

How can paddy rice farmers adapt to climate
change? A case study of Climate-Smart Agriculture
(CSA) in Luang Prabang province, Laos

Longlao Nyianu

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School of Geography, Environment and Earth Sciences

Victoria University of Wellington

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Abstract

Laos is a small and developing nation in Southeast Asia that is vulnerable to climate change. Some of the more severe effects of climate change in Laos are droughts, flooding and insect pests which are impacting rice production. Many paddy rice plantations throughout the country are facing large shortages of rice production for commercial sale and subsistence use. This thesis explores how paddy rice farmers may adapt to climate change effects by focusing on a village in Luang Prabang province, Laos. Drawing on the climate adaptation framework, Climate – Smart Agriculture (CSA) and qualitative interviews with farmers in Thongphiengvilay village, I explore how CSA may help farmers adapt to climate change.

The results of this study show that CSA could help Thongphiengvilay farmers cope with increased drought and pests. I also argue that CSA could build on or complement existing Traditional Ecological Knowledge (TEK) already used by farmers. Furthermore, my results indicate that CSA could help farmers who currently use synthetic approaches to tackle their decreasing rice price production. For example, synthetic fertilisers that are currently being used by farmers could be replaced with organic CSA approaches and produce similar yields and also ensure the environmentally sustainability of farmers' lands for future seasons. Therefore, this thesis recommends a CSA approach for adapting to climate change in Thongphiengvilay village by implementing Climate – Smart Villages (CSVs).

Key words: climate change adaptation, CSA, TEK, Laos

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Longlao Nyianu

Master of Environmental Studies

Victoria University of Wellington

New Zealand

Acronyms

ADB	Asian Development Bank
BSC	Bachelor of Science
CABI	Center for Agriculture and Bioscience International
CARDI	Cambodian Agriculture Research and Development Institute
CO ₂	Carbon Dioxide
CSA	Climate Smart Agriculture
CSVS	Climate Smart Villages
DAFO	District Agriculture and Forestry Office
DDT	Dichloro Diphenyl Trichloroethane
EE	Ecological Engineering
EEPSEA	Economy and Environment Program for the Southeast Asia
FAO	Food and Agriculture Organization
GAS	Golden Apple Snail
GDP	Gross Domestic product
GHG	Greenhouse Gas
HEC	Human Ethics Committee
IK	Indigenous Knowledge
INGOs	International Non-Governmental Organizations
IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
Lao PDR	Lao People's Democratic Republic
MAF	Ministry of Agriculture and Forestry
MEnvStud	Master of Environmental Studies
NAFC	Northern Agriculture and Forestry College
NAFRI	National Agriculture and Forestry Research Institute
NDMC	National Disaster Management Center
NREO	Natural Resources and Environment Office
NSC	National Statistic Center
PAFO	Provincial Agriculture and Forestry Office
PDONRE	Provincial Department of Natural Resources and Environment

SDGs	Sustainable Development Goals
SO ₂	Sulfur Oxide
TDDPM	Thai Department of Disaster Prevention and Mitigation
TEK	Traditional Ecological Knowledge
UN	United Nations
UNDP	United Nation Development Program
VUW	Victoria University of Wellington
WFP	World Food Program

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Chapter 1: Introduction

1.1. Research Background

Rice is the world's second largest cash crop behind wheat (Matthews, Kropff, Horie & Bachelet, 1997) and vital for the economic wellbeing of many nations in Southeast Asia (Cheng, 2016). Almost 90 per cent of people who live in Southeast Asia consume rice for every single meal and many of them are reliant for this crop plantation for household income and subsistence living (Khadka, 2016). Some countries in Southeast Asia, such as Vietnam and Thailand, also export rice around the world. Each year, these countries export many millions of tons of rice to the global market. These rice exports are vital for the Southeast Asian economy, as it reaps very big revenues and creates numerous jobs in many different countries. However, in recent years, the amount of rice yields has decreased substantially due to the changing climate (Lipper et al., 2014; Mathews et al., 1997). The global phenomenon of climate change has contributed to an increase in extreme weather events, such as droughts and tropical storms that produce regular intense floods in the Southeast Asian region. Consequently, rice production systems have been severely impacted. Throughout the region, paddy rice farmers are producing less and less rice for export.

As a result of this climatic change impact on rice production, many countries in Southeast Asia are considering how to adapt to climate change events. For example, Redfern, Azzu and Binamira (2012) illustrate how the International Rice Research Institute (IRRI) in the Philippines have developed a waterproofing gene from the rice seed 'Scuba rice', which helps the negative impacts of flooding. To elaborate, this adaptation strategy allows the rice crop to survive in flooded land for more than two weeks. These authors further point out that this technology has been implemented across 10 Asian countries, such as Thailand, Vietnam, Cambodia, Nepal and Bangladesh. Encouragingly, scuba rice also provides better yields and recovers faster after flooding compared with traditional rice varieties (Redfern et al, 2012).

In addition, terrace systems and duck rice farming are other adaptation approaches that have been used in Vietnam and China for many generations. Rice farmers in South Vietnam use terrace rice systems to harvest water in the rainy season to use in the dry season. This farming practice is not only beneficial for water storage, but it also helps to control the spreading of weeds in the paddy field. Thus, terrace rice systems can also avoid the use of herbicides and labour force and this, in turn, helps farmers save money and time, and is better for the environment.

Lao PDR (Lao People's Democratic Republic) or Laos is also one of the less developed countries in Southeast Asia in which almost 85 per cent of the population are subsistence rice farmers (Global Facility for Disaster Reduction and Recovery, 2011; German Society for International Cooperation, 2015). These local farmers are currently experiencing the effects of climate change and are at risk of not having enough food to eat as well as not being able to produce surplus rice for sale. International Non-Governmental Organisations such as the Food and Agriculture Organization (2010) have examined these issues in-depth along with Bouldam (2012).

Bouldam (2012) points to some of the impacts of climate change on lowland paddy rice production in the middle and southern provinces of Laos. Namely, Bouldam (2012) identifies areas that have been flooded during the monsoon season which, in turn, has caused massive economic loss for farmers. Similarly, many rice farmers also face drought and insect pest issues during the period of producing rice. Flooding and pests put a large amount of stress on local paddy rice farmers because they have to invest more and more money into their production systems, and this makes rice farming unprofitable.

Consequent to these climate change induced impacts, the government of Laos has worked closely with several organisations to look for adaptation solutions. These government moves are very important for the Lao people, particularly subsistence rice farmers who need to have the capacity to feed their family members throughout the year from growing rice. Therefore, this thesis will examine some of the policies the Lao government is proposing to tackle climate change. There have been many

studies looking at the impact of climate change on rice production as well. Therefore, this thesis will also show some of the research on climate change adaptation, globally, and in Laos.

However, no research to date has looked at the efficacy of Climate–Smart Agriculture (CSA) in Laos. CSA is an adaptation approach developed by the Food and Agriculture Organisation or FAO (2010). CSA approaches have been successfully implemented in parts of Southeast Asia in terms of helping rice paddy farmers adapt to climate change. Therefore, this thesis will explore how effective CSA could be for rice paddy farmers in Luang Prabang Laos.

1.2. Research Objectives

The central aim of this research is to explore how paddy rice farmers may adapt to climate change. In particular, I focus on a case study in Luang Prabang province, Laos. It is here that I explore the possibility of using CSA as an adaptation strategy. This project will therefore investigate some of the ways CSA might help farmers in terms of food security and profitability.

1.3. Research Methodology

This research takes a qualitative approach by using semi – structured interviews to collect data. Epistemologically, this project is grounded in critical realism. Details of the research approach and methodology are provided in chapter 4 of this thesis.

1.4. Research Significance

This thesis contributes to the literature in the field of Environmental Studies on farmers’ adaptation to climate change and build on existing examples of CSA in practice. The findings of this study helps fill the current gap regarding climate change adaption strategies in Laos. Findings will also build capacity for rice farming in the wider Asian region. Importantly, I want my findings to help rice farmers in Luang Prabang in their efforts to adapt to climate change for their own food security and economic livelihoods as I am from this region myself. Therefore, this research also

hopes to produce an educational component in Luang Prabang that helps raise awareness of the effects of climate change.

1.5. Thesis Outline

This thesis comprises of 6 chapters. A brief description of each chapter is provided below:

Chapter 1 provides a brief overview of key concepts and theories used in this thesis. Then I explain my research objectives and methodology. The significance of this research as well as its contributions are also discussed. Finally, a thesis outline illustrating the structure of this research is provided.

Chapter 2 reviews the relevant literature regarding the impact of climate change on paddy rice production systems globally and in Southeast Asia. Then, I further investigate some of the adaptation strategies used to lessen the negative impacts of climate change on paddy rice production. In particular I expand on both a Traditional Ecological Knowledge (TEK) approach and Climate – Smart Agriculture (CSA). This chapter closes with an explanation of why I chose the conceptual framework CSA to use in this thesis, followed by my central research question and sub–questions that guide this project.

Chapter 3 explores the context of Laos especially in relation to its geographical, social and economic factors. I pay special attention to the Lao climate along with issues of drought, flooding and insect pests and their impact these phenomena have on paddy rice production. Following this discussion, I examine farmers’ livelihoods and their adaptation strategies regarding climate change. Finally, this chapter illustrates the topography and agricultural situation of the chosen study site, Thongphiengvilay village in Luang Prabang province.

Chapter 4 begins demonstrating the research philosophy of this study, namely its epistemological foundations. This chapter then details the methodological aspects of my project. I explain why I used a qualitative approach in this research and how and why I decided to use semi–structured interviews as a method for data collection.

In this chapter I also explain the process of fieldwork such as how I recruited participants and then analysed and interpreted my results. Finally, chapter 4 concludes by discussing some of the ethical considerations that arose during fieldwork and the process of entering and leaving the field.

Chapter 5 outlines the empirical findings of this research gathered from interviews. This chapter presents these findings by using a thematic structure adapted from the interview questions used. These themes were also organised based on the central question and sub-questions of this thesis.

Chapter 6 discusses the qualitative outcomes and important themes of my findings. This chapter compares and contrasts my findings in relation to relevant literature guided by the research questions outlined in chapter 1 of this thesis. Once my analysis is completed, I then discuss potential limitations of this analysis, provide recommendations academically, and reflect on the capacity of CSA as a potential adaptation strategy for rice paddy farming in Luang Prabang. I finish this chapter and this thesis with a brief conclusion.

Chapter 2: Literature Review

2.1. Introduction

This chapter explores the need for climate change strategies to help farmers adapt to the impacts of the changing climate in Laos. By reviewing the impacts of climate change, such as droughts, floods and pests on rice paddy production, a main conclusion I make is that CSA is a viable option to help the adaptation process. This chapter will also illustrate that there is no single or universal adaptation strategy and that local climates and people need to be part of any adaptation strategy. However, to understand the global phenomenon of climate change, this chapter will start by discussing some general impacts on paddy rice production and finish with a rationale as to why I have chosen CSA to explore climate change adaptations for rice farmers in Luang Prabang.

2.2. Climate change Impacts on Rice production: A Global Overview

Increasing evidence shows the negative impacts climate change is having on rice production globally. Rice is the world's second largest cash crop behind wheat (Matthews, et al., 1997, Khadka, 2016, Karim, & Riazuddin, 1999) and is vital for the economic wellbeing for people worldwide and many nations in Southeast Asia (Cheng, 2016, Redfern, Azzu & Binamira, 2012). The impacts of climate change on rice production can generally be characterised by the way climatic and weather conditions have changed in a given area and how that alters rice growth. Plants can gradually adapt to changes in climatic conditions over time: However, the intensity of change that has occurred in many rice growing regions has been too much and fast for most rice to adapt (Boulidam, 2014).

In recent years, rice production has substantially decreased in many parts of the world due to the dramatic and prolonged changes in climate. Much research has already shown the adverse impacts of climate change on rice production in Southeast Asia, for example the aforementioned work by Redfern et al., (2012). Rice production has been a focus throughout this geographical area because of the

importance of rice as a commodity and food source for the region (Redfern et al., 2012, Matthews et al., 1997). Scholars have concluded that the changing climate in Southeast Asia poses an increasing and complex threat. For instance, changes in temperature can affect plant function, which can then lead to declines in rice yields (Redfern et al., 2012, Matthews et al., 1997). A study that simulated the impact of climate change on rice production found results that are relevant for Laos. Specifically, using the rice varieties ORYZA1 and SIMRIW, the researchers claimed that the average rice production in the Asian region may decline by 3.8 per cent over the next century as a result of climate change (Mathews et al., 1997).

In another study, Sarker, Alam and Gow (2012) explore the relationship between climate change and rice yields in Bangladesh. These researchers found that more extreme climate variables have had significant impacts on most varieties of rice used. In particular, an increase in the average minimum temperature during the rice season has a statistically significant negative effect on the cultivation of Aman rice (Sarker et al., 2012). In fact, rice yields in South Asia are predicted to decline by 10 per cent for every degree Celsius increase in annual average temperature (Sarker et al., 2012; Zhang, Zhu & Wassmann, 2010). Therefore, an increase in minimum average temperatures of *two degrees* Celsius will lead to a yield loss of approximately 0.36 tons per hectare in South Asian countries (Vaghefi, Shamsudin, Makmom & Bagheri, 2011). A rice productivity reduction of this magnitude has the potential to cause massive economic losses to many rice farmers in the region.

Similarly, Bouldam (2012) contends that the most serious environmental issue of the current century that directly affects the growing conditions of crops is climate change. Moreover, Bouldam (2012) identifies rice as especially at risk because increased occurrences of drought are especially harmful for rice production given the amount of water that is needed for rice cultivation. Over the past few decades, globally, there has been an increase in greenhouse gas (GHG) emissions such as carbon dioxide (CO₂) and sulfur dioxide (SO₂) which causes changes in global temperatures and rainfall. These circumstances directly and indirectly affect agricultural sectors (Bouldam, 2014). Referring to the Intergovernmental Panel on Climate Change's (IPCC) measurement record, worldwide temperatures have

already increased by 0.3 – 0.6 degrees Celsius since 1860, and the last two decades have been the warmest (Boulidam, 2014). This author further points out that increases in temperature causes several environmental problems such as sea level rise and more intense and extreme weather patterns. Some of the more urgent problems for rice farmers are increases in drought, floods, wildfires and pest growth. Such environmental issues may not directly prevent rice from growing but they disrupt the process and function of rice production in numerous regions globally, wherein Third World countries are the most vulnerable (Boulidam, 2014). It is in this context that I argue climate change has the potential to negatively impact many rice farmers in the Asian region. Therefore, it is important to examine how rice farmers may prepare for, and adapt to, some of these impacts.

2.3. Impacts of Droughts on Paddy Rice Production

The impacts of climate change on rice production throughout Asia, in particular, have become rather dire because of the two-fold situation that most Asian countries are also Third World nations. In most Asian nations, farmers grow rice as food to feed their family and for income generation (Redfern, Azzu & Binamira, 2012).

Redfern et al (2012) argue that changes in temperature not only greatly influence the growth duration, but also the growth patterns and the productivity of paddy rice. Redfern et al (2012) also report that in the Philippines, the yield of dry season rice crops decreased by as much as 15 per cent for each degree Celsius increase in mean temperature in the growing season. Worryingly, there are estimates that present a picture of future rice yields whereby a further decrease of 3.8 per cent in rice production in Southeast Asia may occur. Such a prediction is based on water scarcity (owing to low rainfall) and increased temperatures, both issues a result of the climatic change throughout the twenty-first century (Redfern et al., 2012).

Even more concerning is that by 2100, Indonesia, the Philippines, Thailand and Vietnam are anticipated to experience a probable decline of about 50 per cent of rice yields. Moreover, the study authors point out that rice yield decreases could range between 34 per cent in Indonesia to an astonishing 75 per cent in the

Philippines (Redfern et al, 2012). However, this prediction is based on a climate modeling scenario where no adaptation and no technical improvements are made (Redfern et al, 2012). Therefore, exploring means of adaptation seems crucial to address these climate change impacts.

Boulidam (2012) has conducted simulation research to examine the impacts of climate change on the lowland paddy rice production potential in Savannakhet province, Laos. In this study, Boulidam (2012) argued that rice farming productivity in this province is probably going to experience a great reduction caused by increasing weather patterns like drought. Low rainfall for farmers in this area means the capacity of farmers to cultivate their rice crops will be severely diminished as farmers do not have the money or resources for irrigation schemes.

Similarly, Alam (2015) conducted a project on farmers' concerns over water scarcity in drought-prone environments. Based on a case study in the Rajshahi District, Bangladesh, Alam (2015) states that both water scarcity and drought presented considerable risks to the farming communities there. In fact, the author stated that the capacity of this agriculture region to earn enough money from rice production - the area's main source of income - was seriously threatened.

Even more concerning was Alam's (2015) finding that not only droughts have become a recurrent phenomenon in the country in recent years, particularly in the northwest regions, but also that the increased occurrence of flooding has become another recurring natural disaster throughout rural Bangladesh. To give a sense of the scale, the author points out that over 100 million people live in rural Bangladesh and these people are largely subsistence farmers, in that, they grow rice to feed themselves (Alam, 2015). Droughts also appear to be getting worse. Drought is now affecting rice crops in all three cropping seasons. Resultantly, Alam (2015) points out that between 0.45 and 0.34 million hectares of land are currently marked by severe droughts each year during the three cropping seasons in Bangladesh, particularly in the Rabi, Pre-Kharif and Kharif regions.

Increase in droughts will greatly impact rice production in Southeast Asia. Drought is an intensely exacerbating constraint on rice production in water-limited

environments, like upland areas where many rice paddy fields are located (Korres, Norsworthy, Burgos & Oosterhuis, 2017; Redfern et al., 2012). Drought can also result in low crop yields because it damages the flowering stages and shortens the life cycle of the plant (Korres et al., 2017). Compounding these issues, research shows that drought not only damages the flowering stages or the rice plant but also disturbs the photosynthetic process of growing rice crops (Korres et al., 2017).

Consequently, many farmers in Southeast Asia are finding it more and more difficult to maintain healthy rice production levels. Lack of water also causes other problems. As farmers can no longer depend on seasonal rainfall to irrigate their paddy fields, they have to buy water which is very expensive. This puts further pressure on the profitability of rice production (Cheng, 2016; Redfern et al., 2012).

For example, Cheng (2016) conducted a study in Doung Khpos commune Cambodia and found that rice farming was becoming more and more difficult as farmers relied on rainwater and canals. However, the increase in drought and the price of canal water was making rice farming unprofitable. Thus, in order to sustain farmers' profitability from paddy rice production, it is important to understand how farmers can tackle some of these issues through climate change adaptation.

2.4. The impacts of floods on paddy rice production

It may seem counterintuitive that both droughts and floods are increasingly damaging rice production in Southeast Asia. While rice thrives in wet conditions, it cannot survive when submerged under water for long time periods (Redfern et al., 2012). Therefore, stagnant flood waters can affect rice crops at all stages of growth. What is especially damaging is the submergence under water at the vegetative stage (Redfern et al., 2012). Several researchers argue that flooding, mostly during the monsoon season, is a serious threat to rice productivity.

In fact, Redfern et al (2012) reveal that flooding is considered to be one of the key environmental issues affecting rice production in Southeast Asia currently. They argue that extreme tropical storms caused by the La Nina weather pattern has resulted in, and will continue to result in, flooding throughout the region and they

note that it is very difficult to mitigate (Redfern et al., 2012). Presently, roughly 15-20 million hectares of rice fields are flooded each season with a loss of up to US\$1 billion every year in the Southeast Asian region (Mitin, 2009). The Thai Department of Disaster Prevention and Mitigation (TDDPM), Ministry of Interior, recorded that in 2010, flooding in Thailand killed 231 people whilst also causing economic losses of around 32- 54 billion baht. There was also a great reduction in rice yields that year dropping from 32,116,100 tons in 2009 to 31, 597,200 tons in 2010 - a total loss of 518,900 tons in one year.

