A Comprehensive Study on Food Security among Rural Farming Households in Southern Laos

ラオス南部における農家世帯のフード・セキュリティに関する包括的研究

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By

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DEDICATION

I dedicate this thesis to my parents—Father Mr. Bounmark SILIPHOUTHONE and Mother Mrs. Chanlub SILIPHOUTHONE—who were always supporting, encouraging and praying me to be able to get such success and honor.

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ABBREVIATION

ACIAR	Australian Centre for International Agricultural Research
AE	Adult Equivalent
AEC	ASEAN Economic Community
ASEAN	Association of South East Asian Nations
ADB	Asian Development Bank
CCHIP	Community Childhood Hunger Identification Project
CI	Calorie Intake
CPI	Consumer Price Index
CSI	Coping Strategies Index
CWFS	Committee on World Food Security
DoA	Department of Agriculture
DoS	Department of Statistics
DS	Dry Season
FAO	Food and Agriculture Organization of the United Nations
FCS	Food Consumption Score
FE	Food Consumption Expenditure
FRAC	Food Research and Action Center
FANTA	Food and Nutrition Technical Assistance Project
FSR	Food Security Ratio
FSSQ	Food Sufficiency Status Questions
GDP	Gross Domestic Products
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoL	Government of Laos
H/A	Height-for-Age
Ha	Hectare
HDDS	Household Dietary Diversity Score
HDI	Human Development Index
HFIAS	Household Food Insecurity Access Scale

IFAD	International Fund for Agriculture Development
IPCC	Intergovernmental Panel on Climate Change
Kcal	Kilocalorie
Kg	Kilogram
Lao PDR	Lao People's Democratic Republic
LAK	Lao Kip (currency of Laos)
LBS	Lao Statistics Bureau
LECS	Lao Expenditure and Consumption Survey
LSIS	Lao Social Indicator Survey
MAF	Ministry of Agriculture and Forestry
MEM	Ministry of Energy and Mine
MoH	Ministry of Health
MLSW	Ministry of Labor and Social Welfare
MPI	Ministry of Planning and Investment
MVs	Improved Rice Varieties
MUAC	Mid-Upper-Arm-Circumference
NAFRI	National Agricultural and Forestry Research Institute
NAPP	National Institute of Agricultural Planning and Projection
NERI	National Economic and Research Institute
NHANES	National Health and Nutrition Examination Survey
NGOs	Non-Government Organizations
NRRP	National Rice Research Program
NTFPs	Non-Timber Forest Products
OLS	Ordinary Least Squares
QTYC	Quantity of Food Produced on Farm Available for Consumption
QTYB	Quantity of Rice Borrowed and Consumed
QTYF	Quantity of Food Collected from the Forest and Consumed
QTYP	Quantity of Food Purchased and Consumed
QTYR	Quantity of Food Provided by Friends and Relatives
RA	Rice Requirement per Adult per Annum

RD	Rice Department
RVS	Risk and Vulnerability Survey
SPSS	Software Package for Statistical Analysis
TDK	Thadokkham Variety
TSN	Tasano Variety
W/A	Weigh-for-Age
WFP	World Food Programme
WS	Wet Season
U.S. FSSM	United States Food Security/Hunger Survey Module
UGSAS	United Graduate School of Agricultural Sciences
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational Scientific and Cultural Organization
USD	United States Dollar
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 Background of research

Although there has been impressive progress in reducing the Global Hunger Index (GHI) from 29.9% in 2000 to 21.7% in 2015, the persistence of hunger remains the critical challenges for global development owing to multifaceted factors, such as persistent poverty, natural disasters, rapid population growth, and rising food prices, political instability. The main causes of hunger are also linked to poor infrastructures, ecological constraints, and poor quality of water and sanitation (Smith et al., 2000; Kennedy, 2002). According to the recent estimates of the Food and Agriculture Organization of the United Nations (FAO), more than 868 million people or 12.5% of the global population—roughly one in eight—are estimated to suffer from chronic undernourishment in term of dietary energy supply (FAO, 2012). About 26% of the world's children are stunted, and 2 billion people suffer from one or more micronutrient deficiencies. Most undernourished people (98%) live in developing countries, mainly in rural Asia, such as South Asia, East Asia, and Southeast Asia. Globally, the World Food Programme (WFP), the International Food Policy Research Institute (IFPRI), and FAO are the primary organizations focusing on food security. FAO's database of Food Balance Sheet (FBS) for individual countries has been updated in order to provide an overview of the average food supply (kcal/capita/day) at the macro level. At the household and individual levels, the definitions of various food security indicators have been significantly expanded, which approximately 450 household food security indicators have been evolved in recent decade (Hoddinott, 1999). However, there has been a lack of consensus on accurate and standardized tools to measure food security. Some measures are suitable for one area, but not for the

others areas. Therefore, there is a need to understand the alternative indicators of household food security which are reliable and suitable to use in developing countries.

Lao People's Democratic Republic (Lao PDR or Laos)—a landlocked country—is classified by United Nations (UN) as one of the forty-eight least developed countries in the world (UN, 2014). It is located in Southeast Asia, bordering with Myanmar and China to the northwest, Vietnam to the east, Cambodia to the south and Thailand to the west. The total areas covers 236,000 square kilometers with a relatively small population of approximately 6.5 million inhabitants (Department of Statistics, or DoS, 2012). More than 70% of the total population live in rural area and about 70% of the workforces are engaged in subsistence agriculture, especially rice cultivation. The development in Lao PDR is relatively low compared with neighboring countries. Although Laos has made significant progress in economic development, which the average Gross Domestic Product (GDP) increased from 321 USD in 2000 to 1,320 USD in fiscal year 2011, the country is still ranked at 138th out of 187 countries on the Human Development Index (HDI) of the United Nations Development Programme (UNDP) due to low life expectancy (67 years old), high under-five child mortality rate (79 person per 1,000 live births) and infant mortality rate (68 person per 1,000 live births) (National Economic Research Institute, or NERI, 2012 and Ministry of Health and Lao Statistics Bureau, or MoH and LSB, 2012).

Like in many countries in the world, poverty and food insecurity are the fundamental problem that impede national socio-economic development, considering the amount of resources required to reduce its impacts (Nimoh et al., 2012; Edwards et al., 2007). Eradicating poverty and food insecurity has been indicated as the primary goal of the state and also the first objective of the Millennium Development Goals (MDGs). It is important to indicate that the Lao government is approaching its goal of poverty eradication (e.g., less than 24% in 2015, and a steadily declining poverty rate from 39.1% in 1998 to 27.6% in 2008), the country has achieved rice-sufficiency at more than 2 million tonnes since 1999, meaning that annual per capita rice

consumption is higher than a requirement of 171 kg of milled rice. Accordingly, the average food supply (2,377 kcal/capita/day) is greater than the international standard (2,100 kcal/capita/day). In spite of this attainment, there is a concern about an imbalance of food insecurity incidence among regions, agro-ecosystem zones, communities, and households. The progress of enhancing food supplies at regional, provincial, and district levels has not yet been fully achieved. Out of the total 141 districts, about 31% reported of having rice surplus above the requirement and 21% was able to produce enough rice for whole year, while 48% experienced rice shortage (Government of Laos or GoL, 2015). About 30% of the population—mainly live in rural areas—has insufficient food for more than 6 months (Asian Development Bank, or ADB, 2006).

From previous studies, it has been realized that the situation of food and nutrition security has not significantly improved (DoS, 2010; Foppes, 2008; Fullbrook, 2010; Rigg, 2012; FAO, 2013, NERI, 2014). According to Lao Expenditure and Consumption Survey (LECS) from 2003 to 2008, the prevalence of household food insecurity has increased from 19.8% to 24.6%, especially in the rural areas from 21.5% to 27.1% (DoS, 2010). Moreover, 44.2% of children under five years old are moderately stunted, and 26.6% are underweight (MoH and LBS, 2012). The ratio of food insecurity in upland areas (38%) is relatively high compared to lowland areas (18%), especially in the northern and eastern mountainous areas, where people are highly dependent on slash-and-burn agriculture and collecting wild food. They are likely to suffer with poor living standards and the problems of food shortage. Many of them live in small isolated villages, where social services such as health care, education, and clean water are not widely available due to geographic constraints. To integrate these groups into the country's development plan, the government has been implementing a number of strategies and programs in collaboration with international donors such as UNDP, World Bank (WB), and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). One of these is a resettlement program which

was adopted during the National Forestry Conference in 1989 that involved relocating one-quarter of the country's population by 2000 (Evrard and Goudineau, 2004). This resettlement initiative was intended to achieve the following five objectives using the tactics of Focal Site Development (FSD), village consolidation, and land and forest allocations: (1) reduce shifting cultivation, (2) improve access to and service delivery of resources, (3) eradicate opium production, (4) address security concerns, and (5) promote cultural integration (Baird and Shoemaker, 2005). The justifications for promoting resettlement differed from region to region, despite the singular nationwide resettlement policy. The priorities, however, were consistently stated as responding to the needs for education, health care, and basic infrastructures, and stabilizing shifting cultivation through the intensification of other types of agriculture, commercial logging, and by promoting land tenure reform. Through implementation of the policy, there have been several positive changes in villagers' lives, such as improvement of roads, electricity, education, health services. Nevertheless, it is expected that the level of food insecurity will remain high at the start of relocation and the living standard of those who resettled has not improved. Even so, there is limited literature on how the effect of resettlement program on rural livelihood, including household income and food security in the resettled rural upland areas.

Food insecurity is a problem not only for people in upland areas but also in lowland area. Many lowland households—in particular those who cultivated only rain-fed lowland rice—are still highly vulnerable to experience with food insufficiency, largely owing to food price changes, loss of natural resources, loss of land for cultivation, and natural disasters such as floods and drought, caused by climate change and uncertain weather (DoS, 2010). The limited availability of agricultural land due to rapid population growth and land transformation seems to have a negative impact on food security in the future if new applied agricultural technologies and supplementary food production on small plots (i.e., home garden)

are not introduced, especially in remote area where agricultural land is the main sources of food and cash crops (Yamada, 2014).

Based on the above mentioned, household food security in rural areas has become extremely important, this subject continues to place as the top of the policy agenda of Lao government; however, detailed information on the analysis of household food security in Laos is either inadequate or unavailable (FAO, 2011) and the severity of food insecurity and coping strategies are not fully understood. Understanding the situation of food security is required comprehensive household surveys from different agro-ecology zones.

1.2 Objective of the study

The main objective of this study is to understand household food security under the different agro-ecology zones in rural areas of Laos. In order to achieve the main objective, the study focuses on the following specific objectives:

1. To identify the characteristics of alternative indicators of household food security.
2. To investigate the coping strategies and factors affecting household food security in rural upland areas.
3. To examine how livelihood change after resettlement and determine the factors influencing on household income in the post-resettled upland area.
4. To investigate the food security situation and to identify the determinants of food security in the rural lowland areas.
5. To examine the effect of traditional home gardens on household food security, measured by food consumption score, in the rural lowland areas.
6. To assess the effect of floods on household economy and food security in the flood-prone rice growing areas.
7. To find out the proper policy interventions that can promote better household food security in Laos.

1.3 Structure of the study

In order reach the main objective, this study is organized into ten chapters, as shown in Figure 1.1. Chapter 1 presents general background of this study, including statement of problems. Chapter 2 begins with introduction of the conceptual framework of food security, followed by the summary of the direct and indirect indicators for measuring household food security and the existing literature on the determinant of household food security. In addition, this chapter briefly described the situation of food security, rice sufficiency, nutrition and poverty as well as the trend of rice production in Laos.

Chapter 3 presents the research methodology, which mainly focuses on the detailed information of the study areas in Champasak and Sekong Provinces. The typical sources of data collection and data analysis are also explained in this chapter. However, detailed description on food security measurement and analytical method is specifically described in each chapter. The next chapter compares the prevalence of food security based on the alternative indicators with the benchmark indicator. Also, this chapter identifies the characteristics of each alternative indicator, which is suitable to apply for measuring household food security in the Lao context.

Chapter 5 describes the severity of household food security in the upland areas of Sekong Province. This chapter also highlights the coping strategies that upland households used during the months of food shortage and the determinants of household food security. Chapter 6 observes the farming activities and livelihoods of those people who had resettled from highland to lower land areas. A panel regression analysis is utilized in this chapter to examine the determinants of household income after resettlement from 2012 to 2014.

Chapter 7 utilizes a daily calorie intake approach to analyze household food security and its determinant factors among rain-fed lowland rice-farming households in two poor villages of Champasak Province. In this chapter, the significant role of food from forest is highlighted. Chapter 8 investigates the relationship between home

garden and dietary diversity through multiple regression analysis. This chapter also describes the characteristics of home gardens in rural lowland areas of Laos. Chapter 9 highlights the effect of floods on rural household economy and household security in the flood-prone areas. Finally, the conclusion, policy implications and recommendations for further study are presented in the last chapter.

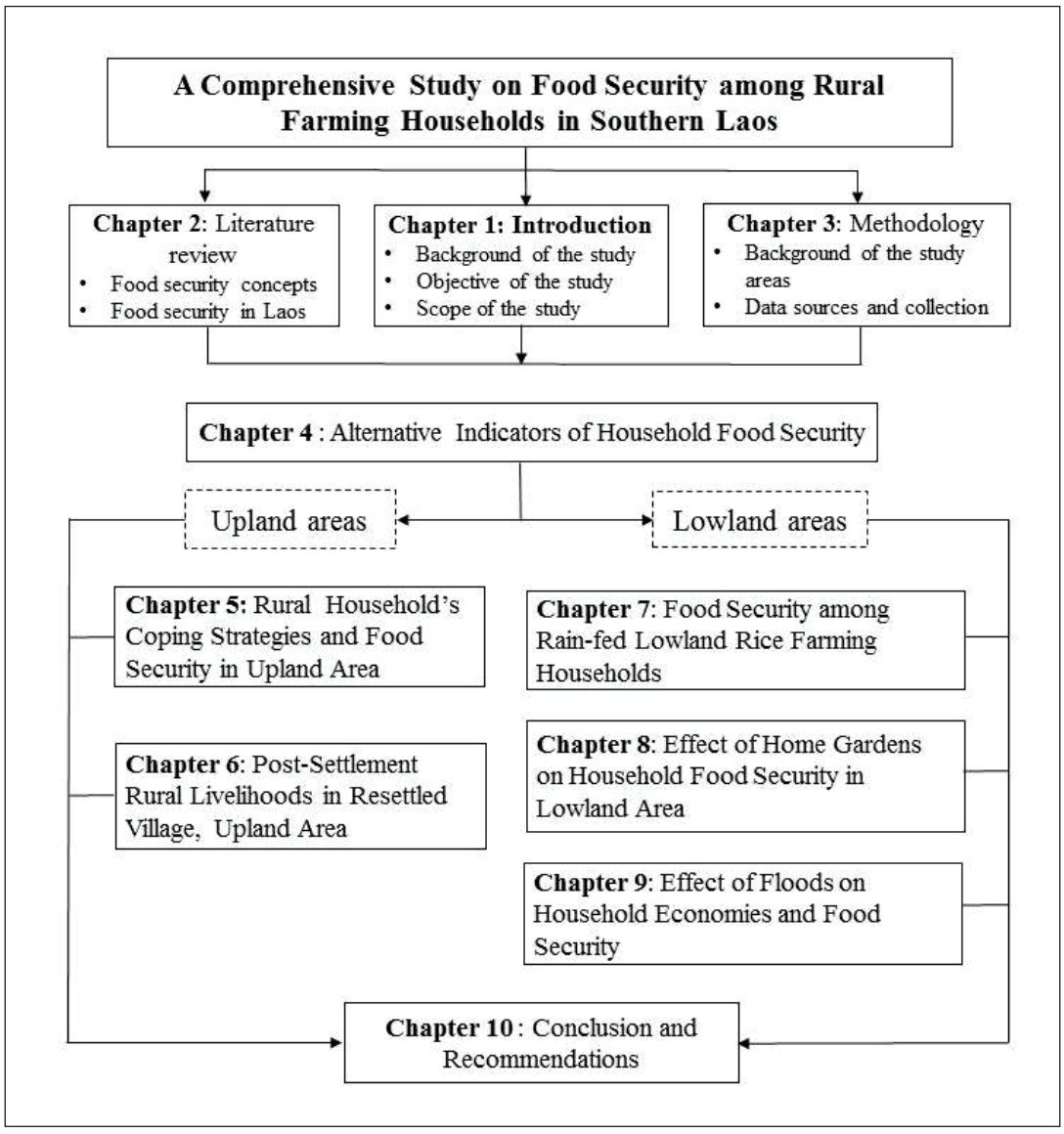

Figure 1.1: Organization of the thesis

CHAPTER 2

OVERVIEW OF FOOD SECURITY CONCEPTS, MEASUREMENT, AND THE EXISTING LITERATURE

2.1 A conceptual framework of food security

The phrase of food security has been defined by many researchers from different backgrounds since 1960s (Hoddinott, 1999). There are more than two hundred ways have been used to describe the definition of food security (Smith et al., 1993). In 1974, the concept was defined in the World Food Summit as "availability at all time of adequate world food supplies of basic foodstuffs to sustain a steady as steady expansion of food consumption and to offset fluctuation on production and price." In 1996, World Food Summit developed the most suitable definition in the wider scientific community "a situation that exists when all people, at all times, have physical, social and economic access to sufficient food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). This definition consists of three pillars, namely food availability, food access and food unitization. In the context of Lao PDR, food security is defined as ensuring "enough food and foodstuffs for every person at any time, both in material and economic aspects, with increasing demand on nutritional quality, hygiene and balance so as to improve health and enable normal development and efficient work" (National Institute of Agricultural Planning and Projection, or NAPP, 2000).

In 2012, the Committee on World Food Security (CWFS) revised the definition of food security as "a situation that exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs for an active and healthy life." By this definition, food security is predominantly based on four core elements: availability, accessibility, utilization and

stability. These four elements—which are commonly used to assess household food security—are described as follow:

Food availability is determined by domestic production and focuses on the supply side of food security at the national, regional, and sub-regional levels. At the household level, domestic production refers to food produced and/or acquired by means of physical efforts by household members. This can be crop production, animal production, fishing, or hunting and gathering of Non-Timber Forest Products (NTFPs), which household members then consumed. In addition, people can acquire food by bartering for it or exchanging it at the market.

Food accessibility is an important element because all individuals and families need access to food physically and economically. Accordingly, this element can be divided into physical and economic access. The physical aspect relates to food availability and infrastructure, such as roads and marketplaces, while the economic side refers to a household's ability to buy food. To assess household food access, it is required to gather information household composition, household expenditure patterns with a focus on food and non-food items, calorie intake, consumption of major products and socioeconomic profiles. These information can be used to estimate amounts of food consumed, composition of the diet and nutrient availability at the households and individual levels.

Food stability refers to the capacity to store and save food at all levels. At the national level, the stability of food is reliant on the government's ability to respond to the demand for food in an emergency when the food supply is not regular due to natural disasters such as floods and droughts, fluctuating prices, and seasonal unemployment. Additionally, the stability of food depends on the stability of market, which depends on the balance between supply and demand.

Food utilization refers to: a) households' use of food that they have access, and b) individual's ability to absorb nutrients (that is, the body's ability to efficiently digest food, or conversion efficiency). In other words, it relates to food preparation,

dietary diversity, the intra-household distribution of food, feeding practices, clean water, sanitation, and healthcare. In this approach, the sufficiency of individual's energy and nutrient intake is a basic measure of food utilization.

As mentioned above, the concept of food security involves nutrition as it strongly correlates with food utilization. Figure 2.1 shows a conceptual framework of food and nutrition security—which was originally developed by UNICEF in 1998 (Smith and Haddad, 2000). This framework attempts to identify the factors that influence nutrition security. The factors are categorized into three casual pathways, namely immediate, underlying and basic causes. The immediate causes of nutrition security are food intake and health status. The causes of food intake are directly associated with insufficient access to food, especially the ability of household to spend on food, while environment conditions and health services—such as poor health care, inadequate sanitation and lack of safe water—are highly correlated with health status. Meanwhile, inadequate maternal and child care practices has a significant influence both inadequate food intake and poor health conditions. The nutrition programs and policy interventions, which can be used to improve underlying causes are depicted in Figure 2.1.

Regarding to the basic causes of nutrition security, poverty eradication, reduction of income disparity among the population, applying advanced agricultural technologies, availability of natural resources, and improving human resources are considered as the potential factors for dealing with basic causes (Babu et al., 2014).

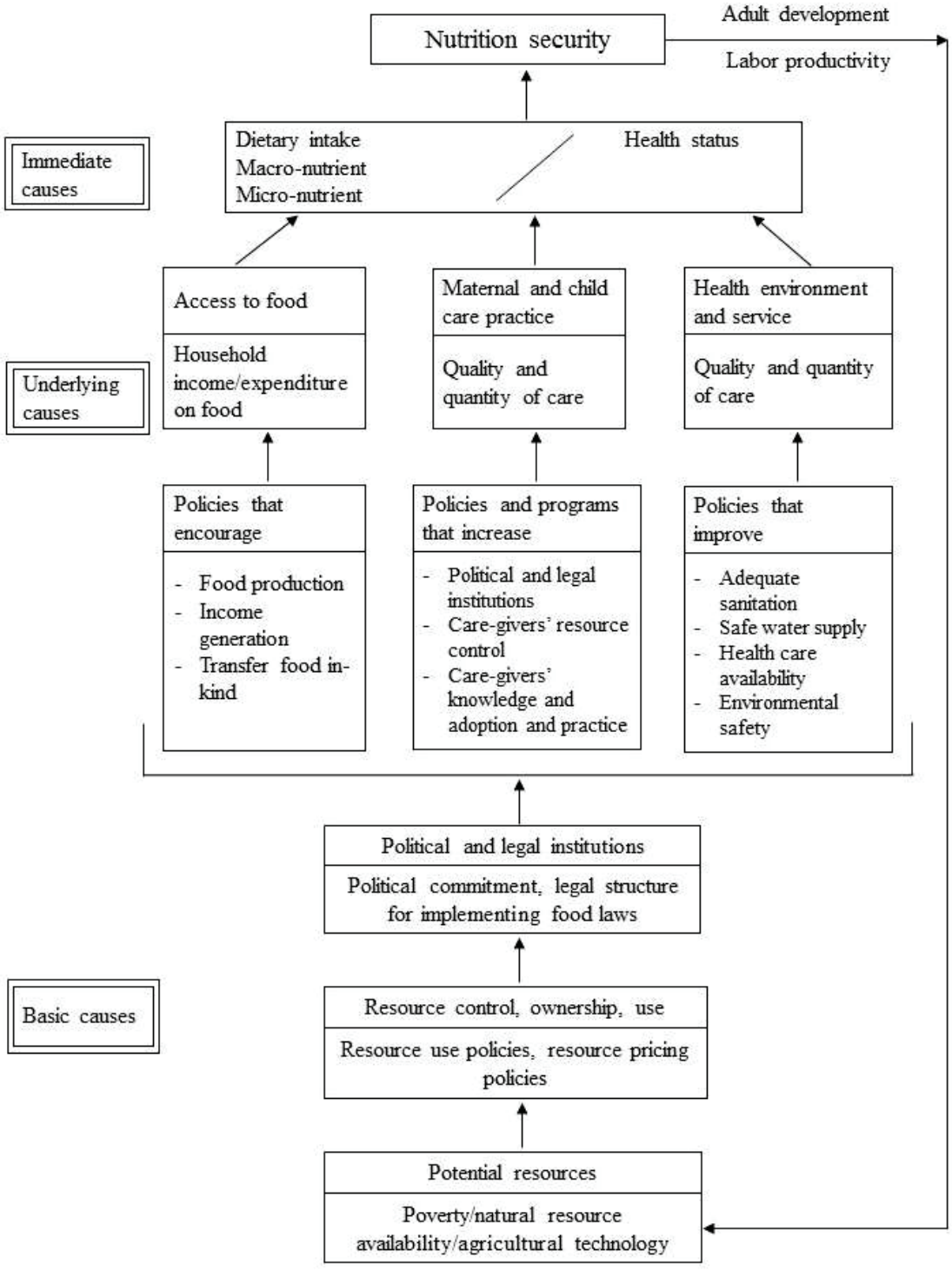

Figure 2.1: A conceptual framework of food and nutrition security

Source: Smith and Haddad, 2000

2.2 Overview of the existing literature of food security indicators

Food security is a multidimensional concept and there is no single indicator can perfectly capture the severity of the problem (Carletto et al., 2013). Thus, along with a conceptual definition, a variety of criteria for assessing it at the household and individual levels have been extensively developed. According to literature review, food security indexes can be classified as direct and indirect indicators (Maxwell and Frankenberger, 1992; Smith et al., 2006 and Zalilah and Geok, 2008). Direct ones are chiefly used in questionnaires to ask about experiences and behavior related to food scarcity, rather than about nutritional status and health conditions. Indirect indicators are sometimes used in questionnaires to gather information on income and spending habits, as well as health and nutritional status. The outcomes of indirect criteria can help infer the seriousness of food insecurity at the household and individual levels.

2.2.1 Direct indicators

Radimer and her colleagues developed the Radimer/Cornell food security measures at Cornell University to evaluate hunger for households, women, and children in the United States (Radimer et al., 1990). Twelve items formed three subscales, each comprised of four elements that cover household food insecurity, women's food insecurity and hunger, and child hunger. Some items were phrased as statements to overcome participants' reluctance to discuss their experiences of hunger. Both adults and children were asked about restrictions on food security, and most items related to anxiety over the quantity and quality of food consumption. The National Health and Nutrition Examination Survey (NHANES) used a similar criterion, the Food Sufficiency Status Questions (FSSQ), to estimate the number of people facing food insufficiency in the U.S. The FSSQ applied to both the household and individual levels.

At the household level, information is collected on perceptions of food sufficiency, the reasons for it (such as a lack of food), and the number of days per

month that people had no food or money to buy it. At the individual level, participants are asked to answer seven questions about the frequency of and reasons for going without food or money, experiences on reducing the number of meals eaten per day, and skipping a meal for a whole day (Briefel and Woteki 1992). This indicator is limited due to a lack of information on the link between FSSQ and dietary intake, nutritional status, and other health conditions.

The Community Childhood Hunger Identification Project (CCHIP) surveys of the Food Research and Action Center (FRAC) provide one of the easiest and fastest measures of hunger and household food insecurity. In face-to-face interviews, eight questions ask whether adults or children in the home have been affected over the past 12 months by a shortage of food due to limited resources. The CCHIP's scale score is based on yes-no questions. A ranking of 1 to 4 shows the risk of hunger, and 5 or more affirmative responses indicate household food insecurity. A prior survey in Pittsburgh, Pennsylvania in the U.S, conducted with 1,080 households where at least one child was under 12, revealed that the mean scale score of the CCHIP was strongly associated with coping strategies and health problems in children (Kleinman et al., 1998).

The U.S. Food Security/Hunger Survey Module (U.S. FSSM) is one of the most reliable indexes, and is widely used to assess household food security. It was first developed in the early 1990s by the Federal Interagency Food Security Measurement Project under the United States Department of Agriculture (USDA), and has been applied annually in the U.S. Current Population Survey (Bickel et al., 2000). The U.S. FSSM is an 18-item questionnaire on food deficits among adults and children due to lack of money and food over a specific period, such as the past 30 days or 12 months. The answers provide a continuous measurement scale score that classifies households into 4 categories: (1) food-secure, (2) food-insecure, (3) food-insecure with moderate hunger, and (4) food-insecure with severe hunger.

The Household Food Insecurity Access Scale (HFIAS), developed by the Food and Nutrition Technical Assistance Project (FANTA), was adapted from the U.S. FSSM. The original 18 items were modified to only focus on a household's adults due to differences in children's age and gender, the number of children in a home, and family structure, which could affect responses to the questions about children. HFIAS has a yes/no response format that is easy to understand (Melgar-Quiñonez et al., 2006). Nine questions relate to experiences of food shortage and the sufficiency of food consumption at the quantitative and qualitative levels. Household food security can be categorized based on the summary of a scale score (Coates et al., 2007). Various researchers have proven HFIAS to be an effective indicator of household food security. For example, Mae et al. (2009) showed that among community health volunteers in Addis Ababa, Ethiopia, the level of food insecurity was negatively linked with dietary diversity, as well as per capita income. Melgar-Quiñonez (2006) found that there was a statistically significant correlation between per capita FE and the HFIAS scale score.

The Coping Strategies Index (CSI) is defined as the behavioral responses needed to deal with food insufficiency at the household level (Maxwell et al., 1999). The CSI is based on the weighted aggregation of information on the severity and frequency of the various coping strategies that households adopt during times of food scarcity. These strategies include eating less preferred food, reducing portions of food, borrowing money for purchasing food, purposely not eating for a day, selling household assets such as livestock or other possessions, lowering children's educational expenses, and short-term labor migration (Maxwell, 1996).

Data collection for this method is simple, quick, and low cost, and takes less time to administer for both respondents and enumerators. The CSI can express the adequacy and vulnerability of households. However, the CSI is difficult to conceptualize, and its outcomes can be misleading, because the gap between wealthy and low-income respondents could reveal the reduction in the amount of food

consumption. In addition, respondents are more likely to report a number of coping strategies in order to receive assistance from the government (Hoddinott, 1999).

Markers of dietary diversity such as the Food Consumption Score (FCS), and the Household Dietary Diversity Score (HDDS), developed by FANTA, are also criteria for quantifying household food security. These two indicators are based on a frequency-weighted dietary diversity score (DDS). Both the FCS and HDDS indicators are less time-consuming, and inexpensive to calculate compare with quantitative methods, such as calorie consumption. The HDDS uses a simple count of 12 food groups that a household consumes over a reference period, typically 1 – 15 days. The number of food items the family uses is calculated; the more times a household consumes food, the more likely it is to be considered food-secure.

The FCS is based on how frequently a person consumes eight food groups (cereals, meat/fish/eggs, milk, beans, vegetables, fruits, sugar, and oil/fats) for a seven-day recall, starting from the date of the survey. Each food group the participants consume is multiplied by its weight, and the results are summed up to create the FCS. The WFP developed the FCS, which has been widely used as a proxy indicator for food and nutrition security (WFP, 2008). Previous studies have shown that the weighted score of the FCS strongly correlates with other food security indicators, such as per capita calorie consumption, food expenditures, and asset index (Hoddinott, 1999; Ruel, 2003; Hoddinott and Yohannes, 2002; Kennedy et al., 2010). Wisemann et al. (2009) argued that the FCS is a superior measure for gauging dietary diversity based on the number of different food group consumed as it can capture the consumption of both specific nutrient types and an overall balanced diet. Pipi et al. (2014) pointed out that individuals will diversify into higher-value and micronutrient-rich foods when they have fulfilled wither basic calorie needs.

In spite of the facts above-mentioned, there are some limits to using the FCS to determine food security, such as lack of information on intrahousehold food consumption as well as the seasonality of food consumption. In other words, FCS

does not shed light on the causes of consumption deterioration, and does not record the amount of food consumed.

2.2.2 Indirect indicators

Calorie availability is measured according to spending and consumption data during the recall period, which usually lasts a day, 1 – 2 weeks, or one month at most. This method has been widely used and perceived as the most acceptable food security measure in the developing world over the past decade (Rose and Charlton, 2002; Haile et al., 2005; Oldewage et al., 2006; Arun and Keshav, 2006; Babatunde et al., 2007; Idrisa et al., 2008; Abebaw et al., 2010; Sisay et al., 2012; Carletto et al., 2013; Kakota et al., 2013; Rufino et al., 2013). The amount of food consumed or bought is gathered over a specific time period. The data can then be converted into kilocalories per capita per day based on demographic information (e.g., the age and sex of all household members). Finally, the data is compared against household and individual energy requirements. Scholars generally consider this criterion to be the most reliable indicator (Chung et al., 1997 and Wiesmann et al., 2009) due to sufficient caloric energy intake, which is essential to maintaining normal body functions for an active and healthy life. In addition, an adequate CI is important for children's growth and development.

Food consumption expenditure (FE) is measured by whether a household is classified as food-insecure, which in turn is based on monthly per capita food spending, and compared to the cost of a minimum food basket. Information on how much a family spends on food is collected over a specific time period, such as one month. In addition, the value of food grown for consumption by household members (e.g., rice, vegetables, and other crops) is taken into consideration. This technique has been extensively used to assess household food security in developed and developing countries alike (e.g., Rose and Charlton, 2002; DoS, 2010; Lo et al., 2012). This method is limited due to a lack of knowledge on the types of food people buy. Some

purchased foods are expensive but provide few calories (such as some animal-based foods). As a result, the FE level might be close to the cost of a minimum food basket, but the quantity of calorie consumption could be inadequate.

Anthropometric measures are commonly used to estimate the prevalence of malnutrition[1] in children under the age of five year. Criterion such as size, weight, and body proportions—including weight-for-age (W/A), height-for-age (H/A), weight-for-height (W/H), and mid-upper-arm-circumference (MUAC)—are widely used to capture nutritional status. Anthropometric indicators include benefits such as low-cost data collection; furthermore, information on nutritional status can be used to target relief operations and monitoring for policy interventions (Maxwell and Frankenberger, 1992). However, the main challenge for this index is that it does not take into account all the dimensions of food security concepts. Hence, it does not always correlate with food availability and access; others factors such as health status, sanitation, and maternity can influence the outcomes of nutritional status.

