THE RESILIENCY OF COMMUNITY BASED FOOD SECURITY MANAGEMENT SYSTEM: A CASE STUDY OF BAN MAERAWAN, YOKKRABUTR SUBDISTRICT, SAM-NGAO DISTRICT, TAK PROVINCE

NATCHA SORNHIRAN

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
2014

Thesis
entitled

THE RESILIENCY OF COMMUNITY BASED FOOD SECURITY MANAGEMENT SYSTEM: A CASE STUDY OF BAN MAERAWAN, YOKKRABUTR SUBDISTRICT, SAM-NGAO DISTRICT, TAK PROVINCE

……..
Miss Natcha Sornhiran
Candidate

……..
Lect. Kulvadee Kansuntisukmongkol,
Ph.D. (Ecology)
Major advisor

.....……..
Assoc.Prof. Rungjarat Hutacharoen,
M.Sc. (Technology of environmental management)
Co-advisor

……..
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

...……..
Lect. Ratchaphong Klinsrisuk,
Ph.D. (Urban Environmental Management)
Program Director
Master of Science Program in Technology of Environmental Management
Faculty of Environment and Resource Studies
Mahidol University

Thesis
entitled

THE RESILIENCY OF COMMUNITY BASED FOOD SECURITY MANAGEMENT SYSTEM: A CASE STUDY OF BAN MAERAWAN, YOKKRABUTR SUBDISTRICT, SAM-NGAO DISTRICT, TAK PROVINCE

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science
(Technology of Environmental Management)
on
June 29, 2013

……..
Miss Natcha Sornhiran
Candidate

……..
Asst. Prof. Somsak Sukwong,
Ph.D. (Forest Management)
Chair

……..
Lect. Kulvadee Kansuntisukmongkol,
Ph.D. (Ecology)
Member

……
Assoc.Prof. Rungjarat Hutacharoen,
M.Sc. (Technology of environmental management)
Member

……..
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

...……..
Assoc. Prof. Kampanad Bhaktikul,
Ph.D. (Civil and Environmental Engineering)
Dean
Faculty of Environment and Resource Studies
Mahidol University

ACKNOWLEDGEMENTS

The success of this thesis can be succeeded by the intensive supervision, guidance and support from researcher's major advisor, Lect. Kulvadee Kansuntisukmongkol and also the co-advisor, Assoc. Rungjarat Hutacharoen, and Assist. Prof. Somsak Sukwong. I absolutely appreciate the kindly and invaluable advices from them indeed.

Nevertheless, I would like to thank Thai Meteorological Department, members of Ban Maerawan in Yokkrabutr subdistrict, Sam-ngao district, Tak provinces that provide the data for the thesis. Without these data, the thesis cannot be complete.

Furthermore, thanks to all my teachers who give all of knowledges. I also would like to thank all of faculty of environmental and resource studies staffs who help facilitate thesis documents. Moreover, thanks all friends including ES16, ES18 and ET 38 for joyful and helpful recommendations.

Finally, I would like to show gratitude to my family which always encourage and attentively concern until completion of both thesis and education. Besides, all mistakes and misconceptions of the thesis are completely under researcher's responsibility.

Natcha Sornhiran

THE RESILIENCY OF COMMUNITY BASED FOOD SECURITY MANAGEMENT SYSTEM: A CASE STUDY OF BAN MAERAWAN, YOKKRABUTR SUBDISTRICT, SAM-NGAO DISTRICT, TAK PROVINCE

NATCHA SORNHIRAN 5436541 ENTM/M

M.Sc. (TECHNOLOGY OF ENVIRONMENTAL MANAGEMENT)

THESIS ADVISORY COMMITTEE: KULVADEE KANSUNTISUKMONGKOL, Ph.D., RUNGJARAT HUTACHAROEN, M.Sc.

ABSTRACT

The aims of this study were 1) to analyze the characteristics of resiliency of community food security, 2) to analyze factors that affect household and community food security and 3) to develop a conceptual framework of community food security management. This research applied qualitative and quantitative approaches, collected data using a questionnaire, in-depth interviewing, and a focus group discussion. The Statistical Package for Social Science was used to analyze the data.

The study found that the study area is located in an area at risk of seasonal drought and flooding with severe and frequent incidents of crises. Hence, the community has developed a number of ways to cope with the crises, which include appropriate resource utilization in each season, water management, forest and land use management, as well as socio-economic livelihood adaptation. The factors affecting current household food security in a direct way consisted of number of household occupations, planting diversified types of plants, diversification of food resources, knowledge of wild mushrooms and animal collection from the community forest, main occupation of household being agriculture, settlement periods, and practice of organic agricultural farming. Finally, the conceptual framework of the resiliency of the community-based food security management system was proposed according to the observations and conclusions made from the collected primary data, which describes operations of households, the community, and government offices.

KEY WORDS: FOOD SECURITY/ RESILLIENCY/
/ SEASONAL DROUGHT AND FLOODING

161 pages

ความสามารถในการฟื้นตัวของระบบการจัดการความมั่นคงทางอาหารของชุมชน กรณีศึกษา
บ้านแม่ระวาน ตำบลยกกระบัตร อำเภอสามเงา จังหวัดตาก
THE RESILIENCY OF COMMUNITY BASED FOOD SECURITY MANAGEMENT SYSTEM: A CASE STUDY OF BAN MAERAWAN, YOKKRABUTR SUBDISTRICT, SAM-NGAO DISTRICT, TAK PROVINCE

ณัชชา ศรหิรัญ 5436541 ENTM/M

วท.ม. (เทคโนโลยีการบริหารสิ่งแวดล้อม)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: กุลวดี แก่นสันติสุขมงคล, Ph.D., รุ่งจรัส หุตะเจริญ, M.Sc.

บทคัดย่อ

การศึกษาความสามารถในการฟื้นตัวของระบบการจัดการความมั่นคงทางอาหารของชุมชน กรณีศึกษา บ้านแม่ระวาน ตำบลยกกระบัตร อำเภอสามเงา จังหวัดตาก เป็นการศึกษาการจัดการความมั่นคงทางอาหารของชุมชน มีวัตถุประสงค์เพื่อวิเคราะห์ลักษณะการฟื้นตัวของระบบการจัดการความมั่นคงทางอาหาร วิเคราะห์ปัจจัยที่ส่งผลต่อความมั่นคงทางอาหารชุมชน และพัฒนาแผนภาพความคิดของการจัดการความมั่นคงทางอาหารของชุมชน โดยใช้วิธีการเชิงคุณภาพและปริมาณ รวบรวมข้อมูลทุติยภูมิด้านภูมิศาสตร์และภูมิอากาศของพื้นที่ และข้อมูลปฐมภูมิ ด้วยแบบสอบถาม การสัมภาษณ์เชิงลึก และจัดสนทนากลุ่ม นำข้อมูลมาวิเคราะห์ด้วยการพรรณนา ใช้แผนภาพและตารางประกอบ และใช้เครื่องมือทางสถิติ (Statistical Package for Social Science)

พบว่าชุมชนประสบปัญหาความมั่นคงทางอาหารจากความแห้งแล้งและอุทกภัยซ้ำซาก และชุมชนจัดการกับปัญหาดังกล่าวโดย การใช้ประโยชน์ทรัพยากรอาหารอย่างเหมาะสมตามฤดูกาล การจัดการน้ำ การอนุรักษ์ทรัพยากรป่าไม้และการจัดการการใช้ประโยชน์ที่ดิน และการจัดการเศรษฐกิจสังคม

ปัจจัยภายในของครัวเรือนที่ส่งผลต่อความมั่นคงทางอาหาร ได้แก่ จำนวนอาชีพ การปลูกพืชหลากหลาย การพึ่งพาแหล่งอาหารหลากหลาย การมีความรู้ในการเก็บหาเห็ดและสัตว์จากป่าชุมชน การประกอบอาชีพเกษตรกรรมเป็นอาชีพหลัก จำนวนปีที่ตั้งถิ่นฐาน และการเลี้ยงสัตว์แบบปลอดสารเคมี โดยทุกปัจจัยส่งผลต่อความมั่นคงทางอาหารแบบแปรผันตรง ผลการศึกษาทั้งหมดสามารถสรุปในรูปแบบแผนภาพความคิดลักษณะการฟื้นตัวของระบบการจัดการความมั่นคงทางอาหารของชุมชนซึ่งประกอบด้วยปัจจัยของ ครัวเรือน ชุมชน และหน่วยงานราชการ ที่ส่งเสริมให้เกิดความสำเร็จในการจัดการความมั่นคงทางอาหารของชุมชน ที่ได้ค้นพบจากงานวิจัยครั้งนี้

161 หน้า

CONTENTS

	Page
ACKNOWLEDGEMENTS	**iii**
ABSTRACT (ENGLISH)	**iv**
ABSTRACT (THAI)	**v**
LIST OF TABLES	**viii**
LIST OF FIGURES	**ix**
CHAPTER I INTRODUCTION	**1**
1.1 Background and justification	1
1.2 Objectives	5
1.3 Scopes of studies	5
1.4 Assumption	6
1.5 Conceptual framework	7
1.6 Definition	8
1.7 Expected outcome	8
CHAPTER II LITERATURE REVIEW	**9**
2.1 Definitions, concepts and theories of food security and risk	9
2.2 Community Resiliency	25
2.3 Context and food resource of study area	27
2.4 Relevant researches	33
CHAPTER III RESEARCH METHODOLOGY	**36**
3.1 Research procedure	36
3.2 Quantitative research	37
3.2 Qualitative research	40
CHAPTER IV RISK IN FOOD SECURITY: PROBLEMS AND IMPACTS	**43**
4.1 Geography	43
4.2 Problems and impacts of food security	48

CONTENTS (cont.)

	Page
CHAPTER V FOOD SECURITY STATUS AND FACTORS THAT AFFECT FOOD SECURITY	**56**
5.1 Socio-economic and food resource consumption data	56
5.2 Food security status	66
5.3 Household factors affecting food security	72
5.4 Diversity of seasonal food resources	83
5.5 Conclusion and analysis	87
CHAPTER VI RESILIENCY OF COMMUNITY FOOD SECURITY MANAGEMENT SYSTEM	**93**
6.1 Management of food security risk	93
6.2 The resiliency of community food security management system	115
CHAPTER VII CONCLUSIONS AND RECOMMENDATIONS	**124**
7.1 Conclusions	124
7.2 Recommendations	127
REFERENCES	**131**
APPENDICES	**136**
Appendix A The questionnaires	137
Appendix B Climate forcast data of study area (by Southeast Asia Start Regional Center, Chulalongkorn University)	150
Appendix C Household food consumption	155
BIOGRAPHY	**161**

LIST OF TABLES

Table		Page
2.1	Detail of indicator's component	20
3.1	Research procedure	36
3.2	Household factors that effect to food security (independent variable)	38
3.3	Clarify indicators of each dimension of food security (dependent variable)	39
4.1	Timeline of community development	50
5.1	Household socio-economics data	61
5.2	Household food security status	69
5.3	Dependent and independent variables are analyzed in Regression	72
5.4	Multiple regression coefficients (Reduced Model) of household factors on food security (Availability)	77
5.5	Logistic regression coefficients (Reduced Model) of household factors on food security (Access)	79
5.6	Logistic regression coefficients (Reduced Model) of household factors on food security (Stability)	80
5.7	Multiple regression coefficients (Reduced Model) of household factors on food security (Stability)	82
5.8	Variance analysis result of community food types and quantity consumption	86
6.1	Time line of community food resources management	95
6.2	Comparison of household and community between disaster and non-disaster case	97
6.3	Food consumption and activity calendar	103

LIST OF FIGURES

Figure		Page
1.1	Conceptual framework	7
2.1	A framework for analyzing vulnerability to future food insecurity	24
2.2	The casual structure of vulnerability	25
2.3	Model of stress resistance and resilience over time	26
2.4	Study area map	31
4.1	Topographic map	45
4.2	Accumulated monthly rainfalls in 2003-2012 of Tak province graph	46
4.3	Land use map	47
5.1	Household food producing and collecting proportion in winter	85
5.2	Household food producing and collecting proportion in summer	85
5.3	Household food producing and collecting proportion in rainy	86
5.4	Household food producing and collecting proportion in each season	86
6.1	Renewal cycle	99
6.2	The mapping of water resource management system of community	108
6.3	Conceptual framework of community food security management	120

CHAPTER I
INTRODUCTION

1.1 Background and justification

Humans need food to survive. Therefore, food is one of four factors of necessity in human living because food assists in repairing worn parts, providing energy and body growth in infants in particular. It also assists in controlling body chemicals and organ systems, and prevents and resists disease by strengthening the body. Hence, food is important basic factor of human living (Nongnapas Thiengamol, 2009). It is widely accepted that food or food security is one of the most important issues for humans.

Thailand is a food source with high biodiversity because of its tropical location which is a little bit above the equator and adjacent to seas. Hence, the country has a suitable climate for surviving, growing, and breeding of living things throughout the whole year. However, climate is different in each region depending on the location and height of the region. Overall, the climate of Thailand is not severe and does not fluctuate as occur in subtropical and temperate zones. Therefore, it is not a factor limiting the living of living things. Secondly, the topography in each region of Thailand is different; for instance, the northern region has high mountains, the northeastern region is highland, the central region is central plains, the southern region is highland/ plateau interspersed with plains and has monsoon season all year round. Due to diversified geography and climate, it can support diversified forest types such as hill evergreen forest, coniferous forest, mixed deciduous forest, dry dipterocarp forest, dry evergreen forest, tropical rain forest, peat swamp forest, mangrove forest etc. Each type of forests has a specific characteristic and different plants and wildlife. Thirdly, Thailand is located at the center of the distribution of plant and wildlife species entering from surrounded neighborhood countries. For instance, the north and northeast receive the influences from Burma; Himalayan Mountain, and southern China while the southern region is influenced from Malaysia etc. These reasons have

led Thailand to become a major source of biodiversity (Kamthorn Theerakup, 1990). The high biodiversity has created fertility in food for living and fertile soil for agriculture.

In the meantime, global and national development has focused on economic development which causes activities that deteriorate the resource and quality of environment. This decreases quantity and quality of food resources; whereas the population increases. Also, climate variability from the greenhouse effect has made many areas of the country face risks in insufficient food quantity and quality (Nongnapas Thiengamol, 2009). In particular with global climate change, it affects agriculture and society in various aspects such as drought, flood, and inconsistent rainfall quantity. These severe incidents increase risk on activities in relation to resource utilization and food insecurity (Northern Development Foundation (NDF) and Huai Hin Lad Community, 2011).

The statistics of forest area in Thailand by the Department of Forestry shows that in 2008 Thailand has forest area of 171,596 km^2 out of the total areas of 513,115 km^2 which is accounted for 33.44%. The forest area has been decreased from 1973 which was 221,707 km^2 or 43.21%; whereas the report of environmental quality situation in 2010 states that forest resource situation of Thailand from 2008 – 2009 will have positive possibility. From a survey in 2010, conserved forest is accounted for 20.22% of the country's area. However, forest invasion, illegal logging etc. are still critical issues for forestry resource management of Thailand. In contrast, overall of mangrove forest area has been continually increasing since 2000 due to a campaign of public and private sectors. Additionally, seagrass sources are in fairly good condition; whereas, coral reefs at the gulf of Thailand are rather ruined because of tourism activities, waste water etc. Furthermore, rare marine animals at the gulf of Thailand and Andaman Sea have been dramatically decreased because of natural variability and human activities. In contrast, freshwater fishery resources have increased because water quality in 2007–2009 has been continually improved. Nevertheless, there are some degraded water resources as a result of waste water from community and industrial factories etc. In regards to soil resource, it has been faced with many problems; for example, soil degradation, the lack of distribution of land holdings etc. For mineral resource; particularly energy resource, it is used for energy which results

in air pollution and greenhouse gases. In the past 10 years, CO_2 emission has been continually increasing. In 2009, CO_2 was emitted at 208,475,670 tons/ year. Flood disaster had cost more than 1,100 million Baht and drought had cost 383,360,145 Baht. Also, a statistical record predicts that the number of villages facing drought will increase. According to National Statistical Office (2010), it is stated in regard to socio-economic, domestic household has an average monthly expense increasing from 2009 of 3.8% while the central region has the highest portion spent on food, beverage, and tobacco.

For Thailand's environmental and socio-economic situation, it shows that forest and agricultural areas are food sources. Hence, environmental quality is a major factor of food resource and also economic factor that affects to food. It is difficult to control and predict all these influences of food security. This has led to the situation of the Thai population facing risks in food security due to inability to control quantity and quality of food and food resources.

Food security in this research can be clarified that the food security needs to be compatible with community context. There are previous studies that compiled with opinions of local people in a community and it is summarized that the food security term covers "Food security includes (1) rights and access to resource base in food production and gathering (land, water sources, genetic resources) leading to sufficient, diverse, safe, nutritious and sustainable food to consume, (2) rights and equal access to food distribution system – food sharing, markets, reserves, and supports, (3) stable and sustainable food system (social and ecological systems) for current and future quality of life for households and communities, and (4) knowledge transfer in food system to be suitable to social and ecological systems" (Kulvadee Kansuntisukmongkol, 2013). Regarding food security risk, it is a part of the study of food security which is a factor affecting food security. This emphasizes events that may affect future food security. Each area has its own type of risk, frequency, period etc. (Christan and Macro, 2006) and is also impacted upon by different types of risk. A person, who is able to manage and cope with those risks, would have food security in the future.

In Thailand, some strong communities that engage in agriculture and rely on forest resources are able to be resilient to normal conditions. For example, they

manage food in accordance with a community system that can react to climate variability and changes in socio-economic conditions. The community system provides the capability to have sufficient consumable food all year round. One of the communities that has this characteristic is Ban Maerawan, Yokkrabutr Subdistrict, Sam-ngao District, Tak Province. This research will use this community as a study area as it is a good case example that will allow the studying of characteristics of food resources, risk, and food security management systems as this community is located at river basin which is also on natural levee next to the Wang River. The community also has deciduous dipterocarpous forest which is a foothill serrate with a curly plain. This geographical location provides the land with fertility, however, also makes it at risk to flood which is an issue the community has faced before and is even more of a severe problem at present. Fortunately, the community is strong and united and able to manage the food resources in the community despite its geography. The community's ecosystem resiliency means it has been able to consume food throughout the year. This has led to the community receiving awards in relation to community forest management, economy, and food. These achievements confirm the ability of the local community to manage food during climate variation and the changes in socio-economic conditions from many public agents. For instances, in 1989 the community received a winner award in small water resource storage development; weir, at provincial level, in 2002 received an award for local forest-community food from Department of Forestry, in 2007 received a winner award of excellence community forest at provincial forest, in 2008 received a second-best award of excellence community forest at regional level, and is a model village of sufficiency economy at level 3 of Bank for Agriculture and Agricultural Cooperatives (promote community enterprise) etc.

Therefore, this research aims to study food security of households and community with respect to framework defining security that the researcher has collected and evaluated to suit this research. Hence, the research studies 3 dimensions of food security including type and quantity of food resources that households rely on each season; from both within the agricultural area and community forest of households in combination with household internal factors which are assumed to influence food security as well as study resiliency or community food security

management. This will lead to an analysis of the resiliency of the community food security management system, factors affecting community food security, differences of food security in each season, and also develop a mind map for community food security management. The result of the study will show the risks of community food security, potential for resiliency, household internal factors that affect food security, and a mind map of the community food security management system that can be implemented, applied, or developed with other communities that are facing risks in relation to food security.

1.2 Objectives

1.2.1 To analyze characteristics of resiliency of the community based food security management system

1.2.2 To analyze factors that affect household and community food security

1.2.3 To develop a conceptual framework describing the community based food security management system

1.3 Scope of studies

Scope of study area: This research aims to study food security and factors that affect community food security at a household level and analyze the risk and capabilities of a community to be resilient by employing the case study at Ban Maerawan Community, Yokkrabutr Sub-district, Sam-ngao District, Tak Province by studying all households at the community which consists of 135 households. This research aims to conduct a study on households that rely on natural resources, self-production, exchanges among community households, and exchangs through markets. These components will illustrate characteristics of relying on a diversified food sources.

Scope of variables: This research is a study of the characteristics of food reliance and management of the study area to find how to rely on food resources in each season all year round. It will also study risk characteristics by studying the effect

that climate variance has on food resources from different sources in each season; methods of risk management of these issues and community resiliency that support and preserve community food security; and internal factors of households that affect the capability of risk management of food security.

1.4 Assumption

Due to geographic characteristics of the village, the community faces food security risk which affects the food security differently in 3 seasons with statistical significance. Meanwhile, the community works on ecosystem and social resiliency since the community faced these problems. Also, there are some internal factors of households that affect each household to have different characteristics of food security.

1.5 Conceptual framework

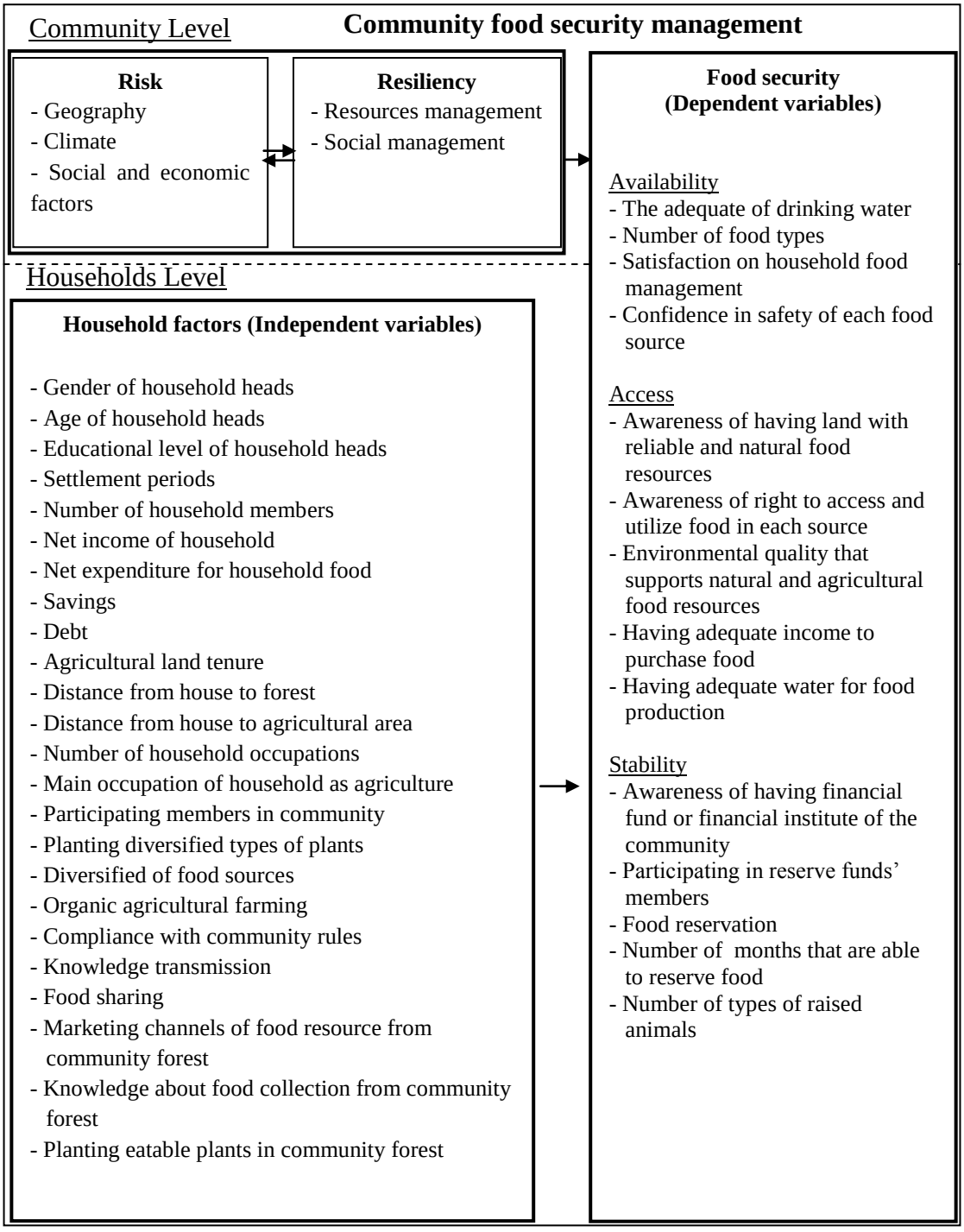


Figure 1.1 Conceptual framework

1.6 Definition

Food security in this research can be defined as household level sufficiency in food in terms of quantity and quality, with access to food resources through an appropriate method that is compatible with the environment and community life style as well as the ability to buy safe food as if needed. Such a person or household would also need to be adaptable to risky situations that affect food security, and also be able to cope with and manage those risks.

Food security risk in this research can be defined as a condition that leads to food insecurity and an unreliable situation that occurs from local geographical features of the areas, climate variability and disaster, and changes in socio-economic conditions which causes negative impacts on food security.

Resiliency in this research can be defined as the strength to withstand a severe disaster or hard lifting though the ability to adapt or handle any incidents either socio-economic or natural disasters, also ability to return conditions to normal after such as incident.

1.7 Expected outcome

This research aims to study a community based food security management system that is surrounded by risk from climate variability which is a location that has repeated inundation. A result of this study is a conceptual framework of a community management system which will be a mind map that can be applied with other communities that face similar problems or risks in food security, and also identify factors affecting food security that will be used as a community development guideline in other areas as to strengthen food security in the meantime.

CHAPTER II
LITERATURE REVIEW

This study, researcher has gathered all information related to topic and objectives of the study which comprises following document

- Definitions, concepts and theories of food security and risk
- Community resiliency
- Context and food resources of study area
- Relevant researches

2.1 Definitions, concepts and theories of food security and risk

Food means things that are edible, life supporting (Royal Institute Dictionary cited in Nongnapas Thiengamol, 2009). Food is also defined as life because human need food for survive. Food is important for body to grow and organism system. Food is source of energy, anabolism, repairing an organism of the body etc. (Nongnapas Thiengamol, 2009). In the past, human found foods because of the need for living but today human can produce foods more than their needs. However, development of science and technology have resulted the growth of population while food production has been monopolized by some business groups, and also processes of food production are unsafe which result in food shortage or lacking of nutrition in some population (Nongnapas Thiengamol, 2009). These have led to a concept of food security. Then, it has become an important issue, and its term has also been defined by many participants (people).

2.1.1 Definition of food security

The food security has been defined the same as academic and international organization (Surachai Raksachat, 2002) such as meeting of "World food security and world food summit" in 1996 in Rome, Italy; has defined as a situation that people want

to safely access the food in terms of physical and economic dimension and have adequate food for consumption as they need (Revathi, B. 2000:50 cited in Surachai Raksachat 2002).

Roumasset, In Chisholm & Tyers, Eds., 1982: 129 cited in Surachai Raksachat 2002 defined food security is ability to achieve food consumption in any levels no matter food production, food price, or consumer's income is uncertain.

While Sajin Prachason 2009 referred to Food and Agriculture Organization of the United Nations (2006) that the use of this term was officially used during the World Food Conference in 1974. The conference pointed out that food security is a problem resulting from "insufficiency of supply" of a country or a region.

Later, due to insufficient food from food exporter because of the inaccessibility to food, this has led to a development of a concept of food security with complex dimensions. There was proposed of a concept of the right to food which in the past only the food supply in macro level was paid attention. This time, food security is considered in a dimension of "access" and "stability" in individuals and households (David McKeown, 2006 cited in Sajin Prachasun 2009)

Regarding elements to foster food security, FAO mentioned about 3 dimensions which are availability, access, and stability. When these dimensions are perfectly integrated, it can develop ability both individual and household level in producing food, purchasing, and consumption. These contribute to food security both in quantity and quality (Revathi B., 2000).

In 2006, FAO has categorized and defined the term of food security into 4 sub-dimensions:

Availability: the adequacy of food quantity and its quality may be produced in domestic or imported as well as food assistance.

Access: access to food resource that is sufficient for individual and obtain proper and nutritional food. The resource means ability of individual to determine controlling any group of goods in accordance with a context of law, political, economy, and society of community (including traditional rights such as to access public resource of a community).

Utility: food utility is adequate amount of food, clean water, and taking care of health in order to reach a good nutrition that response to physical needs. This implies relationship with imported factors that are not food.

Stability: To have food stability, population, household, and individual must be able to access to adequate food at all times in order to avoid risk of inaccessibility to food as a result of any emergency crisis (such as economic crisis or climate) or natural incidents (such as food insecurity or seasonal food). This term covers availability and access dimension.

Meanwhile, an international organization that works on economic, social and political development in developing countries or south centre (Surachai Raksachat, 2002) has expanded elements of the food security in accordance with a framework of FAO's comprising 5 dimensions with the definition of food security. The definition is a status that people are able to access to food that contributes to good health at all time. This relates to a context of sustainable development as it is concepts of basic factors that people need; which should be obtain regularly and continually. They are as follows.

1) Food sufficiency refers to food distribution to all people. The food must consist of basic nutrition needs, adequate, and efficiency; especially, in South Asia and Africa, where the average amount of calories per day per person is very low.

2) Autonomy is a qualitative concept that relates to national and social groups in a society. For domestic and internal level, autonomy is a status when a nation does not agree to be under the control of foreign policy or other international organization. This issue is related to dependence on food imports from abroad because imported food is a phenomenon indicating an inability to produce food within a country. If food exporting countries face with any war or crisis, it will make the importing countries affected unavoidably. Also, regarding foreign debt, it is a common problem of developing countries which is a major factor decreasing in self-reliance in food as well.

3) Confidence is to believe that the food supply is adequate during the climate variability, season of the year, and other factors including changing of economic conditions and social dynamics. Therefore, it is necessary to seek for

reliable food supplies to reserve for the domestic people. The reserved food is from domestic food production, imported food, and access to sources of food reservation. Moreover, it is necessary to cooperate from all sectors of society in order to maintain the sufficiency of food.

4) Equity is one of the most important dimensions because it is a way to ensure that all individuals and social groups have an equal access to food especially for the poor, such as poor farmers. In this case, it is necessary to reform agriculture so that these groups of people can access to agricultural resources such as arable land which is an important factor or a base of food source for people in rural areas.

5) Sustainability and sustainable development imply a context of development that the future generation will be able to meet with what the current generation meets in terms of utility and access. Therefore, regarding sustainable food security, it is attempting to help future generation have enough food to consume. To achieve this, it requires a paradigm shift in development, then develop the meaning that imply about developing both in quantity; economic growth, and quality; quality people and society. Otherwise, only the aspect of economic growth or only one dimension will result in long-term which will exceed a limitation of the development. In other words, there will be more pollution which is negative externalities and cause unsustainable.

In addition, Sajin Prachason 2009 also gave the concept of food security in other dimensions; which may not about food directly but still affect to food security. The further study may be required to undertake assessment such as vulnerability. For instance, there are opportunities to be under standard of food security situation. There is a concept focusing future risk in terms of psychological and social dimension, which is a matter of feeling concerned about food and the right in food.

Sayamol Kraiyulwong (n.d.) commented on an article about policy of food security of the southern part of Thailand that the concept of food security is a guideline for Thailand and global society to determine that all humans have the right to have good health and have adequate good quality of food to eat. Food security is also derived from local culture or local wisdom and its ecological resource. Food security can be achieved if there is no monopoly in the production structure, access to

the resource, and ability to produce, access, and resource management as well as adequate consumption which will lead to good health.

Sayamol Kraiyulwong (n.d.) also mentioned that the concept of food security relates to a concept of basic human right that is guaranteed by Constitution of The Kingdom of Thailand, B.E. 2550 (2007) in a category of the freedom of Thai people, in section 66. It is stated about the right of community with the right of individual to engage in management, preservation, and utilization of natural resource and environment as well as its biodiversity in a sustainable way. Basic policy for National Article, section 83, the government shall promote and encourage the sufficient economic philosophy, and section 84 states that the government must follow an economic policy that contributes to sustainable development, having fair income distribution, and promote farmers to group together etc.

Meanwhile, there is a study of the definition of food security in the context of Thailand, which has developed a meaning of community participation; for example, a research project on Community food security management: An analysis of swamp forest wetland management in northeastern of Thailand and mixed deciduous forest – dry evergreen forest in a western region with the Driver-Pressure-State-Response (DPSIR) Model by Kulvadee Kansuntisukmongkol (2013). Kulvadee (2013) studied on a term of food security in a dimension of a community that it is "The right and access to the resources which is a natural producing system, having equally food distribution system, having stability, and sustainability of the food system, having continuing knowledge building by making a community to modify food system to be appropriate with its social system and ecosystem. Then, it will lead to a variety of foods with nutrition and good quality, adequate food for consumption, safe, and sustainable for better life quality of household and communities from now to future". The meaning relates to the dimension of social system and shows a connection between the ecosystem as a source of food and community food security with significant in eight aspects: (1) implication of self-reliance in food, (2) implication in food safety (3) implication in food adequacy (4) implication in household economy (5) implication in the right to access and manage the resources (6) implication in continuing knowledge building (7) implication in social stability, cultural preservation, sharing, and supportive, and (8) implication in ecological stability from production

and food collection that support the ecosystem. Community food security can be summarized in overall that the food security includes: (1) the right and access to the food resources of the community which is a producing system and food resource collection (e.g. land, water, plants and wildlife). This will lead to adequate, variety, safe, high quality in nutrition, and sustainable food for consumption (2) the right and the access to food distribution system of a community equally (e.g. the exchange, trading market, reservation, and community food assistance (3) the stability and sustainability of the food system (social system and ecosystem) for life quality of households and communities, and (4) to develop knowledge about food system so that the community can adapt the food security to be suitable with their social systems and ecosystems.

For an official definition of food security of the Thailand, there is a definition from Thai National Food Commission Act (2008 cited by Nongnapas Thiengamol, 2009). The food security is defined as "access to adequate food for consumption in the country, with safe food, having nutrition, suitable for each age in order to have good health, also having production system, maintain the ecological balance, and maintain natural food resources in the country both in normal or disaster situation, or terrorism arise due to food ".

From a review of international and domestic documents related to the study of food security, it found that almost all of the food security's definition mentioned or defined in accordance with the scope of FAO with 4 dimensions. The definition is described in different ways but the meaning is similar. There may be other issues added depending on a main study of researchers such as a focus on cultural studies, sovereign rights issues etc. Nevertheless, the reviewed definitions and concepts are applied in this study as to reach international and systematic. The study identified food security as a dimension in accordance with FAO's 3 dimensions including the availability, access, and stability. For the utility, it will be eliminated as its meaning covers other aspects, more comprehensive, and is difficult to apply with the studied area. In addition, the reviewed concepts will be applied in respect to each dimension, then, it will relate to the context of the studied area and the objectives of the study. According to the study, the researcher analyzed the definition of community food security as "an individual or household in the community has adequate quantity

and quality of food, ability to access to food with the right approach which is proper with the community's environment and lifestyle, and ability to buy safe food as needed with the flexible while facing risk situations that affect food security, and ability to manage and cope with those risks".