Flooding causes the most damage in areas where it is traditionally already particularly wet. In many areas of Southeast Asia, farmers rely on annual rain precipitation for their crops (Redfern et al., 2012). Such farmers are generally resource poor and therefore cannot afford irrigation systems (Redfern et al., 2012). Redfern et al., (2012) estimate that over 100 million people rely on regular rainfall to irrigate their farm crops in the Southeast Asian region.

However, Lucas (2011) has found that flooding has devastated large amounts of rice production in these areas. It is estimated that 1.5 million hectares of paddy fields in Thailand, Vietnam and Cambodia are very vulnerable to flooding and some areas are already being inundated with floods, the worst seen in many years (Asada, Matsumoto, & Rahman, 2005, Lucas, 2011). Lucas (2011) also points to several other serious consequences of these climatic events. For example, he suggests that the region will likely experience a big rise in food costs as low harvests will create a greater demand.

Talking to Cambodian farmers, Lucas (2011) mentioned that one farmer said he was worried about the ability for him to even grow enough rice to feed his family. Another concern expressed by these farmers was that floods were also occurring as a result of heavy rain that lasts for weeks, a feature of the monsoon season they fear will become usual. Another very concerning consequence of such heavy and persistent rainfall is that it creates an imbalance in the ecosystem. One imbalance that has already caused much harm is a growth in the types of insects that are

considered to be pests in the rice farming sector throughout Southeast Asia (Mitin, 2009).

2.5. The impact on paddy rice production from pests

Compounding the negative impacts of droughts and floods on paddy rice production in Southeast Asia is the increased occurrence of pests, considered to be one of the most damaging issues for rice farmers in terms of crop productivity. Singleton (2003) conducted a review of how rodent pests were harming rice crops throughout 11 Asian countries. The author looked into how rodents harmed rice crops just before harvest time. Singleton found that under traditional rice farming systems, rodents have the potential to generate ongoing crop losses of about 5 – 10 per cent per year. To put this into perspective, a loss of 5 per cent of rice production is equal to roughly 30 million tons of rice, which is enough food to feed 180 million people in a year (Singleton, 2003).

What the rodents - usually rats - actually do is damage the rice crop by cutting the stems and eating the rice grain right before harvest (Singleton, 2003). The rodents then hoard rice in their nest burrows. In the 1980s in Bangladesh, approximately 57.8 kilograms of rice per hectare was found stored in rats' nests. This totaled a 5.7 per cent loss in rice production based on the estimated average national yield for 'deepwater rice' in the rice season of 1982/1983.

Rodents are considered to be a very damaging pests to the production of 'deepwater rice'. For instance, up to 52 per cent of fields had experienced significant rat damage during the harvest of the wet season rice (Singleton, 2003). Singleton found that there was very little information on the impacts rodents were having on rice production and said at the time of his publication the most recent information was 15 years old.

However, Singleton (2003) provides a helpful context in illustrating the damage rodents can inflict on rice paddy farming. Cambodia is a case in point. Rice farmers there have reported that rodent pests pose the greatest risk to rice production, especially in times of population outbreaks which is exacerbated by increasing warm

and wet climates (Singleton, 2003). Comparable to the Bangladeshi farmers just discussed, rodents are a particular issue just before the main harvest (Singleton, 2003). The author further points out that rats in Cambodia are an issue across the different methods of rice farming. Although it was lowland rice production that was most severely impacted and unfortunately this is the most common agricultural method used in Cambodia (Lipper et al., 2014). 86 per cent of rice in Cambodia is rainfed lowland rice with 8 per cent being irrigated lowland production. 6 per cent is deepwater and upland rice production (Lipper et al., 2014). Some studies have also highlighted how 27 per cent of lowland rice farmers reported wet-season rat problems, and 46 per cent recounted dry-season rat problems (Singleton, 2003).

Owing to the small scale, self-sufficient style of rice farming in Cambodia, outbreaks of rat populations severely threaten food security. In fact, in 1996 there was a critical food shortage because rats had not only damaged crops but also invaded rice storehouses. Enough rice was destroyed that could have fed over 50,000 people in a year (Singleton, 2003). In that year (1996) official statistics note that the commercial rice lost amounted to 0.3 per cent of total national production. However, Singleton (2003) queries this claim and says these statistics do not reflect the large losses that occurred. Specifically, Singleton (2003) points to how at the village level the reports of damage rats had caused sent considerable amounts of people into serious chronic poverty, signaling the total loss at a national level was much higher than 0.3 per cent.

Another very damaging pest to rice crops in Asia are insects (Karim & Riazuddin, 1999). Karim and Riazuddin (1999) conducted research on how insects impact rice production in Pakistan. These authors showed that there were over 50 insect pest species affecting rice crops in this country. Stem borers, leaf folders, plant-hoppers and grasshoppers proved to be the most damaging. Such a variety of pests posed varying issues and also attack plants depending on the insect's life cycle. For instance, grasshoppers eat newly germinated seedlings and cause them to wither. On the other hand, adult grasshoppers feed on the leaves and shoots and, at times, cut the ear heads. Unfortunately, if the sprouting inflorescence part of the rice flowers is affected, rice grains become chaffy. The authors found that especially in

the months of August and September, heavy defoliation can occur because of such attacks (Karim & Riazuddin, 1999).

Another study conducted by Kiritani (2007) shows the impact of global warming and land use change on pest growth in Japan. The author points to rice and fruit bugs that have grown in population because of the warming climate. The Golden Apple Snail (GAS) is one of the most damaging pests that have increased in number and eat rice crops and other aquatic plants (Joshi, 2005). The GAS is 20-40 mm long and is the most destructive plant pest because they can destroy the entire rice seedling, and a whole crop, during the germinating stage and can eat at least 20 per cent of rice crops once the seedlings are transplanted. This snail pest will cut the base of rice seedlings with its layer tooth and eat the succulent and tender leaves (Joshi, 2005).

Joshi (2005) points to how during the 1980s, the snail caused a huge loss in income in the Philippines. The estimated rice crop damage was US\$1 billion. The concerning issue is that the GAS continues to breed and has increased its range area from 425,862 hectares of Philippine rice fields in the 1980s to 900,000 hectares in 1991 (Joshi, 2005). In fact, during 1993, due to the large expansion of the GAS population, Filipino farmers had to spend about US\$23 per hectare on synthetic commercial molluscicides in 1993, an increase from US\$9 per hectare used the previous year (Joshi, 2005). Nationally this was an expenditure of US\$7.4 million that year (Joshi, 2005). The Filipino government introduced adaptation strategies that were meant to aid this situation. Unfortunately, due to an absence of funding, the GAS spread too quickly throughout the country. Ten years after they introduced adaptation strategies the ongoing costs of the GAS pest were estimated to be between US\$425 million and US\$1.2 billion. Therefore, it seems better adaptation strategies are needed to counter the issues of pests, flood and drought experienced in rice farming presently.

2.6. Adaptation strategies

In the context of the multiple issues facing rice production in Asia and the lack of funding or ability to combat climate change, this section will explore some strategies that may be useful for climate change adaptation in relation to rice production. Money is of course a key issue and Alam (2015) has noted that adapting to climate change is a large financial investment, which Third World countries do not have the capacity to provide. Moreover, adaptation to climate change regarding rice production systems is a complex situation and needs a range of skills and knowledge (Redfern et al., 2012). In other words, there is no one right way to mitigate the effects of drought and flood as each country and region has its own complex set of circumstances (Alam, 2015). For example, each place or locality has its own geography, topography, socio-economic systems and weather conditions. Therefore, when designing climate change adaptation strategies, it is important to learn about, and listen to, the locality or community in question (Alam, 2015).

Mertz, Mbow, Reenberg and Diouf (2009) emphasise that employing local approaches and competencies, as part of an overall solution or mitigation plan is very valuable. According to the Intergovernmental Panel on Climate Change (IPCC, 2001) adaptation strategies can be classified into a number of forms. Planned adaptation is the result of a deliberate policy decision based on an awareness that climatic conditions have changed or are about to change. Autonomous adaptation however - based on farmers' traditional and cultural knowledge to adapt to climate change - is most applicable to climate change adaptation related to rice farming in Third World countries.

Adaptation strategies can be used both on farm and in other working areas separate from farming depending on their suitability (IPCC, 2001; Pachauri, Allen, Barros, Broome, Cramer, Christ... & Dubash, 2014). A planned adaptation approach is generally seen as more efficient and more effective than an autonomous adaptation approach for addressing climate variability. However, in developing countries, autonomous approaches may be more appropriate in times of crisis because of lack

of government funding and resources and a richness of local knowledge (IPCC, 2001; Pachauri et al., 2014).

Mitin (2009) has explored these two types of long-term adaptation strategies in an Asian context. In the context of Vietnam, Mitin (2009) explains that, on one hand, a planned adaptation strategy involves policy recommendations. In this context the state introduces an agricultural technological plan for adaptation for farmers and shows them how and when to cultivate the crops. This scheme is often introduced through agricultural institutes. On the other hand, an autonomous adaptation strategy is based on the traditional and cultural knowledge of local farmers, such as using traditional rice seeds and implementing crop rotation.

Redfern et al., (2012) also argue that a better understanding and application of Indigenous knowledges and coping strategies is important for adaptation by, for example, using traditional seeds that are more resilient than modern varieties. The IPCC (2001; see also Pachauri et al., 2014) also concludes that a range of strategies may be helpful. The most effective ones the IPCC proposed were: The use of new crop varieties, livestock species; crop and livelihood diversification; a change in planting dates; planting trees, more efficient irrigation; and plans for soil and water conservation. These adaptation measures in agriculture for addressing climate change are also in a more general sense a more sustainable way to practice agriculture. However, there are already certain local adaptations occurring to mitigate the effects of climate change and deserve some elaboration. Therefore, the next section will expand on the concept of Traditional Ecological Knowledge (TEK). Then the second half of the section will focus on the Climate-Smart Agriculture (CSA), a strategy devised by the Food and Agriculture Organisation of the United Nations, an approach that I will use for my thesis's conceptual framework.

2.6.1. Traditional Ecological Knowledge (TEK)

Traditional Ecological Knowledge (TEK) is a common agricultural strategy for farmers in developing countries. TEK is defined as "the knowledge database and adapted practices of Indigenous and local community around the world" (Sharma, 2017, p.

455). TEK is also known as “indigenous knowledge, people’s knowledge, traditional science or traditional wisdom” (Sharma, 2017; Berkes, Folke, & Gadgil, 1994, p. 272). Redfern et al (2012) argue for the importance of TEK, given that adaptation to climate change, especially regarding rice production systems, is a complex situation and needs better understanding and application of Indigenous knowledge and coping strategies.

To elaborate, Sharma (2017) and Yuan, Lun, Cao, Min, Bai and Fuller (2014) discuss that TEK is knowledge that is gained slowly and is implicitly connected to the local environment. This kind of knowledge can constitute stories, songs, proverbs, cultural values, beliefs, rituals and community laws alongside agricultural practices, including the development of plants species and animal breeds. Notably, Traditional Ecological Knowledge is widely used in South and Southeast Asian countries, especially within paddy rice farming systems.

An example of TEK use is explained by Yuan Lun, He, Cao, Min, Bai ... & Fuller (2014). These authors explored how TEK is used in a Hani rice terrace village in Southwest China. They demonstrate that the Hani Rice Terrace system has existed for more than one thousand years and that it follows a TEK approach to cultivation and natural resources management. For instance, the rice farmers in Southwest China only used manure and traditional weeding techniques to promote and sustain the rice crops. It is a practice that has been refined over many generations. Over several hundred years, TEK has enabled the Hani people to manage their terrace farming and other natural resources in environmentally and economically sustainable ways (Yuan et al., 2014).

Another area that TEK has proved helpful in is rice terrace farming in the Philippines. There, water is being managed and conserved by using micro-watersheds, a TEK technology suitable for highland areas (Redfern et al., 2012). The efficacy of this system is demonstrated by the constant presence of water on rice fields, which in turn generates water percolation and ground water recharge (Redfern et al, 2012). This process is helpful for other water uses as well. In fact, the system as a whole supplies farmer with a constant stream of water, buffering them from precarious

rainfall (Redfern et al., 2012). In addition, one major advantage of this water ponding method in rice cultivation is that it prevents weeds from growing, which enables farmers to avoid the use of herbicides and reduces labour costs.

A final illustration of TEK comes from Vietnam, where many rice farmers have been applying TEK to rice production systems for centuries. One of these practices consists of using ducks in rice farming. Men, Ogle, and Lindberg (2002) conducted research with smallholder farms in the Mekong Delta of Vietnam to evaluate the potential of how ducks can help to eliminate insect pests and weeds within a plot of rice plantation area. The result has shown that ducks not only eliminate weeds and pests by eating them but they also help improve the soil quality as well. Thus, after a few weeks of releasing those ducks into the paddy rice field, the insect pests that affected the rice crops had been fully eliminated (Men et al., 2002). Moreover, after the rice harvesting season these ducks are then sold to the market at a very good price (Men et al., 2002).

Therefore, I suggest TEK has the potential to play a prominent role in climate change adaptation in relation to rice production in Asian countries. Not only can TEK practices help control pests and weeds, but it can also potentially help generate profitability and income for rice farmers.

2.6.2. Conceptual framework - Climate-Smart Agriculture (CSA)

Climate-Smart Agriculture or CSA is another approach to climate change adaptation especially designed for farmers from poor countries (FAO, 2010). According to the FAO, CSA was also specifically designed to help farmers implement agricultural systems to mitigate the effects of climate change. I think that this approach may be useful for rice farmers wanting to follow the autonomous adaptation strategy that Mitin (2009) describes as it seems to support the use of TEK methods in each location.

Therefore, I intend to use CSA as a conceptual framework for understanding farmer adaptation to climate change in Luang Prabang. I choose CSA as a focus because it seems like a strategy that is both environmentally sustainable and able to aid

profitability for subsistence farmers. For instance, some rice farmers in Cambodia have applied Climate-Smart Villages (CSVs), a practice of the CSA framework (Ferrer, Yen, Kura, Pavelic, Amjath-Babu, & Sebastian, 2018). This application has worked well for these local farmers in Cambodia which will be discussed more in-depth in chapter six. Cambodia experiences comparable weather patterns to that of Laos and conducts similar rice farming activities. Therefore, CSVs in Cambodia are a viable case study for exploring how one may work in Laos. Hence, I use CSA as a conceptual framework to investigate how it may help Thongphiengvilay village become a CSV (Ferrer et al., 2018).

FAO, a United Nations Organisation, formed the concept of CSA in 2010. The concept came out of research conducted by FAO addressing increasing the issue of global food insecurity. Given that one of the biggest causes of food insecurities is climate change, the FAO maintains CSA holds a lot of potential for helping rice farmers adapt to climate change in the Asian region (Lipper, Thornton, Campbell, Baedeker, Braimoh, Bwalya...& Hottle, 2014). CSA consists three main aims: “1. sustainably increasing food security by increasing agricultural productivity and incomes; 2. building resilience and adapting to climate change; and 3. developing opportunities for reducing greenhouse gas emissions” (FAO, 2010, p.1). These three aims are detailed below.

2.6.3. Food security and agricultural productivity

According to research conducted by the FAO, 75 per cent of the world’s population who are considered poor live in rural areas. Therefore, agriculture is very important to these people as it provides food for family and food for sale; the revenue of these are important as it provides an income (WFP, 2019). To alleviate poverty in these areas, boosting productivity at the same time as reducing costs is a priority. However, ‘yield gaps’, which indicate the differences between actual yields and potential yields, are very big in many poor rural areas (Lowder, Scoet, & Singh, 2014). The same gaps also exist in livestock productivity. FAO research concluded that increasing the efficiency of soil, water, fertiliser, and livestock feed could generate more abundance whilst also being cost effective. Crucially, such methods, more

often than not, result in lower greenhouse gas emissions compared with past farm practices (FAO, 2010).

2.6.4. Building resilience and adapting to climate change

The fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC), discussed the effects of climate change on crop and food production and pointed out that these effects are already evident in several regions of the world. These effects were by far more negative than positive. Significantly, the report concluded that developing countries were highly vulnerable to climate change presently and in the future (Field et al., 2014). They measured this in terms of medium-and long-term time spans. Both average and maximum seasonal temperatures are projected to continue to increase, leading to higher than average rainfall in some areas and lower than average rainfall in others. In short, wet places are going to get wetter, and dry places are going to become drier (Porter et al., 2014). Even now, the amount and severity of extreme climatic events, such as drought, heavy rainfall and subsequent flooding and high maximum temperatures are occurring. Worryingly, people who are live in rural areas in poor countries, who rely on agriculture for food and income are in a very precarious situation (Porter et al., 2014).

The FAO (2010) believes there are opportunities to mitigate these impacts from climate change. However, effective adaption strategies need to be implemented presently and intensively. Even the FAO recognises though, that any strategy needs to be localised in that the needs of region to region even in a small country such as Laos, is important. This is why this research intends to focus on just one region in Laos, Luang Prabang. Climate change adaptation approach from the FAO like CSA can therefore be helpful, such as increasing productivity through the use of agro-ecology principles and landscape approaches (some agricultural methods under TEK approach). In addition, reducing climate risk through diversification and efficient employment of agricultural inputs may help. Lastly, stress tolerant crop varieties may also increase resilience, all of which will vary from region to region and country to country (FAO, 2010).

2.6.5. Reducing Greenhouse Gas Emissions

A big issue facing poor nations in agricultural areas is greenhouse gas emissions (GHG). Agriculture activity is responsible for around a quarter of total anthropogenic GHG emissions globally. Agricultural production contributes to emissions mainly through crop and livestock management, as well as through deforestation. GHG emissions from agricultural sectors are also projected to drastically increase if the emphasis on economic growth or 'business-as-usual' growth strategies continue (FAO, 2010).

However, there are ways greenhouse gas emissions can be reduced, signaling how climate change mitigation can aid in the process of climate change adaptation. Reducing emission intensity (e.g the CO₂eq/unit product) through 'sustainable intensification' is one key idea currently being mooted (Field, 2014). This process involves implementing new practices that increase the efficiency of input use such as feed so that the increase in agricultural products is greater than the discharge of emissions (Field, 2014). Another important emissions reduction strategy is by increasing the 'carbon-sequestration capacity' of farms.

To elaborate, some plants and soils have the capacity to actually remove CO₂ from the atmosphere and store it in their bodies – this is what is called 'carbon sequestration'. Thus, planting trees that perform this 'carbon sequestration' could help (Ferrer et al., 2018). Additionally, reducing soil disturbance (through a reduced or no-dig process) is another way of sequestering carbon on farms. However, these forms of emissions reduction will not last if the trees are cut down and soil is intensively and routinely plowed. Thus, these practices need to be adhered to as carbon sequestration could be very beneficial for agricultural climate change adaptation and food security (FAO, 2010).

Some International Non-Governmental Organisations (INGOs) have conducted pilot projects using 'carbon sequestration and other practices that a CSA approach outlines throughout Asia and the Pacific. One demonstration in Cambodia showed how a CSA approach may assist local farmers to adapt to climate change (Ferrer et al., 2018). For instance, the Cambodian study concluded that smart pest

management, a 'plant clinic' and rainwater harvesting in the summer led to better rice productivity (Ferrer et al., 2018; see also Lipper et al., 2014). These farmers in Cambodia used both radio and cellular Smartphones to receive news about the project (Ferrer et al., 2018). This was an important part of keeping local Cambodian farmers informed about the project. This is one example of how CSA can build on TEK, as CSA can use TEK and also modern technology such as Smartphone software applications.

How CSA would work in Laos is not yet known (Lipper, McCarthy, Zilberman, Asfaw & Branca, 2018). Pilot programmes have been implemented in places, but these implementations have been recent and so results are not conclusive (Lipper et al., 2018). Another reason there are no conclusions of the efficacy of CSA in Laos, is that there is a large climate and landscape variability in the country. Therefore, the climate change effects in Laos will vary. This thesis then aims to address part of this gap by exploring the potential of CSA as an adaptation strategy for rice farming in one province in Laos, Luang Prabang, place where CSA has not been implemented.

