Standard deviation**	**Minimum**	**Maximum**
The number of total plant species of Karang people from these 2 villages	**30.7**	**13.8**	**6.0**	**69.0**
- Bang Kloi	33.8	15.0	8.0	69.0
- Pong Leuk	27.7	12.0	6	66
The number of wild plant species of Karang people from these 2 villages	**10.0**	**5.6**	**0**	**26.0**
- Bang Kloi	11.5	5.8	1.0	26.0
- Pong Leuk	8.4	5.0	0	24.0
The number of crop plant species of Karang people from these 2 villages	**20.8**	**9.0**	**3.0**	**45.0**
- Bang Kloi	22.3	9.8	5.0	45.0
- Pong Leuk	19.4	8.0	3.0	42.0
Diversity of total plant species of Karang people from these 2 villages	**0.02**	**0.03**	**0**	**0.22**
- Bang Kloi	0.03	0.05	0	0.22
- Pong Leuk	0.01	0.03	0	0.14
Diversity of wild plant species of Karang people from these 2 villages	**0.04**	**0.04**	**0**	**0.21**
- Bang Kloi	0.05	0.04	0	0.21
- Pong Leuk	0.03	0.03	0	0.15
Diversity of crop plant species of Karang people from these 2 villages	**0.04**	**0.04**	**0**	**0.24**
- Bang Kloi	0.04	0.04	0	0.22
- Pong Leuk	0.04	0.04	0	0.24
The proportion of number wild plant species to number of crop species in 2 villages	**0.5**	**0.2**	**0**	**1.6**
- Bang Kloi	0.5	0.2	0.1	1.6
- Pong Leuk	0.5	0.2	0	1.3

6.1.1 The number of wild plant species (species richness)

From surveying the cultivated plant species of Karang people from Baan Bang Kloi and Baan Pong Leuk around their houses for utilization, 109 crop plant species and 110 wild plant species were found. The highest number of total plant species (both wild and crop plant species) grown in household homestead agroforest was 69 species. It was found in Baan Bang Kloi. The lowest number of plant species grown in household homestead agroforest was 6 species found in Baan Pong Leuk. Moreover, the average cultivated wild plant species was 10 species. One household in Baan Bang Kloi was found growing26 species and 2 households in Baan Pong Leuk do not grow any wild plant species. Furthermore, comparing 2 villages, 88 wild plant species were found at Baan Bang Kloi and 82 species were found at Baan Pong Leuk. Baan Bang Kloi in average cultivated 12 species of wild plants more than the other village. On the other hand, the average cultivated wild plant species at Baan Pong Leuk was 8 species.

Both villages grew crop plants for household consumption only. The average of crop plant species found in both villages was 21 species and the maximum of around 45 species was found in one household at Baan Bang Kloi and the minimum of 3 species was found in one household at Baan Pong Leuk. The study found overall 100 species of crop plants at Baan Bang Kloi and around 98 species at Baan Pong Leuk. The average value of cultivated crop plant species found at Baan Bang Kloi was 22 species which was higher than the average of Baan Pong Leuk as can be seen in table 6-2.

6.1.2 The plant species diversity

The plant species diversity index was analyzed using the fraction of individuals belonging to each species and the total plant species which could be calculated by Shannon-Wiener Index (H) equation. The index of total plant species diversity of both villages was 3.94, whereas the index of wild plant species diversity and the crop plant species diversity is 3.03 and 3.50 respectively. The index is high meaning that the areas were not disturbed (No/Low impact) because the plant community in tropical zone generally has the index between 1.5 and 3.5 Dachanee Emphandhu (2005).

Total plant species diversity index at Baan Bang Kloi was 3.77. The index of wild plant species diversity equals 2.82 whereas the index of crop plant species diversity equals 3.32. In addition, total plant species diversity index at Baan Pong Leuk was 3.79 while the wild plant species diversity index was 2.97 and crop plant species diversity index was 3.37.

Table 6-2 presented that the overall plant species and wild plant species mostly were found in Baan Bang Kloi but the crop plant species were found most at Baan Pong Leuk (the value was underlined at table 6-2). The result corresponded with the value of beta diversity. The crop plant species had economic value which were found at Baan Pong Leuk more than Baan Bang Kloi. The different duration of village settlement and other factors would be mentioned later.

6.1.3 The proportion of number of wild plant species to the number of crop plant species

The study of the proportion of number of wild plant species to the number of crop plant species found that only one household in each village has higher number of wild plant species than crop plant species. One household at Baan Pong Leuk was found growing wild plant species in an equal amount to crop plant species. The proportion at village level showed the value of 0.5 for Baan Bang Kloi and of 0.4 for Baan Pong Leuk, which cultivated wild plant species around their residences less than crop plant species. The highest ratio of 1.6 was found in Baan Bang Kloi whereas the lowest ratio of 0 was found in 2 households of Baan Pong Leuk, which do not grow wild plant species, as shown in table 6-2.

6.2 The relationship of household demographic, economic and social characteristics to plant species diversity conservation in Karang homestead agroforests

This part of research studied at household level due to its decision effected on cultivated plant around houses for utilization. The heads of household mainly made a decision about growing plants around their houses; thus, household demographic,

economic, and social factors together with community-level factor (village) influenced on areca palming decision in terms of collecting plants for cultivation in homestead agroforest. This research found that most heads of household were men whose age were around 19-79 years old and they mostly were illiterate and their main occupation was a farmer and some households had minor occupation as worker. Besides, number of household members was between 4-7 people and the number of household workers was generally 2 persons. The minimum number of worker was 1 person per household but the maximum number of workers was 12 people per household. The highest household income was over 35,000 Baht per year and the expense was more than 15,000 Baht per year. The overview of income and expense of Baan Bang Kloi was higher than Baan Pong Leuk. Both villages mostly had no dept. The Karang people mostly collected wild plant species from upper Bang Kloi to grow in their homestead agroforests. They had to spend 1-2 days with total distance around 25 Km., for travelling to the source, as shown in table 6-3.

Table 6.3 The household demographic, social and economic characteristics of Baan Bang Kloi and Baan Pong Leuk

Variable	Percent	Mean	S.D.	Minimum	Maximum	Expected relationship
Head of household factors						
Gender						
-Male	73.6					+
-Female	26.4					
Age (Year)		43	13.2	19	79	+
Level of education (Year)		2	4	0	12	-
Household level socio-economic factors		3	2	1	12	+
Household member						
Main occupation	62.3					
-Agriculture	4.7					
-Handicraft	18.9					
-Work as employee	7.5					
-Staff in national park	6.6					
-Other						
Minor occupation	64.2					
-none	10.4					
-Agriculture	21.7					
-Work as employee	3.8					

economic, and social factors together with community-level factor (village) influenced on areca palming decision in terms of collecting plants for cultivation in homestead agroforest. This research found that most heads of household were men whose age were around 19-79 years old and they mostly were illiterate and their main occupation was a farmer and some households had minor occupation as worker. Besides, number of household members was between 4-7 people and the number of household workers was generally 2 persons. The minimum number of worker was 1 person per household but the maximum number of workers was 12 people per household. The highest household income was over 35,000 Baht per year and the expense was more than 15,000 Baht per year. The overview of income and expense of Baan Bang Kloi was higher than Baan Pong Leuk. Both villages mostly had no dept. The Karang people mostly collected wild plant species from upper Bang Kloi to grow in their homestead agroforests. They had to spend 1-2 days with total distance around 25 Km., for travelling to the source, as shown in table 6-3.

Table 6.3 The household demographic, social and economic characteristics of Baan Bang Kloi and Baan Pong Leuk

Variable	Percent	Mean	S.D.	Minimum	Maximum	Expected relationship
Head of household factors						
Gender						
-Male	73.6					+
-Female	26.4					
Age (Year)		43	13.2	19	79	+
Level of education (Year)		2	4	0	12	-
Household level socio-economic factors		3	2	1	12	+
Household member						
Main occupation	62.3					
-Agriculture	4.7					
-Handicraft	18.9					
-Work as employee	7.5					
-Staff in national park	6.6					
-Other						
Minor occupation	64.2					
-none	10.4					
-Agriculture	21.7					
-Work as employee	3.8					

Table 6.3 The household demographic, social and economic characteristics of Baan Bang Kloi and Baan Pong Leuk (Cont.)