2.1.2 Risk in food security

From the definition of food security, the authors notice that a term of risk in food security is needed to be considered; for example, stability dimension is one of the four dimensions which are parts of food security's definition of the FAO. It is stated the stability dimension is a condition that households or individuals have no risk to access to food etc. However, the study suggests that risks in food security are the factors affecting the food security. Therefore, it is necessary to pay more attention and study the characteristics of each area and proper methods to cope with this issue. Although presently there is no invention or documents about the theory of risk in food security directly but the risks in food security have been mentioned and given importance. There are theories that are similar and relate to the risk in food security such as the vulnerability in a dimension of food security which means a person or households are in a situation of low standard of food security which is lower than the minimum for criteria of food security at a particular time. A concept of vulnerability focuses on the risk in food insecurity in the future. Each group of people has different levels of vulnerability depending on risk characteristics, ability to cope with risks or uncertainty of the situation (Sajin Prachason, 2009). For an assessment of vulnerability, there is no standard method to assess the vulnerability (Christian and Macro, 2005 cited by Sajin Prachason 2009). However, there are examples of vulnerable analysis in other views which focus on the sources of risk. It refers to emergent incidents to trend or seasonal events and potential in community risk management (Pasquael, 2006 cited by Sajin Prachason 2009).

It can be said that the risk is a major factor affecting the vulnerability or likely to face with food insecurity in the future which is an issue that should be studied in order to protect the risk or reduce such vulnerability.

Despite Thailand is fertility and has high diversity of resources which is food source, particularly for communities that rely on forests and agricultural areas,

those resources exposure to the impacts of climate change and the economic and social development as inevitable.

According to the report of the Food and Health: Toward a "new coverage" or increasing of injustice by Thailand Trend Monitoring Project (TTMP) (n.d.), it has specified circumstances and food trends. There are 3 critical situations which are undernourishment, malnutrition, and consumption gap between rich and poor countries. Undernourishment is worldwide. Nearly 800 million people in developing countries are starving, and about 34 million people in the developed world. Malnutrition is also worldwide. World Watch Organization has estimated that nearly half the world's population faces with this condition. The population approximately 1.2 billion people who are mostly in developing countries are in the under nutrition, lacking of energy and essential nutrients. And about 1.2 billion people, mostly in developed countries face with a problem of over nutrition. The over nutrition is overweight and causes obesity. Regarding consumption gap between rich and poor countries, it is consumption of the poor countries consume as much as rich countries such as increase in meat consumption. Moreover, the study also indicated the risk in food security is likely to affect to other 5 problems. Firstly, a cultivated area per person tends to decrease due to increasing in population and soil degradation and etc. Secondly, agricultural technology tends to be raised such as expanding irrigation and the use of biotechnology. Thirdly, agriculture is likely to be commercial. Crops are grown to feed animals. Fourthly, global cereal reservation has declined in the past few years. Developing countries need to rely on grains from industrialized countries. Fifth, there is more demand in household agriculture and organic food or ecology diet. As described, it shows that the risk in food security has at least three critical factors, which are as follows.

1) Natural capital and the increase of population: land is the most important natural capital in food production. Due to increasing population, suitable areas for cultivation have been reduced. Currently, estimated cultivation areas reduce to 0.25 hectares per person while the demand of food is increasing. Some studies estimated that in 2030 the world will demand for food will increase to 1.3 billion tons of grain which are higher than the grain product than the past 30 years. There is also distribution of suitable areas for cultivation is still a problem which is

also difficult to solve a problem of hunger in some areas. Besides, soil degradation causes the decline in productivity. This problem is difficult to solve because of heavy encroachment and destruction of natural capital.

Water is a natural capital for food production. Currently, the water shortage is worldwide including several large rivers as it also happens with the Chao Praya River in Thailand. It is getting dry and makes the groundwater slowly recover. This condition will lead to water shortage and impacts to the decreasing of grain production as low as 10 per cent.

Regarding to oil, it is a wasteful natural capital which is used more in agriculture in a form of mechanical propulsion and production of fertilizers and pesticides. When the oil runs out, it intensifies food production even more severed.

2) Agricultural technology: it is a hope to solve the situation of food insecurity. Agricultural technology has developed continuously for several millennia such as plant and animal breeding by farmers. Also, there are many more recent technologies such as gene modification in plants and animals by business corporations in this field. There is argument relating to Green Revolution which started after World War II whether the gene modification is able solve a problem of hunger and poverty in developing countries or not.

3) Economy, Society, and Politics: these are very important factors with 2 issues to consider including 1) Management of farms, lands, and trading; it is likely to be factory farming, production for trading in order to gain profit. This causes agricultural households or poor smallholder agriculture cannot survive. Eventually it leads to a monopoly which is disadvantage to both farmers and consumers, 2) Poverty; it is social hostility and political stability. This condition makes the situation even more serious hunger.

In relation to the articles that have discussed the risk in food insecurity in Thailand; the article in the journal Health Thailand 2012, it indicates that farmers are facing with the problems to access input especially land, the decline in the agricultural resources, liability among farmers, agriculture and food system monopoly by capitalists and middlemen. Also, a high cost of agricultural farmers is from using chemicals and excessive risk to health problem, environmental degradation, energy

crisis and global warming as well as competition issues; including international trade and trade liberalization. All factors both directly and indirectly impact on food security.

In addition, there are studies a production system of agroforestry and community forest management with climate change, and food security creation of a Karen Community in the northern part of Thailand by Northern Development Foundation and Huai Hin Lad Community in 2011. The study referred to global climate change affecting to agriculture and Thai society in several aspects such as flood and drought problems, disorders of rainfall quantity because of climate change. These circumstances increase risks in resource utility and food insecurity.

From the review of the documents shows that risk is complex. It is in other matters and also has different causes. The researcher processes the definition by semantic understanding from the documents that "a situation that is uncertain or unusual events because of geographical features of the area, climate variability, or socio-economic changes which cause negative impacts on food security".

2.1.3 Indicators and study of food security

Many different definitions of food security have been stated. Indicators of food security have been compiled and this study collects the indicators only from domestic. According to the study of indicators of food security development by Sajin Prachason (2009), the definition of food security indicators refers to a set of factors to measure a dimension or multiple dimensions of food security which shows a current status or condition, and changes or results of intervention. Since the past, there have been various studies about indicators development. However, there is no perfect index which is able to cover all dimensions of food security (Daniel Maxwell, 1999 cited in Sajin Prachason, 2009). In terms of practicing, the study of food security will select one or multiple indicators depending on a concept, target, objective and condition of a researcher because each indicator has different advantages and disadvantages; for instance, income index reflects to the access of food for people who do not produce their own food. Nevertheless, direct measurement takes more time and may not gain an accurate data. Also, a strategy index of household’s adaptation emphasizes on the vulnerability and ability to manage risk but its disadvantage is a method or behavior

may be different in each area. Then it is difficult to compare with other contexts. Diversity index of food assists to indicate the quality of food consumption in household and also send signals to the vulnerability which is needed to consider together with food quantity.

Regarding an indicator which is a popular set of study to evaluate food security status at a community level from the reviewed documents, it shows that the indicator of food security in community by Sustainable Agriculture Foundation (Thailand) and network (Sustainable Agriculture Foundation (Thailand), <http: //www. sathai.org/th> cited by Kulvadee Kansuntisukmongkol, 2013) studied on many communities in all regions during 2010, totally 26 communities with the scopes of the study including 1) to study on a definition of "food security at a community level" from farmer's household and other groups 2) to study on food source of household and community 3) to study on self-reliance in food of household and community by considering from food resources and other factors which relate to producing food by household and community 4) to develop indicator of food security of household and community, and other factors relating to vulnerable risk and potential of community in order to analyze a trend of food security in the future and 5) to study on a status of food security of household and community in accordance with the indicators of food security at community level. For the indicator development, it indicates that to measure food security at a community level, it does not only apply the indicators of nutrition or economic status of household but also measure from food production system of household and community, community participation in determining a policy of marketing and food standard that is sold in a community as well as building knowledge about a local food system of the community and health condition of household and community, and the right in culture and development that will maintain the food system of the community, food reservation, and gathering a group of people to solve a problem of food shortage of household and community. Furthermore, the measurement comprises risk, vulnerability, and potential of community as indicators to build stability and sustainability in a normal condition and food crisis. Risk and vulnerability will reflect a context relating to food security at a community level. The risk can be both external and internal factors. For examples, the external factors are natural disaster or state of war. The internal factors are decreasing in a proportion of

self-reliance in food and community potential assessment at a household and community level that will response to the crisis and possible risks. These will be a tool in planning and development as well as building strength of food security of household and community in the future.

Table 2.1 Detail of indicator's component

Indicators	Details
1. Autonomy	
1.1 Adequate food and water for consumption all the year	1) food quantity in household and community must be enough to the demand in household and community all year round including adequate water 2) variety of food for consumption in each meal
1.2 Portion of food source	1) portion of food for consumption at household and community 2) portion of food from local nature resource in a community 3) portion of food from exchange within a community 4) portion of food expense in a household
2. Right on coastal and marine resources	
2.1 Size of area	1) forest, water and public natural resource in coast are food source of community
2.2 Fertility of natural resource	1) fertility of natural food relating to water resource, forest , and agricultural plantation has a diversity of plants and animals which are food resource to household and community 2) fertility of food in a coast and sea in aspect of quality and diversity from mangrove swamp, canal, forest and sea grass which is food resource of local fisherman
2.3 Right to access natural resource	1) right of community to conserve public forest of community (which is also a watershed), the coast and sea 2) having rules and regulations to manage natural resource and public area by having committee, activities from community to manage and utilize natural resource and public area as well as coastal and marine management
2.4 Knowledge and local wisdom in collecting natural product	1) having belief, knowledge, and local wisdom related to natural resource management including forest, water resource, and marine

Indicators	Details
	2) having local culture in culinary and food processing by utilizing natural resource such as coastal and marine resource 3) delivering knowledge about consumption using local food resource to youth in a community
3. Right in productive resource base	
3.1 Productive resource genetic	1) having plants and animals in household and community
3.2 Land factor	1) owning land that is sufficient for food production
3.3 Water resource for agriculture	1) having water resource for agriculture
4. Food security in economic dimension and the right in food system	
4.1 Distribute farm product of household or community or measuring from food expense	1) proportion in farm product distribution and proportion between food expenditure and total household expenditure
4.2 Household income	1) balancing in household economic, income, expense, debt, and saving 2) diversified sources of revenue; having major and minor revenue 3) having policy guarantee for household livelihood through measure of government
4.3 Food access in market system	1) having sources for food trading or diversified market 2) having equally diversified food distribution system and support to both producers and consumers 3) having community market system that household and community are able to determine a standard
5. Access to food quality	
5.1 Food safety and nutrition	1) producing process must not use chemical as well as food processing and packaging or process in sale distribution. 2) considering the sources of food and producing process for buying decision 3) regarding to health in terms of disease, consider from household and community disease which is related to food

Indicators	Details
	4) accessing to consumption information
6. Dimension in culture and development	1) existing of belief, household and community attitude toward public resources including food collection and reservation 2) food sharing or food exchanging within a community that has different ecosystem 3) availability of community assisting system in a form of fund such as rice bank, financial fund, community welfare etc. 4) local culture relating to food and utilize local resource in cooking
7. Risk, vulnerability, and potential of household and community	1) natural disaster and climate change, risk from drought, flood, and landslide that affecting agricultural and fishery product 2) risk from self-reliance in household and the decrease in community food 3) factor from war and starvation
8. Potential of household and community	1) ability of household in solving problem 2) group gathering to assist in community food

(Applied from Sustainable Agriculture Foundation (Thailand), <http: //www. sathai.org/th> cited by Kulvadee Kansuntisukmongkol, 2013)

A study of indicator and action plan of food security at Ban Tha Chang, Panantoong Sub-district, Phatthalung Province by Alternative Agriculture Network, Phatthalung Province, Rice University incorporating with Sustainable Agriculture Foundation (Thailand) in 2012-2013 which indicate food security relating to the above indicators. The indicators include 4 dimensions. Each dimension consists of following indicators.

1. Adequate food and water for consumption all year round: the indicators are adequate rice for consumption in a whole year, clean water for consumption, various kinds of food and adequate amount of food, searching food from natural resource, ability to produce food from agriculture, and obtaining raw material and food from the market.

2. Right and access to food system of community: the indicators are area to be natural resource, fertility of local natural resource, right to access natural resource, storage and extend heredity, sufficient land to produce food, adequate water resource for agriculture, distribute product from agricultural areas of household and community, ability to access food in the market system, and safe food and nutrition.

3. Risk and vulnerability of local food source: the indicators are food security level with factors from disaster and climate change, terrorism, and internal conflict; which will be effect to both food consumption and production, and also factors from developing country policy to food production area and behavior change in household and community.

4. Potential of household and community to local food security: the indicators are food storage and production of household, creating group to develop well-being and well-eating of community, developing network and partnership for goods to a community, allocating and exchanging of food, knowledge and ability to collect food from natural resource.

There is also a study on the status of food security of farmers in Thailand. Alumni Rural Reconstruction and Friends (Pongtip Samranjit, 2002 cited by Sajin Prachason, 2009) studied both a qualitative and quantitative status of food security base on a stability framework of FAO in 4-dimensions. They organized meeting and seminar, developing food calendar and production calendar, quantitative study, and using household survey data with measure of food security as follows: 1) purchasing situation or purchasing power of households, 2) cost structure within the household, 3) the acquisition, distribution and adequacy of food, 4) house structure and facilities, 5) sickness and death of household members, 6) levels of food production in a household, 7) levels of participation in a community of households 8) attitudes and factors affecting food security 9) problems within the community with the solutions.

From the above research and studies, they mostly mention food security indicators in general which cover risk in food security. As mentioned, risk in food security is a part of the food security definition. However, risk is an issue that has a major role to food security. For the risk in food security that the researcher has collected, it shows that there are risk and causes of the food insecurity. It depends

upon the context of each area and also includes natural factors and unexpected environmental issues. Therefore, it is not necessary to study vulnerability and risk in food security or to find a method to cope with those risks and improve those vulnerabilities as well as prevent food insecurity that may occur in the future. For instances, the study of the conceptual framework for analysis in vulnerability in food security by Christan and Macro (2006), developed the conceptual framework about vulnerability (Figure 2.1). A concept in the conceptual framework is to identify a situation and condition of food security in accordance with current factors. It depends on the level of risks which depends on the ability to manage these risks. They then studied the current situation and risk characteristics. Hence, risk management will affect food security in the future.

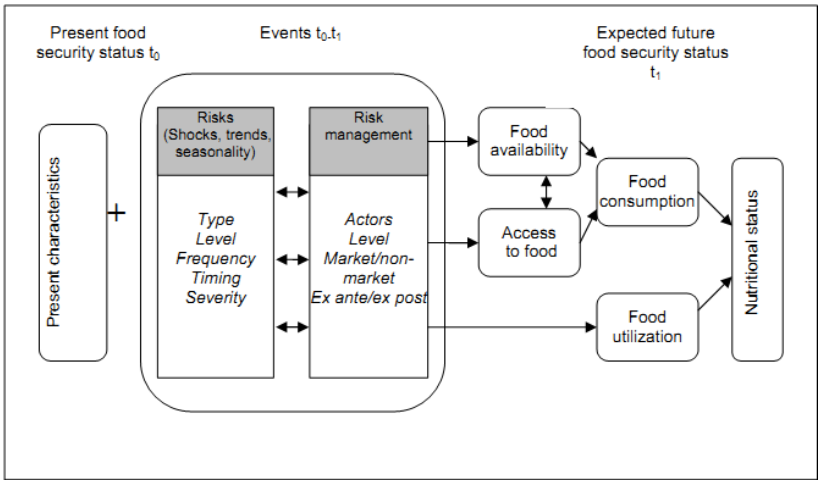


Figure 2.1 A framework for analyzing vulnerability to future food insecurity. (Christan and Macro 2006)

Regarding the study of climate variability and social vulnerability, Hans, Thomas and Michael (1994) stated in terms of sociology and geography can cause food insecurity. They have studied and created a mind map illustrating a pattern of logical vulnerability (Figure 2.2). They applied principles of the openness effects, capability, and potential to release impacts and compiled an explanation in a dimension of human ecology, political ecology, and right in society. The study covered characteristics of each dimension of a studied community to find the

dimension of each pattern by using information about political ecology, sharing, social relationship, and the increase in capability.

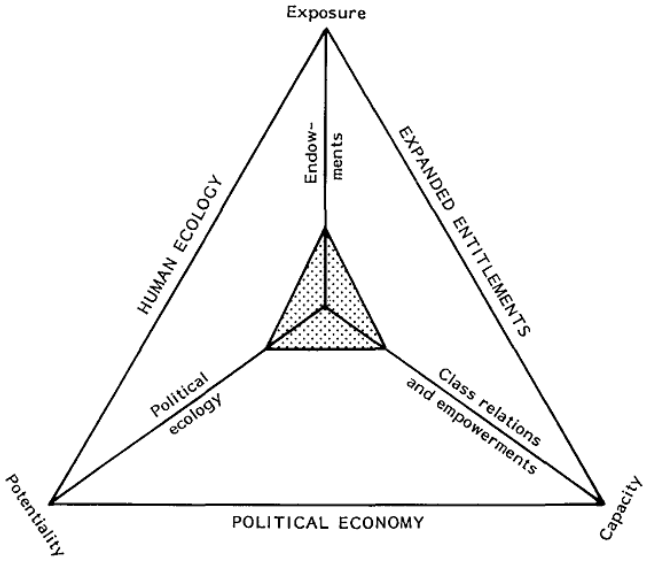


Figure 2.2 The casual structure of vulnerability. (Hans, Thomas and Michael 1994)

Reviews of indicators in food security allow the researcher to use this as a guideline to determine indicators in order to identify food security in the area. This will be applied with a frame of security, which is summarized into 3 dimensions. From the review of terms and definitions and the concept of food security, it assists in measuring community food security while some indicators can indicate risks and household risk indicators. Moreover, some parts of a conceptual framework of the study can be a guideline to study risk and risk management at the community level as the researcher applies the conceptual framework.

2.2 Community resiliency

Community resiliency is theory developed from theory of physical resilience or ecosystem resilience to human resilience and community or society, which have the same basic. The root of resilience word derives from bounce or rebound. When this word is applied in ecosystem, human or community, it is mostly studied together with understanding in risk and vulnerability because they are

unavoidable. In other words, every community will face with risk or vulnerability in some ways including physical or environmental, basic infrastructure, economic, and social vulnerability (Rhys and Ken 2012). Hence, processes of community's resilience will create the changes by decreasing those vulnerabilities and able to solve and adapt with those issues.

A concept of resilience is interesting. It means perception and ability to cope with the severity or hard lifting. Also, ability to recover or restore to normal condition after fighting with those severity (Bonnano, 2005; Cutter et al., 2008; Maguire & Cartwright, 2008; McAslan, 2010, 2011; Tanner, Mitchell, Polack, & Guenther, 2009 cited by Rhys and Ken 2012). Things that need to be considered for ability of community to resilient include physical characteristics of community, management steps or methods of community, and social characteristics of community. These indicate ability level of community resilience.

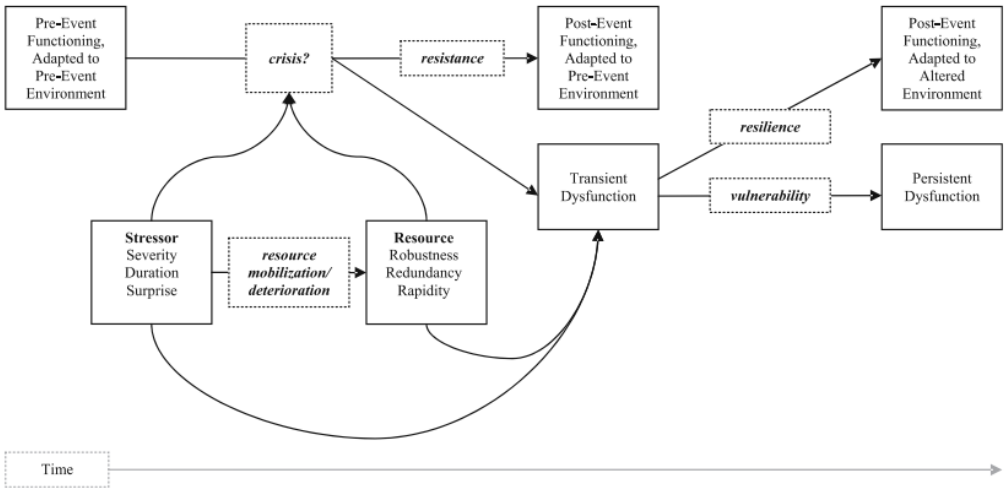


Figure 2.3 Model of stress resistance and resilience over time. (Fran, Susan, Stevens, Karen and Rose, 2008)

In terms of resistance, it occurs when resource is efficiently and sufficient. Then, it will help community to cope with the effects. While community resilience is a process that community is able to adapt after facing with disturbance (Fran, Susan, Stevens, Karen and Rose, 2008).

2.3 Context and food resource of the study area

2.3.1 Characteristics of location

A studied area is at Moo 5, Ban Mae Rawan Community, Yokkrabutr Sub-district, Sam-ngao District, Tak Province. It is situated in the north of Sam-ngao District and far from Sam-ngao district office approximately 25 km. It is a sub-watershed of lower Wang River which is a part of watershed of the Wang River. It also has the Wang River as an important water resource flow through which is at the end of the Wang River adjacent to Lampang Province.

Wang watershed is situated between Ping and Yom watershed which cover an area approximately 10,793 km^2 or 6,745,734 Rai. It is a stream and the shortest length of the Chao Praya River. Most areas cover 2 provinces which are Lampang and Tak Province and more than 90 per cent is in Lampang Province. The length of the stream is about 460 km. It comes from Pee Pan Nam Mountain Range at Doi Luang, Ban Pa Hoong, Pan District, Chiang Rai Province. In this district area, it is a border between Lampang, Payao, and Chiang Rai Province. The water flows along the valley and flows into the plain in Muang District, Lampang Province and flows to Ping River which is located behind Bhumibhol Dam for 30 km. at Ban Pak Wang, Tak Oak Sub-district, Ban Tak District, Tak Province (Hydro and Agro Informatics Institute, 2013).

The upper geography of Wang watershed is mountain range and forest with slope from the mountain which is watershed, then continuing to valleys and plain and meet at Ping River. Wang River Watershed consists of medium and small streams with major rivers; which are Wang River, Nam Mae Soi, Nam Mae Dui, Nam Mae Jang, and Name Mae Dum etc. The separation of rivers and streams of Wang watershed is determined in accordance with results of the study of survey research project design 25 hydro stations of main watershed of Thailand by Department of Water Resources which divides Wang watershed into 7 sub-watersheds. The studied area is situated at lower Wang sub-watershed with an area of 3,151 km^2 which is most areas of the watershed. It covers Ko Ka, Mae Ta, Sobprab, Thoen, Mae Prik District, Ban Tak and Sam Ngao District, Tak Province. Major sub-watersheds are Huai Mae Prik and Huai Mae Salid with a total of 22 sub-districts. The ended part of Wang River at the studied area due to the slope; therefore, the river becomes more meandering

channel which creates river bend. At the bend, it makes speed of water flow slower. When there are high amounts of water runoff, the drain is slow. Then, there is inundation, especially at the meandering channel or the bend. However, the curve of the river makes the other side of the river collect more sediment layer. Then, the other side of the river has less sediment layer. When it is inundated the lower area becomes natural monkey-cheek. Therefore, the amount of flood between two sides is different. Furthermore, the meandering channel of the river causes inundation while it creates a natural monkey-cheek. The natural monkey-cheek assists in water drainage and natural water detention storage which releases the severe impact from inundation/ floatation. However, a plain next to the river has a specific characteristic because the riverside once inundated it becomes flood plain. It can be said that when there is inundation from the river. The inundation brings sediment from watershed to collect on soil and later becomes natural levee which is next to the river, back swamp, and river terrace. A narrow plain at river bank that collect sediment has made the soil fertile and has mineral which is suitable for doing agriculture. In general, land use at a plain relies on a plain behind the levee and usually utilizes this area for growing rice.

The geography of the village is a wide plain expanding along both sides of the Wang River; in the meandering channel part of the river. The height of sea level in the settlement area and forest is approximately 0 – 3,000 meters. There are agricultural areas along both sides of the river. In the west, there are house settlements with 0 – 300 meter height. Next to this area, there is a slope, foothills, and mountains. There are sub-rivers of the Wang River which are an important water resource for the village. There are 2 main sub-rivers; Huai Tueng and Huai Mae Rawan. The sub-rivers' watershed is on the west mountain. Particularly, Huai Mae Rawan is very important because it connects to the Wang River in the northern part of the village. Adjacent to the village is a huge area of forest with 301 – 3,000 meter height. It consists of community forest with an area of 181 Rai, community forest that co-operate together with other 6 villages for 15,400 Rai. This area is located on a mountain which locates the Bhumibhol Dam. It is also a monsoon shield from the south west which causes different climates between the west and east of Tak Province. Therefore, it makes the eastern area a rain shadow, which is an area of the study.

Regarding to climate, according to the secondary data, it shows that amount of rainfall at the studied area is not higher than 450 millimeters/ month (Department of Meteorology). During May and September, there are high amount of rainfall while there are less amount of rainfall in other months which is not higher than 350 millimeters/ month. In summer, it takes long which is from February to June. The temperature starts to get cooler in November until January. Moreover, rainy season starts from May to September with average annual runoff (in 1971-2001) approximately 1,000 million cubic meters (Hydro and Agro Informatics Institute, 2012). The season can be categorized by the characteristics of rainfall and climate in each area which can be categorized as follows. Winter takes approximately 4 months which starts from November to February. It is dry season with a minimum amount of rainfall all year round (not higher than 50 millimeters/ month).

This area also has winter and summer. Each season takes about 4 months. For summer, it covers 2 periods which starts from March to April, and July to August. It is a period that has normal amount of rainfall (approximately not higher than 250 millimeters/ month) and has tropical climate. In rainy season, it takes about 4 months which covers 2 periods; from May to June and September to October which has the highest amount of rainfall in a year (approximately 50-400 millimeters/ month). An amount of rainfall in each year is still inconsistent in each month or season. Some months of some years that usually have high amount of rainfall becomes having less amount of rainfall. Some months of some years that usually have less amount of rainfall or no rain becomes having more rain.

According to geography and climate data, the studied area is a plain beside the river and adjacent to the foothill. Also, there is forest as food and economic resource. This area is suitable for doing agriculture which also makes food and economic resource. For the forest area at western foothill of the village, it is plant community; deciduous dipterocarp forest, accommodating diversified edible plants; for examples, vegetables, mushroom, amphibian, reptile, and insects. Regarding agriculture, it can produce food at foothill and central plain which is next to the river. At foothill, it can do crop farming, orchard, raise animals, and few rice paddy fields. At the plain next to the river, the villagers engage in rice paddy fields and orchard. Therefore, geographic ranges and climate of the studied area is a major determinant

which is a foundation of fertile natural resource which leads to availability of diversified and large amount of food resource.

Nevertheless, this location can also get natural disaster because of the continuity of the location which receives water from other areas. As a result, it is difficult to control the flood. As mentioned earlier, the village is located at the end of the Wang Watershed which is affected from the water runoff of the river's watershed; which is from Chiang Rai, Payao, and Lampang Province. There are mountains and forests connected to the river's watershed. This assists in balance of water quantity in the river. Nevertheless, many changes of the river basin are over the ability of the community to control as well as the quantity and variance of amount of rainfall. Moreover, there is risk from the outsiders' invasion to use the resources which causes the changes and impacts on the food resource.

Particularly, climate variability is risk to food security. This issue has caused more impacts especially in a form of natural disaster which occurs more frequent and more severe. These may occur from natural variability or human activities. At present, there is a serious issue on climate variability. It is anxious/ worried that it will cause more problems in the future as mentioned in Chapter 2. According to future climate forecast data which is forecasted by Southeast Asia START Regional Center, Chulalongkorn University (see Appendix B), there is possibility of temperature rising in the next 30 years (in 2039), 60 years (in 2069), and 90 years (in 2099) (Figure in Appendix B). In the past 30 years (year base from 1980-2009), an average temperature was 24-28°C, the highest temperature at 40-45°C, and the lowest temperature at 10-15°C. In accordance with temperature forecast with many developments on earth, there are guideline A2 which is development that similar to the past, emphasizing on economic development more than environmental sustainability. Guideline B2 is development in a way of balancing by developing economic together with environment. Guideline A1B is development that emphasizes on environmental preservation. It found that an average temperature, highest temperature, and lowest temperature are possible to have higher temperature which is about 1-2 (+)°C for the number of heat days (number of days having temperature higher than 35°C). From the past 30 years (during year base), number of heat days in a year round is 90-120 days. From the forecast, it is predicted number of heat days will be increased to 15-60 days.

Number of cool day (number of days having temperature lower than 16°C) within the past 30 years (year base), there are about 15-30 days. From the forecast, number of cool day will be decreased to 5-20 days. A total amount of rainfall from the past 30 years (year base), an average amount of rainfall is 1,400 milliliters/ year. From the forecast, an amount of rainfall will be similar to year base accept some areas will have more rainfall which is 10-20 per cent and a number of rainy day (number of days having rain more than 3 millimeters per day and number of days having heavy rain more than 35 millimeters per day). From the past 30 years (year base), an average number of rainy days was 90-120 days. Regarding the forecast, number of rainy days will be similar to year base which is possible to decrease more than 5 days and is possible to increase more than 10 days. The difference will be number of years that are forecasted and a method of forecasting. Regarding number of days having heavy rain in a year round will be closed to a year based. In accordance with climate forecast from scenario of the future model, it shows the variability of temperature and rainfall quantity which have direct impacts on food resource and the occurrence of disaster which are risk to food security in the future.

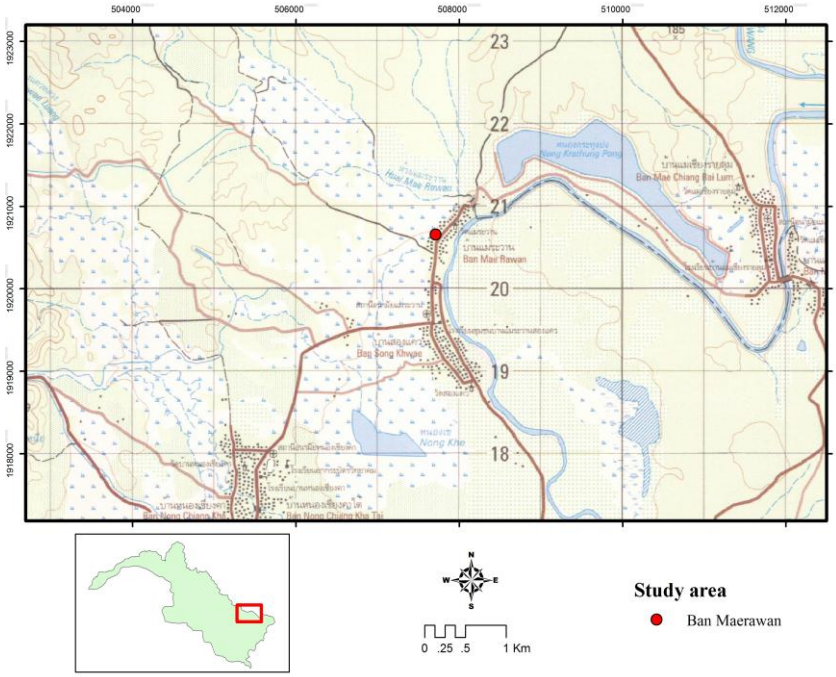


Figure 2.4 Study area map

2.3.2 Food resource utilization

Most community member engages in agriculture, rice cultivation, crop farming, orchard, and collecting forest product. Few of them occupy in employee and public officers. Community forest is both direct and indirect use which is Pa Ton Forest. It is a dry dipterocarp forest with an area of 181 Rai and community forest 15,400 Rai. It is situated on a high land adjacent to the river in the west of the village. Regarding agricultural areas, some of them are next to the forest, slope down to the river, and are rice paddy fields, crop farm, and orchard. Some of them are next to the river which is a plain and are rice paddy fields and orchard.

Food resource reliance in respect to a location context will be reliance on community forest and agriculture land. Due to cultural factor, the other food source of community is food exchange between households. Additionally, purchasing food from market assists both food producer and non-producer able to access to food source. It can be summarized that household at a studied area relies on 4 food sources including natural resource, producing, exchanging, and trading. These are compatible with other studied areas that have been studied about food security; for example, community food security management: analysis in swamp forest wetland management in the northeastern region, and mixed deciduous forest – dry evergreen forest in the west with the use of the frame of Driver–Pressure–State–Response (DPSIR) Model by Kulvadee (2013). An analysis includes the study community food security management with 2 communities that rely on different resources. In the past, there is fertile resource; whereas, at present it faces with development from public sector. This research utilizes Driver–Pressure–State–Response (DPSIR) Model in order to study food security management system and risk on food insecurity as to build monitoring system for in food security with participation to swamp forest wetland community and mixed deciduous forest – dry evergreen forest. These have been presented as policy for food security management. It is found food resource of the community comprises natural ecosystem, agricultural ecosystem, market, and food exchanging or sharing among household.

For the community, food is an important issue. Food resource is very important to the community. The studied community has good practice on food resource management; particularly natural resource which is public use. Therefore, to

preserve quality and quantity of the resources to community member in a long term, it can be observed from the availability of utilization rules and regulations or activities relating to community forest conservation. Furthermore, other activities support the capability to access the 4 food resources of the community.

Due to the geographical location of the studied area that support the flood, as it is a low land stands on levee next to the river, and has mountains in the west. These affect water runoff from the Wang watershed during large quantity is unable to drain together with water runoff from mountain in the west of the village. These are risk from nature or flood. From the reviews, the studied area receives repeated flood annually and most agriculture rely on rainfall. Then, it is risk from inconsistent rainfall in each year. This is a result from climate variability. Also, the studied area faces with other risks on the other hand the community receives an award in water management and resource management from many agencies as mentioned in Chapter one. This shows that the community has risk in food security in some ways and is able to manage those risks.

2.4 Relevant researches

Apart from the research on climate variability and social vulnerability in sociology and geography that cause food insecurity by Hans, Thomas and Michael (1994). Moreover, a study of conceptual framework for vulnerability in food security analysis by Christan and Macro (2006) has applied and implemented a concept and theory. Furthermore, there are researches in Thailand in relation to food security that are similar to this research of resiliency of community based food security at Ban Maerawan Community.