My project will be guided by a central overarching question followed by two sub-questions:

Research questions

Central research question:

What role might CSA play in climate change adaptation for rice farmers in Luang Prabang?

Sub-question 1: What are some of the ways CSA might help subsistence rice production for farmers in Luang Prabang?

Sub-question 2: What are some of the ways CSA might help rice farmers' profitability in Luang Prabang?

2.7. Summary

In this chapter, I have discussed that different climate variations pose different impacts on paddy rice production in several parts of Asia depending on the topography. Researchers have examined the different impacts of climate change, such as droughts, floods and pests and how these impacts can be mitigated through some of the adaptation strategies. This chapter also demonstrates that there are no single and specific adaptation strategies to cope with the impacts of climate change on rice production. Therefore, I chose to use Climate-Smart Agriculture (CSA) to consider how local adaptation strategies may be used in Luang Prabang Laos. As a conceptual framework of this study a CSA approach will also inform the epistemology, methodology and fieldwork approaches in this thesis.

Chapter 3: Laos in Context

3.1. Introduction

This chapter provides a context for this thesis. It explores the geography of Laos and its social and economic status. Following this, I will discuss the climatic conditions, pests that affect rice production, farmer's livelihoods and how farmers are currently adapting to climate change. For the rest of the chapter, I will focus on discussing livelihoods and agricultural production in relation to climate change in Luang Prabang, with specific attention given to Nane district and Thongphiengvilay village.

3.2. Topography

Laos or Lao People Democratic Republic (Lao PDR) is a small landlocked country located in the middle of Indochina Peninsular (Global Facility for Disaster Reduction and Recovery, 2011; UNDP, 2009). Laos shares a border with five neighboring nations: Namely Cambodia to the south; China to the north; Vietnam to the east; and Thailand and Myanmar to the west and northwest. The total land area of Laos is about 236,800 square kilometers. Approximately, 80 per cent of the land area is made of up of mountainous slopes which are mainly found in the northern part of the region (UNDP, 2009). The remaining 20 per cent of the country is considered to be mostly flat in the southern part of Laos. Due to these geographical features, social and economic development throughout the country is difficult. For example, agriculture, especially paddy rice farming is challenging given flat land is optimal for this crop.

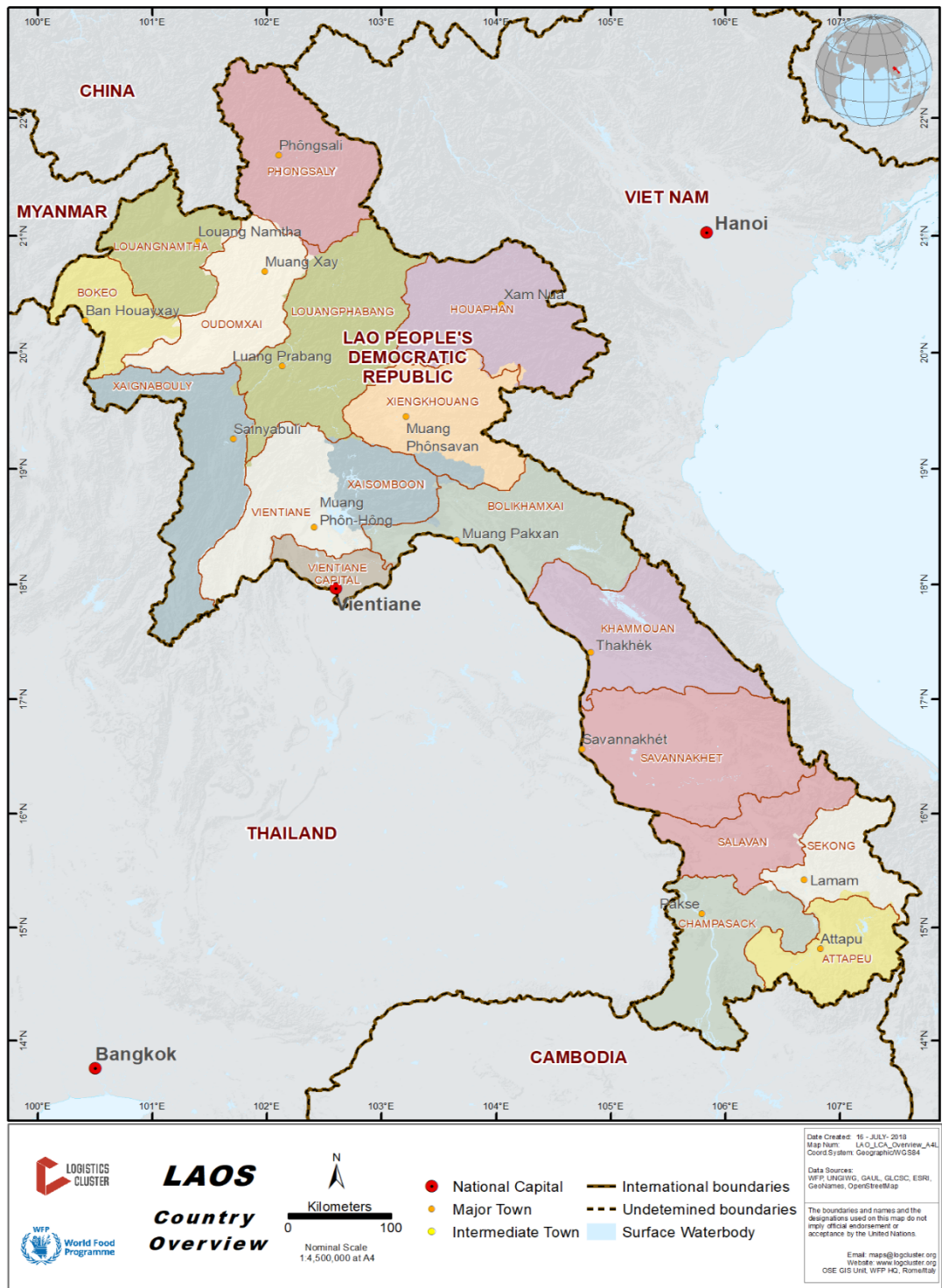


Figure 3.1. Geographical location of Laos. Source: <https://dlca.logcluster.org> > display > DLCA > 1+Laos+Country+Profile

3.3. Social and economic development

In terms of government administration, Laos is comprised of 17 provinces and one capital city; Vientiane Capital. These provinces are further divided into districts and villages across the nation (see figure 3.1). In 2012, Laos had a total population of about 6.8 million people (United Nations, 2015). The proportion of male and female's population is relatively equal, with women accounting for 51 per cent of the total population and males 49 per cent (Lao statistics Bureau 2016). The average population density is approximately 24 per square kilometres which is the lowest density in Southeast Asia (UNDP, 2009).

Even though Laos has a lot of available land used for agriculture and other development purposes, it still ranks as one of the world's least developed countries in terms of socio-economic and infrastructural development (United Nations, 2015; Global Facility for Disaster Reduction and Recovery, 2011; German Society for International Cooperation, 2015). This is largely because over 77 per cent of the Laos population lives in rural area with only 23 per cent of people living in urban areas (UNDP, 2009). This situation makes it difficult for those who reside in remote areas to access good healthcare services, safe food and education. Consequently, more than 23 per cent of the total population are still living under the poverty line (UNDP, 2009). Due to the majority of the population living in rural areas, 77 per cent of the labour force works in the agricultural sector with the rest of the population working as civil servants or other urban services. Importantly, 77 per cent of farmers still produce mainly for subsistence living (UNDP, 2009) which means growing rice is not just about making profit but for many it is about being able to eat. Thus, farmers cultivate various crop species for both family consumption and commercial sale, such as vegetables, cassava, sesame seeds, rice and also teak and rubber tree. However, it is rice that is the most important crop as Lao people eat it every day.

In regard to economic development, after Laos became independent in 1975, the government introduced economic reform (UNDP, 2009). Since the 1980s the country has opened its doors for international investors and created a free market-oriented economy with decentralisation policies. Decentralisation policy means

“ the provinces as a strategic unit, the districts as a financial and planning unit, and the village as an implementation unit” (UNDP, 2009, p. 13). The government made these reforms to boost industrialisation and increase modernisation. The United Nation Development Programs (2009) indicated that the average Gross Domestic Product (GDP) growth per head in Laos was about 7.9 per cent in 2007 which was much higher than it had been previously. These figures indicate that such changes in economic reforms improved the economy significantly.

It is commonly known that the main reason for such economic was because of mining and hydropower projects. Hydropower projects are also set to increase as the government aims to make Laos the central battery of Asia by 2030. In contrast, the growth rate within agricultural sectors decreased sharply. Farming dropped from 51.1 per cent in 2000 to 40.3 per cent in 2007 (UNDP, 2009). Government prioritisation has contributed to this decrease, but so has climate change.

3.4. Climate

The climate of Laos is tropical and is influenced by the southeast monsoon that contributes to significant rainfall and humidity across the country. There are two main seasons in Lao: The rainy season (from May to mid-October) and the dry season (from mid-October to April) (UNDP, 2009). The average annual rainfall ranges between 1300 and 3000 mm, and the temperature varies depending on each region (UNDP, 2009). The average temperature in the northern and eastern mountainous areas and the plateaus are 20 degree Celsius, and on the plains and southern regions, the temperature ranges between 25 and 27 degree Celsius. The National Statistic Centre (NSC), (2006) notes that the average temperature for the country is 26.5 degree Celsius. However, in recent years, the weather has become much hotter and drier.

For many centuries Laos has experienced temperatures and rainfall throughout the year suitable for rice farming. However, in the last few years, weather patterns have changed which makes it more difficult for farming. An example of weather change has been global temperature increases. The Asian Development Bank (ADB) has

shown that an increase of temperature and rainfall variability will bring about 2.5 – 10 per cent decrease in crop productivity by 2020 and around 5 – 30 per cent by 2050 in Southeast Asia. Lao PDR is also experiencing an increase of floods and droughts, which could be a sign of climate change. Floods and droughts pose severe consequence for farmer’s crops and therefore livelihoods. With this combination, various studies on climate change mapping for Southeast Asia, sponsored by the Economy and Environment Program for Southeast Asia (EEPSEA) state that Laos is ranked one of the most vulnerable countries to climate change in Southeast Asia region as shown below (see figure 3.2).

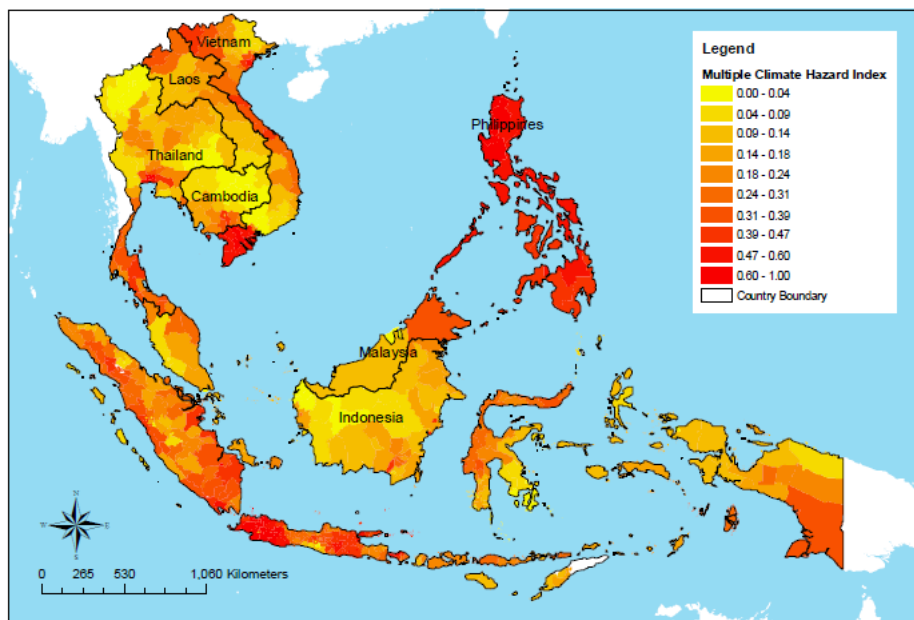


Figure 3.2 Southeast Asia climate change and vulnerability and sensitive areas
 Source: Food and Agriculture Organization (2010)

3.5. Pests on rice production

Another issue that is impacting farming livelihoods is pest species that destroy rice crops. Some of these pests are rice bugs, snails, grasshoppers, rodents and sometimes birds. Douangboupha, Khamphoukeo, Inthavong, Schiller & Jahn (2006) demonstrated that there is a correlation between extreme weather conditions and the occurrence of pests. For example, the occurrence of armyworms are associated with high rainfall. In fact, some paddy rice plantation areas in the central and southern parts of Laos are already becoming damaged by rice bugs (Doungsila, n.d).

The destruction from rice bugs cause serious problems for rice production in the country. Since 2007, the invasion of rice pests has negatively impacted the national economy.

As mentioned in the social and economic development section above, rice crop yield has decreased sharply due to a rise in rice pests. One of the most serious pest invasions throughout the life cycle of rice growing, as mentioned by Douangboupha et al, (2006), is the rodent. These authors in collaboration with the Australian Centre for International Agricultural Research (ACIAR) and National Agriculture and Forestry Research Institute (NAFRI) show that there are more than 53 rodent species in Laos, with 14 of them considered to be potential agricultural pests, causing colossal loss to agricultural crops. These rodents will eat the rice grain including both pre-harvested and post-harvested seasons, especially within the grain store. Doungboupha et al, (2002) further elaborated that there is a strong correlation between rodent population outbreak and farmer's livelihoods. This is because more than 50 per cent of farmer's rice productivity will be destroyed by rodents while storing them in the rice shed after harvesting.

3.6. Farmers' livelihoods

Achieving food security by 2030 is one of the Sustainable Development Goals (SDGs) of the Lao people. In order for this to happen, the Lao government and various International Non-Governmental Organisations (INGOs) are working closely together to make sure that the people in Laos will have enough food to eat so as a country, Laos can move towards sustainable food security by 2030. One of the INGOs that works closely with farmers and the poor to promote food security and nutrition is the World Food Program (WFP). WFP supports the vision of the government of Laos to achieve the goal of "a prosperous country, with a healthy population, free from food insecurity, malnutrition and poverty" (WFP, 2019, pp. 01). Having said that, as mentioned previously, due to more than 77 per cent of the population residing in remote and mountainous areas, many Lao people are still very poor.

The combination of climate change, particularly drought, flooding and pest infestation, and existing poverty, makes food insecurity in Laos difficult to achieve. Indeed, the World Food Program in Laos further demonstrates that climate change itself acts as a catalyst for “declining land availability, volatile price, low agricultural productivity, lack of access to markets and lack of diversified livelihood options” (WFP, 2019, pp. 01). This situation makes agricultural activities more and more challenging for local farmers and will require more financial investment into farming practices, especially farming technology and synthetic fertilisers. Due to the low adaptive capacity to climate change and the lack of knowledge to mitigate climate change impacts, Lao farmers in particular are finding it is harder to feed their family members each year.

3.7. Farmers’ strategies: Towards climate change adaptation

Climate change adaptation is one of the many priorities that the government of Lao PDR is paying close attention to, so as to ensure sustainable livelihoods for its people. In order to promote resilience in the agricultural sector, Lao PDR needs assistance in improving the knowledge base surrounding climate change, strengthening agriculture and rural sector policies and developing institutional capacities so that systematic adaptation planning can be carried out. According to the United Nation Development Program (2011) the government of Laos has done a lot of good things so far to mitigate the impacts of climate change across the country. For instance, the Lao government:

“has developed and implemented a wide-range of policies that directly or indirectly relate to Climate Change and/or agriculture adaptation to climate change. The main overall development goals reflect international commitments and focus on poverty reduction, economic growth and social development, advancement of infrastructure and investment in hydropower and mining, but also protecting the environment and gender equity. They

also acknowledge that future economic growth continues to rely on the sustainable use of the natural resource base and capacity of the agricultural sector to adapt to climate change challenges. Development in the Agriculture and Natural Resources sector focuses on commodity oriented agricultural production, stabilisation of shifting cultivation and enhanced productivity” (UNDP, 2011, p. 24).

Table 3.1. Policies and policies recommendation to mitigate the impacts of climate change:
Source: from United Nation Development Program [UNDP] (2011, p. 24)

Policies and policy documents
1. Improve capacity of National Disaster Management Centre (NDMC)
2. Promote secondary professions to improve livelihoods
3. Land use planning
4. Promotion of relevant paddy and other crops
5. Technical capacity of local agricultural officers
6. Improve relevant crop varieties and animal species
7. Improve crop and animal disease laboratories
8. Processing and storing of food and feed
9. Establishment or strengthening of farmer groups
10. Promote soil improvement
11. Bank erosion protection
12. Integrated Pest Management
13. Organic fertiliser research

Apart from these general policies and policies recommendations to mitigate the impacts of climate change across the land, the government of Lao PDR still provides some more specific visions and goals within the agriculture and food security sector to adapt to climate change as details below.

Table 3.2. Climate change adaptation options. Source adapted from FAO (2010, p. 11-12)

Adaptation options:
<p>1. Mainstreaming climate change into the Agricultural Sector’s policy, Strategies and Action Plan through planning and designing of future investment programmes (irrigation, agriculture assets and production system) which take into account climate abnormality and climate change issues including the enhancement of adaptive capability for the Agriculture Sector.</p>
<p>2. Enhancing the productivity through promoting Conservation Agriculture (e.g. no-tillage agriculture), utilising agricultural biomass for rehabilitating soil quality instead of burning, development of suitable plant species including climate-resilient and disease-resilient crop varieties using indigenous knowledge for adaptation to climate change at the national and local levels.</p>
<p>3. Improving and monitoring water resources and water supply system, and rehabilitation of the flood control system.</p>
<p>4. Strengthening the financial instruments and capacity development for farmers; improving the development of small and medium size farming in the rural areas; and supporting community-based adaptation measures.</p>
<p>5. Undertaking a country-specific, sector-based research on the vulnerability, impacts and adaptation options of the agricultural sector in Lao PDR at the macro-scale as well as the village level.</p>
<p>6. Enhancing information dissemination and extension support to technical staffs and Lao farmers in regard to climate change preparedness and responses.</p>
<p>7. Improving cooperation mechanisms among concerned sectors and strengthening the regional and international cooperation.</p>

Table 3.3. Climate change mitigation. Source: adapted from FAO (2010, p. 12-13)

Mitigation options:
<p>The main GHG emission from the agriculture sector in Lao PDR is methane from rice cultivation, enteric fermentation and manure management and nitrogen oxide from the excessive application of chemical fertilisers. The mitigation priorities will include the following:</p> <ol style="list-style-type: none">1. Reducing methane emissions from paddy fields by exercising water management, soil amendments, organic matter management, different tillage, rotation, and cultivar selection;2. Reducing methane emissions from enteric fermentation by improving production efficiency;3. Reducing emissions from livestock manure through balanced feeding, lowering the N content of the animal feeds, anaerobic digestion for methane production for use as a source of cleaner energy, waste application (dosing and injection) and the introduction of household-based, community-based and animal farm-based biogas facilities;4. Promoting new technology transfers such as biogas digester for electricity and bio-ethanol production as a means of wastewater treatment generated from agri-processing industries.

Even though the government of Laos has very explicit plans and clear policies to adapt to, and mitigate the impacts of climate change (See table 3.1, 3.2 & 3.3), on the village level they are not implemented. This is unfortunate as many of these methods correspond to CSA and TEK approaches. The present situation then can cause local farmers to become very frustrated as even when some of these strategies are used, they often do not suit the locality in which they are implemented.

3.8. Luang Prabang: Topography, livelihoods and agriculture

As mentioned, Luang Prabang is located in the northern part of Laos where mountains form up to 85 per cent of the total land area. The remaining 15 per cent of land area is considered as flat. This flat region is the only area suitable for paddy

rice farming (PAFO, 2017). Therefore, the majority of people who live in the higher regions concentrate more on slash and burn cultivation and upland rice farming rather than paddy rice farming practice. According to the Provincial Agriculture and Forestry Office (2017), Luang Prabang comprises of 12 districts and 753 villages with the population of about 459,189 people across the province. The main source of income for this province is services and tourism. However, these sectors only benefit a small group of people who live in urban areas. Thus, people who live in remote areas remain poor. Consequently, 4 districts namely, Phonxay, Pak Seng, Viengkham and Phonthong out of the 12 in the region still live under the poverty line which means more than 4000 families across these districts have not made enough to eat throughout the year.