Variable	Percent	Mean	S.D.	Minimum	Maximum	Expected relationship
Household income(Baht)		64,274	56,910	3,600	275,520	-
Household expense (Baht)		25,325	17,709	2,308	90,000	-
Debt (Baht)		8,440	8,564	200	20,000	-
Source of plants species	50.0					
-collected by themselves	18.9					
-bought	8.5					
-relatives/neighbor	22.6					
-not cultivated						
Distance from dwelling to forest areas		19	10	0	25	-
Community level factor						
Village						
-Bang Kloi mu 1	49.1					
-Pong Leuk mu 2	50.9					+

The relationship between household level together with community level factors and wild plant species diversity in Karang homestead agroforest was analyzed by employing Multiple Regression to test the relationship between 1 dependent variable and multiple independent variables (over 2 variables) with the significance level at 0.05. The independent variables were consisted of the head of household factor, such as gender, age, level of education; socio-economic factor, such as the number of household worker, main occupation and minor occupation, household income, household expense, household dept, source of plant species, the distance from residence to forest area; and community factor, such as the different village settlement duration and settlement characteristic. The dependent variables included the number of plant species (species richness), plant species diversity index, and the ratio of number of wild plant species to the number of crop plant species in their homestead agroforests. The expected result of the analysis between independent variables and dependent variable was as followed

Household level factor

1. The different factor of head of household is expected to affect the cultivated plant species diversity by Karang people

1.1 Male household heads would grow wild plant species more than female

1.2 Age of household heads would have the positive effect on plant species diversity. The older the heads of household, the more species are grown in their homestead agroforests.

1.3 The level of education of household heads would have a negative impact on cultivated plant diversity. The lower education the heads of household had, the more species are grown in their homestead agroforests.

2. The different socio-economic factor is expected to influence the cultivated plant species diversity of Karang people

2.1 If the households had plenty of household workers, high number of plant species would be grown in their homestead agroforests.

2.2 The households whose main occupation was farmer would grow more plant species in their homestead agroforests.

2.3 The households whose minor -occupation was farmer would grow more plant species in their homestead agroforests.

2.4 The households which had low income would grow more plant species in their homestead agroforests.

2.5 The households which had low expense would grow more plant species in their homestead agroforests.

2.6 The households which had low dept would grow more plant species in their homestead agroforests.

2.7 The households collected wild plant species by themselves would grow more plant species in their homestead agroforest.

2.8 The households which was near the forest area would grow more plant species in their homestead agroforests.

Community level factor

Baan Pong Luek, settled for a long time with scatter settlement characteristic, would conserve more plant species diversity in their homestead agroforests.

6.2.1 The relationship of household and community level factors and the number of plant species in homestead agroforests

Table 6.4 Multiple regression coefficients of independent variables for the number of plant species (species richness)

	Number of plant species					
	Total plant species		Wild plant species		Crop plant species	
	b (S.E.)	B	b (S.E)	β	b (S.E)	β
Independent variables						
Village	-7.48 (2.55)**	-0.27	-3.33 (1.08)**	-0.30	-3.87 (1.64)*	-0.21
Gender (Male)						
Age (Year)	0.27 (0.10)**	0.25			0.21 (0.06)**	0.30
Level of education (Year)						
Household member						
Main occupation (Agriculture)	9.74 (3.1)**	0.33	2.79 (1.13)*	0.24	6.11 (2.00)**	0.32
Minor occupation (Agriculture)	11.49 (4.59)*	0.26			7.86 (2.96)**	0.27
Household income (Baht)						
Household expense (Baht)						
Debt (Baht)	0.01 (0.01)*	0.18			0.01 (0.01)*	0.20
Source of plant species						
Distance from dwelling to forest areas (Km.)						
(Constant)	14.37 (4.74)		9.89 (0.99)		8.31 (3.06)	
Number of observations (N)	106		106		106	
R^2	0.25		0.12		0.26	

Note. *p <0.05, **p <0.01, ***p <0.001

The number of plant species

The number of total plant species can be significantly explained by village, age of household heads, agriculture occupation, debt condition. These factors significantly influenced household heads to collect wild and crop plant species to grow in their homestead agroforests with the significance level of 0.05. R^2 is 0.25 meaning that 25% of the variation in the number of total plant species can be explained by the model.

The number of wild plant species in homestead agroforests can be significantly explained by village and the main occupation as farmer at the

significance level of 0.05. R^2 is 0.12 meaning that 12% of the variation in the number of wild plant species can be explained by the model.

The number of crop plant species can be significantly explained by village, age of household heads, agriculture as main and minor occupation, and dept condition. These factors significantly influenced household heads to collect crop plant species to grow in their homestead agroforests with the significance level of 0.05. R^2 is 0.26 meaning that 26% of the variation in the number of crop plant species can be explained by the model. It should be noted that the factors that significantly influence households to grow both wild and crop plant species in homestead agroforests include the difference of village which differs in terms of the duration and settlement characteristics, age of heads of household, the agricultural occupation, and the household dept condition ($p<0.05$). However, considering only crop plant species found that the significant factor influencing the number of crop plant species to be grown in homestead agroforests was the dept condition. The finding was in line with the trend of plant species expansion and commercial value of plants around residences. The Karang people from both villages grow more crop plants around their houses and farms because of the external economic pressure which made Karang people need more commercial crops. The national park used to allocate area for Karang people to do paddy fields but they chose to cultivate commercial crops such as white silk, corn, chili, banana and mango due to the fact that these crops could get higher price. Moreover, planting rice could not get a good profit and farmers needed to wait for rainfall only; thus, they cultivated commercial crops in order to earn higher income and need money to buy food.

It can be said that the heads of household with different age, main occupation as agriculture, dept condition and village factor which differs in terms of settlement duration including the different settlement characteristic significantly influenced Karang people to collect plant species to grow around their houses. Table 6-5 to 6-8 presented the hypothesized independent factors in full model and statistically significant factors in reduced model as followed:

Table 6.5 The multiple regression coefficients for the number of total plant species

	Number of total plant species			
	Reduced model		Full model	
	b (S.E.)	β	b (S.E)	β
Independent variables				
Village	-7.48 (2.55)**	-0.27	-8.67 (2.85)**	-0.31
Gender (Male)			-1.27 (3.02)	-0.04
Age (Year)	0.27 (0.10)**	0.25	0.26 (0.11)*	0.24
Level of education (Year)			0.23 (0.43)	0.07
Household member			-0.09 (0.96)	-0.01
Main occupation (Agriculture)	9.74 (3.1)**	0.33	10.90 (3.57)**	0.37
Minor occupation (Agriculture)	11.49 (4.59)*	0.26	12.07 (5.07)*	0.27
Household income (Baht)			$2.05X10^{-5}$ (0.00)	0.09
Household expense (Baht)			$-8.19x10^{-5}$ (0.00)	-0.10
Debt (Baht)	0.01(0.01)*	0.18	0.01 (0.01)	0.18
Source of plant species			-1.39 (2.93)	-0.05
Distance from dwelling to forest areas (Km.)			0.07 (0.14)	0.05
(Constant)	14.37 (4.74)			
Number of observations (N)	106			
R^2	0.25			

Note. *p <0.05, **p <0.01, ***p <0.001

The number of total plant species = 14.37-7.48 (village) + 0.27 (age) + 9.74 (farmer occupation) + 0.01 (dept condition)

As equation above, the influenced factors on the number of total plant species, both wild and crop plant species included 4 positive factors: age, agriculture as main and minor occupation -occupation, and having dept. The finding corresponded with the research hypothesis:

1. The age of household head had positive influence on the number of total plant species. The older the household heads, the higher number of plants are grown in homestead agroforests. The increase of 1 year of age of heads of household brought about 0.3 species increase around their houses.

2. The households whose main occupation was agriculture would cultivate 10 plant species more than the household whose main occupation was not agriculture.

3. The households whose minor occupation was agriculture would cultivate 12 plant species more than household whose minor occupation was not agriculture.

4. The households having low debt would cultivate plant species more. The reduction of 1 baht of debt brought about 0.01 species increase in their homestead agroforests.

The village factor which had different duration of settlement together with the settlement characteristic of both villages were found statistically significant in explaining the variation of number of total plant species in homestead agroforests, which corresponded with the research hypothesis. The community that had settled for long time (Pong Leuk) maintained 8 plant species in their homestead agroforest less than the community just settled (Bang Kloi).

The comparison of the independent and dependent variables in terms of standardized beta found that the main occupation as farmer had higher magnitude of influence on the number of total plant species than village variable, the minor occupation as farmer, age of household head and debt condition. The value of standardized beta were 0.33, 0.27, 0.26, 0.25 and 0.18 respectively.