2.3 Selected literature review on the determinants of food security

Since the mid-1990s, a number of studies have examined the relationship between socio-economic factors and household food security status. Webb (1993) summarized the factors that are associated with food security in accordance with each element of food security. These factors can be grouped into five categories, namely household resources, levels of farm and non-farm production, household income, household and individual consumption, and individual nutrition, as shown in Figure 2.2. Chung et al. (1997) argued that these factors are principally described by theory rather than by a specific set of empirical studies. In fact, results of factors influencing household food security in each area are different based on locations and socioeconomics context as the people of each area have a unique way of living.

[1] Malnutrition refers to all deviations from adequate nutrition, including undernutrition and over-nutrition, resulting from inadequacy (or excess) of food and/or disease (MoH and LSB, 2012)

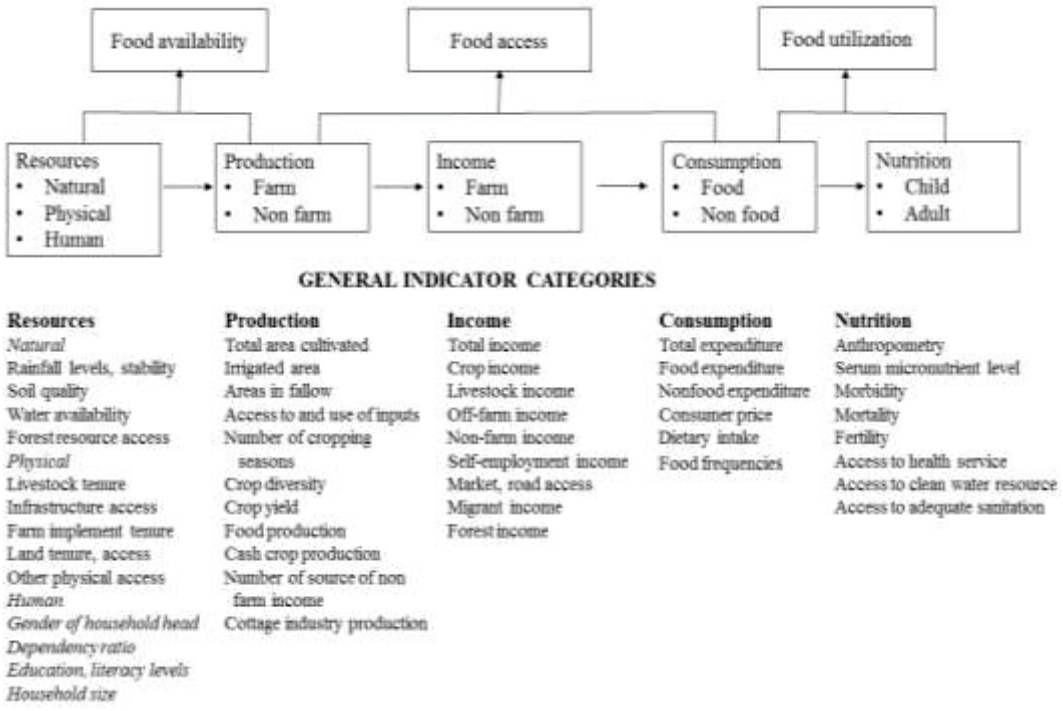

Figure 2.2: List of indicator in association with each element of food security
Source: Webb et al., 1993 and Chung et al., 1997

For instance, Feleke et al. (2003) carried out the research in Ethiopia to investigate the relative importance of supply-side and demand-side factors of food security. The study found that technology adoption, farming system, farm size, and land quality positively correlated with the probability of household being food-secure. In contrast, demand-side factors such as household size and access to market were not significant effect, meaning that the supply-side factors are more powerful than the demand-side factors for determining household food security.

Babatude et al. (2007) used logistic regression model to examine the determinants of food security status of rural farming households in Kwara State of Nigeria. Per capita calorie intake was used as food security indicator. The results revealed that about 63% of respondents were food-insecure as their daily calorie intake was lower than the recommended daily calorie intake (2,260 kcal/capita/day).

The analysis of logistic regression model showed that educational level of household head, households monthly income, quantity of food from own production had positive and significant association with food security status, while age of household head was negative and significant effect on food security. The policy implications of this study focused on providing agricultural inputs with affordable prices in order to increase farm size and food production, and promoting education programs on health and birth control to reduce the consuming of unbalanced diets and over family size.

Sultana and Kiani (2011), using a logistic regression model, examined the determinants of household food security in Pakistan. The analysis of this study based on micro data taken from Pakistan Social and Living Standard Measurement survey (2007-2008). Food consumption expenditure per adult equivalent was used to classify food security status. The results showed that education attainment of household head positively affected to household food security, while dependency ratio and place of residence had a negative association with food security, indicating that those who live in urban areas seem to be food-insecure as compared to those who live in rural areas. This was because people living in urban areas were likely to have less assets ownership, and mainly engaged in seasonal employments and informal sectors.

Joshi (2011) studied the determinant of food insecurity in Nepal. He used daily calorie intake per adult equivalent to measure food security status of 209 households. The results showed that about 51% of the households were food-insecure households. Larger household size and high dependency ration statistically associated with the probability of being food-insecure. On the other hand, male-household head, involvement in group, total land holding, and access to irrigation had a negative correlation with food insecurity.

Rahim et al. (2011) examined the factors influencing household food security status in Northwest of Iran. Six questions derived from U.S.FSSM were used to classify household food security status into three categories: high food security, low food security, and very low food security. Out of the total respondents (2,442

households), 970 households (39.7%) had low food security and 488 households (20%) had very low food security. The variables that had significant effect on food insecurity status were distance from city, residential infrastructure, number of centers that provides food, family size and education level.

Kakota et al. (2013) examined household vulnerability to food insecurity and its determinants in two semi-arid districts in Malawi. The vulnerability of household to food insecurity was measured by annual maize available per adult equivalent. Results showed that the determinants of household vulnerability to food insecurity were household income, household member, farmland size, access to on-farm employment, access to climate information and adoption of modern agricultural technologies. Based on the findings, the study recommended policymakers to provide farm inputs and credits facilities to low income households to enhance food security.

The other factors that are significantly correlated with food security included home ownership, amount of fertilizer application, land fertility, household income, farming experience, crops yield, and per capita production (Olson et al., 1996; Rose et al., 1998; Haile et al., 2005; Keshav and Arun, 2006; Edwards et al., 2007, and Oni et al., 2010).

2.4 Overview of food security and rice sufficiency in Laos

As mentioned in Chapter 1, although the Lao economic growth has progressively achieved with an average of 8% per year and the poverty incidence has declined from 39.1% in 1992 to 27.6 in 2008, food and nutrition security remains a concern. Table 2.1 shows the prevalence of food insecurity and the average of rice insufficiency month in Lao PDR based on the LECS 1997/1998 – 2007/2008. Overall, the rate of food insecurity has fluctuated in the past decade. The proportion of food-insecure households in nationwide reduced from 32.5% in 1997/1998 to 19.8% in 2002/2003, while the trend increased to 24.6% in 2007/2008, possibly due to household were likely to spend more on non-food consumption rather than food

consumption. In other words, there has been a slow progress in improving food insecurity, socially in rural areas. A recent survey of LECS (2007/2008) showed that the prevalence of food insecurity in the rural areas of Laos was considerably high (27.1%) compared to the urban areas (18.5%). Higher rate of food insecurity was also found among households in central (28.1%) and northern regions (24.8%). Within agro-ecological zone, households living in upland areas were more likely to be food-insecure (38.1%) compared with midland (25%) and lowland areas (18.5%). Many upland households, mainly engaged in shifting cultivation, are likely to experience food shortage due to low household cash income and low upland rice production, resulting from poor soil fertility, pervasive weeds and pests, and lack of livestock (see Appendix 1 for more details). Sengxua et al. (2009) reported that four provinces in the northern region namely Phongsaly, Oudomxay, Luangprabang and Huaphanh—where large of land are occupied by mountains—were not able to produce enough rice to support local consumption needs. On the other hand, the southern provinces located along the lowland areas of Mekong River, namely Saravan, Vientiane, Savannakhet, Bolikhamxay, had sufficient rice with the high surplus of rice production.[2]

As rice is staple food and contributes about 70% of calorie intake (Pandey, 2001), rice self-sufficiency has long been used as a measure of food security (Yasuyuki and Rambo, 2004; Douangsavanh, 2006; Manivong and Douangsavanh, 2007; Sparkes, 2013 and Yamada, 2014). More than 90% of Lao people eat glutinous rice in daily three meals. DOS (2010) reported that the average months without rice has gradually reduced from 4.1 months per year in 1997/1998 to 2.4 months per year in 2007/2008 (Table 2.1). In the reality, however, the situation of rice shortage is more severe, which is affected not only to highland and upland households but also among lowland households. Manivong and Douangsavanh (2009), which undertaken

[2] Sengxua et al. (2009) estimated per capita rice requirement by province based on the nationwide rice production in 2008. A total of paddy rice 350 kg per capita per year was used as a standard to classify which province is surplus of rice production.

"benchmark rice production survey" with 321 lowland farm households in Savannakhet Province in 2007, indicated that 40% of lowland households experienced rice shortage with an average of 5.4 months per year, which the period of rice shortage ranged from 4-9 months. Yamada (2014) reported that rice deficit in lowland areas was mainly due to low rice yield, caused by water shortage, labor shortage as well as pests and diseases.

Table 2.1: Food insecurity and rice insufficiency in Lao PDR (%)

	Food insecurity			Rice sufficiency (months per year)		
	1997-98	2002-03	2007-08	1997-98	2002-03	2007-08
Residence						
Rural	34.5	21.5	27.1	4.7	2.1	2.6
Urban	22.3	14.3	18.5	4.0	2.9	1.8
Region						
North	36.1	23.3	24.8	2.2	2.3	2.6
Central	32	19.8	28.1	4.6	3.4	2.4
South	38.8	18.7	21.8	5.4	3.0	2.6
Elevation						
Lowland	n/a	16.3	18.5	n/a	2.5	2.1
Midland	n/a	22.8	25.0	n/a	3.4	3.6
Upland	n/a	25.9	38.1	n/a	2.6	2.2
Total	32.5	19.8	24.6	4.1	2.8	2.4

Source: Author's calculation based on LECS (1997/1998; 2002/2003, and 2007/2008)

Another assessment on food security in Laos is the 2007 WFP report—entitled "A Comprehensive Food Security and Vulnerability Analysis" or CFSVA. The main objectives of the study were to provide a comprehensive analysis on the overall national food security situation throughout the country and to address the questions on who is vulnerable to food insecurity, how many are they, where are they located, why are they food-insecure, and how food or other forms of assistance can assist to reduce food insecurity and support their livelihoods. The findings showed that 13.4% of the Lao people were food-insecure, as measured by FCS. The majority of food-insecure households lived in mountainous areas, and relied on upland farming. Most

of them were farmers with limited activity in fishing and hunting. Moreover, they were likely to be unskilled labor, and the educational level of the household heads was low (WFP, 2007). The main conclusions of this study were summarized as follow:

1. Chronic malnutrition in rural areas of Laos is considerably high
2. The economic growth over the past decades does not affect to the improvement of nutritional status of the Lao rural population
3. 13% of rural households have poor food consumption
4. The Sino-Tibetan ethnic groups are the most disadvantaged and food-insecure, followed by the Hong-Mien and the Austro-Asiatic. These ethnic group mainly live in the northern highlands and the central and southern highland.
5. Fat intake is relatively lower compared to other food groups. Use of vegetables oil in the diet is rare, and most fat comes from animal sources.
6. Access to wild meat and aquatic resources (animal protein) is crucial for ensuring food security for vulnerable groups.

When comparing food insecurity from different surveys, it is important to note that the rate of food insecurity, measured by WFP based on FCS, was relatively low (13.4%) compared with the NSC's estimation of 24.6% (based on FE). In the provincial level, the largest proportion of food-insecure households (based on FE) was in the province of Sekong (50.3%), Xiengkhuang (45.6%), Huaphanh (39.4%), and Phongsaly (31.2%). Whereas, the highest prevalence of food insecurity (based on FCS) was in the province of Bokeo (41.8%), Saravan (30.7%), Xiengkhoung (25.2%), and (23.7%), as shown in Figure 2.3. These two studies showed contrasting results of food insecurity. Given this circumstance, policymakers and development practitioners are likely to have questions on which indicator is more reliable and suitable to use in Laos. Before designing policies and programs to improve food insecurity,

understanding the concept associated with each indicator of food security is therefore necessary.

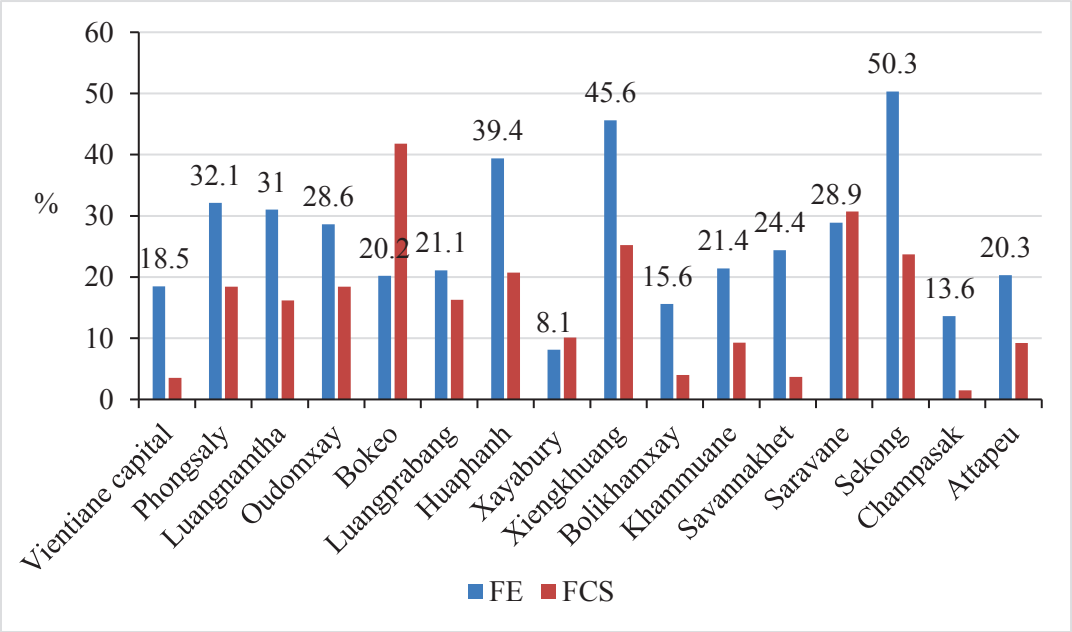

Figure 2.3: A comparison of food insecurity measured by FE and FCS

Sources: WFP (2007) and DoS (2010)

2.5 Nutrition in Laos

Given the linkage between nutrition and food utilization, understanding widespread malnutrition in Lao PDR is necessary. Chronic malnutrition is widely considered to have a long-term impact on socioeconomic development. Foppes (2008) pointed out that stunting at early age is directly linked to poor physical development and the development of the brain and the ability to learn. A recent report of Lao Social Indicator Survey or LSIS 2011/2012 concluded that malnutrition rate in Laos remained considerably high. In overall, one-quarter of children under the age of five year were underweight (26.6%). Nearly half of children (44%) were stunted and 6% of children were wasted (too thin for their height). Children living in rural villages, in northern and southern regions of the country are more likely to be stunted and

underweight than those living in urban, central, and lowland areas. As can be seen in Table 2.2, the incidence of stunting in rural areas was comparatively higher (49%) than urban areas (27%). In addition, approximately 51% and 48% of children living in northern and southern regions were respectively stunted, especially in Phongsaly, Huaphanh and Sekong Provinces. With regard to underweight, high rate of underweight was found among children in southern region (35%), while in the central and northern regions accounted for 23% and 26%, respectively. LSIS 2011/2012 also showed the incidence of wasting was considerably high in southern region (7.9%) compared to northern (5.3%) and southern (5.4%).

The causes of malnutrition in Lao PDR are multidimensional. WFP (2007) highlighted inadequate care and feeding practices, particularly breastfeeding and weaning had a significant correlation to malnutrition of infants in Laos. Some ethnic groups women tend to not eating fish and meat after giving birth, resulting in poor quality of the mother milk. Permite (2006) also pointed out that wrong combination of food was one of the factors affecting malnutrition and poor childhood development in Lao PDR; hence promoting diversity of food consumption by increasing intake of protein and micronutrient such as fish, meat and vegetables would be useful. Pernille and Phithayaphone (2005) suggested the possible options to improve rural nutrition by growing diversity of fruits and vegetables in home garden. Fruits and vegetables are rich in micronutrient and increase diversity of diet, which can prevent various diseases and malnutrition.

Risk and Vulnerability Survey, or RVS (MAF, 2013) pointed out that the reduction of stunting and underweight significantly associated with improved sanitation and hygiene practices, better access to nutrition knowledge, and improved education level household head. Moreover, increasing food consumption score from low level to high level leads to reduce the prevalence of stunning and underweight by 7% and 4% respectively. Another key point to remember is that income growth is not sufficient to tackle the problem of malnutrition, it is important to consider the other

complementary factors, such as availability of health care service, maternal education, effective child-care, access to clean water and sanitation and household food security (Babu et al., 2014).

Table 2.2: Prevalence of malnutrition in children under 5 years (%)

Categories	Stunning (Height for age)	Underweight (Weight for age)	Wasting (Weight for high)
Residence			
Urban	27.4	16.1	5.4
Rural	48.6	29.3	6.1
Rural with road	47.8	29.0	6.1
Rural without road	53.8	31.5	5.7
Region			
North	51.4	26.2	5.3
Central	38.1	23.1	5.4
South	46.6	34.7	7.9
Total	44.2	26.6	5.9

Source: MoH and LSB, 2012

2.6 Poverty situation in Laos

While food insecurity and poverty do not share the same meaning, they both are a strongly correlated phenomenon. Besides measuring food insecurity, understanding poverty is important in improving the living conditions of rural people (Joshi, 2011). In Laos, poverty or *"Thuk"* is defined as the situation of household or individual who are deficient in a certain of food (2,100 kcal/capita/day), adequate clothing, permanent housing and access to health, education and transportation services" (GoL, 2012). According to recent report of DoS (2010), poverty incidence has been gradually declining from 39.1% (1997/1998) to 27.6% (2007/2008); the government expected this to fall to 19% in 2015. However, the government attempts to challenge the problem centered on the high level of poverty in rural areas and the poor living conditions of rural people has not improved for several generations (Rigg, 2012).

Although the poverty rate in rural areas reduced from 42.5% in 1992/1993 to 31.7% in 2007/2008 (Table 2.3), it remains high compared with 17.4 % in urban areas (DoS, 2010), meaning that rural people—mainly belong to ethnic minorities group—are unlikely to benefit from the economic growth owing to geographic constraints (Kakwani et al., 2001). The reasons of poverty among rural population are varied. Oraboune (2008) reported that poor Lao households were characterized by the amount of rice insufficiency, lack of land for cultivation, natural disasters (flood and drought), livestock loss, less water for agriculture, and less cash investment to make livelihood improvement. Anderson (2006) and Phomtavong (2010) indicated that non-irrigated land area, grazing land area, female literate levels, household business, education, agricultural mechanism, dependency ratio, male head of household, age of household head, and number of livestock were significantly correlated with poverty in Laos.

Table 2.3: Estimates poverty incidence by region in Laos (%)

Overall poverty incidence	1997-98	2002-03	2007-08
Residence			
Rural poverty	42.5	37.6	31.7
Urban poverty	22.1	19.7	17.4
Region			
North	47.3	37.9	32.5
Central	39.4	35.4	29.8
South	39.8	32.6	22.8
Total poverty	39.1	33.5	27.6

Source: Author's calculation based on LECS, 1997/98; 2002/03; 2007/08

2.7 Agricultural development plans and trend of rice production

2.7.1 Government plans on agriculture and food security

The goals and visions of Lao government on agriculture and food security are primarily focused on ensuring stabilization of food supply, potential agricultural products, and sustainable agricultural development together with rural development (MAF, 2015). MAF and related ministries approved the food security tactics from

2001 – 2010 in October 2000. The strategy—mainly focused on rice self-sufficiency as it accounts for more than 70% of CI— was broken down into three periods and included the following aims:

- The period 2001 – 2005: To produce enough food and stabilize food production, with an average annual production of 450-500 kg of paddy rice per capita; to resolve the problem of food circulation in areas with poor accessibility; and to improve the level of food security at the household level.
- The period 2005 – 2010: To achieve food security by producing an average annual per capita production of 500 kg paddy rice per capita.
- The period 2010 – 2020: To achieve and maintain nutritional security in all respects, with an average CI of 2,600 – 2,700 kcal/person/day. With this goal, rice and carbohydrate should accounts for 64% of total calorie intake, followed by meat, fish and egg (9%), vegetables, fruits and bean (3.5%), and fats, sugar and milk (23.5%). Furthermore, MAF revised the strategies for the period 2020, which the proportion of calorie intake derived from rice and carbohydrate should reduce from 64% in 2020 to 53% in 2025, while the proportion of egg and fish should increase to 10%, vegetables, fruits and bean (4%) and fats, sugar and milk account for 33% (MAF, 2015).

Table 2.4 summaries the achievement of agricultural sector related to food security and proposed plan to 2025. Since 2000, the country has achieved rice-sufficiency and the tendency of rice production has continuously increased. In 2012, the nationwide rice production was estimated about 3.5 million tonnes with an average consumption of 520 – 540 kg/person/year. Other targets such as crops, vegetables, meats and fish were also reported to increase from 2006 to 2012. The supply of meat, fish and egg increased from 227,000 tonnes in 2006 to 314,690 tonnes in 2012. Accordingly, an average annual consumption of meat, fish and egg increased from 39.6 kg/person in 2006 to 48.2 kg/person in 2012.

According to the plans for 2020, an average annual consumption of meat, fish and egg is expected to increase to 65 kg/person in 2020. Of these, per capita fish consumption is 30.6 kg/year, followed by pork (13 kg/year), poultry (9 kg/year), beef (6kg/year), and egg (6 kg/year). In addition, per capita consumption of vegetable and fruit is expected to increase 44 kg/year and 8.1 kg/ year, respectively. To achieve the goals, there is a need to increase the production of rice, vegetables, crops, and meat and fish by 2020, as showed in Table 2.4.

Table 2.4: Summary of agriculture and food security plans

Year	Achievement in 2012	Plans for 2025
Rice production	- Total rice production (3.5 million tonnes), 80% derived from rain-fed lowland rice, followed by irrigated rice (15%) and upland rice (5%). - Per capita rice production: 520 – 540 kg/person	- Increase 4.7 to 5 tonnes of rice production (70% are glutinous rice and 30% for non-glutinous rice). - Rice for consumption 2.5 million tonnes - For exportation and market: 1 – 1.5 million tonnes - Storage: 0.4 million tonnes - Seed: 0.1 million tonnes - Processing: 0.5 – 0.6 million tonnes
Crops and vegetable production	- Sweet corn:181,000 tonnes - Root crops (exclude cassava): 255,000 tonnes - Fruits (e.g. banana, papaya, pineapple, water melon): 647,000 tonnes - Vegetables: 910,100 tonnes	- Sweet corn: 228,000 tonnes - Root crops: 304,000 tonnes - Fruits: 800,000 tonnes - Vegetables: 1.5 million tonnes
Livestock and fishery	- Meat and egg:178,690 tonnes - Fish: 136,560 tonnes - Average consumption (meat, fish and egg): 48.2 kg/person/year	- Meat and egg: 258,000 tonnes - Fish: 229,500 tonnes - Average annual consumption of meat, fish and egg: 65 kg/person/year.

Source: MAF, 2015

2.7.2 Trend of rice production and the impact of flood on rice cultivation

Rice production dominates more than 80% of the total crop areas in Lao PDR. Rice is cultivated in the three agro-ecosystems: rain-fed lowland, rain-fed upland, and irrigated lowland. Rain-fed lowland rice (or paddy rice) utilizes water from rainwater as it is normally cultivated in the wet season (June to November). In this system, rice is grown in bunded fields and soil is flooded for at least part of the crop season. With irrigated lowland, rice is grown during the dry season (December to April), which irrigation water is used. The rice varieties planted in this season are non-photosensitive with the maturity ranging from 120 to 145 days. The majority of rain-fed lowland and irrigated rice areas are located in central and southern regions along the Mekong River. In contrast, rain-fed upland or upland rice, which refers to the farming system practicing on sloping field through slash-and-burn or swidden systems, is mainly practiced in the northern region and along the southeast region. In this ecosystem, upland rice is grown in unbunded field and water come from rainfall.

Over the last decades, the nationwide rice harvested area steadily increased from 460,000 ha in 1995 to 940,000 ha in 2013 although it had fluctuated from 1985 to 1995 (Figure 2.4). Rice production has undergone tremendous changes since the 1990s. On average, the nationwide rice production was approximately 1.3 million tonnes per annum during 1985-1998. A significant breakthrough occurred in the mid-1990s, which rice production increased from 2.4 million tonnes in 2002 to 3.4 million tonnes in 2013 (Figure 2.4). This is a consequence of increasing rice yields. The average rain-fed lowland rice yield raised from 2.67 tonnes/ha in 1985 to 4 tonnes/ha in 2013, with an average growth rate of 2% per year. Moreover, the yield of irrigated lowland rice steadily changed from 2.65 tonnes/ha in 1985 to 4.76 tonnes/ha in 2013 owing to the adoption of improved rice varieties (MVs), utilization of chemical fertilizer, availability of irrigation facilities, and the government commitment to support rice production (ADB, 2006).

In the early 1990s, the rice varieties grown were mostly traditional varieties, with the MVs accounting for only 2% - 5% of the total rice area. Subsequently, the adoption rate of MVs widely expanded up to 80% in 2002, mainly in the lowland rice areas in the Mekong River Valley (Inthapanya et al., 2006). The findings, which conducted in Savannaket and Champasak Provinces, showed that the adoption rate of MVs in the dry season was almost 100%, and about 96% was in the wet season (Siliphouthone et al., 2012). The popular rice varieties are varied depending on the locations in each area. For instance, Phon Ngam 3 (PNG3) is the most famous rice varieties in Champasak Province, followed by Phon Ngam 6 (PNG6) and Thadokkham 1 (TDK1). On the other side, Tasano 3 (TSN3), RD10 and TDK1 are among the famous rice varieties growing in Savannaket Province.

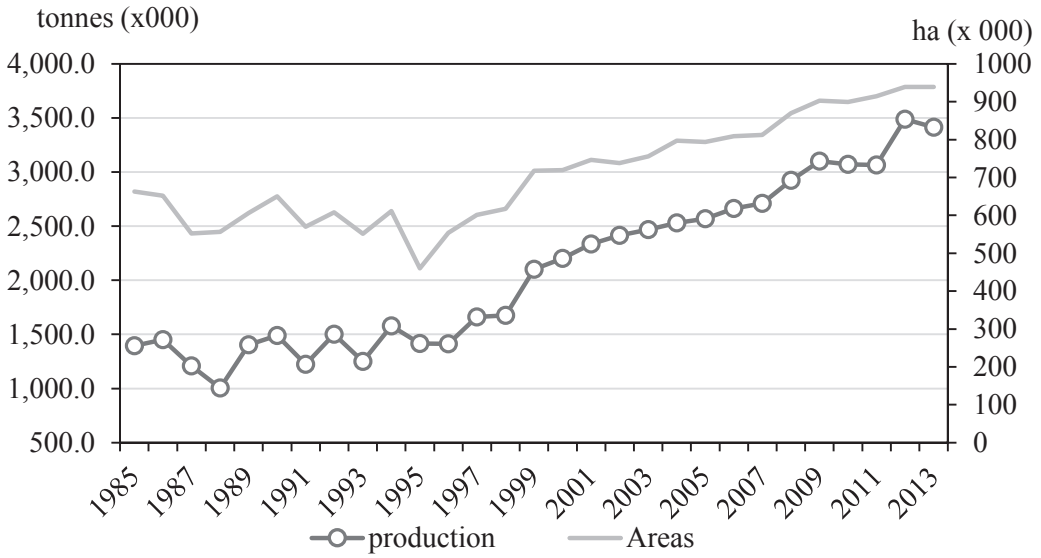

Figure 2.4: Overall rice area and rice production during 1985 – 2013

Source: DoA (2005 – 2013)

Figure 2.5 presents data relating to the rice area from different agro-ecological zones. According to the most recent data in 2013, rain-fed lowland rice dominates about 77.5% of the total harvested rice areas in Laos, followed by upland rice (12.6%) and irrigated lowland rice (9.8%). From 1985 to 2004, there was a marked change in

the areas of upland rice, which declined from 270,000 ha in 1985 to 120,000 ha in 2004. Accordingly, the land available for shifting cultivation became stagnant due to the ban of government to stabilize shifting cultivation farming. By contrast, the cultivated area of irrigated rice slightly increased from 53,000 ha in 1998 to 92,200 ha in 2013 owing to the expansion of irrigation systems in the lowland areas.

Regarding rice production from each agro-ecosystem, the large share of rice production was under the rain-fed lowland, accounting for 80% (2,734,900 tonnes) of the total production, while the rice production derived from irrigated areas was 439,000 tonnes or 12.8% and upland rice (246,000 tonnes or 7.2%), as showed in Figure 2.6. There was a gradual change in the tendency of rain-fed lowland rice production from 1995 to 2013. In some years, however, rice production originated from rain-fed lowland rice was either stagnant or decreased due to natural disasters (droughts and floods). In addition, the other factors that cause low rice yield were soil infertility and pests and diseases (Schiller et al., 2001; Sengxua et al., 2009).

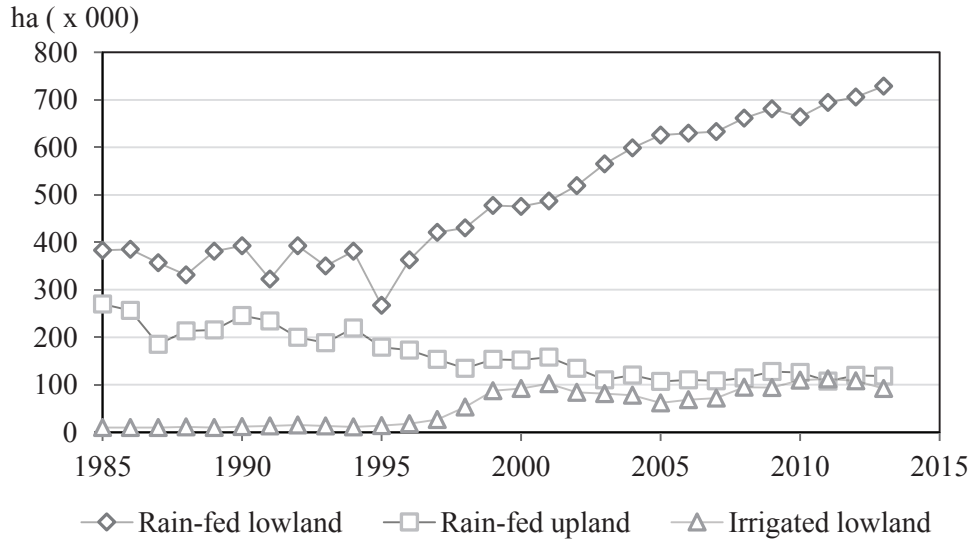

Figure 2.5: Trend of rice harvested area in different ecosystems

Source: DoA (2005 – 2013)

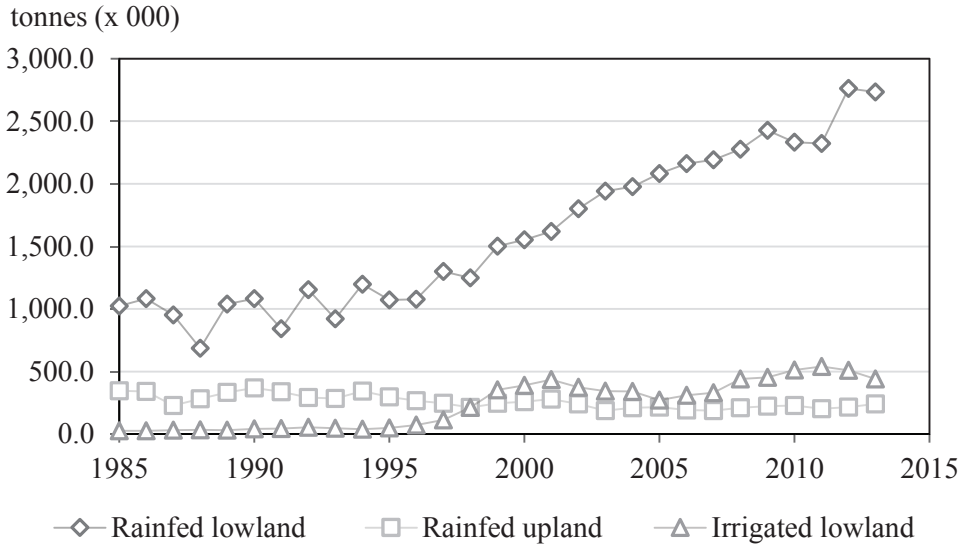

Figure 2.6: Rice production in different ecosystems

Source: DoA (2005 – 2013)

As mentioned earlier, seasonal flooding is one of the major abiotic stresses on lowland rice production. Table 2.5 shows the damaged areas caused by floods in the wet season from 1994 to 2013. In past twenty years, large rain-fed lowland were affected by flooding on thirteen occasions. In 1995, nearly 30% (about 55,000 ha) of the planted areas of rice in the central region was severely affected. In 1996, 18.7% (23,720 ha) of the planted areas in southern regions was completely damaged compared with 0.5% (353 ha) of the planted areas in northern region. The large proportion of farmlands in central and southern regions are susceptible to flooding due to lower terrace nearby Mekong River and its tributaries, while lowland rice areas in the northern is usually located in the high terrace along the mountains.