Eighty per cent of Luang Prabang citizens reside in remote areas with most of them being farmers that mainly produce food for family consumption. PAFO (2017) states that even though these farmers grow various types of crops such as sesame, job's tear, teak and rubber plantation, the main crop that every farmer grows is rice. Rice production systems in Luang Prabang province is divided into two main types, such as upland rice farming and paddy rice farming. The total land area used for paddy rice production system is approximately 15,000 hectares but for the upland rice farming is more than 20,000 hectares (PAFO, 2017). This is due to the geographical difficulty as mentioned previously that about 85 per cent of the land area is mountainous. Therefore, more farmers are involved in upland rice production system rather than paddy rice production. According to PAFO's annual report (2017), both of these rice production areas are decreasing due to the impact from climate change, especially the increased rates of flooding and landslides.

To elaborate, during the monsoon season, many parts of the province are flooded by heavy rain which causes massive landslides across several districts. In addition, rice production systems in some districts, such as Phonxay and Viengkham are facing a large invasion of insect pests, especially grasshoppers and rodents. These circumstances make it harder for farmers to sustain levels of production that are enough to feed their family. Therefore, many villages are facing food insecurity and hunger throughout the year.

Even though Nane is not considered as a poor district according to the PAFO, many rice farmers are still facing the impacts of climate change and are not able to produce enough rice to eat. There are more than 28,000 people in Nane district and approximately half are farmers. Apart from rice production, these local farmers also grow vegetables, such as tomatoes, chilies, cabbages and corn for family consumption and for commercial sale. However, rice production is the major crop that every family cultivates for food.

Thongphiengvilay is the biggest area used for rice production in Nane district with a total of 175 hectares according to the head of the village I talked to. Villagers have cultivated rice there for many generations as their main form of sustenance for their family's consumption. In the past, rice farmers were not worried about hunger because the yield that they produced was enough to feed their family members throughout the year. In contrast, in recent years, farmers have found it harder and harder to produce rice in this area because of the existence of drought and pests. Drought and insect pests are the two major constraints for rice production in Nane district as well as Thongphiengvilay village. Due to these reasons, I have decided to base my thesis in this village to look at how paddy rice farmers might adapt to climate change by using Climate Smart Agriculture.

Chapter 4: Research methodology

4.1. Introduction

This chapter details the methodological approach used in this research, the details of the fieldwork and the methods used for data analysis. I will begin by examining critical realism as the epistemology that guides this research. Then, I explain how this epistemology forms part of an overall qualitative methodology before outlining my positionality. Once this is detailed, I outline the research location, the recruitment of participants and my research timeline. I also describe the process of entering the field and how I recruited and met participants. Importantly, I discuss my research methods which were semi-structured interviews. I will then elaborate on data keeping and analysis, in conjunction with the ethical considerations I took during this project. Finally, I reflect on leaving the field.

4.2. Epistemology: critical realism

The term 'epistemology' is defined as "the theory or science of the method and ground of knowledge. It is a core area of philosophical study that includes the sources and limits, rationality and justification of knowledge" (Stone, 2008, pp. 264). Furthermore, Stone (2008) illustrates that an epistemology is used for identifying a belief or justifying what kind of knowledge gets used in research, often leading to the question; 'How do we know what we know?'. To this end, Creswell (2014) contends that researchers need to choose an epistemology and methodology that is line with their personal beliefs and worldviews. Therefore, regarding my own research that looks at farmer adaptation in Laos, I have come to realise that critical realism is the most appropriate and useful epistemology for this thesis.

A critical realist epistemology recognises that a reality has been shaped over time by social, cultural, political and economic process (Danermark, Ekstrom, & Jakobsen, 2005). Importantly though, a critical realist epistemology also understands truth changes from person to person (Danermark et al., 2005). For example, there is a reality of rice farming in Laos, and critical realism is a helpful way to understand that

the farmers I interviewed all have different perspectives. Recognising one's position in the world is important from a critical realist position (see section 'Positionality' in this chapter). A critical realist is also mindful of everyday realities such as farming which is an important contrast to social constructionists who maintain the world is socially constructed and therefore have less of a focus on the material world (Danermark et al., 2005). The materiality of rice farming is something that is very important for me and Lao culture which is why critical realism is the epistemological position in this research project.

4.3. Qualitative methodology

Critical realism epistemology is consistent with a qualitative approach to research (Danermark et al., 2005). For example, a qualitative methodological approach recognises the existence of multiple viewpoints and the partiality of knowledge. It also aims to explore the meanings and feelings of participants involved in the research and how they make sense of their own lives and experiences. Therefore, qualitative research methods are in line with my epistemological approach. A qualitative approach can help me to understand the issues of farmer adaptation to climate change in Laos in-depth. This is because qualitative research can help explore the complexities within people's lives (Riley, 2010), and it is this kind of data I have explored in this thesis. A qualitative approach also enables me to engage with participants more informally (Flick, 2006; Riley, 2010) and this is important when talking to rice farmers in Laos as many of my participants were uneducated and would not have felt comfortable talking in a highly formal setting (see section 'Positionality' in this chapter).

Qualitative methodology seeks to explore an individual's perceptions, feelings and experiences of phenomena. This has allowed me in this thesis to take into account my participants' views and then further build on the meaning of the data with my own views and thoughts (Creswell, 2003). Consequently, a qualitative approach enabled me to explore issues that are in-depth, but also the detail of rice farmers' day to day lives (see Creswell, 2003). Therefore, using a qualitative approach for this thesis supported my objectives which were to listen to participants' personal

farming experiences, and knowledges and perceptions of past and current weather patterns, regarding paddy rice production systems.

To fully engage with participants' complex lives and histories, I also drew on the qualitative technique of storytelling. Storytelling is a common way for people to express meaning in an everyday context and is a significant aspect of qualitative research often used in what is called 'life story' research (Ellis & Berger 2003; Liamputtong & Ezzy 2005). I did not use a life story approach. Rather, I drew on this technique by using the concept of anecdote or story to elicit histories of farming and land use. Because of its informality, I think this made farmers feel more comfortable imparting details compared to having to answer a survey (Ellis & Berger 2003). Thus, this thesis employs certain principles of storytelling research within a semi-structured interview approach (see section 'semi-structured interviews' in this chapter).

4.4. Positionality

Qualitative research, especially qualitative research that draws on participants' everyday lives, requires the researcher to position themselves in relation to participants and the fieldwork area (Chacko, 2004; Riley, 2010). Positioning myself also seems important given that I am originally from a rice farming family in Luang Prabang. This position in some ways allows me cultural access to rice farming families in Luang Prabang. To elaborate, my local farming positionality provided me with cultural access and that probably enabled farmers to feel more relaxed and confident when talking to me, in conjunction with me using an informal approach more generally (see previous section of this chapter).

However, I also needed to disclose to farmers that I had considerable legal power in this situation, as I am employed by the Lao government and this provides me with a number of benefits. For one, it was very helpful that my position in the government allowed me access the head of the village, and other government bodies were obliging in providing important information regarding the annual report and statistics on agriculture and weather conditions. The village head I spoke to also

helped me find research participants. Therefore, when it came time to talking to research participants and other local villagers, they tended to listen to me and respect what I said without skepticism. Moreover, it seemed that when I presented my identification to locals, they felt that they could trust me and that I was a legitimate researcher (Flick, 2006; Riley, 2010).

However, there are some aspects about my positionality that were not so helpful and at times presented barriers between me and participants. Even though I was part of the Lao government staff and also a local who comes from a rice farming family, I still had Western qualifications. I have completed a Bachelor of Science (BSc) in Environmental Studies and my project in Luang Prabang was for a Master of Environmental Studies (MEnvStud). I observed that some research participants were quite wary of me when they discovered this knowledge as it positioned me as an 'outsider' (see Chacko, 2004).

Furthermore, many people were not comfortable with the interview process, especially using devices such as a voice recorder. Some people expressed worry that the knowledge they gave me could affect their livelihood as farmers, due to their suspicion over Western interventions that in the past have deemed rice production for subsistence living 'undeveloped' or 'uncivilised' (see Shiva, 2014). Therefore, I did spend some time reassuring my participants that I was there to help them in ways they wanted, and I was not coming into their homes to make them do anything they did not want to do. In addition, I told all research participants that their information will be kept confidential. Overall then, I felt my Lao positionality helped me greatly. Hence, I was happy in the end with my decision to focus on Luang Prabang as a site for fieldwork.

4.5. Research location, recruitment of participants and research timeline

4.5.1. Research location

Luang Prabang province is one of the eight provinces located in the northern part of Laos with a total area of about 16,875 square kilometers, the second largest province behind Savannakhet. It borders Phongsali province to the north, Vietnam

to the northeast, Houaphan province to the east, Xiengkhouang province to the southeast, Vientiane province to the south, Saiyabouli province to the southeast and Odomxay province to the west. Luang Prabang province consists of 12 districts namely: Luang Prabang, Xiengngeun, Nane, Pak Ou, Nam Bak, Ngoy, Pak Seng, Phonxay, Chomphet, Viengkham, Phoukhoun and Phonthong districts (see Table 4.1). All these districts combined have a population of approximately 459,189 people.

Table 4.1. List of districts in Luang Prabang by Province and Population. Source: Adapted from National Statistics (2015)

No	District names	Population (2015)
1	Luang Prabang	90,313
2	Xiengngeun	33,395
3	Nane	28,130
4	Pak Ou	25,823
5	Ngoy	29,692
6	Pak Seng	22,159
7	Phonxay	32,557
8	Chomphet	30,076
9	Viengkham	28,557
10	Phoukhoun	23,211
11	Nam Bak	68,863
12	Phonthong	19,093

Around 80 per cent of the population in Luang Prabang province are involved in farming practices for subsistence living with only about 20 per cent of the people working as civil servants (National Statistics, 2015). However, even though more than half of the population are commercial farmers, most of the area in Luang Prabang is mountainous. Such landscapes are remote and make it very difficult for commercial agricultural production, especially rice production, as rice is a crop that likes moisture and flat land (see National Statistics, 2015). According to the Provincial Agriculture and Forestry Office (PAFO), Nane district is the second largest rice production area next to Nam Bak district. However, even though Nam Bak

district is a larger rice farming area the farmers there are involved in upland rice production systems rather than lowland rice paddy production systems. Owing to the difficult geographical access and my own experience with lowland rice production, I chose Nane district, particularly Thongphiengvilay village as a case study for this research project, bearing in mind Nam Bak district would be an important future research area for exploring the feasibility of CSA approaches.

Nane district is about 60 square kilometers and is situated in the south of Luang Prabang province. It is a district that is comprised of several villages and towns with a population of approximately 28,130 people. About 75 per cent of the population cultivates rice for both subsistence living and income generation. Thongphiengvilay is one of the many villages in Nane district that grow rice for family consumption and for sale. There are 202 families and 175 hectares used for rice production systems in this village. According to the District Agriculture and Forestry Office (DAFO), Thongphiengvilay village is one of the places in Nane most affected by climate change, which is another key reason why I decided to base my research in this area.

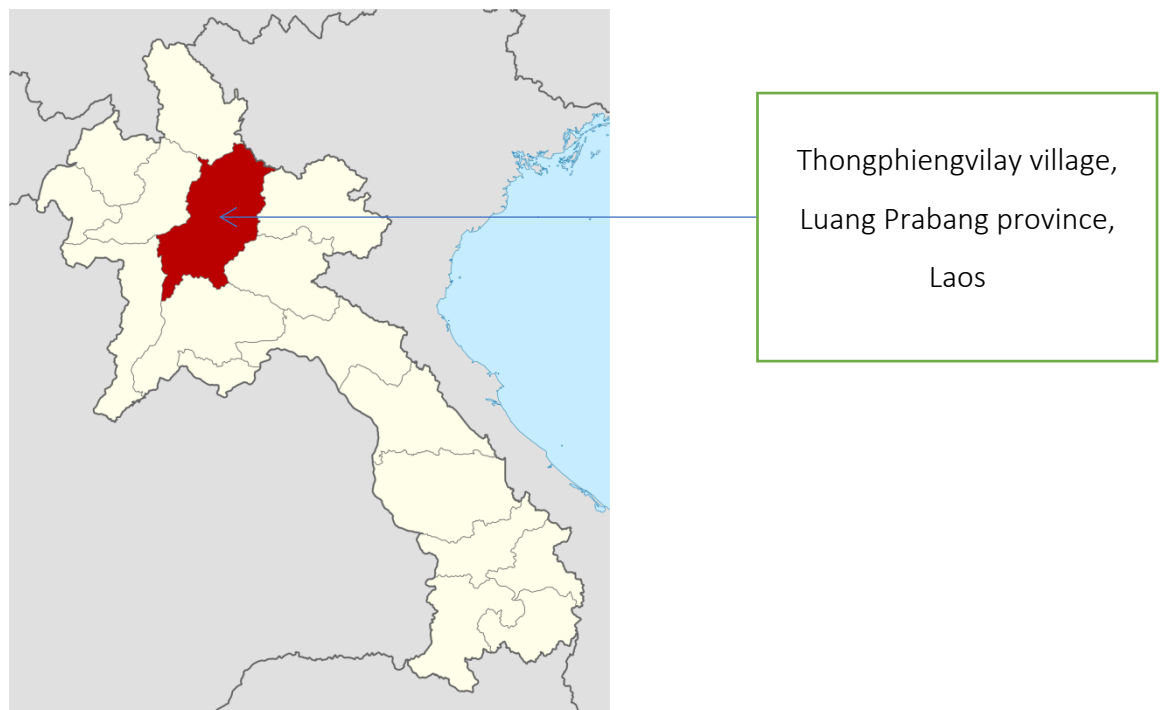


Figure 4.1. Map of Laos showing Luang Prabang province.

Source: Adapted from National Statistics (2015)

4.5.2. Entering the field

Entering the field is a very momentous occasion. It marks the time when ethics applications, health and safety forms, consent forms, information sheets and interview schedules, have all been created and filled out. When I entered the field, my research had already been approved by the Human Ethic Committee (HEC) at Victoria University of Wellington (VUW) (on the 27th of May 2019, approval number 27374). I had also received the required health and safety approval form and I also had a letter of recommendation from my supervisor. Having received all these supporting documents, as per Lao custom, I immediately submitted them to my institution of work in Laos, the Northern Agriculture and Forestry College (NAFC). From within my place of work, I was then able to get approval from the deputy director and I was able to get help with contacting potential research participants. Once I had received a confirmation letter from my work that I could start interviewing, I began my fieldwork a few days later.

When I arrived in Luang Prabang province, I had reorganised all the necessary documents in order to get them ready to submit to the relevant government offices in Luang Prabang. As I am a government official who works for the NAFC, under the administration of Ministry of Agriculture and Forestry (MAF), the process of reaching my research participants is quite different and complicated because we have to first get approval from a national office and then a district office (and then also a village chief or head) in order to be able to meet with any research participants (in this case, paddy rice farmers). I had met with the deputy director of NAFC and had a discussion with him about my research topic. I had also shown him my information sheet, supporting letter and request letters and explained to him that all these documents had been approved by the Human Ethic Committee at Victoria University of Wellington. After our discussion, the deputy director drafted me an additional official request letter combined with all the documents I got from VUW such as information sheet, support letter and request letter for another submission to the Provincial Agriculture and Forestry Office (PAFO), Nane District Agriculture and Forestry Office (DAFO) and head of Thongphiengvilay village.

After I received approval and an official consent letter from my place of work, I then met with the head of PAFO and the Nane DAFO by submitting all the documents from VUW and the official letter from my workplace so as to gain permission to conduct my research. After reviewing those documents, permission from PAFO and Nane DAFO to approach research participants was obtained. The head of the Nane DAFO then nominated a technical staff person to contact the head of the village to make an appointment with him in order to meet and discuss the possibility of conducting research in his village. While setting up a meeting with the village head, I immediately showed him the official request letter from my workplace institution and those from VUW. It was then that the head of the village helped me recruit 15 paddy rice farmers to participate in my research process.

4.6. Recruiting and meeting participants

Once the village head have found some potential participants, I met them one by one at their home with the head of the village and a government staff person who was nominated by the Nane DAFO. However, it is unlikely that the presence of these two government bodies greatly affected the outcome of the interviews, because these government people were from rice farming backgrounds. Therefore, I think participants felt at relative ease in their company. Nevertheless, it is important to note that my data was mostly collected in the presence of government representatives, an issue which be discussed later in this section.

When I met each potential participant, I first explained my research purpose, introduced myself, and then showed participants the information sheet and consent forms. Once they had read the information and asked any questions, they then signed the consent forms. Overall, I was happy with the response rate and the rapport generated between participants and myself. Participants seemed happy with the purpose and scope of the project.

Eventually, with all the required permissions from both governing bodies and villagers, I was able to begin the interviews. All selected participants were farmers who both produced rice for commercial sale and subsistence living. At first, I used a

systematic sampling recruitment method, which is a type of probability sampling method in which sample members are selected at random (Yin, 2016). I then proceeded to contact my research participants one by one based on the list I had produced, but due to the fact that many farmers were busy with their farm work during the day time, and there is no electricity in the village meeting house at night, I had to change methods. Therefore, I decided that rather using a systematic sampling approach I used a convenience sampling technique, which is a type of non-probability sampling method whereby the sample is taken from a group of people easy to contact or to reach (Yin, 2016). As the name implies, a convenience sampling recruitment method is a more flexible approach to interviewing and this technique allowed me to interview farmers on my participant list based on their availability and preference (Yin, 2016).

During the interviewing process, three research participants were interviewed each day and it took me five days to complete all the interviews (see Table 4.2). However, on day five, I only interviewed one participant because I had more than enough data from research participants already interviewed. Throughout the interviewing process, both the head of the village and a government official who worked for the Nane DAFO guided me to each participant's home. Having these government bodies accompanying me provided great benefits as it made it more official and therefore more likely that interviewees were punctual, followed each question and were ready to be interviewed at the arranged time. However, having as intimated, such official bodies with me potentially led to limitations as in Lao culture villagers do not tend to express intense emotional feeling associated with their perceptions and experiences on issues such as climate change in such a formal setting. Nevertheless, participants answered in great detail all the questions I asked them and their knowledge of rice farming and how it has changed over time was immensely informative. I also found that even though some farmers appeared quiet sometimes, all participants were fully engaged and, I think, still managed to freely answer the said questions and add their own thoughts, feelings and perceptions.

Table 4.2. Interview details by day, number, sex and age. Source: author

Days	Number of participants	Sex	Age (years)
Day 1	03	Male	54, 60, 46
Day 2	03	2 Male, 1 female	38, 30, 71
Day 3	03	Male	91, 65, 51
Day 4	03	Male	28, 44, 51
Day 5	01	Female	42

4.7. Timeline

This thesis took 12 months to complete. It started at the first week of March 2019 and the first three months (March - May) were spent developing a research proposal, applying for ethics application and fieldwork preparation. This required me creating research questions, consent forms, information sheets, complete a health and safety form and organise my travel details. One and half months (5 June – 22 July) were used for fieldwork and data collection at Thongphiengvilay village, Nane district, Luang Prabang province, Lao PDR. The remaining months were used on data transcription, data analysis, writing and editing.

4.8. Research methods

Semi-structured interview was the main research methodology used in this research. Details of the semi-structured interviews I conducted are outlined below followed by an expansion on issues regarding data keeping, ethics and my fieldwork experiences.