Table 6.6 The multiple regression coefficients for the number of wild plant species

	Number of wild plant species			
	Reduced model		Full model	
Independent variables	**b (S.E.)**	**β**	**b (S.E)**	**β**
Village	-3.33 (1.08)**	-0.29	-3.61 (1.14)**	-0.32
Gender (Male)			0.29 (1.25)	0.02
Age (Year)			0.06 (0.04)	0.14
Level of education (Year)			0.08 (0.18)	0.06
Household member			0.25 (0.40)	0.08
Main occupation (Agriculture)	2.79 (1.13)*	0.24	3.33 (1.49)*	0.28
Minor occupation (Agriculture)			3.63 (2.06)	0.20
Household income (Baht)			-8.92×10^{-6} (0.00)	-0.09
Household expense (Baht)			-1.38×10^{-6} (0.00)	-0.03
Debt (Baht)			1.37×10^{-4} (0.00)	0.15
Source of plan species			-0.65 (1.22)	-0.06
Distance from dwelling to forest areas (Km.)			0.03 (0.056)	0.06
(Constant)	9.89 (0.99)		5.8 (2.67)	
Number of observations (N)	106		106	
R^2	0.12		0.20	

Note. *p <0.05, **p <0.01, ***p <0.001

The number of wild plant species = 9.89 – 3.33 (village) + 2.79 (farmer)

This research found that there were 2 factors affecting the number of wild plant species grown around the residences, namely village factor which was different in terms of the settlement duration of community plus the different settlement characteristic of these 2 villages, and the factor of main occupation of household head as farmer. Therefore, this analysis demonstrated that the community, which settled for a long time, grew 3 species less than the other community with new settlement and the household whose main occupation was agriculture collected wild plant species 3 species more than the household whose occupation was not farmer.

The comparison of the independent and dependent variables in terms of standardized beta found that the village variable had higher magnitude of influence on the number of wild plant species than the variable of main occupation as farmer. The value of standardized beta were 0.29 and 0.24 respectively as shown in table 6-6.

Table 6.7 The multiple regression coefficients for the number of crop plant species

	Number of crop plant species			
	Reduced model		Full model	
	b (S.E.)	β	b (S.E)	β
Independent variables				
Village	-3.87 (1.64)*	-0.21	-4.92 (1.82)**	-0.27
Gender (Male)			-1.53 (1.93)	-0.08
Age (Year)	0.21 (0.06)**	0.30	0.19 (0.07)**	0.28
Level of education (Year)			0.15 (0.28)	0.07
Household member			-0.33 (0.61)	-0.06
Main occupation (Agriculture)	6.11 (2.00)**	0.32	7.55 (2.28)**	0.40
Minor occupation (Agriculture)	7.86 (2.96)**	0.27	8.63 (3.24)**	0.30
Household income (Baht)			$2.89x10^{-5}$ (0.00)	0.18
Household expense (Baht)			$-6.97x10^{-5}$ (0.00)	-0.13
Debt (Baht)	0.01 (0.01)*	0.20	0.01 (0.01)	0.17
Source of plant species			-0.74 (1.87)	-0.04
Distance from dwelling to forest areas (Km.)			0.03 (0.09)	0.04
(Constant)	8.31 (3.06)		10.06 (4.31)	
Number of observations (N)	106		106	
R^2	0.26		0.28	

Note. *p <0.05, **p <0.01, ***p <0.001

The number of crop plant species = 8.31-3.87 (village) + 0.21(age) + 6.11(farmer as main occupation) + 7.86 (farmer as minor occupation) + 0.01 (debt condition)

As equation above, the influenced factors on the number of crop plant species were village, age, agriculture as main occupation and minor occupation, and debt condition which corresponded with the research hypothesis:

1. The age of household head had positive influence on total number of plant species. The older the household heads, the higher number of plants are grown in homestead agroforests. The increase of 1 year of age of heads of household brought about 0.2 species increase around their houses. The increase of 10 year of age of heads of household brought about 2 species increase around their houses.

2. The households whose main occupation was agriculture would cultivate 6 crop plant species more than the household whose main occupation was not agriculture. 3. The households whose minor occupation was agriculture would cultivate 8 crop plant species more than household whose minor occupation was not agriculture

4. The households having low debt would cultivate crop plant species more. The reduction of 1 baht of debt brought about 0.01 species increase in their homestead agroforests or the reduction of 100 baht in debt would increase 1 more crop plant species in their homestead agroforests.

5. Baan Pong Leuk grew 4 crop species less than Bang Kloi.

The comparison of the independent and dependent variables in terms of standardized beta found that the main occupation as farmer had higher magnitude of influence on the number of crop plant species than age of household head, the minor occupation as farmer, village variable, , and debt condition. The value of standardized beta were 0.32, 0.30, 0.27, 0.21 and 0.20 respectively.

6.2.2 The relationship of household and community level factors and the plant species diversity in homestead agroforests

Table 6.8 The multiple regression coefficients of independent variables for the diversity of plant species

	Diversity of plant species					
	Total plant species		Wild plant species		Crop plant species	
	b (S.E.)	β	b (S.E)	β	b (S.E)	β
Independent variables						
Village			-3.62 (1.08)**	-0.32		
Gender (Male)						
Age (Year)					0.00 (0.00)**	0.26
Level of education (Year)						
Household member						
Main occupation (Agriculture)	-0.02 (0.01)*	-0.22	4.03 (1.29)**	0.34		
Minor occupation (Agriculture)			3.81 (1.94)*	0.21		
Household income (Baht)						
Household expense (Baht)						
Debt (Baht)					$2.46x10^{-6}$ (0.00)***	0.39
Source of plant species						
Distance from dwelling to forest areas (Km.)						
(Constant)	0.04 (0.01)		8.81 (1.12)		0.02 (0.12)	
Number of observations (N)	106		106		106	
R^2	0.05		0.15		0.21	

Note. *p <0.05, **p <0.01, ***p <0.001

The plant species diversity

The diversity of total plant species in homestead agroforests can be statistically significantly explained by main occupation of household heads as farmer at the level of significance of 0.05.R^2 is 0.05 meaning that only 5% of the variation in the diversity of total plant species can be explained by the model. The agriculture occupation or farming of Karang people was mainly growing chili, tomato or potato mixed with rice. Therefore, the agriculture or farming was the main household occupation which influenced on the knowledge and experience to get benefits from wild plant species more than other occupations.

The diversity of wild plant species in homestead agroforests can be statistically significantly explained by village, and main and minor occupation as farmer at significance level of 0.05. R^2 is 0.15 meaning that 15% of the variation in the diversity of wild plant species can be explained by the model. The wild plant species diversity has relationship with village and occupation as agriculture factors. The different settlement duration together with the different settlement characteristic of 2 villages were the import issue. Baan Pong Leuk stayed in this area for a long time. The influence of socio-economic development from nearby cities affected Baan Pong Leuk in terms of reducing growing wild plant species while Karang people from Baan Bang Kloi still perceived the benefits of growing wild plant species around their houses. This would cause the difference in wild plant species diversity found in 2 villages. Karang people from Baan Bang Kloi grew more wild plant species around their houses. Furthermore, the settlement characteristic of these 2 villages was different. The settlement at Baan Pong Leuk was far from each other so they had more land tenure; in addition, their farms and settlement area were in the same area or nearby. Nonetheless, the settlement at Baan Bang Kloi was clustered to each other and the farmland was far apart. In addition, the farmland that was allocated by the national park was not suitable for planting despite the fact that it was far from water resource and the soil was rough which led Karang people from Baan Bang Kloi planting plant species around their houses.

The diversity of crop plant species can be statistically significantly explained by age of household heads and household debt condition at significance level of 0.05. R^2 is 0.21 meaning that 21% of the variation in the diversity of crop plant species can be explained by the model. Therefore, the diversity of wild and crop plant species in homestead agroforests, can be seen influenced by factors of village, age of household heads, household occupation as farmer, and household dept condition. Table 6-9 to 6-11 demonstrated full and reduced model as follows:

Table 6.9 The multiple regression coefficients of total plant species diversity

	Diversity of total plant species			
	Reduced model		Full model	
	b (S.E.)	B	b (S.E)	β
Independent variables				
Village			-3.75 (1.19)**	-0.33
Gender (Male)			0.25 (1.26)	0.02
Age (Year)			0.07 (0.04)	0.16
Level of education (Year)			0.08 (0.18)	0.06
Household member			0.24 (0.40)	0.08
Main occupation (Agriculture)	0.02 (0.01)*	0.22	3.35 (1.50)*	0.28
Minor occupation (Agriculture)			3.43 (2.12)	0.19
Household income (Baht)			$-8.43x10^{-6}$ (0.00)	-0.09
Household expense (Baht)			$-1.22x10^{-5}$ (0.00)	-0.04
Debt (Baht)			0.00 (0.00)	0.15
Source of plant species			-0.64 (1.23)	-0.06
Distance from dwelling to forest areas (Km.)			0.04 (0.06)	0.07
(Constant)	0.04 (0.01)		5.42 (2.82)	
Number of observations (N)	106		106	
R^2	0.05		0.20	

Note. *p <0.05, **p <0.01, ***p <0.001

Total plant species diversity = 0.04+0.02 (main occupation as farmer)

As from this equation, the factor which influenced on the overall plant species diversity was the main occupation as farmer corresponding with the hypothesis. Households whose main occupation was farmer collected both wild and crop plant species to grow in their homestead agroforests more than households whose main occupation was not farmer.