Other severe damage of flooding on rice production was in 2009, 15,464 ha or 8% of the rice planted areas in southern region was heavily destroyed by Typhoon Ketsana. Similarly, in 2011, 7% (14,062 ha) of planted areas in southern region—mainly in Champasak Province—was severely damaged by Tropical storms "Haima" and "Nok-Ten". More recently, in 2013, southern region was heavily hit by a tropical

depression, which 11.5% (24,782 ha) of the rice planted rice was completely damaged. These floods are primarily caused by prolonged heavy rain during annual monsoons in the southwest and northeast. The heavy rainfall causes the waters of the Mekong River and its tributaries to rise to a dangerous level. In addition, the UNDP (2011) has claimed that rapid deforestation, insufficient dyke protection along the main rivers, poor functioning of water control gates, and poor land use planning are key contributors to flooding in Laos. Various ministries, line agencies, and international organizations have been assigned the responsibility of preventing floods and mitigating their effects. For instance, the MAF is responsible for reducing deforestation, managing watershed, and implementing irrigation systems; the Ministry of Energy and Mines (MEM) controls the effects of floods through the construction and utilization of downstream dams; and the Prime Minister's Office oversee the entire system of flood responsibility. Despite these institutional responsibilities, inadequate funding and general lack of flood countermeasures restrain the implementation of effective flood management practices in Laos.

Table 2.5: Damaged areas by floods in the wet season from 1994 - 2013

Year	Northern ha (%)	Central ha (%)	Southern ha (%)	Total ha (%)
1994	4,464 (8.3)	28,783 (13.7)	3,135 (2.6)	36,382 (9.5)
1995	1,500 (2.5)	55,061 (29.0)	5,759 (4.9)	62,820 (16.9)
1996	354 (0.5)	41,863 (15.7)	23,720 (18.7)	65,937 (15.3)
1997	225 (0.3)	26,200 (10.2)	6,750 (5.2)	33,275 (7.9)
2000	20 (<0.1)	28,350 (10.6)	14,530 (11.0)	42,900 (9.0)
2001	240 (0.3)	30,193 (11.4)	11,790 (8.2)	42,223 (8.7)
2002	1,810 (2.2)	24,151 (8.5)	8,103 (5.3)	34,064 (6.6)
2006	1,098 (1.2)	300 (0.1)	4,735 (2.6)	6,133 (1.0)
2007	1,170 (1.2)	16,123 (4.5)	9,765 (5.3)	27,058 (4.3)
2008	1,018 (1.0)	35,370 (9.4)	818 (0.4)	37,206 (5.6)
2009	430 (0.4)	7,273 (1.9)	15,646 (8.0)	23,349 (3.4)
2011	579 (0.6)	81,350 (20.8)	14,062 (7.0)	95,991 (13.8)
2013	1,563 (1.5)	19,120 (4.7)	24,782 (11.5)	45,465 (6.2)

Source: DoA, 2006 – 2013 and Shiller, 2012

CHAPTER 3

METHODOLOGY

3.1 General background of the survey areas

This study was undertaken in the provinces of Sekong and Champasak, which are located in southern Lao PDR (Figure 3.1). Champasak is well known as the most developed province of the southern region; its income per capita increased from 730 USD in 2008 to 1,514 USD in 2013. It has a total areas of 15,429 Km^2 with the total population of 670,122 in 2012. Rice cultivation in the lowland areas is the main livelihood activities. The total rain-fed lowland rice areas of this province covers 106,380 ha, and the average rain-fed lowland rice yield is 4.38 tonnes/ha (DoA, 2012). Agricultural productivity in this province is vulnerable to climate change. Rice and other crops have recently faced threats from increasing rainfall (+175 mm/year) and temperature (+2.5^oC mean annual temperature). Rainfall variability is the largest among the provinces in Lao PDR (1,464 mm in 2010 and 2,182 in 2011) (DoS, 2012). In addition, nearly 8% of all households in this province (8,575 households) live below the national poverty line. Inequality of poverty between urban and rural areas remains high—5,867 households in the rural areas are poor as compared with 2,770 households in the urban areas (DoS, 2010).

Sekong Province has an area of 8.742 km^2 comprising 229 villages that are home to 17,158 households with total population of 103,326 in 2012. This province is administratively divided into four districts including Thataeng, Lamam, Kaleum and Dakcheung. Despite of its availability in term of natural resources such as agricultural land for coffee growing, rivers, and forestry, Sekong falls in the list of the poorest provinces in Lao PDR as the poverty incidence accounts for 51.8% in 2007-08 and the annual per capita GDP was only 550-600 USD. The eradication of poverty

is unequal across districts, and a number of poor households are suffering from very low living standards, mainly in the mountainous villages. In 2012, Kaluem and Duchueng districts remained with the highest proportion of poor households in the province which accounted for 61.7% and 56.7% of total households. Poor road accessibility especially during the rainy season is the major constraint for development in these two districts. Also, in this province, people from several small mountainous villages were moved to villages in the lowland areas, which have more opportunities to access social services.

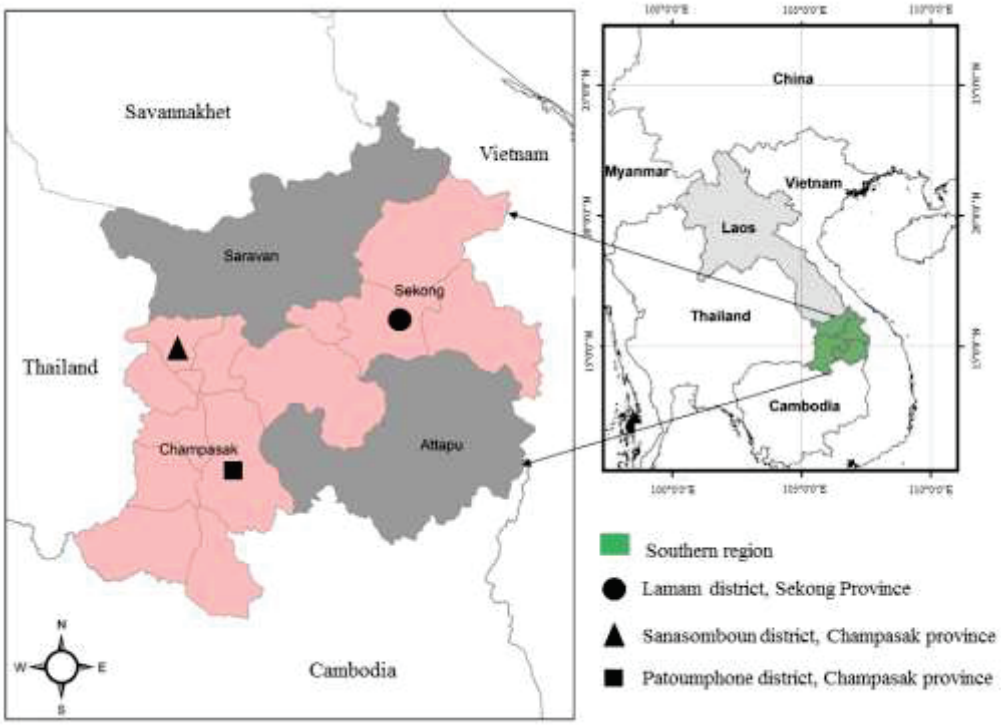

Figure 3.1: Study areas

3.2 Villages and households sampling

A purposive sampling method was used to select the study village, while a random sampling methods was used for selecting respondents in each village. In Champasak Province, four lowland-villages in Pathoumphone District and one flood-

prone village in Sanasoumboun district were covered the survey. In Sekong Province, the survey was carried out in the one remote upland village and a lowland village in accordance with the purpose of the study. A total of 309 households were surveyed using structured questionnaires. Table 3.1 presents the name of the villages covered by the survey, the number of respondents, and the farm characteristics in each village.

Table 3.1: Characteristics of sample village in different agro-ecological zone

Zone	Village	District&Province	Main characteristics	N	Chapter
1	Tokongkeo	Lamam, Sekong	Located in the mountains. Accessible by road only in the dry season. Rice is grown in both the rainfed upland and the rainfed lowland. The people collect NTFPs. District officials regard this village as poorer than villages in other zones.	60	Chapter 4, 5 and 6
2	Nathong Huaykoh	Pathoumphone Champasak	Located in the lowlands near forested mountains. Accessible by dirt roads in both the wet and dry seasons. The people only grow rainfed lowland rice and collect NTFPs. These villages are regarded as poor village. Non-rice crops and vegetables are grown in small home gardens.	58 30	Chapter 4, 7, and 8
3	Nongkhae Tomoh Phone	Pathoum-phone Champasak Lamam Sekong	Located along and near the main road, these villages have good irrigation systems. The people grow rice in the lowland areas in both the wet and dry seasons. Non-rice crops and vegetables are grown in small home gardens.	33 10 18	Chapter 4
4	Khili-Khamyard	Sanasomboun, Chapasak	Located along the Xedon river and flood-prone areas. The people grow rice both the wet and dry seasons. Rice cultivation is susceptible to flood.	100	Chapter 9
	Total respondents			309	

3.3 Data sources and collection

The data used in this study is mainly based on primary data collected through household survey. The data collection was undertaken in cooperation with local relevant offices in each district, such as the District Agriculture and Forestry Extension Offices (DAFOs), District Rural Development and Poverty Eradication Offices, and Healthcare Center, and Regional Rice Research Center. The household surveys were carried out in different period of time during the January 2013 to September 2015. Before the field surveys were undertaken, the questionnaire was translated from English into Lao language and pretesting questionnaire was also conducted. The enumerators—local healthcare officers and agricultural extension workers—were oriented to understand the research objectives, and trained on how to use questionnaire in order to obtain usable data from the respondents. Additionally, personal observation, focus group discussion with informal village committees, and key informants were carried out to gather additional information (Figure 3.2)

Secondary data was also gathered from academic articles and papers, books, working papers, research reports, statistics reports from relevant departments, and government and non-government documents. Most importantly, the data of household surveys conducted by National Rice Research Program was used to compare the effect of flood on household food economy and food security (please see the data collection in Chapter 9 for more detail).

Figure 3.2: Individual interview and focus group discussion

3.4 Data analysis

This study particularly depends on quantitative analysis, in which the data gathered from field surveys. Computer software packages such as Microsoft Excel was used for data entering, while data analysis was done using Statistical Packages for Social Science (SPSS) and STATA. Basically, this study used simple descriptive analysis such as frequencies, percentage, mean, and cross tabulation. Specifically, the statistical and econometric methods include binary logistic regression, Ordinary Least Squares (OLS) regression, multiple linear regression model, sensitivity and specificity analysis, and panel regression analysis (Table 3.2). The model specification of each analytical method is discussed in more detail in accordance with the specific objectives of each chapter.

Table 3.2: List of analytical tools applied in each chapter

Analytical tools		Purposes	Chapters
1) Descriptive statistics	1. Mean 2. Frequencies 3. Percentage	Describing the characteristics of farmers, percentage of food security status and the coping strategies that farmers used	Chapter 4, 5, 6,7,8 and 9
	4. Pearson correlation and cross tabulation	The link between benchmark indicator and alternative indicators	Chapter 4
2) Empirical analysis	1. Sensitivity-specificity analysis	The nearest classification of alternative food security indicators with CI	Chapter 4
	2. Binary logistic regression	Factors affecting household food security	Chapter 5 and 7
	3. Multiple linear regression	The association between the number of coping strategies that farmers used and socio-economic characteristics	Chapter 5
	4. Panel data regression	Factors contributing to household income change	Chapter 6
	5. Ordinary Least Squares (OLS)	The effects of having home garden on dietary diversity score	Chapter 8

CHAPTER 4

ALTERNATIVE INDICATORS OF HOUSEHOLD FOOD SECURITY: EVIDENCE FROM RURAL LAOS

4.1 Introduction

In developing countries, food security indicators have been significantly expanded in recent decades; however, the technique for collecting and analyzing data is different for each criterion; some are quantitative while others are qualitative, such as those based on perception and self-assessment. Choosing indicators depends on various factors such as the availability of human and financial resources, time, and technical skills (Hoddinott and Yohannes, 2002). Using a benchmark indicator (e.g., calorie intake, income and spending on food, and anthropometric measures) is very time-consuming, makes data collection expensive, and requires advanced technical skills to analyze and interpret the criteria, especially in developing countries (Chung et al., 1997; Swindale and Bilinsky, 2006). Therefore, numerous alternative indexes have been applied in recent years that are reliable, simple, inexpensive for collecting and analyzing data, and less time-consuming. These include the food consumption score (FCS), the U.S. Food Security/Hunger Survey Module (U.S. FSSM), and food consumption expenditure (FE). Some indicators are suitable for one area, but not for others (Maxwell and Frankenberger, 1992).

In Laos, although the average food supply (2,377 kcal/capita/day) was greater in 2009 than the international standard (2,100 kcal/capita/day), an imbalance of food insecurity among regions, agro-ecosystem zones, communities, and households concerns policy makers at all levels. The National Statistical Center (NSC) and the WFP conducted two food security assessments nationwide in 2007 (DoS, 2010 and WFP, 2007). However, these two studies had different results. The NSC came up with

an estimate of 24% for FE, leading to a much higher amount of food insecurity, compared with the WFP's calculation of 13.4% (based on the FCS).

National and local policy makers do not have access to clear information on food security and they lack awareness of food security concepts, which leads to inaccurate data on food security (FAO, 2011). The existing standardized tools for tracking household food security are inconsistent. Hence, when implementing appropriate policy interventions in targeted areas of Laos, it is important to improve our understanding of indicators that are reliable, as well as simple to derive and apply. This study compares circumstances of food insecurity based on the FCS, the U.S. FSSM, and FE, with the benchmark indicator being calorie intake (CI). Furthermore, the study identify the characteristics of the alternative indicators for measuring household food security in the context of rural Laos.

4.2 Research methods

4.2.1 Study areas and data collection

The study was conducted across six villages in the provinces of Sekong and Champasak in southern Laos (Table 4.1). In 2013, a total of 208 households were randomly interviewed using a structured questionnaire. Of these homes, 121 households were interviewed in February (after the harvest) and 87 in September (the beginning of the lean season) due to poor road conditions, which impeded access to the villages. Thus, information on food consumption and expenditure patterns is only valid for these months. To capture an overview of rural areas in Laos, the respondents were selected based on heterogeneous aspects of ethno-racial identity, with 50.5% being Lao Loum, 36% Alak, and 13.5% Lawea. In addition, this study considered different agro-ecological zones for choosing the site. About 42% depended on lowland rice cultivation in the wet season, 29% grew lowland rice in both the wet and dry seasons, and 29% of respondents who live in the upland areas farmed upland rice as their main livelihood. To avoid estimation bias, the questionnaire was tested before

using it, and enumerators from district agricultural offices and health care centers were trained to become familiar with the questionnaire.

Table 4.1: Sample size in different agro-ecological zones

Zone	Village	Province	Ethnicity	N
1.Upland	Tokongkeo	Sekong	Alak	60
2.Rain-fed	Huaykoh	Champasak	Lawae	30
lowland	Nathong	Champasak	Lao Loum	57
3.Rain-fed +	Nongkhae	Champasak	Lao Loum	33
irrigated areas	Tomoh	Champasak	Lao Loum	10
	Phone	Sekong	Lao Louam	18
Total	6	2	3	208

4.2.2 Description of the benchmark indicator

Calorie availability, which has been widely used as a benchmark of food security, can be derived from the household CI level during the recall period, especially over 24 hours, 7 days, and 30 days. For this study, all food expenditures, including cash and non-cash purchases, were recorded over a 30-day recall period. The value of food that families produced and stored (such as rice and home gardens), as well as in-kind, exchanged, and loaned food were also estimated. Then, the quantities of all foods that households consumed were converted into kilocalories (kcal) based on the table "Food Items and their Calorie Value" published by the Asian Development Bank (ADB, 2001). Next, the amount by the number of family members was adjusted. Finally, the amount of CI/capita/day was compared with the average calorie requirement set by the 1997–1998 LECS, which is 1,976 kcal/capita/day, as showed in Table 4.2.

4.2.3 Three alternative food security measures

In this study, three alternative indexes: the FCS, the U.S. FSSM, and per capita FE were selected to compare the prevalence of food security with CI. Each indicator

is seen as representative in terms of a dietary diversity survey, the experience of food insecurity, and a survey on household income and spending. Table 4.2 summarizes the qualitative comparison between CI and the three alternative criteria in terms of cost, time, required skills, and reliability.

4.2.3.1 Food Consumption Score (FCS)

The FCS was determined by calculating how frequently families consumed food items over seven days. The items were then sorted into eight food groups: cereals, meat/fish/eggs, milk, beans, vegetables, fruits, oil/fats, and sugar (WFP, 2008). Subsequently, each food group was multiplied by an assigned weight; the sum of the weighted food group scores formed the FCS. Households with an average FCS equal to or greater than 35 were designated as food-secure, while those households whose FCS was less than 35 were deemed as food-insecure.

4.2.3.2 Food Security/Hunger Survey Module (U.S. FSSM)

The U.S. FSSM employs 18 questions to ask a household whether it had enough food or money over the past 12 months to meet all of its members' basic needs (Bickel et al., 2000). In the responses, "1" means yes and "0" means no. The point was added up and adjusted them as a scale score from 0 – 10, with 0 indicating food security, and scores near 10 showing the most severe degree of food insecurity. Homes with a scale value equal to or less than 2.32 were ranked food-secure, while those with a scale score higher than 2.32 were designated as food-insecure.

4.2.3.3 Per capita food consumption expenditure (FE)

Per capita FE was measured based on the household's expenses for different types of food such as meat, fish, vegetables, fruit, and ingredients for the 30 days prior to the survey. In addition, respondents estimated the monetary value of the food they consumed based on their own production, food gathered in the forest, in-kind payments, home gardens, exchanged food, and loaned food. Consequently, both cash

and non-cash FE were summed up into a total expenditure value and then adjusted to household size. The status of household food security were measured by the cost of a minimum food basket per capita per month, estimated by the LECS (2007/08) to be 124,848 LAK/capita/month (16USD). Households were deemed as food-insecure when per capita FE was not enough to cover the cost of a minimum food basket

Table 4.2: A comparison of each indicator's main features

Characteristic	CI	FCS	U.S. FSSM	FE
Recall period	Past 30 days	Past 7 days	Past12 months	Past 30 days
Cost	High	Low	Low	Moderate
Use of time	High	Low	Moderate	Moderate
Skill	High	Low	Low	Moderate
Reliability	High	Low	Moderate	High
Cut-off point	1,976 kcal/capita/day	≥ 35	≤ 2.32	124,848 LAK/capita/month
Usefulness	- Can estimate the real portion of food intake. - Identifies vulnerable households and individuals. - Dietary quality can be measured.	- Basic estimate of food gaps and nutritional intake. - Measures of actual food consumption. - Easy to collect data. - Can capture dietary quality.	- Easier and more user-friendly. - Identifies the severity of food insecurity based on scale score. - Can capture the notion of food sufficiency.	- Used to assess national food and nutritional status, as well as poverty measures. - Can take dietary quantity and quality into account. - Vulnerable households can be identified.
Limits	- Periodicity bias. - It is expensive to collect data. - Difficult to estimate foods consumed outside the home.	- Cannot capture the amount of food consumed. - Lack of information on income and expenditure. - Recall bias.	- Cannot capture all dimensions of food insecurity. - Periodicity bias. - Lack of nutritional information.	- Respondents cannot remember their habits over long periods of time. - Lack of knowledge on types of food. - Some foods are expensive but have few calories.

Source: Adapted from Hoddinott (1999) and Perez-Escamilla and Segall-Correa (2008)

4.2.4 Analytical methods

To examine the link between the benchmark indicator and the alternative criteria, the study used several methods such as descriptive analysis, the correlation coefficient, and cross tabulation analysis. In addition, a sensitivity-specificity index was employed to assess how well the alternative indicators predicted food security status. This technique systematically examines errors of exclusion and inclusion by referring to a benchmark indicator (Chung et al., 1997). "Sensitivity" is the proportion of truly food-insecure households that the alternative indexes regard as food-insecure (the number of true positives / (number of true positives + number of false negatives)). "Specificity" refers to the amount of genuinely food-secure households that the alternative criteria consider as food-secure (the number of true negatives / (number of true negatives + number of false positives)). If an alternative indicator is to be effective at identifying food security, both sensitivity and specificity must be high.

4.3 Results and discussion

4.3.1 Food security status and its correlation

Most respondents (53.3%) were between 30 and 50 years old, with the mean age being 42. Household size ranged from 2 to 29 members, with an average of 7.6. The average educational level of household head was 4.1 years, 51% of respondents have completed primary school while one quarter (25%) have not entered in school. The results showed that food-secure households classified by the benchmark indicator (i.e., CI) measured out at 38.5%. In contrast, food security status as categorized by the FCS was much higher at 52.9%, followed by the U.S. FSSM (40.9%), and FE (30.8%), as shown in Table 4.3.

Table 4.4 shows Pearson's correlation between the average CI (kcal/capita/day) and the three alternative criteria. As expected, an average CI had a positively significant correlation with the FCS and FE. The mean score of the U.S. FSSM had a negatively significant correlation with calorie consumption, implying

that an increase in the U.S. FSSM's scale score leads to a decrease in CI. Additionally, there was a significant association among the alternative indicators, meaning that each alternative measure seems to be a proper indicator of food security.

Table 4.3: Food security status

Food security status	Mean ± S.D	(n=208)	%
Based on CI	1,790 ± 878.5		
Food-secure		80	38.5
Food-insecure		128	61.5
Based on the FCS	37.3 ± 10.3		
Food-secure		110	52.9
Food-insecure		98	47.1
Based on U.S. FSSM	2.82 ± 2.02		
Food-secure		85	40.9
Food-insecure		123	59.1
Based on the FE	109,583 ± 82,150		
Food-secure		64	30.8
Food-insecure		144	69.2

Source: Author's calculation based on the 2013 household survey

Table 4.4: Correlation between CI and other measures

Indicators	CI	FCS	U.S. FSSM	FE
CI	1			
FCS	0.161*	1		
U.S. FSSM	-0.516**	-0.335**	1	
FE	0.778**	0.224**	-0.543**	1

Note: * and ** Significant at the 5 % and 1 % levels, respectively.

Source: Author's calculation based on the 2013 household survey

4.3.2 Comparing food security classifications and sensitivity-specificity analysis

To reach a concrete validation, the cross tabulation was used to compare between CI and the alternative criteria based on the cut-off point of each measure, as shown in Table 4.5. In general, CI and the three alternative indexes significantly

correlate with each other. However, the degree of correlation is weaker regarding the FCS, resulting from a mismatch between the FCS and CI. Of the 128 households classified by CI as food-insecure, 60 (46.9%) were categorized as food-secure according to the FCS, while only 12 (9.4%) were food secure based on FE.

Table 4.5: Cross tabulation between CI and other measures

Alternative measures of food security	Benchmark indicator (CI)			
	Food insecure	Food secure	Total	χ^2
FCS				
Food-insecure	68 (32.7)	30 (14.4)	98 (47.1)	
Food-secure	60 (28.8)	50 (24.1)	110 (52.9)	4.82*
U.S. FSSM				
Food-insecure	95 (45.7)	28 (13.4)	123 (59.1)	
Food-secure	33 (15.9)	52 (25.0)	85 (40.9)	31.3**
FE				
Food-insecure	116 (55.7)	28 (13.5)	144 (69.2)	
Food-secure	12 (5.8)	52 (25.0)	64 (30.8)	71.5**
Total	128 (61.5)	80 (38.5)	208 (100)	

Note: *, ***, and *** significant at the 10%, 5% and 1% respectively

Source: Author's calculation based on the 2013 household survey

Table 4.6 shows a comparison of the sensitivity-specificity analysis among the three alternative indexes. The analysis revealed that FE had an excellent specificity and sensitivity compared to the U.S. FSSM and the FCS. There was a good match of classification for a household's food security status between FE and CI, which was correctly ranked at 80.7%. There were 81.2% truly food-insecure households, and 80.7% truly food-secure ones. The good match of classification was 70.7% for household food security as predicted by the U.S. FSSM and CI, with a good specificity at 77.2% and a sensitivity of 61.1%. The FCS was correctly calculated at 56.8%, with a good specificity (69.4%) but a low sensitivity (44.5%). Given the findings in Table 4.5, it is not surprising that the FCS showed low sensitivity due to large errors of exclusion.

Table 4.6: Likelihood ratio (LR) of sensitivity-specificity analysis for positive and negative tests

Indicators	ROC	S. D	Sensitivity	Specificity	Correctly classified	LR+	LR-
FCS	0.574	0.029	44.5%	69.4%	56.8%	1.48	0.78
U.S.FSSM	0.692	0.032	61.1%	77.2%	70.7%	2.68	0.50
FE	0.809	0.033	81.2%	80.6%	80.7%	4.17	0.23

Note: ROC refers to Receiver Operating Characteristic;

Source: Author's calculation based on the 2013 household survey

It is important to stress that although FE is the nearest indicator to CI from the viewpoint of its actual validity, using it (based on the average FE per month) is slightly complex since it requires a moderate level for the cost of data collection, required skills for estimating both cash and non-cash food spending, and the time it takes to conduct interviews. Hence, there is a need to consider another indicator when resources and skills are lacking. The results showed that the U.S. FSSM, a subjective method, served as a proper measure of household food security in the context of rural Laos for the 30 days or 12 months prior to the survey. This is because data collection needs to be effective and low-cost, and interviews need to be conducted in a moderate amount of time. Previous research also used the U.S. FSSM to gauge food security and hunger (e.g., Rose et al., 1998; Noppawan and Pamela, 2004; Avita et al., 2007; Edwards et al., 2007; Agarwal et al., 2009, and Rahim et al., 2011). One study, carried out with a sample of 153 Canadian women over 30 days, found a mean U.S. FSSM score that had a statistically significant correlation with calorie and nutrient intake (Tarasuk and Beaton, 1999). Swindale and Bilinsky (2006) demonstrated that by asking through questions on anxiety, uncertainty, and the inadequate quality and quantity of food in the home, indicators of food security can be successfully applied to circumstances in developing countries. These kinds of questions are simple, valid indexes for assessing and tracking household food security.

It seems inappropriate to use the FCS as an alternative criterion since the percentage of correct classifications was low. This finding is in line with previous results (Baumann et al., 2013); Baumann et al. validated the use of the FCS against the benchmark indicator (i.e., CI) in Laos. They showed that using the FCS as a proxy for food security is unreliable, and that this measure does not mimic the food security status predicted by the benchmark indicator. A possible reason for the low reliability of the FCS is that the household diet in rural areas is diverse. People eat a wide range of natural foods such as bamboo shoots, wild vegetables, aquatic resources (fish), and root crops, especially during the wet season, while other foods such as meat, eggs, and beans are eaten occasionally. On the one hand, the FCS is a superior measure of food security with its own specific aims, such as analyzing the consumption of nutrient types and a balanced diet. It is also simplified, has a lower cost, and takes less time for data collection, and respondents are generally able to answer the questions without difficulty (Hoddinott, 1999; Headey and Ecker, 2012, and Pipi et al., 2014). In this sense, it is possible to utilize the FCS when human and financial resources are limited, despite of its low reliability.

4.4 Summary

This study compares food insecurity prevalence based on the FCS, U.S. FSSM, FE, with the benchmark indicator CI. A sensitivity-specificity index and cross tabulation analysis were applied to identify the reliability and suitability of alternative indicators for measuring household food security in the context of rural Laos. A total of 208 households in the rural zones of southern Laos were randomly surveyed in 2013. Results show that the indicator of CI categorized 38.5% of the households as food-secure, compared with FE (30.8%), U.S. FSSM (40.9%), and the FCS (52.9%).

Interestingly, all three alternative indexes statistically correlated with the benchmark indicator. Of the other three choices, the reliability FE is relatively high compared to U.S. FSSM and FCS. FE had a matching rate of 80.7 %, followed by the

U.S. FSSM (70.7%) and the FCS (56.8%). However, using FE is slightly complicated, especially when resources are not available and skill for collecting data and analyzing the indicators are lacking. In other words, the difficulty of using this indicator is not much different from the benchmark indicator. Consequently, the other indexes, namely the U.S. FSSM and FCS should be considered as an extra option for evaluating food security. These two alternative indicators have some advantage such as low cost for data collection, low skill requirement and time-saving, despite of their low reliability. Given this circumstance, the U.S. FSSM was selected to apply in Chapter 5 and 6 to identify the severity of food insecurity in the upland areas, while the FCS was used to identify the dietary diversity of food intake in Chapter 8.

CHAPTER 5

RURAL HOUSEHOLD'S COPING STRATEGIES AND FOOD SECURITY IN UPLAND AREA

5.1 Introduction

Food insecurity remains one of the critical challenges for socio-economic development in Laos. The highest food insecurity levels are found mostly in mountainous areas and among ethnic minority groups, especially in Sekong Province. According to WFP, food insecurity affects 50.3% of people living in this province. Moreover, about 60% of children less than 5 years of age are stunted, and nearly half are underweight. The mountainous terrain is a major constraint in eradicating food insecurity; most upland villagers live in scattered small villages where they are unable to access roads, markets, and social services, such as education and health care. Despite of the high prevalence in highland areas, the severity of food insecurity in among upland households has received less attention, and the question on how do rural households cope or response during the period of food crisis? and what are the socioeconomic factors and individual resource factors that influence food security among remote upland households are overlooked. Understanding the cause of food insecurity at the household level is essential to provide information to local, national, and international organizations in order to eradicate food insecurity and improve the livelihoods of rural people.

In this study, coping strategy is defined as the actual response to mitigate the effect of insufficient food to meet the requirement of households and serve as a gateway to livelihood security (Regassa, 2011). Globally, the use of strategies to cope with food insecurity have been documented in the past two decades. The common coping strategies, which used to deal with food insufficiency, were reducing number of meals and the amount of food intake, use of buffer stock, seasonal migration,

skipping meals, consumption of less preferred food, borrowing money and foods, selling assets, purchasing food on credit, and gathering wild foods were the common coping strategies (Mohapatra, 2012; Shariff and Khor, 2008; Quaye, 2008; Rashid et al., 2006; and Arun and Keshav, 2006). The type of coping strategies depends on several components such as household composition, human capital, and household's asset. In Laos, the relationship between socioeconomic factors and the use of coping strategies has not fully understood.

Therefore, the aims of this study were 1) to investigate the severity of food insecurity, 2) to find out the coping strategies and analyse the relationship between socio-economic characteristics and number of coping strategies used, and 3) to identify the factors affecting household food security in the rural upland areas.

5.2 Research methods

5.2.1 Data collection

This study was conducted in Tok Ong Keo village of Lamam district, a mountainous area of Sekong province, located about 37 Km from the provincial capital Sekong. Out of the 82 households in the sample village, a total of 60 households were surveyed through face-to-face interviews using a structured questionnaire during January 2013. However, 22 households were excluded because they were not available during the field survey. The questionnaire consists of information on household composition, upland/lowland rice areas, rice production, household income, and experience of food insecurity over 12 months.

5.2.2 Classification of coping strategies and household food security

The concept of coping strategies used in this study refers to any actions related to dietary change, obtaining food or income during the lean season. The list of coping strategies were developed based on focus group discussion and literature review.

Respondents were then asked about what kinds of coping strategies that they applied during the period of food deficit in the past year.

The U.S. FSSM was used to measure the degree of food insecurity and hunger. The answer from 18 items of U.S. FSSM provides a continuous measure scale score, which can be used to classify households into four following categories (Keenan et al., 2001):

Food secure (0–2.32): Households show no or least evidence of food insecurity.

Food insecure without hunger (2.33–4.56): Household members are concerned about the adequacy of household food supply and have adjusted to household food management, including reduced quality of food and increased unusual coping patterns.

Food insecure with moderate hunger (4.57–6.53): Adults have decreased food intake, meaning they have repeatedly experienced the physical sensation of hunger.

Food insecure with severe hunger (6.54–10): All households with children have reduced the children's food intake to an extent indicating that children have experienced hunger.

5.3.3 Data Analysis

A multiple linear regression was applied to examine the association between the dependent variable (the number of food consumption strategies, and income/expenditure strategies), and socio-economic characteristics (explanatory variables), including age of household head, education level, household size, farm size, annum per capita income, and number of relatives and friends (Table 5.6).