Kulvadee (2013) has conducted a research on assessment of factors in food security by a model of DPSIR in the research of Community-based Food Security Management: the Analysis of Communal Management of Seasonally Flooded Forest in the Northeast and Mixed Evergreen and Deciduous Seasonal Forest in the West using Driver-Pressure-State-Impact-Response Model. It was found that major factors that assists in food security management at household level. There are (1) agricultural patterns that cultivating diversified plants such as Swidden cultivation or integrated

agriculture (2) diversified of food sources (3) performing follow community rules and regulations (4) knowledge delivery (5) diversified of market (6) doing organic agriculture (7) receiving consumption's information, and (8) food sharing, helping in relation to food, and factors in social population that would affect food security such as gender, age, educational background of household head, settlement periods, number of household members, household net income and net expenditure in food, saving and debt, land holdings for agriculture, forest utilization for agriculture, area for collecting forest product, distance from home to forest and agricultural area, number of occupations, main and minor occupation, and member group. This research concluded that factors for food security management are response factors that resulted from DPSIR. The factors are organizing institute to be integrated with related stakeholders to manage as well as developing knowledge and implementation which will make these systems as mentioned previously. It is necessary to aware of the value of food resource at the local area. The response from the 8 patterns is necessary to realize situation and connection between dimensions of food security in a model DPSIR.

Regarding to the thesis in household food security: 10 years after the operating of Rasi Salai Dam, the study aims to study the situation of community food security comparing to the past 10 years, and to study factors affecting food security situation. Factors affecting food security are gender, age, educational background of household head, number of household members, settlement periods, occupying in agriculture as a main occupation, number of occupations in a household, distance from home to the forest, distance from home to the agricultural area, land holdings for agriculture, income, food expenditure, and number of groups that engaging in community member.

Regarding to the study of food resource security among communities adjacent to PahDaeng community forest Prae Province, biodiversity of food resource from community forest was studied. The factors affecting the biodiversity, and present an issue that a community utilize for monitoring the biodiversity by a method of collecting related secondary data and collecting primary data by employing questionnaire, survey form for lists of food resource from community forest that the local people collecting for consumption, and in-depth interview from key informants by employing Seasonal analysis as a tool to analyze data in descriptive analysis,

multiple regression analysis, and recommendation on monitoring the biodiversity in accordance with a conceptual framework of Pressure-State-Response (PSR). As a result, it shows factors expected affecting food security be classified into household, economic, and social factors. Household factors consist of gender, age, educational background of household head. Economic factors consist of household income, value of food resource from community forest, and distribution channel of food resource from community forest. Next, social factors consist of number of household members, household occupation, distance from home to community forest, land holdings for agriculture, settlement periods, member of community forest, knowledge in collecting food resource from community forest, and behaving in respect to community rules and regulations in collecting food resource from the community forest. Lastly, community factors comprise knowledge in collecting food resource from the community forest, eatable plants that are planted in community forest, and rules and regulations in collecting food resource from the community forest. In consequence, the factors affect to diversity of food resource (edible plants) from the forest are revenue, participating in community forest member, having knowledge in collecting mushroom and phak wan. For factors affecting diversity of food resource (wildlife) are revenue and having knowledge in collecting eggs of red ants.

Regarding the collected documents about factors affecting community food security in Thailand, it shows that each study has different indicators for food security. Nonetheless, there are factors affecting food security in similar and compatible. It can be classified into population, economic, and social factor. This study therefore takes factors from the reviews; that would affect food security. Then it can be a guideline which factors affecting food security in respect to the framework of this study. Hence, this research summarizes variables that are needed to be proved whether they affect food security or not as stated in the conceptual framework in Chapter one.

CHAPTER III
RESEARCH METHODOLOGY

The methodology of this research is mixed between qualitative and quantitative methods. The qualitative methods comprise collecting secondary data and primary data which consists of in-depth interview and focus group discussion. The quantitative method is composed of household survey by using questionnaires. The process and steps of the research are as the objectives which are (1) to analyze resiliency of community based food security management system, (2) to analyze factors affecting community food security, (3) to develop conceptual framework describing community based food security management system.

3.1 Research procedure

Table 3.1 Research procedure

Objectives	Procedure	Methodology
1. Analyze factors effecting food security of community	- Survey for household primary data including factors of population, economic, social and community, food security characteristics, and food reliance in each season of household at the study area by employing questionnaire	Quantitative
2. Analyze resiliency of management system of food security of community	- collecting secondary and primary data including information of meteorology, risks related to seasonal food resource in each month of the year, land use allocation for food resource from community forest, and other management that are compatible with climate by employing in-depth interview and focus group discussion	Qualitative

Objectives	Procedure	Methodology
3. Develop conceptual framework of food security management of community	- Compiling information from in-depth interview, focus group discussion, and questionnaire to analyze and design conceptual framework (mind map) of food security management in accordance with the characteristics of the study area	Qualitative

3.2 Quantitative research

Quantitative study in this research is a survey research from household survey in different dimensions of food security in order to analyze the food security situation and internal factors of households that affect community food security as the following details.

3.2.1 Research tools

This study employs questionnaires as a tool to collect data. The questions are able to determine characteristics of households and characteristic of consumption in accordance with dependent and independent variables within the scope of research. Additionally, the questions regarding general information are included to assist in data analysis. The questions comprises as follows.

Part 1: the questions are about factors affecting dependent variables of this study. The questions ask about characteristics of household population including gender, age, occupation, status, education of household head; who decides for household's livelihood, household's economic; including income, food expenses, and household's social background; the number of household members, occupation, participating members in community resource management, food knowledge and food resource collection (see Table 3.2).

Table 3.2 Household factors that effect to food security (independent variable)

Variable	Measure level	Unit
1. Gender of household heads	Nominal scale	
2. Age of household heads	Ratio	year
3. Educational level of household heads	Ratio	
4. Settlement periods	Ratio	year
5. Number of household members	Ratio	Person
6. Net income of household	Ratio	Baht
7. Net expenditure for household food	Ratio	Baht
8. Savings	Nominal scale	
9. Debt	Nominal scale	
10.Agricultural land tenure	Ratio	Rai
11. Distance from house to forest	Ratio	Kilometer(s)
12. Distance from house to agricultural area	Ratio	Kilometer(s)
13. Number of household occupations		Occupation
14. Main occupation of household as agriculture	Nominal scale	
15. Participating members in community	Nominal scale	
16. Planting diversified types of plants	Ratio	Type
17. Diversified of food sources	Ratio	Source
18. Organic agricultural farming		
19. Compliance with community rules	Nominal scale	
20. Knowledge transmission	Nominal scale	
21. Food sharing	Nominal scale	
22. Marketing channels of food resource from community forest	Ratio	Channel
23. Knowledge about food collection from community forest	Nominal scale	
24. Planting eatable plants in community forest	Nominal scale	

Part 2: this part consists of information about dependent variables of the study (food security indicators). The questions are about types and quantity of food resources that households collect from the forest, grow in agricultural areas, purchase from the local market, or exchange among neighborhoods in each season of a year. Moreover, the question enquires about the fertility and the right to use benefits from food resource in accordance with 3 dimensions of food security (see Table 3.3). These questions will lead to information of each indicator. Further detail of the questions is in Appendix A.

Table 3.3 Clarify indicators of each dimension of food security (dependent variable)

Variables	Measure level	Unit
Availability		
Adequacy of drinking water	Nominal scale	
Number of food types	Ratio	Type
Satisfaction on household food management	Ratio	Score
Confidence in safety of each food source	Ratio	Score
Access		
Awareness of having land with reliable and natural food resources	Nominal scale	
Awareness of right to access and utilize food in each source	Nominal scale	
Environmental quality that supports natural and agricultural food resources	Nominal scale	
Having adequate income to purchase food	Nominal scale	
Having adequate water for food production	Nominal scale	
Stability		
Awareness of having financial fund or financial institute of the community	Nominal scale	
Participating in reserve funds' members	Nominal scale	
Food reservation	Nominal scale	
Number of months that are able to reserve food	Ratio	Month
Number of types of raised animals	Ratio	Type

3.2.2 Target population

Target population of quantitative study in this research comprises head of households at the study areas. All households of the village which is 135 households are studied. They produce their own food, use forest resources relying on the sharing system within the community and purchase food from local market. As a result, it shows diversified food sources.

3.2.3 Data analysis

After using questionnaires for collecting primary data from heads of households at the studied area, the obtained data will be analyzed quantitatively as follows.

(1) Descriptive Approach Analysis using SPSS program (Statistical Package for Social Science) and Microsoft Office Excel to manage data of internal factors at household level in a form of Percentage, Mean, and Standard Deviation that shows household characteristics of the studied areas.

(2) Analyze relationship of factors (independent variable in Table 3.2) that effect food security (dependent variable in Table 3.3) by analyzing Multiple and Logistic Regressions using a program of SPSS for WINDOWS.

(3) Analyze the differences of food security in each season by analyzing variance (ANOVA) with the use of SPSS for WINDOWS

3.3 Qualitative research

This part will collect data regarding risk, risk management and characteristics of the resiliency of community based food security management system in order to summarize risk conditions and community resiliency after facing food security risk. Then, a mind map will be created from data evaluation obtained from the study which can be achieved by analyzing the overall community food security management. The mind map will show steps and factors that can be described about community food security management with the following details.

3.3.1 Data collection

To collect data that can assist in understanding problem, risk, and management of community in relation to food resource. The researcher collects data by compiling additional secondary data and collects primary data from key informants with the following details.

3.3.1.1 Secondary data collection

To study risk condition from climate on food resource utilization, this study therefore collects secondary data regarding meteorology from Thailand Department of Meteorology consisting of 10 years record of monthly rainfall data and collects geography data of the studied area using geographic map. The obtained data will assist in understanding the characteristics of the area; whether it supports or is an obstacle to types and quantity of food resource and utilization.

3.3.1.2 In-depth interview and focus group discussion

This research employs an in-depth interview and focus group discussion in order to collect data from village leaders who are knowledgeable and specialize in food resource utilization to gain information in relation to food resource in terms of risk and resiliency of the community food security management system (see Appendix A).

3.3.2 Target population

Target population for in-depth interview consists of community leaders in accordance with administration, village headmen, village headman assistants, and community activity leaders such as president of housewife group for the in-depth interview. In addition, target population for the focus group discussion consists of knowledgeable persons in regards to water management, community forest, wild food, and agriculture.

3.3.3 Data analysis

To analyze data, obtained secondary and primary data will be analyzed in qualitative and quantitative form as follows.

(1) Obtained secondary and primary data from in-depth interview and focus group discussion will be summarized in a time line. Climate characteristic and the changes in community socio-economic conditions.

(2) Analyzing the risk characteristics of food security and other management in order to decrease the risk and resiliency of food security management of the community by analyzing types, characteristics, time taking, and frequency of risk as well as a method to release impact on food security.

(3) Bringing secondary and primary data to create a production calendar and activity calendar about food of the community by demonstrating types and amount of food resources that the community relies on in public areas and agricultural areas during each month of the year and also important activities that organized by the community

(4) Developing a conceptual framework (mind map) of the community food security management system

CHAPTER IV
RISK IN FOOD SECURITY: PROBLEMS AND IMPACTS

The study of resiliency of community based food security management system is studying about community management on risk that effect on consumption of food resources. Therefore, it is necessary to know about general geography which is a determinant of resource's characteristics that community relies on and the community activity which reflect problems of consumption of food resources. The researcher compiles secondary and primary data regarding geography, climate, food resource, development of community activities as well as consumption of community food resources and risks from problems. The compiled data will be foundation to understand ecosystem and community context. The characteristics of current food security, risk, or effects about food from the past, community management, and future trend of community food security will be stated. The results of study will be divided into 2 parts which are geography and problems and impacts of food security.

4.1 Geography

According to the reviewed documents of the studied area in Chapter 2 and collected secondary and primary data, it shows that the studied area is located in the east of Tak Province and is adjacent to Lampang Province. It is also situated in some part of lower Wang River watershed. The village or studied area also has Wang River as an important river. This river travels through the village while up stream of Wang River is in Chiang Rai Province, which also flows through Payao and Lampang and meet Ping River in Tak Province. The Wang River flowing through the studied area is the end of the main river and is located at a less slope topography, which makes the shape of the meandering channel, and has a decreased rate of water flow. It also leads to the flood plain and has seasonal flood. When there are high amounts of water runoff, the drain is enabled because the meandering channel makes water flow much

slower. However, the inundation makes the soil fertile; for instances, a levee that collects sediment from the river, fertile plain behind which is suitable for doing agriculture, fertile river terrace which is suitable for agriculture when the water is not inundated. Furthermore, the meandering channel of the river causes inundation while it creates a natural monkey-cheek. The natural monkey-cheek assists in water drainage and natural water detention storage which releases the severe impact from inundation/ flood.

With regards to the village geography, it is a wide plain expanding along both sides of the Wang River; in the meandering channel part of the river. The height of sea level in the settlement area and forest is approximately 0 – 3,000 meters (Figure 4.1). There are agricultural areas along both sides of the river. In the west, there are house settlements with 0 – 300 meter height. Next to this area, there is a slope, foothills, and mountains. There are sub-rivers of the Wang River which are an important water resource for the village. There are 2 main sub-rivers; Huai Tueng and Huai Mae Rawan. The sub-rivers' watershed is on the west mountain. Particularly, Huai Mae Rawan is very important because it connects to the Wang River in the northern part of the village. Adjacent to the village is a huge area of forest with 301 – 3,000 meter height. It consists of community forest with an area of 181 Rai, community forest that co-operate together with other 6 villages for 15,400 Rai. This area is located on a mountain which locates the Bhumibhol Dam. It is also a monsoon shield from the south west which causes different climates between the west and east of Tak Province. Therefore, it makes the eastern area a rain shadow, which is an area of the study.

According to secondary data regarding climate (Figure 4.2), it was found that the amount of rainfall at the studied area is less than 450 millimeters/ month (Department of Meteorology). During May and September, there are higher amounts of rainfall, while during the other months there is less and not reaching more than 350 millimeters/ month. In summer, it takes long which is from February to June. The temperature starts to get cooler in November to January. Moreover, the rainy season starts from May to September with average annual runoff (in 1971-2001) approximately 1,000 million cubic meters (Hydro and Agro Informatics Institute, 2012). Nevertheless, according to rainfall data of each month along with information

from in-depth interviews and focus group discussions, it was found that the season can be categorized by the characteristics of rainfall and climate in each area which can be categorized as follows. Winter takes approximately 4 months which starts from November to February and is a dry season with the lowest amounts of rainfall all year round (not higher than 50 millimeters/ month). Summer also lasts for 4 months but covers 2 periods which starts from March to April, and July to August. It is a period that has a normal amount of rainfall (approximately not higher than 250 millimeters/ month) and a tropical climate. The rainy season covers 4 months from May to June and September to October which has the highest amount of rainfall (approximately 50-400 millimeters/ month). Nevertheless, the amount of rainfall in each year can still be unreliable in different months or seasons. Occasionally it was found during some years, months with usually high amounts of rainfall were found to have less or some months with normally lower rainfall recorded higher amounts.

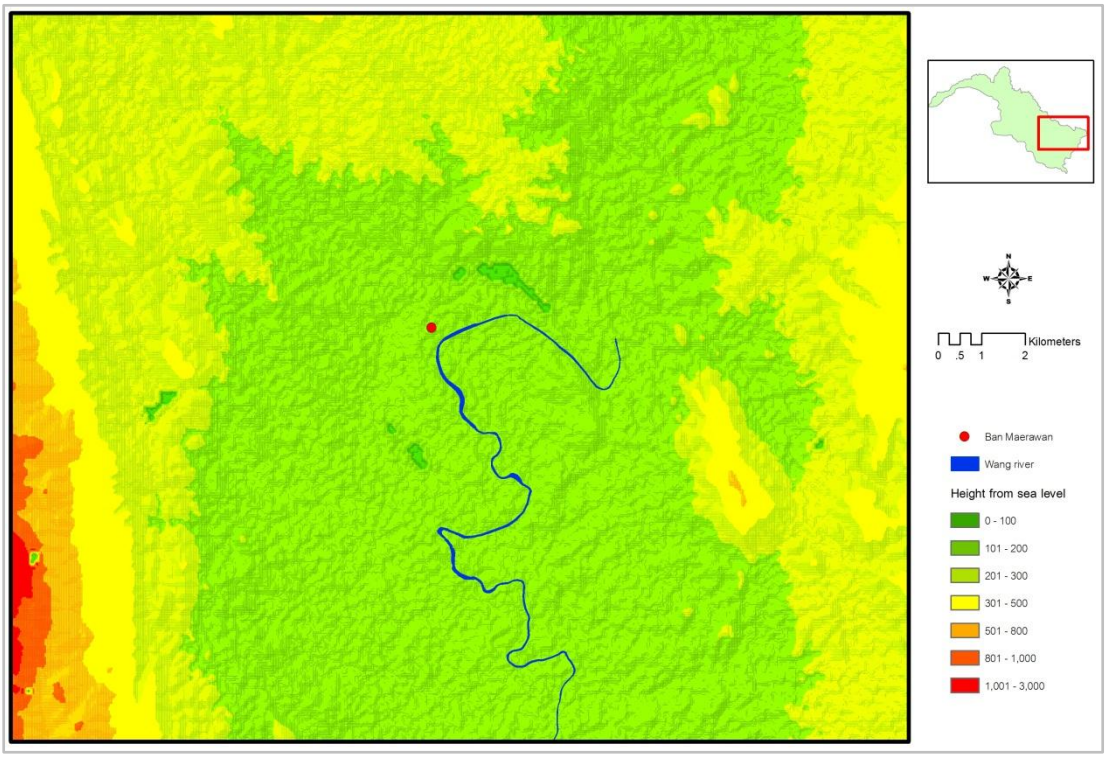


Figure 4.1 Topographic map

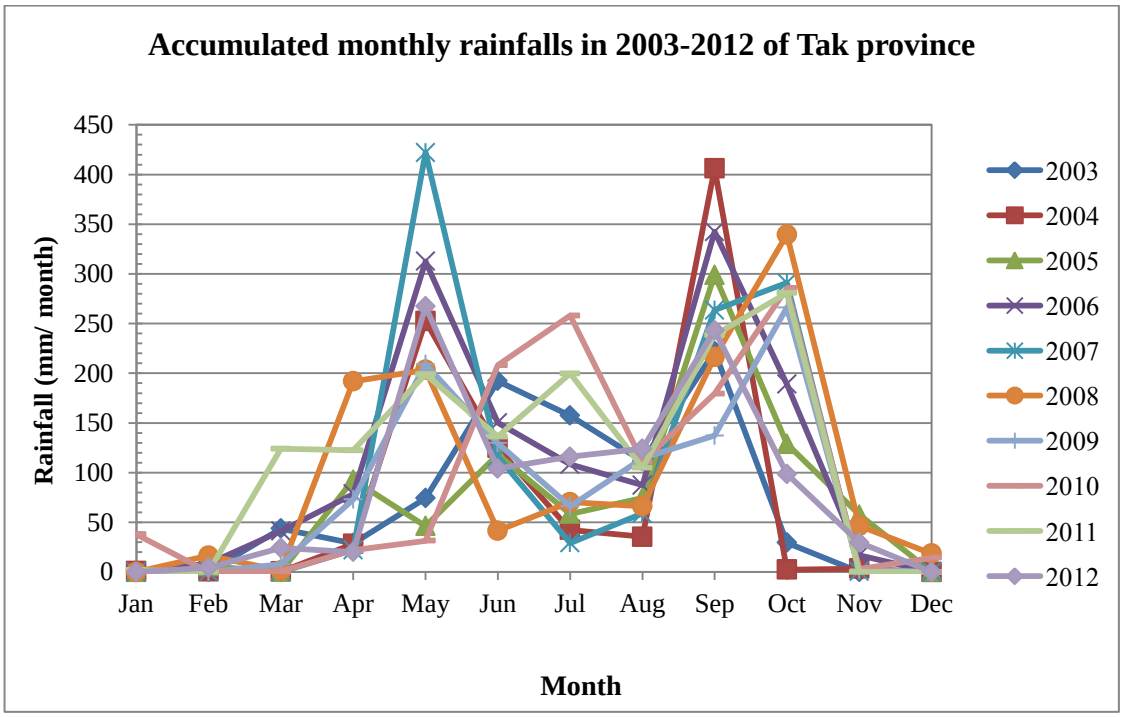


Figure 4.2 Accumulated monthly rainfalls in 2003-2012 of Tak province graph (Applied from Kulvadee Kansuntisukmongkol, 2013)

According to geographic and climate data, the studied area is a plain next to the river and adjacent to a foothill. There is also a forest nearby serving as a food and economic resource. This area is suitable for agriculture which produces further food and economic resources. The forest area at western foothill of the village is plant and wildlife community; deciduous dipterocarp forest, accommodating diverse range of eatable plants and wildlife; for example, vegetables, mushroom, amphibian animals, reptile, and insects. Regarding agriculture, crop farming, growing orchards, raising of animals, and cultivating a few rice paddy fields are all undertaken at the foothill. While at the plain next to the river, in the villagers engage in just cultivating rice paddy fields and growing orchards (see land use map in Figure 4.3). Therefore, the geographic ranges and climate of the studied area is a major determinant and a foundation of fertile natural resources which leads to the availability of a diversified and plentiful amount of food resources.

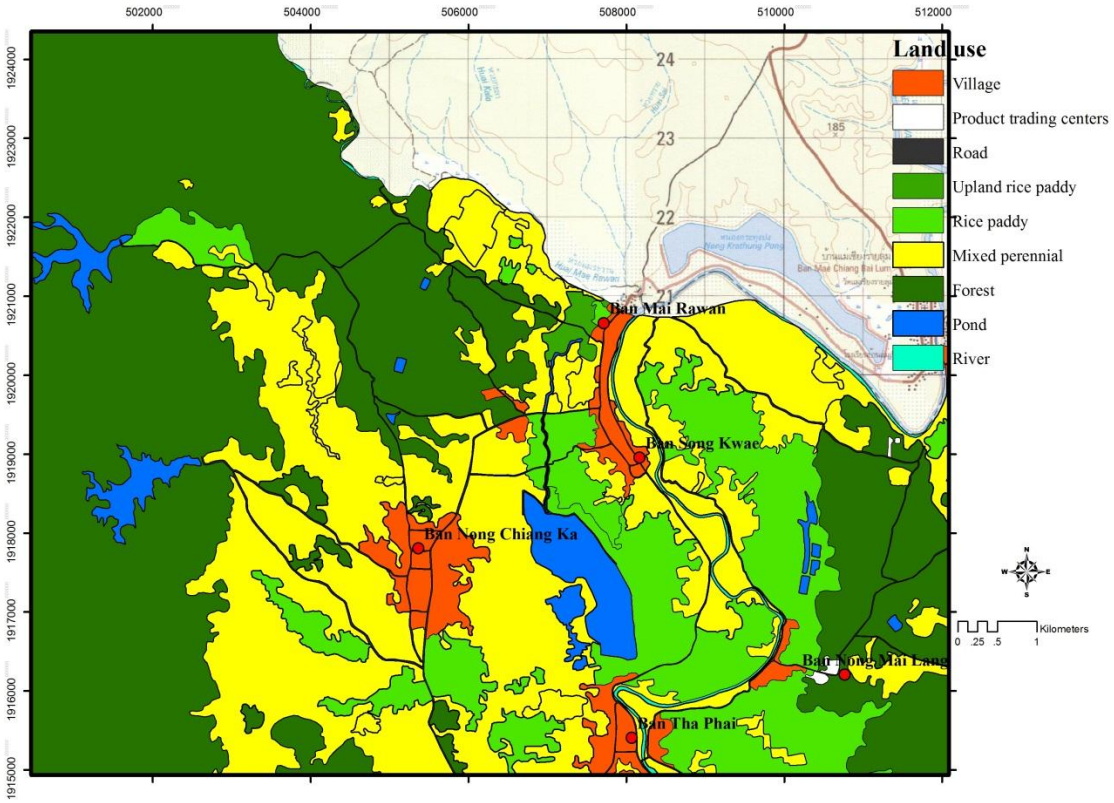


Figure 4.3 Land use map (Applied from Kulvadee Kansuntisukmongkol, 2013)

In contrast, this geographic range is also prone to natural disasters due to the continuity of the location which receives water from other areas. As a result, it is difficult to control the disaster. As mentioned earlier, the village is located at the end of the Wang River which is affected from the water runoff of the river's watershed; which is from Chiang Rai, Payao, and Lampang Province. There are mountains and forests connected to the river's watershed. This assists in balance of water quantity in the river. Nevertheless, many changes of the river basin are beyond the ability of the community to control as well as the quantity and variability of amount of rainfall. Moreover, there is also risk from an invasion of outsiders using the resources which could cause changes and impact on the food resource.

Due to the connected ecosystem, the next sub-titles and chapters will explain about the management and importance of having a connected ecosystem which leads to food security and resource management due to climate issues and the changes in socio-economic conditions.

4.2 Problems and impacts of food security

According to geographic data, the location of the village provides benefits to its resource's fertility but also puts it at risk to water shortages and natural disasters. Nevertheless, the community has been settled at the location for a long period of time. The local people have been working and participating in many activities which have created a harmonious relationship with the area and the community is able to consume resource in terms of food collection and food production through agriculture. On the other hand, the community has also been faced with problems about water shortages, natural disasters, and economic crisis which affect wild food quantity and agricultural products. This research has compiled community activities that were developed and obstacles encountered and recorded them in a table to help explain about the problems and effects of food security in the next section (see Table 4.1).

Ban Mae Rawan Community was established in 1872, with families migrating from Thoen District from Lampang Province and Ban Tak District from Tak Province to settle in the area; the settlement area is a plain adjacent to the Wang River which is fertile and able to support agriculture. Economic plants that were popular at the beginning were tobacco and rice. Later, in 1879 more people migrated to this area and it established itself as a formal village and has been developed. Since 1877, there has been a continuous record kept of the villages' community activities. Since that time, there has been an increase in activities, particularly activities to do with natural resources due to the land's fertility as mentioned earlier as well as the reliable forest resource. Consequently, the community has developed a relationship with these resources as well as utilizes them. However, knowledge and understanding about resource consumption have not been given enough importance and in addition, the entering of outsiders to the community has degraded the forest. In 1982, county council member Seetoon Tangnoi was a village headman. He developed the village and received the second best award of excellence for the village. Furthermore, he understood the importance of forest resource conservation and developed processes in forest conservation and initiated coordination with public sectors. In 1984, the area at the connected areas between agricultural areas of the local people and forest area was scoped to be approximately 20 Rai and was preserved for public use. This activity has been supported by the Land Development Department through the planting eucalyptus

(*Eucalyptus melliodora*) and neem (*Azadirachta indica*) for selling wood and generating income for the community without forest invasion. However, during this period the forest area was a public area because the local people lacked the knowledge and right to take care of and conserve community forest. Hence, the local community faced a problem of overuse of the resource. Then, in 1985, the village received a winner award of an excellent village in district level. There was a land allocation for agriculture at Rai Dong Pattana. The households of the community were equally allocated the land. These areas could be used for rice paddies, orchards, crop farming or other agricultural activities. At that time, the community also faced the problem of climate which affected agriculture in accordance with geographic range and climate conditions. The community was faced with drought and shortages of water in doing agriculture which actually forced knowledge development in water management through visiting other sites or participating in training. As a consequence, the community applied the knowledge and experiences gained to use within the village. Then, in 1989, the village received a winner award in a competition of small water resource development at a provincial level; weir.

In 1992, there was a private company that surveyed forest in order to do granite concession. The local community realized that it is a risk to lose forest and water resource because Pa Ton Forest is a watershed that provided water to the village and nearby villages. It would also impact the local life style and local agriculture as well as the future resources for the next generation. In 1994, the community got together to protest the concession by using the savings from selling tree crops from their plantation to fund their claim for refusing the granite concession. In 1995, the community faced severe drought which made the local community aware of the need to take care of and conserve the forest. Additionally, in 1998, 1999, and 2011, the community faced the flood which affects agricultural product and accommodation. Particularly, in 2011, the village faced both severe drought and severe flood within the same year.

During in 1998, monoculture was promoted such as banana and papaya as well as the establishment of a learning center; community philosopher network, in order to build educational resource, natural resource management, and a life quality development center for the community. Within the same year, the community received

excellence learning center from Office of the Non-Formal and Informal Education of Tak Province. Later, in 1999, the local community started to develop knowledge by sending 12 community members to be trained in community forest conservation management with the Forestry Office of Tak Province at Lan Sang National Park in Tak Province. This led to the registration the public forest to become the community forest of Mae Rawan community which is a forest area of 181 Rai with support from the Forestry Office of Tak Province. In 2000, there was a project of conservation and restoration of Pa Ton Forest which was supported by the Research Council. In addition, the area of the community forest had been increased to 766 Rai in accordance with Forest Act of BE 2484 and 2544. Next, the community representatives attended forest ranger training. In 2002, Research Council of Chiang Mai promoted and supported community forest expansion by building a community forest network which consists of 5 villages including a village in Yok Krabutr Sub-district, Sam-ngao, Tak Province, and 2 villages in Prik Sub-district, Mae Prik District, Lampang Province. Hence, the total forest area increased to 15,400 Rai. Afterwards, the community conducted activities relating to resource management, water resource management and other activities such as building check dams, in 2003 building firebreaks, in 2006 bringing a principal of sufficient economic philosophy to the community and implementing since 2008 as well as develop organic agriculture to have safe consumable food in 2013. It is necessary for these activities to be practiced continually and also monitored and developed because they are community life quality determinants and will result in better life quality and ensure there is enough strength to face future problems. The details in regards to the tangible management relating to community food security will be presented in the next chapter.

Table 4.1 Timeline of community development

Year	Activities	Remarks
1872	Community settlement	
1879	Housing for registration	
1977	Began to record community activities	
1982	County council member Seetoon Tangnoi was a community leader	
1984	Scope forest area for 10 Rai for public utilization by Land	

Year	Activities	Remarks
	Development Department of Tak Province with the assistance in eucalyptus and neem planting	
1985	Allocated the public area for private agricultural use (name Rai Dong Pattana)	
1989	Received a winner award in small water resource development	
1990	Begin to be promoted monoculture (Dainty Banana or Kluay Kai)	
1992	Investor entered the village for granite concession at Pa Ton Forest	
1994	Gathered people to refuse granite concession	
1995		*
1998	Established learning center community philosopher Ban Mae Rawan	**
1999	Pradit (a village headman) built 181 Rai of community forest and had community representatives training with provincial forestry	**
	Be promoted growing corn, purple eggplant, papaya, and sweet corn	
2000	Pa Ton Forest conservation and preservation project by the support of Research Council to expand community forest to 766 Rai	**
2001	Training volunteer forest rangers	**
2002	Research Council of Chiang Mai Province supported community forest expansion together with 6 villages with a total area of 15,400 Rai	**
	Be promoted raising of pigs	
2003	Building rockfill check dam (The watershed management unit of Huai Maeprik)	**
2004		**
2005	Release cancellation monoculture	**
2006	Making firebreak to expand community forest to 1,016 Rai	
2008	Sufficient economy level 1	
2009	Sufficient economy level 2	
2010	Sufficient economy level 3	
2011	Road construction by government sector along the river in the east of the village to solve flooding issue of other villages in the next areas	**
2012		*
2013		*

Remarks:*Facing severe drought **Facing flood

According to a record of settlement and other developments of the community, it shows that the community has fertile resources that support food security form nature. Particularly, community is strong; for instances, regularly contributing in community development. However, physical characteristics of the studied area and some national socio-economic development have caused problems which can be summarized as characteristics of problems that affect community food security and can be further classified into 2 main problems which are problems from human activities and natural variance.

Problems from human activities or socio-economic conditions of the community in the past comprises problems with direct impacts on forest resources which also impacts on food resources and indirectly impacts on controlling the water balance of forest; for instances, over utilization of the resource, illegal logging, collecting food resource from outsiders, and granite concession at Pa Ton Forest which is an important food resource of the community. These problems are common issues and similar to those faced by other communities in Thailand. Also, due to the global and Thailand economic development, there are more investors invading forests for resource utilization. If the local community lacks strength or people to conserve the resource, deforestation would be occur which has already happened as at present the number of forest areas have already decreased. In a case of Ban Mae Rawan, there is more forest utilization which makes the local community worry about its fertility in the future. Therefore, there is land use allocation in the village which is used especially to help decrease illegal logging in the forest. Nevertheless, the biggest event of having outsider invasion was a group of people who wanted to conduct granite concession to gain the granite resource from the area in order to generate revenue for them. If the concession had occurred in the village, it would impact on food resources both directly and indirectly impact on the community. However, due to the strength of the community, it was able to successfully protest such an action. This event made the local community more united as they had a shared goal to preserve the community forest. It was also a starting point of activities relating to resource and other activities which helps in developing the strength of the community as well as the life style of its members. However, the problem of food resource invasion from outsiders still presents because there are abundant forest resources as well as food resources. In

contrast, other communities have less resources which make the people from these communities enter to Mae Rawan to collect food resources; particularly termite mushrooms, which is a critical issue now.

Besides, indirectly impacting on food security, it leads to the severity of the impact from flood. The indirect impact will increase the risk to the community of low quality food and shortages of food that they produce. For instances, monoculture promotion from the public sector will lead to the use of chemicals in agriculture. When the way of agriculture was changed to monoculture, it required huge amounts of investment and used more chemicals. This caused the households to take more risks with each investment in monoculture. There was also the risk of disasters, disease, and insects which can ruin the monoculture product. Moreover, the development in public utility was not compatible with the geography. As the village is located at the end of the Wang River which is a plain, there is inundation in the area. Moreover, with the lack of understanding of the ecosystem, the roads were constructed along the river, and also higher than the river as a dike for other villages in the east. In the past, this location is a natural monkey cheek which stores water before draining. After the roads were constructed, it caused flood in the west side of the village which is a housing area and agricultural area of Ban Mae Rawan. The water quantity and flood was higher than usual.

Another risk to food security is the issue of climate change. This issue is having more of an impact than the past; for examples, more frequent and severe disasters. This may be occurring due to natural variability and human activities. According to an in-depth interview and focus group discussion analyzing with secondary data, the studied area was affected by climate; mainly 2 types, which are drought and flood. In regards to drought, it mostly takes place in the forest on the mountain and agricultural area at foothill. This is because it is located in rain shadow which makes less rainfall in winter, summer, and some years of rainy season. Also, forest invasion in the past and soil texture of the ground surface is rough which makes the soil incapable of absorbing water. Furthermore, in the past, there was no water management at the mountain area and foothill; therefore, there was no water storage. This has led to insufficient amount of water for agriculture. Also, there was less amount of rainfall in the rainy season in some years which led to a lack of moisture.