4.8.1. Semi-structured interviews

Semi-structured interviewing is a method that aligns well with a qualitative methodology and was a suitable tool for helping me achieve my research objectives. Face-to-face Interviews are useful in helping researchers understand participant interpretations and experiences of social and economic life, which is what I wanted

to know more about. Using a semi-structured approach also allows the researcher to gain a deep understanding of the relationship between people and place, as this method allows participants to tell their own story (Riley, 2010). Semi-structured interviewing techniques also allow farmers or research participants to have their own space and time to produce answers based on the questions asked by the interviewer (Fife, 2005). Practically, semi-structured interviews consist of a set of open-ended questions, which the interviewer can adapt and improvise on according to the context (Riley, 2010). This approach greatly assisted me whilst talking to paddy rice farmers who liked a more informal and relaxed atmosphere during interviewing. Yet at the same time, a semi-structured approach also allows for the interview to be directed and can thereby produce helpful data to compare and contrast (Riley, 2010). Therefore, I think semi-structured interviewing as a technique worked well.

4.8.2. During fieldwork

At first, the location for the interviewing was going to be held at the village meeting house. However, there was no electricity in the meeting house and after a few conversations, it also became apparent that many paddy rice farmers felt inconvenienced by coming all the way to a meeting house after they had been working in the fields all day, especially because of the poor road conditions and the lack of transportation. Therefore, I decided to meet each farmer at their home. To work around their schedule, I interviewed farmers in the evening, especially from 5.30 to 9 pm. Evening interviewing was practical as most research participants were involved with farming activities during the day time so it was only after finishing their work, that I went to their house with the head of the village and the Nane DAFO staff to conduct interviews. The length of the interview varied, depending on what kind of farming difficulties they have faced and how do they have adapted to those issues. However, on average it took me approximately 20-25 minutes per participant with the total of 8 questions. In addition, before starting the interview process, I briefly introduced myself to participants and explained where I worked and studied. This

self-introduction helped to minimise farmers' anxieties as some of them have never been asked and recorded like this before.

Although some interviews took place inside the house, some also took place outside, which attracted other family members. Interestingly, some family members also interacted with me sometimes during the interview process while farmers continued to answer the questions. Unfortunately, when some interviews were conducted outside the house near the road, it was too noisy to hear what was being said when I later played back the voice recorder. Therefore, I am very glad I took interviewing notes. By using these interviewing techniques, I also found I gathered more data than I needed. So even though I initially planned to interview 15 paddy rice farmers I ended up interviewing 13 paddy rice farmers including some of the family members' comments.

By investing some time in ensuring participants were interviewed at a time and a location that was most convenient to them, I was able to gain additional information about the context of paddy rice farming. I was able to see their home and family life, and this provided me with supplementary useful background information. For example, at times I accompanied farmers out in their rice fields which provided context for how farmers worked. The semi-structured nature of my approach also allowed me to navigate difficult circumstances. For example, when I sensed farmers were not understanding the question, I had room to change my approach at the time by asking questions in a way that was more understandable to local farmers. In addition, I think that the interactions from family members was actually helpful when using a semi-structured approach.

4.9. Data keeping and analysis

There are number of different ways to analyse data in social science, especially using qualitative methodologies. However, generally when using techniques like semi-structured interviewing approaches, an inductive approach to analysing data is used (Hammersley & Atkinson, 2007). An induction approach allows an exploration of

what the data has to offer rather than using a deductive technique, which is helpful for quantitative methods that have much larger amounts of data to process.

I was very careful with how I recorded and safeguarded my data when I had finished conducting each interview. Each day whilst in the field, I put all the information gathered into labeled files to make it easier for me to sort through later. After all interviews had been completed, I started to transcribe each interview. However, because all interviews were spoken in the Lao language, I interpreted each interview into English whilst transcribing. This took longer than I thought as I had to think very carefully at times about how to translate certain things. I, the sole researcher in this project was the only person who transcribed interviews. So, interviews are interpreted from the Lao language to English by my own understanding of both languages.

Once the transcription was complete, I read through the data over and over again before putting them into different categories. I then used a manual coding approach using Microsoft Word's cut and paste function to code the data and identify key themes. The central themes that arose from my research were 'drought', 'pests', 'livelihoods' and 'climate change adaptation strategies'. During interviews, these were the most commonly spoken of issues farmers discussed at length and were themes that I imagined would be helpful thinking through in the context of CSA.

4.10. Ethical considerations

I do not believe I encountered any major ethical issues during fieldwork. There were times when I had to adapt to the local customs and procedures, such as the requirement to have a government official present at the interviews. This is Lao custom and is unavoidable for anyone wanting to do research in villages. Even though the head of the village and a government staff from DAFO were present during interviews though, I have taken steps to hopefully protect participants from any harm. I am aware of the privacy and confidentiality issues that need to be considered when conducting research with people and I have acted accordingly. In this thesis, I will not identify the names of my interviewees and will take every step to ensure such confidentiality. My data is stored in a locked office and on a password

protected laptop and I have followed the ethical procedures such as using consent forms, information sheets and valuing and respecting the relationships with everyone involved in this project, core parts of ethical qualitative research (see Fisher & Anushko, 2008).

During interviewing, I also kept in mind that climate change impacts on rice production will not be a new issue for these local paddy rice farmers, because they have been facing these problems year after year. Some years the impacts have been more serious than other years depending on the weather patterns. Therefore, I did acknowledge that farmers might perhaps feel distressed by discussing these issues in-depth. Hence, I tried to make sure I talked about these issues in a sensitive manner so that any rising levels of stress were minimised.

4.11. Leaving the field

According to Yin (2016) leaving the field is a very significant process. This is because if the collected data is insufficient, there are usually no more chances for the researcher to get back to the research location again for a second time. Therefore, researchers need to mitigate this risk when leaving the field by going back and reviewing recorded data whether or not they think what they have is sufficient (Snow, 1980). The day before leaving the field, I had invited the head of the village and a government staff member for dinner at the guesthouse I stayed in during fieldwork to build on the relationship already forged which may be helpful for me in the future. Regarding other people who were involved in helping me with fieldwork I thanked them and said goodbye through phone calls and emails. Furthermore, for the research participants who requested a summary of their interview, I gave it over to them by usually loading it onto his or her children's computer. Lastly, I also gave each farmer a gift of chocolate and candy from New Zealand in order to express my sincere thanks to them for giving up their valuable time and participating in my project.

Chapter 5: Presentation of findings

5.1. Introduction

This chapter presents the key findings of this study. The findings are divided into four main themes and many sub-themes according to my data analysis. For example, some topics that will be covered in this chapter are: (i) the present situation of the climate, (ii) pests; (iii) farmer's livelihoods and (iv) climate change adaptations. This chapter will demonstrate that the major environmental problems facing paddy rice farmers in recent years at Thongphiengvilay village are drought and pests. In addition, some paddy rice farmers also state that growing rice for both subsistence living and for commercial sale can secure their livelihoods. However, some contend that the occupation of rice farming — owing to climate change — is becoming too precarious and is resulting in food insecurity. This chapter also finds that there is no single solution for adapting to climate change; but that there are various approaches towards climate change adaptation depending on farmers' previous experiences.

5.2. Changes in weather patterns

Weather was considered to be one of the most important factors impacting farmers. Bad weather (for farming) seemed to be the overall issue preventing good rice paddy production. All farmers I talked to mentioned that weather conditions were getting worse and rice farming was therefore becoming more difficult. Based on my data analysis from interviews I found that most research participants reported that the weather has changed a lot over time and not for the better. This changing climate was making rice production less viable each season. The most pressing irregularity in the weather has been that Luang Prabang has become hotter and drier. This has caused an imbalance in the two main seasons in Laos, the rainy season and dry season. A paddy rice male farmer who has cultivated rice for more than 20 years in Thongphiengvilay village explains what has occurred:

“Recently, the weather is not very good for rice production because of the rain patterns. For example,

some years there is too much rain and some years there is no rain, so this circumstance causes a lot of issues for rice cultivation. This year has been the worst compared to others due to the lack of rainwater which, in turn, results in wide-spread drought. In the last few years at this time, I would have had the seedlings in the field for some time by now but not this year. This year, I sowed the seedlings almost two weeks later, yet the germination process is still very slow due to the lack of rainwater to stimulate it (participant FA01: male, 54 years. Interviewed June 15 2019)’’.

This farmer points to how, without rain, paddy rice is not able to be grown effectively. This is because there is no more moisture in the soil to promote or support the rice crop. Notably, in the past three and four years, rice farmers in this village faced minor weather problems for rice cultivation but were still able to grow rice during June and July. As one respondent (participant FA02) remarked:

“in the past, I have not often faced the issue of drought because the plantation area I grow rice in is located in a very suitable place. It can collect the rainwater very quickly and also this area just located behind the village. Therefore, all the water use from household is running into my rice field directly and this makes it easy to plant rice. (However) this year the weather is completely different from other years due to the irregular rainwater which has led to signs of drought. I found that my fishpond is drying out due to the lack of rainwater. Many of my fish are now dead. If there is no rain after August, it means that the growing season has been passed and I cannot grow rice anymore as the age of the seedling would be too old for transplanting into the field

(participant FA02 male, 60 years. Interviewed June 15 2019)''.

During interviews, most paddy rice farmers said that they normally grow rice between the end of May and mid-June. For rice growing, this period is the best time for planting seedlings and preparing to plough the paddy field in order to get ready for transplanting. However, the planting date is starting to change because of drought. Sometimes farmers now have to adjust the planting dates from mid-June to mid-July or even at the end of July. An excerpt from an interview explains that the reasoning for this change is due to lack of rain:

''Last year this time (June), I had already done rice cultivation because there was enough rain. However, this year I have not started yet due to the dry conditions. The soil is completely dry, and I am not sure if there will be any rainwater available for rice cultivation this year (participant FA11, male, 44 years. Interviewed June 18 2019)''.

In addition to this comment, another respondent stated that *''this year the weather is completely different as it is too hot and dry. Many streams and rivers in the village are almost dried up because there has been no rain for many months (participant FA10)''.* If there is no rain, people will not only be able to grow rice for family consumption or for commercial sale. Compounding this situation is that farmers also cannot plant other crops like vegetable either. For example, a village elder who was a rice farmer for more than 30 years told me:

''There is no rain this year so many crops are dying. 20 years ago, the weather was very good for not only rice production systems but it was also very suitable for other cash crops such as sugarcane, cassava, banana and corn. However, in recent years all these cash crops have disappeared from the garden because of drought. In addition, in the past while we were cultivating rice, there

were many aquatic animals living in the rice fields such as frog, fish and crab. We caught them for food every day. However, in recent years, all of these animals have disappeared and I think that this is the consequences of climate change, especially drought (participant FA08, male, 65 years. Interviewed June 17 2019)”.

These comments from farmers show that the weather keeps changing year after year, for the worse, putting more and more stress on farmers’ livelihoods in Thongphiengvilay village. Interestingly, these local paddy rice farmers expressed what they are really concerned about is drought and talked less about the negative effects of flooding. For example, one respondent (participant FA05, male, 30 years. Interviewed June 16 2019) illustrated that:

“Sometimes there is too much rain which causes massive flooding and some time there is no rain that can lead to drought. These climatic irregularities cause countless difficulties for rice farmers like us. However, drought is more destructive than flood according to my experience”

5.2.1. Droughts

There have been numerous environmental concerns in the recent years that have presented more and more challenges for farmers. These include floods, the existence of insects and pests, and droughts. Droughts in particular are a very serious environmental issue facing the paddy rice farmers I interviewed. For one, rice plantations require more water than other crops. Without rainwater or irrigation, people from Thongphiengvilay, Nane district will not be able to grow rice properly. Rice also needs continuous moisture to promote the growth rate, something that drought prevents. According to the data from my interviews, most paddy rice farmers faced the same issues related to growing rice because of increased drought. As one respondent remarked during their interview: *“I am a rice*

farmer in this area for more than 21 years and the common environmental issue that I have faced as a rice paddy farmer is drought (participant FA09, male, 51 years. Interviewed June 17 2019)”.

I myself have never faced hot and dry weather like it has been in the last few years. The rain usually comes at the end of May to mid – June. However, this year there still had not been rain when I visited throughout June. One rice farmer explained that drought poses a lot of issues for rice growing, as lack of water affects the germination process and reduces yield loss which are completely difficult and costly to mitigate. He also mentioned how this last season has been the worst yet:

“in the past, the weather has been really good for paddy farming and the yield has been abundant. However, in recent years, especially this year it is too hot and dry. I think that the yield will be decreased as the seedlings now in the field are almost dead due to the lack of water to help support them (participant FA12, male, 51 years. Interviewed June 18 2019)”.

5.2.2. Effects of drought

Drought creates many negative consequences for rice crop growing both before and after sowing. One thing that occurs during growing is that it slows the propagating process and causes yield loss. One farmer who had recently turned 95 years old emotionally contended that:

“ In the past few years this time, June, the rice crops were already about 60 centimeters high because of the regular rain patterns. However, as you can see now, this year, on the paddy field, the rice crop is only 20 centimeters high, so it is about 40 centimeters different. This situation is because of drought and heat (participant FA08, male, 65 years. Interviewed June 17 2019)”.

This effect of drought has stunted the growth rate of this farmer's crops, causing the plants to grow much more slowly than usual. Interviewees also commented that it was not only rice crops that have been damaged, but other vegetation as well, and this situation was not new to them. Based on interview analysis most research participants described that drought is not something new to them. Most farmers said in the past three or four years, drought has been occurring. However, farmers said this last season (in 2019) they experienced a very prolonged drought. Some farmers mentioned that after cultivating rice for approximately 2 to 3 months, they found there was often not enough water to stimulate their rice crops into their flowering stage. In these instances, the grain will be without milk. As one research participant mentioned:

"Since becoming a rice farmer in 2005, I have noticed that drought also damages the flowering stage of the rice crop because it is at this time that the plant needs a lot of rainwater to produce rice grain. If there is no rainwater, this can result in empty grains or grain without milk and this will lead to yield loss (participant FA10, male, 28 years. Interviewed June 18 2019)".

Interestingly, many research participants also said that during the seeding period, birds often pick the grain from the plantation area. This is a result of drought because as there is no rain, the seed will not germinate quickly which then provides more time for the birds to then eat the seed. These birds will kick the soil surface on the plantation area and eat the rice grain before the germinating process begins. Hence, farmers have to regrow it again in order to make sure that he or she have enough seedlings to transplant. During the interview, a respondent relayed to me her experience with this situation:

"There have been quite a number of changes in the weather particularly, the existence of drought, flood and insect and bird pests. When I sow rice seed in the paddy field while waiting for rainwater, the bird will eat the rice

seed before the rain (can germinate it). Therefore, I have to sow it over and over again. It is a very time consuming and costly process to sow the seed again because the rice variety (I use) is very expensive and it is difficult to find these seeds with such short notice (participant FA13, female, 42 years. Interviewed June 19 2019)’’.

It is clear then, that rainwater is a really important and necessary constituent in farming systems. The farmers I interviewed did also say that they would like to pump water from the local stream into their rice fields, but it is very costly and would therefore make rice farming unprofitable. Furthermore, many of the streams and small rivers in the area I interviewed were almost dried up anyway because there had been no rain for many months in the village.

5.2.2.1. The effects of drought on germination

In the past few years at Thongphiengvilay village, many rice farmers said that they normally plant seedlings at the end of May every year. It generally takes two weeks to germinate and another two weeks for transplanting to the paddy field if there is sufficient rainfall. However, the year (2019) I conducted fieldwork, it was very hot and very dry and there has been no rain since April until the time of interviewing (end of June). This meant that some rice farmers had not yet planted any seeds. Of the farmers who had tried sowing seeds, they told me that the rice kernels had not germinated. For example, this is what one respondent mentioned during their interview:

“This year I sowed the seeds over two weeks ago, but the germination process is so slow due to the lack of water to support it. Consequently, I think that if there is rain coming during July, I will sow the seeds again in order to have a good seedling to transplant into the paddy field (participant FA10, male, 28 years. Interviewed June 18 2019)’’.

The farmer here described how having mature and strong seedlings for transplanting is an essential part of the rice cultivation process. This is because strong plants will provide more productivity at the end of the season at harvest time. As another respondent remarked:

“according to my personal experience, as a rice farmer, a good seedling always provides more yield during the harvesting season. I think that they are more tolerant to the sun and pests as they have more leaves (participant FA13, female, 42 years. Interviewed June 19 2019)”.

Drought not only prevents healthy germination; it can also cause the seed to become rotten. Based on my data analysis, I found there were quite a few rice farmers that had explained how they had dug into the soil after some time where seeds were not germinating to see what had happened. They found the seed rotten as it was too hot in the ground for them. This is very bad news for farmers as this greatly reduces their yield at harvest time.

5.2.2.2. Drought leading to yield loss

Yield reduction is caused by many things from the beginning to the end of the rice paddy growing period. One of these factors is drought. In fact, during interviews, all farmers I interviewed raised the same issue concerning yield loss presently, and it was drought. For instance, a paddy rice farmer at Thongphiengvilay village who cultivates rice for subsistence production to feed his family told me:

“In previous years, I could have produced about 110 sacks of rice per one hectare but last year after the harvesting season, I got just 70 sacks. This is because last year it only rained early, during the plantation period (June and July). So, there was no rain during the flower development stage which is needed so the rice plant can absorb rainwater to make milk. Consequently, many grains became empty and did not ripen properly. I think

that is the reason why I just got 70 sacks rather than my usual 110 sacks (participant FA12, male, 51 years. Interviewed June 18 2019)''.

This farmer explained that if the weather is too dry during flowering development stage, the rice crop will not be able to make milk effectively. This is because all the leaves turn yellow, preventing the plant from going through its photosynthesis stage properly. The rice plant needs nutrients garnered from the photosynthesis process to help feed the grain. So, if the rice crops do not receive these nutrients, the grain will be empty causing massive yield loss.

5.3. Pests

Pests are not a new issue for rice farmers in the area where I conducted interviews. Pests occur year after year and throughout the plantation period. However, some years are more serious than other years depending on the climate. Farmers told me that there were several different species of pests damaging their rice crops that varied according to each development stage of the plant growth cycle. One farmer explained to me this in more detail:

''According to my observations, snails will eat the rice crop at a very young age, especially after a few weeks of transplanting. And grasshoppers will damage the leaves just before the flowering stage. Then, stinkbugs and rats destroy the rice crop during the milking and harvesting season (participant FA06, female, 71 years. Interviewed June).

However, many paddy rice farmers mentioned that the pests have never been as many as they have been in this last year (2019) and they did not know where they have come from. During an interview one farmer expressed her frustration:

'in the past, there have not been too many pests. However, currently there are so many of them damaging

our crops and I do not really know where they come from. I spray Dichloro Diphenyl Trichloroethane (DDT) twice every month, but this does not affect their life cycle because they are very resistant to the chemical spray. So, I think that the existence of these pests could cause a massive rice yield reduction this year. I am afraid that they will eat all my small seedlings in the field, and I will not have enough seedlings to transplant at the end of June. This is very difficult to tackle (FA13, female, 42 years. Interviewed June 19 2019)''

5.3.1. The impact of pests

There are many pest species that destroy rice crops, depending on each development stage of the plant life cycle. However, different pest invasions result in different impacts. Some pest species damage the root system, some eat the stems and leaves and other suck the milk and eat the rice grain. As one research participant reported:

''there are a lot of pests now, especially rice beetles. This pest lives under the roots of the rice plant and they will destroy the root system which leads to the massive loss of young seedlings as these rice crops will die (participant FA04, male, 38 years. Interviewed June 16 2019)''.

The farmer has shown here that when the small seedling gets damaged and dies, the amount of seedlings he receives for transplanting will not be enough. Furthermore, it is very difficult to reseed as by this time the seedling's sowing period has passed. Therefore, the farmer's yield will decrease.

Alongside the rice beetle, snails also cause a colossal impact on rice production in Thongphiengvilay village. From reviewing my data analysis, I noticed most paddy rice farmers said that there were a lot of snails in the paddy fields this year (2019). In

fact, one farmer mentioned they could fill 5 sacks of snails from just a hectare of the rice plantation area. Additionally, concerned about this large population of snails, a rice farmer mentioned to me that: *“If the snails invade the plantation area only one night, approximately 30 per cent of the total rice crop will be damaged (Participant FA05, male, 30 years. Interviewed June 16 2019)”*.