A logistic regression model was employed to identify the determinants of household food security. To set up a dependent variable, the food security status was reorganized from four categories into two. Households that were food insecure with moderate and severe hunger were combined into a single broader category and classified as a food insecure or households with hunger (Y = 0). In contrast,

households that were both food secure and insecure without hunger were classified as food secure or households without hunger (Y = 1). The explanatory variables, which were selected include education, household size, number of relatives and friends, cultivated upland areas, upland rice yield, cultivated rain-fed lowland rice, and livestock ownership (Table 5.7).

5.3 Results and discussion

5.3.1 General information of respondents

Table 5.1 summaries the profiles of respondents. All households belonged to the Alak ethnic minority group who rely on upland farming system by shifting cultivation practice. Overage, the educational level of household head was about second grade of primary school (2.35 year), in which about 35% of respondents were uneducated, and 30% had not completed primary school. On average, the household size was 10 members, ranging from 2 to 29. This average household size was considerably high compared to the country average household size (5.7 members). This can be explained due to the fact that more than 50% of sample households comprise more than 2 families who live in the same dwelling and share at food. The number of friends and relatives of household heads was about 18 households.

The average cultivated upland area was 1.06 ha/household with an average fallow period 6-10 years. On average, the rice yield was very low 747 kg/ha compared with the average in country (1,900 kg/ha) owing to the pests and diseases injury (e.g. weeds, rodents, wild pigs, ants, and birds). In addition, the use of traditional rice varieties and poor soil fertility were reported as the major constraints of low productivity. The average farm size of lowland rice was 0.33 ha/household with average rice yield of 904 kg/ha. This average yield was considerably low compared with the national average of 3,910 kg/ha. Livestock was another farming along with rice cultivation. The common livestock raised in the study areas were cattle, buffalo, pig and poultry, and the average tropical livestock unit (TLU) per household was 0.63.

Table 5.1: Basic socioeconomics characteristics of respondents

Characteristics	Mean	S.D
Educational level household head (year)	2.35	2.32
Household size (person)	9.95	5.41
Number of relatives and friends (household)	18.35	16.30
Cultivated upland size (ha)	1.06	0.44
Upland rice yield (kg/ha)	747	0.45
Cultivated rain-fed lowland rice size (ha)	0.33	0.35
Livestock ownership (TLU*)	0.63	0.46
Household income (USD/year)	358.0	754.2

Source: Author's calculation based on household survey 2013

* TLU is calculated based on the number of livestock and the exchange ratio for livestock (e.g., cattle = 0.7, pig = 0.2, and poultry = 0.01)

5.3.2 Food security and poverty situation

Table 5.2 summarizes the food security and poverty situation in the year of survey. The results show that about 55% of households experienced at least 1–3 months of rice shortages, and 38.3% reported longer rice shortage periods of more than 3 months from July to October, while only 6.7% were able to produce sufficient rice to meet the requirement of their households all year round. About 95% of sampled households lived under the national poverty line (180,000 LAK or USD 23/capita/month). In contrast, only 5% lived above.

The results regards to the food security status revealed about 61.7% of households were categorized as "food insecure with moderate hunger." This means that most adults in the study area frequently experienced the physical sensation of hunger. They employed rationing as a coping strategy, which includes limiting the amount of food given to each household member at mealtimes and reducing the number of meals eaten in a day. Moreover, about 11.7% of households surveyed were "food insecure with severe hunger," indicating that the amount for food intake for

children living in these households was reduced owing to lack of food and money to purchase food. Conversely, about 21.6% and 5% of households surveyed were categorized as "food insecure without hunger" and "food secure," respectively.

Table 5.2: Poverty and the severity of food insecurity

Characteristics	Freq. (n=60)	%
Number of rice shortage months		
No experience	4	6.7
1-3 months	33	55.0
More than 3 months	23	38.3
Poverty line		
Below poverty line	57	95.0
Above poverty line	3	5.0
Food security status of households		
Food secure	3	5.0
Food insecure	13	21.6
Food insecure with moderate hunger	37	61.7
Food insecure with severe hunger	7	11.7

Source: Author's calculation based on household survey 2013

There are two possible reasons for the high severity of food insecurity; 1) most of the households are engaged in upland farming through shifting cultivation practice where productivity is very low and not enough rice for home consumption due to large household size; 2) The study area is located in mountainous area where there are a few traders owing to the fact that there are not many agricultural products produced in the study area. In addition, the traders are constrained by poor road condition, especially in the wet season. Although there are some traders who bring products from the town for sell and exchange with livestock (pig and poultry), those are mainly home use products (e.g., bowl, clothes, blanket, and batteries), rather than selling food stuffs. In this sense, the opportunity to sell non-agricultural products or purchase foods during the lean season is limited, resulting in lack of additional sources of income and foods. In the survey, about 66% of per capita income sources were derived from

temporary workers, followed by selling livestock such as pig and poultry (16%), off-farm income (6%), Non-Timber Forest Products (5%), while remittance, and sold rice/crops accounted only 4% and 3%.

5.3.3 Description of food security based on U.S. FSSM

The anxiety, experiences, perceptions, and adjustment regarding food insecurity and hunger reported by respondents are illustrated in Table 5.3. Of the sample households, 96.7% reported that they could not afford balanced meals for both adults and children and they relied on a few kinds of low-cost food for children. In addition, the majority of respondents (93.3%) had worried that food would run out, about 83.3% stated that the food they bought did not last owing to lack of money to purchase more, 75% had cut or skipped meals for adults, and 43.3% had felt hungry but did not eat. Moreover, approximately 66% of households with hunger acknowledged that they had cut the size of children's meals and skipped meals for children (50%). This implies that half of households in the resettled areas relied on non-nutritious food for their children and children did not have enough to eat. Declining food consumption among children can lead to poor health and malnutrition in the future. It was observed that rice was often eaten together with chili paste, vegetables, bamboo shoots, and sometimes, fish and chicken. However, meat was eaten only occasionally, mainly at such events as traditional spirit sacrifices, wedding parties, and village festivals.

Table 5.3: Affirmative response from the U.S. FSSM Questionnaires

No. (Q) [a]	List of 18 questions from the FSSM	N = 60 (%)	Household without hunger [c] N =16 (26.7%)	Household with hunger [d] N = 44 (73.4%)	t-test
2	Worried food would run out	56 (93.3)	12 (75.0)	44 (100)	0.00***
3	Food bought did not last	50 (83.3)	12 (75.0)	38 (86.4)	0.30
4	Could not afford to eat balanced meals [b]	58 (96.7)	15 (93.7)	43 (97.7)	0.45
5	Few kinds of low-cost food for children	58 (96.7)	14 (97.5)	44 (100)	0.02**
6	Could not feed children a balanced meal	58 (96.7)	14 (87.5)	44 (100)	0.02**
7	Children were not eating enough	33 (55.0)	4 (25.0)	29 (65.9)	0.00***
8	Adult(s) cut or skipped meals	45 (75.0)	6 (37.5)	39 (88.6)	0.00***
8a	Adult(s) cut or skipped meals, 3+ months	0 (0)	0 (0)	0 (0)	N/S
9	You ate less than felt you should	44 (73.3)	5 (31.5)	39 (88.6)	0.00***
10	You were hungry but did not eat	26 (43.3)	2 (12.5)	24 (54.5)	0.00***
11	You lost weight because not enough food	N/S	N/S	N/S	N/S
12	Adult(s) not eat for whole day	18 (30.0)	1 (6.3)	17 (38.6)	0.02**
12a	Adult(s) not eat for whole day, 3+months	0 (0)	0 (0)	0 (0)	N/S
13	Cut size of children's meals	29 (48.3)	0 (0)	29 (65.9)	0.00***
14	Children skip meals	22 (36.7)	0 (0)	22 (50.0)	0.00***
14a	Children skip meals, 3+months	0 (0)	0 (0)	0 (0)	N/S
15	Children ever hungry	21 (35.0)	0 (0)	21 (47.7)	0.00***
16	Children not eat for whole day	1 (1.7)	0 (0)	1 (2.7)	0.55

Source : Author's calculation based on 2013 household survey
Note : *** and ** denotes significance at 1% and 5%;
[a] The first question (Q1), which is asked whether do you have enough food to eat or not, is a screening question. This question is not part of the actual scale so it is excluded from Table 5.3; [b] Balanced meal is defined as "at least three types of food group, such as rice, meat, fish, egg, green leafy vegetables"; [c] "Household without hunger" refers to those households that are food secure and insecure without hunger; [d] "Household with hunger" refers to those households that are food insecure with moderate and severe hunger.

5.3.4 Food consumption coping strategies

Given the high prevalence of food insecurity, the rural upland households adopted combination coping strategies, ranging from 2 to 20 strategies to minimize their vulnerability and to cope with the food shortage problem. The most common food consumption strategy was gathering wild foods, employed by 97% of households

(Table 5.4). The ordinary wild foods are bamboo shoots, wild tubers, mushroom, leafy vegetables, edible insects, wildlife (wild pigs, and small fishes) which are mainly used for home consumption rather than selling due to lack of market places. This result is in line with the study conducted in the upland areas of Luang Prabang and Oudomxay Provinces, northern Lao PDR (Douangsavanh, 2006), and in the rural areas of Nepal (Arun and Keshav, 2006). They indicate that the collection of forest products was the common practice to cope with food deficit.

Table 5.4: Food consumption strategies

List of coping strategies		Freq.(n=60)	%
1	Gathering wild foods	58	96.7
2	Reducing meals from 3 to 2 times a day	57	95.0
3	Relying on less preferred/inexpensive foods	51	85.0
4	Limiting food intake of adults for children	50	83.3
5	Reducing the portion/size of meals	49	81.7
6	Borrowing rice from relatives and friends	43	71.7
7	Consumption cassava and corn	36	60.0
8	Sending members to beg for rice	34	56.7
9	Consumption rice seed for the next season	32	53.3
10	Sending children to eat with relatives/friends	22	36.7
11	Skipping all meals for the whole day	14	23.3

Note: Respondents were allowed to select more than one answer using multiple answer questions
Source: Author's calculation based on household survey 2013

Among the other food consumption strategies, a variety of high-risk coping strategies were commonly employed. These strategies were reducing the meals served each day (95%), relying on less preferred/inexpensive foods (85%), limiting food intake of adults for children (83%), reducing the portion/size of meals (82%), consumption rice seed for next season (53%), and skipping all meals for a whole day (23%), as showed in Table 5.4. The findings of this study imply that more than 80% of the sample households reduced and adjusted their food consumption, especially during the period of food shortage (July to October). Figure 5.2 shows the expected

negative effect of using high-risk coping strategies. The continuation of reduction in the amount of food intake and relying poor food consumption may lead to health problems, malnutrition, poor physical and cognitive development, and poor working performance in the further. In other words, the prevalence of malnutrition may relate to non-food factors, such as inadequate care practice for children, lacking of health service, and an unhealthy environment (FAO, 2008).

It was observed that the majority of villagers lived in unhealthy environments and lacked health knowledge, such as information about how to avoid and treat illnesses. All households have no use of a toilet facility at the time of survey, and some households did not even boil their drinking water. Consequently, of the total sample households, forty experienced with Malaria, followed by Diarrhea diseases (34 households) and fewer (23 households) over the past 12 months. About 69% and 62% of households—who experienced with Malaria and Diarrhea diseases respectively—were food insecure with moderate hunger. These results indicate that rural households are forced to spend a lot of money for health care treatment rather than purchasing food for consumption during the food crisis. Thus, the consequences of food insecurity in the rural areas will have higher severity in the future.

Figure 5.1: Children are pounding rice and some are washing clothes
(January, 2013)

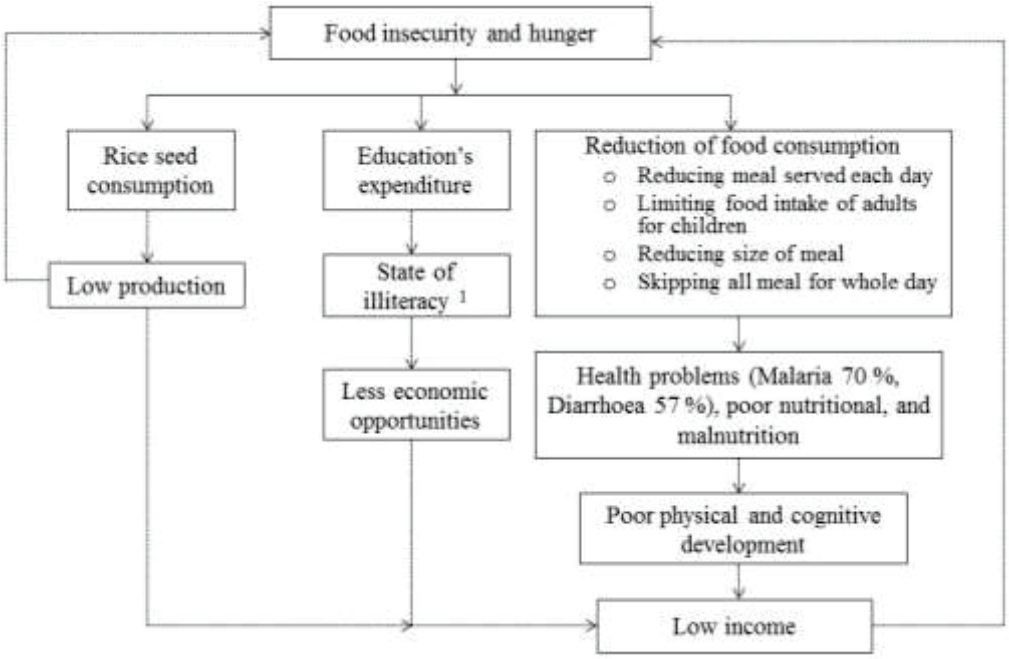

Figure 5.2: The expected negative effect of using high-risk coping strategies

5.3.5 Income/expenditure coping strategies

The results in relation to income/expenditure strategies revealed that purchasing food on credit (85%), using household savings (78%), and selling livestock (75%) were reported to be the most regular coping strategies to deal with food shortage, as shown in Table 5.5. Most households purchased rice on credit from grocery stores and their friends inside and outside the village, but this strategy could not control all the lean season due to limited amount of rice in the grocery stores and among their friends. Moreover, some of households failed to repay the loans because of the chronic food shortage, resulting in a risk of losing future access to credit.

Although using savings to purchase rice is often used, this strategy often fails because the amount of savings is limited. It is important to recognize that selling

[1] "State of illiteracy" refers to the ability to read and write an official language. This study raises the issue of illiteracy due to most of the respondents are often communicate in ethic language "Alak". Thus, if the parents reduce the education expense, the possibility of children to quit from study may happen, resulting in illiteracy and less economic opportunities when they grow up in the future.

livestock seems to be the most appropriated approach for coping during the food crisis in the study area. Pig and poultry rearing are the most important income generating activities in the study areas. A similar study (Nimoh et al., 2012) also indicated that the rearing and selling of livestock (poultry) was the important income generating to ensure food availability. The other strategies include finding an alternative job to get money, growing paddy rice, borrowing money from relatives/friends, cultivating more crops, seasonal migration, and reducing children's education expenditure appear to be less common strategies to deal with food scarcity.

Table 5.5: Income/expenditure coping strategies

List of coping strategies used		Freq. (n=60)	%
1	Purchasing foods on credit	51	85.0
2	Using household savings	47	78.3
3	Selling livestock	45	75.0
4	Finding an alternative job	35	58.3
5	Growing paddy rice	31	51.7
6	Borrowing money from relative/friends	28	46.7
7	Cultivating more crops	23	38.3
8	Seasonal migration	18	30.0
9	Reducing children's education expenditure	12	20.0

Note: Respondents were allowed to select more than one answer using multiple answer questions.
Source: Author's calculation based on household survey 2013

5.3.6 Relationship between socio-economic and coping strategies used

The result of multiple linear regressions showed that educational level of household head and per capita income had negative correlation with food consumption coping strategies. However, the variable of education positively associated with income/expenditure coping strategies (Table 5.6). This means that household's head who have higher education seem to use income/expenditure strategies than food consumption. This is because income/expenditure strategies have a positive effect in the long run such as growing paddy rice and cash crops. A number

of relative and friends was significantly positive association with food consumption strategies, meaning that those households, who have a large number of relatives and friends, are more likely to use a wide range of food consumption strategies, in particular borrowing rice and money.

Age of household head was found to have a negative correlation with income/expenditure strategies, indicating that older household's head are less likely to use coping strategies than younger one. In other words, older people seem to have less capacity to work hard such as growing more crops, migration, and etc. Household size was not significant for both coping strategies, but it had a positive correlation, meaning that larger household size are more likely to use a number of coping strategies, especially food consumption strategies.

Table 5.6: Relationship between socio-economic characteristics and the number of coping strategies used

Socio-economic characteristics	Food consumption strategies			Income/expenditure strategies		
	Coef.	S.E	t-value	Coef.	S.E	t-value
(Constant)	7.865	1.385		5.869	0.901	
Age of household head (year)	-0.016	0.024	-0.644	-0.029	0.016	-1.815 *
Educational level of HH head (year)	-0.370	0.155	-2.391**	0.086	0.101	0.851
Household size (person)	0.081	0.068	1.118	0.037	0.044	0.839
Farm size (ha)	-0.284	0.767	-0.370	-0.325	0.499	-0.652
Per capita income (LAK)	-0.117	0.045	-2.624**	-0.038	0.029	-1.299
Number of relatives	-0.054	0.021	2.574**	-0.002	0.014	-0.160

N = 60; R^2 (Food consumption) = 0.301; R^2 (Income/expenditure strategies) = 0.135;

** and * Sig. at 5% and 10%, respectively.

Source: Author's calculation based on household survey 2013

5.3.7 Determinant of household food security

The results of the logistic regression model showed that the education level of the household head is a positively significant influence on household food security,

as shown in Table 5.7. The marginal effect showed that a unit increase in education level of the household head, holding all other variables at their mean, leads to a 6% increase in the probability of the household being food secure. This implies that higher education levels make household heads more likely to have the capacity to use the resources that he or she owns more rationally, and to learn more idea about how to increase agricultural productivity. Moreover, those who are educated seem to have the ability to escape from food insecurity through participating in non-farm income generating activities, such as construction work, petty trade, and other services. It was reported that there were only five people in the village who go to work in towns or big cities. Language barriers are a possible explanation as about 60% of the respondents, especially those among food insecure households, were unable to read and write the official Lao language. As a result, their access to non-farm work was limited and their average non-farm income was only USD 190 per household per year, whereas that of literate households was USD 370 per year. In addition, the impact of education on food security can be viewed as a key factor in accessing public information, such as agricultural information, concerning health, nutrition, and hygiene because most information is often written in Lao language.

Table 5.7: Determinants and marginal effect of household food security

Variables	Coeff.	t-value	dy/dx	t-value
Constant	-1.15	- 0.95		
Education (year)	0.43	2.19 **	0.06	2.48 **
Household size (person)	-0.35	-2.88 ***	0.05	-2.96 ***
Number of relatives and friends (household)	-0.04	-1.29	0.01	-1.42 *
Cultivated upland size (ha)	0.68	0.52	0.11	0.75
Upland rice yield (kg/ha)	0.38	0.85	0.06	0.46
Cultivated rain-fed lowland rice(ha)	0.57	0.92	0.09	0.53
Livestock ownership (TLU)	2.42	2.62 ***	0.51	2.45 **
Log-Likelihood: -23.854 Pseudo R2 = 0.314 (Prob.chi : 0.000)				

Note : ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels, respectively

Source : Author's calculation based on 2013 household survey

As expected, household size was statistically significant at the 1%. A one-unit increase in the number of household members, computed at sample means, resulted in a 5% decrease in the probability of the household being food secure. This indicates that larger household size may not provide more labor for food production but represents more mouths to feed and higher consumption demand. In the case of the study area, about 51.6% of households comprised at least two families who lived in the same dwelling and shared food. Of these, about 90.3% were among the food insecure households. Most were young married couples living with parents and were likely to depend on their parents because of resource constraints to construct a new house. Moreover, the majority did not generate any income owing to limited non-farm income activities around the village and lack of micro credit to start livestock farms.

With regard to livestock ownership, the marginal effect revealed that a one-unit increase in the livestock ownership (TLU), calculated at sample means, resulted in a 51% increase in the possibility of food security. Livestock production, especially pigs and poultry, contributed to about 88% of farm cash income (USD 66 per household per year), which was used mainly for buying rice and other food to meet the basic nutritional needs of all household members, resulting in increasing self-consumption. Another key point to remember is that about 7% of the households surveyed obtained cash income from selling cattle and buffalo, which was used to cover expenses for building houses.

The result shows that the average number of livestock (cattle=1.7, pigs=3, and poultry=25) reared by food secure households were higher than those of food insecure household (cattle=0.4, pigs=1.8, and poultry=8.3). The major problems in livestock rearing were insufficient technical knowledge to prevent livestock disease, lack of funding to purchase young animals, such as calves and piglets, and lack of feed. About 75% of households indicated that their poultry had died from disease, while 50% of households that kept larger livestock, such as buffaloes and cattle, indicated that there was a lack of feed near the village during the dry season. Insufficient number

of female laborers was a constraint to keeping more pigs and poultry. In the study area, women played a vital role in not only domestic works, such as food preparation and gathering wild food, but also in productive tasks. According to the survey results, women had 95% of responsibility for poultry and local pig rearing. However, they seem to be overlooked from agricultural programs because the majority of women did not speak or understand the Lao language.

It is essential to note that both the cultivated upland farm size and the upland rice yield were not statistically significant, but positively influenced food security. The marginal effect shows that a one-unit increase in cultivated upland rice areas and rice yields would lead to the probability of food security increasing by 11% and 6%, respectively. This implies that households that have larger cultivated upland rice areas and gain higher yields are likely to have higher production levels to support their home consumption. However, villagers were not allowed to expand upland rice areas owing to a ban on shifting cultivation, resulting in a shorter fallow period (3–5 years). The decline in fallow period was accelerated by land use restriction and resulted in poor soil fertility, a cause of low rice productivity (747 kg/ha). In addition, weeds, rodents, wild pigs, ants, and birds were another important cause of low productivity.

With regard to lowland rice cultivation, the results showed that rain-fed lowland areas have no statistically significant correlation with household food security. This is because many resettled villagers lacked knowledge on farm management practices, such as methods of land preparation, fertilizer application, and use of improved rice varieties. They were likely to receive less support from agricultural officers, especially on how to increase lowland rice productivity. Accordingly, the average rain-fed lowland yield cultivated by resettled villagers was very low (904 kg/ha). In addition, most of the resettled villagers from mountainous areas were new rain-fed lowland cultivators, so they could not suddenly adapt to the new technologies of lowland paddy fields (Douangsila, 2012). The number of relatives and friends had a negative influence on household food security. A possible

explanation is the tradition and culture of the Alak ethnic group, whose people depend highly on relatives and friends when they face food shortages. It was reported that although the total rice production in resettled households did not cover their annual needs, they shared their own rice or other food with relatives and friends who experienced food shortage.

5.4 Summary

This study aimed to investigate food security in upland area, to find out the coping strategies used, and to identify the factors influencing household food security. The primary data was based on interview with 60 households in a mountainous village of Lamam district, Sekong province. A subjective food security indicator, namely U.S. FSSM, was used to measure the severity of food insecurity. A linear regression was employed to examine the correlation between the number of coping strategies that farmers used to deal with food insecurity and socioeconomic characteristics. Moreover, a logistic regression model was used to examine the factors influencing food security. Results showed that 55% and 34% of households experienced rice shortages for about 1–3 months and more than 3 months, respectively. 62% were categorized as "food insecure with moderate hunger" and about 12% were "food insecure with severe hunger." This means that most adults in the study areas frequently experienced the physical sensation of hunger.

To overcome the food shortage, about 11 food consumption and 9 income/expenditure coping strategies were employed. The common food consumption strategies used were gathering wild food, followed by reducing the number of meal from 3 to 2 times a day, relying on less preferred/inexpensive foods, limiting food intake of adults for children. The results showed that the number of coping strategies that farmers used are negatively associated with income and educational level of household's head, whereas the number of relative had a positive correlation. In relation to income/expenditure coping strategies, purchasing food on

credit, using household savings and selling livestock were reported to be regular strategies. The results of logistic regression model revealed that the education level of household head, and livestock ownership had a positively influence on food security, while household size negatively associated with food security.

CHAPTER 6

POST-SETTLEMENT RURAL LIVELIHOODS IN LAOS: A CASE STUDY OF A RESETTLED VILLAGE IN SEKONG PROVINCE

6.1 Introduction

Although the Lao government is approaching its goal of poverty eradication (e.g., less than 24% in 2015, and a steadily declining poverty rate from 39.1% in 1998 to 27.6% in 2008[1]), about 43% of upland Laotians, who belong mainly to ethnic minority groups and rely on slash-and-burn agriculture, are still considered poor (DoS, 2015). In order to improve the livelihood of the villagers, resettlement program has been implementing by combining household from various ethnic groups and scatted villages in the remote highlands to lowland areas and along roads. Though its implementation has extended over two decades, resettlement continues to receive widespread interest throughout Laos, as a number of highland villages are still in the process of being relocated. In addition, though some populations from isolated villages have already been moved to new sites and others have merged with larger villages, past studies found that the nationwide resettlement plan could not achieve its core objectives of eradicating shifting cultivation and improving the living standards of rural people due to a number of challenges and problems (Evrard and Goudineau, 2004; Douangsila, 2012 and Rigg, 2012). For example, most people who were resettled experienced difficulties in adjusting to new environments, finding alternative sources of income, and adapting to new farming practices such as lowland rice cultivation (Romagny and Daviau, 2003); further, the land available for shifting

[1] According to the LECS, monthly per capita consumption expenditure was used to measure the national poverty rate. Per capita consumption expenditure was measured based on the total value of expended household food and non-food items plus the in-kind value of own-produced items consumed on a monthly based divided by the number of household members.

cultivation had previously been controlled, which has resulted in shorter fallow periods as well as soil degradation and lower yields (Goudineau, 1997). Some resettled households were allocated inadequate parcels of land for cultivation, and this incited land-use conflicts and social problems between new arrivals and existing local residents (Douangsila, 2012). More recent evidence (Siliphouthone and Yasunobu, 2014) indicates that 95% of the resettled people in Sekong Province are still living below the poverty line, even several years after relocation, and 73% lacked food security and experienced hunger during the early stages of their relocation.

Considering this situation, without proper implementation strategies, resettlement seems to have negative outcomes that result in rural poverty, food insecurity, and livelihoods. In fact, those who have been resettled may even become more constricted. A number of studies relating to Laos' resettlement program have been conducted mainly in the northern region and some near hydropower projects (Romagny and Daviau, 2003; Evrard and Goudineau, 2004; NAFRI, 2007; Phonevilay, 2013). In the southern region—where several villages have recently been relocated and some are still being resettled—have received little attention.[2] Some of these previous studies focused on the health sector, especially the mortality rate after resettlement (Romagny, 2005); however, little research has been undertaken to observe the livelihoods of those who have been resettled. As such, more studies are needed to better understand changes in livelihoods of these migrants, including farming activities and household income over time. Understanding these changes might enable policymakers and rural developers to construct better future resettlement

[2] Possible reasons why most previous studies on Lao resettlement were in the northern region are because the majority of people in the northern region remain very isolated compared to those in the southern region. Most villagers are minorities living in upland areas and rely mainly on slash-and-burn agriculture and poppy cultivation. Thus, most of the rural development projects—mainly supported by international organizations—focused on the northern region rather than provinces on the southern region.

plans, and minimize the risk of unsuccessful implementation. Thus, this study aims to clarify farming activities and livelihoods after resettlement, and examine the determinants of household incomes, using three years of panel data.

6.2 Background of the study area

Ban Tok Ong Keo within the Lamarm District of Sekong Province was selected as the study area (Figure 6.1). The initial resettlement of this upland village occurred in 1978 (before the First National Forestry Conference), when the villagers were relocated about 2 km away to a plains area near roads, where the average altitude was about 600 m above sea level. In the initial year of resettlement, the local government provided housing materials such as zinc roofing sheets, and, in some cases, goats and pigs. The villagers continued to cultivate rice in their original upland fields using shifting cultivation methods; the total land available for cultivation was about 336 ha, with an average fallow period of 6 to 10 years. In 2000, some households were able to develop lowland paddy fields (about 5 ha) near the village. Then, in 2010, all of the villagers were moved to a larger and more permanent location (i.e., considered the second resettlement), about 1 km away from the previous settlement, because the government had selected this village as an FSD project,[3] and their house at the previous location had been reclaimed for the development of more lowland paddy fields.[4]

[3] FSD projects are linked to the national resettlement program. These project are selected by local authorities to concentrate development resources in certain geographic areas with the aim of alleviating poverty among rural populations in remote areas, provide food security, promote commercialization of agricultural production, eliminate shifting cultivation, and improve access to development services (Baird and Shoemaker, 2005).

[4] The main aims for developing lowland paddy fields are related to government policy to reduce and replace shifting cultivation with lowland rice cultivation, which is generally considered a more productive farming system.

Since 2013, there has been a primary school up to the fifth grade, a lower secondary school up to the first grade, and a rural health center to serve villagers in their new location. The gravity-fed water system has also been available since 2012, and the number of households with indoor sanitary systems increased from 0% in 2012 to 64% in 2014. The government bank, called "Nayoby," provides loans with an average annual interest rate of 7% to the villagers. Despite these amenities and services, the study area has no formal groups, such as a village development fund, or a farmers' association.

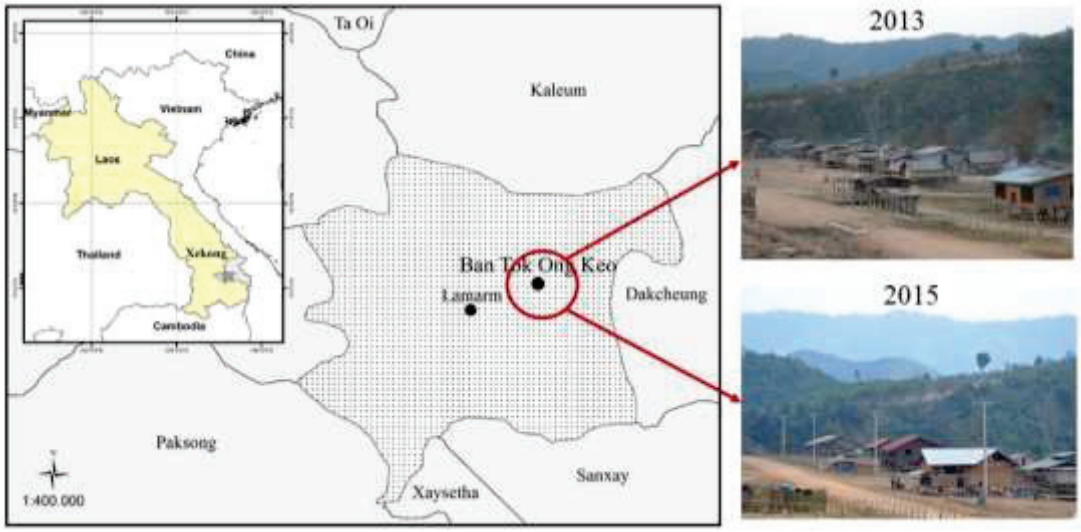

Figure 6.1: Tok Ong Keo Village 2013 and 2015

"Ban" refers to "Village"

6.3 Research methods

6.3.1 Data collection

Following the second resettlement of these villagers in 2010, the field surveys were undertaken during January and February in the years 2013, 2014, and 2015 to gather information for the previous year (e.g., 2012, 2013, and 2014 data). Of the 82 total households in the village, 60 households were interviewed using a structured questionnaire. After the three rounds of surveys had been completed, however, data

from only 48 households were included in the final analysis due to low data reliability for some households, unavailability of other households, and the migration of two households during the survey period. In addition, personal observations, focus group discussions with informal village committees, and key informants were carried out to gather additional background about the resettlement.