Table 6.10 The multiple regression coefficients of wild plant species diversity

	Diversity of wild plant species			
	Reduced model		Full model	
	b (S.E.)	β	b (S.E)	β
Independent variables				
Village	-3.62 (1.08)**	-0.32	-3.75 (1.19)**	-0.33
Gender (Male)			0.25 (1.26)	0.02
Age (Year)			0.07 (0.05)	0.16
Level of education (Year)			0.08 (0.18)	0.06
Household member			0.24 (0.40)	0.08
Main occupation (Agriculture)	4.03 (1.29)**	0.34	3.35 (1.49)*	0.28
Minor occupation (Agriculture)	3.81 (1.94)*	0.21	3.43 (2.12)	0.19
Household income (Baht)			$-8.43x10^{-6}$ (0.00)	-0.09
Household expense (Baht)			$-1.22x10^{-5}$ (0.00)	-0.04
Debt (Baht)			0.00 (0.00)	0.15
Source of plant species			-0.64 (1.22)	-0.06
Distance from dwelling to forest areas (Km.)			0.04 (0.06)	0.07
(Constant)	8.81 (1.12)		5.42	
Number of observations (N)	106		106	
R^2	0.15		0.20	

Note. *p <0.05, **p <0.01, ***p <0.001

Wild plant species diversity = 8.81+ 3.62 (village) + 4.03 (farmer as main occupation) + 3.81 (farmer as minor occupation)

There were 3 factors influencing the increase in wild plant species diversity: the main and minor occupation as farmer and the village factor. Households whose main and minor occupation was agriculture would have higher wild plant species diversity in their homestead agroforests than households whose main and minor occupation was not agriculture. Moreover, the community settles for a long time (Pong Leuk) conserved wild plant species diversity less than the community just settled (Bang Kloi).

The comparison of the independent and dependent variables in terms of standardized beta found that the main occupation as farmer had higher magnitude of influence on the diversity of wild plant species than village variable, and the variable of minor occupation as farmer. The value of standardized beta were 0.34, 0.32, and 0.21 respectively.

Table 6.11 The multiple regression coefficients of crop plant species diversity

	Diversity of crop plant species			
	Reduced model		Full model	
	b (S.E.)	β	b (S.E)	β
Independent variables				
Village			-0.02 (0.01)	-1.91
Gender (Male)			-6.85 (0.08)	-0.01
Age (Year)	0.01 (0.01)**	0.26	0.01 (0.00)**	0.31
Level of education (Year)			0.01 (0.01)	0.12
Household member			0.00 (0.00)	0.16
Main occupation (Agriculture)			0.01 (0.01)	0.12
Minor occupation (Agriculture)			0.14 (0.01)	0.11
Household income (Baht)			$-1.88x10^{-7}$(0.00)	-0.27
Household expense (Baht)			$6.47x10^{-8}$(0.00)	0.03
Debt (Baht)	$2.46x10^{-6}$ (0.00)***	0.39	$2.59x10^{-6}$ (0.00)***	0.41
Source of plant species			-0.02 (0.01)	-0.19
Distance from dwelling to forest areas (Km.)			0.00 (0.00)	0.10
(Constant)	0.02 (0.12)		0.02 (0.02)	
Number of observations (N)	106		106	
R^2	0.21		0.35	

Note. *p <0.05, **p <0.01, ***p <0.001

Crop plant species diversity = 0.02+0.01 (age) + $2.46x10^{-6}$ (debt condition)

From this equation, it found that the factor influenced crop plant species diversity was age of household heads and household debt condition. The age of household heads had a positive effect on crop plant species diversity which meant the older the household heads were, the higher diversity of crop plant species are found in homestead agroforests. One year increase in age of household heads brought about an increase of crop plant species diversity of 0.01.Moreover, higher diversity of crop plant species was found in households that had less debt. A decrease of 1 baht of debt brought about an increase of crop plant species diversity of $2.46x10^{-8}$.

The comparison of the independent and dependent variables in terms of standardized beta found that the household debt condition had higher magnitude of influence on the diversity of crop plant species than age of household head. The value of standardized beta were 0.39, and 0.26 respectively as shown in table 6-11.

6.2.3 The relationship of household and community level factors and the proportion of the number of wild plant species and number of crop plant species in homestead agroforests

The multiple regression analysis of the relationship of household and community level factors towards the proportion of number of wild plant species to number of crop plant species did not yield any statistically significant relationship.

6.3 Research discussion

The multiple regression analysis found that the difference of villages factor, age of heads of household, occupation (main and minor occupation as farmer), and household debt condition were significantly related to plant species diversity, both wild and crop plant species.

The factor influencing plant species diversity most was the main occupation of household as farmer_due to the fact that farmer was occupation which grew wild plant species in their homestead agroforests more than other occupations. The crop species mostly planted by Karang people were chili, tomato or potato mixed with rice; therefore, the agriculture was the main occupation of household so there was the correlation with the knowledge and experience of utilizing wild plant benefits more than other occupations. This study corresponded with the research of Sompol Semsawat (2005), which found that the household whose occupation was agriculture had more chance to use forest area in order to farm or use the forest resources for farming such as bamboo. Therefore, the farmer highly depended on forest resource more than other occupations and the research of local people participation in maintaining forest resource and increasing green area of Apichai Puntasen and Danai Srimora (1996) mentioned that the local people around forest area were important to maintain and increase green area in order to conserve and naturally rehabilitate natural surroundings. Thus, the agricultural occupation should be promoted for people around forest area to have long term income. Sadudee Punpugdee (2003) additionally said that agroforestry included many big trees and plants in every layer and the commercial crops should be appropriated with the area with the aim of cohabitation between forest

and agricultural area together with increasing biodiversity as well as reducing dependency on forest resources. Ratchaniwan Phimsirikul (2004) studied the factors of dependency on forest resources of people lived nearby Phan Don Pha Kho National Reserve Forest, Nongsaen district, Udonthani province and found that the household main occupation in terms of agriculture had relation to the dependency of forest resources, particularly bamboo shoots; thus, the promotion about household main or minor occupation as agriculture should have bamboo at the farm or house in order to reduce dependency on forest resources.

It can be said that agroforestry had an important role for the people who lived around forest area and limited land. It responded the basic needs about food and sufficient useable wood. It was considered as direct utilization and the indirect benefit was to reduce trespassing forest.

The settlement duration and the settlement characteristic of both villages were different. The fact that Karang people from Baan Bang Kloi immigrated to this area later than Karang people from Baan Pong Leuk caused different land reservation for settlement and farming. In other words, Karang people from Baan Pong Leuk had stayed at this area before it was declared as the national park. They could occupied the bigger land whereas newly immigrants of Baan Bang Kloi could occupy the land in average not over 7 rai per household. Houses scattered along the village road. The farmland and the residence were the same area or close to each other. Baan Bang Kloi immigrated in 1996, the land was allocated by government so the settlement was limited. The house was lined closed to each other and the farmland and the residence area were separated. The furthest farmland from the residence was around 2 km. The difference in settlement duration and characteristic of 2 villages as mentioned above affected plant species in homestead agroforests of both villages. The plant species, both wild and crop plant species, were mostly found at Baan Bang Kloi. Baan Bang Kloi tended to grow plant species for food advantage, herbal healing and decoration, whereas Baan Pong Leuk tended to grow crop plant species. Due to the fact that the planting behavior under belief in planting wild plant near house including limited land area, Karang people from Baan Bang Kloi could plant plenty plant species. The number of plant species at Baan Bang Kloi was higher. The settlement duration of Karang people at Baan Pong Leuk was influenced by economic development and

external social pressures more than Karang people at Baan Bang Kloi. The plant characteristic that was mainly found at Baan Pong Leuk was crop plant species with commercial value.

One important factor influencing crop plant species diversity was the household debt condition. . Both Baan Pong Leuk and Baan Bang Kloi started cultivating these crop plants for commercial value; moreover, the government support through Kaeng Krachan National Park provided perennial tree species to Karang people after immigration. The perennial tree species which had economic value were coconut, jackfruit, betel, sato, mango, santol and bamboo. Moreover, the agriculture sector promoted Karang people to plant commercial crops such as durian, rambutan, and plum mango because the commercial crops were able to sell and create income as well as reduce debt because planting rice was not effective enough. Hence, the tendency of commercial plants to be cultivated around residence gradually increased until household debt decreased and income increased. However, growing crop plant species and practicing agroforestry needed the local people practice including familiarity, area potentiality and market demand. The research of Sadudee Punpugdee (2003) studied the comparison of socio-economic characteristic and local dependency on forest resources of community practicing agroforestry and monoculture in An Rue Nai Wildlife Sanctuary, Chachoengsao province and found that the farmers who practiced agroforestry could reduce their debt more than practicing monoculture which emphasized on market. The farmer who practiced the monoculture was risk to face deficit because the price was fluctuated while the agroforest system mostly was mainly for household consumption and the rest was sold to be income; therefore, the farmer did need to buy chemical or herbicide to maintain their productivity compared with monoculture. Therefore, when people around forest did agroforest, it increased both diversity and decreased household debt.