Many farmers told me that snails will eat the stems and the leaves of the rice crop and eventually the plants will die. They believed that if the snails kept eating the stems and the leaves like this without eliminating them, farmers will be going hungry. They reasoned this because of the reality that these snails pose a massive threat to rice crop productivity.

Grasshoppers are another common pest for rice farmers that also contributes to heavy damage of the rice plant and leads to major yield losses. Every farmer I interviewed in the village said that they often found grasshoppers throughout the year and not only on rice crops but also maize, sugarcane and other grasses. However, grasshoppers were found on rice more than any other crop, especially during the flowering and milking stages. During one interview a rice farmer who had been farming for 28 years explained:

“the grasshopper has a very special life cycle. They will lay eggs in the dry season (during September to November) in the soil and will be born in the rainy season (around June to early July). The grasshopper population will then destroy the rice stem, in particular eating the leaves and sucking the rice milk. The rice stem will finally dry up which greatly affects rice productivity (participant FA08, male, 65 years. Interviewed June 17 2019)”.

Grasshoppers cause widespread impacts on rice yields compared to other insect pests. They will eat through plantation after plantation because they can fly long distances when they are born and rise out of the ground. Even though rice farmers also talked a little bit about stinkbugs and rodents, they mentioned that they are less damaging than grasshoppers and less common. During my interviews and

discussions with paddy rice farmers, they told me that they only saw stinkbugs and rodents some years, and during some seasons they see none. Farmers were not really sure why this was the case.

However, even though the destruction stinkbugs and rodents cause are not that harmful they still reduce rice productivity. In fact, one interview participant suggested: *“Based on my experience, the destruction caused by stinkbugs is very similar to grasshoppers. It just sucks the rice milk during the pregnancy period. In addition, the rodents come around during the harvesting season in order to eat the rice grain (Participant FA11, male, 44 years. Interviewed June 18 2019).* Still, overall, research participants told me that they are not too worried about stinkbugs and rodents because the population of them is quite small compared to grasshoppers.

5.4. Farmers’ livelihoods

People living in Thongphiengvilay village are involved with various types of employment besides rice farming. However, rice farming is the most common occupation, whether it is for commercial or subsistence production, or (as is usually the case) both. According to my data analysis from interviewing, I found that some families have enough rice to eat throughout the year to sustain the family’s consumption without buying extra rice from the market. However, other rice farmers could not produce sufficient amounts annually, so they had to buy more rice from other farmers and from the market so that they had enough to eat. Therefore, paddy rice farmers in this area experienced both food security and food insecurity. What determined food security or insecurity depended on each farmer’s family size, and how much of a plantation area they owned, which I will discuss in the next two sections.

5.4.1. Food security

Achieving food security is every paddy rice farmer’s ambition and expectation. Many local rice farmers in this area described that achieving food security is not an easy job and it depends on various factors, especially climatic conditions, family status and farming techniques. However, most paddy rice farmers believe that they can

produce enough rice to eat throughout the year. For example, this is what a research participant mentioned during one of my interviews:

“Since becoming a rice farmer, I have never bought extra rice from the market for family consumption. This could be because of how small my family is. I would say that being a rice farmer can make my life better. In past seasons, I have produced about 150 sacks per year per hectare and I sell around 1 to 2 tones at the market which gives me enough money to buy clothes and food for my family members (participant FA02, male, 60 years. Interviewed June 15 2019)”.

Paddy rice farmers in this village showed that family size plays a very significant role in food security. Three to four people eat approximately 40 sacks per year, whatever remains is sold to the market or to locals who do not have enough rice to eat. The money from selling rice can be used to purchase a family’s necessary utilities, such as medicines, clothes and support for children’s education. Regarding this latter point one research respondent mentioned:

“I don’t think that being a farmer is an easy job, but I have to do it because there is no other choices for me. I would not be able to find a job even if I graduated with a university degree. However, I acknowledge that I do make enough rice to eat annually and still have some spare rice to sell to support my children’s education when they face financial difficulties. Therefore, I know for certain that being a rice farmer can make my life better (participant FA07, male, 91 years. Interviewed June 17 2019)”.

Some farmers also made the point that being able to grow enough rice to eat all year long is not only good in that it provides food, but it is also much cheaper than buying it from the market. This is because some years rice merchants put a very high price

on rice products. For example, the price of the rice will soar when droughts and floods have occurred. This means that if there is a severe drought one year, rice merchants will sell rice at very high prices that are unaffordable for locals. The merchants justify their decision based on there being less rice in the market and that it was much harder to cultivate. Because of this unpredictable situation one rice farmer I interviewed discussed his rationale for growing:

“To be honest with you, I do not make any money from the rice farming systems I use. So I only cultivate rice for family consumption. It may not be much rice but I feel that cultivating rice for just my family is much cheaper and therefore a good investment compared to buying it directly from the market (participant FA11, male, 44 years. Interviewed June 18 2019)”.

During the interview with participant 11, the farmer told me that he only invested around 2 million kip (approximately 250 USD) per hectare throughout the entire rice production season. The productivity from one hectare is about 105 sacks per season per year. However, if locals were to buy this amount of rice from the market, it could cost them about 5 million kip (or 650 USD). Consequently, being rice farmers is what all interviewees preferred and were willing to do. In contrast, based on the data analysis from the interviews, some paddy rice farmers also stressed that they have faced food insecurity and hunger due to the big size of their respective families and that the land used for rice cultivation is limited.

5.4.2. Food insecurity

Food insecurity can be defined as a situation where people do not have enough to eat or that they do not have potential or means to feed their family. Many paddy rice farmers in this village told me during interviews that in the past 4 and 5 years, they have been able to produce enough rice to eat throughout the year even if their family is very large. However, some farmers mentioned that last year (2018) and this year (2019) they have been unable to feed their family because the weather has

been too hot and dry. There has not been enough rain for paddy rice farming which makes food security very challenging. One farmer stressed to me that he used to be able to grow enough rice for his family consumption and profit but that this is changing now:

“ To be completely open with you, as you see there is my barn. Four years ago, I could have produced about 200 sacks and my barn would be full of rice. However, this year I have calculated that I will only be able to get around 80 to 90 sacks. This is due to the reality that this year the weather is very dry. My fishpond is located in the middle of my paddy field and is getting dry and many aquatic species, especially carp fish will be dying soon if there is no rain. I am afraid this situation will put me as well as my family into a situation of food insecurity or hunger. I don't think I will be able to support my children's education either like I used to, all due to the warmer climate (participant FA08, male, 65 years. Interviewed June 17 2019)”.

These comments show that climate change plays a key role in food insecurity in this village as it reduces rice productivity and damages other sources of food like fish. The paddy rice farmers I interviewed told me that if the weather is hot and dry in the future like this year (2019), people in this area including paddy rice farmers will face food insecurity and hunger and this has never happened before. An old male rice farmer further suggested that:

“I personally think that in recent years the weather has become hotter so this will lead to more drought in the future I think. So, if there is no irrigation or no rain like it has been in the past people will be going hungry because they will not be able to produce enough rice to eat. Hence, irrigation or rainwater is the key element to

achieve food security (participant FA08, male, 65 years. Interviewed June 17 2019)''.

Similarly, another paddy rice farmer who had been a rice farmer for more than 15 years also expressed that climate change, especially dry weather will contribute to food insecurity and hunger in the future. He reasoned that there is not enough rain to sustain the rice crops he cultivated. During his interview, he remarked:

''This year is too dry and I think people in this area will be going hungry. Food insecurity will eventuate because if we cannot grow rice this year, rice will be very expensive at the market which many people will not be able to afford (FA12, male, 51 years. Interviewed June 18 2019)''.

This farmer's statement explicitly associates drought with high food prices. His statement suggested that high food prices can cause a huge gap between the rich and the poor as poor people are considered to be the group of people who have many children and less access to natural capital like rice plantation areas. A bigger sized family will therefore often find it more challenging to feed all members compared to a smaller sized family. For instance, this is what a young male paddy rice farmer who had only been married for five months stated:

'' I cannot make a living out of rice production because I have a very big family. There are more than 10 people in my family so the 60 to 70 sacks of rice I can grow is insufficient for my family's needs. So, at the end of each year, I have to buy extra rice from the market to sustain my family. Also, after the harvesting season, I have to go down into the town to work in construction in order to earn more money for family expenses (participant FA09, male, 51 years. Interviewed June 17 2019)''.

This excerpt quoted above shows how food insecurity and hunger is an important and urgent issue currently facing the village where I conducted fieldwork. It also implies that much thinking on these matters of food insecurity is required. Therefore, this chapter will now look to what farmers talked about in relation to climate change adaptation, food insecurity being a common result of climate change. In studying my interviews with the paddy rice farmers, the analysis suggested that there are numerous climate change adaptation strategies that are already used by farmers. These adaptation strategies have been formed from their experiences and the lessons learnt from cultivating rice in the past.

5.5. Climate change adaptations

Paddy rice farmers value climate change adaptation as an important step towards food security and profitability. According to the data analysis from interviews conducted by myself, I suggest that paddy rice farmers in Thongphiengvilay village who cultivate rice for subsistence living and for commercial sale have very distinctive approaches towards combating or adapting to climate change. Some farmers do apply local forms of Traditional Ecological Knowledge (TEK) to tackle climate change issues as they feel it is more sustainable, friendly to the environment and beneficial for their health. However, other farmers believe that chemical fertiliser sprays are the best and most appropriate adaptation strategies to mitigate the impacts of climate change on rice production. These farmers claim synthetic approaches saves time and is more effective than a TEK approach. It is also interesting to note that other adaptation strategies, such as animal raising and crop rotation systems, have been taken up by some paddy rice farmers even though on a small scale. These farmers believe that animal raising, and crop rotation systems are workable options to adapt to climate change as at least they can sell these animals and vegetables to the local market so that they can get some money to buy extra rice to sustain their family. Therefore, Traditional Ecological Knowledge, chemical fertiliser sprays, animal raising, and crop rotation systems are outlined below as the principle adaptation strategies farmers used to address the issue of climate change impacts on paddy rice farming at Thongphiengvilay village, Nane district, Luang Prabang province, Laos.

5.5.1. Traditional Ecological Knowledge

Traditional Ecological Knowledge or Indigenous Knowledge is one of many approaches that local paddy rice farmers living in Thongphiengvilay village use to address climate change issues. However, even though many farmers have used TEK knowledge for several decades, TEK in Thongphiengvilay village is not defined by these words but rather they expressed TEK in a number of ways depending on their level of education. Generally, TEK can be seen as traditional and organic approaches to rice paddy farming that have been practiced for a long time. Suffice to say, even if farmers use in everyday life what is commonly defined as TEK in the academic literature, farmers often were not sure what they were doing was considered TEK practice as one research respondent described during their interview:

“I have applied some natural ways to improve the soil condition of my land, but I am not really sure if that is Traditional Ecological Knowledge. For example, I collect animal waste each year and spread that over the paddy field before ploughing as I believe this makes the soil more fertile and leads to better yields (FA07, male, 91 years. Interviewed June 17 2019)”

This quote illustrates that the farmers inherently understand and apply TEK practice, but often do not know how to express it as such due to the limitations of education and them learning about the term ‘TEK’. Some farmers had never been to school and some had just finished high school. Therefore, these farmers found it difficult to understand what TEK is about. However, farmer 11 did know about TEK practice and he had been a farmer for more than 21 years. He told me that he has used TEK for rice production for many years and it works very well for him as he explained:

“I have used TEK for my rice production for many years and I have found that it is very helpful. I collect manure, especially pig and cow waste. Before ploughing, I spread the waste throughout each plantation block and plough

them into the soil. This process will increase the soil fertility and boost the rice yield. For example, last year my productivity was quite high because of this TEK practice (participant FA11, male, 44 years. Interviewed June 18 2019)''.

This farmer went on to tell me that he only has a small piece of land used for rice farming, so poor soil condition is always an issue for rice production. Therefore, increasing soil fertility by utilising animal waste is an important and workable approach to make rice production sustainable. In addition to fertilising with manure, some participants told me how changing rice varieties that are more tolerant to climate change, especially drought, not only helps boost their productivity, but also makes a softer grain to eat. For example, one participant highlighted:

''I switch rice varieties every two years as this can increase the rice productivity and make the rice softer to eat. For example, I get a better yield when I plant a steam rice variety compared to using a sticky rice variety. Steam rice varieties gives more than 100 sacks per hectare, but sticky rice varieties only provide 80 sacks per hectare per year (participant FA04, male, 38 years. Interviewed June 16 2019)''.

This quote discusses how different rice varieties will produce different yields and also implies that using the same variety in the same plantation area for many years will reduce the quality of the rice, making it harder to eat and therefore harder to sell. Therefore, changing rice varieties is considered to be an important approach because it will not only result in better grain quality but also contribute to farmer's profitability and soil health.

Similarly, adapting to climate change, especially when there is not enough rain by adjusting plantation dates, is another strategy that sometimes helped secure farmers' livelihoods. Many farmers in Thongphiengvilay village noted that in the past the rainy season usually starts from the beginning of June to mid – October every

year. However, last year and this year, the rain pattern has slightly changed from mid – June to July. Therefore, what farmers can do is wait until the rain starts in July and adjust their farming systems accordingly. Not changing the dates of plantation can result in very poor yield as rice will not grow properly with no rain. According to one farmer’s experience, he said that adjusting the plantation dates is better for rice cultivation rather than trying to grow rice in June with no rain, as he explained:

“Changing the planting date, I think is one of the most significant things I can do to address the issue of climate change. Usually, I cultivate rice in mid of June every year but if there is no rain, I will not plant it because the young plant will die now because of drought. Therefore, I will wait until it rains. I found that this is a really helpful adaptation strategy as this way the seedlings will survive and grow better compared to planting in June when there is no rain available (participant FA11, male, 44 years. Interviewed June 18 2019)”.

From my data analysis an interesting issue about pests also become apparent. In Thongphiengvilay village some farmers suggested that pests account for about 30 per cent of yield loss. This loss occurs partly because some paddy rice farmers in this area have never used pesticide sprays before as they know that chemical sprays cause massive consequences for the environment and human health. Generally, farmers also do not use pesticides when they are only cultivating enough rice for household consumption. Thus, TEK is their first choice to combat pests. For instance, one very interesting TEK approach employed by a paddy rice farmer was to mitigate the invasion of stinkbugs during the flowering and milking stages of the rice crop.

“The action that I take to address the impact of stinkbugs is hanging rotten crabs and fish nearby the plantation areas, where stinkbugs are damaging the crops, so that when these stinkbugs smell that bad smell from the crab and fish, they will fly to eat those rotten crabs and fish

instead of sucking milk from the grain of the rice crop. I found that this is very helpful and a workable adaptation method to tackle the invasion of insects, especially stinkbugs (participant FA11, male, 44 years. Interviewed June 18 2019)''.

Similarly, this same farmer explained the use of another TEK practice that is used to control rodents entering his rice field:

''as I mentioned previously, the most common environmental issues that I face as a paddy rice farmer is drought and insect pests, in particular rodents. The only possible action that I can take to address this issue is natural practices. I use a traditional mouse trap to control the rodent that will get into my paddy field to eat the grain. Even though this method is not completely tackling the invasion of rat populations, it is a very effective approach because at least half of them are killed. In addition, this natural action is friendly to the environment and safe for health (participant FA11, male, 44 years. Interviewed June 18 2019)''.

These comments by farmer 11 demonstrate that although TEK does not fully ease the impacts of climate change, it does to some extent and it is also friendly to both nature and human health. However, one research participant argued that even if paddy rice farmers used various types of TEK practice to mitigate the impact of climate change on rice production systems, without water or irrigation, food insecurity and hunger will be inevitable in this area. This farmer further stated that irrigation is fundamental to achieving food security and profitability. What follows is how he expressed this point during the interview:

''The only plan and adaptation strategy I have now in mind that I think will help secure a livelihood in rice paddy farming is irrigation. Irrigation is key to achieve food

security. Even though I have an excellent plan, without water I cannot do anything to secure a livelihood as every plant needs water to promote the growth rate. If the Asian Development Bank (ADB) and the District Agriculture and Forestry Office (DAFO) make irrigation happen in this coming December, I have hopes that Thongphiengvilay village will remain a main source of food supply for Luang Prabang province as this place is currently the second largest in terms of rice production systems in Luang Prabang province (Participant FA13, female, 32 years. Interviewed June 19 2019)’’.

In conclusion, irrigation seems to be an important factor when discussing how to mitigate the impact of climate change, like the irregularity of weather and drought, in Thongphiengvilay village.

5.5.2. Chemical fertiliser usage

Alongside the use of TEK practices on rice production systems, chemical fertiliser was also an adaptation strategy taken up by several farmers in this area. Based on my data analysis from interviews, I found that generally, in the past not too many rice farmers used chemical fertilisers, pesticides or herbicides on their rice production systems as the weather has been suitable and it has rained regularly throughout the year. However, in recent years, the weather has become very hot and dry and this has caused various environmental issues for farmers, such as drought, pests and weeds. Therefore, some believe that chemical sprays are the appropriate approach to secure their livelihood and profitability during this changing climate situation. The following quote illustrates this point quite well:

“To be honest with you, in the past in this production area there have not been too many people using chemical fertilisers because the weather has been so good, what I mean here is that there has been enough

rainwater for the rice plantations. However, in recent years, especially this year, more and more paddy rice farmers keep using sprays due to the harsh environmental conditions. For me personally, I also use these chemical fertilisers too because it is very easy to buy, and the process of spraying is also stress-free. It saves me so much times compared with using TEK. I basically use a large amount of herbicide as I have said it saves my family so much time to do other tasks outside rice production. I understand that using a lot of chemical sprays is bad for human health and the environment, but I have no choice (participant FA12, male, 51 years. Interviewed June 18 2019)''.

This farmer's opinion shows that using chemical sprays can provide both benefits and drawbacks for rice farming. However, rice farmers who apply this adaptation approach argue that the benefits outweigh the costs in many ways. This is due to the fact that by using herbicides, it saves farmers more than a month of time to perform other household chores instead of just sitting on the rice field all day to do hand weeding. Therefore, farmers who use chemical sprays have more time to make money to sustain their family status compared to those who use TEK practices. In addition, some rice farmers told me that chemical fertilisers not only help save time, but it also enhances productivity. For example, this is what a female paddy rice farmer highlighted to me:

''I have never applied TEK practice for rice production systems. I only use chemical fertilisers to boost the rice yield. I noticed that without using chemical fertilisers, I can only get about 30 to 40 sacks per year. However, by using synthetic fertiliser, the productivity almost reaches 60 sacks per 0.5 hectare per year which is almost double (participant FA05, male, 51 years. Interviewed June 18 2019)''.

This paddy rice farmer demonstrates that the use of chemical fertiliser is far more effective compared to natural approaches. This is because it works better and is easier to use. In contrast, during one interview one farmer interestingly discussed how he would like to also try using natural based approaches to increase rice yield as he knew chemical based approaches caused harm to health and the environment. However, he mentioned that natural based approaches are very complicated to learn. This is what he said on the matter:

“I think in the future I will still keep using chemical fertilisers to boost or keep the rice yield regular. I would like to use natural based approaches, but it is a very complex process and I do not know how to do it properly due to my lack of knowledge in this particular field. Because of this, I think chemical fertiliser use works best for me as a rice farmer. (Participant FA05, male, 51 years. Interviewed June 18 2019)”.

Aside from the potential for helping farmers save time and increasing rice productivity, insecticides work really well in terms of eliminating pests from the rice field. During interviews, some farmers indicated that in recent years insect pests seem to have become more tolerant to synthetic insecticides compared to the past. Hence, farmers now use a stronger form of insecticides, otherwise, the insect pests will result in yield loss and food insecurity. One rice farmer explained:

“The action that I take when I face farming difficulties, especially the invasion of pests, is using insecticides such as DDT. However, some insect pests are completely difficult to tackle because they are very tolerant to pesticides already. Therefore, increasing the concentration of DDT is required otherwise these pests will eat all the rice crop within a very short period (participant FA12, male, 51 years. Interviewed June 18 2019)”.