This in turn affected some types of food's resource quantity such as a lesser amount of mushroom which impacted the community through lack of food and income opportunity. In regards to floods, they can be classified into 2 types which are a great flood and overflowed flood. A great flood can occur at the foothill which is an agricultural area for crop farming and rice paddies. The causes are similar to the drought issue but it occurs in rainy season which is when there is heavy rain in a short period of time or long hour. Due to the forest being degraded in the past, coarse soil, and unavailability of water storage or things that help in decreasing speed of water flow, absorbed water in the soil becomes water runoff and reaches high speed due to the slope of the area. This ruins the agricultural product at foothill. An overflowed flood usually happens in rainy season but can happen in other season due to the variability of rainfall quantity as mentioned in the village's geography at the end of the Wang River which is low land inundation as well as located on a meandering channel. Therefore, when huge amounts of water runoff from the watershed come, the water is unable to be fully drained causing the water to overflow. In general, the water overflows to the natural monkey cheek in the east of the village. Then, it overflows to the west of the village which is the housing area. Nevertheless, the western part of the village is low land behind levee. Next to the housing area to foothill, the Huai Mae Rawan flows through; which is a sub-river that flows from the mountain and meets the Wang River. Hence, when there is a large amount of water runoff from the watershed as well as high amounts of rainfall, the rain fall will flow along Huai Mae Rawan and meet the Wang River. If there is high amount of water, the amount of water in Huai Mae Rawan will overflow. Consequently, this location will receive the overflow from both the Wang River and Huai Mae Rawan. This affects houses, agricultural areas, orchards, and paddy fields in the area located along the river. At present, the housing area in the west of the village faces more severe flood due to the road construction that aims to prevent flood in the eastern part of the village which makes the overflow go to the west and causes more inundation.

Regarding droughts and floods, they are occurring with the higher severity due to development of human activities such as road construction and forest encroachment. At present, there is a serious issue on climate variability. There is concern that it will cause more problems in the future as mentioned in Chapter 2.

According to future climate forecast data which is forecasted by Southeast Asia START Regional Center (see Appendix B), there is a possibility of temperatures rising in the next 30 years (in 2039), 60 years (in 2069), and 90 years (in 2099) (Figure in Appendix B) including an average temperature, highest temperature, and lowest temperature. It is possible to have higher temperatures all year round of about 1-2 (+)°C. The number of heat days (number of days having temperature higher than 35°C) is forecasted to increase to 15-60 days while number of cool days (number of days having temperature lower than 16°C) is forecasted to decrease 5-20 days. A total amount of rainfall in a year in the future will be close to the base year except some areas will have more rainfall of about 10-20 per cent and number of rainy days (number of days having rain more than 3 millimeters per day and number of days having heavy rain more than 35 millimeters per day). In the near future, it tends to decrease more than 5 days and tend to increase more than 10 days. The difference will be number of years that are forecasted and the method of forecasting. Regarding number of days having heavy rain all year round will be close to the base year. In accordance with climate forecast from scenario of the future model, it shows the variability of temperature and rainfall quantity which will have direct impacts on food resources and the occurrences of disasters which are risks to food security in the future. This data provides important information which guides food security management preparation so that the community can cope with the situation of climate variability which is becoming more severe. This will also reflect the usefulness of the study of community food security management system which will be described in the next chapter.

CHAPTER V
FOOD SECURITY STATUS AND FACTORS THAT AFFECT FOOD SECURITY

From secondary and primary data of the studied area, as mentioned in Chapter four; about geography, climate, problems and impacts on community food security, the overall risks since the past have been identified. These are foundation aspects that help in understanding characteristics of food resources and consumption by the community. This chapter will explain about quantitative data that was obtained from household interviews. The questions are related to each dimension of food security as well as household socio-economic condition which is a variable used to analyze factors that affect food security in each dimension. This study was conducted with respect to a conceptual framework. Therefore, the result will clarify the overall condition of community food security at present. If we look at each factor, it will show that presently the community is able to manage food security effectively with its geographical characteristics, livelihood, and crisis. They will also help to find the differences in food resource consumption in each season as well as what factors affect each dimension of food security in each household. The chapter classifies the results into 4 main topics which are socio-economic and food resource consumption data, food security status, household internal factors affecting food security, and diversity of food resource in different seasons.

5.1 Socio-economic and food resource consumption data

Although physical characteristics of the location can create problems or be an obstacle to food resource consumption, the area is fertile and provides food resources to the community. The community is aware of the value of these resources and has preserved the resources until present. This research has collected secondary and primary data relating to socio-economic conditions and food resource

consumption in order to analyze food resource management with these conditions. The results show general characteristics of households and food reliability which will be analyzed in the next topic as follows.

From the collected secondary data relating to general information of the community, there are 135 households that live in this community and most members have occupations in agriculture. After 100 households were interviewed with a questionnaire, general information on household socio-economic condition was revealed as follows (see detail in Table 5.1).

There are household settlements in this community range from 2–85 years. Most of them have been settled approximately 41-60 years (36 %), followed by 61–80 years, 21-40 years, 1–20 years, and more than 80 years respectively. Heads of households are mostly female or 51 % at the age from 31–92 years old. Most of interviewees are 51–70 years old (66 % of the interviewees), followed by 71-90 years old, 31-50 years old, and more than 90 years old.

Households at Ban Mae Rawan have 1-8 household members. Most households (44 % of the households) have 3–4 members, followed by 1–2 members, and 5–8 members. In terms of educational background, heads of household have not completed studying up to a master degree level. Seventy-one per cent of educational levels are primary, followed by high school, bachelor degree, and master degree, not taking school, and vocational education. Each household has income from 600–220,000 Baht per month. Most households (74 % of them) have a monthly income of less than 15,000 Baht, 15,001–30,000 Baht, 30,001–50,000 Baht, and higher than 50,000 Baht respectively. Food expenses for households were found to range from zero monthly food expenses up to 15,000 Baht per month. Eighty-six per cent of households have food expenses of 1–5,000 Baht per month, followed by 5,001–10,000 Baht, no food expenses, and 10,001–15,000 Baht respectively. Eighty per cent of households have savings while 55 % of the households have debt.

Most households; 86 %, participate in community member. Regarding occupation, there are 4 occupations. Most of them engage in 1-2 occupations which is 74 %. Most households or 69 households engage in agriculture. Most of them grow rice, do integrated agriculture, raise animals; mostly are cows and layer chicks. Moreover, there are few white silk cotton tree (or kapok) and mimosa plantations.

Other occupations are employee, serving as public officers, trading, no occupation, and others; working in a temple or Buddhism related, master of ceremony, working in the community's hydro, and collecting forest product respectively. Most households have no minor occupation. Nevertheless, some households have minor occupation which mostly are temporary employee; 28 households. The temporary employee is responsible for general works or collecting forest product (that are order by employers), agriculture, collecting forest product, trading, serving as public officers, and others respectively.

In terms of livelihood and cultural and traditional characteristics, Ban Mae Rawan Community relies on each other like a family. All households are Buddhist. They have learnt Buddhism from Buddhist monks and senior people from generation to generation. This benefits local people and they can apply knowledge from the Buddhism in real life which brings peace to the community. Moreover, the local people give an importance on participating community activities such as activities relating to Buddhism and education. Meanwhile, the local people maintain on local belief; ghost. It is an over natural power which can be both beneficial and harmful, for instances, taking care of the community. Mae Rawan Community mostly inherits Lanna (or northern region of Thailand) culture such as traditions and ceremonies. For examples, they count a day follow Lanna calendar even wedding ceremony and making merit for a new house etc. Additionally, there is a belief in necromancy, local spirits, as well as practicing in rituals or worships to the angels or spirits. Furthermore, these practices require food. It is a symbol and important component of doing the rituals and worships. There are worship and religious ceremony relating to agriculture or food in each month. The food is also varied.

In regards to geographical characteristics and resources, the community relies on collecting food from the community forest and agricultural area for consumption and trading. In addition to the reliance, due to a harmonious relationship among the community members, it makes the community members rely on food sharing within the community; which is a local culture. With the global development, there have also been changes on the reliance of food by Thai people at present. The Thai people now rely more on buying food at food markets which is also the case at Ban Mae Rawan. Food trading at the markets or other places is an optional source of

food for community. These places can include anywhere food is bought from other households within the same community, the community's market or nearby villages and in the town.

It can be summarized that Ban Mae Rawan Community has 4 reliable food sources which are food collected from the forest, self-producing agricultural product, food sharing or exchanging, and trading or buying. The majority of households (57 %) rely on 4 sources and some of them rely on 3 and 2 sources. There are very few households that rely on just 1 source. If comparing food quantity from agriculture and collection from the forest, most households; which is 92 %, get food from the agricultural plantation. This is consistent with local occupation of each household with the majority in agriculture as mentioned earlier. When food quantity of each food type is categorized, it shows that food production has the highest proportion; 70.2 %. This is also consistent with community data that shows rice is a major economic plant. In addition to food production, vegetation from agriculture, wild mushrooms, wild animal, forest vegetation, and planted mushrooms make up 21.3, 4.3, 3.8, 0.4, and 0.004 respectively.

To produce agricultural vegetation, most household members own agricultural land and engage in agriculture which has been occurring since the first ancestors settled the area. Each household owns agricultural land from 1-57 Rai. Most households own 1-10 Rai, followed by 11-20 Rai, 21-30 Rai, more than 40 Rai, and 31-40 Rai respectively. Additionally, the distance from the house of each household to their agricultural land ranges from 0–8 km. The most common distance between home to the land is approximately 0–1 km at 58 %, followed by 1.1–5 km, and then more than 5 km respectively. Moreover, in an agricultural plantation, there are 1-20 types of vegetation with the majority of people at 57 % planting 1-5 types. As mentioned, rice is major food and economic product of the community. Most rice farmers produce rice during wet season or grow rice once a year depending on the suitable season; they mainly grow rice for consumption and sell the surplus. Regarding other vegetation or plants, there are varied. There are edible and non- edible plants such as soy bean, corn, kapok, mimosa, cauliflower etc. These are planted in farms, orchards, or rice paddy fields after rice harvest. For other vegetation such as home-grown vegetables, they are planted in the household area. Some plants in particularly thrive during winter. Some

households raise animals to sell; such as cows and pigs, as well as for consumption; such as chickens and ducks; these animals can be raised all year round. The community can also use chemicals, no chemicals, or a mixture of both in agriculture and raising animals. In terms of rice cultivation, the majority of households (33 households) do mixed agriculture; for planting crops and raising animals, most household practices the use chemicals. The chemicals used are chemical fertilizer for planting crops and animal food that has some chemical as a component that helps in raising animals.

Characteristics of food resources utilization, the community members utilize food resources in different ways. Most community members spend time in growing rice during rice cultivation's season. After that they plant vegetations for consumption and selling. At the same time, they also raise animals for consumption and selling. During rainy season, they usually enter to the forest to collect food for consumption and selling and mostly collect mushrooms. Moreover, the community members spend their free time in a meeting or participating in activities relating community and life quality development focused on food and health; for instances, management planning about monitoring water quantity for agricultural use, organic agriculture's project, activities relating to money saving or career development etc.

Regarding food collection in the forest, the local people are allowed to access the area of more than 10,000 Rai which is a community forest and well-conserved by nearby villages. There are not many types of forest plants that are edible. Most community members collect the same types of plants. Some households collect the plants for consumption while others collect the plants for trading. Some households do not collect the forest plants but instead buy the plants from neighborhoods. Distance from houses to the forest can vary from 1-19 km. The most common distance is 1-5 km at 91 %, followed by 6-10 km, and then further than 10 km. When collecting food from the forest, the community has rules and regulations to conserve the resources however there is no rule about the types of food collected. Nevertheless, most households have stated that they do not follow the rules and regulations; stated by 53 % of households. There are also people who have stated that they collect food in accordance with the rules and regulations which means collect only the food without damaging the forest. An even smaller proportion of households

did not even realize that the community had the rules and regulations in place. Moreover, most households; 93 %, never grow any eatable plants in the forest. Regarding knowledge transmission in producing and collecting food, there is knowledge transmission, particularly in collecting wild animal in an agricultural plantation; 31 households. There is knowledge transmission in every household. For households engaging in agriculture and collecting food from the forest, most of them educate knowledge of each resource. On the other hand, there is less knowledge transmission in raising animals. This can be because most households educate their household members that raising animals is a natural way or just leaving the animals naturally (let them go or walk around freely).

Table 5.1 Household socio-economics data

Variable	Number of household (n =100)	Percent	Mean	Standard deviation	Min	Max
Gender of household heads						
Male	49	49				
Female	51	51				
Age of household heads (Years old)			**62.38**	**11.62**	**31**	**92**
31-50	11	11				
51-70	66	66				
71-90	22	22				
> 90	1	1				
Educational level of household heads						
No education	4	4				
Primary	71	71				
Secondary	18	18				
Vocational	1	1				
Bachelor	3	3				
Master	3	3				
Settlement periods (Years)			**53.32**	**18.31**	**2**	**85**
1 – 20	8	8				

Variable	Number of household (n =100)	Percent	Mean	Standard deviation	Min	Max
21 – 40	17	17				
41 – 60	36	36				
61 – 80	35	35				
> 80	4	4				
Number of household members (Persons)			**3.17**	**1.55**	**1**	**8**
1-2	39	39				
3-4	44	44				
5-8	17	17				
Net income of household (Baths)			**14,285**	**23,867.90**	**600**	**220,000**
< 15000	74	74				
15000-30000	22	22				
30000-50000	2	2				
> 50000	2	2				
Net expenditure for household food (Baths)			**2,651**	**2,412.04**	**0**	**15,000**
0	4	4				
1-5000	86	86				
5001-10000	9	9				
10001-15000	1	1				
Savings						
Yes	80	80				
No	20	20				
Debt						
Yes	55	55				
No	45	45				
Land tenure (Rai)			**0.75**	**0.56**	**0.08**	**4**
< 1	63	63				
1-2	36	36				
3-4	1	1				

Variable	Number of household (n =100)	Percent	Mean	Standard deviation	Min	Max
Distance from house to forest (n=75) (Km)			**3.53**	**3.29**	**1**	**20**
1-5	69	90.8				
6-10	5	6.6				
> 10	2	2.6				
Distance from house to agricultural area (n=83) (Km)			**1.85**	**1.69**	**0**	**8**
0-1	48	57.8				
1.1-5	31	37.4				
> 5	4	4.8				
Number of household occupations (Occupations)			**1.87**	**0.83**	**0**	**4**
0	4	4				
1-2	74	74				
3-4	22	22				
Main occupations of household (n=103)						
No occupation	4	3.88				
Agricultural	69	66.99				
Trading	5	4.85				
Gathering	1	0.97				
Employee	14	13.59				
Official	7	6.8				
Etc.	3	2.91				
Minor occupations of household (n=117)						
No minor occupation	32	27.35				
Agricultural	21	17.95				
Trading	12	10.26				
Gathering	14	11.97				
Employee	28	23.93				
Official	6	5.13				
Etc.	4	3.42				

Variable	Number of household (n =100)	Percent	Mean	Standard deviation	Min	Max
Participating members in community						
Yes	14	14				
No	86	86				
Compliance with community rules						
Yes	31	40.8				
No	40	52.6				
Don't know	5	6.6				
Planting eatable plant in community forest						
Yes	7	7				
No	93	93				
Agricultural land tenure (n=83) (Rai)			**10.45**	**9.91**	**1**	**57**
1-10	56	67.47				
11-20	19	22.89				
21-30	5	6.02				
31-40	1	1.2				
> 40	2	2.41				
Number of plants (Types)			**5.1**	**4.84**	**0**	**19**
1-5	48	48				
6-10	22	22				
11-15	9	9				
16-20	5	5				
Number of food sources (Sources)			**3.39**	**0.803**	**1**	**4**
1	2	2				
2	14	14				
3	27	27				
4	57	57				
Knowledge transmission in raising animal (n=32)						
Yes	6	18.75				
No	26	81.25				

Variable	Number of household (n =100)	Percent	Mean	Standard deviation	Min	Max
Knowledge transmission in collecting wild animal in agricultural land (n=31)						
Yes	31	100				
No	0	0				
Knowledge transmission in collecting mushroom in agricultural land (n=1)						
Yes	1	100				
No	0	0				
Knowledge transmission in planting vegetable (n=72)						
Yes	52	72.2				
No	20	27.8				
Knowledge transmission in growing rice (n=62)						
Yes	46	74.2				
No	16	25.8				
Knowledge transmission in collecting wild mushroom (n=74)						
Yes	57	77.03				
No	17	22..97				
Knowledge transmission in collecting wild animal (n=64)						
Yes	50	78.1				
No	14	21.9				
Knowledge transmission in collecting vegetable (n=45)						
Yes	32	71.1				
No	13	28.9				
Raising animal process (n=34)						
Organic	2	5.9				
Chemical	32	94.1				
Mix	0	0				

Variable	Number of household (n =100)	Percent	Mean	Standard deviation	Min	Max
Vegetable planting process (n=72)						
Organic	6	8.3				
Chemical	58	80.6				
Mix	8	11.1				
Rice growing process (n=62)						
Organic	7	11.3				
Chemical	22	35.5				
Mix	33	53.2				

5.2 Food security status

In accordance with a conceptual framework of this study, a framework of food security of FAO is categorized into 3 dimensions comprises availability, access, and stability dimension. The researcher uses the framework to develop indicators to develop questions for interviewing households, then, summarize research results in accordance with each dimension as follows (see Table 5.1).

5.2.1 Availability

The availability dimension consists of 3 variables which are adequate drinking water, number of food types, satisfaction on household food management, and confidence in safety of each food source of household.

- The adequate of drinking water indicates household has enough drinking water. It is found that most households; 95 %, have enough drinking water.

- Number of food types indicates diversity of food resources of each household. Generally, households have 1-43 types of food that they rely on with an average of 15 types. Most households (47 %) have 11-20 types of food, followed by 1-10 types of food, 21-30 types of food, 31-40 types of food, and 41-50 types of food.

- Satisfaction on household food management is score rating to express how much the households satisfy their food management. The score represents

confident level which ranges from 1-10 points. The score rating indicates status of having food at the household and at which satisfied level. The results show that the households satisfy in household food management at 6-10 points; which is between moderately to highly satisfy. Most of them highly satisfy with their food management with an average score of 9 points. And mostly highly satisfy with their food management with 8-10 points or 88 %.

- Confidence in safety of each food source: households rate for confident score in food safety which ranges from low to high. A confident level ranges from 1-10 points. The scores of all sources will bring together and divided by number of food sources that the households rely on. Therefore, a total score is 10 points. An overall confidence in food safety will indicate how much the households feel safe in food quality that they consume in which level. As a result, households are between moderately to highly confident ranges from 5-10 points, with an average of 8 points, and mostly are very confident ranges from 8-10 points or 57 %.

5.2.2 Access

Access dimension consists of 5 variables which are having land with reliable and natural food resources, environmental quality; its fertility, that support natural and agricultural food resource. Also, there is enough income to purchase food and have the right in food collection at public area. There is adequate water for food production. The variables of the access dimension are mainly relating to feeling and opinion whether the households have the right or enable to access to utilize food in each source equally to other community members or as the households need or not.

- Awareness of having land with reliable and natural food resources: due to a scope of the studied area that having 1 village, there is similarity in natural food resources. The community has its own community forest. The results of this variable assist in clarifying whether the households have natural food resources to rely on or not. The results show that each household knows that the community has natural food resource which they can rely on.

- Awareness of right to access and utilize food in each source: this variable indicates that if the community has a public land for community utilization, the households realize or not that they are able to access and collect the food as they want.

The results show that most households (99 %) realize that they are able to enter and collect food at public area.

- Environmental quality that supports natural and agricultural food resource: this variable reflects knowledge and opinion of each household whether the households realize that they have good environmental quality that benefits in food collection and producing food or not. The results show that most households (97 %) realize that the community has good quality of environment that contributes to natural and agricultural food resources.

- Having adequate income to purchase food: this variable indicates the households are able to access to food by using their money from income to purchase food. As a result, most households or 95 % stated that their households have enough income to purchase food for consumption while some households (5 %) stated that their income is not enough for purchasing food.

- Having adequate water for food production: this indicates each household are able to access water resource or have good quality and enough quantity to produce quality food in the agricultural plantation or to produce food as need or not. The results show that most households (70 %) have adequate water to produce food in the agricultural plantation. Some households do not occupy in agriculture and some of them think that there is inadequate water to do agriculture (30 %).

5.2.3 Stability

Stability dimension consists of 5 variables which are having financial fund or financial institute of the community, participating in reserve funds' members, food reservation, number of months that are able to reserve food, and number of types of raised animals.

- Awareness of having financial fund or financial institute of the community: this is an opinion or knowing of each household that the community has financial fund or financial institute for emergent incidents whether this fund can assist in food purchasing or not, particular when households face with financial problems. In consequence, 98 % of households know that the community has financial institute.

- Participating in reserve funds' members: this variable indicates whether each household is a member of community financial institute in order to have a

reserved budget for producing food or purchasing food when facing with any emergent incidents. As a result, 90 % of households are a member of community financial institute.

- Food reservation: this variable indicates the security of each household in regards to the ability to have food reservation as long as they want even when the household is unable to collect or produce food or ability to have food reservation when facing with any crisis. As a result, 81 % of households have food reservation in different methods of the food reservation.

- Number of months that are able to reserve food: this variable indicates time period which shows the food security that how long each household is able to have food reservation if they face any crisis or unable to access to food resources. In general, the households are able to reserve food up to 8 months in averagely. It is found that most households or 63 %, reserve food up to 9-12 months, 1-4 months, no food reservation, and 5-8 months accordingly.

- Number of types of raised animals: this variable indicates food reservations' sources and the savings of the households. In a case of crisis that makes the households are unable to access to food resources or not have enough money to buy food, the households will be able to generate income from selling raised animals, consuming the raised animals or products from the raised animals. As a result, most households do not raise animals. For the households having raised animals, there is about 1 type of raised animals in each household in average, maximum 4 types, and mostly 1-2 types.

Table 5.2 Household food security status

Variable	Number of household	Percent	Mean	Standard deviation	Min	Max
Availability						
Adequacy of drinking water					**0**	**1**
Yes	5	5				
No	95	95				

Variable	Number of household	Percent	Mean	Standard deviation	Min	Max
Number of food types (Types)			**14.98**	**7.42**	**1**	**43**
1-10	33	33				
11-20	47	47				
21-30	17	17				
31-40	2	2				
41-50	1	1				
Satisfaction on household food management (Scores)			**8.77**	**1.06**	**6**	**10**
1-3	0	0				
4-7	12	12				
8-10	88	88				
Confidence in safety of each food source (Scores)			**8.13**	**1.19**	**5**	**10**
1-3.0	0	0				
3.1-8.0	43	43				
8.1-10.0	57	57				
<u>Access</u>						
Awareness of having land with reliable and natural food resources					**1**	**1**
Yes	100	100				
Awareness of right to access and utilize food in each source					**0**	**2**
Yes	99	99				
No	1	1				
Environmental quality that supports natural and agricultural food resources					**0**	**2**
Yes	97	97				
No	3	3				
Having adequate income to purchase food					**0**	**2**
Yes	95	95				

Variable	Number of household	Percent	Mean	Standard deviation	Min	Max
No	5	5				
Having adequate water for food production					**0**	**2**
Not produce food	13	13				
Yes	70	70				
No	17	17				
Stability						
Awareness of having financial fund or financial institute of the community					**0**	**1**
Yes	98	98				
No	2	2				
Participating in reserve funds' members					**0**	**1**
Yes	90	90				
No	10	10				
Food reservation					**0**	**1**
Yes	81	81				
No	19	19				
Number of months that are able to reserve food (Months)			**8.23**	**5.12**	**0**	**12**
0	19	19				
1-4	12	12				
5-8	6	6				
9-12	63	63				
Number of types of raised animals (Types)			**0.58**	**1.02**	**0**	**4**
0	66	66				
1-2	27	27				
3-4	7	7				

5.3 Household factors affecting food security

In this study, food security indicators are designed from the reviewed documents and obtained data, then, variables are selected in accordance with the conceptual framework of this study as mentioned earlier. There are also variables that are designed and selected from the reviewed documents and obtained data in order to study household internal factors. These variables would affect other variables that are indicators of food security status. Then, these will be analyzed which household internal factors affects food security and at which level. The result from each household would be different. Additionally, the researcher analyzes all the selected factors in order to find relation with a technique of Multiple Regression and Logistic Regression between a set of variables; which is household internal factors, and each variable; food security indicators (Dependent and independent variables are shown in table 5.3).

Table 5.3 Dependent and independent variables are analyzed in Regression

Variables	Unit of Measurement	Scale of Measurement
Household factors (Independent variable)		
Gender of household heads	Male/ Female	Nominal
Age of household heads	Year	Ratio
Educational level of household heads	Year	Ratio
Settlement periods	Year	Ratio
Number of household members	Person	Ratio
Net income of household	Bath	Ratio
Net expenditure for household food	Bath	Ratio
Savings	Yes/ No	Nominal
Debt	Yes/ No	Nominal
Agricultural land tenure	Rai	Ratio
Distance from house to forest	Kilometers	Ratio
Distance from house to agricultural area	Kilometers	Ratio
Number of household occupations	Occupation	Ratio
Main occupation of household as agriculture	Yes/ No	Nominal

Variables	Unit of Measurement	Scale of Measurement
Participating members in community	Yes/ No	Nominal
Planting diversified types of plants	Type	Ratio
Diversified of food sources	Source	Ratio
Agricultural process (Growing rice)	Organic/ Chemical/ Mix	Nominal
Agricultural process (Planting vegetable)	Organic/ Chemical/ Mix	Nominal
Agricultural process (Raising animal)	Organic/ Chemical/ Mix	Nominal
Compliance with community rules	Yes/ No	Nominal
Knowledge transmission	Yes/ No	Nominal
Food sharing	Yes/ No	Nominal
Marketing channels of food resource from community forest	Channel	Ratio
Knowledge about food collection (vegetable) from community forest	Yes/ No	Nominal
Knowledge about food collection (mushroom) from community forest	Yes/ No	Nominal
Knowledge about food collection (animal) from community forest	Yes/ No	Nominal
Planting eatable plants in community forest	Yes/ No	Nominal
Food security (Dependent variable)		
Availability		
Adequacy of drinking water	Yes/ No	Nominal
Number of food types	Type	Ratio
Satisfaction on household food management	Score	Ratio
Confidence in safety of each food source	Score	Ratio
Access		
Awareness of having land with reliable and natural food resources	Yes/ No	Nominal
Awareness of right to access and utilize food in each source	Yes/ No	Nominal
Environmental quality that supports natural and agricultural food resources	Yes/ No	Nominal
Having adequate income to purchase food	Yes/ No	Nominal

Variables	Unit of Measurement	Scale of Measurement
Having adequate water for food production	Yes/ No	Nominal
Stability		
Awareness of having financial fund or financial institute of the community	Yes/ No	Nominal
Participating in reserve funds' members	Yes/ No	Nominal
Food reservation	Yes/ No	Nominal
Number of months that are able to reserve food	Month	Ratio
Number of types of raised animals	Type	Ratio

Multiple Regression analysis in accordance with the above variables in a dependent variable having Ratio data, the results will be summarized for Coefficient of Multiple Regression with Unstandardized and Standardized Coefficient (b(S.E.) and β). For the variables having Nominal data, it will be summarized by Regression Coefficient in a form of Odds Ratio (OR). Both coefficients will influence to relation in accordance with a higher value that is higher than factors having less coefficient value. In a case of factors having positive relation, it means having variation relation. For negative relation; which has (-) at the front of the coefficients, it means having reverse variation. This will be considered in accordance with characteristics of data in each factor and explain the ability in forecasting (R^2) the factors that are needed to find the relation with the following detail.

Availability

It is found that there are variables having household internal factors affecting which are number of food types that households utilize. Detail of factors affecting and relationship of the factors as in Equation 1. For other variables that show adequate food in each household in this study are adequate drinking water, satisfaction in food management of household, and confidence in safety of each food source of households. As a result, every household has very closed value from the equation. Also, there is no household internal factor in this research that affects to the variables (see the Coefficients in Table 5.4).

Equation 1: number of types of food that household utilizes = -2.03 + 2.25 (number of occupations) + 0.94 (diversity of producing plants) + 2.11 (diversity of food sources) + 3.34 (knowledge in collecting wild animal in the community forest)

Factors that relate with number of food types that households utilize including number of occupations, growing diversified plant species, rely on diversified food sources, and having knowledge in collecting wild animal from the community forest. There is direct variation relation with level of statistical significance ($P< 0.001$). Number of food types that the households utilize will increase to 2.25, 2.11, and 0.94 types when number of occupations increase to 1, food sources increase to 1, and number of types of plant species increase to 1 respectively. The households that are knowledgeable about collecting wild animal are possible to have more food types more than the households that are not knowledgeable about collecting wild animal to 3.34 types of food.

When it is considered from Standardized Regression Coefficient (β), it is found that planting diversified plant species mostly affects to number of food types that are utilized by the households. The value of Standardized Regression Coefficient is 0.61. Next, numbers of occupations, diversity of food sources, and knowledge in collecting wild animal have the value of β at 0.25, 0.23, and 0.198 respectively.

Access

It is found that there are variables having household internal factors that affect. It is having adequate drinking water to produce food. Detail of factors affecting and relation of factors are as Equation 2. Other variables that show food accessibility of each household in this study are awareness of having local and natural food resource, awareness of the right in collecting public food, having good environmental quality and fertility that support natural food resources and agricultural plantation, and having enough income for food expenses. As a consequence, there is closed value among the households. Also, there is no household internal factor in this research that affecting to the variables (see the Coefficients and Odds Ratio in Table 5.5).

Equation 2: Having adequate drinking water to produce food = -0.46 + 2.12 (Main occupation of household as agriculture)

There is 1 factor that has relation with having adequate drinking water to produce food which is occupying in agriculture as a main occupation. It is a direct variation relation with level of statistical significance ($P< 0.05$). It also shows that the households; that occupy in agriculture as a main occupation, have more adequate water to produce food if comparing to other households that do not occupy in agriculture at 8.35 times (calculating from $OR = e^B$).

Stability

There are variables that have household internal factor and have an effect; which are food reservation, number of months that is able to reserve food, and number of types of raised animals. Detail of factors affecting and relation of factors as Equation 3-5 respectively. Other variables that show adequate food in each household in this study are awareness of having financial fund or financial institute of the community and participating in financial institute members. In consequence, there is closed variable among the households (or in each household) and there is no household internal factor in this research that affects to the variables (see the Coefficients and Odds Ratio in Table 5.6 and 5.7)**.**

Equation 3: food reservation = -1.63 + 0.96 (diversity of food sources)

Equation 4: number of the months that are able to reserve food = 3.25 + 0.58 (settlement periods) + 4.15 (knowledge on wild mushroom collection)

Equation 5: number of raised animal types = 0.074 + 1.58 (raising animal with non-chemical)

There is a factor that have relation with food reservation which is diversity of food sources by having direct variation relation with a level of statistical significance ($P< 0.05$) when the households have more than 1 food source. The

households have an opportunity to reserve food is increased to 161 % (calculating from $100*|e|^{B}$-1).

Factors that have relation with number of months that can reserve food are years of settlement and knowledge in collecting wild mushrooms. There is direct variation relation with a level of statistical significance (P< 0.05). Number of months that households can reserve food will increase to 0.58 month with the households that have been settled increase 1 year. Knowledge in collecting wild mushrooms has direct variation relation with a level of statistical significance (P< 0.001). The households that are knowledgeable about collecting wild mushrooms tend to be able to reserve food longer than other households 4.15 months. When it is considered from Standardized Coefficient, it shows that knowledge in collecting wild mushrooms affects to number of months that households can reserve food with the value of coefficient 0.41 while years of settlement has less effect as the coefficient is 0.21.

Moreover, there is one factor that relates with number of raised animal types which is raising animals with non-chemical with direct variation relation with a level of statistical significance (P< 0.001). The households that raise animals with non-chemical tend to have number of raised animal types more than other households 1.58 types.

Table 5.4 Multiple regression coefficients (Reduced Model) of household factors on food security (Availability)

Variable	Multiple regression coefficient							
	Adequacy of drinking water		Number of food types		Satisfaction on household food management		Confidence in safety of each food source	
	b (S.E.)	β	b (S.E.)	β	b (S.E.)	β	b (S.E.)	β
Gender of household heads								
Age of household heads								
Educational level of household heads								
Settlement periods								
Number of household members								
Net income of household								
Net expenditure for household food								
Savings								

Variable	Multiple regression coefficient							
	Adequacy of drinking water		Number of food types		Satisfaction on household food management		Confidence in safety of each food source	
	b (S.E.)	β	b (S.E.)	β	b (S.E.)	β	b (S.E.)	β
Debt								
Agricultural land tenure								
Distance from house to forest								
Distance from house to agricultural area								
Number of household occupations			**2.25 (0.51)	0.25				
Main occupation of household as agriculture								
Participating members in community								
Planting diversified types of plants			**0.94 (0.85)	0.61				
Diversified of food sources			**2.11 (0.55)	0.23				
Organic agricultural (Growing rice)								
Organic agricultural (Planting vegetable)								
Organic agricultural (Raising animal)								
Compliance with community rules								
Knowledge transmission								
Food sharing								
Marketing channels of food resource from community forest								
Knowledge about food collection (vegetable) from community forest								
Knowledge about food collection (mushroom) from community forest								
Knowledge about food collection (animal) from community forest			**3.34 (0.93)	0.198				
Planting eatable plants in community forest								
(Constant)			-2.03 (1.78)					
N			100					
R^2			0.74					

Notes: b = Regression Coefficients for Independent Variables, β = Standardized Regression Coefficients, S.E. = Standard Errors for Independent Variables (In Parentheses), * P (Significant Level) <0.05, ** P (Significant Level) < 0.001

Table 5.5 Logistic regression coefficients (Reduced Model) of household factors on food security (Access)

Variables	Logistic regression coefficient									
	Awareness of having land with reliable and natural food resources		Awareness of right to access and utilize food in each source		Environmental quality that supports natural and agricultural food resource		Having adequate income to purchase food		Having adequate water for food production	
	B	OR	B	OR	B	OR	B	OR	B	OR
Gender of household heads										
Age of household heads										
Educational level of household heads										
Settlement periods										
Number of household members										
Net income of household										
Net expenditure for household food										
Savings										
Debt										
Agricultural land tenure										
Distance from house to forest										
Distance from house to agricultural area										
Number of household occupations										
Main occupation of household as agriculture									**2.122	8.35
Participating members in community										
Planting diversified types of plants										
Diversified of food sources										
Organic agricultural (Growing rice)										
Organic agricultural (Planting vegetable)										
Organic agricultural (Raising animal)										
Compliance with community rules										

Variables	Logistic regression coefficient									
	Awareness of having land with reliable and natural food resources		Awareness of right to access and utilize food in each source		Environmental quality that supports natural and agricultural food resource		Having adequate income to purchase food		Having adequate water for food production	
	B	OR	B	OR	B	OR	B	OR	B	OR
Knowledge transmission										
Food sharing										
Marketing channels of food resource from community forest										
Knowledge about food collection (vegetable) from community forest										
Knowledge about food collection (mushroom) from community forest										
Knowledge about food collection (animal) from community forest										
Planting eatable plants in community forest										
(Constant)									-0.46	0.63
N									100	
R^2									0.26	

Table 5.6 Logistic regression coefficients (Reduced Model) of household factors on food security (Stability)

Variable	Logistic regression coefficient					
	Awareness of having financial fund or financial institute of the community		Participating in reserve funds' members		Food reservation	
	B	OR	B	OR	B	OR
Gender of household heads						
Age of household heads						
Educational level of household heads						
Settlement periods						
Number of household members						
Net income of household						
Net expenditure for household food						

Variable	Logistic regression coefficient					
	Awareness of having financial fund or financial institute of the community		Participating in reserve funds' members		Food reservation	
	B	OR	B	OR	B	OR
Savings						
Debt						
Agricultural land tenure						
Distance from house to forest						
Distance from house to agricultural area						
Number of household occupations						
Main occupation of household as agriculture						
Participating members in community						
Planting diversified types of plants						
Diversified of food sources					*0.96	2.61
Organic agricultural (Growing rice)						
Organic agricultural (Planting vegetable)						
Organic agricultural (Raising animal)						
Compliance with community rules						
Knowledge transmission						
Food sharing						
Marketing channels of food resource from community forest						
Knowledge about food collection (vegetable) from community forest						
Knowledge about food collection (mushroom) from community forest						
Knowledge about food collection (animal) from community forest						
Planting eatable plants in community forest						
(Constant)					-1.632	0.196
N					100	
R^2					0.17	

Table 5.7 Multiple regression coefficients (Reduced Model) of household factors on food security (Stability)

Variable	Multiple regression coefficient			
	Number of months that are able to reserve food		Number of types of raised animals	
	b (S.E.)	β	b (S.E.)	β
Gender of household heads				
Age of household heads				
Educational level of household heads				
Settlement periods	*0.58 (0.25)	0.21		
Number of household members				
Net income of household				
Net expenditure for household food				
Savings				
Debt				
Agricultural land tenure				
Distance from house to forest				
Distance from house to agricultural area				
Number of household occupations				
Main occupation of household as agriculture				
Participating members in community				
Planting diversified types of plants				
Diversified of food sources				
Organic agricultural (Growing rice)				
Organic agricultural (Planting vegetable)				
Organic agricultural (Raising animal)			**1.58	0.73
Compliance with community rules				
Knowledge transmission				
Food sharing				
Marketing channels of food resource from community forest				
Knowledge about food collection (vegetable) from community forest				
Knowledge about food collection (mushroom) from community forest	**4.15 (0.92)	0.41		
Knowledge about food collection (animal) from community forest				

Variable	Multiple regression coefficient			
	Number of months that are able to reserve food		Number of types of raised animals	
	b (S.E.)	β	b (S.E.)	β
Planting eatable plants in community forest				
(Constant)	3.25 (1.47)		0.074 (0.085)	
N	100		100	
R^2	0.21		0.53	

5.4 Diversity of seasonal food resources

Apart from the food security's indicators from the variables of the research, the researcher has studied types and quantity of food in each season for each household (Amount of household food consumption as shown in Appendix C) at the studied area in order to analyze the differences in types and quantity of food. In regards to the conceptual framework of this study, the local geography and climate are some of the reasons that cause droughts and floods. Also, it shows that the community has food all year round but the food types are varied with respect to different seasons. This has led to the study of how the households at the studied area rely on food from the forest and agricultural area in each season. To study, the researcher applies ANOVA and compares the differences in the number of types and quantity of food that the households produce and collect in 3 seasons. The season is divided in accordance with information from key informants; from in-depth interviews and focus group discussion about the monthly climates of the area including winter (November to February), summer (March to April and July to August), and rainy season (May to June and September to October). The obtained data is also presented in the form of pie charts and bar graphs in order to illustrate the proportion of food reliability on each type of food in each season.