Karang adults (25-44 years old) were obviously seen, both male and female, because people during these ages immigrated in 1996 then people, in these ages, were not familiar to grow new plant species whereas the government supported Karang people to grow commercial crops around their houses in 1997; as a result, Karang people around these ages knew more plant species whereas the teenagers had less experience and were not familiar with the forest area. This was in line with

Siriwan Utta (2004) which suggested that the youth used the forest benefits through collecting forest products or areca palming toys but when they grew up and had more experience, the use of forest benefits would be more various such as medicine, food, construction and invention by forest resource. Attapol Chariyapongphan (1999) presented that the head of household was old people; they greatly depended on bamboo shoot which was cultivated around their houses corresponding with Sompol Semsawat (2005) which found that the head of household was adult people who had to earn for living and were more familiar with the area so they greatly depended on forest resources. It can be said that experience and necessity affected the head of household to grow more plant species.

Other factors such as head of household's gender, level of education of head of household, number of household workers, household income, household expense, source of collecting plants and distance from dwelling to forest areas in these 2 villages were not different in terms of relationship with collecting plant species to grow around their houses.

As for gender, this research found that head of household was male more than female but the difference of gender did not affect on increasing plant species diversity around house because female and male had to discuss each other in every aspects for reducing mistake. This reflected the women role towards maintaining plant species diversity. The report of local knowledge in terms of natural resource management and sustainable biodiversity along with tribe's tradition in Thailand of Udom Charoenniyomprai (2006) showed that women had an important role to select and store seed; moreover, women had knowledge about grain. The role of women towards maintain plant species diversity was in Millat (2003), at Bangladesh, most of plants around the houses were taken care by female in line Trinh (2003) found that female had a decision to select food plants for growing more than depending on community forest. Moreover, male had more chance to go to forest for collecting forest product, but for the management and areca palming a decision to plant, male mostly planted commercial plant. To consider the plants in both villages found that most plants were food plant. It is possible that women had a role to collect plants around their houses for food or taking care of children needed to know fundamental healing; as a result, female had more knowledge in terms of plant; however, the

depended forest resource Sompol Semsawat (2005) found that male greatly depended on forest resource more than female because male was the head of household who was necessary to find food and create household income that was different from female; thus, male more depended on forest resource. This finding presented the decision areca palming between female and male went together which reflected the sustainable natural resource management of Karang people which had security.

As for level of education, the majority of head of household were illiterate. There were 26 households that the head of household studied corresponding with Sompol Semsawat (2005) found that the level of education was not different in terms of dependent on forest resource and Karang people were cultivated and promoted planting by the national park's staff. Thus, the difference of level of education did not impact on collecting plants to plant.

As for number of household workers, the maximum of household worker was up to 12 people per household but the number of worker who was farmer was only 2 persons per household. Patimaporn Phongsuksawat (2003) found that if there was a high number of household members, the chance of depending on forest resource would be high as well for consumption; conversely, the household has fewer members, the chance of depending on forest resource was less as well. Therefore, the household worker was not farmer, the depended on forest resource was also less which did not effect on collecting plant to cultivate.

As for household income, categorizing groups of household income found that 72 households had income higher than 35,819 baht/year and 67 household had expense more than 16,471 baht/ year which meant if household had higher income, their expense would be high as well. The households with high income would depend on other resources instead of natural resources. Juthamanee Sangsawang (2000) explained that the household having high income tended to conserve more because they had a chance to use other resource; on the other hand, the household having low income collected forest resource in order to reduce household expense so their expense also reduced. However, most of Karang people did agroforest for household consumption. Sadudee Punpugdee (2003) showed that the income of farmer who did agroforest had less income than the farmer who did monoculture which emphasized on trade and profit but agroforest had less expense about buying fertilizer or herbicide

than monoculture. Consequently, more than a half of Karang people did not have debt and the household which had debt more than 4,158 baht was similar with the household had debt less than 4,158 baht. Thus, it was possible that the different income and expense of household did not affect on cultivating plant around their house.

The collection of wild plant species to grow in homestead agroforests reduced the expense in buying seeds and conserved local plant species (in situ conservation). This study found that Karang people mostly collected the plant species from the forest area by themselves and selected and kept seeds of crop species generally for consumption such as rice, white silk, banana, chili, and tomato, whereas other plants, such as herbs, ginger, galangal oil and lemon, were bought or gotten from relative; furthermore, the household did not keep the plant species, the source of plant species did not influenceplant diversity around the houses.

Karang people collected forest products at upper Bang Kloi such as wood for building house or collecting product which was planted before moved such as areca palm and white silk that had the distance approximately 25 Km. They had to spend 1-2days for travel. The distance for food plant was closer.

In short, the factor which had significant relationship with collecting both wild and crop plant species to cultivate around the houses of Karang people mainly was occupation as farmer that was important to increase the plant species diversity and conserve local plant species. Although this study found that the diversity was not impacted, the plant species diversity tended to change because there were plenty of introduced species and if they continuously grew the introduced species, the local plant species diversity would be replaced. Therefore, commercial crop species should be promoted together with local plant species especially herbal in their area because it was another way of conservation plant species diversity; at the same, it increased the plant value including reducing local dependency on forest resource.

CHAPTER VII
CONCLUSION AND RECOMMENDATION

The study of utilization and conservation of wild plant species diversity, a case study Karang villages at Kaeng Krachan National Park, had objectives to study the local knowledge in utilizing and conserving plant species diversity in Karang homestead agroforests and to examine the factors influencing households and communities' decision to collect wild plant species to grow around their houses, in order to formulate guideline and recommendation concerning the roles of local people and communities to reduce dependency on forest resources including biodiversity conservation around residences. This study employed household survey using questionnaire and in-depth interview which was consisted of household and village characteristics including data on, demographic, economic, and social characteristics of households. Moreover, species list was conducted to compile and analyze plant diversity. The researcher collected data from the census of 106 households, interviewed heads of household and key informants during April to May 2009 and analyzed data by using SPSS for Windows for descriptive and inferential statistics including percentage, mean, standard deviation, minimum, maximum together with multiple regression. The biodiversity value was analyzed through Shannon-Wiener Index (H). This research was summarized as follows:

7.1 The local knowledge in utilizing and conserving plant species diversity

7.1.1 Wild plant utilization

The number of plant species around the residences of both Baan Bang Kloi and Baan Pong Leuk for utilization was 219 species from 72 families 171 genus which

were classified in 2 main types: crop plants of 109 species and wild plants of 110species. These plant species were categorized into 4 types of plant habits: climber (32 species); herbaceous (74 species); shrub (50 species); and tree (63 species). Zingiberaceae species were found most, 12 species. When these plants were categorized into their usage characteristic, 6 types of utilization were found, such as plants for herbal healing, household consumption, ornament, food, toxics and rituals. Some plants had more than 1 purpose. The utilization of Karang people in these 2 villages was mostly for food (50% of total usage); for healing (28%); for household utilization (14%); for ornament (6%) and for ritual and for toxic (1%), respectively.

7.1.2 Distribution and abundance of plant species in communities

The plant species that were found wildly distributed in many households with very high quantity were mango (*Mangifera indica* (L.)), pineapple (*Ananus bracteatus* Schult.f)), tamarind (*Tamarindus indica* L), banana (Musa sp.), eggplant (*Solanum aculeatissimum* Jacq.), coconut (*Cocos nucifera* L.), yellow turmeric (*Curcuma longa* (L.)), white silk *(Ceiba pentandra* (L)), jackfruit (*Artocarpus heterophyllus* Lam) and zerumbet ginger (*Zingiber zerumber* (L.) Sm.), which were for food. The plant species, which were rarely cultivated, were garden spurge (*Euphorbia hirta* L.(Euphoribiaceace)), bamboo grass (*Thysanolaena mixima* Kuntze), luuk tai bai (*Phyllanthus amarus* Schumach. & Thonn), (*hydnocarpus ilicifolia king*), (*Clausena* sp), Lok Hat (*Artocarpus lacucha Roxb.* Ex Buch.-ham) and red wood (*Adenanthera pavonina* L.).They were found grown in only 1 household.

After categorized into 4 types of plant habits, namely climbers, herbaceous plants, shrubs and trees, it was found that Karang people largely cultivated plants for food and lightly cultivated medicinal plants which were neither rare species nor extinct species but were local plant species in the forest. However, the economic wild plants were seldom cultivated and these wild plants had the medical property and mostly were for household consumption.