In order to understand the pattern of livelihood activities in the resettled areas, first the farming type of each household was identified to observe whether or not upland farming has been changed or replaced over time. Next, the respondents were asked to perceive their livelihood improvement based on four aspects: human, physical, financial and natural capitals (Ellis, 2000). Finally, household income was used as an indicator of livelihood outcome (Zeleke and Asfaw, 2014), where household income was calculated from the amount of money obtained from crops sales, livestock sales, off-farm incomes, non-farm incomes, and the sale of non-timber forest products over the previous 12 months. In addition, the quantity of rice produced on-farm was converted into a monetary value as all respondents heavily depended on their own farm for home consumption. With this information, the poverty status of each household was able to identify based on income-poverty[5] in accordance with the National Committee for Rural Development and Poverty Eradication, developed in 2012 (Government of Laos, 2012)

6.3.2 Model specifications

To better understand the factors that contribute to household income change, a panel data regression analysis was employed to investigate the effects of the explanatory variables on individual household income over time. Using such panel

[5] Income-poverty is measured based on the amount of income required to fulfill basic needs, such as food, clothing, health care, and education as well as shelter for a given period in a given location. In rural areas of Laos, a household is considered as "poor" if its income is under 180,000 LAK (23 USD) per capita per month (Government of Laos, 2012).

data is more advantageous than cross-sectional data because it provides a more accurate inference of model parameters to help capture the complexity of human behavior and to control for unobserved variables (Hsiao, 2007). This study used gross household income as the dependent variable, while the explanatory variables included the number of active laborers per household, occupation of household members (e.g., teacher), area of upland rice cultivation, area of lowland rice cultivation, number of livestock owned, amount of credit borrowed, participation in logging activities, and presence of livestock diseases. The mean of each variable over the three-year survey period is provided in Table 6.1. The regression model used to identify the determinants of household incomes is summarized in the following equation:

$$y_{it} = \beta_1 x_{it} + \alpha_i + u_{it};$$

where y_{it} = annual household income, i = entity and t = time; x_{it} = the independent variables; β_1 = the coefficient for the independent variables; and u_{it} = the error term

In this study, two techniques were used to analyze the panel data: fixed effects estimation and random effects estimation. To select which estimations would be more efficient for interpreting the effect of explanatory variables on gross household income in an econometric analysis, the Hausman test was used to check for a significant difference between the fixed effect and random effect estimators. If the p-value of the Hausman test is larger than 0.05, random effect is preferred; conversely, if the Hausman test is less than 0.05, then fixed effect is preferred.

Table 6.1: Description of variables (n=48)

Variable	Definition	Expected sign	2012	2013	2014
Dependent (Y)	Log of gross household income per household (million LAK)		5.24	6.55	10.31
Independents					
Active labor	Number of household members who are economically active (15 to 65 years of age)	+	4.7	4.2	5.5
Occupation	Dummy variable; 1 if a household member work as teacher; 0 = otherwise	+	2%	6%	15%
Area of upland rice	Area of upland rice cultivated in the previous year (ha)	-/+	1.06	0.81	0.86
Area of lowland rice	Area of lowland rice cultivated in the previous year (ha)	+	0.32	0.39	0.45
Livestock owned	Number of livestock owned by the household, converted into TLU	+	2.15	3.48	3.10
Amount of credit	Amount of credit borrowed by the household (million LAK)	+	0.0	7.31	11.65
Participation logging	Dummy variable; 1 if household member is participated in timber logging; 0 = otherwise	+	8%	6%	35%
Livestock disease	Dummy variable; 1 if livestock disease was the cause of livestock deaths; 0 = otherwise	-/+	79%	33%	50%

Source: Author's calculation based on 2013, 2014, and 2015 household surveys

6.4 Result and discussion

6.4.1 General information about the village

Results showed that the size of the population and total households in the study area have increased slightly, as shown in Table 6.2. Of the total village area of 2,100 ha, about 48 ha are used for growing rice in the lowland paddy fields, but only 36 households are able to use these areas owing to insufficient land allocation and plans for development. Consequently, most villagers continue to rely on upland rice cultivation for their primary livelihood. However, the land available for upland rice has been restricted by the government's policy to promote resettlement, which has led

to a reduction of shifting cultivation[6]; accordingly, the average fallow period has been reduced from 8 to 12 years to 3 to 5 years, and the areas of upland rice cultivation have been reduced from the 336 ha available between 1978 to 2010, to 220 ha after the latter year's resettlement.

In addition to rice cultivation, most households were engaged in raising livestock. At the beginning of the survey, there were 217 pigs, 108 buffaloes, 93 goats, 30 cattle, and 1,314 units of poultry (Table 6.2). Two years later, in 2014, these numbers had increased, especially those for cattle and goats. NTFPs such as bamboo shoots, wild tubers, leafy vegetables, and wildlife (e.g., wild boar) were collected both for direct consumption and for sale, to supplement household incomes. Moreover, crops and vegetables, such as cassava, chili peppers, cucumber, pumpkin, sweet corn, taro, and yard long beans were grown, both in the upland fields and in some home gardens.

Table 6.2: General information on the study area

	2012	2013	2014
Population	813	842	879
Number of households	81	89	84
Lowland rice areas (ha)	48	48	48
Irrigated rice areas (ha)	0	6	7
Upland rice areas (ha)	220	220	220
Number of buffalo (head)	108	103	111
Number of cattle (head)	30	144	115
Number of pigs (head)	217	201	224
Goats (head)	93	225	109
Poultry (units)	1,314	1,716	1,137

Source: Focus group discussion 2013 and 2015

[6] The government views shifting cultivation as an unsustainable and inefficient use of natural resources. In order to support the stabilization of shifting cultivation, land-use zoning and land allocation were implemented in the study areas in 2010. These programs regulated villagers' access to forest areas and generally resulted in shorter fallow periods.

6.4.2 Farming practices

In this study, the types of farming areas and activities were classified into three categories in accordance with two factors: upland rice and lowland rice (Table 6.3). During the first year of the survey, all households practiced upland rice farming on an average plot of 1 ha. Of these, 50% belonged to Type I (upland rice + lowland rice) while Type II (upland rice only) accounted for 50%. During the third year of the survey, the percentage of farming areas by Type II had slightly decreased to 41.7%. Conversely, the number of households under Type III (lowland rice only) steadily increased over the same period. This indicated that the proportion of households that engaged only in upland farming had declined, as a result of the restrictions on land available for shifting cultivation, while the number of households engaged in lowland rice farming increased, from 0% in 2012 to 18.7% in 2014.

Table 6.3: Types of farming reported during the three surveys (n= 48)

	Type of farming	2012	2013	2014
I	Upland rice + lowland rice (%)	50.0	45.8	39.6
II	Upland rice (%)	50.0	33.4	41.7
III	Lowland rice (%)	0.0	20.8	18.7
	Total	100.0	100.0	100.0

Sources: Author's calculation based on 2013, 2014 and 2015 surveys

Table 6.4 illustrates a comparison of rice productivity from lowland and upland farming over the three-year survey period. Results showed that the average lowland rice yield in the study area was not improved and relatively low (934 kg/ha in 2012 and 829 kg/ha in 2014) compared to the national average (3,910 kg/ha in 2012 and 3,950 kg/ha in 2014), despite the availability of water during the rice growing season. This is due to the fact that most of those who resettled lacked experience in lowland rice cultivation, their knowledge of how to increase lowland rice productivity was limited due to the lack of technical support from extension workers, and there was little training in new farm management practices.

Table 6.4: A comparison agricultural outcome over three years

	2012	2013	2014
Upland rice			
Yield in the study areas (kg/ha)	754.3	870.1	778.0
Yield for national average (kg/ha)	1,800	2,080	n/a
Farm size (ha)	1.06	1.05	1.0
Rain-fed lowland rice			
Yield in the study areas (kg/ha)	934.0	1,016.7	829.3
Yield for national average (kg/ha)	3,910	4,000	n/a
Farm size (ha)	0.64	0.57	0.76
No. of livestock (head)			
Cattle	0.8	2.5	1.8
Buffalo	1.25	1.3	1.5
Pig	2.2	2.6	2.0
Poultry	10.4	8.5	8.1
Goat	0.9	1.1	1.5
Households raising livestock (%)			
Cattle	27.1	68.8	64.6
Buffalo	41.7	52.1	50.0
Pig	79.2	79.2	68.8
Poultry	68.8	75.0	54.2
Goat	31.3	37.5	37.5

Source: Author's calculation based on 2013, 2014 and 2015 household surveys

In addition, the number of each kind of livestock raised by each household was relatively small. On average, the number of cattle, buffaloes, and goats per household increased slightly over the survey period, by about 1 to 2 heads. Many households bought young cattle and buffalo from other villages for the purpose of breeding them as a source of wealth, to sell, or for use during significant occasions, such as spirit sacrifices. Pigs and goats were bred primarily for sale, while poultry were bred mainly for home consumption. This implies that raising livestock seems to have become market-oriented. A number of challenges to keeping livestock, however, were identified; most notably, the outbreak of livestock diseases and an insufficiency of pastureland. The ratio of households raising poultry and pigs decreased slightly from the initial year of the survey to the final year due to pervasive livestock diseases.

Although most extension workers and rural developers have strongly encouraged villagers to raise livestock, they tend to overlook the provision of necessary knowledge to prevent livestock diseases, as well as provision of veterinary services. Moreover, there was insufficient pastureland for buffaloes and cattle during the dry season; accordingly, some livestock were unhealthy and more vulnerable to disease.

6.4.3 Livelihood improvements, food insecurity, and poverty

Table 6.5 shows the perception of livelihood improvement. Results revealed that about 90% of households perceived that the educational opportunities for their children have improved, owning to the availability of primary school as well as a lower secondary school, constructed in 2013. About 77% of respondents reported that they can easily access to the healthcare center, which has reduced their time to walk or travel long distances to obtain health services. Most importantly, about 96% perceived that transportation from their village to the town, especially in the wet season, is better than before because of road improvements. Regarding financial and natural capitals, 52% of households perceived that the capabilities to increase household income and food sufficiency were improved over the three-year survey period, while 45.8% of households were not improved as expected, meaning that these households continue to face difficulties in escaping poverty due to a lack of food and low household income.

Figure 6.2: New road, electricity and gravity-fed water system (Feb, 2015)

There has been a positive trend in increasing rice sufficiency, with the number of households that did not experienced a rice shortage increasing from 6.3% in 2012 to 20.8% in 2014. Moreover, the number of food-secure households—measured by the U.S.FSSM —increased from 4.2% in 2012 to 10.4% in 2014, and the number of food-insecure households with moderate hunger reduced significantly, from 62.5% in 2012 to 10.4% in 2014. However, some households (37.5%) continued to experience a rice shortage for longer than three months during the survey periods (Table 6.6). The continuation of rice insufficiency is likely a reflection of the restriction for upland rice field and soil degradation, resulting in low productivity. In addition, during the three-year survey period, the number of households living below the national poverty line declined from 93.4% in 2012 to 87.5% in 2014 (Table 6.6). About 85% of those who resettled were considered chronically poor, while only 12% were able to move out of the poverty level during the survey period. This means that most resettled households remained below the poverty level by the end of the survey period owing to low levels of household income.

Table 6.5: Households' perception on livelihood improvement after three years of resettlement (n=48)

Livelihoods outcome	Better	Unchanged	Worse
	%	%	%
Improved access to school	89.6	10.4	0
Improved access to healthcare services	77.1	20.8	2.1
Improved access to transportation	95.8	4.2	0
Housing conditions	62.5	35.4	2.1
Increased household income	52.1	45.8	2.1
Food sufficiency	52.1	45.8	2.1

Source: Author's calculation based on 2015 household surveys

Table 6.6: Poverty status and food insecurity (n=48)

	2012	2013	2014	2012-2014
Poverty incidence (%)	93.4	87.5	87.5	-5.9
Rice shortage (%)				
No experience	6.3	14.6	20.8	14.5
1 to 3 months	56.2	22.9	41.7	-14.5
More than 3 months	37.5	62.5	37.5	0
Food security status				
Food secure	4.2	n/a	10.4	+6.2
Food insecure	27.1	n/a	75.0	+47.9
Food insecure with moderate hunger	62.5	n/a	10.4	-52.1
Food insecure with severe hunger	6.3	n/a	4.2	-2.1

Source: Author's calculation based on 2013, 2014, and 2015 household surveys

6.4.4 Household income

Since road access to Sekong Province was upgraded in 2012, a number of traders have been able to access villages, opening up non-farm opportunities. In some cases, this has led to an increase in household incomes; for example, there was a sudden change in average household incomes from 5,247,000 LAK (650 USD) in 2012 to 10,313,000 LAK (1,278 USD) in 2014. The main sources of income for most villagers were from non-farm works (e.g., salary and wage jobs, logging, and construction) and gross income from rice (Table 6.7). Although the average household income has changed over time, results showed that not all households were able to earn more money sequentially. About 14% of households reported that their annual incomes had decreased gradually, and 17% had moved into a lower household income category compared to their status in the first year of the survey (Figure 6.3). In contrast, about 27% of households have been able to continuously increase their household income, with 42% moving into higher income categories over the survey period. The reason for this may be due to the fact that these income-increased households were mainly engaged in non-farm income employment, such as petty trade, working as teachers, or for Chinese mining companies located in just outside the village. They might also have larger areas for lowland rice farming and/or have a greater number of livestock.

Table 6.7: Gross household income (thousands of LAK/household)

Income sources	2012		2013		2014	
	LAK	%	LAK	%	LAK	%
Gross income of rice	2,199	41.9	1,855	28.7	2,039	19.8
Upland rice	1,649		1,310		1,260	
Lowland rice	550		545		779	
Crops and vegetable sale	51	1.0	227	3.4	41	0.4
Livestock sale	632	12.1	1,118	17.0	408	3.9
Big livestock	373		704		229	
Small livestock	259		414		179	
Off-farm	213	4.0	137	2	6	0.1
Non-farm	1,923	36.6	2,768	42.2	7,127	69.1
Masonry	680		1,091		884	
Salary (teachers)	875		1,367		3,735	
Logging	-		153		1,681	
Petty trade	333		127		164	
Remittance	2		-		314	
Others	33		30		349	
NTFPs	230	4.4	446	6.7	692	6.7
Total	5,248	100.0	6,551	100.0	10,313	100.0

Source: Author's calculation based on 2013, 2014, and 2015 household surveys
Note: Gross household income in 2013 and 2014 was deflated by Consumer Price Index.

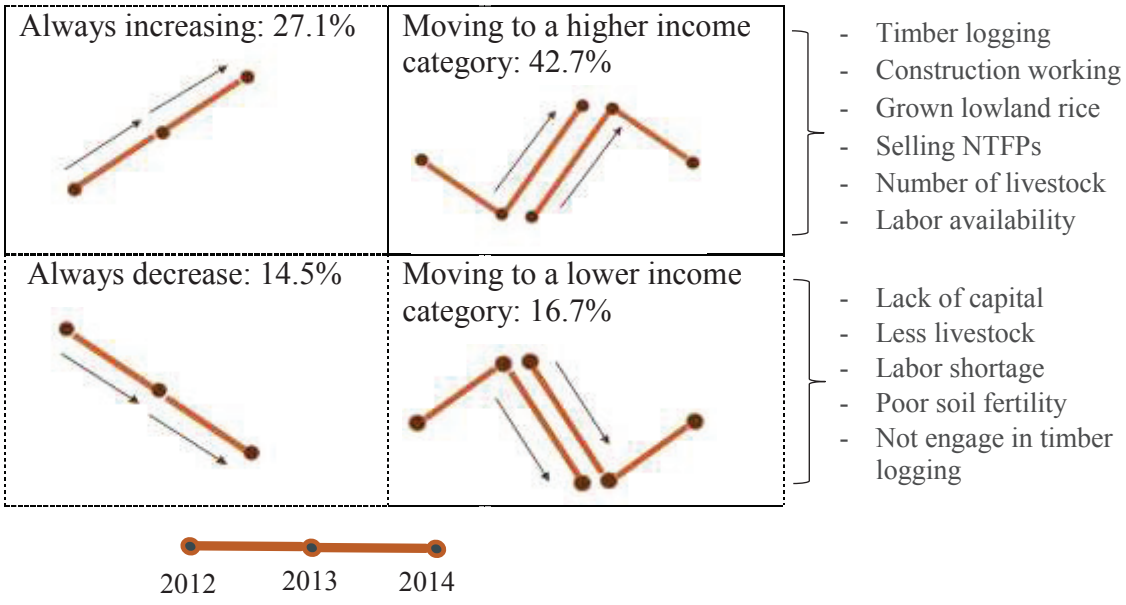

Figure 6.3: Categories of household income transition 2012 – 2014

6.4.5 Determinants of household income

To analyze these findings more compressively, this study used panel regression analysis with both fixed and random effect estimations, as shown in Table 6.8. The p-value of the Hausman test is less than 0.05, implying that the null hypothesis is rejected. In this sense, the fixed effect method is more appropriate for interpreting the effects of explanatory variables on gross household incomes in an econometric sense. The results obtained from the fixed effect method revealed that adult labor has a positive significant correlation with household income, where those households with several working adults are more likely to engage in income-generating activities, gathering and selling non-timber forest products, and hunting wildlife to sell. Moreover, these households seem to cultivate rice both in the upland and lowland areas, revealing that the variable of lowland rice cultivation has a statistically significant influence on household incomes (i.e., households that practice lowland rice farming with large fields tend to have more rice available to sell once the household food needs are met). Access to areas for lowland rice cultivation is the most important resource in rural farm production; however, some households could not access lowland rice areas due to land availability, which is limited to only 46 ha; inequality of farmland allocation[7]; or lack of interest in lowland rice cultivation. Expectedly, the variable of occupation—if one of the household members is a teacher either in primary or lower secondary school—is positively correlated to household income, reflecting the fact that working as a teacher in rural areas could result in the earning of high wages (about 2,000,000 LAK or 250 USD) owing to the government's

[7] According to key informant interviews, the allocation of lowland fields has not been officially managed, meaning that villagers have no rights to land tenure. The decision of land allocation for lowland rice cultivation is made by the village committees in accordance with the number of villagers who are interested in farming. However, around 2010 there were not many villagers interested in growing lowland rice because they were not familiar with the practice and they needed more labor to reclaim and develop the land to get it ready for cultivation.

policy to encourage the training and employment of rural teachers. Although many villagers intending to support their children become teachers, it is not easy to enroll in teacher-training schools due to lack of financial support.

Number of livestock owned has a positive and significant effect at the 1 percent level. Households that have a large number of livestock could increase their household incomes by selling livestock, especially cattle and buffaloes. Participation in logging activity also has a positive effect on household incomes, implying that those households engaged in logging seem to obtain higher incomes; however, timber logging is an illegal activity in the study areas and it is considered as an unstable source of income.

Table 6.8: Regression results

Log household income	Fixed effect		Random effect	
	Coef.	P-value	Coef.	P-value
Adult labor (person)	0.71	2.15**	0.84	3.58***
Occupation (dummy variable)	18.02	5.47***	20.41	10.36***
Cultivated upland rice (ha)	-1.29	0.95	-2.44	-2.29**
Cultivated lowland rice (ha)	1.13	1.63*	0.02	0.02
Owned livestock (TLU)	1.24	3.09***	0.65	2.87**
Amount of credit (LAK)	-0.02	-0.36	0.00	0.19
Participation logging (dummy variable)	4.65	2.89***	4.36	3.25***
Livestock disease (dummy variable)	-0.27	-0.23	-0.22	-0.22
Constant	-0.66	-0.34	1.43	1.16
Number of households	48		48	
Number of observations	144		144	
Overall R-square	0.34		0.38	
Hausman test (Prob >chi = 0.04				

Source: Author's calculation based on 2013, 2014 and 2015 household survey

6.5 Summary

This study observed the implementation of resettlement program in the remote mountainous areas in Sekong Province. The objectives of the study were to examine how livelihoods change after resettlement and to determine the factors influencing on

household income. The study was carried out in Tok Ong Keo Village—where the government had selected as a focal site to alleviate poverty and eliminate shifting cultivation. A total 60 households were surveyed using a structured questionnaire in 2013, 2014, and 2015. Results revealed that farming activities changed from shifting cultivation to lowland rice cultivation after resettlement, and the average household income increased from 650 USD in 2012 to 1,278 USD in 2014. At the individual household level, however, some households (37.5%) suffered from rice shortages for longer than three months during the survey periods owing to limited land for rice cultivation and low rice yield in both upland and lowland areas. About 31% reported that their income decreased steadily when compared to the first year of the survey. In addition, 85% of households were identified as being chronically poor during the survey period. The results of panel regression analysis showed that household income was positively associated with number of adult labor, occupation, area of lowland rice cultivation, participation in logging activities, and number livestock of ownership.

CHAPTER 7

ANALYSIS OF FOOD SECURITY AMONG RAIN-FED LOWLAND RICE-FARMING HOUSEHOLDS
"A DAILY CALORIE APPROACH"

7.1 Introduction

Despites of the significant growth of economic over the past decade, more than 70% of the Lao population still live in rural areas and rely on subsistence agriculture, particularly rice cultivation. Rice ecosystems in Lao PDR can be classified into three groups: irrigated lowlands (108,037 ha), rain-fed lowlands (711,134 ha), and rain-fed uplands (119,840 ha). Of these, rain-fed and irrigated lowlands support the largest number of farmers, who mainly reside in the central and southern regions and are widely perceived to be food-secure. Even so, most of the farmers in rain-fed lowland areas, especially in the rural areas, are vulnerable to food insecurity from different types of shocks such as flood and drought (WFP, 2007; Yamada, 2014). Schiller (2013) reported that rain-fed lowland rice production faces a number of constraints such as unstable rainfall pattern, pests and diseases, and poor soil fertility, which could push farmers in these areas back into food insecurity. Other factors such as rising input cost, fluctuating output prices, and unsure trade policy are reported to limit farmers' incentive to intensify production in order to achieve rice self-sufficiency. Furthermore, rural households continue to face poor economic conditions due to limited cash income, which affects their livelihood and food security situation. Some households with a production surplus also face a rice deficit, because their surplus is sold to meet demands for cash to pay off debts.

The above-mentioned facts raise to the following questions: How is the food security situation in the rural rain-fed lowland rice areas? What are the coping strategies to mitigate the effect of food shortage? What are the determinants of household food security in the rural rain-fed lowland rice areas? This study proposes

to provide food security information for all levels of policy makers to plan for both short- and long-term development in Lao PDR. The aims of this study are to 1) investigate the food security situation and coping strategies and 2) identify the determinants of household food security in the rural rain-fed lowland rice areas.

7.2 Data description and analysis

7.2.1 Data collection

This study was undertaken in Huaykoh and Nathong—two poor remote villages—in Pathoumphone District of Champasak Province. A systematic sampling procedure was adopted in selecting the sample households from the two villages. A list of households who were categorized as poor and middle households was obtained from the village head of these two villages. A representative sample of 88 households were interviewed in September 2013, using a structured questionnaire. Finally, only 78 households were selected for analysis after eliminating cases in which the questionnaire was not properly administered.

Despite of the small sample, the findings of this study will serve the purpose because the population (households in the rural rain-fed lowland rice areas of Lao PDR) is homogenous. The questionnaire covered detailed information on household information, household cash income, food and non-food expenditure, land and livestock ownership, rice and other crops grown and harvested, collection of food from the surrounding forest, and coping strategies used during periods of food deficit.

7.2.2 Description of the study areas

Huaykoh village, one of the poorest villages in the district, represents ethnicity (the Lawae ethic group); this village covers an area of 666 ha with a total population of 210 (37 households). According to the village headman, 86.4% (32 households) of the total households are categorized as “poor” while only 5 households are

"moderately wealthy" [1]. Of the total village area, 36 ha are devoted to rain-fed lowland rice production. Nathong village has a total population of 590, divided into 93 households, all belonging to the Lao Loum ethic group (the majority of Lao people). Of the total households, there are 61 "moderately wealthy," 24 "well-off," and 8 "poor." This village covers an areas of 772 ha, of which 84.2 ha are used for rain-fed lowland rice cultivation.

7.2.3 Measurement of household food security

The calorie intake per person per day was used to determine the food security status. The calorie intake was calculated for each household based on production data and food consumption. Information on food items produced on farm[2], food items purchased or gathered from the forest, and those received from friends and relatives were derived in detail during the last 30 days of the survey, estimated through recall method. With this information, the food security ratio (FSR) was calculated as shown in Eq 7.1. FSR includes total energy in available food (on-farm produce, purchased, collected from forest, and received from friends and relatives) divided by the minimum calorie requirements for a household member. A FSR higher than one implies that the household meets its minimum energy requirements and has access to surplus energy. Therefore, such household were categorized as food-secure.

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[1] According to the village headman, poor households are those who frequently experience rice shortage based on their own farm production and they have less livestock and land holding. Moderately wealthy households usually have enough rice to eat for whole year, but sometime they do not. These households raise livestock mainly poultry and pigs. Well-off households are always food sufficient and have more resources, including money, land, livestock (cattle and buffalo) than poor and moderately wealthy households

[2] Food items produced on farm consists of rice and home garden products (e.g., poultry, chilies, spring onion, green mustard, sweet corn, papaya, banana, cucumber, yard long bean, and eggplant.). Food items purchased includes rice (in case purchased or borrowed), pork, beef, fishes, egg, other ingredients (oil and spices), vegetables, fruits, and tubers. In addition, information on food items gathered from the forest are fishes, bamboo shoot, mushroom, edible insects, and wild vegetables were collected.

$$FSR_i = \frac{\sum_{m=1}^{p}(QtyC_m \times E_m) + (QtyP_m \times E_m) + (QtyF_m \times E_m) + (QtyR_m \times E_m)}{\sum_{j=1}^{n} K_j} \quad (7.1)$$

where FSR_i is the food security ratio for household i; $QtyC_m$ is the quantity of food m produced on farm available for consumption (kg); $QtyP_m$ is the quantity of food m purchased and consumed (kg); $QtyF_m$ is the quantity of food m collected from the forest and consumed (kg); $QtyR_m$ is the quantity of food m received from friends and relatives and consumed (kg); E_m is the energy content of food item m (kcal kg^{-1})[3]; K_j is the minimum energy requirement (1,976 kcal/person/day)[4] for member j; and n is the number of members in household i.

7.2.4 Analytical method

In consistent with the second objective, a logistic regression model was used to identify the determinants of food security. In addition, marginal effect was applied to provide a good approximation of the probability change of the dependent variable from a one-unit change in the explanatory variables (the food security status is bivariate, taking the value 1 for food-secure households, and 0 for food-insecure households). The model considered 9 explanatory variables, including education, rice-farming experience, dependency ratio[5], livestock (in tropical livestock units [TLU]), possession of two-wheel tractor, rain-fed lowland rice yields, and number of relatives and friends. Two unobservable variables, village dummy and access to home gardens, were included in the model analysis. The multicollinearity of all explanatory variables was examined. The following logistic regression model was used:

[3] The quantities of all food consumed was converted into kilocalories (kcal) for correspondence with the Food Items and Their Calorie Value table (ADB, 2001).

[4] The minimum calorie requirement for rural people in Lao PDR was 1,976 kcal/person/day, set by Lao Expenditure Consumption Survey 1997/98.

[5] Dependency ratio refers the number of dependent household members, who are younger than 15 or older than 65, to the working members those age 15 – 65.

$$Ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right) = \beta_0 + \sum_{j=1}^{k=10} \beta_j X_{ij} + \varepsilon_i \qquad (7.2)$$

where $\emptyset_i$ is the conditional probability of household *i,* which is food-secure, β_j the parameter to be estimated, and X_{ij} the explanatory variable that predicts food security. Once the conditional probabilities are calculated, the marginal effects of the continuous individual variables on food security can be calculated from

$$\frac{\partial \emptyset_i}{\partial X_{ij}} = \emptyset_i(1-\emptyset_i)\beta_j \qquad (7.3)$$

The marginal effects of the discrete variables are computed from the difference in probabilities estimated with the variable is set to 1 and 0 ($X_i = 0$ and $X_i = 1$).

7.3 Results and discussion

7.3.1 Food security status among rain-fed lowland farming households

The survey results show that the daily calorie consumption per capita ranged from 710.4 to 3,915 kcal/day, with an average of 1,815 kcal (Table 7.1). Of the total calorie intake, 88.5% is contributed by rice, followed by fish and meat (8.3%), vegetables and fruits (2%), and milk, sugar, and oil (1.2%). However, these findings slightly differ from previously published data. Pandey (2001) indicated that rice accounts for more than 70% of the calorie consumption in Lao PDR. In the research site (a rural area), rice is normally consumed three times a day with an average intake of 164.1 kg per person per year. A number of food products such as fish, vegetables, egg, and meat are also eaten together with rice.

For a clearer analysis, dietary diversity[6] was examined by a seven-day recall process in accordance with the guideline of WFP. The results show diverse food consumption patterns among the sample households, with a variety of vegetables,

[6] Dietary diversity was used to examine the household food consumption pattern. The frequencies of eight food groups that a household consumed (cereals, meat and fish, milk, pulse, fruits, vegetables, oil/fat, and sugar) were recorded by seven-day recall in accordance with the guideline of WFP.

often eaten 6 days/week, followed by fish (5 days), sweets (2 days), fruits (1.4 days), fats and oils (1 day), milk (0.8 days), and pulses (0.1 days). Meat is only occasionally eaten, mainly at events such as wedding parties and village festivals.

These results indicate that household food consumption patterns in the rural areas are likely varied and characterized by sufficient dietary diversity for a healthy life because most rural households rely on food from forest collected during the lean season (e.g., wild vegetables, bamboo shoot, mushrooms, fish and aquatic resources, and edible bracken). However, the sample households generally eat small portions of food, and some important food groups such as oils (cooking oil), and fats, milk, beans, potatoes, and meat are seldom consumed. This is probably because sample households have limited income to access these types of food and lack knowledge about nutritional food. Consequently, the average calorie intake is less than the recommended amount, and nutritional problems may occur from low consumption of protein and micronutrients. This finding is consistent with a previous study by Pernille (2006), which indicated that malnutrition in Lao PDR is due to a variety of causes, including wrong combinations of food, less access to diverse food sources, and chronic poverty.

Based on the recommended daily calorie intake (1,976 kcal/person/day), it was found that 43 households (55.1%) were food-insecure and 35 households (44.9%) were food-secure (Table 7.1). This result implies that more than 50% of sample households were unable to meet the basic calorie requirement. In this study area, self-sufficiency in rice is still a crucial component of food security as it contributes more than 80% of the calorie intake in the sample households. The finding shows that about 28.2% of households had sufficient rice, while 34.6% experienced 1 to 3 months and 37.2% more than 3 months of rice shortage. The rice shortage period was longer among food-insecure households, with 55.8% of them experiencing rice shortage for more than 3 months. The lean season generally lasts from August to November (before the rice harvest).

Table 7.1: Summary statistics of food security

Items	Food-secure	Food-insecure	Total
Food security indicators			
Number of households	35 (44.9%)	43 (55.1%)	78 (100%)
Average calorie intake (kcal/person/day)	2,476.7	1,277.4	1,815.5
Minimum	2,006.5	710.4	710.4
Maximum	3,915.8	1,918.7	3,915.8
Rice shortage period			
Average rice insufficiency (months per year)	1.37	3.74	2.67
No experience	19 (54.3%)	3 (7.0%)	22(28.2%)
1–3 months	11 (31.4%)	16 (37.2%)	27 (34.6%)
More than 3 months	5 (12.3%)	24 (55.8%)	29(37.2%)

Source: Author's calculation based on 2013 household survey

7.3.2 Coping strategies on food insufficiency

Overall, rural households used several different coping strategies to mitigate food insufficiency. As shown in Table 7.2, the most common coping strategies used were gathering NTFPs (53.8%), borrowing rice from relatives/friends (43.6%), borrowing cash from relatives/friends to purchase rice and food (42.3%), relying on less-preferred food (39.7%), seasonal migration (30.8%), and selling livestock (17.9%). Some food-insecure households adjusted and reduced food consumption; about 19% of food-insecure households limited food intake of adults in favor of children, some reduced the portion/size of each meal (16.3%), and some reduced the number of meals from 3 to 2 (16.3%).

It is important to note that NTFPs can be directly consumed as food, used as medicine, and sold or exchanged to buy rice. Our finding shows that the most widely consumed NTFPs were fish, bamboo shoot, wild vegetables, and wild mushroom while malva nuts and cardamom were mainly sold. Edible NTFPs are not only play a crucial role in food security and nutritional diversity for the households but also significantly contribute to their income. On average, roughly 57% of respondents,

mainly in Huaykoh village, received some cash income from harvesting NTFPs, which contributed 23% of the total annual income. They used this cash income mainly to buy rice and other food items (e.g. fish, pork, vegetables and spices) during the food shortage period of a year — August to November. Moreover, it was used to cover other expenses, including health care and medicine, clothing, and education for children. However, 97% of respondents believed that NTFPs, particularly fishes, bamboo shoots, wild vegetables and mushrooms, malva nuts, cardamom, have dramatically decreased in quantity compared with the previous five years. This is because both villagers and outsiders can freely picked them from the forests, resulting in over-harvesting. This is obviously unsustainable. For instance, malva nut production tends to peter out because of over-harvesting under the evolving markets, although it has significantly contributed to household cash income.

Table 7.2: Type of coping strategies used

No	Coping strategies used	Food-secure		Food-insecure		Total	
		N=35	%	N=43	%	N=78	%
1	Gathering NTFPs	14	40.0	28	65.1	42	53.8
2	Borrowing rice from relatives/friends	13	37.1	21	48.8	34	43.6
3	Borrowing cash from relative/friends	12	34.3	21	48.8	33	42.3
4	Using household saving	13	37.1	20	46.5	33	42.3
5	Relying on less-preferred food[7]	11	31.4	20	46.5	31	39.7
6	Seasonal migration	7	20.0	17	39.5	24	30.8
7	Selling livestock	3	8.6	11	25.6	14	17.9
8	Limiting food intake of adults in favor of children	4	11.4	8	18.6	12	15.4
9	Reducing the portion/size of meal	3	8.6	7	16.3	10	12.8
10	Harvesting rice at early maturity	2	5.7	4	9.3	6	7.7
11	Reducing meal from 3 times to 2 times	1	2.9	7	16.3	8	10.3

Source: Author's calculation based on 2013 household survey

[7] Less-preferred food denotes the food that people do not desire to consume, but they have no choice since they could not afford to buy or access desired food due to lack of money. In other words, it is an inexpensive foods which are unpalatable and less nutritious.