This farmer explained that increasing the concentration of pesticides and insecticides is necessary because if they do not do it, they will not get enough rice to eat throughout the year due to the destruction pests cause. Thus, to ensure food security and profitability, they take what they say is the right decision even if it means harming the environment and human health. Ultimately, this paddy rice farmer stressed that hunger is more serious than preventing environmental harm.

5.5.3. Animal raising and crop rotation system

Besides the use of TEK and synthetic fertiliser, which were the two main adaptation strategies that arose during interviews, animal raising, and crop rotation system were two less frequently used natural based approaches. Both can be considered TEK practices that worked really well for farmers to adapt to climate change. To elaborate, rice farmers explained that if there is no rain, it means that the possibility to grow rice for subsistence living and for commercial sale will be very low. So, animal raising was one option to secure a livelihood. For example, this is what a rice farmer mentioned during their interview:

“I think that what would help secure a livelihood in rice paddy farming is animal raising. I currently have about 14 cows in my paddy field. I think if I cannot produce enough rice to eat, I will sell some of my cows to buy more rice from the market for family consumption and support my children’s education. This could be one possible way to secure a livelihood for my family and adapt to the hard environmental conditions (participant FA08, male, 65 years. Interviewed June 17 2019)”.

In relation to the above-mentioned quote, another rice farmer who had been a farmer for more than 20 years in the village said that cow farming is very simple process. This is what he expressed from his experience:

“I contend that if there is no rain to grow rice, cow farming is a very good back up plan. This is because some cow species are tolerant to climate change, particularly drought. We can leave them eating grass all day long at the field and then take them back home in the evening. Also, these cows will leave a lot of waste into the soil which is very good nutrition as it can improve the soil fertility. Apart from that I also get some money from selling these animals for a very good price (participant FA01, male, 54 years. Interviewed June 15 2019)”.

This quote shows that cattle farming not only improves soil fertility, but it also helps creates profitability for farmers during these harsh environmental conditions such as drought. Apart from cattle farming, crop rotation systems are also another natural based approach for adapting to climate change and securing family livelihoods. Many rice farmers can make some money to support their family from this activity because they grow a lot of different crop species to sell at the market. Beside this, crop rotation systems can also improve the soil conditions which is very beneficial for rice production after harvesting these crops. For instance, this is what one rice farmer remarked during their interview:

“I would like to practice a crop rotation system as this practice will not only generate income for my family but it also makes the soil more fertile and good for the next rice growing season. However, in order to make this activity happen, irrigation needs to already available for us (participant FA06, female, 71 years. Interviewed June 16)”

This statement shows the potential for food security and climate change adaptation through crop rotation. However, most rice farmers contended that without irrigation, they cannot grow these crops or rice sustainably. This is due to the fact

that all crops need a constant supply of water to sustain good growth. From these comments it seems that irrigation is key to achieve food security in this village.

Chapter 6: Discussion of findings from Thongphiengvilay village

6.1. Introduction

This chapter brings together the literature discussed in this thesis and the findings of the fieldwork. It is also a part of this thesis where I can engage in a thorough discussion of what the findings illustrate. I used the CSA framework to guide my research and explore rice farmers' perceptions of the impacts of climate change and adaptation measures. During the interviews, participants mentioned drought as the most concerning aspect of climate change. All the farmers I talked to pointed out that drought was a serious issue which they said was getting worse. Therefore, the first section of this chapter will discuss drought as an issue of climate change and how it is affecting poor rice farmers (FAO, 2010; IPCC, 2001; Pachauri et al., 2014).

The second biggest concern I gathered from my findings was the occurrence of pests, which is another issue set to get worse with the increase of climate change (FAO, 2010; IPCC, 2001). However, the pests discussed in the literature review of this thesis and the pests that farmers discussed during fieldwork were not the same. In particular, birds were a pest that farmers at Thongphiengvilay village discussed but it was not an issue I found in the literature. Nonetheless, insects such as grasshoppers seem to be a common pest for many rice farming countries.

To discuss these findings, I draw on comparable examples such as the study by Cheng (2016) carried out in the Doung Khpos community in Cambodia and other instances, also in Cambodia, where climate smart villages (CSVs) are being trialed. CSVs are villages that have adopted the principles of CSA (FAO, 2010; Ferrer et al., 2018). Then, I will discuss the use of TEK (traditional ecological knowledge) and synthetic technologies in Thongphiengvilay village and in other comparable areas to assess the viability of CSA interventions. I suggest this is an important issue to discuss given that the farmers in my research used a variety of adaptation approaches to tackle the impacts of drought and pests.

Lastly, I will bring the issues of drought, pests, TEK practices, the use of synthetic technology and CSA together to assess the issue of food security and insecurity. The

issue of people having access to nutritious and affordable food is a serious and growing problem among most rice growing nations who are mostly also poor (FAO, 2010). This is especially the case in a place such as Thongphiengvilay village, because farmers there grow rice not just for profit but also to live from all year round as rice is their staple food. Therefore, if rice growing is impacted, then food insecurity is a major threat that is not easily solved. To discuss this issue, I will link to the discussion on TEK and synthetic technology practices by drawing on my findings and case studies examples from Cambodia. Ultimately, I will argue that CSA interventions are needed in Thongphiengvilay village to address food insecurity and aid the ongoing issue of drought caused by climate change.

6.2. Drought and Flooding in Thongphiengvilay village

Drought was the most cited issue that arose during fieldwork. Every farmer I talked to discussed with me that it was a very hot and dry season this year (2019) and that this seemed to be worse than other years and was definitely getting worse each season. The occurrence of drought is also a common issue globally as the effects of climate change increase around the world (Field et al., 2014; IPCC, 2001). Cheng (2016) also notes the serious situation in Cambodian rice farming communities, a neighboring country of Laos, regarding the effects of drought. In her thesis, Cheng explains that for rice farming to continue in the wake of increasing drought, irrigation is needed. However, Cheng points out that this is a prohibitive cost for most farmers. This is a very similar situation to that of Thongphiengvilay village as respondents mentioned that irrigating their paddy fields would be too expensive.

Drought poses a serious problem then. As Redfern et al (2012) argue, in the Philippines, the yield of rice crops dropped as much as 15 per cent for each degree Celsius increase in temperature. These temperature changes are predicted to get much worse. As discussed in the literature review of this thesis, Redfern et al (2012) have modelled what increased drought will do to countries similar to Laos in climate and geography, namely Indonesia, the Philippines, Thailand and Vietnam. In fact, these countries are expected to experience a fall in rice yield of approximately 50 per cent, and up to 75 per cent, if nothing is done to mitigate the situation.

The increase of drought discussed by the farmers I interviewed also resonated with Boulidam (2012) who conducted research in Laos. Boulidam (2012) contends that rice farming specifically will be greatly impacted by the increases in drought as rice crops need a lot of water. Boulidam (2012) also based his findings on the presence of drought already being visible in the southern provinces of Laos, especially, Savannakhet. A common issue that drought causes to the actual rice crop is in the ways it damages the flowering stage of the crop and affects the photosynthetic process of growing rice crops (Korres et al., 2017). This is also what the farmers I interviewed mentioned, as discussed in the previous chapter.

As stated in chapter two, Alam (2015) investigated the effects of drought on rice growing communities in Bangladesh. Alam (2015) posits that water scarcity is a basic unmet need that will severely affect people's ability to cultivate rice. Based on his own fieldwork in the Rajshahi District, Alam (2015) says the increase in extreme climate events will make rice farming almost impossible (Alam, 2015). Alam (2015) pointed to how flooding was a large issue for people in the Rajshahi District as it destroyed crops. However, in my fieldwork most participants were less concerned about flooding and more worried about drought. This is illustrated by the fact that during the interviews, none of the participants mentioned flooding as the major climate change issues in the village.

Many empirical studies in Southeast Asia show that drought is indeed a significant and increasing issue for rice growing regions in two main ways. Firstly, the water-hungry rice plants are very susceptible to the effects of droughts; this can create an extremely difficult situation whereby farmers' ability to cultivate rice for profit is threatened as well as their ability to have enough rice to eat for the year. Secondly, these rice growing regions tend to be poor, and therefore, farmers cannot afford expensive adaptation strategies such as irrigation (Cheng, 2016). Therefore, I argue CSA could be a very helpful set of tools for helping to mitigate the effects of increased droughts in Thongphiengvilay village. As mentioned, in contrast to the literature, I reviewed in Chapter 2, the farmers I interviewed did not see flooding as an issue. This is partly because there was no rain for a very long period of time which

made the rice plantation in Thongphiengvilay village very dry. Hence, I contend that it is important to be aware of local needs and gather empirical evidence to figure out what kind of support CSA models can provide for adaptation.

To this end, CSA potentially has the ability to curb the effects of drought in Thongphiengvilay village. In conjunction with the International Rice Research Institute (IRRI), a CSA pilot was undertaken in Rohal Suong in Battambang Province, Cambodia which, as argued, is comparable to Laos in terms of rice growing and economics situation (Ferrer et al., 2018). In 2017, some Cambodian farmers were asked to trial 'climate tolerated rice varieties' (Ferrer et al., 2018). These seeds were called CAR15.

Also involved was the Cambodian Agricultural Research and Development Institute (CARDI) who helped carry out the trial (Ferrer et al., 2018). Overall, the farmers who took part said the new seeds appeared to be effective against drought. Consequently, CSA pilot schemes like this may help rice farmers in Thongphiengvilay village. I reason this because every farmer I spoke to said drought was the most pressing issue. They explained how they had never before the 2019 season seen such low rainfall. They mentioned even when rain did occur it was too late and often the seeds they sowed had already been eaten by birds as they failed to germinate. So, if drought resistance seeds were to be used and trialed in Thongphiengvilay village, then hopefully seeds would germinate before the birds can eat them.

What was also piloted in Rohal Suong was the CSA practice of rainwater harvesting (Ferrer et al., 2018). This seemed less successful because of the certain conditions in Rohal Suong village and the uncertainty of rain. However, this may be potentially useful for Thongphiengvilay village as the rainy season was still very wet and when I was there I saw how the geography was conducive for holding rain water. Essentially, the rain harvesting system was carried out by villagers who restored the village ponds. Ponds needed to be dug out and have trees planted around them to support their ability to retain more water. It was found that one pond could serve around 50 farms or families and did help farmers through the dry period (Ferrer et al., 2018).

However, to be helpful for many people, ponds would need to be constructed strategically or else it will be too expensive pumping the water. Reflecting on how these ponds worked during a workshop held in 2017 (Ferrer et al., 2018), farmers also noted that regenerating ponds also helped support aquatic life. This was also a key issue that was raised by participants in my study. For example, some farmers explained that they used aquatic life for their own consumption, but the species that they usually fish have died with the lack of water in the ponds. Therefore, if there were climate smart ponds to be constructed in Thongphiengvilay village then aquatic species could continue as another food source, strengthening food security. Of course, constructing ponds would also be a way of containing water to use during the dry season when there is no rain. However, like in the climate smart village recommendations, ponds would need to be constructed strategically so people did not have to walk far to use them: But as intimated during fieldwork I located large areas near the village that could be potentially dug out as ponds.

6.3. Pests in Thongphiengvilay village

There are many small animals that live in and near rice paddy fields in Laos. Many farmers I interviewed talked about these animals. They mentioned some species that they like to catch and eat, like the aquatic species just mentioned. In contrast, there were also some farmers who mentioned how, for example, stinkbugs, birds, snails and rats are a big problem for farming and considered pests. In general, then farmers were looking for a way to eliminate animals like rats and birds, as the problems that they cause each season has become more intense.

These findings overlap with other research findings on pests in Southeast Asia. For example, Singleton (2003) argues that rats are a big issue in the region as they eat rice crops just before harvesting. Damaging up to 5-10 per cent of rice collected in a season, rats can cause serious harm to family farms. In terms of climate change, this is going to become a bigger issue as a study based in Cambodia Singleton (2003) reviewed, argued that rat populations are going to increase because of warmer weather. Another issue the author pointed to was rats invading store houses in Cambodia where rice was kept. As explained from my findings, Lao farmers also

store their rice so they can have enough to eat over the course of the year. Therefore, this could be an issue for the future of rice farming in Luang Prabang, although this particular issue was not something that concerned the farmers I interviewed.

Three kinds of pests that the farmers I interviewed talked about were birds, stink bugs and grasshoppers. Birds have become an increasing issue because the lack of rain does not allow the rice seed to germinate in time and so the seed stays in the ground and the birds come and eat them. Birds were an interesting finding as the review of the literature I have conducted showed very little mention of birds becoming more of a problem due to climate change. Thus, I think this was an important difference in terms of my findings and current literature. Such a difference may be because birds are not so much of an issue in other countries or because it is a secondary issue. To elaborate, birds only become an issue when the rice seed does not germinate so they are not an issue on its own. These wider repercussions need to be taken into consideration though for projects like climate smart villages to work.

The literature and my findings both discuss the impacts of insects, although grasshoppers were the main issue in Thongphiengvilay village. Grasshoppers are also a main pest for farmers in Pakistan as Karim and Riazuddin (1999) argue. However, they identified over 50 insects that were impacting rice cropping, including stem borers, leaf folders, plant-hoppers, which my farmers did not talk about. However, the farmers of Luang Prabang did talk about snails and there has been much literature on this. As discussed in my literature review, Kiritani (2007) argued that climate change is allowing a proliferation of the Golden Apple Snail (GAS), which is argued to be one of the most damaging pests for rice farming nations (Joshi, 2005). In particular, the Philippines was a country where this snail was so widespread that it damaged the country's economy. Subsequently, US\$ 23 per hectare was spent on synthetic commercial molluscicides.

The farmers I interviewed did not talk about the GAS specifically, as the snails they came across were a Lao native species, but the two kinds of snails are comparable

in terms of prevention or adaptation. For example, one of the CSA initiatives trialed in Cambodia by the Centre for Agriculture and Bioscience International (CABI) was Ecological Engineering (EE) for the control of insects and pests (CCAFS, 2018; Try, Dyna, Ferrer, Yen, Kura, & Sebastian, 2015). EE is way to control pests and insects without the harmful synthetic chemicals in common insecticides and pesticides (Ferrer et al., 2018). EE can also increase the level of biodiversity in rice paddy fields.

In practice, EE involves planting certain flowers or plants that attract pest insects so that the rice crop is left to grow, or certain flowers are grown that attract beneficial insects and these insects will then fight the harmful ones (Ferrer et al., 2018). In the trial, some rice paddy plots used insecticides and pesticides and others used the EE approach and the yields were actually similar, so farmers were willing to use this EE approach as it cost less and provided approximately the same yield (Ferrer et al., 2018). In this trial, in Rohal Suong village, local sunflowers, orange and yellow cosmos flowers were used as these were flowers that would be most useful and available (Ferrer et al., 2018).

For this intervention to work in Laos, some research would need to be done as to what flowers could be most beneficial and easily obtained for farmers. Moreover, a wider report would probably need to be conducted as Rohal Suong village was first assessed of its needs and present situation before it became a climate smart village (CSV) test case (Ferrer et al., 2018). Certainly, the methods and dominance of rice production are comparable in Rohal Suong and Thongphiengvilay villages, as are the general weather patterns. However, in the reports produced from the trialing of CSA methods, the specific pests and insects were not identified, which makes it difficult to compare to the pests the farmers I interviewed talked about. Moreover, as with the studies conducted by Singleton (2003), Kiritani (2007) and Karim and Riazuddin (1999), participants in my study did not mention pests and insect species native to Luang Prabang so the applicability of CSA to Thongphiengvilay village would need to be first assessed.

6.4. TEK and synthetic technologies use in Thongphiengvilay village

Part of assessing whether CSA would be applicable to Laos, and even Thongphiengvilay village becoming a climate smart village, would be to examine the use of insecticides, pesticides, herbicides and synthetic fertiliser and/or the use of local or Traditional Ecological Knowledges by rice farmers. CSA is based on methods that fit with the environment and therefore are more in line with TEK practice than the use of synthetic technologies. The farmers I interviewed, as I explained in the previous chapter, had differing opinions on this matter and practiced both approaches variably.

Some farmers chose to use synthetic technologies to control pests and boost production. Try, Dyna, Ferrer, Yen, Kura, and Sebastian (2015) also noted in their assessment in Cambodia that many farmers opted to use synthetic technologies. The use of these materials was often because farmers in Rohal Suong village were using new rice varieties such as Sen Kra Ob, Sen Pidor, Sar Kra Nhanh, OM, and IR. These seeds provided bigger yields to farmers which is the main reason they bought them from either local dealers, NGOs, or through government schemes. However, these kinds of rice also needed more chemical fertilisers, pesticides and even more water than the regular seeds they used (Try et al., 2015).

Even though these kinds of seeds were not used in Thongphiengvilay village, I think that if they were offered to farmers, some would take them up. I reason this because some farmers said to me that they use synthetic technologies because they get a better yield more quickly, which is what these seed varieties also claim to achieve. Therefore, I think it may be helpful for these farmers to introduce ideas of CSA for the long-term sustainability of rice farming in Thongphiengvilay village. As Try et al., (2015) also point out, even using synthetic fertiliser on organic seeds degrades the soil, which then requires putting more and more fertiliser on each season.

Furthermore, using synthetic fertilisers damages waterways; this is a big issue in poor countries with little environmental regulation (FAO, 2010). Using synthetic fertilisers also contributes to GHG emissions, so directly contributes to the climate change issue (FAO, 2010). As explained in the literature review, these kinds of

practices are set to continue globally unless the current model of growth is addressed. Even though small farmers hardly contribute to this effect, Try et al., (2015) point out that some farmers in Rohal Suong village were and are practicing farming methods that are harmful for their health and the environment. And this was also a finding in my interviews.

However, some farmers I interviewed did use TEK practices that are quite similar to the CSA practices Rohal Suong village trialed. For instance, one farmer I interviewed explained that he hung up rotten crabs and fish so the stinkbugs would gather there rather than eating the rice crops. Rohal Suong village used similar natural methods for creating an organic fertiliser. In particular, villagers experimented with agroforestry (Try et al., 2015). Agroforestry essentially means pairing certain trees with agricultural lands so both tree and land can benefit thereby producing an environmentally healthy, low cost, long-term form of agricultural production (Try et al., 2015).

An actual CSA trial of agroforestry was carried out in Rohal Suong village and this was followed up by an assessment of how it worked out and a summary of what participants did in practice (Ferrer et al., 2018; Try et al., 2015). Firstly, volunteers were selected and then introduced to the idea of agroforestry. Guidelines and mentoring were also available to cope with any issues or misunderstandings. Once the areas and people were chosen certain tree seedlings were ordered and planting began. Trees were planted along farm borders, farmers' houses, community ponds, and in school grounds. It was successful and the concept was also introduced to two neighboring villages (Ferrer et al., 2018; Try et al., 2015).

In terms of a natural fertiliser, the trees provided leaf litter which then composted into the ground to enrich the soil. Trees also began providing shade which kept the rice paddy fields wetter. Some of the trees planted also acted as a barrier for certain pests that eat rice crops. For women and children, some of the trees saved time foraging in far way forests as many of the trees planted grew edible fruits. Overall, these trees improved the soil quality and, thus, reduced the need for synthetic technologies (Ferrer et al., 2018; Try et al., 2015).

Planting trees is also a very helpful way to address the issue of carbon emissions in agriculture, emissions that lead to climate change (Field et al., 2014; IPCC, 2001). In general, farming produces a lot of methane emission, even by simply digging over a plot of land. CSA discusses a way to help reduce these carbon emissions. As introduced in the literature review, 'carbon-sequestration capacity' is way of planting certain species that remove carbon from the atmosphere and store it inside themselves. These mitigation strategies point to how CSA may be helpful in Southeast Asia for climate change adaptation as during fieldwork I realised that in a Lao context mitigation is intricately tied to adaptation and vice versa. Tree planting is one such examples, as it is a method of adapting to hotter climates and increased drought *at the same time as* mitigating carbon emissions.