7.1.3 Similarity and differences of plant species between 2 villages

The gamma diversity of both villages was 219 species. The diversity in one area (Alpha diversity) at Baan Bang Kloi was 188 species and Baan Pong Leuk 180 species. The plant species diversity difference (Beta diversity) of these 2 villages was found at 68 species whereas the rest of 151 species were found similarly in 2 villages. The similar plant species of these 2 villages was greatly high with Jaccard's similar index of 0.82 or 82%.

Out of the different plant species of both villages (Beta diversity) of 68 species, 38 species was only found at Baan Bang Kloi and 30 species at Baan Pong Leuk. Baan Pong Leuk had the economic plants more than Baan Bang Kloi while Baan Bang Kloi had plants for food, for medicine and for decoration more than Baan Pong Leuk.

7.1.4 Knowledge on wild plant species

Food plant species

The total of 138 species of food plants (4 unidentified species) from 52 families were found around Karang people' residences. These species mostly were in Cucurbitaceae family (8 species), Zingiberaceae (7 species) and other family as shown in table 5-14. They were categorized by plant habits as tree (31%); herb (28%); shrub (23%); climber (18%). The food plant species grown around Karang people' houses were 80 species of crop plants or introduced plants and 58 species of wild plants or local plants.

Medicinal plant species

The total medicinal plant species around Karang people' houses was found 79 species (6 unidentified species) from 43 families, Zingiberaceae (5 species) and Rutaceae, Palmae, Leguminosae-Caesalpiniodeae and Euphorbiaceae (4 species) as shown in table 5-16. The plant species which had medicine property were tree (33%), shrub (28%), herbaceous plants (23%) and climber (16%) respectively. More than a half of these plants were wild plants (54 species) and crop plants (25 species).

Household use and ornamental plant species

This study found 40 species of this type from 27 families which were Gramineae family (6 species), Palmae (3 species), Meliaceae (3 species).They were

tree (63%); herb (20%), shrub (10%) and climber (7%), most of which were wild plants (29 species) and crop plants (11 species).

Ornamental plant species

The ornamental plants around Karang people were found around 16 species from 14 families, most of which were shrub, tree and climber, respectively. The majority of plants were crop plants (11 species) and wild plants (5 species) for decoration and for being a fence around their houses.

Ritual and toxic plant species

The plants used for ceremony of Karang people included betel nut (Areca catechu) and betal (*Piper bettle* L.). Flowers for rituals included marigold (*Tagetes erecta* L.) and cockscomb (*Cnestis palala* (Lour.) Merr.). Rice, moreover, was used at the ceremony because it was the main component for ritual. The auspicious flowering plant species or plants to protect oneself from evils typically included plant species in Iridaceae family, such as wan hon daen (*Eleutherine Americana* (Aubi.) Merr.) and turmeric (*Curcuma aeruginosa* Roxb.). These plants were grown in the same direction with head of beds or were brought back home during going to forest in order to protect them from danger.

Furthermore, there were 3 toxic plant species namely lumpongpa (*Datura metel* L.var.metel), maduea plong (*Ficus hispida* L.f.), haw si na (Karang language). Karang people believed that if they excessively eat them, it would harm them.

Rituals and beliefs in terms of plant species conservation

Karang people showed the obvious role in biodiversity conservation through their beliefs and rituals which could be seen from delivering their babies till finality that were related to forest; for instance, the navel of children put inside the bamboo tube which was placed under the big tree due to the fact that they believed the big tree would protect the kids and if anybody cut this tree, the children' morale would disappear; as a result, the kids got sick or were in danger. Therefore, they truly protected this tree. To send dead people spirit to the heaven, they believed that bird was the representative of sending spirit to heaven; therefore, during making merit for die people, they generally made bird from soft wood such as white silk tree or betal tree. Karang people needed plants for their ritual; hence, they planted white silk tree and betal tree around their houses for convenience. Additionally, there was the

ceremony in relation to paying guardian spirit to protect their crops by using sticky rice and offering things from their area particularly sticky rice which they did not eat but planted for ceremony that was another way to conserve local sticky rice species.

In other words, the belief and ritual of Karang people was transferred from many generations until it became their thinking and expression in form of traditional value system which was very clever and sharp way to cultivate awareness towards maintain forest including, it was the spiritual commitment between people and nature from generation to generation.

Cultivation and plant species conservation

The cultivation around their houses was one of forest resource conservation activities in form of homestead agroforestry. Breeding, propagating and conserving wild plant species were mainly for local usage. These activities were in line with the way of living, tradition and local wisdom of community through practicing agroforetry and plant species conservation of Karang people around their houses. Simple nature-based methods were conducted, such as the ways to plant climbers or vines. Karang people, regularly, raised the both side of these climbers like upturned bell in order to let water flow altogether. They believed that if there was much water at the kink, the root would grow more. Karang people selected thin wood without rubber for plant propagation and classified plant species based on remarkable features of each plant; for example, they noticed from leaves and stems to separate caladium from taro due to the fact that taro has black spot at the middle leaves and the stem characteristic is white color; on the other hand, the caladium has no spot and the stem characteristic is green. They generally collected wild plants and bound with the big trees as mango and jackfruit around their houses or the orchid was put inside the pot and hung it.

There were 2 types of agricultural systems within these 2 villages. The majority was rice farming and the other was commercial crops such as white silk, lemon, and banana at their fields. This change was from the limited land and soil nutrition was degraded, together with disease and pest accumulated. Moreover, cultivating rice had to depend on rainfall only because they do not have water pumps or irrigation. Consequently, Karang people had to adjust cultivated plants by planting more commercial crops in order to get money for buying rice. Another factor was that

they needed cash for household expense such as motorcycle, television and tuition fee for their children, house renovation to make it more permanent; thus, planting commercial crops were another way to earnhigher income. Conversely, the wild plant species in their homestead agroforests decreased and were replaced by commercial crops.

7.2 Plant species diversity

The study found 219 species from 72 families 171 genus in Karang homestead agroforests. The highest number of species was found in Zingiberaceae family (12 species). The researcher categorized plant species into 4 types of plant habits: herbaceous (74 species, accounting for 34%), trees (63 species, accounting for 29%); shrub (50 species, accounting for 23%) and climber (32 species, accounting for 14%). These plant species were grouped as crop plants of 109 species and wild plants of 110 species.

These plants were typically used for food (50% of total usage); herbal medicine (28%); plants for household use (14%); ornamental plants (6%) and ritual and toxic plants (1% each).

For wild plant species around household area, this study found that the maximum of 26 species of wild plants were planted in one household at Baan Bang Kloi and one household at Baan Pong Leuk did not grow any wild plant species. When consider wild plant species at community level, it was found that 88 wild plant species was found at Baan Bang Kloi and 82 species at Baan Pong Leuk. The proportion of number of wild plant species to crop plant species in both villages was less than 1. It was just only 2 households which had the proportion of higher than 1.Karang people, both villages, grew wild plant species less than crop plant species. Regarding the plant species diversity, this research found that both villages had the plant species in high level. Baan Bang Kloi and Baan Pong Leuk had the plant species diversity according to Shannon-Weiner diversity index of 3.77 and 3.79 respectively.

7.3 The factors influencing local conservation of plant species diversity in homestead agroforests

The study of factors influencing households and communities' decision to grow plant species around residences employed multiple regression analysis and found that both villages were different in plant species diversity in homestead agroforests. Baan Bang Kloi was rather new settlement with 14 years period of settlement while Baan Pong Leuk had migrated to the area for many generations. The different duration of settlement caused Karang people from Baan Pong Leuk to start planting introduced crop species around their houses; in addition, the settlement characteristic of Baan Pong Leuk had the farm land and residence in same area; as the result, the quantity of plant individuals (stems) were found more than Baan Bang Kloi which had the farm land far from their residences. People in Baan Bang Kloi, however, had their belief towards wild plant utilization particularly herbal species so they grew wild plant species more than Baan Pong Leuk.

Another influenced factor on collecting plant species to grow around houses was the main and minor occupation as farmer. They usually accommodated various plant types at their farming fields due to the fact that Karang people had integrated farming system, having crop plants together with others.

Besides, older age of household heads brought about higher amount of both crop and wild plant species grown in homestead agroforests. Crop species with especially high economic value gradually increased around their houses in order to reduce their debt.

Other factors, such as gender, level of education, numbers of household labors, household income, expense, source of plant species, distance between dwelling and forest areas were not significantly influence household decision making to grow wild plant species in homestead agroforests.

7.4 Guideline and recommendations to support local people and community roles in reducing dependency on forest resources and conserving biodiversity

The existence of production system and biodiversity conservation, particular plant species diversity, has its key in local wisdom and local knowledge because this knowledge does not only benefit plant genetic resource conservation but also the food production system of local people. The community avails biodiversity of forest through planting various kinds of plants at the fields and home gardens. This study, additionally, found that Karang people typically cultivates plants that they knows their advantages; for instance, the household knows cooking, they greatly grow food plants. Therefore, plant species conservation particular wild plants be paid attention with local knowledge and benefits that people could get from plant species.