7.3.3 Determinants of household food security

Analysis of the survey data revealed that household food security in the rural rain-fed lowland rice area is determined by four factors: dependency ratio, rain-fed lowland rice yield, number of relatives, and rice-farming experience. The dependency ratio has a negative effect on food security. The marginal effect shows that a unit decrease in the dependency ratio, with all other variables held at their mean, leads to a 30% increase in food security (Table 7.3). This finding is consistent with previous studies (e.g., Joshi, 2011; Sultana and Kiani, 2011; and WFP, 2007). The possible explanation is that most dependent members are children who are unable to work or help their parents effectively, resulting in labor shortage. In addition, most households with a relatively larger number of non-working members are more likely to have a limited farm size. They do not have adequate capacity to allocate time for on-farm work, gathering food from natural sources, and other income-generating activities. Consequently, the probability of food insecurity is high.

Rice yield has a significant positive relationship to food security; farmers who obtain a higher rice yield tend to be food-secure. The marginal effect indicates that a unit change (1 tonne) in rice yield, other variables in the model remaining constant, improved the probability of food security by 18%. The main reason for this is that rice is a staple food that contributes up to 88.5% of the total calorie intake, compared to the national average of about 70%. As pointed out by Pandey (2001), per capita consumption of milled rice by Lao people is high for the region, at 163 kg. It should be noted that the mean difference in rice yield was higher for food-secure (3.1 tonne/ha) than food-insecure (1.94 tonne/ha) households because of various problems. Among food-insecure households, 78% believed that low rice yield is due to pests and disease (e.g., apple golden snail, stem borer, rice bug, and thrips), followed by drought (30%), and soil infertility (12 %). Most importantly, about 48% of food-insecure households indicated that their land dedicated to rice farming were severely damaged by floods, resulting in low rice yield (0.86 tonne/ha) and food insecurity. In addition,

lack of information on good management practices, such as how to control pests and diseases, from agricultural extension agents and lack of resources or limited access to credit for purchase of farm inputs (e.g., chemical fertilizer or pesticide) may have led to the low rice yield in the study areas.

Social network indicators, such as number of relatives, were strongly correlated to food security. The marginal effect reveals that a unit increase in the number of relatives per person, calculated at sample means, results in a 38% increase in the probability of food security. Households with a large number of friends and relatives tend to have interpersonal trust and they are more likely to manage food shortage both ex ante and ex post by sharing food and reciprocity. As pointed out in Table 7.2, more than 40% of the respondents used strategies to mitigate the effects of food insecurity by borrowing rice and money to buy food from relatives and friends. This is important in allowing the household to have ability to access food as well as financial resources over time. Moreover, social networks clearly have as an important role in receiving agricultural information, such as new rice seed and fertilizer applications. Farmers who have adopted new technologies are expected to share their knowledge and experience with friends and relatives.

Rice-farming experience was positively correlated to food security, meaning that household heads with greater farming experience tend to have an insight and ability to minimize the risk of food shortage. Other variables such as education, village dummy, livestock, possession of two-wheel tractor, and home gardens were not statistically significant, though they were positively related to food security. Regarding the village dummy, despite the proportion of poor households in Huaykoh, reported by village headman, was higher than Nathong village, the food insecurity in Huaykoh village (67.8%) is not very different from Nathong village (48%). One reason is that Huaykoh villagers tend to have more chance to gather NTFPs, especially malva nuts which are high demand product in markets. As a result, they are likely to use cash from selling NTFPs to purchase rice and other foods to feed all household members during the lean season.

Table 7.3: Determinant and "marginal" effect of food security

Explanatory variables	Means	S.D	Coef.	t-value	dx/dy	t-value
Years of formal education	3.97	2.95	0.06	0.58	0.016	0.58
Rice farming experiences (in years)	22.2	13.1	0.04	1.87*	0.010	1.86*
Dependency ratio	1.14	0.67	-1.21	-2.24**	-0.300	-2.26**
Village (1 = Huaykoh; 0 = otherwise)	35.8%	NA	0.55	0.73	0.138	0.73
Livestock per person (TLU)	0.31	0.36	0.68	0.90	0.169	0.90
Two-wheel tractor (1=have; 0 = otherwise)	42.3%	NA	0.09	0.16	0.024	0.16
Rain-fed lowland rice yield (tonne/ha)	2.42	1.52	0.72	2.42**	0.179	2.39**
Home garden (1 = accessible; 0 = otherwise)	66.6%	NA	0.33	0.48	0.083	0.48
Number of relatives per person (person)	0.40	0.59	1.53	1.88*	0.379	1.87**
Constant			-2.60	-1.78*		

Log-likelihood -31.98 Pseudo R^2 = 0.398 (Prob. chi 0.000)
Note: 1) * and** indicate significance at the 10% and 5% levels, respectively.
Source: Author's calculation based on 2013 household survey.

7.4 Summary

The objectives of the study were to investigate the food security situation and coping strategies, and to identify the determinants of household food security in the rain-fed lowland rice areas. A calorie intake per person per day was used to classify household food security status and a logistic regression model was employed to determine the factors affecting household food security. The results showed that the average calorie intake per capita was 1,815 kcal per day, in which 88% derived from rice. On the other hand, other food such as meat, eggs, oils and fat are eaten in small portion. About 55% of the respondents were food-insecure as their calorie intake was less than the minimum requirement. More than 50% of sample households relied on gathering NTFPs and the assistance from their relatives during the food crisis. The empirical model revealed that dependency ratio, rice yield, number of relatives, and rice-farming experience significantly correlated to food security in the rain-fed lowland areas.

CHAPTER 8

THE EFFECT OF TRADITIONAL HOME GARDENING ON RURAL HOUSEHOLD FOOD SECURITY IN THE LOWLAND AREAS OF SOUTHERN LAO PDR

8.1 Introduction

Achieving food security and nutritional wellbeing in developing countries became increasingly more important policy objectives under the Millennium Development Goals. In Southeast Asia, some countries have already achieved these targets, but many others still suffering from food insecurity. Within the Lao PDR, food insecurity continues to top of the government's policy agenda. About 24.6% of the Lao population is classified as food-insecure, with the brunt of this borne by those living in rural areas. Moreover, about 16% of children under five years old are severely stunted (DOS, 2010; Pernill, 2006).

In Lao PDR, food insecurity is caused not only by rice insufficiency, low cash income, and structural poverty but also by health and nutritional factors, such as poor dietary intake, micronutrient deficiencies, poor hygiene, and health problems (Pernill, 2006). Increasing household income, food availability, and the diversification of nutritious food are possible solutions to alleviate food insecurity and malnutrition. Most rural Lao farmers are unable to produce sufficient rice and other types of food to feed their families year-round due to natural disasters (floods and drought), limited farmland, water shortages, soil infertility, and low productivity (ADB, 2001). Also, rapid population growth has put considerable pressure on land, giving rise to land fragmentation, which has a negative impact on food production. Under the circumstances, supplementary food production on small plots (i.e., home gardens) must be intensified and promoted to increase the availability of food crops, particularly those rich in micronutrients, throughout the year.

Home gardens are excellent examples of supplementary of food production systems. Home gardens can be described as small plots of land around a homestead or within walking distance of the home on which a mixed cropping system is maintained. A variety of vegetables, fruits, tubers and herbs can be grown in a home garden and constitute important sources of the micronutrients and diverse foods that are required to sustainably reduce malnutrition. Previous research has revealed that home gardens can significantly enhance food and nutritional security, improve family health and livelihoods, and provide additional cash income (Bhattacharjee et al., 2006; Adekunle, 2013; Galhena et al., 2013l and Sangakkara and Frossard, 2014). Taruvinga et al. (2013) found that having a home garden positively influences household food security by increasing dietary diversity and the intake of micronutrient-rich foods. In addition, using a larger farm area for home gardening was found to positively influence on food availability in western Kenya (Musotsi et al., 2008).

Although home gardens have been widely studied, especially in developing countries, research discussing how home gardens can improve food security in rural areas of Lao PDR is limited (Pernille and Phithayaphone, 2005). Moreover, home gardens tend to be overlooked by Lao policymakers and agricultural officers because of a lack of evidence and information. As such, this study aims to fill this gap by examining the effects of traditional home gardens[1] on household food security, in terms of dietary diversity scores, and presenting an overview of the characteristics of home gardens in the rural Lao context.

8.2 Data description and methodology

8.2.1 Study areas

[1] In rural areas of Laos, traditional home garden refers to a subsistent food production systems on small plots of land near the homesteads or paddy field where a few different kinds of vegetables, herbs and fruits are grown in home garden. In addition, traditional home gardens are maintained by family labor and its products are mainly used for home consumption.

The study was carried out in Huaykoh and Nathong villages of Pathoumphone District, Champasak Province, Southern Lao PDR. A total of 88 households were randomly interviewed in September 2013 using a structured questionnaire covering household profiles, food consumption (using seven-day recall), cash income, and home garden characteristics, including size, vegetables grown in both wet and dry seasons, and constraints on home gardening. In addition, a focus group discussion was conducted to gather more information on home gardening activities. Then, the survey data was analyzed both qualitative and quantitative methods.

8.2.2 Description of dietary diversity score

The dietary diversity score (DDS), which was developed by the WFP, was used as indicator of household food security. High dietary diversity exists when there is a large variety of foods in the daily diet; this helps ensure adequate nutrient intake and promote optimal health (Baumann et al., 2013).

The DDS was calculated by summing the frequency of consumption of food items over the past seven days. The food items were then grouped into eight standard food groups, including cereals, meat and fish, milk, pulses, fruits, vegetables, oil/fats, and sugar, as shown in Table 8.1. Subsequently, each food group was multiplied by its weight, based on its nutritional content; the aggregate of the weighted food groups forms the household DDS. Finally, households were classified into three categories based on DDS thresholds: poor food consumption, borderline food consumption, and acceptable food consumption. Households were classified as having "acceptable food consumption" or being "food-secure" if the DDS was over than 35[2], indicating that household food consumption was sufficiently diverse to support a healthy life. On the

[2] According to WFP's guideline, households that score above 35 are considered to have an acceptable food consumption consisting of sufficient dietary diversity for a health life. Basically, they are expected to consume rice and vegetables (7 days/week), followed by a frequent (3 days/week) consumption of fish, 2 days/week for fruit, oil and sugar (staple*weight + vegetable*weight + fish*weight + fruit*weight + oil*weight + sugar*weight = 7*2 + 7*1 + 3*4 + 2*1 +2*0.5 + 2*0.5 = 37).

other hand, a household with a DDS between 21.5 and 35 or below 21 was classified into the "borderline" or "poor food consumption" group, respectively. These two groups are both considered "food-insecure." (WFP, 2008).

Table 8.1: Collected food items, food groups and relative weight for the calculation of the DDS

	Food items	Food groups	Weight
1	Rice, maize, cassava, other roots and tubers (sweet potato, yam, taro)	Cereals, tubers and root crops	2
2	Meat (poultry, pork, beef), eggs, fish and other aquatic animals	Meat and fish	4
3	Milk/milk products	Milk	4
4	Pulses (including beans, tofu, bean curd)	Beans	3
5	Vegetables (green, leafy vegetables, shoots and mushroom)	Vegetables	1
6	Fruits (banana, apple, orange, etc.)	Fruits	1
7	Sugar	Sugar	0.5
8	Oil, lard	Oil/fats	0.5

Source: WFP, 2008
Note: In this study, the concept of Dietary Diversity Score (DDS) is similar with Food Consumption Score (FCS)

8.2.3 Model specification

Ordinary Least Squares (OLS) regression was used to estimate the effect of having a home garden on the DDS, controlling for other independent variables using the following form.

$$logDDS_i = \tau_0 + \sum_{j=1}^{9} \beta_j logX_{ji} + \varepsilon_i,$$

Where *DDS* denotes the dietary diversity score, in logarithm form. X_{ji} is a vector of explanatory variables, τ_0 and β_j are parameters to be estimated, and ε_i is the regression error term. The model was estimated with 10 explanatory variables, including the variable of interest, an indicator for having a home garden, as well as the age, gender, and literacy of the household head, household size, village-level dummy variables, the number of friends and relatives within village, access to fishing,

household cash income, and size of farmland (Table 8.2). Multicollinearity among the explanatory variables was examined to minimize any bias in the estimation.

The effect of the explanatory variables on the DDS has been hypothesized as follow: The variable home garden is considered as a source of vegetables, fruits, and tubers, which are important to enhance the dietary diversity. Households with home gardens may have more food production to feed their all members, and larger size of home gardens may have several kinds of vegetables that lead to increase DDS. Therefore, the estimated coefficient is expected to be a positive.

Regarding the household characteristics variables, the age of household head is assumed to be a positive influence on DDS because the older households head may have greater farming experience as well as ability to cope during food shortage period. Sex of household is expected to have a positive effect on DDS. Male-headed households are likely to obtain various agricultural information and access several sources of foods, such as fishing and gathering wild food.

Education of household head is measured as the literacy of households head. Having ability to read and write the Lao language can be considered as an indicator to access public information, such as agricultural information, concerning health and nutritional knowledge. On the other hand, educated household head may have strategies to acquire food to feed all household members. Hence, the expectation of education is a positive correlation with the DDS.

In most rural areas of Laos, larger households, especially those with many children, are generally poor and less able to access diverse food sources. Thus, household size is expected to be a negative effect on DDS. A village dummy variable is unobservable variable. Those households who reside in Huaykoh village, where most villagers reside nearby forest, may have more chance to obtain a variety of foods from forest. Hence, the estimated coefficient is expected to be positive. Regarding the social network, reciprocal assistance is widely observed in the rural areas of Laos. Head of households who have more friends and relative within the village are likely

to share and receive food from their networks that lead to increase DDS. Thus, number of friends and relatives within village is assumed to have a positive influence on DDS.

Access to fish and aquatic resources is another important variable. Households who access to fish and aquatic resources are more likely have better intakes of protein and micronutrients that lead to increase DDS. Farm size is measured based on cultivated rice areas. Households with more farmland are more likely to have food available from their own farm production as well as household income from selling rice. In other words, these households may spend their money to purchase other food items, such as fish, meats, eggs, and fruits, instead of buying rice during the lean season. Therefore, it is expected to have a positive effect on the DDS. Regarding the household income, households with higher income may have more purchasing power for several kinds of food, such meat, fish, and fruit, especially during the lean season (before harvesting). The estimated coefficient is thus expected to positive.

8.3 Results and Discussion

8.3.1 Households characteristics

Summary statistics for the socioeconomic characteristics of the sample households are presented in Table 8.2. Most of the household heads (83%) were male, with an average age of 42 years. About 67% of respondents were able to read and write the Lao language, and 31% were from the Alak ethnic minority group. The average household size was 6 people, ranging from 2 to 13. Most of the sample households heads were farmers who relied on rain-fed lowland rice cultivation; the average farm size was 0.93 ha and the average rice yield was only 2,149kg/ha.

The median cash income per household was 8.9 million LAK (USD 1,073), which is relatively low compared to the average for Champasak Province (USD 3,650/household/year) and the nation as whole (USD 3,379/household year). The largest share of income came from nonfarm sources (50%), such as masonry work and remittances. Other major income sources were NTFPs (23.2%), farm cash income

(22.3%) and off-farm activities (3.6%). Among income earned from farming activities, livestock production, mainly cattle and pigs, contributed about 61%, followed by selling rice (20%), while income gained from selling cash crops (cassava and sugarcane) and vegetables accounted for only 11% and 8% of total farm cash income, respectively.

Table 8.2: Results of regression model predicting household DDS

Explanatory variables	Mean	S.D	Coeff.	t-value
Age of the household head (years)	41.9	14.0	-0.001	-0.22
Gender of household head (dummy: 1=Male; 0 = Female)	83%	0.37	-0.004	-0.06
Literacy of household head (dummy: 1 = literacy; 0 = otherwise)	67%	0.47	0.102	2.09**
Household size (people)	6.15	2.13	-0.104	-1.63
Village (dummy: 1 = Huaykoh village; 0 = Nathong village)	31%	0.46	0.037	0.63
Number of friends and relatives within village (people)	1.64	1.77	0.040	3.01***
Having a home garden (dummy: 1 = yes; 0 = no)	63%	0.48	0.133	2.10**
Access to fish and aquatic resources (dummy: 1 = yes; 0 = no)	28%	0.45	0.144	2.40**
Annual household cash income (million LAK)	8.59	9.42	0.004	1.39
Cultivated rice areas for the household (ha)	0.93	0.59	0.058	1.75*
Constant 3.41 (t-value 30.8 ***); Observation (88); R-squared (0.322); Prob > F=0.000				

Note: 1) *, ** and *** indicate significant at the 10%, 5%, and 1% levels, respectively.
2) Exchange rate: USD 1 = 7,780 Kip
Source: Authors' calculation based on the 2013 household survey

8.3.2 Household dietary diversity

Results for dietary diversity, which was examined via a seven-day recall, is shown in Figure 8.1. As expected, the results show that within the studied week, rice was generally consumed most often (on all 7 days), followed by fish (5 days), green leafy vegetables (4 days), sugar (2 days), and bamboo shoots and mushrooms (2 days). Animal-source foods such as eggs, chicken, beef, pork and milk are consumed less than 1 day a week on average.

This could be because the survey was conducted in September, the beginning of rice shortage period; during this time, certain rice-deficient households primarily used their cash to purchase rice rather than other types of food. In addition, meat is eaten rarely in these villagers, being mainly reserved for community events such as parties or village festivals. Thus, most villagers rely mainly on NTFPs such as fish, bamboo shoots, and mushroom, as well as vegetables from their home gardens.

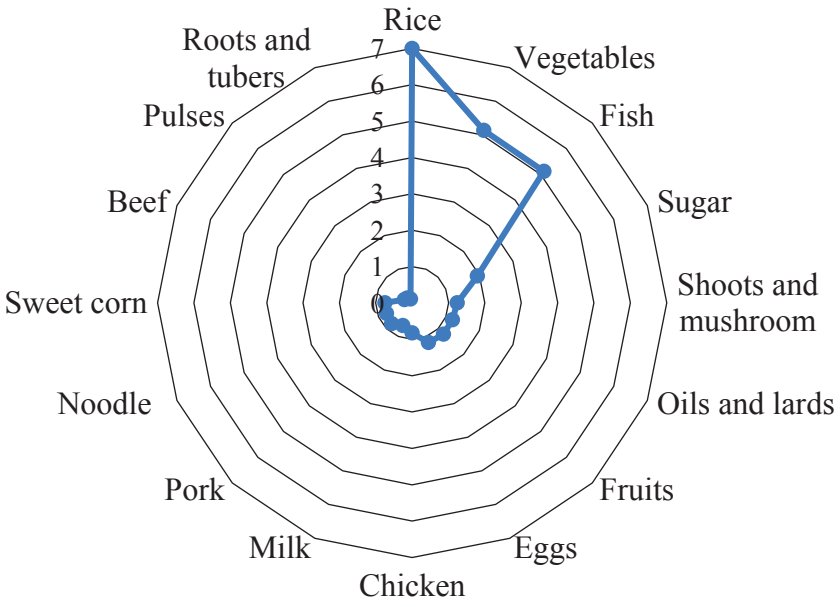

Figure 8.1: The average food consumption over a recall 7 days
Source: Author's calculation based on the 2013 household survey

Table 8.3 summarizes the average household's food security status, based on the DDS categorization. On average, the household DDS was 40.2, although it ranged from 21–73. The DDS was statistically different at the 5% significance level between households with home gardens (41.9) and those without home gardens (37.2). About 67% of the sample households were food-secure, while 33% were food-insecure. Importantly, the level of food security was higher among households with home garden (75%) than among those without (53%). This means that households with

home gardens are more likely to consume a variety of vegetables (6 days) than households without home gardens (4 days).

However, it is unclear why the remaining 25% of households with home gardens were food-insecure. Possible reasons include lower household incomes, limited access to fish, and improper home gardening practices. The majority of food-insecure households depended on unstable income sources, such as transplanting, harvesting, construction workers, and remittances from relatives in other districts. Accordingly, their average income (3,517,000 LAK) was considerably lower than that of the food-secure households (10,053,000 LAK). Lower-income households are likely to use their resources to purchase rice for consumption, rather than other food items. In addition, none of the food-insecure households had access to fish, whereas about 33% of the food-secure households were able to access to fish and aquatic resources. Another possible explanation involves the number of vegetables grown in the home garden, which was lower than for food-secure households.

Table 8.3: Category of DDS according to presence of a home garden

Dietary diversity score category	Without home garden		With home garden		Total	
	Freq.	%	Freq.	%	Freq.	%
Low DDS (below 21)	1	3.1	0	0.0	1	1.1
Medium DDS (21 – 35)	14	43.8	14	25.0	28	31.9
High DDS (above 35)	17	53.1	42	75.0	59	67.0
Total	32	100.0	56	100.0	88	100.0

Pearson chi2 (2) = 5.4534; Pr =0.065; Fisher's exact = 0.043

Source: Authors' calculation based on the 2013 household survey

To clarify how home gardens connects to food security, Table 8.4 shows the sources of vegetables and fruits for consumption for both groups; the results show that about 64.3% of households with home gardens reported consuming vegetables from their own farms daily or almost daily, and 30% sometimes consumed wild vegetables,

such as edible bracken and Pakwan (*Melientha suavis*). On the other hand, about 75% of households without home gardens relied on gathering wild vegetables, but did not do so every day. Moreover, 18.7% did not consume vegetables during the survey week. The finding offers some confirmation that home gardens play an important role in household food security in terms of food diversity among rural Lao farmers.

Table 8.4: Source of vegetables and fruits consumption over the past seven days

Sources of vegetables and fruits	Vegetable		Fruits	
	With home garden (N=56)	Without home garden (N=32)	With home garden N=56	Without home garden N=32
Purchased	3.6%	6.3%	8.9%	6.3%
Home production	64.3%	0	44.6%	34.4%
Forest	30.3%	75.0%	0	0
Received in kind	1.8%	0	5.4%	15.6%
No consumption	0	18.7%	41.1%	43.7%

Source: Authors' calculation based on the 2013 household survey

8.3.3 Determinants of rural household dietary diversity

Results, which were obtained from OLS analysis, revealed that there was a positive and significant relationship between a rural household's DDS and the members' access to fish and having a home garden (Table 8.2). Access to fishing increased the DDS by 14%, implying that households in which members fish regularly are likely to have higher nutritional diversity as a result of consuming fish and other aquatic resources, which are important sources of protein, micronutrients, and energy. Additionally, these households earned about 10% of their total annual income from selling fish; this cash income was mainly used to buy rice during the months of rice shortage. However, 97% of survey respondents opined that the amount of fish available had decreased dramatically in the previous five years due to over-fishing.

Most importantly, having a home garden increased the DDS by 13%. This finding is consistent with previous research from South Africa (Taveuving et al., 2013) and implies that home gardens provide a variety of vegetables, fruits, tuber, and herbs that serve as sources of micronutrients and enable households to diversify food consumption. Home gardens also serve to increase food supply and availability, thereby better meeting the nutritional needs of household members (Pernille and Phithayaphone, 2005).

Another important result is that the literacy of the household head, the number of friends and relatives he or she had within the village, and the cultivated rice areas were all significantly related to the DDS. It is important to note that households who have larger number of friends and relatives within villages are more likely to share food among their friends and relatives. Household size was not statistically significant, but had a negative impact on DDS, implying that larger household size are more likely to become food-insecure. Unexpectedly, annual household cash income was not significantly related with the DDS. The reason is due to the fact that the cash income figure referred to the whole year, while the DDS was randomly calculated based on only a seven-day recall process.

8.3.4 Home garden characteristics

In the study areas, home gardening activities can be undertaken in both wet and dry seasons. Of the 88 households studied, 64% maintained a home garden in the wet season, while about 42% maintained a home garden in the dry season (Table 8.5). Home gardening activities in both seasons were predominantly undertaken by women applying traditional methods, such as using uncertified seed, little manure, no chemical fertilizer, and inappropriate fencing to protect crops from domestic animals, such as goats, pigs and chickens.

About 36% of sample households had no home garden, mainly because they lacked of suitable land on which establish a home garden, were short on labor, had

limited access to water or poor access to markets for selling vegetables, lacked farming skills and knowledge related to home gardening, or could not access agricultural extension services. The result also showed that the nutritional worth of vegetables produced in home gardens was undervalued; some villagers lacked adequate knowledge of nutrition and rarely considered nutritional aspects when planning food consumption. In other words, despite all households being within the same village, some households may be not interested in home gardening since they are likely to participate in non-farm income-generating activities, such as petty trade and construction workers.

Table 8.5: Home garden characteristics

Characteristics	Wet season	Dry season
No. of households (n (%))	56 (64%)	37 (42%)
Size of home garden (m^2)	197 m^2	105 m^2
Less than 50 m^2	29 (52%)	25 (68%)
50 – 200 m^2	19 (34%)	8 (21%)
More than 200 m^2	8 (14%)	4 (11%)
Location of home garden	Nearby paddy field and dwelling	Nearby dwelling
Water sources	Streams, rainfalls, and wells	Groundwater and wells
Labour used	Both men and women	Women, elderly and children
Problems	Caterpillar and bug, chicken and pig	Chicken and pig

Source: Authors' calculation based on the 2013 household survey

The studied farmers typically spent their time during the wet season caring for rice fields; as such, during the wet season home gardens are mostly located near paddy fields to make it is easier to manage them. However, some households reported that vegetables such as lettuce, coriander, and green mustard were susceptible to the heavy monsoon rains and certain diseases due to a lack of netting. In the dry season, home gardens are located near dwellings. The average size of a home garden was larger in

the wet season than in the dry season (197m^2 versus 105 m^2). In the wet season, the main source of water for gardening was rainfall and streams, while underground water and wells are mainly used for home gardening during the dry season. The results showed that more than 20 different types of vegetables and others plants were cultivated in home gardens in both wet and dry seasons, as shown in Table 9.6. About 75% of respondents with home gardens had grown chili and spring onion, followed by coriander (62%), mint (57%), green mustard (48%), and eggplant (46%). Cucumber, sweet potato, and lettuce were grown only in the dry season.

Table 8.6: List of vegetables grown in home garden

List of vegetables	Freq. (n=88)	%
Chilies	42	75.0
Spring onion	42	75.0
Coriander	35	62.5
Mint	32	57.1
Green mustard	27	48.2
Eggplant	26	46.4
Lemon grass	25	44.6
Sweet corn	22	39.3
Yard long bean	18	32.1
Ginger	17	30.4
Papaya	14	25.0
Gourd	12	21.4
Morning glory	12	21.4
Tomato	8	14.3
Banana	4	7.1
Sesame	2	3.6
Ivy gourd	2	3.6
Sweet pumpkin	1	1.8
Cucumber (only dry season)	14	25.0
Lettuce (only dry season)	14	25.0
Sweet potato (only dry season)	5	8.9

Source: Authors' calculation based on field survey 2013

The vegetables, fruits, tubers and herbs produced in home gardens were primarily used for household consumption. Surplus products, especially fresh chili, were processed (e.g., into dried chili) and sold to outside traders. In contrast, cucumber, sweet corn, lettuce, green mustard, and eggplant were only sold within the village due to a lack of markets in nearby villages. Of the households with home gardens, about 21% (12 households) were able to sell surplus garden products. The cash income generated from selling surplus garden products contributed 2.8% of total household income. This cash income was primarily used for children's education and purchasing rice in shortage times and was not sufficient to feed the entire family. As such, most households that experienced rice shortfalls had to gather NTFPs, such as malva nut, and cardamom, to sell; fish, bamboo shoots and wild vegetables and mushrooms were mainly harvested for home consumption.

The median number of vegetables grown in a home garden was four. About 57% of households with home gardens grew 3-5 different vegetables in their garden, 25% grew 2 types of vegetables, and 18% grew more than 6 types of vegetables. The number of vegetables grown in most home gardens in this study was thus less than that recommended by a previous study conducted by Food and Agriculture Organization (FAO) in Vientiane Municipality, Vientiane, and Bolikhamxay Provinces in central region of Lao PDR (Bhattacharjee et al., 2006), which suggested that home gardens should include more than eight types of vegetables in order to improve the nutritional status of rural Lao people. This shortcoming is mainly due to limited farm area, poor information on nutritional benefits of home gardening, and lack of knowledge and information, weak extension and advisory services, and a lack of vegetables seeds in the study areas.

8.4 Summary

The aim of this chapter was to examine how the cultivation of a home garden plays an important role in household food security, as measured by dietary diversity

score. A total of 88 households from two rural villages of southern Lao PDR was randomly interviewed using a structured questionnaire. Ordinary Least Squares (OLS) was employed to estimate the effect of having a home garden on household dietary diversity. The results showed that about 63% of respondents maintained a home garden in the wet season. Most importantly, about 75% of households with home gardens were food secure, as compared with 53% of households without home gardens. Household dietary diversity in these rural villages was found to be positively associated with access to fishing, having to a home garden, the literacy of the household head, and the number of friends and relatives in the village. Significantly, having a home garden leads to a 13% increase in dietary diversity, implying that home gardens can significantly improve food security and contribute to better nutrition through food diversification. Most of home gardens were practiced using traditional techniques including use of uncertified seed, lack of fertilizer, inappropriate fencing to protect the crop from domestic animals. In addition, most villagers lacked of nutritional value of vegetables produced in home gardens.

CHAPTER 9

THE EFFECT OF FLOODS ON HOUSEHOLD ECONOMIES AND FOOD SECURITY IN LOWLAND RICE FARMING HOUSEHOLDS IN LAOS

9.1 Introduction

Recent increases in the frequency and intensity of natural disasters have been caused by various factors, including climate change, weather variability, and human activities (Dilley, 2000; IPCC, 2013). Of the more than 2,600 disasters around the world in the last decade, 41% occurred in Asia (International Federation of Red Cross and Red Crescent Societies, 2014). These disastrous events have resulted in the loss of life, displacement of vulnerable persons, damage to property, high levels of poverty, and food insecurity (Vathana et al., 2013; Haraguchi and Lall, 2013). The number of people at risk for these negative outcomes—the majority of which live in developing countries with high poverty rates—has similarly increased each year. Previous studies have demonstrated the general effects of floods on rural household economies, particularly the loss of crops and livestock and how these losses have reduced household income and rendered food scarce (Kirsch et al., 2010; Chi et al., 2012; Haile et al., 2013). One study, performed in Cambodia showed that floods also negatively affected household consumption, resulting in poor household welfare (Vathana et al., 2013).

As a country that is substantially affected by floods, Laos is characterized by a high percentage of the population that live under the poverty line (27.6%). Most of the population (70%) live in rural areas and rely on subsistence agriculture, which is dominated by rice cultivation. In the lowland areas, rice production is highly susceptible to natural disasters, primarily floods and drought (Schiller et al., 2013). Floods, which typically occur between May and September each year, can cause up

to $1 billion of damage to agriculture crops, livestock, public health, infrastructure, and family assets. Table 9.1 illustrates the regularity with which floods have occurred in Laos. Since 1966, the country has experienced more than 35 floods of various magnitudes, mainly in the central and southern regions of Laos (Ministry of Labor and Social Welfare, or MLSW, 2013; MPI, 2014). Though all floods were costly, the years between 2009 and 2013 saw a substantial increase in the economic costs attributed to them. In September 2009, more than 180,000 people in the southern region—which represented 23% of that region's population at the time—were seriously affected by Typhoon Ketsana. Similarly, in 2011, Tropical storms Haima and Nok-Ten brought heavy rains to Laos. These rains directly affected over 82,000 families in 96 districts across 12 provinces and caused over $174 million USD worth of damage in Laos (NERI, 2012). More recently, a series of five major storms crossed Laos, causing severe flooding in 12 provinces, and approximately $280 million USD worth of damage (GoL, 2013).

As evidenced by the damage caused by the aforementioned storms, the widespread effects of floods remain a major concern for rice farmers. Most farmers in rural areas have few resources, making them susceptible to floods. Moreover, weather changes have caused a number of unexpected floods in recent years. The likely recurrence of these events is likely to have negative effects on Lao rice farming and the general welfare of the country's population. Although past research has explored the impact of floods on national economies in a general sense, little (if any) research has examined the effects of floods on economic factors and food security at the household level. To redress this gap in literature, this seeks to assess the effect of floods on household economies and food security of lowland rice-farming households and to examine the coping strategies to deal with the effect of floods within the Sanasomboun district, Champasak province in Laos.