From an observation of data about food resource utilization at the studied area, in-depth interview, and focus group discussion on collecting types of food from the forest and agricultural plantations during one year, it is found that the community has knowledge about food in the community forest during each season and has diversified activities relating to agriculture throughout a year. These have contributed to an availability of food adequate for consumption throughout the year.

In this research, the researcher analyzes the number of types and quantity of food resources in 3 seasons which are winter, summer, and rainy season and determines whether there are any differences in different seasons or not. To achieve this, data obtained from household interviews was studied and as a result shows that in summer and rainy season (excluding rice and economic plants for calculation), most food resources that the households utilize are collected from the forest, particularly in rainy season. In winter, a proportion of food utilization is from agricultural production (Figure 5.4). During winter and summer, there are 4 types of food collected which are agricultural vegetation, wild vegetation, aquatic animals, amphibians, insects, and product from insects in an agricultural plantation and the forest. During rainy season, there are 6 types of foods which include the same types of food as in summer and winter but also wild mushrooms and mushrooms in an agricultural plantation. In winter, the majority food types that are utilized (Figure 5.1) are aquatic animals, amphibians, insects, bugs, and product from insects in an agricultural plantation which makes up 37 % of all food types, followed by agricultural vegetation, aquatic animals, amphibians, insects, bugs, and product from insects in forest; and wild vegetation in descending order. In summer, the highest proportion food types that are utilized are aquatic animals, amphibians, insects, bugs, and product from insects in forest which makes up 65 %; followed by agricultural vegetation; wild vegetation; and aquatic animals, amphibians, insects, bugs, and product from insects in an agricultural plantation in descending order (Figure 5.2). For the rainy season, the majority of food types utilized are wild mushrooms which make up 54.5 % of all food types; followed by aquatic animals, amphibians, insects, bugs, and product from insects in forest; wild vegetation; wild animal, amphibians, insects, bugs, and product from insects in agricultural plantation; agricultural vegetation; and mushrooms in agricultural plantation in descending order (Figure 5.3). Therefore, it can be summarized that rainy season provides the most types of foods. Also, there are different types of food in each season that households utilize depending on the suitability of those types of food in each season and the need of utilization of those foods by the households.

When the data of types and quantity of food in each season is summarized in a pie chart and graphs, it is obvious that each season provides different types and quantities of food that households utilize. To find the differences, an ANOVA is used

in order to find each season's different types and quantities of food and whether there is statistical significance or not. Consequently, types and quantity of food resources of the community at present have differences with a statistical significance ($P<0.001$) as in Figure 5.10. Number of food types in each season is different in each season. The rainy season has the highest average number of food types, followed by winter, and then summer (rainy season has an average in food types more than in winter 3.15 types, more than in summer 4.32 types; while winter has an average in food types more than in summer 1.17 types). Food resource quantity is also different between rainy season, winter, and summer. During rainy season, there is more food resource utilization (the average of food type quantity in rainy season is more than winter 181 kg and more than summer 190 kg) while in winter and summer there is not a difference with statistical significance.

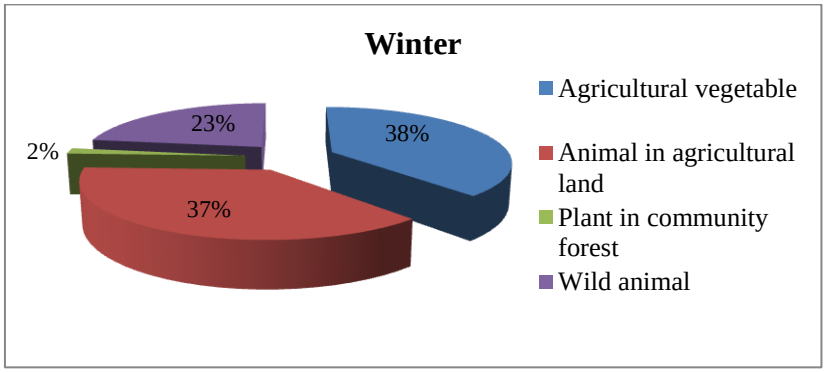


Figure 5.1 Household food producing and collecting proportion in winter

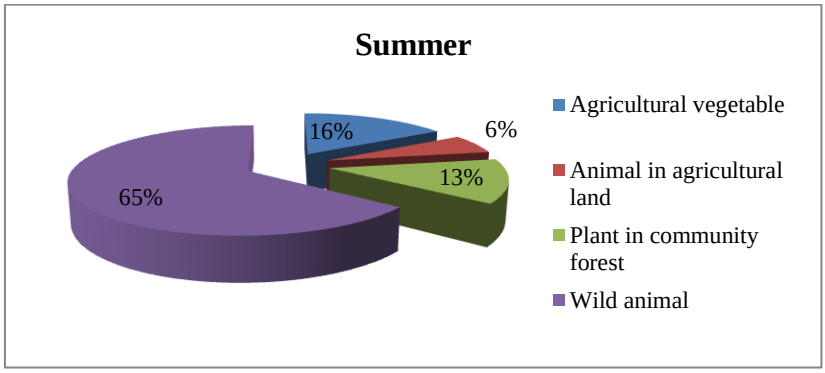


Figure 5.2 Household food producing and collecting proportion in summer

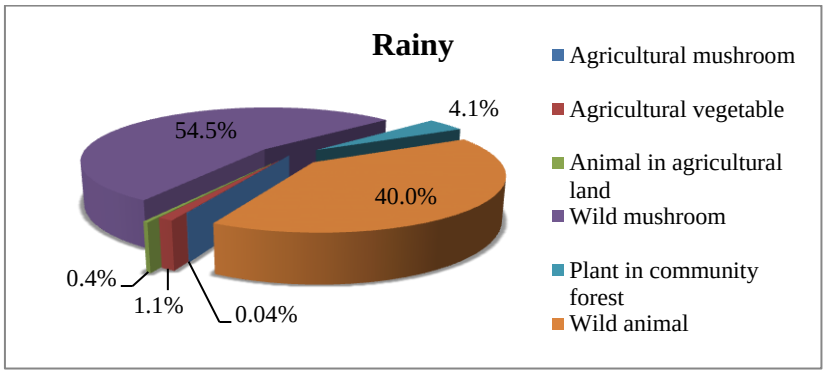


Figure 5.3 Household food producing and collecting proportion in rainy

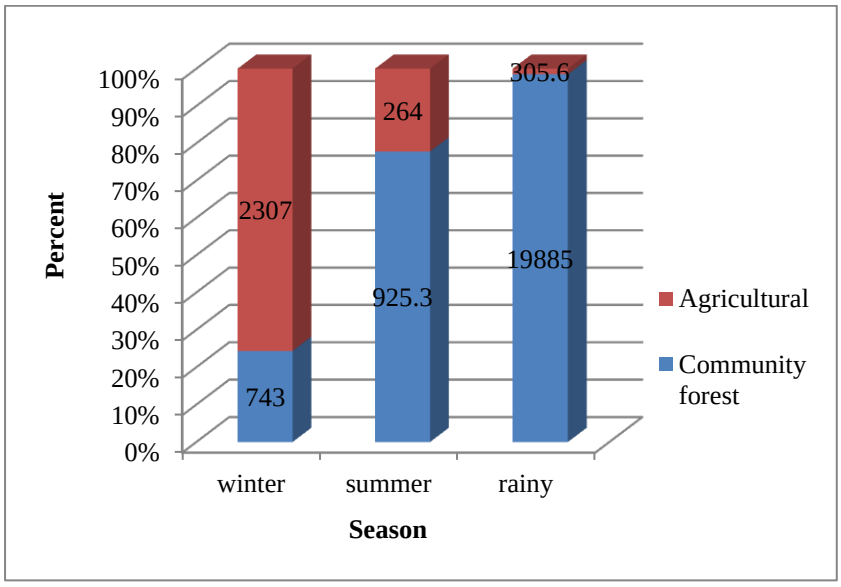


Figure 5.4 Household food producing and collecting proportion in each season

Table 5.8 Variance analysis result of community food types and quantity consumption

Variable	Season			Sequence of mean
	df	F	P	
Food types (Collected and produced food)	2	67.842	0.000	3>1>2
Food amounts (Collected and produced food)	2	42.059	0.000	3>1=2

Notes: 1 winter (November to February), 2 summer (March to April and July to August) and 3 rainy season (May to June and September to October).

5.5 Conclusion and analysis

The analysis in this part will be in accordance with the objective 2 of this study; to analyze factors affecting to community food security by interviewing households with the use of questionnaire and analyze by statistical tool. The results are as follows.

Food security in a dimension of availability, most households or 95 % of them have adequate drinking water, satisfy with their household food management and are highly confident in the safety of food sources that they rely on; which is at 8-10 points or 88 % and 57 % accordingly. Most households or 47 % of them also rely on food 11-20 types; with household internal factors affecting food availability in a variable number of food types that households rely on. From the Multiple Regression Analysis as in equation 1, it shows that number of occupations, relying on various food sources, and having knowledge in collecting wild animal are factors affecting direct variation to number of food types that households utilize with statistical significance respectively.

Regarding access dimension, it shows that every household knows that they have natural resources which are a community forest. It is a natural food resource that the households can utilize. Ninety-nine % know that they have the right to access the resources while 97 % of the households think that the community has a good quality of environment which benefits to the quality of food resources in the forest and agricultural plantation. For the ability to generate income to buy food, most households or 95 % of them are confident that they have enough income to buy food. Regarding households engaging in agriculture, most of them or 70 % of them have adequate water to produce food in the agricultural plantation. There is a household internal factor which is occupying in agriculture as a major occupation. This affects having adequate water to produce food in the agricultural plantation which is direct variation with statistical significance in accordance with Logistic Regression Analysis as in equation 2.

Regarding stability dimension, 98 % of households aware that the community has financial institute to reserve money in case of emergent incidents as well as for money saving. Most households or 90 % of them participate in the financial institute members. In regards to food reservation in a form of food reservation, mostly

or 81 % of the households (63 households) reserve food either storing or processing food which can reserve up to 9-12 months. Moreover, other form of food reservation is raised animals which can be sold or consumed when facing crisis or income shortage. There are 34 % of households that raise animals. Additionally, 27 % of households have 1-2 types of raised animals. It was also found that there are household internal factors affecting food reservation; which are number of longest months that can reserve food and number of types of raised animals in accordance with equation 3, 4, and 5 respectively. Relying on various food sources affects to food reservation. Years of settlement and knowledge in collecting wild mushrooms affect to number of months that can reserve food. Years of settlement have more effects. Raising animals with non-chemical affects to number of types of raised animals. All factors affect to 3 variables with direct variation with statistical significance.

It can be concluded that socio-economic factors of households affecting food security at least one variable in any dimension including number of occupations, growing various plant species, relying on various food sources, having knowledge in collecting wild mushrooms, occupying in agriculture as a major occupation, years of settlement, knowledge in collecting wild mushrooms, and raising animals with non-chemical. Every variable affects direct variation with statistical significance. Particularly, relying on various food sources affect to 2 variables of availability and stability dimension.

Household socio-economic factors affecting food security of this research relate to the results of other researches that studied about household socio-economic factors that affect food security with different conceptual frameworks. For instance, number of occupations, there is a research of Household Food Security: 10 Years after The Opening of Rasi Salai Dam (Saritnirun, 2011). This study analyzed possible factors that would affect food security. The analysis includes variables from 4 dimensions of food security in accordance with FAO with a method of Multiple Regression Analysis. It is found that number of occupations is a factor with positive effects per duration of rice and pickled fish reservation, proportion of food from forest and agricultural plantation per quantity that suggest Thai people consume, and proportion of food from forest and agricultural plantation per food quantity that households consume. This research explained when households engage in various

occupations, it benefits the households have more food sources and alternative food. In a case of sample community of this research, there are various occupations such as agriculture, forest product collection, trading, temporary employee etc. Some occupations provide food directly and generate income for households to buy food. However, engaging in occupations assist the households have options in access to food and bring adequate food as the households needed. In the meantime, a study of Seasonally Flooded Forest and Household Subsistence Livelihood: A Case Study of The Lower Songkhram River Basin (Phreuk Jirasatayaporn, 2007) shows that more number of occupations in a household contributes to more food security. It is analyzed that more occupations may be contributed to more types of food. For examples, if there are more occupations such as fishery, the households will have more chance to consume fish. Even if there are more occupations, the households will have more chance to consume meat or vegetables.

Saritnirun (2011) found that occupying in agriculture as a major occupation is a factor affecting positive outcome to period for rice reservation. Proportion of food quantity from a forest and agricultural plantation per quantity that suggesting Thai people to consume, and proportion of food quantity from a forest and agricultural plantation per all food quantity that household consumes are variables in food security of availability dimension for this research. On the contrary, Aryastami, Fernandez, and Vans (1991) found that occupying in agriculture correlates with a status of food security. Life style of farmers relies on markets less than other occupations because the farmers are able to produce food; rice in particular, either for consumption or food reservation for emergent incidents. Furthermore, a research of Community-based Food Security Management: the Analysis of Communal Management of Seasonally Flooded Forest in the Northeast and Mixed Evergreen and Deciduous Seasonal Forest in the West using Driver-Pressure-State-Impact-Response Model (Kulvadee Kansuntisukmongkol, 2013), it found that households that occupying in agriculture as a major occupation have more types and quantity of food resources from a forest and agricultural plantation. Meanwhile, it is found that relying on various food sources have positive effect to confidence in safety of market, river, and drinking water as well as have positive effect to food collection in a forest, income, good health in accordance with 12 main nutrition and in all seasons; rainy

season, winter, and summer. Proportion of forest and agricultural plantation product quantity per food quantity that consume by household, proportion of fish quantity and aqua animals per quantity that suggesting Thai people to consume, proportion of selling food resource quantity from forest and agricultural plantation per food (food from forest and agricultural plantation) consumption, quantity of selling food from forest and agricultural plantation, food resource quantity that collect from forest and agricultural plantation, and number of food types from forest and agricultural plantation have negative effects to chemical agriculture while this research does not find these factors have negative effects to variables in every dimension of food security. Regarding factors in doing agriculture, mixed agriculture has positive effects to good health, proportion of consuming food from forest and agricultural plantation per quantity of food consumption from all food sources, number of food nutrition in 12 nutritional categories during rainy season, winter, and summer, and confidence in food safety from market and river. In contrast, it is different from this research because it is found that non-chemical agriculture and raising animals affects the households to have more food security.

However, according to a research of A Practice Model for Sustainable Agriculture Assessment: A Case Study of the Sustainable Cultivation of Thai Hom Mali (Jasmine) Rice in Thailand (Kitipong Chaimanuskul, 2011). The research developed indicators in sustainable agriculture with a case study of sustainable growing Jasmine rice in Thailand. The research employed farmers in the northern, northeastern, central, and southern region with one province per one region as a sample of the study. The research also studied on household, socio-economic, and environmental factors that affect to sustainable agriculture by using Logistic Regression Analysis. The results show that a factor that is related to this study is the use of pesticide which affects with statistical significance negatively or inverse variation to many variables that indicate the sustainable growing Jasmine rice in the northern, northeastern, and southern region. In other words, using fewer chemicals leads to more sustainable growing Jasmine rice. The research analyzed that most agricultures consider about using pesticide in growing the rice but the amount of the pesticide is used as it is necessary and appropriate to eliminate some types of pests,

particularly in the southern region, mostly the farmers grow rice for consumption; therefore, they do not need infected chemical.

Regarding factors relating having knowledge in collecting food from the forest, it is related to the study of Food Resource Security at Community Forest Ban Pa Dang in Prae Province (Phasika Chakbuth, 2012). It found that having knowledge in collecting mushrooms and phak wan has positive effect to diversity of food resource; plants in a community forest. Also, having knowledge in collecting red ants' eggs is a factor affecting positive effect to diversity of food resource; wild animal in a community forest.

Furthermore, from the reviewing literature of Seasonally Flooded Forest and Household Subsistence Livelihood: A Case Study of The Lower Songkhram River Basin and Community-based Food Security Management: the Analysis of Communal Management of Seasonally Flooded Forest in the Northeast and Mixed Evergreen and Deciduous Seasonal Forest in the West using Driver-Pressure-State-Impact-Response Model, these studies have been analyzed and compared with the results of the study of the researcher. It shows that these 2 researches have the same factor that affects to many variables that indicate food security with statistical significance which are not in a scope of this study; which are factors of community. For instances, there are more than 1 sample community as to find differences whether different communities may have resource management or some different components will affect food security different or not. Meanwhile, other household internal factors that are analyzed, the data are all from every community of the studied areas. This makes the researcher to study about food security, management by community affect to household characteristics of those communities. This also affects to the differences of food security of each household. However, this research has found factors as summarized above that they are factors that households living in the same community having the same resource management affects food security differently with statistical significance.

Meanwhile, there are many variables in this research that do not affect food security indicators in any dimension. In particular, basic factors; such as age and gender, are related and can be further explain in accordance with a research of Wantanee Chairit et al. As they have studied factors that correlate with food security

of seniority in rural areas in the southern region by employing statistical analysis to find relation between household socio-economic factors and food security in terms of quantity, quality, safety, and the anxiety on food. It shows that there are factors; household income, social support, and health condition, correlate with food security. Regarding factors; gender, education, marital status, and number of household members, they do not correlate with any variables. The research is analyzed by applying a theory of ecosystem of Bronfenbrener. As it is stated that food security does not only relate to a person but it also correlates with environment such as family and community. Family and social factors are supporter that may more correlate with food security. For this research, methods of utilizing resources from collecting and producing are factors affecting to food security with higher statistical significance.

To sum up, household socio-economic factors have positive effects to food security as presented in the results comprise factors about diversity and methods to obtain food, number of diversified occupation, growing diversified agricultural plants, relying on various food sources, assist households to have more alternatives to access and obtain food as they need, either normal condition or crisis. When it is unable to access to one food source, earning less income from one occupation due to economic crisis or natural disaster, or even having decreased in agricultural product, the households are still able to have food or income from other sources as to reserve food security. Regarding occupation, it is found that self-producing food is an important factor of food security because the households are able to control food by non-chemical production. The non-chemical production benefits more food security. In the meantime, to obtain food resource from the forest, if the households have knowledge in food collection, it benefits to food security to have more reserved food. In other words, if the households have alternatives in diversified resource utilization; particularly occupying agriculture as a major occupation with non-chemical use and collect food with knowledge, this will ensure the households have more food security and have less risk in food security if comparing to other households.

CHAPTER VI
RESILIENCY OF COMMUNITY FOOD SECURITY MANAGEMENT SYSTEM

Based on the problems and impacts of community food security mentioned in Chapter four, this research indicated the studied area is very abundant of food resources. In different seasons, there are different types and quantity of food resources. However, the utilization, the invasion, the socio-economic development, and natural disaster created the more severe drought and flooding. Even though since 1992 or around 20 years ago after the community set up, community members started realizing about the significance of ecosystem and cooperation to recover the forest, but the damages of forest needs time. Additionally, the climate changes and the improper development are also influencing the delay of forest recovery. Chapter five indicated the situation of food security in different dimensions, and the differences of socio-economics of each household which relying on various variables.

This Chapter demonstrates the community management process to maintain the abundant of ecosystem and food security. This proper management will strengthen community in the long term to adjust themselves to the risky changes in each season. Finally, this research aims to design the food security management conceptual framework to encourage community deal with other relevant challenges. Researcher divides the presentation topics into 2 comprising of (1) Management of food security risk (2) The resiliency of community food security management system.

6.1 Management of food security risk

When community faced the challenges on the cycle and severe natural disasters such as drought and flooding that directly influenced the food security due to the land invasion, improper land management, forest invasion, and the activities creating negative impacts to those disasters; community started to observe and seek for

solutions. The challenges and solutions were concluded in the table 6.1 based on different times. The in-depth interview about development of community provided this research the information about problem solving of this community. Community realized about impacts from the damages of resources, and then they initiated the protection measure by stop expanding the agricultural land and invading the forest. Community reserved some part of the land for Eucalyptus and Neem as commercial plantation under the support of the Land Development Department (LDD). Also the community reserved and generated the land for community members (Rai Dong Pattana) in equal proportion for the plantation and other agricultural activities purposes. Later, there was the Granite concession coming in but community foresee the negative impacts to the forest, community members protested against this idea and they success the demands. After that, community received different development from government such as the promotion of mono-crop plantation, the road construction that blocking the river flow, and so on. In the same time, the drought the climate change severely and frequently happened, hence community members started to observe and seek for the solutions more seriously. They did brain storming and sending community representatives for the exposure trips such as attending much training on forest conservation, water irrigation, Information Technology (IT), research writing, data presentation, facilitation and resource person skills, sufficiency economy, and so on. After attending various capacity building projects, community members gained knowledge on forest management, water management, socio-economic management, and academic works. They understand the relevant ecosystem factors and able to emerge them to the problems. Community members realized the recovering the forest ecosystem – the source of water – helped to reduce the impacts from drought or flooding. Adapting livelihood encourage them sustainably live strongly with challenges. Accordingly, the community initiated the forest management at household level, community level, and network. Table 6.1 is demonstrating the management at each level. The reason why started at the community level is because the community has common activities to protect the abundant of forest in the past. They have measures to recover the forest such as forest management, land allocation and land use management, rules and regulations to utilize the resources. After that, the management intended to expand the community forest at network level, together with water

resource management. The indirect benefit or water resource management is it provided the moisture to atmosphere and recovers the forest. Community understood the risk of mono-crop plantation; accordingly they learned how to manage agricultural practices appropriately since the household level. Community members adapt themselves to implement the integrated agricultural system and reduce the application of chemical substances. Moreover, community members applied the principle of sufficiency economy in their daily lives as well as expanding to increase the community income.

Table 6.1 Time line of community food resources management

Year	Event	Activity	Activity level
1984-1985	Over resource used and started concerning in further forest abundant	Scoped forest area for 10 Rai for public utilization with the assistance in eucalyptus and neem planting	2
		Equally allocated the public land to be private agricultural land (Rai Dong Pattana)	2
1992-1994	Investor entered the village for granite concession at the community forest	Protested the granite concession	2
1999-2006	Be promoted mono-crop agricultural from government office	Release cancellation monoculture	1
	Faced severe drought and flooding every year	Scope community forest area and training volunteer forest rangers	2
		Developed water management	2
		Expanded scope of the community forest	3
		Adapted the appropriate plantation according to the location	1
2007-present	Faced the health problems from practiced of chemical agricultural	Reduced using chemical in agricultural	1
		Adapted the sufficiency economy to livelihoods	1

Year	Event	Activity	Activity level
	Faced severe drought and flooding continuously	Developed economic cooperation enterprise in the community	2
		Continuously develop water management	2

Notes: 1 = Household 2 = Community 3 = Network (Cooperate to other villages)

This research found that the major problems influencing the food security are drought and flooding. Some years they faced drought while some years confronted flooding or both in the same year. (Table 4.1 is demonstrating the year and natural disasters and the table 6.2 is demonstrating the comparative management information of household and community when they did not face the disaster and when they did). Households in community adjusted the methods and timing they utilize to collect natural resources in each year. It was depending on the challenges or damages they were facing. In some years without drought or flooding, the households collected forest products in each season in the normal practices for instance; collecting mushrooms and frogs in rainy season, cultivating ant's eggs in summer, and so on. Households who live with agriculture activities such as rice growing normally started plantation in rainy season. In some years with drought, some forest foods were less or ran out and the households who relied on the forest products directly got impacts. So they solved problems by buying those products from the markets in other areas or just consumed other products available. In the agricultural areas where facing drought, households solved problem by using the underground water and reduce their production or wait until the rain come again to start the production. In the flooding period, households postponed rice growing after it recovered. Community coordinated with the disaster warning with other communities about the amount of water influx to community so that they could handle the flood effectively. However, in this flooding case, the forest product collection did not get to high effect. Besides, every year community continuously plan to handle the natural disaster whether or not matter it has tendency to happen. Community had water management system such as building the irrigation system to trap water for agriculture and planting the tree for long term solution. Household adapted themselves to do the integrated agricultural system and

grow big trees, so that they can utilize no matter with or without disaster. Even with the disaster, their resources might not get much damaged. In the worst case, only some plants got damaged, while the rest are available for community consumption. Community organized the collective group to guarantee the production price.

Table 6.2 Comparison of household and community between disaster and non-disaster case

		Drought case		Flooding case	
	Non-disaster case	**Household**	**Community**	**Household**	**Community**
Agricultural management	Start rice growing on May	Apply using underground water or reduce the production	Develop water management, recover community forest , and economic cooperation enterprise for agricultural product trading	Start rice growing on October (After flooding)	Develop water management, recover community forest , and economic cooperation enterprise for agricultural product trading
	Do mono-crop planting	Do the integrated agricultural system and mostly planting for consumption		Do the integrated agricultural system and mostly planting for consumption	
		Apply growing big trees such as capoc (plant for trade product and collect wild animal in capoc farm)		Apply growing big trees such as mimosa (plant for trade product)	
Community forest management	Collect wild products in each season in the normal practices	Households got impacts from less or ran out of some wild foods So they buying those products from the markets in other areas or just consumed other products available.	Recover and conserve community forest by using water management, create the rules, and expand conservation area to other village	-	Recover and conserve community forest by using water management, create the rules, and expand conservation area to other village

The primary data applied in this research to conclude the community management measure in different period of time were detailed factors and elements of management to successfully solve problems about food security. Researcher classified management into two topics including direct resource management and socio-economic management to create strength and promote the effective resource management as detailed below.

6.1.1 Resource Management

Resource in this research means food resource and resource that is significant for food production such as forest and water. The major principle of resource management is to encourage community to access and utilize even during the disaster. Data from the interview and focus group indicated community having sustainable resource conservation concept. Majority of community members over utilize resources or applying the wrong practices. They had experiences on utilizing forest products appropriately, according to different types of foods in each season. Community developed the effective water management process to produce enough foods in the agricultural areas and able to handle the drought or flooding situations. The geographic area is 0-3,000 meters high from the sea level, as mentioned in Chapter four. It is the watershed area near the west of mountain. It covers forest area of the big mountain with diversity of geography or habitat. The watershed area near river is suitable for settling the shelters, operate orchard and rice field. The river bank is where aqua lives lay their eggs. In the flooding season, the nutrient sediments spread all over the foothills. The biodiversity is vary from one level to another such as the drought in summer and winter, in some parts of the mountain still have water source or trees where some lives living there and community able to collect for their consumption. The roles and benefits of forest ecosystem are mechanisms to create flexibility and assure community has resources for their consumption. However, community realized the significance of forest in the past until present, as well as conserve and recover the forest by diverse methods. This maintain the required productivity and diversity of resources in community, even though the risks on climate changes and socio-economic still exists.

Resource management is very significant for resiliency of food security management system in community, because resources produce foods. Resource management of community influences the recovery of resources or ecosystem where the foods exist. According to the concept "Resiliency" of Holling, recovering or the life cycle of natural process is relevant to the nature and society. The sustainability if ecosystem is depending on the adaptation of society and environment. This concept mentioned about the adaptation of adaptive cycle (Figure 6.1) which clearer explaining the resilience process of ecosystem. The process includes the growth or existing of ecosystem, the maintaining, the changes, disturbances, and resilience alliance. In his research the resources from the agricultural areas and community forest are the important foods and ecosystem. The resources are very abundant and support the production and food collecting of community in the past (Part 1 and part 2), however they faced impacts from many problems as mentioned (Part 3). The community's and households' resource management process, either the agriculture or community forest (Table 6.2), are facilitating the ecosystem recover to provide food security for community which is the 4th Part of adaptive cycling theory according to Holling.

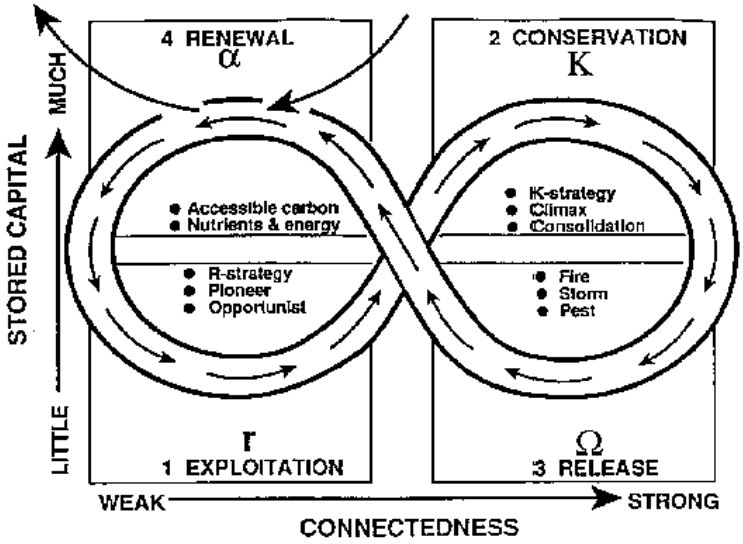


Figure 6.1 Renewal cycle (Holling and Sanderson, 1996)

Community relies on cooperation, the existing concept and seeking new concepts for resource management. They improve and apply the appropriate

knowledge for the areas, and also get assistance in terms of knowledge and budget from diverse organizations continuously. Researcher classifies the measures of community's resource management into 3 topics as followed.

6.1.1.1 The Appropriate Resource Utilization in each Season

The long term problem in the past until now is drought and flood. These two even more severe and frequent day by day, because of the climate changes and human activities. However, it happened only in some period of time. Based on the analysis of variance, this research found that community access and utilizes resources differently in each season. In the meantime, the information from in-depth interview and focus group indicated that community realized the different of resource types in each season, so they utilize them in the different amount. Additionally, communities recognize the impacts of those problems on foods in different seasons and prepare different measure to handle the situations in different period of times. Community is able to live their lives appropriately, according to the areas and the weather. The resource management process encourages food security in the different periods of time.

Community is depending on forest product's collection and food production in agricultural sector. (Table 6.3 demonstrates the foods from the forest and agricultural areas). In winter, there was cool and less rain or even without rain, but the weather is suitable for some plants to grow. Community members rely on foods from agricultural sector in the beginning of winter when the rice is also cultivated. In November of every year, community has the rice cultivation tradition when farmers share their labor to cultivate rice and celebrate together. In January, there is a tradition to consume the new rice produced. In February, community organizes the ancestor memorial tradition. After rice cultivation period, farmers can grow vegetables such as cabbages, broccoli, Chinese kale and so on. Besides, green bean is also a good optional crop to grow, because farmers can also use the leaves after cultivation as bio-fertilizer. In winter, the insects and some eatable animals are available in the farm such as crickets, squirrels, and so on. The sealing lac is another business to operate in this season. Some households with enough water resource start the next round of rice farming. In the past, the problems and impacts in winter is

drought and farmers cannot growth rice and mono-crop. Nowadays, water reservoir can supply enough water for the village, and majority of households are able to grow vegetables, integrated farming system, rice farming, and operating the fruits orchards.

In summer, there was more rain and moisture than in winter. The cotton seeds, forest vegetables and wild lives are available to cultivate, especially some insects or products from insects. The traditions in summer are offering foods for the monks. In March, the biggest chanting about story of Gautama Buddha as Vessantara. In this tradition, villagers prepare rice, chilly, onion, garlic and so on to offer the monks. In April the most famous tradition is "Songkran or Water Tradition" when people play water and donate foods and money to the temples, as well as make merit for ancestors. In July, it is the day before Buddhist lent, people offer foods and money to the temples, do chanting, worship and walk around the church, and arrange the candle decorated parade. Normally there is no disaster in summer, except drought and less abundant of resources in some years.

In rainy season, there are a lot of resources. Cotton seeds are still available for cultivation. The rice farming starts in some areas. Some rainy days, villagers can look for mushrooms and some wildlife. Community members normally look for the forest product in the nearby areas and sell those products such as mushrooms, frogs, and fishes. Besides, many kinds of forest vegetables are available in this season, especially bamboo shoot. However, forest product collecting is not population in this season. The traditions in rainy season are; Vesak Day in May when people make merit and chant together, prepare the basket of foods and making merit for ancestor and spirits in September, the end of Buddhist Lent in October, celebrate the god of rice, Thot Kathin (the annual merit-making ceremony in which new yellow robes are presented to Buddhist monks by laymen).