In addition, planting perennial trees should be promoted because this study found that the wild plant species, which have economic value, are less planted; however, if the government promotes the local people to plant these trees, it is another way to conserve these plants including create income that is the way to practice agroforestry in form of conserving local plant species in their habitats (in situ conservation) corresponding with the way of living of Karang people and local ecosystem. The plant species conservation has various advantages as followed:

1. Conserving plant species within their own habitats is under the influence of natural selection. The diversity of adapted genes in plant species can be raw materials for plant breeding for better quality and quantity in the production systems.

2. Local agroecosystem conservation is to maintain cultural diversity, to respect the holy spirit and to study the local knowledge in terms of food production system, healing, and sustainable natural resource management

3. Agroecosystem conservation is to conserve local plant species for food, medicine and utilization including ecosystem conservation, production system and food source of community for sustainable food security

4. Agroforest can reduce invading forest area for logging; in other words, to conserve local wisdom especially biological diversity should record this knowledge or collect genetic resource (ex situ) but these genetic resources should conserve at the

local area (in situ) by letting local people are able to survive at the environment that they can manage, develop and adapt their knowledge to the needs and changes.

Moreover, the difference in settlement duration between Baan Bang Kloi and Baan Pong Leuk affected land reservation for farming and the settlement characteristic of both villages was dissimilar as well. Karang people of Baan Pong Leuk settled before this area were declared as the national park; thus, the settlement characteristic was scattered along the village road and the land per household was bigger than Baan Bang Kloi. However, in Baan Pong Leuk the number of cropand wild plant species was found less than Baan Bang Kloi. Therefore, the way to increase plant species diversity around residences should emphasize on the appropriate agricultural production system in order to augment production per unit area and income for reducing dependency on forest resources.

7.5 Recommendation for future research

To find an appropriate way of human-forest coexistence, the study of local wisdom and knowledge of homestead agroforest is considered as an effective choice to be implemented for managing protected areas. It is required to have the understanding, acceptance and support for participatory conservation from the government and local users directly.

Therefore, the future research should study the plant species diversity related to the seasonal food security due to the fact that Karang people likely grow wild and crop plant species for food. The dependency on forest resources mainly focuses on food. If there is the study of seasonal plant food species, more various wild and crop plant species, including endangered ones would be found for further conservation in the areas. The roles of local people to conserve biodiversity would be strengthened. This could be set up as a guideline of conflict management in the point of relocating local people from forest areas despite the fact that local wisdom and knowledge in plant species utilization greatly increase diversity and conserve local plant species.

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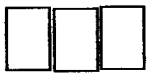
APPENDICES

APPENDIX A



แบบสอบถาม

เรื่อง การใช้ประโยชน์และการอนุรักษ์ความหลากหลายของพันธุ์พืชป่า

กรณีศึกษา ชนเผ่ากะหร่างในเขตอุทยานแห่งชาติแก่งกระจาน

แบบสอบถามนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ของนางสาวอรวรรณ บุญทัน นักศึกษาหลักสูตรวิทยาศาสตรมหาบัณฑิต สาขาเทคโนโลยีการบริหารสิ่งแวดล้อม คณะสิ่งแวดล้อมและทรัพยากรศาสตร์ มหาวิทยาลัยมหิดล โดยมีวัตถุประสงค์เพื่อศึกษาพัฒนาการขององค์ความรู้และความหลากหลายของชนิดพันธุ์พืชป่าที่ชาวกะหร่างนำมาปลูก รวมถึงปัจจัยที่ส่งผลต่อการตัดสินใจของครัวเรือนและชุมชนในการนำพืชพันธุ์จากป่ามาปลูก และการลดภาระการพึ่งพิงจากป่า ซึ่งจะเป็นแนวทางหรือข้อเสนอแนะเกี่ยวกับบทบาทของชุมชนและชาวบ้านในการอนุรักษ์ความหลากหลายทางชีวภาพในแปลงเกษตรและสวนรอบบ้าน

ข้อมูลที่ได้จากการตอบคำถามของท่านจะเป็นประโยชน์สำหรับการศึกษาและการวิจัยในครั้งนี้ โดยคำตอบที่ได้รับจะถือเป็นความลับและนำมาใช้เฉพาะในงานวิจัยเท่านั้น

วันที่ทำการสัมภาษณ์ ..... ชื่อผู้ให้ข้อมูล .....

สถานที่ทำการสัมภาษณ์ บ้านเลขที่ ..... หมู่ ..... บ้าน .....ตำบล.....

อำเภอ .....จังหวัด .....

1. ข้อมูลส่วนบุคคล

1.1 เพศ ( ) ชาย ( ) หญิง

1.2 อายุ .....ปี

1.3 ระดับการศึกษาสูงสุด ( ) ไม่ได้เรียน ( ) ประถมต้น ( ) ประถมปลาย
( ) มัธยมต้น ( ) มัธยมปลาย ( ) ปริญญาตรี
( ) อื่น ๆ (ระบุ).....

2.1 ข้อมูลทางเศรษฐกิจและสังคม

2.1 จำนวนสมาชิกในครัวเรือนที่เป็นแรงงานในการนำพืชป่ามาปลูก

เพศชาย จำนวน.....คน

เพศหญิง จำนวน.....คน

รวมจำนวนสมาชิกในครัวเรือนทั้งหมด.....คน

2.2 จำนวนอาชีพของสมาชิกครัวเรือน.....อาชีพ

2.3 อาชีพหลักของสมาชิกครัวเรือน ( ) เกษตรกรรม ( ) รับจ้าง ( ) ค้าขาย

( ) เจ้าหน้าที่อุทยาน ( ) อื่นๆ (ระบุ).....

2.4 อาชีพรองของครัวเรือน

( ) ไม่มีอาชีพรอง

( ) มีอาชีพรอง ได้แก่

( ) เกษตรกรรม ( ) รับจ้าง ( ) ค้าขาย

( ) เจ้าหน้าที่อุทยาน ( ) อื่นๆ (ระบุ).....

2.5 รายได้ (ปี/ครัวเรือน) .....ปี

2.6 ครอบครัวของท่านมีรายจ่ายรวมต่อปี เป็นเงินประมาณปีละ.....บาท

2.7 ครอบครัวของท่านมีหนี้สินหรือไม่

( ) ไม่มี ( ) มีเงินออม.....บาท

( ) มี จำนวน.....บาท

2.8 นับถือศาสนา/ ความเชื่อ ( ) ผี ( ) พุทธ ( ) คริสต์ ( ) อิสลาม ( ) อื่น ๆ.....

2.9 ครัวเรือนของท่านมีที่ดินอยู่ในความครอบครองจำนวนเท่าใด (ให้นับรวมที่ดินที่เป็นที่ตั้งบ้านเรือนที่อยู่อาศัย ที่ทำกินและที่ดินอื่นๆ ทุกประเภท ทั้งที่มีเอกสารสิทธิ และที่ไม่มีเอกสารสิทธิ)

( ) ไม่มีที่ดินในความครอบครอง

( ) มีที่ดินในครอบครอง รวมจำนวนเนื้อที่.....ไร่/งาน/ตารางวา

2.10 แหล่งพันธุ์พืชที่นำมาปลูก

( ) เก็บเอาไว้เอง

( ) จากหน่วยงานราชการ

( ) ซื้อพันธุ์มาเอง

( ) จากญาติ พี่น้อง

( ) อื่น ๆ .....

2.11 ระยะทางจากที่อยู่อาศัยถึงพื้นที่ป่า.....เมตร ใช้เวลาในการเดินทาง.....นาที

3. ปัจจัยภายนอก

3.1 ท่านเคยนำพันธุ์พืชจากป่ามาขายหรือไม่

( ) ไม่เคย

( ) เคย

สิ่งที่นำมาขายคือ.....ราคา/หน่วย.....

3.2 ท่านเคยนำพันธุ์พืชที่ปลูกมาขายหรือไม่

( ) ไม่เคย

( ) เคย

สิ่งที่นำมาขายคือ..... ราคา/หน่วย.....

3.3 ในกรณีที่ท่านนำพืชจากป่ามาปลูกในพื้นที่ทำกิน ท่านเคยถูกเจ้าหน้าที่จับกุมหรือไม่

( ) ไม่เคย

( ) เคย

บทลงโทษในการจับกุม (จำนวนครั้งของการจับกุม).....