Table 9.1: Damage caused by floods in Laos from 1966-2013

Year	Type of damage	Damage cost (Thousands of USD)	Region affected
1966	Flood	13,800	Central
1968	Flood	2,830	Central
1969	Flood	1,020	Central
1970	Flood	30	Central
1971	Flood	3,573	Central
1972	Flood and drought	40	Central
1973	Flood	3.7	Central
1974	Flood	180	Unknown
1976	Flash flood	9,000	Central
1978	Flood	9,000	Central
1979	Flood and drought	3,600	Northern, Southern
1980	Flood	3,000	Central
1981	Flood	682	Central
1984	Flood	3,430	Central, Southern
1985	Flood	1,000	Northern
1986	Flood and drought	2,000	Central, Southern
1990	Flood	100	Central
1991	Flood and drought	3,650	Central
1992	Flood and drought	302,151	Central
1993	Flood and drought	21,828	Central, Southern
1994	Flood	21,150	Central, Southern
1995	Flood	15,000	Central
1996	Flood and drought	10,500	Central
1997	Flood and drought	1,860	Southern
1999	Flood	7,450	Central, Southern
2000	Flood	6,684	Central, Southern
2001	Flash flood	808	Central, Southern
2002	Flood	14,170	Northern, Central, Southern
2004	Flood	750	Southern
2005	Flash flood	1,317	Central, Southern
2006	Flood	3,636	Central, Southern
2007	Flash flood	8,056	Northern, Central and Southern
2008	Flood and flash flood	4,384.4	Northern, Central
2009	Flood (Typhoon Ketsana)	518,000	Southern
2011	Flood (Haima and Nok-ten)	174,000	Central, Southern
2013	Flood	280,000	Central, Southern

Source: MLSW (2013) and MPI (2014)

9.2 Data description and methodology

9.2.1 Study areas

In consultation with the National Rice Research Program (NRRP), this study selected Khili-Khamyard village in Sanasomboun district of Champasak province as the focal area of study (Figure 9.1). In September of 2013, Champasak province was significantly affected by floods after prolonged heavy rain. Approximately 13,000 families in 318 villages across all 10 districts were affected, and about 10,287 hectares of land designated for the cultivation of rice (about 12% of all area for rice) were completely destroyed. Of all the rice areas in the province, about 41.6% was located in Sanasomboun district. Owing to its location along the Se Don River, Khili-Khamyard village is one of the most flood-prone areas in this district. There are 347 households in Khili-Khamyard, most of which rely on rain-fed lowland rice cultivation to support their livelihoods. Of the 759 hectares of land within the village dedicated to agriculture, 500 hectares (65.8%) and 200 hectares (27.6%) are devoted to rice in the wet season (WS) and dry season (DS), respectively.

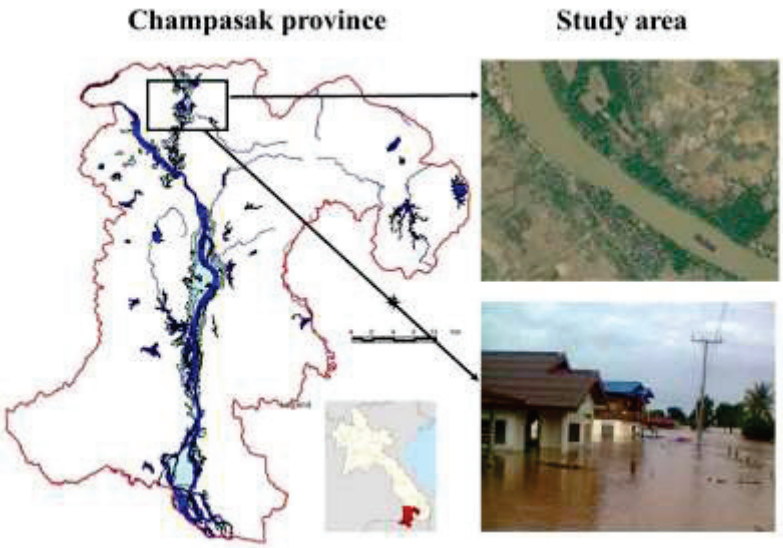

Figure. 9.1: Study areas.

Source: https://www.google.co.jp/maps and National Rice Research Program

9.2.2 Data reliability

In this study, the effect of floods on household economies and food security was assessed by comparing a "flood year" to a "normal year." In August 2014, a structured questionnaire was randomly administered to 100 households in Khili-Khamyard village. The questionnaire included questions related to each household's socio-economic characteristics, rice cultivation and production during the wet and dry seasons, the nature of the floods to which they were subjected, household income, food consumption behaviors, and coping strategies used in the year 2013. All responses collected via this questionnaire were treated as "flood year" data. "Normal year" data were based on 50 surveys that had previously been administered by the NRRP in Khili-Khamyard village in 2008. The objective of NRRP's survey is to understand the agro-ecological and socio-economic characteristics of the farmers in the flood-prone, rice-growing area. To improve the reliability of the data which was collected in 2014, the bio-physical features of the study sites was compared during the normal and flood years (see Table 9.2). The population of the village slightly increased from 1,775 in 2008 to 1,853 in 2013. In addition, some households with access to irrigation water are able to cultivate irrigated rice during the dry season. The respective cultivated areas in the wet (521 ha) and the dry seasons (210 ha) were similar during the flood and normal years.

As shown in Table 9.3, the socio-demographic characteristics of the sample households was evaluated. About six people comprised the average household during the normal and flood years. Of these six individuals, about three were classified as full-time workers, on average. Mean educational attainment was roughly five years of schooling (i.e., primary school). On average, the amount of land dedicated to cultivating rain-fed lowland rice during the normal year was not different from the flood year. About 90% of households cultivated in their own land, while the remaining households rent other farmers' land to cultivate. More than 93% of households typically engaged in transplanting techniques during both the normal and flood years.

Still, some households engaged in direct seedling techniques during the dry season. In sum, the socio-demographics features of the respondents in the normal and flood years were roughly similar, despite that the respondents in 2008 and 2013 differed. Given their similarities, it was determined that the datasets were comparable, thereby allowing us to compare the effect of floods on household economies and food security in the two years of interest.

Table 9.2: Socio-demographic characteristics of the Khili-Khamyard village

	Normal year (2008)	Flood year (2013)
Population	1,775	1,853
Number of household	342	347
Households engaged in farming (%)	100	100
Areas of wet season rice (ha)	521	521
Areas of dry season rice (ha)	210	210
Adoption of improved rice varieties (%)	100	100
Households with electricity (%)	100	100
No. of irrigation pump in the village	4	5

Source: Author's calculation based on the 2008 and 2014 household surveys

Table 9.3: General household's characteristics

Characteristics	Normal year (2008) N = 50		Flood year (2013) N = 100	
	Mean	S.D	Mean	S.D
Household size (person)	6.18	1.88	5.96	2.18
Less than 6years old	0.60	0.88	0.70	0.93
6 to 16	1.76	1.26	1.40	1.23
17 to 65	3.68	1.80	3.73	1.87
More than 65years old	0.14	0.35	0.13	0.37
Number of full-time workers	3.64	1.80	3.0	1.46
Years in education of respondent (year)	4.66	3.06	5.46	3.11
Households engage in WS farming (%)	100		100	
Households engage in DS farming (%)	56		71	
Average farm size in WS (ha)	1.44	0.88	1.56	0.71
Average farm size in DS (ha)	0.42	0.40	0.43	0.44
Areas by tenure status				
Owned-cultivated (%)	91.0		92.0	
Rented-in (%)	9.0		8.0	
Average rice yield by season				
Wet season (kg/ha)	2,529	997	579.9	649
Dry season (kg/ha)	4,614	1,358	4,210	2,370

Source: Author's calculation based on the 2008 and 2014 household surveys

9.2.3 Indicator of household economy and food security

In this study, gross household income was used as a proxy for household economy. Respondents were asked to specify all household members' sources of income in the past 12 months prior to the survey to avoid bias attributable to seasonality. Household income was divided into nine categories such as gross income from rice, crops sales, livestock sales, non-farm activities, off-farm income, and sale of non-timber forest products. To properly capture rice income, measuring only monetary sales is not sufficient; because most households depend heavily on home production, the value of production used for home consumption must also be accounted for. However, the cost of inputs for rice production was excluded from analyzing due to the limitations of the NRRP data. The Consumer Price Index (CPI) was used to convert the nominal value of household income into a real value.

In addition, rice available per adult equivalent was used as a proxy indicator for household food security, as rice is a staple food in Laos, where over 85% of the Lao population depends on it. Moreover, self-sufficiency in rice has long been used as an indicator of food security in Laos (i.e., Douangsavanh, 2006 and Sparkes, 2013). With respect to calorie needs on the basic of each individual's age, this study considered adults to be persons between the ages of 16 and 65 years old; children under the age of six were treated as half an adult. Persons between the ages of six and 16 and over the age of 65 were treated as 0.8 adults (these standards are consistent with ADB, 2001). The caloric requirements based on sex was excluded from the analysis due to these data being absent from the 2008. The Asian Development Bank's recommended daily calorie intake 2,315 kcal per adult per day was used to estimate the annual rice requirement per adult per annum.

Because rice (a) represents roughly two-thirds all calorie intake among participants and (b) has roughly 3,550 calories per kilogram (Pandey, 2001), each adult in Laos consumed about 1,550 kcal (66.6 percent of 2,315 kcal) per day from

rice. Using this estimate, it was determined that each year, every adult required about 159 kilogram (1,550 kcal/day × 365 days) × (1kg/3,550 kcal).

In addition, information related to farm-produced rice and other sources of rice in detail was derived during the last 12 months. With this information, a food security ratio was calculated and can be expressed as Eq.1

$$FSR_i = \frac{(QtyC+QtyP+QtyB+QtyR)}{AE_i \times RA} \qquad \text{Eq. 9.1}$$

where FSR_i is the food security ratio for household i; $QtyC$ is the quantity of milled rice produced on a farm available for consumption (in kg); $QtyP$ is the amount of rice purchased and consumed (in kg); $QtyB$ is the quantity of rice borrowed and consumed (in kg); $QtyR$ is the total amount of rice provided by friends and relatives, government agencies, and NGOs (in kg); AE_i is the adult equivalent of households i; and RA is the rice requirement per adult per annum (159 kg). Using this equation as a benchmark, households were considered to be food-insecure if their FSR was less than one. If a household had FSR equal to or greater than one, it was deemed as food-secure.

9.3 Results and discussion

9.3.1 Flood characteristics

Results revealed that all households experienced severe flooding in the middle of September in 2013. The primary cause of these widespread floods into the village's residential areas and rice fields was the rising water level of the Se Don River initiated by heavy rain. Many households were forced to leave their house temporarily and set up camps along Road No. 13 South. Other households relocated to the highland areas until the flood waters receded. The average duration of flooding events was about 11 days, with a maximum duration of 25 days. Floods typically occurred during the reproductive phase of the rice plant (60-70 days-old). On average, floods resulted in water depths of 265 centimeters, though the depth of the water varied substantially

from flood to flood, with a low of 80 centimeters and a high of 500 centimeters. In the last decade, six floods have occurred in the study areas, most typically occurring in August and September.

9.3.2 The effects of floods on agriculture and household economies

During the flood year, most households (96%) indicated that portions of their land dedicated to rice growth were severely damaged by floods (Table 9.4). The losses of rice associated with these floods directly affected the respondents' household food security. On average, these lands yielded less rice during the flood year (580 kg/ha) than the normal year (2,529 kg/ha), as shown in Table 9.3. This lower yield is significantly associated with the duration of flooding and the depth of the water during the flood. To compensate for declines in rice production, 71 households cultivated rice during the dry season. Of these, 13 households (18.3%) borrowed the land from those who have irrigated areas, and 58 households cultivated in their own areas where irrigation water was available. Despite these measure, the amount of irrigated land (210 ha) was not insufficient to cover the need of all flood-affected farmers.

The heavy damage caused by flooding is also harmful to the raising of livestock and maintenance of home gardens. About 75% of households reported that their efforts to grow other foods, including chilies, sweet corn, yard-long beans, and cucumbers were hindered by floods. About 17% reported that they lost poultry or other livestock, resulting in lost income and reduced food availability. There were problems following the floods as well. Diseases borne from insects and other pests (e.g., the golden apple snail and rice bugs), as well as weeds, were pervasive in the following season. Still, the majority of households recognized that flooding served to increase soil fertility and the fish population in the wetlands. Some respondents claimed that they were able to reduce the use of chemical fertilizer by 50% in the season following a flood. The silt deposited from the flood rendered the soil more fertile and provided nutrients that helped to increase rice yield in the following season.

This means that flooding—though damaging—is important for maintaining soil fertility.

Table 9.4: The effect of floods on agriculture

	Severe damage	Moderate damage	Slight damage	No damage
Rice production losses	96%	3%	-	1%
Vegetables and crops	75%	1%	1%	23%
Pest and disease outbreak	46%	25%	14%	15%
Weed problem	22%	13%	23%	42%
Animal dying due to flood	17%	40%	10%	33%
Agricultural equipment losses	8%	4%	6%	82%
Irrigation canal damage	6%	13%	11%	70%

Source: Author's calculation based on the 2014 household survey

Farming was the primary source of income for households, both in the normal and flood years. Non-farming activities and livestock sale accounted for the second and third most lucrative practices, respectively. During the flood year, overall household income decreased by roughly 23.6% relative to the normal year (Table 9.5). Income derived from rice production was particularly hard-hit during the flood year; it fell by about 38.3%, mainly the wet season rice because of the low rice yield. However, this drop in income was not related to change of rice price, as the nominal value of rice price during the normal year (1,500 LAK per kg) was converted to its real value during the flood year (2,340 LAK per kg). The higher price during the flood year is influenced not only by the supply and demand in a given year, but also other factors, including floods and external trade. It is important to note that farmers that grow rice during both the wet and dry seasons typically use rice produced during the wet season for home consumption. Rice produced in the dry season is typically sold. Because of the flood and the accompanying reduction in rice production during the wet season, however, many farmers were forced to use rice produced during the dry

season for home consumption rather than sale. As a result, the flooding caused farmers to experience financial losses in terms of their rice sales.

Table 9.5: Household income

Type of income	Value (thousands of LAK/household/year)			
	Normal year N=50	Flood year N = 100	Difference	% change
1. Gross income of rice	12,300.6	7,586.3	-4,714.3	-38.3
Wet season rice	5,484.5	2,002.8	-3.481.7	
Dry season rice	6,716.1	5,583.5	-1,132.6	
2. Crops sales	412.0	308.4	-103.6	-25.1
3. Non-farm income	2,891.1	2,515.4	-375.7	-14.9
Masonry	843.2	664.0	-179.2	
Petty trade	165.0	549.0	384.0	
Services	561.0	527.7	-33.3	
Lumbering	42.9	446.5	403.6	
Making energy-saving stoves	1,282.1	328.2	-953.8	
4. Livestock sale	2,245.4	2,488.2	242.8	10.8
Poultry	479.7	417.6	-62.1	
Pigs	361.7	553.0	191.3	
Cattle	1,404.0	1,517.6	113.6	
5. Off-farm income	738.4	174.2	-564.2	-76.4
6. Non-timber forest products	413.8	375.7	-38.1	-9.2
7. Remittance	1,056.0	1,603.7	547.7	51.9
8. Rice given by government & NGOs	0	136.3	136.3	n/a
9. Rice given by friends and relatives	0	141.4	141.4	n/a
Total (1+2+3+4+5+6+7+8+9)	20,057.3	15,329.6	-4,727.7	-23.6

Source: Author's calculation based on the 2008 and 2014 household surveys

Note: Exchange rate USD1 = 8,000 LAK

Flooding also adversely affected income derived from non-farming and off-farming activities by about 15% and 76%, respectively. Most households were unable to engage in non-farming income activities, particularly masonry and the production of energy-saving stoves, while income derived from other non-farm activities, such as lumbering and petty trade increased significantly during the flood year (see Table

9.5). Some villagers illegally participated in timber logging to offset their lost income. Few respondents reported migrating to work in a Pakse (the capital city of Champasak province), as there was a lack of non-farm jobs there, and wages paid in Pakse were relatively low. Consequently, some households sought employment in Thailand, where wages are higher. The results show that remittances during the flood year (1,603,700 LAK per household per annum) was larger than remittances received during the normal year (1,056,000 LAK). These remittances, which largely came from family members working in Thailand, accounted for 10.5% of their annual household income, and were spent on basic needs following a flood (e.g., food).

During the flood year, whereas income generated from the sale of livestock (particularly pigs and cattle) increased by 10.8%, income from poultry sale decreased. Interestingly, about 30% of the surveyed households reported that they were forced to sell their livestock (mostly cattle and pigs) to make up for lost income due to the floods. The money earned from selling pigs and cattle was primarily used to purchase necessary items like rice, secure healthcare, and maintain the farmer's living quarters. Conversely, money earned from selling cattle during the normal year was either saved, or spent on house construction, hand tractors, and childhood education. This finding is consistent with past work in this domain, indicating that floods induce cuts in household's investments in physical and human capital to allow for expenditures on necessary consumables (Garbero and Muttarak, 2013).

9.3.3 The effects of floods on household food security and food consumption behavior

During the flood year, average rice consumption per adult was 172.6 kg/year, of which about 72% was produced by the household itself, 20.9% was purchased, 3.7% was received as gifts, and 2.6% was borrowed from friends and relatives. This finding indicates that on average, the sampled households were rice secure; the 172.6 kg of rice consumed in the flood year exceeded the suggested rice consumption per

year (159 kg/adult/year). At the individual household level, however, some households suffered from rice shortages. During the flood year, about 43% of households surveyed reported that they experienced one to three months of rice shortages on the basis of their own production (Table 9.6). Thirty percent reported rice shortage periods of more than 3 months. In contrast, during the normal year, about 88% of farmers produced sufficient rice to feed the members of their respective households.

Table 9.6: Rice insufficiency and household food security status

Characteristics	Normal year		Flood year		difference
	(N =50)	%	(N =100)	%	%
Length of rice shortage					
No experience	44	88.0	27	27.0	- 61
1-3 months	6	12.0	43	43.0	31
More than 3 months	-	-	30	30.0	30
Food security based on rice available					
Food-secure	46	92.0	84	84.0	- 8
Food-insecure	4	8.0	16	16.0	8

Source: Author's calculation based on the 2014 household survey

To explore this topic more comprehensively, this study evaluated the calorie value of rice available to each adult as an indicator of food security. In terms of calorie intake, it was found that the food insecurity increased from 8% in the normal year to 16% in the flood year, primarily driven by decreases in rice production and household income. To mitigate the negative effects of rice shortages and income losses, farmers employed a wide range of ex-post strategies during the flood year. About 43% of households borrowed paddy rice and 25% borrowed money from relatives and friends that lived outside the village (see Figure 9.2). The roughly 238 kg of paddy rice they borrowed were used for home consumption for at least for two months (about 13% of rice consumption per annum). In addition, about 42% of households received about

107 kg of paddy rice from friends and relatives, on average. These findings are consistent with previous studies indicating that a consideration of social networks—most notably, friends and relatives—is important for accessing food and financial resources for the people living in the flood areas (Haile et al., 2013; Vathana et al., 2013). However, because acquaintances have limited resources with which to support those affected by floods, the degree to which the latter can rely on the former for help is limited. As a result, some flood-affected households, especially those who face difficulty in paying back their loans, were forced to borrow money at a high interest rate (10-15%) from traders around the village. This money was largely used to purchase food and childhood education. In addition, households affected by floods sometime borrowed rice, which they were also forced to return at a high interest rate (100%) after harvesting in the dry season.

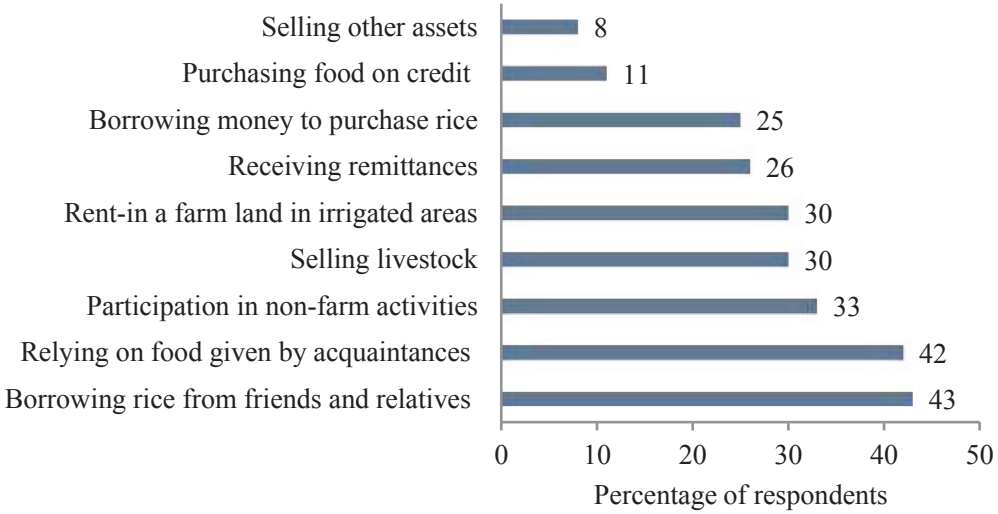

Figure 9.2: Household's coping strategies during the flood year

Source: Author's calculation based on the 2014 household survey

Although 70% of households reported that they had received rice about (about 60kg/household), dried food, and drinking water from the Lao government and non-government organizations (NGOs), these donations were insufficient to feed their

family members. During the flood year, about 47% of households were not afforded the resources needed to eat balanced meals, and 46% relied on low-cost food for their children (Figure 9.3). Moreover, about 27% of households needed to resort to eating food items that they would not normally consume, including noodles, sweet potatoes, sweet corn, and rice soup. Nearly 30% of households engaged in high-risk behaviors to cope with food shortages, including eating rice seed that was reserved for the following season (25%), reducing the quantity of food consumed (12%), and some households reduced number of meals from 3 to 2 times per day (6%).

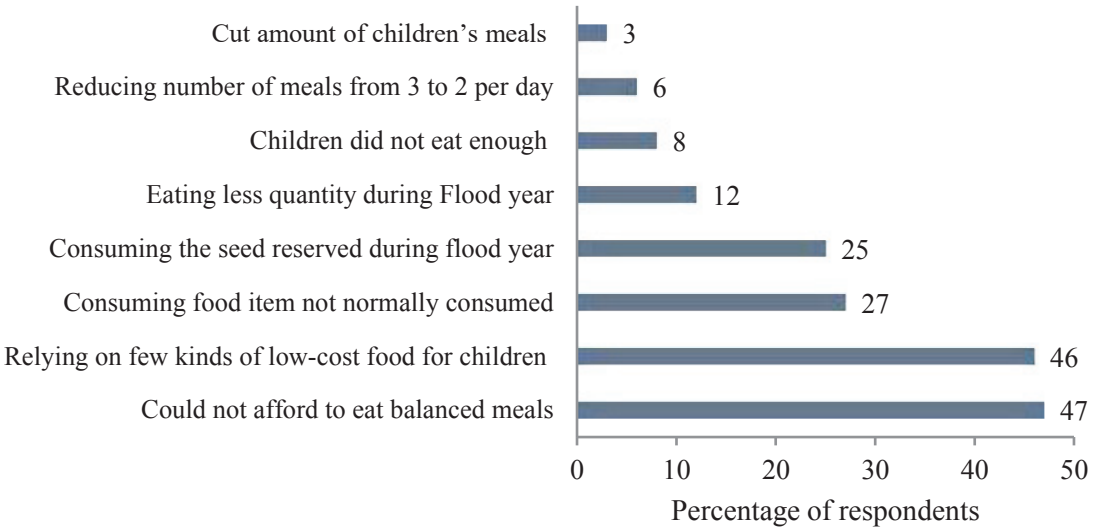

Figure 9. 3: Food consumption behavior and adjustments during flood year
Source: Author's calculation based on the 2014 household survey

9.4 Summary

Given to the fact that the widespread damaging effects of flooding remain as a major concern for rice farmers in Laos, the purpose of this chapter was to assess the effects of floods on household economies and food security among the lowland rice-farming households in the flood-prone, rice-producing areas of the Sanasomboun district, Champasak province in Laos. In this study, the proxy of household income

was gross household income, while rice available per adult equivalent was used as a proxy indicator of food security. The effect of floods on household economies and food security was assessed by comparing a "flood year" to a "normal year". "Flood year" data were based on 100 surveys that were interviewed in September 2014, while "normal year" data were based on 50 surveys that had previously been administered by NRRP in 2008. These two datasets were comparable as the field surveys were undertaken in the same villages and the socio-demographic profiles of the respondents in the normal year and flood years were about similar, despite of the dissimilarity of the respondent's number.

Through this analysis, the results clearly indicated that flooding negatively affected a household's ability to produce rice for consumption, as well as its financial capacities. During the flood year, the average household income was relatively low (15,239,000 LAK/year) compared to normal year (20,057,000 LAK/year). In other words, household cash income declined about 24% relative to the normal year. Moreover, the prevalence of food insecurity increased from 8% in the normal year to 16% in the flood year. To deal with the effects of flooding, nearly 50% of farmers relied on food and financial support from friends and relatives, followed by participation in non-farm activities, selling livestock, and receiving remittances. In addition, nearly 30% of households reported that they had to reduce amount of food intake as well as consumed rice seed reserved for next season.

CHAPTER 10

CONCLUSION AND RECOMMENDATIONS

This chapter is organized into three sections. The first section summarizes the highlight of the study in accordance with the specific objectives. The policy implications of the study are presented in the second section. The last section outlines some recommendations for further studies.

10.1 Summary of main findings

The main objective of this study was to understand household food security under the different agro-ecology zones in the rural areas of Southern Laos. The data used in this study was mainly based on the primary data, which was collected from 309 households living in 7 villages in Sekong and Champasak Provinces from 2013 to 2015. These villages were selected based on the agro-ecology zones: upland, rain-fed lowland, and flood-prone areas. To answer the main objective of the study, several conclusions were summarized in accordance with each specific objective.

10.1.1 Alternative indicator of household food security

The findings of this study based on CI clearly indicated that 38.5% of the sampled households were food-secure as compared to 30.8% based on FE, 40.9% based on the U.S. FSSM, and 52.9% according to the FCS. The coefficient of the FCS, the U.S. FSSM, and FE are significantly correlated with CI, meaning that each indicator can be used to measure food security instead of CE. The results, which were obtained through a specificity-sensitivity analysis, showed that the reliability of FE (81%) is relatively high compared to U.S. FSSM (71%) and FCS (57%). However, FE has various limitations, especially when resources are not available and skills for

collecting data and analyzing the indicators are lacking. Hence, another index such as the U.S. FSSM should be considered as an extra option for assessing food security status. The U.S. FSSM and FCS have some advantage in term of skill, cost and time for data collection in spite of their low reliability. Moreover, the U.S. FSSM can provide useful insights for measuring food security such as the severity of food insecurity, while FCS is more likely to be suitable indicator focusing on the dietary diversity.

10.1.2 Rural household's coping strategies and food security in upland areas

This study utilized the subjective indicator, namely U.S. FSSM, to measure household food security in the upland area of Sekong Province. Results clearly indicated that about 95% lived below the poverty line. At the same time, the prevalence of food insecurity was enormously high; approximately 61.7% were "food insecure with moderate hunger" and 11.7% were "food insecure with severe hunger."

To minimize and cope with food deficit situation, roughly 11 food consumption and 9 income/expenditure coping strategies were employed. The high-risk coping strategies were reported. Most of households coped by reducing meals from 3 to 2 times a day, relying on less preferred/inexpensive foods, substituting food intake of adults for children, reducing the size of meals, consuming rice seeds, skipping all meals for whole day, and reducing children's education expenditure. The use of these strategies could lead to poor working performance, malnutrition, low production and state of illiteracy, resulting in severe food insecurity in the future. The findings also highlighted that the number of the strategies farmers that farmers used was negatively associated with household income and educational level of household's head. The results with regards to the factors that cause household food security showed that educational level of household heads, household size, and livestock ownership had significantly influenced household food security.

10.1.3 Post-settlement rural livelihood in the resettled village of upland areas

Despite the small sample size and short observation period of only three years, the findings obtained from this study underline the important role of resettlement programs in improving the living standards of resettled people over time. After relocation, the livelihood of Laotian settlers has shown an improvement in some livelihood asset categories such as human and physical capital. With regard to financial capital, most of those who resettled have more opportunities to access various income sources; for example, annual household incomes increased from 650 USD in 2012 to 1,278 USD in 2014. In addition, farming activities diversified from upland to lowland cultivation, of which 21% of households have become dependent on lowland rice cultivation, rather than shifting cultivation. However, there were a number of challenges that hindered the living conditions of resellters. About 31% of households were unable to gain higher incomes, compared to their income in the first year of the survey, and 85% were considered chronically poor. Those households with a higher number of active laborers, a household member who worked as teacher, larger areas of lowland rice cultivation, higher numbers of livestock, and more engagement in logging tended to increase their household incomes over the three-year survey period.

10.1.4 Food security among rain-fed lowland rice farming households

The findings presented in this study are conclusive proof that more than half of households in the rural rain-fed lowland rice areas were food-insecure. About 55.8% of sampled households that were categorized as food-insecure reported that they experienced rice shortage periods of more than 3 months from August to October. To minimize the food deficit, therefore, households employed a number of coping strategies, such as gathering NTFPs, borrowing money and rice from relatives, and relying on less-preferred food. Without NTFPs, the farmers in the study area would

lose the opportunity to access food and generate cash income, resulting in erosion of their capital. The results of logistic regression showed that household food security significantly associated with dependency ratio, rice yield, number of relatives, and rice-farming experience. A lower dependency ratio was found to significantly increase household food security. However, this problem is not easy for policymakers to address. Interestingly, number of relatives and food security were strongly related, indicating that social network is crucial for dealing with food insufficiency. Rice yield plays an important role in increasing the probability of being food secure households, suggesting that increasing in rice productivity remains a key mechanism for improving food security.

10.1.5 Effect of traditional home gardens on household food security

The findings of this study showed that about 75% of households with home gardens were food-secure, as compared with 53% of households without home gardens. Household dietary diversity in these rural villages was found to be positively associated with access to fishing opportunities, having a home garden, the literacy of the household head, farm size, and the number of friends and relatives in the village. Most importantly, the results showed that having a home garden led to a 13% increase in the DDS, implying that home gardens can significantly improve food security and contribute to better nutrition through food diversification.

Home garden also served to increase the food supply and availability in the study areas. More than 20 types of vegetables were produced in home gardens and were primarily used for home consumption, not sold. As a result, only 2.8% of total household cash income came from selling home garden produce. Home gardening activities in both wet and dry seasons used traditional methods, including using uncertified seed and non-reliance on extension service. The average home garden size was small, and on average only four types of vegetables were grown per home garden.

Many challenges to cultivating a home garden were found, especially in the dry season, including limited suitable land areas, limited water access, lack of extension services, and labour shortages.

10.1.6 Household economies and food security in the flood-prone areas

The results of this study demonstrated that the floods in Khili-Khamyard negatively affected the production of rice, vegetables, and other crops, and caused the loss of substantial amount of livestock. This study also illustrated the struggles that Lao citizens encounter when they are forced to cope with negative outcomes associated with flooding. These negative outcomes reduced household income by 24%, most of which was lost from rice-derived income. As a result of this lost income, floods exacerbated poverty in the village, and slowed the development of rural areas.

During the flood year, although most flood-affected households (73%) were unable to produce sufficient rice to meet the nutritional needs of the households' members, they were able to maintain their rice consumption through a number of coping strategies intended to overcome the effects of flooding. Most notably, many relied on the help of their friends and relatives in the form of food and financial support. Similarly, some received remittances from family members working in Thailand. In addition, those households with access to irrigation water and a large of number of cattle and pigs were able to overcome losses from rice and get income in the following seasons. However, nearly 30% of households reported that they had to reduce the quantity of food consumed. The prevalence of food insecurity in the flood year was relatively high (16%) compared to only 8% during the normal year.

10.2 Policy implications

Based on the above key findings, this study highlights that different agro-ecology zones have different priority of policy implications for improving food

insecurity and the living standard of rural households in Laos. In the upland areas, although much progress has been made, a significant proportion of upland farmers continues to suffer from food insecurity with chronic poor. Regarding to the lowland areas, food insecurity will not occur unless the rice productivity is improved as well as home garden practice and NTFPs utilization. Specifically, the policy implications of each chapter are listed below:

10.2.1 Alternative indicator of household food security

The findings highlight that using an objective approach such as the FCS might lead to food security bias, since most rural households in Laos rely on a variety of wild foods collected in the fields and in the forest; however, it is unclear whether these foods are consumed in small amounts. Thus, a future study should record the total amount of consumption of each food item. In addition, to make the FCS more feasible to apply, researchers should consider the cut-off point and exclusion of foods consumed in small portions. This study is the first step toward improving knowledge of food security measurements. Policymakers and practitioners should be aware of the reliability as well as the advantages and disadvantages of each indicator according to the situation of application. Seasonal food variation should be taken into account for future research since the data we collected in this study cannot capture annual household food consumption due to the different recall methods and survey period.

10.2.2 Rural household's coping strategies and food security in upland areas

To reduce the high level of food insecurity and hunger in upland areas, both short and long term policy intervention are required. First, food aid programs from national and international organizations should be taken into account in the upland area to avoid the incidence of malnutrition in the future. Second, family planning program would be helpful to avoid malnutrition, especially among the low income

households. Educational level of household heads are needed to be addressed through vocational training to give them an opportunity to find alternative income sources. In other words, the education sector should focus on non-formal education for uneducated and unskilled household heads to improve their ability to access information and deal with the markets. These efforts should also target women who are unable to read and write in the Lao Language in order to give them access to healthcare information and nutritional knowledge.