Problems and impacts in rainy season are the areas get flooded in the west of the mountain damaging the agricultural area around the foothills. In the past, (1999), majority of community members grow mono-crop under supports of government and this damaged environment because the whole areas got flooded. At present, the majority of foothills in the east of village became forest that capable to tolerate the flood such as Mimosa that villagers can also feed the Lac as another income. Besides, villagers also operate the integrated farming system around the

foothills and community creates the trees bank project to change the trees to income. Another problem in rainy season is less rain or drought. Flooding does not follow the amount and consecutive days of rain only, but it also imply maybe the only one day-heavy rains and the soil not able to absorb water for the long term using due to the high slope areas. The overbank flow happened because community put or build something to block the water flow. Community is based in the rain shadow zone with less rain or inconstant rain amount each year. Some year less rain and it influence the amount of mushrooms and wild animal. The solution of community base on their traditional believes is demonstrating to traditions such as in June they have the god worship ceremony and this is similar to the ancestor worship ceremony in February. Some years the rainy season postpone late than normal, villager will organize the "Listen to the snakefish chanting and philosophy". In his ceremony, community invite 1 monk, and offer 1 set of monk consumption goods, many kinds of fishes, and the local rocket. In the most drought year, villager will organize the "Cat Worship" parade. However, the negative impact of less rain to agricultural sector is less than before because community manages water more effective by building the water reservoir.

Besides, in the past until now community raise cows together with doing rice farming. Cow farming is good option because it is not depending on the seasons much. Villagers rely on the forest products, agriculture, and also raising cows. Villagers can sell cows when it grows enough and strong to get good price. Additionally, villagers can sell cow dunk or use it as bio-fertilizer in their farm. At present, some villagers raise pigs, duck, chicken, and other food sources which are not depending on seasons.

Based on the information of the community resource utilization, the most abundant season when villagers can operate their agriculture activities and collect the most of forest products is rainy season. The major crop grown in rainy season is rice. Rainy season is the beginning of rice farming while winter is the rice and Lac harvesting time. Villagers will also grow vegetables in winter but only after the rice harvesting. In winter, farmers can collect foods from the farm and orchards also. In summer, villagers harvest cotton and fruits. However not many villagers grow fruits. Majority of forest products in winter are insects. The natural

disaster in community is flooding and overbank flow water in rainy season. However, based on the statistical analysis, the research found the different of foods amount in three different seasons. In rainy season, there are more foods for community to collect more than in winter and summer. This research also found the different of average types of foods in three seasons. In rainy season, there are more types of foods, and the next is winter and summer respectively. Information from the in-depth interview and focus group, researcher found that villagers still capable to collect forest products and wild life even in rainy season and the area got flooded. Majority of the farm is applying the integrated farming system with the better water system management in the low-plain areas or the high slope area around foothills. Hence, villagers do not face the severe problems about types and amount of foods anymore. In winter, community can still grow vegetables after rice harvesting. In summer, some villagers harvest some kinds of agriculture and forest products for sell. With the less rain amount in some years, villagers face the lack of agriculture foods and wildlife collection, but the appropriate water management improve situation. In conclusion, even though the seasons influencing resources and creating different problems, the good management of community improves and facilitates the resource accessibility and occupation of community members. People live their lifestyle based on available resources. Community felt the abundant of foods and realize they have food security. However, they realize they need to protect and recover resources and live in accordance to the nature to protect food security.

Table 6.3 Food consumption and activity calendar

Season	Month	Wild mushroom	Wild animal and product's	Wild vegetable and fruit	Agricultural activity	Religious ceremony
Winter	Jan		- Fish	- Indian gooseberry	- Plant backyard garden - Start double-crop rice growing - Start raising Lac on mimosa	- Tradition to consume the new rice produced

Season	Month	Wild mushroom	Wild animal and product's	Wild vegetable and fruit	Agricultural activity	Religious ceremony
	Feb		- Bee - Fish - Iguana	- *Adenia viridiflora Craib* - Barking Deer's Mango - Neem	- Harvest double-crop rice - Plant backyard garden	- Ancestor memorial tradition
Summer *	Mar		- Ant's egg - Bee - Fish - Iguana - The subterranean ants	- *Adenia viridiflora Craib* - *Broussonetia kurzii Corner.* - Olive - Pak-wan Tree	- Harvest Cotton	- The biggest chanting about story of Gautama Buddha as Vessantara
	Apr		- Ant's egg - Bullfrog - Fish - Frog - Iguana - The subterranean ants	- *Adenia viridiflora Craib* - *Amorphophallus bulbifer (Roxb.) Blume* - Olive - Pak-wan Tree	- Harvest Cotton	- Songkran
Rainy *,**	May	- Barometer - Earthstars - Green Agaric - Grisette	- Bullfrog Iguana - Cockchafer - The subterranean ants - Fish - Frog - Honey - Small frog	- *Adenia viridiflora Craib* - Bamboo Shoot - Devil's tongue - Pak-wan Tree - Siam Tulip	- Harvest Cotton - Start in-season rice growing	- Vesak Day
	Jun	- Barometer - Earthstars - Green Agaric - *Craterellus sp.*	- Cockchafer - Fish - Frog - Iguana	- *Amorphophallus bulbifer (Roxb.) Blume* - Black currant tree - *Flacourtia indica* - Pak-wan Tree - Siam Tulip	- Harvest Cotton - Start in-season rice growing	- God and ancestor worship ceremony (If the rainy season postpone late than normal: They do listen to the snakefish chanting and cat worship parade)
Summer *	Jul		- Fish - Frog	- Black currant tree - *Flacourtia indica* - *Schleichera oleosa (Lour.) Oken*	- Harvest Longan - Start in-season rice growing	- The day before the Buddhist Lent

Season	Month	Wild mushroom	Wild animal and product's	Wild vegetable and fruit	Agricultural activity	Religious ceremony
	Aug		- Fish	- Bamboo Shoot - Pumpaeng - *Schleichera oleosa (Lour.) Oken*	- Grow in-season rice	- Buddhist lent
Rainy *,**	Sep	- Green Agaric - *Craterellus sp.* - Grisette - *Lentinus polychrous Berk.* - Silver sillago	- Fish - Frog - Small frog	- Bamboo Shoot - *Flacourtia indica* - Frog Bit - *Rauwenhoffia siamensis*	- Grow in-season rice	- Make rice merit and chant
	Oct	- Green Agaric - *Craterellus sp.* - Grisette - *Lentinus polychrous Berk.* - Silver sillago	- Bullfrog - Cricket - Fish - Frog - Small frog	- Bamboo Shoot - *Chebulic Myrobalans* - Frog Bit	- Grow/ Harvest in-season rice	- The end of Buddhist Lent - Tradition of getting rice
Winter *	Nov		- Cricket - Fish - Small frog	- Frog Bit - Indian gooseberry - Jackal Jujube - Olive	- Grow/ Harvest in-season rice - Harvest Lac - Start double-crop rice growing - Plant backyard garden	- River goddess worship ceremony - Tradition of rice cultivation
	Dec		- Cricket - Fish	- Indian gooseberry	- Grow double-crop rice growing - Harvest in-season rice - Harvest Lac - Plant backyard garden	

Notes: * Drought periods ** Flooding periods

6.1.1.2 Water Management

The problems and impacts of food security is involving water resource such as flooding and drought. Less water in dry season and the soil is not able to absorb water for agriculture activity. In rainy season too much rain, and overflow down the hill slope damaging the agriculture areas and shelter around the agriculture area nearby the Wang and Mae Rawan River. The major cause is climate change, less forest, low soil quality not able to absorb the water, and the high slope of the hill. The low plain around the curve part of the river delay the water flow and sometimes create the overbank flow. The outflow of the river is more vulnerable to experience flooding. However, the question to solve this problem is how to slow down the water flow from the uphill and how to trap water to use until the dry season. The research results indicated in the previous chapter and topics demonstrating community able manage the water resource effectively. Water resource is necessary for forest products and agricultural area. It is interesting to study about the effecting management process of this community. Besides, this study found that the major water resource management in this community is setting up the flooding watch group, and forest conservation plan, construction to control water flow.

The water resource management of this community is based on the local knowledge and understanding on their ecosystem and the nature of water flow. That is why they can solve problem of drought, flooding, and overbank flow in the same management system. Community applied the principle of slowing down water flow at the origin of water sources in rainy season, so that the soil capable to absorb water and nourish forest. Water slowly flows to each water reservoir at different levels. Community built the irrigation system to supply the agriculture areas, even in dry seasons. However even in rainy season, the reservoirs have capacity to save water and slowly release it down the irrigation system in the lower plain areas. Community avoids blocking the river flow and built irrigation system starting from Mae Rawan River and it helps agriculture sector. This canal used to handle bit volume of water from Wang River. As mentioned in Chapter four about the nature of river flow in the low plain areas. There are many curves that slow down the river flow and accumulate the mud and tendency to get flood in rainy season. The water will stuck in between the curve and it is called “Monkey cheek”. Water from monkey cheek slowly

flow to the lower part of the river, and it reduce the chances of overbank flow. Villagers understand well about the water flow in curve part of the river, hence they never built anything to block the river flow. Besides, community used the nature of water or “Monkey Cheek” to develop the more effective water reservoir.

Community understood the significance and dependency of ecosystem. To conserve their forest, they need to also conserve the nearby areas also. They have to expand the conserved forest more to increase the abundant of forest. They understand the significance of knowledge on water resource management in the whole range of water not only some parts. The amount of water starts from the origin of river, if community wants to reduce the overbank flow situation, they need to apply much process to manage it. Creating the village network since the origin of river and until the estuary to conserve the forest and inform about the emergency cases on flooding are necessary. Community is able to predict the damages. The network includes 6 villages in Yokkrabutr Sub-district, Sam-ngao District, Tak province; and 3 villages (Song Kwae, Nong Chaing Ka, Moo 6 and 11) in Prik sub-district, Prik District; and 3 villages in Lampang province (Prik Bon, Prik Lum, and Mae Chiangrai Lum).

Referring to the construction for water resource management purpose, villagers learned from the exposure visits with many organizations and other communities how to work on it and applied in their ecosystem. Community built their irrigation system such as reservoir, check dam and water canals. Majority of the constructions were on the west of the hill with origin of water resource (Mae Rawan River). The big dam was built at the origin of Mae Rawan water source, then the cement canal was built to supply water downhill to other 3 smaller reservoirs and dams (upper Hui Tueng monkey cheek, lower Hui Tueng monkey cheek, and lower Hui Tueng reservoir). The check dams were built to slow down the river flow in the upper until the lower Hui Tueng monkey cheek to trap water for supplying in the drought season and release water in the flooding season. The lower Hui Tueng reservoir has water supply canal link to other 2 reservoirs (built by the province administrative organization and the agriculture financial cooperation). Next, there was a dam construction at the end of Mae Rawan River (called the Community Volunteer Dam). The dam connected with cement canal to link one reservoir to another to

facilitate the agriculture activities. At the foothills, the areas are closed to rice plantation areas where the canal (Rong Cha canal) was built to manage water in rainy season. The canal linked Mae Rawan reservoir across the rice field to meet with Wang River and down to Chorakae reservoir in the nearby village. Besides, there was a cement canal linking the upper Hui Tueng monkey cheek and another one built by the provincial administrative organization to supply water to Song Kwae Luang reservoir in the nearby village. This water system trap water to use in the dry season and release flooding in rainy season (See figure 6.2: The Mapping of Water Resource Management System of Community).

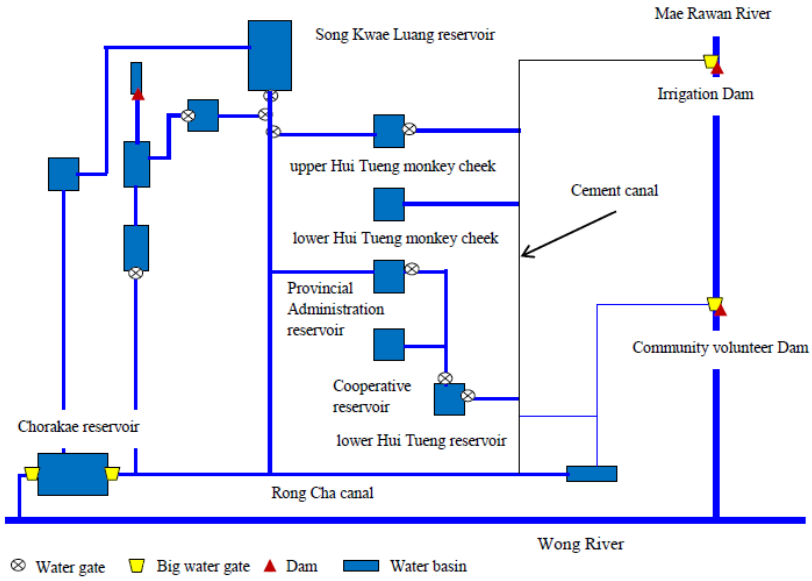


Figure 6.2 The mapping of water resource management system of community

6.1.1.3 Forest Conservation and Land Use Management

Community encountered the drought problem and flooding, so they gave priority to ecosystem and how to control the water amount balance. Ecosystem is the major food source for villagers. In the past when the community first set up, they did not face too much problems as happening nowadays. They started the land use management to increase their incomes and reduce the resources damages and forest invasion. Community reserved some areas for trees plantation and they cut for sell after some years. Additionally community also allocated area for agriculture

activities, so that villagers not invade the forest for agriculture purpose. However, the forest invasion of outsider and the over utilization in the past left the negative impacts until nowadays. The drought and flooding still continuously create troubles for community. The resource management activities to preserve food security of community were conducted based on the confidence and assumption "If community is able to preserve and recover the abundant of forest, it will bring sustainable environment to community member". Even though community has knowledge about food collecting based on different seasons, construction for water management, and networking; however without the serious forest conservation, community would not be able to preserve food security and not able to handle the drought and flooding. Accordingly, as a part of water resource management, the recovering of forest and ecosystem are needed, by building the check dam to slow down the river. The dam slowed down river stream to supply in agriculture areas and trap water to use in the drought season. However, building the dam was just the idea to temporary use representing the forest. Another long-term purpose is how to support the soil able to absorb the water, so that water nourish the forest and the forest control the water amount balance.

Community needs to create the mechanism to protect the improper utilization the forest. Mae Rawan Community chose the land territory identification technique, so that community members have the sense of ownership and cooperate with other members to protect, monitor, and present the forest. Each village send 10 representatives and 2 council members of the Yokkrabutr Administrative Organization to receive training how to conserve the forest with Tak Forestry Department. Later the community forest and committee were set up. Tak Forestry Department issue the legal land title for 181 Rai to become the community forest of the villages. Later the forest expanded to 1,016 Rai. Later community still concerned about the effectiveness to conserve ecosystem and control the balance of water amount. The community consulted each other about the idea of networking and the local research on "The Awareness Raising Process and Community Participation around Pha Ton Forest". The network played major role in forest conservation and recover continuously and sustainably. The project was funded by Thailand Research Fund for the North. The community cooperate with other 6 villages in Yokkrabutr sub-

disrict, Sam-ngao district, 3 villages in Tak province (Ban Song Kwae, Ban Chiang Kha, and Moo6&11), and 3 villages in Prik sub-district, Prik district, Lampang Province (Upper Prik, Lower Prik, and lower Chiangrai). The community forest was finally expanded to 15,400 Rai. The new community forest committee comprises of community leaders from 7 villages (Including Mae Rawan village). In the committee meeting, the rules and activity plan was set to conserve and survey the damaged part of community forest for recovery. According to the forest survey, it was found that the forest was dry and located on the steep hill facing the South. In dry season, the area lacked of water. The surface of soil is much thinner to absorb the water. Only some kinds of plants can grow in this type of forest. This forest was called "deciduous dipterocarp forest". Majority of the area is rock and good quality Granite stone. The knowledge about drought and type of soil is necessary for water resource management planning. The community forest committee agreed to involve participation from people in forest and water resource conservation. The committee organize "Tree Growing" activities and set up the guard to take care of the forest. Later the project proposal was developed to request the funding support from Social Investment Fund (SIF) to develop the capacity of the network. The exposure visits on community forest management were designed at Ban Tung Yao village, Sri Buabaan Sub-district, Muang district, Lamphun province. After the exposure visit, community was able to design and set up their Master Plan to manage community forest. The training of trainers was organized for the leaders to take care of 15 Rai of the forest. Youth training is another activity with the aim to expand preservation idea and awareness raising among the youth. Additionally, the community forest committee drafted the regulations, then informed the Yokkrabutr sub-district and nearby village. The community leaders of each village informed their people about the regulations of community forest management as detailed below;

1) Person who violates the regulation will be fined 1,000 per person.
2) Taking the stone, soil, and sand from the community forest will be fined 1,000 per person.

3) Person who collects forest products in the community restricted area are prohibited to destroy any natural resources.
4) The committee of community forest has to survey the forest twice a month and 8 members in the survey team on one mission night.

When the community forest is abundant and the water resources are properly managed, it helps to reduce the impacts on food security. However majority of the Mae Rawan village are working in the rice fields, operating orchard and animal farm. The appropriate land use plays the important to reduce the risks on food security in the drought and flooding period. Community and community member started to adjust agriculture behaviors according to the environment and problem state. Additionally water management and community forest management need to be taken care of in parallel. Concerning the foothill area called "Rai Dong Pattana", community manage it as the community common land covering the area of 400 Rai. Community allocated this common land for 135 households in the even scale for all. The household utilize this piece of land for agriculture purposes, especially the integrated farming system. This policy aims to stop community members not to invade the community forest. Every blocks of the allocated land can access the water supply from irrigation system or at least having the underground water. In the nearby land, each household has their own land title and freely utilize the land such as rice farming, integrated farming system, and so on. The Climate change and economy impact on mono-crop, community promoted community members to grow the cotton, Siamese neem tree, and others, to reduce the flooding problem. Concerning the rice field and some part of the land near Wang river, the fruit orchard was transformed to grow Siamese neem tree and Lac farming. Nowadays, some part of the land was least out to grow mono-crop such as corn and Casava. In the flooding or drought seasons, this mono-crop land got severe impacts. In the household area, community promotes them to grow the vegetables around the house and keep it for the crisis seasons.

6.1.2 Socio-Economic Management

Besides, managing food security via natural resource management directly, community and households also develop their socio-economic to assure the long term food security. With this integrated preparation, community will be able to adjust themselves and handle natural and socio-economic problems.

Community adjusted their living concept. Mae Rawan has the concept of "Human capacity development". This is the development principle applied from the sufficiency economy. This sufficiency economy philosophy emphasize on self-development such as satisfying in way of life, saving, no greed, sharing, take care of lives and nature, learning compassion, learn new things to develop themselves, household, and community in diverse dimensions. Additionally, this concept encourages people to earn income to access resources, be more careful in life and have life immunity to operate any activity. In the same time, life morality is very significant. People in Ban Mae Rawan village live and share together. Villagers are depending on each other in terms of foods exchange. Community members participate in all collective activities. Villagers applied the concept of sufficiency economy at many levels. Villagers started by prepare foods and household consumption goods to handle any emergency case. They are self-reliance and even be able to help others. The exchanges in terms of foods and other consumption goods are often seen. There are many collective actions were formed for instance cooperative, social groups, saving group, and so on. Additionally, community organized youth activities to inherit the conservative concept and adjust their perspective according to the aim of the community forest concept. People mostly collect foods from the forest and no necessary to invade the forest or using the chemical substances. This actions and concepts reduce the capital for food production, and maintain health of the farmers. It is a self-sufficiency practices in all dimensions. Household can save money from these practices. Besides, the support and cooperation among neighbors create unity among them. The cooperation improved and facilitates the cooperatives formation or even enhances it better to handle the crisis.

There were 13 fund and financial groups were formed in the village with the support of external organizations and the national organizations. There are 3 major types of the group including; financial and insurance institute, cremation and welfare

fund, One million bath group, and saving group. Another type is income generation or economy group such as Rice group, Cow group, Organic vegetable grower group, tree bank group, fish source group, bio-diesel group, water resource management group, housewife group, Lac group. And the last type of grouping is about family and occupation including Love and Care group and farmer group. All groups in community operated effectively and continuously based on the principle of group administrative. The groups need trustworthy and active leaders to operate and participate in the groups, so that the group will be improved all the time. Some group had to write reports for the grants each year. The budget assessed good performance of the group to consider fund allocation in the next year. The action guideline and concept of the community forest group are as followed.

The cremation group in the village participated by all community members. The aim of this group is to provide support in the cremation ceremony for people who passed away.

Million Baht Fund Group aims to provide the loan for community members. The finance source is the Agriculture and Cooperative Bank. The regulations and interest are accordance to the bank rule. Each year the fund can provide 1,000,000 THB loan for members. The eligible members need to be the saving group member also or at least need member of the saving group to guarantee the eligible members.

Saving group aims to encourage community member to save money and provide the interest like the bank. However the amount of deposit money must be regular every month. The member of this group have rights to access the loan of this group itself or able to access the Million Baht Fund.

Rice group aims to purchase rice from community members and sell out for profit. But the profit will be shared among members.

Cow group aims to provide service of financial saving and investment.

Organic vegetable grower group aims to request the fund allocation from the agriculture and cooperative bank to encourage farmers changing to the organic vegetable farming. The seeds will be allocated among members. The strict rule of this group is growing vegetables without non-chemical substances. Community organizes the competition among member.

Tree Bank Group aims to recruit members who grow the tree with DBH value about 8-9 cm per person. But the tree must be planted in the legal land entitle. Once members register with the group, they have to inform the group about what type of tree, where it was planted, and how big it is to the group, so that the group can assess the price. Community member can use this tree to with draw money or pay debt with the bank. Community member can withdraw the tree from the group also, in case they want to cut and sell it. The land where the tree planted still belongs to the owner, not the bank. If the farmer wants to sell their land together with the tree, it is also possible.

Fish source group aims to invest on fish source producing and sell. The group will pay money to the fish source producer and sell the fish source. The surplus profit will be also shared among members.

Bio-diesel group aims to invest in bio-diesel station business. In the first year, members have to invest in the station construction. After the group is able to sell the bio-diesel and gain profit, they profit will be shared among members.

Water supply group aims to provide the loan for funder in their rice field operation.

The housewife group aims to encourage members to save money and participate in the collective activities. The grant provider is The Department of Social Development and Human Security.

Lac farming group aims to provide the good Lac for members. The group got funding support from Provincial Agriculture Department. After the members are able to sell their Lac, then they can return the fund to their group, while they can still keep their own profit.

The love and care group was set up to provide support in any activity regarding good relationship of family.

Farmer group aims to encourage farmer to do social activities together for instance, to clean up the irrigation canals, set up the open-close irrigation system for community, and also conduct the traditional activities relating to agricultural practices.

The collective action or people gathering help to guarantee the activities especially relating to the fund and occupation get stronger and more secure than doing it individually. One observation is majority of the groups in community somehow

directly or indirectly relating to foods, investment, agricultural activities, and profit. The group got supports from diverse organizations. This indicates the group can access the financial security, the market, develop the production equipments, and provide loan or investment fund for the farmers. The overall objectives of the groups are enhancing community members to have good quality of life, better income, produce their foods, access to the loans, and last but not least to have foods security. The aim of all these groups is compliant to the principles of sufficiency economy, starting from households and expanding to the community gathering and community fund and enterprises.

6.2 The resiliency of community food security management system

The utilization of food resources and foods security management consists of the two significant factors including; human society system and ecosystem. This research collected and compiled information relevant to the community's food security management that encouraging community to recover from all problems in their lives. This research found that the mechanisms encouraging community manage forest, water resource, land use, and socio-economic are the skills of knowledge management and institutional arrangements. The researcher found it relevant to traditional ecological knowledge concept of Berkes and Folke. The resources management is comprising of knowledge at 4 levels in analyzing the resource management in climate change including; (1) technical knowledge about natural resources i.e. knowledge of land, animals (2) knowledge in the linkage of bio-resources and eco-system. Community members with this knowledge will be able to observe the nature, relationship of plants and animals in ecosystem, and then they will be able to utilize or manage (Land and resource management knowledge systems). This includes the knowledge about the changes in ecosystem and how to cope with those changes, including the climate change (3) Knowledge about the institution management. This knowledge encourage community members to determine the relationship of people in society and environment, such as respecting to environment, supporting each other in society, regulations and values in society (4) thought and believe to control behaviors to use or access the natural resources (Worldview). This is the learning based on the

reproductive interactions in diverse kinds of relationship with environment. This process leads to the control on human behavior in society. These four levels of knowledge are interacting and depending on each other. They adjust themselves under the changes through learning process of community members either at individual or collective levels (Kulvadee Kansuntisukmongkol, 2013). In this research, researcher analyzed community management to investigate whether or not it is in according with the theory. The research divided the analysis of mechanism to measure the food security management of this sample community in to 3 levels of knowledge management including; knowledge on the utilization of natural resources, knowledge on the linkage of resources in ecosystem as well as the believe about behavior control on the natural resources, and knowledge on institution management. This theory was applied to analyze the resource and socio-economic management in the sample community. This research found that knowledge management and institution management is inter-connected. Community understood their resources and problems. Hence they started to think how to gained more knowledge and technique to manage those resources. Community understood that they had to develop human resource and expand to build the community network to expand knowledge and development technique to accomplish the goal of resource conservation. The traditional and modern knowledge and techniques were emerging in community, while the mechanisms of social institution management were also applied. At the end the institution management will play important role to control the application of knowledge into the effective practices. In the fooling part, researcher explained the detailed analysis on the two elements of food security management.

6.2.1 Knowledge Management

Based on the long and closed relationship and the learning skills with natural resources, community had built up their concern, care, and understanding on natural resources. Community understood the nature is their significant food resources, and it is also the mechanism to control the abundant in the area. This understanding, caring, and skill determined capacity to utilize the natural resource directly and indirectly. When the nature got damaged, they seek the way to manage it properly.

The appropriate resource utilization in different seasons is reflecting the understanding of resource and the weather in community. Besides, it indicated community members were able to indicate the risks and how to cope with it. They learn to know different kinds of foods available in different seasons. The understanding led community member to decide about their agricultural productions and harvesting.

In terms of water management, community demonstrated the well knowledge management. They applied new and traditional knowledge together according to the physical characters. The successful water management in this community was depending on the mechanism and the nature of water flow the mountain to low land. Community understood the slope, overbank flow principles and how to balance it in drought and rainy seasons. Additionally community also understood the water resource needs and where it is available to supply water for community members. They realize the whole water shed system need community network to take care of both forest and water resources in the same time to preserve and set up the emergency warning. By understanding all those, community was able to design the water resource and setting up the water supply system to connect all river flow together to generate enough water for agriculture areas. The sample communities connected with other 6 villages and finally calculate the capacity of the reservoir comparing to the need of community and the actual amount of water.

Forest conservation and land use management is the continuous process and it related to water resource management. Another aim of setting up the water resource network is to conserve the forest. This reflected that community well understood the ecosystem and problems on it. Apart from that, community realize about the roles and value of forest. Building the little irrigation system (check dam) is another process to certify the understanding of community on their environment. Community has effective knowledge on how to slow down the water stream and how to reserve it for the consumption and agriculture purposes, as well as to nourish the trees, so that later the trees will help to slow down water too. Besides, community also has knowledge on land use management. They understood types of plants are significant to increase or reduce the impacts from diverse problems. Community shift from growing mono-crop to the integrated farming system to emphasize on the soil

improvement and increase expand the forest, as well as to reduce the risk or production damages.

In terms of socio-economic management, this research found out community has knowledge about the principle of sufficiency economy. They learned how to set up the cooperative group and understand the essence of sufficiency economy living, sharing among neighbors, and environment conservation. Community realize the importance of inherit knowledge to the next generation. This helps community members to help immunity to handle the impacts of food security in the future.

6.2.2 Institution Management

When community members have closed relationship with the natural resources and have the unity among neighbors, community get good cooperation to solve the problems together. This is the major factor enhancing the strength of community to run their activities. Another successful factor enhancing the strength of community is to have the trustworthy and strong determination leader. Community learned and gained more knowledge to work out in the team to develop community and create understanding about the significance of institution management. Once community members were in the same page and understand the direction of vision, they will give cooperation to set the foundation of sufficiency economy living, especially on utilizing the natural resources and food production. Community realized coordinating with outsiders were needed to protect the whole range of water resources.

Concerning the appropriate resource utilization in different seasons, community members have knowledge about their resources in each area and season. Because community members have closed relationship, the mechanism encouraging them to learn and gain knowledge about resource management is the supports from each other, in the form of traditions and cultural ceremonies. The overall goal is to ensure every household have enough and diverse foods for their consumption in different seasons.

Regarding to the water resource management, apart from community member integrated the traditional and modern knowledge, institution management is necessary. Unity, cooperation, and support among each other encourage the success of

building the check dams to slow down the water stream. Also community was able to create understanding among each other in the same direction on the objective and process of eater management. To access the knowledge and budge for water resources management, community needs to coordinate with others and write up the proposal to request support from outsider organizations. Community had to do task allocation and cooperation with other organizations. Finally the network to preserve water resource and set up the emergency warning is important. The art of speech and skill of convincing are necessary to get cooperation from others.

Forest management, land use management are relating to water resource management. Mechanism of institution management or networking with other communities is also relevant to water resource management. Having the network is not only good for the drought warning case, but also support the expansion of members, expanding the preserved forest area, control the water amount, and provide food source for community. For community, the institution management is necessary for forest conservation. To conserve forest and land use management, community need high cooperation to follow the regulations and share some of their individual land to create common land or income for community. The trust on community leaders about the transparent income management, listen to the risk, and impacts of mono-crop or using chemical substances in food production is necessary.

Regarding to the socio-economic, community used mechanisms to manage institution such as creating trust on community leaders, seriously work, play sample role in sufficiency economy, apply and share knowledge about production and resource collecting for household. Additionally, community members cooperate to run activities together and apply morality in cooperative administration with transparency. Each group in community has their own financial and activity management.

The factors of knowledge and institution management are the major mechanism of community's food security management. Those factors are hiding in the community activities to maintain food security. Researcher found that these factors together with household factors explain the resiliency of community-based food security under the diverse risks. To explain this, researcher developed the mind map to conclude all information of this research in the next topic.

6.2.3 Conceptual framework of resiliency of community food security management

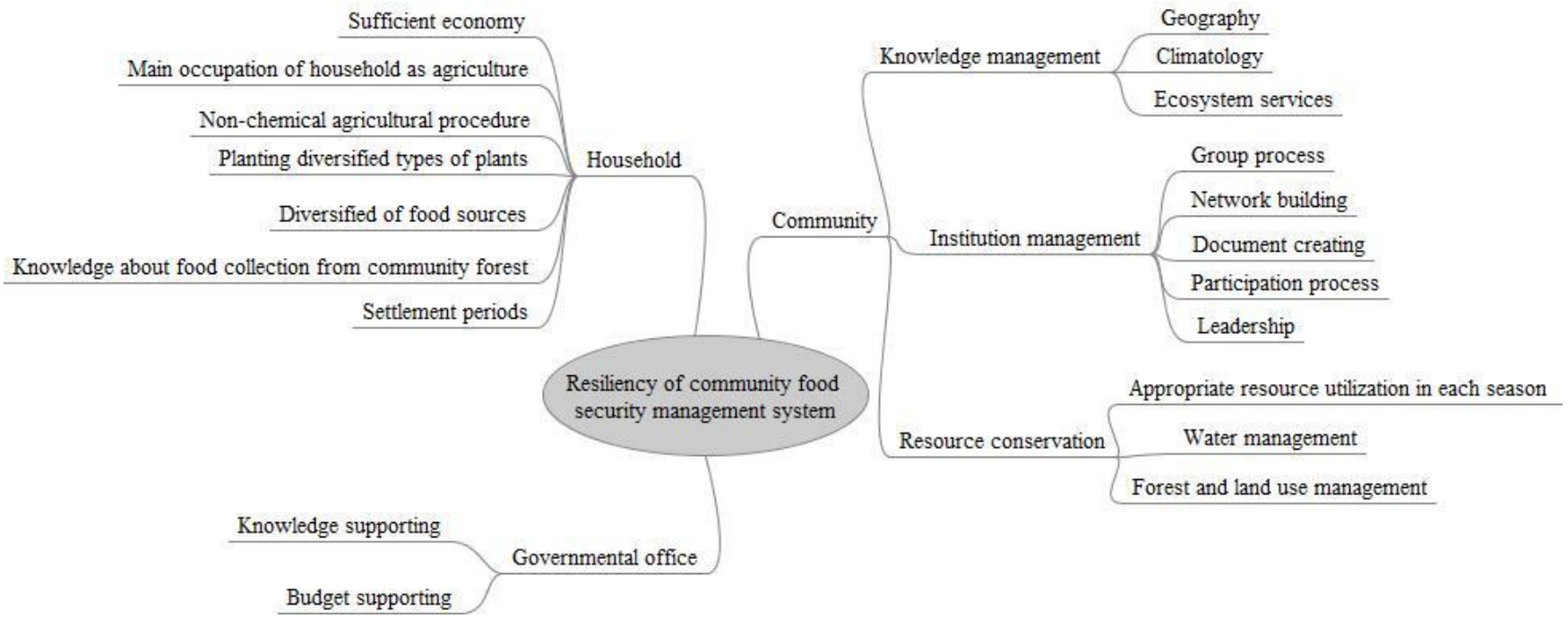


Figure 6.3 Conceptual framework of community food security management

Researcher created this mind map according to the observations and the conclusions made from the collected primary data (household interview, in-depth interview, and focus group). This research found that the factors of community food security management process include the internal factor of household, and the risk management. The community's food security management compositions are household, community, and government offices. The mechanism of food security management is community capacity. Based on the information of natural resource management and socio-economic management which have two mechanisms including knowledge management and institution management, the researcher analyze it in according to the theory of "Traditional ecological knowledge" (Berkes and Folke, 2000). Traditional ecological knowledge comprises of knowledge on resource management, resource management system, organization and institution management, and understanding in the bigger system. The research found that these factors supported the resiliency of community food security system. The mind map of this concept explained all factors of the resiliency, together with the community management. Only some specific factors of household determine the difference of food security. Government offices are significant to push the successful management. Researcher applied the Traditional ecological knowledge theory with the interpretation of researcher; the research found that community needs to have knowledge management, institution management, and natural resource conservation to resilience from the problems or risks.