3.4 ท่านเคยได้รับข่าวสารเกี่ยวกับการอนุรักษ์พันธุ์พืชป่าบ้าง หรือไม่

( ) ไม่เคย (ข้ามไปทำข้อ 3.6)

( ) เคย

3.5 แหล่ง/ประเภทของสื่อที่ได้รับข่าวสารเกี่ยวกับการอนุรักษ์พันธุ์พืชป่า และความถี่ที่ได้รับข่าวสารในแต่ละเดือน

ประเภท/แหล่งของสื่อ	ความถี่ที่ได้รับข่าวสาร	
	ครั้ง/เดือน	หากภายใน 1 เดือนไม่เคยได้รับข่าวสารให้ระบุ เช่น 2 เดือน/ครั้ง
1.โทรทัศน์		
2.วิทยุ		
3. หนังสือพิมพ์		
4. หอกระจายข่าวประจำหมู่บ้าน		
5. เอกสารทางราชการ/อุทยาน		
6. เจ้าหน้าที่ของหน่วยงานราชการ/อุทยาน		
7. ญาติพี่น้อง/เพื่อนบ้าน		

3.6 ท่านเคยได้รับการอบรมหรือให้คำแนะนำจากหน่วยงานราชการ/เจ้าหน้าที่อุทยาน เกี่ยวกับการใช้ประโยชน์และการอนุรักษ์พันธุ์พืชป่า หรือไม่

( ) ไม่เคย

( ) เคย เมื่อ.....(ระบุเดือนและพ.ศ.)

4. ปัจจัยชุมชน

ระยะเวลาที่ท่านย้ายเข้ามาตั้งถิ่นฐานในหมู่บ้าน.....ปี

แบบสัมภาษณ์เชิงลึก

เรื่อง การใช้ประโยชน์และการอนุรักษ์ความหลากหลายของพันธุ์พืชป่า

กรณีศึกษา ชนเผ่ากะหร่างในเขตอุทยานแห่งชาติแก่งกระจาน

สำหรับผู้ให้ข้อมูลที่สำคัญในหมู่บ้านโป่งลึกและบ้านบางกลอย

ประเด็นที่ต้องการศึกษา

1.องค์ความรู้ ภูมิปัญญา ความเชื่อ เทคนิค วิธีการในการใช้ประโยชน์และการอนุรักษ์ความหลากหลายของพันธุ์พืชป่า

2. การถ่ายทอดองค์ความรู้รุ่นต่อรุ่น

3. กลไกทางสังคม (วัฒนธรรม ความเชื่อ พิธีกรรม) ที่มีต่อการอนุรักษ์พันธุ์พืชป่า

<u>แนวคำถาม</u>

1.ชาวกะหร่างมีองค์ความรู้ท้องถิ่นในการเก็บหาและเพิ่มความหลากหลายของชนิดพันธุ์พืชป่าอย่างไรจึงทำให้พืชชนิดนั้น ๆ ยังคงมีอยู่ในพื้นที่ทำกินของตนเอง เช่น

1. วิธีการเก็บหาพืชมาปลูก
2. การเก็บ/ตัดไม้เพื่อใช้สอย
3. แหล่งและฤดูกาลที่เหมาะสมในการเก็บหามาปลูก
4. การเลือกสรรและใช้ประโยชน์จากพันธุ์พืชมาปลูก
5. การแลกเปลี่ยนเรียนรู้จากภายนอก
6. ความรู้ในการคัดเลือกพันธุ์
7. ช่วงเวลาที่มีการนำพันธุ์พืชป่ามาปลูก (Time line study)

2. ครัวเรือน/ชุมชนของท่านได้มีส่วนในการถ่ายทอดภูมิปัญญาหรือองค์ความรู้ในการจำแนกชนิดพันธุ์พืชป่าและการใช้ประโยชน์จากพันธุ์พืชป่า อย่างไร

3. ชาวกะหร่างมีความเชื่อ/ประเพณี/วัฒนธรรม เกี่ยวกับการรักษาความหลากหลายของพันธุ์พืชป่าอย่างไร

4. ท่านเคยคิดที่จะขยายพื้นที่เพาะปลูกหรือนำพันธุ์พืชชนิดอื่นมาปลูกเพิ่มหรือไม่ เพราะอะไร

สำหรับผู้ให้ข้อมูลที่สำคัญที่เป็นเจ้าหน้าที่รัฐ/อุทยานในพื้นที่

ประเด็นที่ต้องการศึกษา

1.บทบาทของหน่วยงาน/อุทยานในการจัดการและส่งเสริมการอนุรักษ์ความหลากหลายของพันธุ์พืชป่า

2. ปัจจัยที่ส่งเสริมให้ชาวกะหร่างนำพันธุ์พืชจากป่ามาปลูกในพื้นที่ทำกินของตน

3. แนวความคิดในเรื่องของการมีส่วนร่วมในการอนุรักษ์ความหลากหลายของพันธุ์พืชป่าของชาวกะหร่าง

<u>แนวคำถาม</u>

1.จากการที่ชาวกะหร่างนำพันธุ์พืชจากป่ามาปลูกในพื้นที่ทำกินของตนเองนั้น หน่วยงานรัฐ/เจ้าหน้าที่อุทยานได้เข้าไปมีส่วนในการจัดการหรือส่งเสริมการอนุรักษ์ความหลากหลายของพันธุ์พืชป่า อย่างไร

2. ท่านคิดว่ามีปัจจัยใดบ้างที่ส่งผลต่อการตัดสินใจของชาวกะหร่างในการนำพันธุ์พืชจากป่ามาปลูกในพื้นที่ทำกินของตนเอง (ทั้งปัจจัยภายนอกและปัจจัยภายใน)

3. จากการที่ชาวกะหร่างนำพันธุ์พืชจากป่ามาปลูกในพื้นที่ทำกินของตนเองนั้น ท่านคิดเป็นการอนุรักษ์หรือเพิ่มความหลากหลายของพันธุ์พืช หรือไม่ อย่างไร

APPENDIX B

บัญชีรายชื่อพันธุ์พืช (Species List) และข้อมูลการใช้ประโยชน์พันธุ์พืช

ลำดับ	ชื่อภาษาไทย	ชื่อภาษากะหร่าง	การใช้ประโยชน์	ส่วนที่ใช้ประโยชน์	สรรพคุณ	ส่วนที่นำมาปลูก	วิธีการปลูก/ขยายพันธุ์

APPENDIX C

ตารางแสดงจำนวนชนิดพันธุ์พืชที่ต่างกันใน 2 หมู่บ้าน จำแนกตามวิสัยพืชและการนำมาปลูกเพื่อใช้ประโยชน์

ลำดับที่	ชนิดพืชที่ต่างในหมู่บ้านบางกลอย	ชนิดพืชที่ต่างในหมู่บ้านโป่งลึก
1	กระโดนแดง	กะมากะ
2	กระเบา	กำลังหนุมาน
3	กระวาน	แก้วมังกร
4	กลึงกล่อม	ขมิ้นขาว
5	กะเรกะร่อน	ชิงชี่
6	แก้งขี้พระร่วง	ชุมเห็ดเทศ
7	โก๊ะโป๊ยที	เต่าร้าง
8	ควินิน	โตโนเอ๊ะ
9	ชายผ้าสีดา	น้ำนมราชสีห์ใหญ่
10	ตดหมูตดหมา	ผักโขมหนาม
11	ตะขบป่า	ผักหวานบ้าน
12	ตำลึง	พันงูเขียว
13	เตอะทู	มะกล่ำต้น
14	เถาส้มเช้า	มะเดื่อปล้อง
15	นางเลว	มะพลับ
16	บัวบก	มันเทศ
17	บี	ยาบขี้ไก่
18	เบาะเกาะชิ	ยาสูบ
19	ปอกระสา	ละหุ่งเครือ
20	ปอท่าคอ	ลาย
21	ผักบุ้ง	ลิ้นมังกร
22	เผือกหอม	ลูกใต้ใบ
23	พญาสัตบรรณ	เลี่ยน
24	พอวี่วอ	สน

ตารางแสดงจำนวนชนิดพันธุ์พืชที่ต่างกันใน 2 หมู่บ้าน จำแนกตามวิสัยพืชและการนำมาปลูกเพื่อใช้ประโยชน์

ลำดับที่	ชนิดพืชที่ต่างในหมู่บ้านบางกลอย	ชนิดพืชที่ต่างในหมู่บ้านโป่งลึก
25	พะโล้	ส้มป่อย
26	มะเดื่อเถา	สะระแหน่
27	มะเดื่ออุทุมพร	สัก
28	มะหาด	หงอนไก่ป่า
29	มันมือเสือ	หนาดใหญ่
30	ยี่หร่า	เฮาะชินา
31	ยูคาลิปตัส	
32	ลำโพงป่า	
33	ว่านสี่ทิศ	
34	สาบเสือ	
35	เสลาขาว	
36	หญ้าคา	
37	หัสคุณ	
38	อุตพิต	

BIOGRAPHY

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