Third, policymakers should address the need for additional food sources during times of food shortage. This can be done by adoption the rice/seed bank program, the program was initially carried out by Oxfam organization in Vientiane province, to assist food-insecure households in access to rice for home consumption as well as the rice seed for the next transplanting. In addition, expanding the budget for the agricultural sector to increase the rice productivity for both in upland and lowland fields is still required. Agricultural extension officers should provide information, in particular, new techniques to increase pig and poultry production and prevent livestock disease to increase household income. Finally, microcredit to start livestock farming is a vital task that should be considered in the upland areas.

10.2.3 Post-settlement rural livelihood in the resettled village of upland areas

To ensure all resettled households have access to various income sources and they are able to improve their living standards, this study recommends rural development planners and extension workers to strengthen veterinary services in order to prevent the livestock from contracting diseases. The policymakers should ensure that all forms of household income must be stable, legal, and environmentally friendly; for example, the rapid increase in income from logging should not be overlooked, as it is unstable and might have the undesirable long-term effect of reducing the availability of wild foods. Agricultural sectors should provide more

technical support and instruction regarding the objectives of increasing rice production, after encouraging farmers to change from upland farming to lowland rice farming. This activity should be monitored, to confirm whether rice yields remain low even after support and instruction.

10.2.4 Food security among rain-fed lowland rice farming households

Given the importance of NTFPs in the rural rain-fed lowland areas, the food security situation among rice-farming households might become much more serious if strategies for sustainable utilization of NTFPs are not developed. Therefore, raising the awareness level about the importance of NTFPs for food security is crucial. Local policymakers should formulate strict regulations for NTFP collection and establish a sustainable NTFP management plan to ensure that rural communities have access to food. Other important recommendations are that, it is crucial to consider aspects of social networks when working to build food security. In other words, providing information on agricultural development technologies in rural communities through social networks, such as relatives and friends, may be important to improve food insecurity. Finally, because of the fact that low rice yield is mainly attributed to flooding, pests and diseases, and poor soil fertility; hence, agricultural extension agents should ensure that food-insecure farmers have access to rice varieties that are suitable to flood conditions. In addition, the government should provide technical knowledge about how to control pests and diseases and improve soil quality to boost per-hectare rice yield in the rural rain-fed lowland rice areas.

10.2.5 Effect of traditional home gardens on household food security

The findings of this study suggest that raising awareness of the nutritional value of vegetables produced in home gardens is crucial for diversifying the diets of people in rural Lao PDR. Agricultural extension workers and local policymakers

should promote the cultivation of home gardens, mainly for home consumption, by providing extension services to help households improve their home gardening practices by expanding the number of vegetables and increasing productivity. Providing additional water sources, such as groundwater, is necessary in order to ensure that rural villagers can maintain home gardens during the dry season. If a markets for their products exists in nearby village, it may be possible to expand home gardens from subsistence to semi-subsistence, thereby increasing household income. This cash income can be then used to purchase rice or other foods, thereby improving rural households' food security.

10.2.6 Household economy and food security in the flood-prone areas

To enhance income sources and improve food security of those households who live in the flood-prone areas, the Lao government should strive to provide more extensive irrigation systems in flood-prone areas. Because heavy rain and floods are frequent, local governments should implement long-term flood countermeasures and consider an ex-ante interventions in the event of flooding in following years. Some possible options include the establishment of a rice bank in flood prone areas in order to minimize food shortage.

10.3 Recommendations for further studies

This research has raised many questions in need for further investigation. The results of food security measured by a daily calorie method has only examined during the lean season; therefore, further studies on the current topic are required in order to verify whether or not the food security situation in other season (after harvest) is different. Regarding to the study on home gardens, this study has limitation which in-depth data on home garden vegetable production volumes (e.g., yields) was not collected. In further research, it will be important to examine the productivity of each vegetables type in order to help rural people increase their food availability.

Since the crucial role of social networks on food security is manifest, it is recommended that further research should examine the characteristics of social network and its relationship with food security as well as the effect of social network on agricultural production and food acquisition. On the other hand, further research should consider the effect of resettlement program on social relationships as well as the indigenous cultures of ethnic minority groups after being resettled.

Finally, this study builds an understanding of household food security in different agro-ecology zones in the rural areas of Laos. However, it is unclear whether the prevalence of household food insecurity in neighbouring countries remains as high as in Laos and what effects regional corporation (ASEAN Economic Community or AEC) has had in response to the problem of food insecurity.

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Appendix

Figure A.1 Causes of low cash income in upland areas
Source: John, 2005

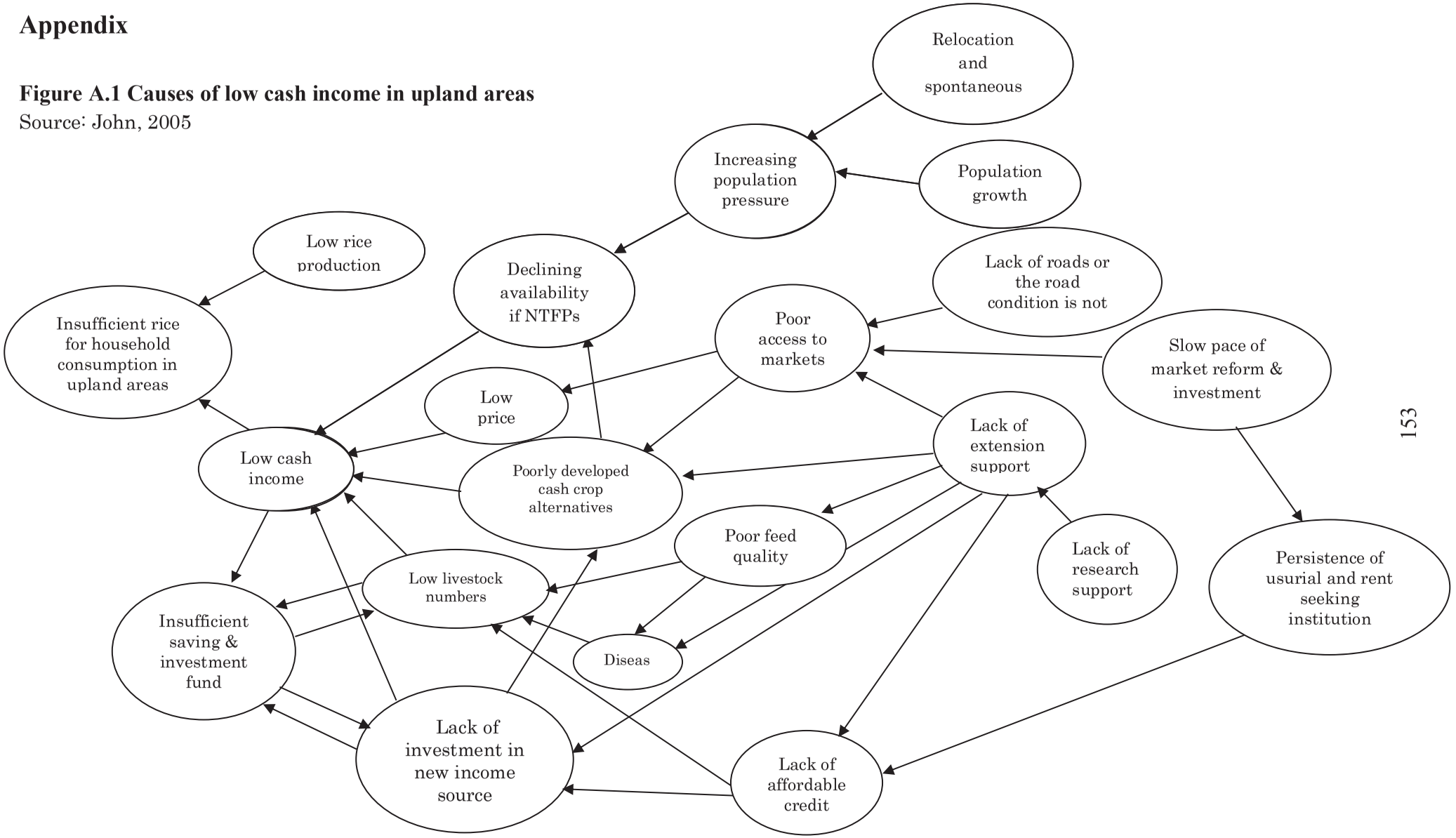
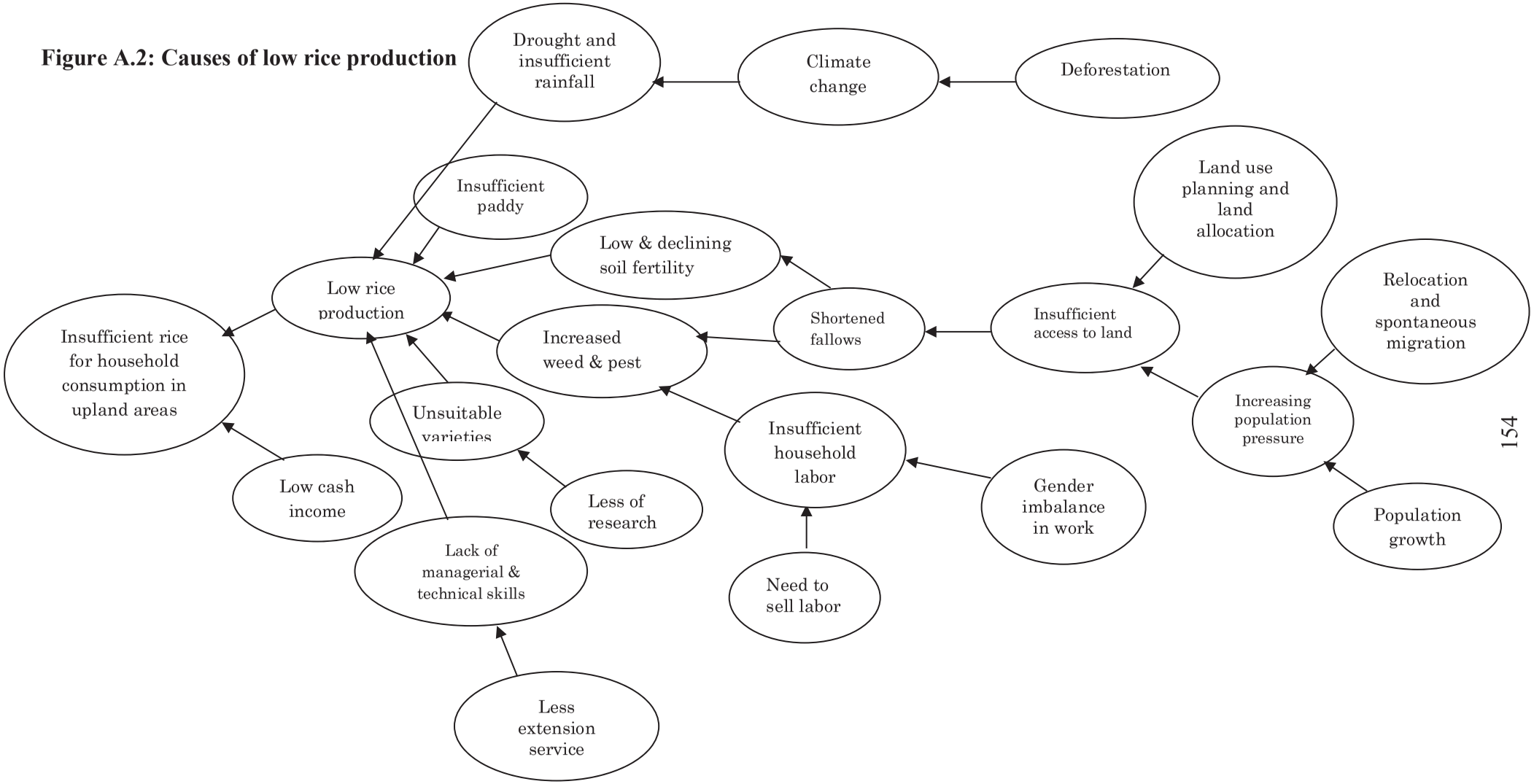


Figure A.2: Causes of low rice production



A Comprehensive Study on Food Security among Rural Farming Households in Southern Laos

Thesis summary

Food insecurity remains a major concern for developing countries including Laos. Although food supply in Laos has been rising dramatically, in which the country produces more than enough food to meet domestics need and surplus the demand, people living in rural areas still suffer from food insufficiency. About 49% of children under five-year old had stunted growth and 29% were underweight. The living standard of rural people has not significantly improved owing to several factors, such as poor infrastructure, acidic soils, natural disasters, and chronic food shortage. Most notably, the ratio of food insecurity in rural areas has increased from 21.5% in 2003 to 27.1% in 2008, particularly in remote upland areas where people are highly dependent on shifting cultivation and collecting wild foods. Food insecurity is a problem not only in upland areas but also in lowland areas. Many lowland farmers who rely only on rain-fed lowland rice are at risk to become food-insecure owing to the intensity of natural disasters, especially flooding, caused by climate change and uncertain weather.

Addressing the issue of food security in both upland and lowland rural areas as well as flood-prone areas is therefore crucial. However, there has been little discussion on food security from different agro-ecology zones, particularly on questions related on what are the socio-economic characteristics that cause food insecurity and how do rural farming households cope during the period of food shortage. Moreover, although alleviating food insecurity is the state's priority, many national and local policymakers in Laos lack awareness of food security measurement.

The existing standardized tools for tracking household food security are inconsistent, resulting in inaccurate data on food security.

Given the above-mentioned fact, the main objective of this study is understand household food security under the different agro-ecology zones in the rural areas of Laos. In order to achieve this objective, the study is divided into ten chapters. The first chapter presents general background of the study as well as defining the statement of the problem. The second chapter presents the conceptual framework of food security, followed by the summary of the direct and indirect indicators for measuring food security. This chapter also explains the situation of food security and nutrition in Laos. The next chapter provides detailed information of the study areas and the typical sources of data collection. The fourth chapter describes household food security measurements and identifies the characteristics of alternative indicators, which are suitable and reliable for using in the context of rural Laos. The fifth and sixth chapters focus on the food security, coping strategies and resettlement program in upland areas, while food security among rain-fed lowland rice farming households, and the association of home garden and dietary diversity are discussed in the seventh and eighth chapters respectively. The ninth chapter highlights household economy and food security in the flood-prone areas. Finally, the conclusion, policy implication and recommendations are presented in the last chapter.

The concept of food security used in this study refers to a situation when all household's members are able to access sufficient food in terms of quantity and quality at all times in order to maintain an active and healthy life. The study was mainly based on primary data carried out with 309 households from different agro-ecology zones in Sekong and Champasak Provinces, Southern Laos, from 2013 – 2015. Although most parts of the agricultural land in the Southern region are suitable for growing lowland rice, cash crops, and coffee cultivation, agricultural productivity in this region is vulnerable to climate change. Moreover, many upland households—predominantly ethnic minority groups live near the border of Vietnam—continue to

experience the highest level of food insecurity in the country, especially in the Sekong Province where 58% of the population are food-insecure.

Alternative indicator of household food security

The objectives of the study were to compare the prevalence of food security based on the food consumption score (FCS), food consumption expenditure (FE) and the U.S. food security/hunger survey module (U.S.FSSM), with the benchmark indicator being calorie intake (CI), and to identify the characteristics of alternative indicator for measuring household food security in the context of rural Laos. In order to assess how well the alternative indicators predicted food security status, a cross-tabulation analysis and sensitivity-specificity index were used. The results revealed that the percentage of food-secure households measured by CI accounts for 38.5%, which was relatively low compared to U.S. FSSM (40.9%) and FCS (52.9%), while the FE indicator categorized 30.8% of households as food-secure. The findings highlighted that FE was reliable indicator of household food security (instead of CI) because its good match of classification was considerably high (81%) compared with U.S. FSSM (71%) and FCS (57%). However, it is slightly complicated to use FE owing to the cost of data collection as well as the skills needed for estimating food spending.

Rural household's coping strategies and food security in upland areas

Taking into consideration the high prevalence of food insecurity in mountainous areas, the study aims to investigate food insecurity in rural upland areas, to find out coping strategies used, and to identify the factors affecting household food security. The U.S. FSSM was used to classify the status of household food security. A multiple linear regression and a logistic regression model were employed. The results revealed that 89% of households experienced rice shortages for 1 to 3 months. To overcome food shortages, many households coped with the situation by reducing meals from 3 to 2 times a day and limiting the amount of food intake of adults in order

to provide for children during the months with food shortage (July to October). The number of the strategies that farmers employed was negatively associated with income and the educational level of the household head. Results obtained from logistic regression analysis showed that the educational level of household heads, livestock ownership and household size had a significantly impact on food security.

Post-settlement rural livelihood in the resettled village of upland areas

This study aims to clarify how farming activities and livelihoods change after resettlement, and to examine the determinants of household income in the post-resettled area. The field surveys were carried out on 60 households living in the mountainous village of Sekong Province in 2013, 2014, and 2015. A panel data regression analysis was applied to examine the factors that contribute to household income change overtime. The results showed that farming activities changed from shifting cultivation to lowland rice cultivation after resettlement. On average, household income increased from 650 USD in 2012 to 1,278 USD in 2014, mainly derived from non-farm works (e.g., formal salary, logging, and construction). At individual households, however, some households (31%) reported that their income decreased steadily when compared to the first year of the survey. Moreover, 85% of households were chronically poor during the survey period. The findings also highlighted that household income positively associated with number of adult labor, occupation, areas of lowland rice cultivation, participation in logging activities, and number of livestock ownership.

Food security among rain-fed lowland rice farming households

The study aims to investigate the food security situation and to examine the determinants of food security among rain-fed lowland rice farming households. A calorie intake (CI) was used to measure food security. A logistic regression model was employed to determine the factors affecting household food security. The findings revealed that the average calorie intake per capita was 1,815 kcal per day, in

which 88% derived from rice. About 55% of households were classified as food-insecure. To deal with food shortage, 54% of households relied on gathering NTFPs and 44% borrowed rice from friends and relatives. An empirical model analysis showed that the dependency ratio was negatively associated with food security, while the variable of rice yield, number of relatives and friends, and rice-farming experience was positively correlated to food security.

Effect of traditional home gardens on household food security in lowland areas

The study examined the effect of traditional home gardens on household food security, as measured by Dietary Diversity Score (DDS). Ordinary least squares (OLS) regression was used to estimate the effect of having a home garden on the DDS. The results showed that 75% of households who have a home garden were categorized as food-secure compared to 53% of households without home garden. Results obtained from OLS regression showed that having a home garden increased the probability of a household being food-secure by 13%, implying that home gardens can significantly improve food security and nutrition through food diversification. Even so, the practice of home gardens mainly used traditional techniques including use of uncertified seed, lack of fertilizer, inappropriate fencing to protect the crop from domestic animals. On average, the size of home garden was small and there are only four types of vegetables grown per home garden. The major constraints in practicing home garden were limited suitable land areas, insufficient water sources, and lack of extension services.

Household economy and food security in the flood-prone rice growing areas

The objective of this study was to assess the effect of floods on household economy and food security of farming households in the flood-prone rice areas. To evaluate these effects, the study compared gross household income and food security—measured by rice available per adult equivalent—during a "flood year" and a "normal year". "Flood year" data was based on 100 households interviewed in

September 2014, while "normal year" data was based on 50 households that had previously been surveyed by NRRP in 2008. The findings clearly indicated that flooding negatively affected a household's ability to produce rice for consumption, as well as its financial capacities. During the flood year, the average household income was relatively low (1,905 USD/year) compared to normal year (2,507 USD/year), indicating that flooding reduced household income by 24%. Moreover, the prevalence of food insecurity increased from 8% in a normal year to 16% in a flood year. To deal with the effects of flooding, nearly 50% of farmers relied on food and financial support from friends and relatives, followed by participation in non-farm activities, selling livestock, and receiving remittances from household members working outside village. In addition, nearly 30% of households reduced the quantity of food consumed.

The findings of this study recommended that FE is the nearest alternative indicator for measuring food security to CI; however, given its complexity and high cost for data collection, U.S. FSSM should be considered as an alternative indicator. Policymakers and practitioners should be aware of the dimensions of each food security indicator, as well as the advantage and disadvantage of using them prior to the survey. It is important to note that different agro-ecological zones have different priorities to reduce food insecurity. In upland areas, promoting non-formal education, family planning programs and veterinary services would be helpful, while addressing the role of social networks, enhancing per-hectare rice yield and raising the awareness about the importance of NTFPs on food security is crucial in rain-fed lowland areas. For diversifying the diet of rural people, policy interventions should promote the cultivation of home garden by providing additional water sources and more knowledge on home gardening practices. The findings derived in the flood-prone areas recommended the policymakers to seek long-term countermeasures, such as improving irrigation systems and establishing rice banks for emergency needs.

ラオス南部における農家世帯のフード・セキュリティに関する包括的研究

論文摘要

ラオスを含む発展途上国において，フード・セキュリティの確保は未だに重大な課題である．ラオス国内の食料供給量は劇的に増加しており，国内需要を上回る量の食料（米）を生産できているにもかかわらず，農村部の人々は食料不足に苦しんでいる．５才以下の子供の約 49%が生育の遅れがみられ，また 29%が標準体重以下である。農村部に住む人々の生活水準は，インフラの未整備や自然災害，慢性的な食料不足などの要因によって十分には改善されていない．農村部において食料不足に陥っている世帯の割合は，2003 年時には 21.5%だったものが 2008 年には 27.1%へと増加しており，とりわけその傾向は，焼畑や採取経済に頼っている僻遠の高地においてより顕著になっている．また，フード・セキュリティは高地のみならず，低地においても問題である．天水稲作を生業としている低地の農民の多くは，洪水をはじめとした自然災害の発生に伴う食料不足の危機にさらされている．こうした自然災害の多くは，気候変動や天候不順に起因したものである．

以上から，ラオスにおける高地，低地および洪水頻発地域におけるフード・セキュリティの問題解決に焦点を当てることは重要な課題である．しかし，異なる農業生態域（agro-ecology zone）におけるフード・セキュリティに対する議論，例えばフード・セキュリティを脅かす社会経済的特徴は何か，農村部の人々はどのように食料不足に対処しているか，といった疑問については未だ答が得られていない．さらに，国家レベルでは食料自給が達成されているとされるが，国や地方の政策決定者はフード・セキュリティの指標について十分に理解できていないため，さまざまな方法で計測された異なるフード・セキュリティ値を用いて政策立案をしがちである．

そこで本研究では，ラオス農村における異なる農業生態域に焦点をあて，また異なる測定方法を用いて，世帯レベルのフード・セキュリティを包括的に分析することを目的とする．

この研究目的のため，本論文は以下の通り 10 章の構成とした。まず第１章では問題の背景と定義が示され，続く第２章では分析の枠組みと世帯レベルのフード・セキュリティの測定方法を概説するとともに，ラオスのフード・セキュリティの現状を明らかにする．続く第３章では，調査地の概況と調査方法について説明する．第４章では，ラオスの実態にあった，より使いやすい世帯レベルのフード・セキュリティの測定方法について提案する．第５章，第６章では，高地農村におけるフード・セキュリティの問題を，食料不足の際に農民がどのように対処しているかについて，また，農村移

転政策による農家所得への影響を通して論じられる．第7章，第８章では，低地天水地域におけるフード・セキュリティの現状を論じ，また家庭菜園の利用に着目した分析により，フード・セキュリティの改善策を提案する．第９章は，低地天水地域の中でも，特に洪水に見舞われやすい地域を対象に，農家経済とフード・セキュリティとの関係を論じている．第 10 章は結論および政策提言である．

本研究におけるフード・セキュリティとは，すべての世帯員が健康を維持するに足りる食料を，いつでも，また質と量ともに十分に，アクセスできる状態と定義している．なお，本研究で用いているデータは，2013 年から 2015 年にかけてラオス南部のセコン県（高地）とチャンパサーク県（低地）といった異なった農業生態域から選出した 309 世帯に対し行った聞き取り調査に基づいている．このラオス南部地域の低地は水稲，野菜，高地はコーヒーなどの農業の盛んな地域ではあるものの，これらの農業生産性は気候変動の影響を受けやすい．さらに，セコン県を含むベトナム国境の近い僻地の高地住民は多くは少数民族であり，ラオスの中で最もフード・セキュリティが確保されていない地域である．そのためセコン県は，人口の 58%がフード・セキュリティが確保されていない世帯となっている．

フード・セキュリティの代替指標

本研究では，現在基準となっているカロリー摂取量 (Calorie Intake: CI)と，その他に代替可能な３つの指標，すなわち食料消費スコア (Food Consumption Score: FCS)，食料消費支出 (Food Consumption Expenditure: FE)，米国フード・セキュリティ／飢餓調査基準（U.S. food security/hunger survey module: U.S. FSSM)を比較し，それぞれ特徴を明らかにするとともに，ラオスにとって最も適した測定方法を明かにした．

感度・特異度分析の結果から，フード・セキュリティの指標として CI 以外の指標を代替的に用いる際に，FE が最も適していることが示された．フード・セキュア世帯割合は各測定結果により数値が異なり，CI で 39%，U.S.FSSM で 41%，FCS(53%)，FE(31%)となった．また，CI による分析結果との一致率が U.S. FSSM は 71%，FCS は 57%だったのに対し，FE は 81%と非常に高い値をとっていた．しかし，FE はデータの収集に労力がかかること，食料消費量の見積もりに技能を要することから，指標として用いる上で複雑さを伴うため利用する際は注意が必要であることを指摘した．

高地地域の農村部における食料不足の対処方法

フード・セキュリティを確保できていない高地地域を観察し，農家が食料不足（フード・インセキュリティ）の際にどのような対処をしているかを明らかにし，また，食料不足に関わる諸要因を特定した．U.S. FSSM を用いて農家世帯を分類した結果，89%の世帯が１~３ヶ月程度の食用米の不足を経験していることが明らかになった．食料が不足する際への対処として，特に米が不足する 7 月から 10 月の期間において，多

くの世帯が1日当たりの食事回数を3回から2回へと減らすこと，大人より子供の食事に優先的に食料をあてることなどの対応で，この時期をなんとかやり過ごしていることが明かになった．また，このように農家が採用した対処数は，世帯の総所得や世帯主の教育程度と負の相関があることが明らかになった．ロジスティック回帰モデルによる分析では，世帯主の教育レベル，家畜の保有，世帯人数がフード・セキュリティに大きく影響していることが示された．

高地地域における移住の影響

ラオス政府は，高地・最僻地の焼畑従事村を，村ごと中山間地に移転させる政策をとっており，移転して生計が変化した世帯のフード・セキュリティの実態を明らかにすることは急務である．移住地域における生計変化について，セコン県の高地農村の60世帯に対して2013年，2014年，2015年の3か年継続して調査をしたパネルデータ分析を行った．この結果，移住後には農業活動が焼畑農耕から低地稲作へと変化していること，世帯の平均所得は2012年の650ドルから2014年の1,278ドルまで増加したことが示された．この所得増加は，農業以外の就業（森林伐採も含む）によるものであった．平均でみると所得が増加していたが，個々の事例では，31%が調査開始年から収入が緩やかに減少しており，また調査期間を通して 85%の世帯は慢性的な貧困状態にあることも明らかになった．パネルデータの回帰分析から世帯所得は成人労働者数，水田耕作面積，伐木労働の実施と正の相関がみられた．

低地天水地域におけるフード・セキュリティ

低地天水稲作地域におけるフード・セキュリティの状況を CI により測定し，フード・セキュリィを決定する要因をロジスティック回帰分析で求めた．この結果，50%以上の世帯が食料を安定的に確保できていない世帯と判別された．また，1日に摂取すべきとされている標準カロリー1,815kcalのうち88%は米から得ていることが明らかになった．食料不足に対処するために，54%の農家は非木材林産物の採取に，44%が親戚や友人から食用米を借りていることが明らかになった．扶養家族数が増加するとフード・セキュリティが悪くなり，イネの収量，親戚や友人の人数，イネの栽培経験年数が多い場合フード・セキュリティが改善されることを実証した．

低地地域における伝統的家庭菜園

家庭菜園の有無が，世帯のフード・セキュリティへ影響するか否かについて，食料多様性スコア（Dietary Diversity Score: DDS）を用いて食料摂取を測定し，最小2乗法を用いて家庭菜園の有無と DDS との関係を明らかにした．この結果，家庭菜園を持つ 75%はフード・セキュア世帯に分類できたが，家庭菜園を持っていない農家のこの値は 53%にとどまった．さらに，家庭菜園があることはフード・セキュア世帯数を

13%増加させると推定された．これは，家庭菜園が摂取食品の多様化をもたらすことによって世帯のフード・セキュリティと栄養状態を大幅に改善することを示唆している．しかし，家庭菜園で栽培されている品目数は平均４品目と多くはなく，また面積も小さい．また，栽培は慣行的技術で行われており，品質が保証されていない種子の利用，肥料の不足，家畜の侵入防止柵の不適切な設置，用水の不足，適切な栽培知識の不足などの課題も明らかとなった．

洪水頻発地域におけるフード・セキュリティ

洪水頻発地域において洪水がフード・セキュリティと農家所得へ与える影響を明らかにするために，洪水年と平年を比較した．フード・セキュリティは成人換算による米の利用可能量として把握した．洪水年のデータは 2014 年 9 月に 100 戸の戸別聞き取り調査によるものであり，平年のデータは 2008 年に National Rice Research Program で行われた 2 次データを利用した．分析の結果，洪水年には世帯所得が 24%減少したこと，フード・セキュリティを満たしていない農家の割合が平年の 8%から 16%まで増加したことが示された．洪水の影響に対処するため，50%近くの農家が友人や親戚からの食料や財政的な支援，非農業に就業，家畜の売却，村外で働いている世帯員からの送金等に依存していることが明らかになった．また，3 割近くの農家は，洪水年には自家消費用の米が足らずに，消費量を減らさざるを得ないことが明かになった．

本研究の成果から導きだされた政策提言は以下の通りである．

フード・セキュリティを評価する指標としては，カロリー摂取量(CI)の代替指標として食料消費支出（FE）が最も良い値である．しかし，FE の調査コストや煩雑さを考慮すると，U.S. FSSM を使うことが提案できる．いずれにしても，フード・セキュリティの数値を用いて政策決定をする場合には，それぞれの測定法の長所や短所を含めた各指標の特性を知ってから利用する必要がある．

高地および低地という異なる農業生態域別のフード・セキュリティについては政策の重点が異なると考えられる．高地におけるフード・セキュリティの確保のためには非公式的な教育，家族計画，獣医士による支援等が効果的である．天水低地地域では，人々の社会的な繋がり（ネットワーク）が担う役割に焦点を当てること，単位面積あたり米の収量を増やすこと，フード・セキュリティにおける非木材林産物の重要性を認識する必要があり，これらの点について，さらなる研究が必要である．また，家庭菜園を持つことは農村部の人々の食品摂取を多用化させ，栄養改善に寄与することから，その普及のために水資源や栽培知識を提供することは有効な策になると言える．洪水が起こりやすい地域では，長期的には灌漑施設の改善が必要となろうが，洪水後に被害を受けた農家が緊急避難的に利用可能なライスバンクの設立等が，今後の対策として推奨できる．

LIST OF PUBLICATIONS

Major publication

1. Inpong Siliphouthone and Kumi Yasunobu (2014): Rural household's coping strategies and food insecurity in the upland areas, Sekong Province, Lao PDR. Japanese Journal of Farm Management. Vol. 52, No. 1/2: 119 – 124.
   Covered in Chapter 5.

2. Inpong Siliphouthone and Kumi Yasunobu (2015): The effects of flood on household economies and food security in lowland rice farming households in Laos. Journal of Japanese Society of Agricultural Technology Management. Vol. 22, No. 3: 69 – 79
   Covered in Chapter 2 and Chapter 9

3. Inpong Siliphouthone, Kumi Yasunobu, Akira Ishida and Hideo Furustuka (2016): The effect of traditional home gardening on rural household food security in the lowland areas of southern Lao PDR. Japanese Journal of Farm Management. Vol. 53, No. 4: 84 – 89.
   Covered in Chapter 8

4. Inpong Siliphouthone, Kumi Yasunobu and Akira Ishida (2016): Analysis of food security among rain-fed lowland rice-farming households in rural areas of Lao PDR: A daily calorie intake approach. Tropical Agriculture and Development. Vol. 60. No.1: 14 – 20
   Covered in Chapter 7

5. Inpong Siliphouthone, Kumi Yasunobu and Hideo Furustuka (2016): Alternative indicators of household food security: Evidence from rural Laos. Japanese Journal of Farm Management. Vol. 54, No.2 (Accepted for publication on 14th May 2016)
   Covered in Chapter 2 and Chapter 4

6. Inpong Siliphouthone, Kumi Yasunobu, and Hideo Furutsuka (2016): Post-settlement rural livelihoods in Laos: A case study of a resettled village in Sekong Province. Journal of Japanese Society of Agricultural Technology Management. Vol. 23, No. 2 (Accepted for publication on 19th May 2016)
   Covered in Chapter 6

7. Inpong Siliphouthone and Kumi Yasunobu (2016): Prevalence and determinants of household food security in resettled areas in Sekong Province, Lao PDR. International Journal of Environmental and Rural Development. Vol.7, No. 1 (Accepted for publication on 29th July 2016).
   Covered in Chapter 5