The major significant factor to create the food security and food security management in the middle of the risks and changes is natural resource management. Natural resource is foods source, as well as playing the role to control the balance of ecosystem. Natural resource conservation includes; 1) the application of knowledge and institution management to utilize resource properly in different seasons 2) effective water resource management 3) forest management and proper land use according to the condition of area and existing risks. All management needs common understanding among community members, in terms of community resource, geography, weather, ecosystem, and the condition of nearby communities. The serious community leaders who have clear goals to conserve natural resources, high morality, and have capacity to convince cooperation from others are necessary. To run the

activities, new techniques and knowledge, and budget are also necessary. As mentioned earlier, all activities in community got supports from diverse organizations including attending the training about community forest management at the province, get the community forest's land title, land allocation by the Department of Land Development, support on local research, and so on. Other factors to encourage the success for community are coordinating with government office to access the knowledge and budget, and gaining more new knowledge through attending the exposure visits in other good models.

Group or collective process is also significant in socio-economic management. It relied on the factors of good institution management, good leaders, good cooperation, creative activities, promoting food security, and income generation to reduce food security risks.

Regarding to the household factors, it is influencing to the food security of household and also the food resource of community. Based on the study of household factors influencing to food security via the statistical analysis, this study found the factors influencing food security in the positive way are including settlement periods in community, planting diversified types of plants, main occupation of household as agricultural, practice of non-chemical agriculture, depending on diverse sources of foods, having knowledge of wild food collection. Households that live longer in community have tendency to access more food security. Working in agriculture sector indicated that household can produce foods. So they are able to control their consumption. Non-chemical agriculture has more tendencies to access more food security, because in the same time it is environmental friendly and good for health of the household. To grow diverse kind of plants ensure food security, this is in accordance to the data analysis of researcher collected from the in-depth interview and focus group. The information indicated that land use pattern in community applied the integrated farming system to reduce the risks. Besides, knowledge of food collection, and relying on diverse sources of foods encourage the households to have food security, because there are more channels and capacity to access foods.

From the interview, this research found that the application of sufficiency economy is significant for food security of the households and provide impacts to community. This concept encourages community members to live their life carefully

and save money. It also encourages households to work hard and have high morality. It supports a good agricultural practice in accordance with the ecosystem. So the household collect foods from the forest with knowledge. Households are able to gain more knowledge for their occupation and provide support to neighbors. Based on this concept community members have to provide good cooperation to community. These mentioned factors are influencing to food security. Living with the sufficiency economy principle encourages household to live in the sustainable ways. Households work in the agricultural sector by using very less or non-chemical substances. This agricultural practice is in accordance to ecosystem. Sufficiency economy emphasizes on doing agriculture for household consumption first, and sells the surplus if any. This concept conserves the biodiversity and reduces the damages on production. Apply this concept also encourage community members to participate and provide cooperation to each other, and finally lead community to the success path of any natural resource management. The community members applied knowledge to understand nature and appropriately collect foods from nature. Also they produce foods appropriately in each season and seek for more knowledge and cooperation to manage water resource and land under the rule of law. Last but not least this concept encourage community member to properly develop the socio-economic in terms of living, work, and gather as groups with knowledge, carefulness, and high morality to management everything in life and community. To manage anything need knowledge, understanding in ecosystem and high morality to work together.

CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

Regarding to the study of the resiliency of community based food security: a case study of Ban Maerawan, Yokkrabutr Sub-district, Sam-ngao District, Tak Province, this research is to study food security of households and community in accordance with a framework of security. A researcher has collected and analyzed obtained data and then applies in this research as to study characteristics of food security, household factors, and management at community level. This research employs a method of interviewing and using questionnaire with households, in-depth interview and focus group discussion in combination with prepared key questions in accordance with the objective of the study. These methodologies contribute to an analysis of problems of food security and resiliency of community food security management system. Then, the analysis will be described including differences of food security in each season (by Analysis of Variance; ANOVA), factors affecting community food security (by Multiple Regression Analysis and Logistic Regression Analysis), and designing conceptual framework for community food security management (by developing a mind map).

This chapter will summarize the major findings of the research as well as recommendation for future study in respect of food security.

7.1 Conclusions

7.1.1 Problems and impacts in food security

From the collected secondary data of geography and climate and interviewing the community, the studied area faces problems relating to food resource due to nature and human activities. It is found that physical characteristics of the studied area are a plain which is at the end of the Wang River, and is situated in a

meandering channel which provides soil fertility and is suitable for agriculture. Moreover, there is forest on a mountain adjacent to a village. The forest is a food source and control water quantity. This attributes benefit the community to have food resources and sources of income. Meanwhile the fertility leads to resource invasion and inappropriate resource utilization. Moreover, climate variability and geographical characteristics of the studied area; which is rain shadow, makes each month of a year has variability of rainfall. For instances, there are less amount of rainfall during dry season (during summer and winter). After that, it leads to drought. In contrast, rainfall quantity is not high during rainy season. However, the geography of the village is foothill and damaged deciduous dipterocarp forest which lead to great flood. Also, the meandering channel causes the water to overflow. In the meantime, a year that has less amount of water runoff will not make great flood and inundation but the location of rain shadow has less amount of rainfall. Then, these lead to the reduction in food resources. From the data, it can be summarized that the studied area has faced with food security from the past until present because of invasion from outsiders and investors and overutilization of resources. Then, it impacts to food resources in the forest which directly impacts to food quantity and indirectly impacts the controlling of water balance. These impacts affect food production in agriculture, cause natural disaster; drought, great flood, and overflow. It mainly directly affects to agricultural product such as rice paddy, crop farming, and orchard product.

7.1.2 Food security and household factors affecting food security

From the study of a status of each dimension of community food security by Frequency Distribution from questionnaire survey data of 100 households, in terms of availability, most households (95 % of the households) have adequate drinking water. Most households (47 % of the households) utilize food resources 11-20 types. Eighty-eight % of the households also highly satisfy with household food management which shows in a score 8-10 points. Fifty-seven % of the households; with a score 8-10 points, are highly confident in safety of food sources that they rely on. For food access, most households (99 % of households) know that they have local food resources to rely on as well as aware that they are able to equally access to the food resources and collect food like other households. In addition, 97 % of households find

that the environmental quality is fertile which benefits to natural and agricultural food resources. Regarding confidence in adequate income for food expenses, most households (95 % of the households) are confident; while 70 % of the households have adequate water to produce food in agriculture. Regarding stability or guarantee in having food, reserve food sources, or reserve money for food expenses, 98 % of the households know that the community has financial institute as a source of money saving and reserving. Ninety-nine per cent of the households participate in financial institute members. Also, most households (81 % of the households) reserve food by reservation or storage and food processing which can be reserved up to 9-12 months. Furthermore, 63 % of the households raise animals as source of reserve money because the animals can be sold and generate income to buy food when the households are money shortage. It is found that the households mostly raise 1-2 types of animals.

Regarding household internal factors affecting food security, number of occupations, growing diversified plants, relying on various food sources, having knowledge in collecting mushrooms and wild animals from a community forest, Main occupation of household as agriculture, settlement periods, and raising animals with non-chemical are factors affecting food security with direct variation.

Furthermore, food security; in terms of types and quantity of food resources in each season, are different with statistical significance ($P<0.001$). Number of food types in each season is also different. An average quantity of food types in rainy season is the highest, followed by winter, and summer. On the other hand, food resource quantity is different in the 3 seasons. The food resource quantity in winter and summer are not different with the statistical significance. In rainy season, the food resource quantity is utilized the most.

7.1.3 Resiliency of food security management system

The studied area faces with risk in food security due to climate variability and human activities as mentioned above. In particular, natural disaster, drought, and flood are more severed because of climate variability, human activities in the past , improper development and degraded forest degradation. To solve the problems, it is started with forest restoration because the forest is a source of controlling water balance by producing moisture. Next, rules and regulations are applied in order to

control the utilization of water. To achieve this, the community has developed themselves from visiting and studying other sites, creating rules and regulations in forest resource utilization, adapting land use to be compatible with the area, adapting behavior in food resource utilization in the forest, and doing agriculture follow the seasons. In addition, it has been adapted a concept and life style in accordance with sufficient economic philosophy for the sustainability. This principle will assist in ability to cope with any unexpected incidents in the future and also socio-economic management which will develop the potential to cope with the incidents. These adaptations will contribute to economic and income development of the community and to have food security with a condition of socio-economic development, disaster, or climate variability.

7.2 Recommendations

7.2.1 Recommendations on the researches' findings

This research is a study of the resiliency of food security management system for the downstream location that is situated on a plain with the meandering channel and at rain shadow. Here used to have fertile food resources and fertile land for agriculture. Since the community faced problems relating to food security from human activities and natural disaster; however, the community is able to manage and cope with this crisis. This research describes about the problem aspects, methods in managing those problems at household level, community level, and up to network level. It is described in an overall management systematically and analyzed food security and household internal factors affecting food security.

These have led to recommendation for food security management for other places or communities that face similar problems in accordance with a mind map (Figure 6.2). It can be a guideline showing knowledge of local wisdom and components of management consisting of households, community, and related public sectors. For a household level, a sufficient economic philosophy should be applied and adapted in a real life, occupying in various occupations; by doing agriculture as a major occupation, and doing organic farm or non-chemical agriculture, growing

diversified plant species, relying on various food sources, and having knowledge in collecting food from forest. Particularly, relying on diversified resources is a factor affecting food security in availability and stability dimension. For a community level, it is necessary to build community participation processes by focusing on building the confidence to a leader of a community, developing activities with the same understanding among the local villagers. When participating in any activities, it is necessary to learn and understand an ecosystem and be able to connect with a larger system consistency. Also, it is necessary to manage organization in a community and expand it to nearby communities that rely on the same and connected ecosystem. Next, there should be coordinating with public sectors which will be an opportunity for the community to gain more knowledge and to ask for a financial budget to support the community's activities. If these can be implemented and practiced, it will help the community manage and cope with the problems affecting food security efficiently with a minimum conflict within the community. Next, it will provide an opportunity for the community to develop activities, having sustainable livelihood, strong community and network.

Moreover, the findings show that natural disaster from inundation is the most frequent. A community; that faces with inundation, is needed to have knowledge about hydro and forest ecosystem. In a case of Ban Maerawan Community, the local community highly understands about the water and local ecosystem. The understanding has led to resource management and developing activities; for instances, to produce soil moisture by building check dam to make the water flow slower, and allows the water to drain naturally without barrier or obstacle. Also, there is no changing land use at a natural monkey cheek area where usually has more inundated than other areas as a natural reservoir, or growing standing timbers that are able to stay long and survive during the inundation.

Regarding recommendation for public sectors, any development projects with any communities should be considered. It is necessary to consider knowledge, understand the ecosystem, and the context of the area prior to develop the area. This will assist in solving the right problem systematically. For instance, road construction; to prevent flood on the east of the village, is not the right way to solve the problem while it also causes other problems because the road is a barrier that make the water

drain a lot slower and also make some other areas have more severed flood. If there was a study prior to construct the road, there would be other alternative management which is more effective and has less impact.

7.2.2 Recommendation for further studies

1. Important issues about food security are a framework of food security term and variables that indicate food security. A concept of food security is complex and specific; especially, different communities and ecosystems contribute to different food security. Also, to analyze the term of food security, it is flexible in accordance with the researcher's interpretation. Therefore, it is very necessary when study on food security, there must be developing a conceptual framework for food security in accordance with the context of the studied area and its ecosystem. It also needs to be careful in scoping of a study as to achieve the results relating to the objectives of the study as much as possible.

2. From this research, the researcher finds that a study of food security covers many issues; particularly, a community or social system that is closed to natural resources, having diversified resources, and occupying in agriculture. Meanwhile, the conceptual framework of food security covers quantity, quality, and guarantee in having food for consumption. The community has a detail in each issue and activity such as having sources of food reservation or money saving to buy food when facing crisis. For the studied area, there are food storage or reservation, food processing, household's ability to generate income from standing timbers that are participated in a tree bank, income and food reservation in a form of raised animals etc. Each practice relating to food security has more important detail which indicates stability of food security and it can be different in each community. Therefore, further studies should collect data relating to each issue that have detail as mention in a context of the studied area. The further studies may study on those issues in the in-depth because the researcher finds that it is important to indicate the guarantee of food security with more detail.

3. The studied area of this research comprises activities relating to resource management and organizational management which relate to life quality development and community food security. In terms of sufficient food

quantity, diversified, and food quality, it is necessary to aware of an importance of ecosystem conservation and taking care of the health. Hence, there are activities with interesting detail which can be studied in order to develop knowledge in a form of academic with an in-depth detail in qualitative and quantitative, technical aspect, process, its effectiveness etc. These may include local culture and life style relating to food that connect to the uniqueness of the resources, methods of nature observation, knowledge or local wisdom in collecting and producing food, visiting and learning resource management at other places, knowledge of hydrological management, agricultural techniques (such as growing rice, raising lac, growing kapok, raising animals, doing mixed agriculture, project of 3 forests and 4 benefits etc). Additionally, the further studies should also study on household economic management and sufficient economic community (comprises self-reliance, development in agriculture, co-operative, or establishing a group for money saving and developing income), local participation process, and expansion of the results of resource conservation from a community level to the connected communities or network etc.

REFERENCES

Agriculture Network, Rice University and Sustainable Agriculture Foundation (Thailand). (2013). A study of indicator and action plan of food security at Ban Tha Chang, Panantoong Sub-district, Phatthalung Province. Rice University.

Berkes, F., and Folke, C. (edited). (2000). Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Cambridge University Press, United Kingdom.

Boonpinon, Kulvadee. (1997). Institutional Arrangements in Communal Resource Management: A Case Study of a Karen Village in a Protected Area. M.S Thesis, Mahidol University.

Chaimanuskul, Kitipong. (2011). A Practice Model for Sustainable Agriculture Assessment: A Case Study of the Sustainable Cultivation of Thai Hom Mali (Jasmine) Rice in Thailand. M.S Thesis. Mahidol University.

Chairit, Wantanee. (n.d.). Factors Affecting Food Security of Elder in Southern of Thailand.

Chakbuth, Phasika. (2010). The Study of Food Resource Security Among Communities Adjacent to Pahdaeng Community Forest Prae Province. M.S Thesis. Mahidol University.

EEA. (1999). State and pressures of the marine and coastal Mediterranean environment, Environment Assessment Series (5). European Environment Agency. Copenhagen, Denmark.

Food and Agriculture Organization of the United Nations (FAO). (2006). *Food Security: Policy Brief*. Issue 2, June.

Fran H., Norris S. P., Stevens B. P., Karen F. W., Rose L. P. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. American Journal of Community Psychology, Volume 41, Issue 1-2

Gibson, C.C., M.A. Mckean and E. Ostrom (eds). (2000). People and Forest: Communities, Institution and Governance. Cambridge: MIT Press.

Hans G. B., Thomas E. D., and Michael J. W. (1994). Climate change and social vulnerability: Toward a sociology and geography of food insecurity. Global Environmental Change, Volume 4, Issue 1.

Hoddinott, John. (1999). "Choosing Outcome Indicators of Household Food Security". Technical Guide.No. 7. Washington, D.C.: International Food Policy Research Institute.

Holling, C.S., Sanderson, S. (1996) Dynamics of (DIS) harmony in Ecological and Social Systems. *Right to Nature: Institutions for Humans and the Environment* Forthcoming, Island Press, Washington, DC.

Hydro and Agro Informatics Institute. (2013). Wang watershed. <http://www.haii.or.th/wiki/ index.php, 10 August 2013>.

Institute for Population and Social Research, Mahidol University. (2011). Food insecurity from global to Thailand. Report of Thai people healthy 2011. Thai Health Promotion Foundation. National Health Commission Office.

Ostrom, E. (1998). Self-Governance and Forest Resources. Publication W97IR3. Workshop in Political Theory and Policy Analysis. Indiana: Bloomington.

International Federation of Red Cross and Red Crescent Societies. 2006. How to Conduct a Food Security Assessment: a Step-by-step Guide for National Societies in Africa: 1st edition, Geneva, Switzerland.

Jirasatayaporn, Phreuk. (2007). Seasonally Flooded Forest and Household Subsistence Livelihood: A Case Study of The Lower Songkhram River Basin. M.S Thesis. Mahidol University.

Kansuntisukmongkol. K., Boonpinon P., Boontun, O., Chansomwong A., Poonbumpen D., Saritnirun P., Kreakaew P., and Sornhiran N. (2013b). Community-based Food Security Management: the Analysis of Communal Management of Seasonally Flooded Forest in the Northeast and Mixed Evergreen and Deciduous Seasonal Forest in the West using Driver-Pressure-State-Impact-Response Model. Thailand research fund.

Kansuntisukmongkol. K., Boonpinon P., Chatteerapab Sirirat., Pongpleeasal Y., Charoenchai O., and Sornhiran N. (2013b). The Study of Traditional

Ecological Knowledge and Best Practices in Climate Change Adaptation of Thailand. Office of Natural Resources and Environmental Policy and Planning Ministry of Science, Technology and Environment.

Kraiyulwong Sayamol. (n.d.). From commercial forest plantation policy to food security in southern of Thailand. <http: //www.food-resources.org/story/245, 10 December 2012>

Krejcie, R.V. and Morgan, D.W. (1970). Determining Sample Size for Research Activities Education and Psychological Measurement. November, 607–609.

Lin T, Cuia J, Camerona S. (2009). Using a network framework to quantitatively select ecological indicators. Ecol Indic 9:1114–1120.

Lovendal, C. R., & Knowles, M. (2006). Tomorrow's hunger: A framework for analysing vulnerability to food security (No. 2006/119). Research Paper, UNU-WIDER, United Nations University (UNU).

Northern Development Foundation and Huai Hin Lad Community. (2011). Agroforestry procedure and community forest management in climate change and food security of northern Karen in Thailand.

Norberg - Hodge, H.; Merrifield, T. and Gorelick, S. (2002). Bringing the Food Economy Home: Local Alternatives to Global Agribusiness. Kumarian Press, West Hartford, CT.

Pimbert, M. (2009). Towards Food Sovereignty. The International Institute for Environment and Development. Gatekeeper 141: November.

Prachason, Sajin. (2009). “Food Security in Thai Society”. Report submitted toUNDP Thailand. <http: //www.sathai.org/th, 20 October 2011>

Raksachat, Surachai. (2002). Food security of maginalized people : consumption patterns and sources of food of selected households in a Karen community, western Thailand. M.S Thesis. Mahidol University

Ravathi, B. (2000). Rural Women and Food Security: Regional Prospects. in Asian Productivity Organization (ed.), Food Security in Asia and the Pacific. Tokyo.

Rhys P.R. and Ken K. (2012) Natural disasters and community resilience: A framework for support, the Australian Institute of Family Studies

Saritnirun, P., Kansuntisukmongkol, K., Choowaew, S., Teartisup, P. (2011). Factors Affecting Household Food Security 10 Years After Rasi Salai Dams Sluice Gate Opened: A Case Study of Local Communities around Rasi Salai Dam, Sisaket Province. The proceeding of the 21th National Graduate Research Conference. May 24, 2011 Faculty of Graduate Studies, Rangsit University.

South Centre. (1997). Universal Food Security: Issue for the South. Atar, Geneva

Southeast Asia START Regional Center. (2012). future climate forecast data. Chulalongkorn University

Swindale, A., and Bilinsky, P. (2006). Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide VERSION 2. Washington, DC: Food and Nutrition Technical Assistance Project (FANTA).

Thailand Trend Monitoring Project (TTMP) (n.d.). Report of food and public health: Towards a "universal," or the even more unfair.

The royal forest department of Thaiand. (2013). Forest information statistics. <http://www.forest.go.th, 2 September 2013>.

Theerakup, Kamthorn. (1990). Biodiversity in natural forest. <http://www.seub.or.th/index.php?option=com_content&view=article&id=214:libery&catid=65:2009-11-12-08-43-25&Itemid=80, 28 August 2013>.

Thiengamol, Nongnapas. (2009). Environment and development 2: Food security. Chalalongkorn University.

Turner, B. L., II, Kasperson, R. E., Matson, P. A., McCarthy, J. J., Corell, R. W., Christensen, L., Eckley, N., Kasperson, J. X., Luers, A., Martello, M. L., Polsky, C., Pulsipher, A., and Schiller, A.: (2003), A framework for vulnerability analysis in sustainability science. Proc. Natl. Acad. Sci. U.S.A. 100: 8074–8079.

Turner, R.K., O'Riordan, Turner, R.K., O'Riordan, T. and Kemp, R. (1991) Climate change and risk management. In Jager, J. and Ferguson, H.L.(eds) Climate change - science, impacts and policy. Proc. Second World Climate Conference. Cambridge: C.U.P.: 397-408.

Turner, R.K., Subak, S. and Adger, W.N. (1996). Pressures, trends, and impacts in coastal zones: interactions between socioeconomic and natural systems. Environmental Management 20(2): 159-73.

Wu, B. and Wang, B. (2004). Assessing impacts of global warming on tropical cyclone tracks. *Journal of Climate*, 17: 1686-1698.

Ziervogel, G., Nyong, A., Osman-Elasha, B., Conde, C., Cortes, S., and Downing T. (2008). Household food security and climate change: Comparisons from Nigeria, Sudan, South Africa and Mexico. In Leary, N., Conde, C., Kulkarni, J., Nyong, A. and Pulhin, J. (eds) Climate Change and Vulnerability. London: Earthscan.

_____. (2012). Food security. *The journal of Health Thailnd.*

APPENDICES

APPENDIX A
THE QUESTIONNAIRES

แนวคำถามที่ใช้ในการสัมภาษณ์เชิงลึก (กลุ่มเป้าหมาย: ผู้นำชุมชน)

1. ประวัติการเกิดน้ำท่วมซ้ำซากของชุมชน
2. ลักษณะการเกิดน้ำท่วม หรือภัยอื่นๆ จากสภาพอากาศ
3. การพัฒนาของรัฐที่กระทบต่อทรัพยากรอาหารของชุมชน
4. พัฒนาการการจัดการทรัพยากรของชุมชน
5. ลักษณะการประกอบอาชีพในชุมชน
6. ผลกระทบที่เกิดขึ้นกับทรัพยากรอาหารของชุมชน รวมทั้งสาเหตุของผลกระทบ
7. แหล่งขายผลผลิตของชุมชน
8. ลักษณะแหล่งซื้ออาหาร การพึ่งพาอาหารจากตลาดของสมาชิกชุมชน
9. การมีส่วนร่วมและความคิดเห็นด้านการจัดการทรัพยากรอาหารในป่าชุมชน ต่อการปรับตัวกับน้ำท่วมซ้ำซากและปัญหาอื่นๆ
10. การรวมกลุ่มเพื่อจัดการทรัพยากรอาหารของชุมชนและความร่วมมือ
11. แนวทางการจัดการทรัพยากรอาหาร หรือการเตรียมรับมือกับน้ำท่วมซ้ำซากหรือปัญหาอื่นๆ ในอนาคต

แนวคำถามที่ใช้ในการจัดสนทนากลุ่ม (กลุ่มเป้าหมาย: ปราชญ์ชาวบ้านที่เชี่ยวชาญด้านเกษตรกรรม ผู้มีความรู้เกี่ยวกับอาหารป่า)

1. มีภูมิปัญญา การสังเกต สภาพอากาศหรือฤดูกาลในพื้นที่อย่างไรบ้าง แบ่งฤดูกาลอย่างไร
2. แหล่งน้ำในชุมชนที่ใช้เพื่อการเกษตร
3. ลักษณะการพึ่งพาทรัพยากรอาหาร (พืช เห็ด สัตว์ แมลง สัตว์น้ำ) ในป่าชุมชนในแต่ละเดือนในหนึ่งปี (ชนิดพันธุ์ที่เก็บหา วิธีการเก็บหา กฎเกณฑ์ชุมชน) พร้อมทั้งบริเวณที่พบ หรือสามารถเก็บหาอาหารชนิดดังกล่าว
4. วิธีการทางการเกษตรของชุมชน เอกลักษณ์ วิธีการที่ปรับตัวกับสภาพแวดล้อมภายในชุมชน
5. วัฒนธรรมการแลกเปลี่ยน แบ่งปัน หรือวัฒนธรรมอื่นๆ เกี่ยวกับอาหารที่สมาชิกในชุมชนทำร่วมกัน
6. ลักษณะแหล่งซื้ออาหาร การพึ่งพาอาหารจากตลาดของสมาชิกชุมชน
7. แหล่งขายผลผลิตของชุมชน
8. ผลกระทบที่เกิดขึ้นกับทรัพยากรอาหารของชุมชน รวมทั้งสาเหตุของผลกระทบ
9. ความเปลี่ยนแปลงของระบบนิเวศป่า หรือลักษณะลำน้ำในช่วงเวลาที่ผ่านมา
10. อาหารชนิดใดบ้างที่มีการปรับเปลี่ยนจำนวนของผลผลิตตามฤดูกาล
11. อาหารชนิดใดในป่าที่เหลือน้อย หรือใกล้สูญพันธุ์ เนื่องจากสาเหตุใด (ในช่วง 10 ปีที่ผ่านมา) เพราะเหตุใด มีวิธีแก้ไขหรือป้องกันอย่างไร
12. ความเปลี่ยนแปลงลักษณะการใช้ประโยชน์ที่ดินของสมาชิกในชุมชน (ในช่วง 10 ปีที่ผ่านมา) เพราะเหตุใด การเปลี่ยนแปลงส่งผลให้ผลผลิตอาหารดีขึ้นหรือไม่ อย่างไร
13. การมีส่วนร่วม การแสดงความคิดเห็น และกิจกรรมกลุ่มด้านการจัดการทรัพยากรอาหารในป่าชุมชน ต่อการปรับตัวกับน้ำท่วมซ้ำซากและปัญหาอื่นๆ

แบบสอบถามครัวเรือน

ส่วนที่ 1: ข้อมูลทางด้านสังคมประชากรและเศรษฐกิจของครัวเรือน

1.1 เพศของหัวหน้าครัวเรือน ❍ ชาย ❍ หญิง

1.2 อายุของหัวหน้าครัวเรือน..... ปี

1.3 ระดับการศึกษาของหัวหน้าครัวเรือน โปรดระบุ.....

1.4 จำนวนสมาชิกในครัวเรือน ..... คน

1.5 **รายได้สุทธิของครัวเรือน ..... บาท/เดือน**

รายจ่ายสุทธิของครัวเรือน ..... บาท/เดือน

รายจ่ายด้านอาหารของครัวเรือน ..... **บาท/เดือน**

1.6 เงินออม ❍ มี แหล่งที่ออมเงิน .....❍ ไม่มี

1.7 หนี้สิน ❍ มี หนี้สินจาก.....❍ ไม่มี

1.8 จำนวนอาชีพทั้งหมด..... อาชีพ

1.9 อาชีพหลัก ❍ เกษตรกรรม ❍ ประมง ❍ ค้าขาย

❍ หาของป่า ❍ รับจ้าง ❍ รับราชการ ❍ อื่นๆ ระบุ.....

1.10 อาชีพรอง ❍ เกษตรกรรม ❍ ประมง ❍ ค้าขาย

❍ หาของป่า ❍ รับจ้าง ❍ รับราชการ ❍ อื่นๆ ระบุ.....

1.11 จำนวนปีที่ตั้งถิ่นฐาน ..... ปี ย้ายมากจาก .....

1.12 ความเป็นเจ้าของที่อยู่อาศัย

❍ พื้นที่เป็นของตนเอง ประเภทของเอกสารสิทธิ์ ☐ สค1 ☐ โฉนด ☐ นส.3, นส.3ก ☐ อื่นๆ ระบุ .....

❍ พื้นที่เช่า ❍ อื่นๆ โปรดระบุ

ขนาดพื้นที่อยู่อาศัย..... ไร่

ครัวเรือนมีแนวโน้มขายที่ดินที่อยู่อาศัยให้กับผู้อื่นหรือไม่ ❍ มี ❍ ไม่มี

1.13 ท่านเป็นสมาชิกกลุ่มของหมู่บ้านหรือไม่ ❍ ไม่เป็น ❍ เป็น ระบุ

.....

ส่วนที่ 2: ความมั่นคงทางอาหาร

2.1 ครัวเรือนของท่านรับประทานอาหารในช่วงเวลาปกติวันละ ❍ 1 มื้อ ❍ 2 มื้อ ❍ 3 มื้อ
หากรับประทานอาหารไม่ครบวันละ 3 มื้อ มื้อใดบ้างที่ไม่ได้รับประทาน
❍ เช้า ❍ กลางวัน ❍ เย็น
ครัวเรือนของท่านมีน้ำสะอาดบริโภคเพียงพอหรือไม่
❍ สะอาด ❍ ไม่สะอาด ❍ เพียงพอ (ดื่มน้ำวันละ 6-8 แก้ว) ❍ ไม่เพียงพอ
แหล่งน้ำที่ใช้บริโภค ❍ ประปา ❍ แม่น้ำ ❍ บาดาล ❍ อื่นๆ (ระบุ) .....
ไม่สะอาด ดูจาก .....มีสาเหตุจาก .....
แก้ปัญหาอย่างไร .....
ไม่เพียงพอ ปีพ.ศ .....เดือน ..... ระยะเวลาที่ไม่เพียงพอ.....แก้ปัญหาอย่างไร .....
2.2 คุณภาพสิ่งแวดล้อมในชุมชนของท่านอุดมสมบูรณ์เพียงพอ ให้ทรัพยากรอาหารในพื้นที่ป่าและเกษตรมีปริมาณและคุณภาพที่ดีหรือไม่
❍ เพียงพอ ❍ ไม่เพียงพอ
2.3 ครัวเรือนของท่านมีรายได้เพียงพอสำหรับรายจ่ายด้านอาหารหรือไม่
❍ เพียงพอ ❍ ไม่เพียงพอ
2.4 ท่านคิดว่าครัวเรือนของท่านมีสิทธิในการเก็บหาอาหารจากพื้นที่ส่วนรวมหรือไม่
❍ มี ❍ ไม่มี
2.5 ในชุมชนของท่านมีกองทุน หรือสถาบันการเงิน เพื่อช่วยเหลือทางการเงินหรือไม่
❍ มี ❍ ไม่มี
ท่านเป็นสมาชิกกองทุนหรือไม่
❍ เป็น ❍ ไม่เป็น
2.6 ครัวเรือนของท่านมีการสำรองอาหาร (เก็บกักตุนหรือถนอมอาหาร) หรือไม่
❍ มี ❍ ไม่มี
(ระบุ) 1.....ปริมาณที่เก็บสำรอง..... สำรองไว้รับประทานได้.....เดือน
2.....ปริมาณที่เก็บสำรอง..... สำรองไว้รับประทานได้.....เดือน
3.....ปริมาณที่เก็บสำรอง..... สำรองไว้รับประทานได้.....เดือน
2.7 ครัวเรือนของท่านพึ่งพาอาหารจากแหล่งใดบ้าง
❍ ป่า ❍ เกษตร ❍ แลกเปลี่ยนหรือแบ่งปัน ❍ ตลาด

<u>การเก็บหาอาหารจากป่า</u>

2.8 ระยะทางจากบ้านถึงป่า .....กม. พื้นที่ป่าที่ใช้เก็บหาของป่า .....ไร่

2.9 ชนิดที่เก็บหา

❍ พืช (ผัก ผลไม้) **ฤดูที่เก็บหา** ❍ ฤดูหนาว ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูร้อน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูฝน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ เห็ด **ฤดูที่เก็บหา** ❍ ฤดูหนาว ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูร้อน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูฝน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ สัตว์และแมลงป่า **ฤดูที่เก็บหา** ❍ ฤดูหนาว ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูร้อน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูฝน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

รูปแบบในการขายทรัพยากรอาหารที่เก็บหาได้จากป่าชุมชน

❍ ไม่ขาย ❍ ร้านค้า ❍ พ่อค้าคนกลาง ❍ ขายเอง ❍ อื่นๆ

2.10 การเก็บหาและใช้ประโยชน์พืชป่า

วิธี ความรู้ในการเก็บหา .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

การเก็บหา ทำตามกฎกติกาของชุมชนหรือไม่ ❍ ทำ ❍ ไม่ทำ

อย่างไร (ระบุ) .....

มีการนำพืชอาหารไปปลูกเสริมในพื้นที่ป่าหรือไม่ ❍ มี ❍ ไม่มี

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาพืชอาหารจากป่าไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

<u>ถ้าเคย</u> ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... <u>สาเหตุมาจาก</u> .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี❍ ขอแบ่งจากเพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

2.11 การเก็บหาและใช้ประโยชน์เห็ดป่า

วิธี ความรู้ในการเก็บหา .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

การเก็บหา ทำตามกฎกติกาของชุมชนหรือไม่ ❍ ทำ ❍ ไม่ทำ

อย่างไร (ระบุ) .....

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาเห็ดจากป่าไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

<u>ถ้าเคย</u> ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... <u>สาเหตุมาจาก</u> .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี❍ ขอแบ่งจาก เพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

2.12 การเก็บหาและใช้ประโยชน์สัตว์และแมลงป่า (รวมสัตว์น้ำ ไม่รวมที่เก็บหาในแปลงเกษตร)

วิธี ความรู้ในการเก็บหา .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

การเก็บหา ทำตามกฎกติกาของชุมชนหรือไม่ ❍ ทำ ❍ ไม่ทำ

อย่างไร (ระบุ) .....

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาเห็ดจากป่าไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

<u>ถ้าเคย</u> ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... <u>สาเหตุมาจาก</u> .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี❍ ขอแบ่งจาก เพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

2.13 มีอาหารชนิดใดในป่าที่เคยมีแล้วหายไปหรือไม่พบไม่สามารถเก็บหาได้ หรือไม่

❍ ไม่มี ❍ มี **(ระบุ)** .....

<u>ถ้ามี</u> มีการจัดการอย่างไร โปรดระบุ.....

2.14 ท่านเคยได้รับการอบรมหรือได้รับความรู้เกี่ยวกับการเก็บหาอาหารจากทรัพยากรอาหารป่าชุมชนหรือไม่ (เจ้าหน้าที่ส่วนป่าชุมชน ประธานป่าชุมชน หนังสือ วิทยุ โทรทัศน์ ญาติพี่น้อง ฯลฯ)

❍ เคย (ระบุ) .....

❍ ไม่เคย

2.15 ปริมาณการเก็บหาอาหารจากป่า

ฤดู	ชนิดพันธุ์	บริเวณที่พบ	เดือนที่เก็บ	ความถี่ของการเก็บหา (ครั้ง/เดือน)	ปริมาณ (กก./ 1 ครั้งการเก็บหา)			
					รวม (กก.)	บริโภคในครัวเรือน (กก.)	แบ่งญาติ (กก.)	ขาย (กก.)

การผลิตอาหารในพื้นที่เกษตร

2.16 จำนวนแปลงเกษตร.....ผืน

2.17 พื้นที่เกษตรกรรมทั้งหมด..... ไร่ เป็นพื้นที่เกษตรที่อยู่ในพื้นที่ป่า ..... ไร่

2.18 ระยะทางจากบ้านถึงพื้นที่การเกษตร ..... กม.

2.19 ความเป็นเจ้าของ

❍ พื้นที่เป็นของตนเอง โดยประเภทของเอกสารสิทธิ์ ☐ สค1 ☐ โฉนด

☐ นส.3, นส.3ก ☐ อื่นๆ ระบุ .....

❍ พื้นที่เช่า

❍ อื่นๆ โปรดระบุ .....

ครัวเรือนมีแนวโน้มขายที่ดินทางการเกษตรให้กับผู้อื่นหรือไม่ ❍ มี ❍ ไม่มี

2.20 ในช่วงเกิดอุทกภัย พื้นที่เกษตรกรรมถูกน้ำท่วมหรือไม่

❍ ท่วม ❍ ไม่ท่วม

ผลผลิตเสียหายอย่างไร (หากมีการแก้ปัญหาแล้ว ในอดีตเป็นอย่างไร) .....

มีการแก้ปัญหาอย่างไร (ปัจจุบัน ที่ผ่านมา หรือแผนในอนาคต)

.....

2.21 มีแหล่งน้ำเพียงพอต่อการเกษตรหรือไม่ ❍ เพียงพอ ❍ ไม่เพียงพอ

ไม่เพียงพอ ปีพ.ศ..... เดือน .....ระยะเวลา .....

ผลกระทบต่อผลผลิต .....การแก้ปัญหา .....

2.22 ชนิดที่ผลิต

❍ ข้าว จำนวนรอบการปลูก ❍ 1 รอบ ❍ 2 รอบ ❍ 3 รอบ

❍ พืช (ผัก ผลไม้) **ฤดูที่เก็บหา** ❍ ฤดูหนาว ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูร้อน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูฝน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

มีการนำพืชอาหารจากป่ามาปลูกรอบบ้านหรือไม่

❍ เคย โปรดระบุ .....

❍ ไม่เคย

❍ เห็ด **ฤดูที่เก็บหา** ❍ ฤดูหนาว ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูร้อน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูฝน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ สัตว์และแมลง (ที่ไม่ใช่สัตว์เลี้ยง) **ฤดูที่เก็บหา** ❍ ฤดูหนาว ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูร้อน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ ฤดูฝน ชนิดพันธุ์ใดบ้าง (ระบุ) .....

❍ สัตว์เลี้ยง ชนิดพันธุ์ใดบ้าง (ระบุ) .....

2.23 การปลูกและใช้ประโยชน์ข้าว

วิธีทางการเกษตร

❍ **อินทรีย์** (การทำการเกษตรที่เลียนแบบธรรมชาติ โดยไม่ใช้ปุ๋ยเคมี" "ไม่ใช้สารป้องกันและกำจัดศัตรูพืช" "ไม่ใช้สารเคมีกำจัดวัชพืช" และไม่ใช้ฮอร์โมนกระตุ้นความเจริญเติบโตของพืช) ☐ ปุ๋ยหมัก ☐ ปุ๋ยคอก ☐ ปุ๋ยพืชสด ☐ จุลินทรีย์ ☐ ปุ๋ยชีวภาพ ☐ สมุนไพร ☐ ใช้แมลงจัดการแมลงศัตรูพืช ☐ อื่นๆ ระบุ.....	❍ **เคมี** ☐ ปุ๋ยเคมี ☐ ยาปราบศัตรูพืช ☐ ยาฆ่าหญ้า ☐ อื่นๆ โปรดระบุ .....
❍ **ผสมผสานทั้ง 2 แบบ** (ใส่ ✓ ลงใน ☐ ตามวิธีการในส่วนของเกษตรอินทรีย์ และเกษตรเคมีด้านบนที่ท่านใช้)	

วิธี ความรู้ในการปลูกให้ผลผลิตดี .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาข้าวไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

ถ้าเคย ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... สาเหตุมาจาก .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี❍ ขอแบ่งจากเพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

2.24 การปลูกและใช้ประโยชน์ผัก ผลไม้

วิธีทางการเกษตร

❍ **อินทรีย์** (การทำการเกษตรที่เลียนแบบธรรมชาติ โดยไม่ใช้ปุ๋ยเคมี" "ไม่ใช้สารป้องกันและกำจัดศัตรูพืช" "ไม่ใช้สารเคมีกำจัดวัชพืช" และไม่ใช้ฮอร์โมนกระตุ้นความเจริญเติบโตของพืช) ☐ ปุ๋ยหมัก ☐ ปุ๋ยคอก ☐ ปุ๋ยพืชสด ☐ จุลินทรีย์ ☐ ปุ๋ยชีวภาพ ☐ สมุนไพร ☐ ใช้แมลงจัดการแมลงศัตรูพืช ☐ อื่นๆ ระบุ	❍ **เคมี** ☐ ปุ๋ยเคมี ☐ ยาปราบศัตรูพืช ☐ ยาฆ่าหญ้า ☐ อื่นๆ โปรดระบุ .....
❍ **ผสมผสานทั้ง 2 แบบ** (ใส่ ✓ ลงใน ☐ ตามวิธีการในส่วนของเกษตรอินทรีย์ และเกษตรเคมีด้านบนที่ท่านใช้)	

วิธี ความรู้ในการปลูกให้ผลผลิตดี .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาผักผลไม้ไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

ถ้าเคย ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... สาเหตุมาจาก .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี❍ ขอแบ่งจากเพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

2.25 การเพาะและใช้ประโยชน์เห็ด

วิธีการเพาะเห็ด

❍ **อินทรีย์** (การทำการเกษตรที่เลียนแบบธรรมชาติ โดยไม่ใช้ปุ๋ยเคมี" "ไม่ใช้สารป้องกันและกำจัดศัตรูพืช" "ไม่ใช้สารเคมีกำจัดวัชพืช" และไม่ใช้ฮอร์โมนกระตุ้นความเจริญเติบโตของพืช) ☐ ปุ๋ยหมัก ☐ ปุ๋ยคอก ☐ ปุ๋ยพืชสด ☐ จุลินทรีย์ ☐ ปุ๋ยชีวภาพ ☐ สมุนไพร ☐ ใช้แมลงจัดการแมลงศัตรูพืช ☐ อื่นๆ ระบุ.....	❍ **เคมี** ☐ ปุ๋ยเคมี ☐ ยาปราบศัตรูพืช ☐ ยาฆ่าหญ้า ☐ อื่นๆ โปรดระบุ .....
❍ **ผสมผสานทั้ง 2 แบบ** (ใส่ ✓ ลงใน ☐ ตามวิธีการในส่วนของเกษตรอินทรีย์ และเกษตรเคมีด้านบนที่ท่านใช้)	

วิธี ความรู้ในการปลูกให้ผลผลิตดี .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาเห็ดที่เพาะไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

<u>ถ้าเคย</u> ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... <u>สาเหตุมาจาก</u> .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี ❍ ขอแบ่งจากเพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ).....

2.26 การใช้ประโยชน์สัตว์ และแมลงจากแปลงเกษตร หรือภายในบริเวณพื้นที่ที่อยู่อาศัย (ที่ไม่ใช่สัตว์เลี้ยง)

วิธี ความรู้ในการเก็บหา .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาสัตว์และแมลงไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

<u>ถ้าเคย</u> ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... <u>สาเหตุมาจาก</u> .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี ❍ ขอแบ่งจากเพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

2.27 การใช้ประโยชน์สัตว์เลี้ยง

กระบวนการเลี้ยง

❍ **อินทรีย์** (การเลี้ยงเลียนแบบธรรมชาติ โดยไม่ใช้สารเคมี" และไม่ใช้ฮอร์โมนกระตุ้นความเจริญเติบโตของสัตว์) ระบุ	❍ **เคมี** ระบุ ....
❍ **ผสมผสานทั้ง 2 แบบ** (ใส่ ✓ ลงใน ☐ ตามวิธีการในส่วนของอินทรีย์ และเคมีด้านบนที่ท่านใช้)	

วิธี ความรู้ในเลี้ยง (เทคนิคพิเศษ) .....

มีการถ่ายทอดความรู้กันในครัวเรือนหรือไม่ ❍ มี ❍ ไม่มี

แหล่งขาย (ระบุ) .....

เคยประสบปัญหาสัตว์ไม่เพียงพอบริโภคหรือไม่ ❍ เคย ❍ ไม่เคย

<u>ถ้าเคย</u> ปีพ.ศ. ..... **เดือนที่ไม่พอ**.....

ชนิดที่ไม่พอ..... <u>สาเหตุมาจาก</u> .....

มีการแก้ไขอย่างไร ❍ ไม่ทำอะไร (ไม่บริโภค) ❍ ซื้อ .....กก./ปี❍ ขอแบ่งจากเพื่อนบ้าน หรือแลกกับอย่างอื่น .....กก./ปี ❍ อื่นๆ (ระบุ) .....

<u>2.28 ปริมาณการผลิตอาหารจากแปลงเกษตร (ข้าว พืช และเห็ด)</u>

รอบที่/ฤดู	**ชนิดพันธุ์**	**เดือนที่ปลูก**	**เดือนที่เก็บเกี่ยว**	**ปริมาณ (กก./ 1 รอบการปลูก)**			
				รวม (กก.)	**บริโภคในครัวเรือน (กก.)**	**แบ่งญาติ (กก.)**	**ขาย (กก.)**

2.29 ปริมาณการเก็บอาหารจากแปลงเกษตร (สัตว์และแมลง)

ฤดู	ชนิดพันธุ์	บริเวณที่พบ	เดือนที่เก็บ	ความถี่ของการเก็บหา (ครั้ง/เดือน)	ปริมาณ (กก./ 1 ครั้งการเก็บหา)			
					รวม (กก.)	บริโภคในครัวเรือน (กก.)	แบ่งญาติ (กก.)	ขาย (กก.)

2.30 ปริมาณการเลี้ยงสัตว์เพื่อการบริโภค

ชนิดพันธุ์ และลักษณะการบริโภคของสัตว์ที่ท่านเลี้ยง

ชนิดพันธุ์สัตว์เลี้ยงเพื่อการบริโภค	ปริมาณสัตว์เลี้ยงเพื่อการบริโภค (จำนวนตัว)	ปริมาณสัตว์เลี้ยงเพื่อการบริโภค (กก./เดือน)
1		
2		
3		
4		

อาหารจากการแลกเปลี่ยน

2.31 ในครัวเรือนของท่านมีการแลกเปลี่ยนพืช และสัตว์ที่เป็นอาหารกับบุคคลนอกครัวเรือนหรือไม่

❍มี ❍ ไม่มี **ถ้ามี** ท่านแลกเปลี่ยนอะไร และกับใคร

ชนิด	รายการ	เดือนที่แลกเปลี่ยน	ปริมาณ (หน่วย / เดือน)

<u>อาหารจากตลาด</u>

2.32 การพึ่งพาตลาด

ในช่วง 1 เดือนที่ผ่านมา ครัวเรือนของท่านมีรายละเอียดในการซื้ออาหาร ในรูปแบบของพืช เห็ด และสัตว์อย่างไรบ้าง และปริมาณเท่าไหร่

ชนิด	รายการ	เดือนที่ซื้อ	ปริมาณ (หน่วย / เดือน)

ความมั่นใจและพึงพอใจในอาหาร

2.33 ท่านมีความพึงพอใจในการจัดการทรัพยากรอาหารของครัวเรือนในระดับใด (ใส่ ✓ตามระดับที่ท่านพึงพอใจ)

10 (พอใจมากที่สุด)	9	8	7	6	5	4	3	2	1 (ไม่พอใจ)

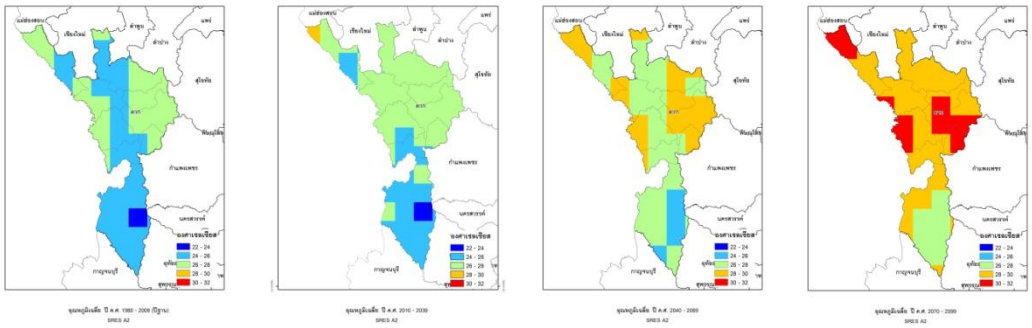
2.34 ท่านมีความมั่นใจในความปลอดภัยของอาหารที่ได้รับจากแหล่งต่อไปนี้ ในระดับใด (ใส่ ✓ตามระดับที่ท่านมั่นใจ)

แหล่งอาหาร	**ระดับความมั่นใจ (มั่นใจมากที่สุด – ไม่มั่นใจ)**									
ตลาด	10	9	8	7	6	5	4	3	2	1
แปลงเกษตร	10	9	8	7	6	5	4	3	2	1
ป่า	10	9	8	7	6	5	4	3	2	1
สัตว์ที่เลี้ยง	10	9	8	7	6	5	4	3	2	1
แม่น้ำ	10	9	8	7	6	5	4	3	2	1
การแลกเปลี่ยน	10	9	8	7	6	5	4	3	2	1

2.35 หากเกิดเหตุการณ์อาหารไม่เพียงพอ ครัวเรือนของท่านมีแผนจะทำอย่างไร

.....

APPENDIX B
CLIMATE FORCAST DATA OF STUDY AREA (BY SOUTHEAST ASIA START REGIONAL CENTER, CHULALONGKORN UNIVERSITY)



ก.ช่วง 30 ปีที่ผ่านมา (ปีฐาน) ข.ในอีก 30 ปี ข้างหน้า ค.ในอีก 60 ปี ข้างหน้า ง.ในอีก 90 ปี ข้างหน้า

แผนที่อุณหภูมิเฉลี่ย (องศาเซลเซียส) ภายใต้สถานการณ์แนวทางแบบ A2 จังหวัดตาก

<u>อุณหภูมิเฉลี่ย</u>

ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) อุณหภูมิเฉลี่ยในรอบปี ประมาณ 24-28 องศาเซลเซียส จากการคาดการณ์อุณหภูมิเฉลี่ยมีแนวโน้มที่สูงขึ้น โดยภายใต้แนวทาง A2 พบว่าในอีก 30 ปีข้างหน้าอุณหภูมิเฉลี่ยมีแนวโน้มที่เพิ่มขึ้นเล็กน้อย ในอีก 60 ปีข้างหน้าอุณหภูมิเฉลี่ยมีแนวโน้มที่เพิ่มขึ้น 1-2 องศาเซลเซียส ในอีก 90 ปีข้างหน้าอุณหภูมิเฉลี่ยมีแนวโน้มที่เพิ่มขึ้นมากกว่า 2 องศาเซลเซียส

<u>อุณหภูมิสูงสุด</u>

ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) อุณหภูมิสูงสุดเฉลี่ยในรอบปี ประมาณ 40-45 องศาเซลเซียส จากการคาดการณ์อุณหภูมิสูงสุดมีแนวโน้มที่สูงขึ้น โดยภายใต้แนวทาง A2 พบว่า ในอีก 30 ปีข้างหน้าอุณหภูมิมีแนวโน้มเพิ่มขึ้นเล็กน้อย ในอีก 60 ปีข้างหน้าอุณหภูมิเพิ่มขึ้นประมาณ 1-2 องศาเซลเซียส ในอีก 90 ปีข้างหน้าอุณหภูมิเพิ่มขึ้นมากกว่า 2 องศาเซลเซียส ภายใต้แนวทาง B2

พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้า อุณหภูมิมีแนวโน้มเพิ่มขึ้นเล็กน้อย ในอีก 90 ปีข้างหน้า อุณหภูมิเพิ่มขึ้น 1-2 องศาเซลเซียส และภายใต้แนวทาง A1B พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้า อุณหภูมิเพิ่มขึ้นมากกว่า 2 องศาเซลเซียส

จำนวนวันร้อน (จำนวนวันที่อุณหภูมิสูงกว่า 35 องศาเซลเซียส)

ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) จำนวนวันร้อนในรอบปีมีจำนวนประมาณ 90-120 วัน จากการคาดการณ์พบว่าจำนวนวันร้อนมีแนวโน้มที่เพิ่มขึ้น โดยภายใต้แนวทาง A2 ในอีก 30 ปีข้างหน้า จำนวนวันร้อนใกล้เคียงกับปีฐาน ในอีก 60 ปีข้างหน้าจำนวนวันร้อนมีแนวโน้มที่เพิ่มขึ้น 30-45 วัน ในอีก 90 ปีข้างหน้าจำนวนวันร้อนมีแนวโน้มที่เพิ่มขึ้นมากกว่า 60 วัน ภายใต้แนวทาง B2 พบว่า ในอีก 30 ปีข้างหน้า จำนวนวันร้อนใกล้เคียงกับปีฐาน ในอีก 60 ปีข้างหน้าจำนวนวันร้อนมีแนวโน้มที่เพิ่มขึ้น 30-45 วัน ในอีก 90 ปีข้างหน้าจำนวนวันร้อนมีแนวโน้มที่เพิ่มขึ้น 45-60 วัน และภายใต้แนวทาง A1B พบว่า ในอีก 30 ปีข้างหน้าจำนวนวันร้อนใกล้เคียงกับปีฐาน ในอีก 60 ปีข้างหน้าจำนวนวันร้อนมีแนวโน้มที่เพิ่มขึ้น 15-30 วัน

อุณหภูมิต่ำสุด

ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) อุณหภูมิต่ำสุดเฉลี่ยในรอบปี ประมาณ 10 - 15 องศาเซลเซียส จากการคาดการณ์อุณหภูมิต่ำสุดมีแนวโน้มที่สูงขึ้น โดยภายใต้แนวทาง A2 พบว่า ในอีก 30 ปี ข้างหน้า อุณหภูมิต่ำสุดใกล้เคียงกับปีฐาน บางพื้นที่มีแนวโน้มที่เพิ่มขึ้นเล็กน้อย ในอีก 60 ปีข้างหน้าอุณหภูมิต่ำสุดมีแนวโน้มที่เพิ่มขึ้นเล็กน้อย ในอีก 90 ปีข้างหน้าอุณหภูมิต่ำสุดมีแนวโน้มที่เพิ่มขึ้นมากกว่า 2 องศาเซลเซียส ภายใต้แนวทาง B2 พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้า อุณหภูมิต่ำสุดใกล้เคียงกับปีฐาน ในอีก 90 ปีข้างหน้าอุณหภูมิต่ำสุดมีแนวโน้มที่เพิ่มขึ้น 1-2 องศาเซลเซียส และภายใต้แนวทาง A1B พบว่า ในอีก 30 ปีข้างหน้า อุณหภูมิต่ำสุดมีแนวโน้มที่เพิ่มขึ้น 1-2 องศาเซลเซียส ในอีก 60 ปีข้างหน้าต่ำสุดมีแนวโน้มอุณหภูมิเพิ่มขึ้นมากกว่า 2 องศาเซลเซียส

จำนวนวันเย็น (จำนวนวันที่อุณหภูมิต่ำกว่า 16 องศาเซลเซียส)

ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) จำนวนวันเย็นในรอบปี มีประมาณ 15-30 วัน จากการคาดการณ์พบว่าจำนวนวันเย็นมีแนวโน้มลดลง โดยภายใต้แนวทาง A2 พบว่า ในอีก 30 ปีข้างหน้า จำนวนวันเย็นมีแนวโน้มลดลงประมาณ 5 – 15 วัน ในอีก 60 ปีข้างหน้าจำนวนวันเย็นมีแนวโน้มลดลง 10-20 วัน ในอีก 90 ปีข้างหน้าจำนวนวันเย็นมีแนวโน้มลดลงมากกว่า 15 วัน ภายใต้แนวทาง B2 พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้า จำนวนวันเย็นมีแนวโน้มลดลง 5-10 วัน ในอีก 90 ปีข้างหน้า จำนวนวันเย็นมีแนวโน้มลดลง 15-20 วัน และภายใต้แนวทาง A1B พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้าจำนวนวันเย็นมีแนวโน้มลดลง 15-20 วัน

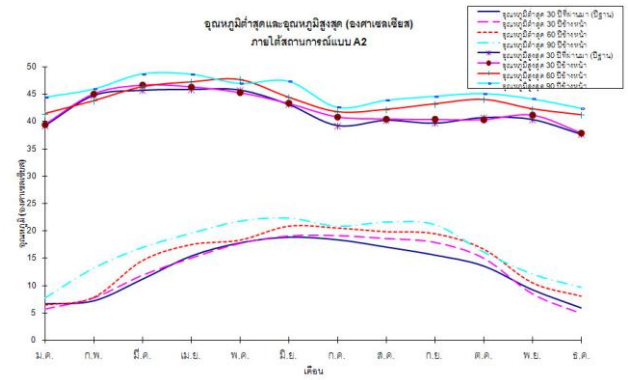
ปริมาณฝนรวมรายปี

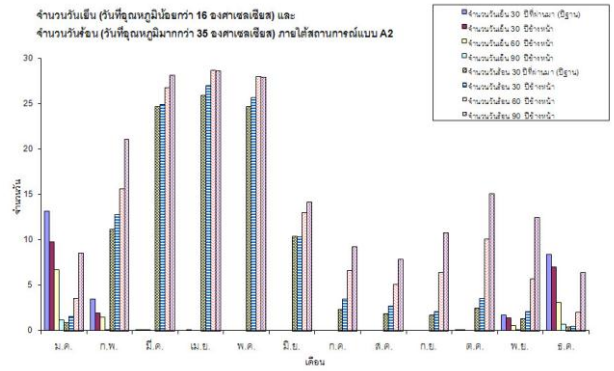
ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) ปริมาณฝนรวมรายปีเฉลี่ยมีประมาณ 1,400 มิลลิเมตร/ปี จากการคาดการณ์ในอนาคตพบว่าภายใต้แนวทาง A2 ในอีก 30 ปีและ 60 ปีข้างหน้าปริมาณฝนรวมรายปีเฉลี่ยใกล้เคียงกับปีฐาน ในอีก 90 ปีข้างหน้า ปริมาณฝนรวมรายปีเฉลี่ยใกล้เคียงกับปีฐาน บางพื้นที่ทางตอนบนของจังหวัดมีแนวโน้มที่เพิ่มขึ้น 10-20 % ภายใต้แนวทาง B2 ในอีก 100 ปีข้างหน้า ปริมาณฝนรวมรายปีเฉลี่ยใกล้เคียงกับปีฐาน และแนวทาง A1B ในอีก 30 ปีและ 60 ปีข้างหน้า ปริมาณฝนรวมรายปีเฉลี่ยใกล้เคียงกับปีฐาน

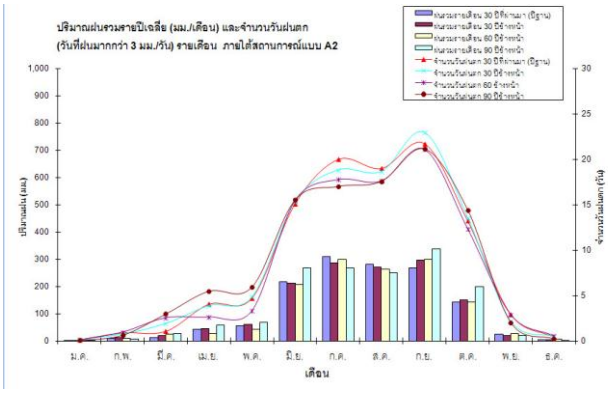
จำนวนวันฝนตก (จำนวนวันฝนตก ปริมาณฝนมากกว่า 3 มิลลิเมตร/วัน และจำนวนวันฝนตกหนัก ปริมาณฝนมากกว่า 35 มิลลิเมตร/วัน)

ในช่วง 30 ปีที่ผ่านมา (ปีฐาน) จำนวนวันฝนตกโดยเฉลี่ยในรอบปี ประมาณ 90-120 วัน จากการคาดการณ์ในอนาคตพบว่าภายใต้แนวทาง A2 ในอีก 30 ปีข้างหน้า จำนวนวันฝนตกใกล้เคียงกับปีฐาน ในอีก 60 ปีข้างหน้า จำนวนวันฝนตกมีแนวโน้มลดลงมากกว่า 5 วัน ในอีก 90 ปีข้างหน้า จำนวนวันฝนตกใกล้เคียงกับปีฐาน ภายใต้แนวทาง B2 พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้า จำนวนวันฝนตกใกล้เคียงกับปีฐาน ในอีก 90 ปีข้างหน้า จำนวนวันฝนตกใกล้เคียงกับปีฐาน บางพื้นที่จำนวนวันฝนตกมีแนวโน้มลดลงมากกว่า 5 วัน ภายใต้แนวทาง A1B พบว่า ในอีก 30 ปีและ 60 ปีข้างหน้า จำนวนวันฝนตกมีแนวโน้มการเพิ่มขึ้นมากกว่า 10 วัน

จำนวนวันฝนตกหนักในรอบ 1 ปี จากการคาดการณ์พบข้อมูลจำนวนวันฝนตกหนักในพื้นที่เล็กน้อย มีจำนวนวันใกล้เคียงกับปีฐาน







ผลการจำลองสภาพอากาศภูมิอากาศอนาคตภายใต้สภาพก๊าซเรือนกระจก ตามสถานการณ์ทางเศรษฐกิจและสังคม แบบ A2, B2 และ A1B (SRES A2, B2 และ A1B)

การคาดการณ์สภาพภูมิอากาศระดับภูมิภาคดาเนินการโดยใช้แบบจำลองทางคณิตศาสตร์ PRECIS (Providing regional Climates for Impacts Studies) ซึ่งเป็นแบบจำลองภูมิอากาศระดับภูมิภาค (RCM) ที่พัฒนาขึ้นที่ The Met Office Hadley Centre for Climate Change ประเทศอังกฤษ ภายใต้แนวโน้มของก๊าซเรือนกระจกในบรรยากาศ 3 แนวทาง ได้แก่

แนวทาง A2 คือ แนวทางที่คล้ายกับลักษณะการพัฒนาของโลกที่ผ่านมาในอดีตถึงปัจจุบัน กล่าวคือ เป็นโลกที่มีความแตกต่างและหลายหลายในเชิงเศรษฐกิจ การเมืองและการเข้าถึง

เทคโนโลยีต่างๆ โดยที่การพัฒนาจะเน้นการเจริญเติบโตในเชิงเศรษฐกิจมากกว่าความยั่งยืนทางสิ่งแวดล้อม ช่วงเวลาที่ใช้ในการศึกษาคือ ค.ศ. 1980-2099

แนวทาง B2 คือ แนวทางการพัฒนาแบบสมดุล และเปลี่ยนแปลงสู่การพัฒนาควบคู่กับการดูแลรักษาธรรมชาติอย่างยั่งยืน เน้นการแก้ปัญหาท้องถิ่น ทั้งด้านเศรษฐกิจ สังคม และสิ่งแวดล้อมที่ยั่งยืน ช่วงเวลาที่ใช้ในการศึกษาคือ ค.ศ. 2010-2099

แนวทาง A1B คือ แนวทางการพัฒนาที่มีการใช้พลังงานแบบผสมผสาน สมดุลทุกแหล่ง กล่าวคือ มีการนาพลังงานชีวมวลมาใช้อย่างผสมผสานและสมดุลกับแหล่งพลังงานอื่นๆ ซึ่งเป็นการพัฒนาดูแลสิ่งแวดล้อมและมีความร่วมมือระหว่างโลกและภูมิภาคอย่างสมดุล ช่วงเวลาที่ใช้ในการศึกษาคือ ค.ศ. 2010-2069 ในช่วง ค.ศ.2070-2099 จำนวนข้อมูลมีน้อยจึงไม่นามาวิเคราะห์

โดยเงื่อนไขการจำลองสภาพภูมิอากาศ Global dataset สาหรับแนวทาง A2 และ B2 ใช้ Max-Planck-Institute for Meteorology’s ECHAM4 และสาหรับ A1B ใช้ Hadley Centre for Climate Prediction and Research HadCM3

APPENDIX C
HOUSEHOLD FOOD CONSUMPTION

Agricultural food consumption

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
พืชเศรษฐกิจ	1	กล้วย	✓	✓	✓	2000
	2	กล้วยน้ำว้า	✓	✓	✓	2000
	3	ข้าวกข.15			✓	5000
	4	ข้าวขาวดอกมะลิ			✓	13000
	5	ข้าวโพด	✓	✓	✓	65400
	6	ข้าวหอมนิล			✓	600
	7	ข้าวหอมมะลิแดง			✓	600
	8	ข้าวหอมมะลิ 105			✓	124780
	9	ข้าวเหนียวกข.6			✓	19550
	10	ข้าวเหนียวกข.10			✓	9300
	11	ข้าวเหนียวเขี้ยวงู			✓	3000
	12	ถั่วเหลือง	✓			13100
	13	มะละกอ	✓	✓	✓	17002
	14	มันสำปะหลัง	✓			20500
	15	ลำไย	✓	✓		5020
ผักสวนครัว	16	กระเจี๊ยบ	✓	✓	✓	4
	17	กระเจี๊ยบขาว	✓	✓	✓	3
	18	กวางตุ้ง	✓	✓		47
	19	กะเพรา	✓	✓	✓	1

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
	20	กะหล่ำดอก	✓			265
	21	กะหล่ำปลี	✓			428
	22	ข่า	✓	✓	✓	8
	23	ขิง	✓	✓	✓	6
	24	คะน้า	✓		✓	108
	25	ชะพลู	✓	✓	✓	3
	26	ชะอม		✓		2
	27	ชาใบหม่อน	✓	✓	✓	2
	28	ต้นหอม	✓	✓	✓	20
	29	ตะไคร้	✓	✓	✓	2
	30	ตำลึง	✓	✓	✓	15
	31	แตงกวา	✓	✓	✓	16
	32	ถั่วฝักยาว	✓	✓	✓	50
	33	น้ำเต้า	✓			5
	34	บรอกโคลี	✓			90
	35	บวบ	✓	✓	✓	28
	36	ผักกาดขาว	✓			65
	37	ผักกาดเขียวปลี	✓			8
	38	ผักกาดหอม	✓			2
	39	ผักชี	✓	✓	✓	20
	40	ผักชีฝรั่ง	✓	✓	✓	8
	41	ผักชีลาว	✓	✓	✓	7
	42	ผักบุ้ง	✓	✓	✓	21
	43	ผักปลัง	✓	✓	✓	4
	44	เผือก	✓	✓	✓	70

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
	45	พริก	✓	✓	✓	17
	46	ฟักข้าว	✓			1
	47	ฟักเขียว			✓	35
	48	ฟักทอง	✓	✓	✓	111
	49	มะกรูด	✓	✓	✓	30
	50	มะขาม	✓	✓	✓	20
	51	มะเขือ	✓	✓	✓	46
	52	มะเขือเจ้าพระยา	✓			3
	53	มะเขือเทศ	✓			3
	54	มะเขือพวง		✓		3
	55	มะนาว		✓		22
	56	รางจืด	✓	✓	✓	10
	57	สะระแหน่	✓	✓	✓	5
	58	หน่อไม้		✓	✓	30
	59	หอมแดง	✓	✓	✓	20
	60	โหรพา	✓	✓	✓	2
	61	อัญชัน	✓	✓	✓	3
	62	ฮ่องเต้	✓			7
ผลไม้	63	แก้วมังกร	✓	✓	✓	10
	64	ขนุน		✓		3
	65	น้อยหน่า	✓	✓	✓	30
	66	แตงไทย	✓	✓	✓	20
	67	มะปราง		✓		5
	68	มะม่วง		✓		3
	69	ลิ้นจี่		✓		10

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
	70	ส้มเขียวหวาน	✓			10
เห็ด	71	เห็ดถั่วเหลือง			✓	3
	72	เห็ดนางฟ้าภูฏาน			✓	3
	73	เห็ดฟาง			✓	3
สัตว์	74	กบ			✓	10
	75	กระแต	✓			30
	76	กระรอก	✓			30
	77	เขียด			✓	1
	78	ไข่แมงมัน	✓			6
	79	จิ้งหรีด	✓	✓	✓	77
	80	นก	✓	✓	✓	20
	81	บ่าง	✓			16
	82	ปลา			✓	20
	83	ปู			✓	14
	84	แมงมัน			✓	10
	85	แย้		✓		30

Community forest food consumption

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
พืช	1	ดอกก้าน			✓	10
	2	โด่ไม่รู้ล้ม			✓	1
	3	ตะขบป่า			✓	1
	4	ตำลึง	✓	✓	✓	64.5
	5	เปียกขยาน			✓	1
	6	ผักกูด			✓	56

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
	7	ผักสาบ	✓	✓	✓	49.5
	8	ผักหนาม			✓	10
	9	ผักหวาน		✓	✓	166.5
	10	ผักหอน		✓		3
	11	แผ่นดินเย็น		✓	✓	31.4
	12	พริก	✓	✓	✓	10
	13	ฟักข้าว			✓	10
	14	มะกอก	✓			25
	15	มะขามป้อม	✓			15
	16	มะเขือพวง	✓	✓	✓	2
	17	มะระขี้นก	✓	✓	✓	5
	18	มะฮ่อย	✓	✓	✓	3
	19	สมอ			✓	1
	20	สะเดา	✓	✓	✓	41
	21	หน่อไม้			✓	381
	22	หน่อไม้ไผ่ตง			✓	2
	23	หน่อไม้สีสุก			✓	150
เห็ด	24	เห็ดขมิ้น			✓	543
	25	เห็ดไข่เหลือง			✓	2002
	26	เห็ดโคน			✓	3083
	27	เห็ดเผาะ			✓	1384
	28	เห็ดลม			✓	573
	29	เห็ดหล่ม			✓	1559
สัตว์	30	กบ			✓	58
	31	กระต่าย	✓	✓	✓	60

ประเภท	ลำดับที่	รายการ	ฤดูกาล			ปริมาณ (กก./ปี)
			หนาว	ร้อน	ฝน	
	32	ไก่	✓	✓	✓	15
	33	เขียด			✓	34
	34	ไข่มดแดง		✓		179
	35	ตะกวด			✓	60
	36	น้ำผึ้ง			✓	40
	37	ปลา	✓	✓	✓	1960
	38	ผึ้ง	✓			3
	39	แมงมัน		✓	✓	48
	40	แมงอีนูน			✓	2
	41	แย้	✓	✓	✓	1571.4
	42	อึ่ง		✓	✓	5722.5

BIOGRAPHY

NAME	Miss Natcha Sornhiran
DATE OF BIRTH	April 15, 1990
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Mahidol University, 2008 - 2011 Bachelor of Science. (Science and Technology of Environmental) Mahidol University, 2011-2013 Master of Science. (Technology of Environmental Management)
HOME ADDRESS	112/42 Surasak Subdistict, Sriracha District, Chonburi Province, 20110 Thailand Tel. 084-6510058 E-mail: natchasornhiran@gmail.com
PUBLICATION/ PRESENTATION	Management of Food Security Risk in a Repeated Flood-Affected Area: a Case Study of Ban Maerawan, Yokkrabutr Subdistrict, Sam-ngao District, Tak Province The proceeding in The Ecological Knowledge on Adapt to Climate Change Conferences and Presented Academic Papers of Thai Forest Ecological Research Network, T-FERN on January 23-24, 2014 at Kasetsart University, Bangkok