There were some problems though with the implementation of the tree planting project in Cambodia. For example, some of the trees died because it was too hot. Some trees also required more labor and time than expected, especially when it came to fencing off the trees from farm animals. Therefore, the farmers who took part in the study concluded that more planning was needed in terms of tree types and their suitability (Ferrer et al., 2018; Try et al., 2015). Even though I did not mention 'carbon sequestration' I think planting trees would be good for sequestering carbon along with other activities such as limiting the amount of times soil is dug, which can avoid carbon emissions escaping from the soil (FAO, 2010). This would also save time for farmers.

In conclusion, I think that TEK and CSA methods could be helpful to people in Thongphiengvilay village. My findings correlated with much of what participants mentioned in the trials in Cambodia. Drought was the biggest issue, with flooding less of a problem. Pests were a big issue as well and I think investigating what kind of TEK or CSA methods could work for combating these issues would be helpful. The trials from Cambodia look promising as in there were successful improvements made and I think with the right adaptations even farmers who used synthetic technologies will see the benefit of a blend between Laos TEK practices and CSA methods. A blend of TEK practices and CSA methods seems like the optimal plan as it respects local knowledge and CSA - with its modern methods and resources -

claims it is geared for adapting to local contexts (FAO, 2010). However, I suggest these practices are only going to work if farmers can see immediate benefits such as less cost and less labour.

As I explained in the literature review, Mitin (2009) discusses an autonomous adaptation strategy to climate change that relies on local knowledges, practices and species rather than a top down policy approach and I think this supports a TEK/CSA approach. The lack of government understanding of what needs to happen locally I think calls for this kind of autonomy if long-term useful changes are to be made.

6.5. Food security and insecurity in Thongphiengvilay village with CSA

In this last section, it is important to bring the issues of drought, pests, TEK practices, synthetic technology use and CSA together to discuss food security and insecurity. One thing most rice growing nations have in common is food insecurity issues because of the increase of climate change. Another issue most rice growing nations have in common is that the agricultural situation is not only a matter of profit, but it is about having enough food to eat. Therefore, the issue of climate change and food insecurity is important. Drought, pests and insects are all predicted to get worse with climate change and so farmers are either generally left to choose between a TEK and synthetic technological approach to combat food insecurity (FAO, 2010). However, CSA offers a way to increase yield (a potential lack in TEK methods) and be environmentally beneficial (which synthetic technologies are not).

In poor subsistence environments, farmers have fewer means to cope when things get worse such as the increased occurrences of droughts and pests. The findings of my study illustrate this point. My findings also overlap with the argument put forward by Lucus (2011). He highlights the situation whereby food will become very expensive as climate change events will produce less yield and therefore the market price for food will rise. This is similar to what some of the farmers I interviewed said was already happening. They explained to me that if they do not grow enough rice to feed their family, they have to buy it from a market or another villager. Like Lucus (2011) found talking to Cambodian farmers, some farmers I interviewed were

worried about not being able to feed their family when things like drought occurs and gets worse.

These examples from Laos and Cambodia show what the FAO calls 'yield gaps' (Lowder, et al., 2014). Yield gaps point to the gap between what the actual yields and potential yields are, in poor areas (Lowder, et al., 2014). The purpose of CSA is to attend to these gaps by incorporating ways that help the land produce as much as it is able but in a sustainable way (FAO, 2010). For the food insecurity in Thongphiengvilay village, water seems to be the biggest issue in terms of CSA intervention.

This was also the finding of Cheng (2016) who argued that a lack of water for farmers was the biggest threat to villagers' food security. Chen argued the lack of water for agriculture purposes directly impacted food security. She also found similar cases of this in Bangladesh and China. What Cheng (2016) proposed was irrigation, a process that ensured year-round water for rice crops. However, she pointed to how farmers could not afford irrigation as to gain water from local canals farmers needed to buy a pump which are very expensive. This is unfortunately the same situation in rural Luang Prabang. As one rice farmer said, detailed in the previous chapter, if pumps were purchased to gain reliable water for paddy irrigation, farming would be too expensive.

Consequently, the pilot tested in Rohal Suong village regarding the CSA practice of rainwater harvesting may be of use in Thongphiengvilay village along with tree planting as discussed in this chapter (see also Ferrer et al., 2018; Try et al., 2015). As mentioned, there were issues with CSA rain harvesting but it seems a good option for the rice farmers I interviewed. Given that it is an issue of food security that is set to get worse, I do think some adapted form of rain harvesting is important to trial in Thongphiengvilay village as one way to prevent food insecurity. In Rohal Suong village farmers also trialed a drought resistance rice variety which I think could be trialed in Thongphiengvilay village.

6.6. Limitations

This thesis looked at farmer adaptation to climate change in Laos, which was based in Thongphiengvilay village Nane district, Luang Prabang, Lao PDR. Even though I tried to make my research as thorough and robust as possible in the time I had, there were, inevitably, a number of limitations. Firstly, this research only uses a qualitative methodology. Specifically, I used semi-structured interviews to collect data. This can be limiting as I had a small sample size. My research is limited in terms of practically implementing recommendations, as my recommendations are based on thirteen farmers' opinions only.

I also did not use a more in-depth qualitative approach. For example, if I had had more time, I would have used a more ethnographic methodology, which would have allowed me to get to know my participants better. Using ethnography would have helped me better understand what happened for paddy rice farmers, who are working in the fields every day. I also would have been able to see firsthand some of the practices farmers used, and especially how they applied TEK or synthetic technologies.

Another limitation in my work was that most research participants were male farmers. There were in fact only two female participants out of thirteen. Therefore, the information that I gathered was inescapably from a mostly male perspective. This is a real limitation as most women in Thongphiengvilay village farm alongside their husbands and do similar work to them. However, it is Lao custom that husbands are usually the ones to formally meet, especially if they are meeting a male like myself.

The last central limitation of this project is the lack of up to date climate and census statistics in Laos. It was very difficult throughout this project to find good data on Lao websites about rice productivity, weather patterns, agricultural economics and climate trends. Therefore, it was hard to provide a generalised overview of the climate change situation in Laos and missing or not update to date data is a limitation in this study.

6.7. Recommendations

These limitations point to what kinds of future research would be helpful. Firstly, a more in-depth qualitative project accompanied with quantitative research may help provide a more accurate picture of climate change issues for Laos. I also think in future research maybe a female researcher would be helpful as this may make it easier to interview female farmers.

There are also recommendations for practical implementation that have come out of this research. Broadly, I think Thongphiengvilay village is an ideal candidate for becoming a climate smart village. As explained in this chapter, my findings suggest that drought and pests are a central and growing concern for farmers, and these are precisely the issues that CSA is set up to address. In practical terms, I think digging ponds for harvesting rainwater would be very helpful in Thongphiengvilay village. This would provide irrigation for farmers when it is not raining. I also think trialing drought resistant rice seeds would be helpful for implementation and also an interesting topic and for further research. Planting trees would also be beneficial for adapting to drought whilst mitigating carbon emissions.

Finally, I think encouraging more CSA and TEK practices to encourage crops to grow more abundantly and more sustainably would be very helpful for rice farmers in Thongphiengvilay village. These practices can be taught to the paddy rice farmers by Nane DAFO's technical staff enabled by the head of the village. To elaborate, CSA approaches could be taught to Nane DAFO's technical staff and then the head of the village would then be able to set up a workshop in the village meeting house and then invite DAFO staff to guide farmers on what to do. In this sense this study could help guide the burgeoning application of CSA in Laos.

6.8. Conclusion

This thesis has explored the efficacy of CSA as a means to combat the issues of climate change that rice paddy farmers are facing in a village in Luang Prabang. I visited this village, Thongphiengvilay and interviewed thirteen farmers there and asked them about their paddy rice production. I specifically asked them about the

changing of the weather and what farming is like presently. They said it is becoming more and more difficult because rainfall annually gets smaller each year. In fact, the rainy season is arriving later and later. These claims are consistent with the effects of global climate change (IPCC, 2001; Pachauri et al., 2014).

In considering the literature and my findings I have discussed the usefulness and potential applicability of CSA along with TEK practices that could help farmers cope with the issues they currently face. Specifically, the problems that drought are causing are a big concern for farmers, along with an increase of pests and hotter temperatures. In reviewing case studies of climate smart villages, I therefore suggest that these models could be very useful for Thongphiengvilay given they were trialed in Cambodia, which has a similar climate and culture to that of Laos. In particular, storage ponds for water, planting certain trees and trying drought resistant rice seeds are some of the implementations that have had some success in Cambodia and that I think would help farmers in Thongphiengvilay. Overall, CSA has clear potential to make a real difference in the daily lives of rice paddy farmers in Thongphiengvilay specifically, and in other regions in Laos more broadly. Given the climate change impacts that Laos is facing, urgent action is needed.

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Appendices

Appendix A – Ethic Approval



Phone 0-4-463 6028
Email judith.loveridge@vuw.ac.nz

MEMORANDUM


TO	Longlao Nyianu
FROM	Dr Judith Loveridge, Convenor, Human Ethics Committee
DATE	27 May 2019
PAGES	1
SUBJECT	Ethics Approval Number: 0000027374 Title: Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) Play in paddy Rice Production in Luang Prabang Province, Laos?

Thank you for your application for ethical approval, which has now been considered by the Human Ethics Committee.

Your application has been approved from the above date and this approval is valid for three years. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Kind regards,



Judith Loveridge
Convenor, Victoria University of Wellington Human Ethics Committee

Appendix B – Support Recommendation Letter from Supervisor



School of Geography, Environment and Earth Sciences
Victoria University of Wellington,
Wellington 6012 New Zealand
Email: wokje.abrahamse@vuw.ac.nz
Phone: +64-4-463 5217

04 April 2019

To Whom It May Concern

I am writing this letter as the supervisor of Longlao Nyianu to support him in collecting data for his master's thesis in Environmental Studies.

Longlao was awarded New Zealand ASEAN Scholarship to study a Master of Environmental Studies at School of Geography, Environment and Earth Sciences, Victoria University of Wellington, New Zealand. In order to complete his degree, he needs to conduct research and write a thesis based on the field work in his home country during 2019.

Longlao proposes to conduct research on "Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang province, Laos?" His field research will be conducted from 03 June 2019 to 15 August 2019.

During his field work, I would be most grateful if you could assist him in providing relevant information and any other support to complete this research.

If you require any further information, please contact me on +64-4-463 5217 or by email at: wokje.abrahamse@vuw.ac.nz

Yours sincerely,

A handwritten signature in black ink, appearing to be 'Wokje Abrahamse', written in a cursive style.

Dr Wokje Abrahamse
Senior lecturer in Environmental Studies
School of Geography, Environment and Earth Sciences
Victoria University of Wellington, New Zealand



Information sheet – Paddy Rice Farmers Interviews

Research title: Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang Province, Laos?

Researcher: Longlao Nyianu

Supervisor: Dr Wokje Abrahamse

Sabaidee and thank you for your interest in this research project. Please read the information below to gain a better understanding of the project. After reading this paper, please feel free to decide whether you would like to participate in this project or not. If you decide to participate, thank you so much for your time and contribution. If you decide not to participate, thank you for your consideration of my request and I wish you all the best with your studies or work.

Who am I?

My name is Longlao Nyianu, and I am a Masters student in Environmental Studies at Victoria University of Wellington, New Zealand. As part of the university's requirements for the completion of my studies, I am doing a research project titled: "*Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang province, Laos?*".

What is the aim of this project?

This project aims to explore what role Climate-Smart Agriculture (CSA) might play in helping rice farmers in adapting to climate change in Luang Prabang, a northern province of Laos. Also, this project will further investigate what are some of the ways CSA might help subsistence rice production for farmers and farmers' profitability in Luang Prabang.

This research has been approved by the Victoria University of Wellington Human Ethics Committee. (Ethic application number: 0000027374).

How will I proceed?

If you agree to participate, I will invite you for face-to-face interview. The interview will take between 30 to 90 minutes. You will be asked about general issues regarding your livelihood, climate change impacts on paddy rice production and how do you adapt to climate change.

The time and location for interview totally depend on your decision. You can feel free to choose when and where you feel most comfortable to talk. However, please note that a safe and uninterrupted place is highly desired given that confidentiality of the interviewee needs to be guaranteed. You can feel free to invite anyone who you think his or her accompany will make you feel relaxed and confident to talk in the interview. However, that person will also need to keep confidentiality of the interview. With your permission, I will make audio recordings and take notes of our discussions. You can stop the interview at any time or refuse to answer any question without giving a reason.

What will happen after the interview?

Your information will be confidential. All the records and notes from the discussions will be kept securely. I will transcribe and analyse the information. Only my supervisor and I will read the notes or transcripts of the interview.

Your name and other identifiable information will not be mentioned in any reports because I have made up a name for you and use different name instead of your real name. Therefore, this will not have any impact on you. The interview transcripts, summaries, and recordings will be kept securely and destroyed after five years since the end of the research.

What will the project produce?

The final report (thesis) of this project will be published and held at Victoria University of Wellington library. I may also use the results of my research for conference presentations and academic reports. I will take care of your information and not identify you in any presentation or report.

What if you would like to withdraw from taking part of the project?

You can withdraw from the research up to four weeks after the interview. If you withdraw, the information you provided will be destroyed or returned to you.

If you accept this invitation, what are your rights as a research participant?

You do not have to accept this invitation if you don't want to. If you decide to participate, you have the right to:

- choose not to answer any question;
- ask for the recorder to be turned off at any time during the interview;
- withdraw from the study up to four weeks after your interview;
- ask any questions about the study at any time;
- receive a copy of your interview recording (if it is recorded);
- read over and make comments on a written summary of your interview;
- agree on another name for me to use rather than your real name;
- be able to read any reports of this research by emailing the researcher to request a copy.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact either:

Student:

Name: Longlao Nyianu
Course: Master of Environmental Studies
School: School of Geography, Environment, and Earth Sciences
Phone: +856 30 5013315 (Laos)
+64 0224761153 (New Zealand)
Email: nyianulong@myvuw.ac.nz

Supervisor:

Name: Dr Wokje Abrahamse
Role: Course coordinator and senior lecturer of Environmental Studies
School: School of Geography, Environment, and Earth Sciences
Phone: +64-4-463 5217
Email: wokje.abrahamse@vuw.ac.nz

Human Ethics Committee information

If you have any concerns about the ethical conduct of the research you may contact the Victoria University HEC Convenor: Dr. Judith Loveridge. Email: hec@vuw.ac.nz or telephone: +64 4 463 6028.



Participant Consent Form – Interviews with Paddy Rice Farmers

Research title: Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang Province, Laos?

Researcher: Longlao Nyianu

Supervisor: Dr Wokje Abrahamse

I have read the Information Sheet and the project has been explained to me. My questions have been answered to my satisfaction. I understand that I can ask further questions at any time.

By signing below, I acknowledge that:

- My name will not be used in reports and utmost care will be taken not to disclose any information that would identify me.
- I may withdraw from this study up to four weeks after the interview, and any information that I have provided will be returned to me or destroyed;
- The information I have provided will be destroyed five years after the research ends;
- I understand that the findings may be used for a master thesis

Please check where is applied:

- I permit the researcher to make audio recordings.
- I permit the researcher to use my quotes in the research.
- I request a summary of my interview.
- I request to receive a summary of the report via my address below

I, _____, agree and consent to the above statements.

Signature: _____

Date: _____

Position: _____

Institution: _____

Mobile: _____

E-mail/Facebook: _____



Interview Schedule

Research title: Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang Province, Laos?

Researcher: Longlao Nyianu

Supervisor: Dr Wokje Abrahamse

Interview questions for paddy rice farmers

1. How long have you been rice farming?
2. What quantities of rice do you cultivate? Is it for subsistence living or for commercial sale?
3. How well can you make a living out of rice production?
4. What kinds of changes have you noticed in weather in the past few years?
5. What are the common environmental issues (for example climate or pests) that you face as a rice paddy farmer?
6. If you have faced farming difficulties because of the changing weather what action have you taken to address this?
7. Have you applied Traditional Ecological Knowledge for rice production? And if so what aspects have been most helpful?
8. What are your plans for the future that will help secure a livelihood in rice paddy farming?

Appendix F – Request Letter to PAFO



Request Letter to Luang Prabang Provincial Agriculture and Forestry Office – Data Collection with Paddy Rice Farmers

Dear: Head of Luang Prabang Provincial Agriculture and Forestry Office (PAFO)
About: Data collection with paddy rice farmers for the completion of a master's thesis

I am Longlao Nyianu, a Lao student studying a Master of Environmental Studies degree at School of Geography, Environment and Earth Sciences at Victoria University of Wellington, New Zealand (VUW) under New Zealand Scholarship. As part of the University's requirements for the completion of my study, I am doing a research project titled: *"Farmer Adaptation in Laos: What role might climate-smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang province, Laos?"* The data collection process, which has been approved by the University, will be conducted during June to August 2019. Then, the collected data will be used to write a master's thesis, which is expected to finish by February 2020. Details of the research are attached to this request letter.

The data collection will take place at Thongpheingvilay village, Nane district where Local farmers produce rice for subsistence living and for commercial sale. There will be face-to-face interviews and participants observation conducted with Local paddy rice farmers. Their identities, participation and information will be kept confidential.

Therefore, with this letter I hope that your permission will be given as it is very necessary for the completion of my data collection process for the research.

Luang Prabang, 25/05/2019

Applicant's signature and full name

A handwritten signature in black ink, appearing to be 'Longlao Nyianu', written in a cursive style.

Longlao Nyianu

Attached documents:

- Support letter from Victoria University of Wellington, New Zealand (Lao and English versions)
- A summary of research proposal (Lao version)
- Full research proposal (English version)

Appendix G – Request Letter to Nane DAFO



Request Letter to Nane District Agriculture and Forestry Office – Data Collection with Paddy Rice Farmers

Dear: Head of Nane District Agriculture and Forestry Office (DAFO)
About: Data collection with local paddy rice farmers for the completion of a master's thesis

I am Longlao Nyianu, a Lao student studying a Master of Environmental Studies degree at School of Geography, Environment and Earth Sciences at Victoria University of Wellington, New Zealand under New Zealand Scholarship. As part of the University's requirements for the completion of my study, I am doing a research project titled: *"Farmer Adaptation in Laos: What role might climate-smart agriculture (CSA) play in Paddy Rice Production in Luang Prabang province, Laos?"* The data collection process, which has been approved by the University and Luang Prabang Provincial Agriculture and Forestry Office (PAFO), will be conducted during June to August 2019. Then, the collected data will be used to write a master's thesis, which is expected to finish by February 2020. Details of the research are attached to this request letter.

The data collection will take place at Thongpheingvilay village, Nane district where local farmers produce rice for subsistence living and for commercial sale. There will be face-to-face interviews and participants observation conducted with local paddy rice farmers. Their identities, participation and information will be kept confidential. Upon your approval of this request letter, the participation of the villagers and any of your staff members in this study will not lead to any losses or disadvantages of their rights and employment in any way.

For the purpose of sample selection, I would like to have your cooperation as follows:

- 1). Directing me to Thongpheingvilay village where local paddy rice farmers cultivate rice for subsistence living and commercial sale
- 2). Introducing me to village heads;
- 3). Providing me with a list of paddy rice farmer in order to facilitate my sample selection process.

Therefore, with this letter I hope that your permission will be given as it is very necessary for the completion of my data collection process for the research.

Luang Prabang, 25/05/2019
Applicant's signature and full name

A handwritten signature in black ink, appearing to read 'Longlao Nyianu'.

Longlao Nyianu

Attached documents:

- Support letter from Victoria University of Wellington, New Zealand (Lao and English versions)
- A summary of research proposal (Lao version)
- Full research proposal (English version)

Appendix H – Request Letter to Village Head



Request Letter to Village Head – Data Collection with paddy rice farmers

Dear: Head of Thongphiengvilay village, Nane district, Luang Prabang province

About: Data collection with paddy rice farmer for the completion of a master's thesis

I am Longlao nyianu, a Lao student studying a Master of Environmental Studies degree at School of Geography, Environment and Earth Sciences at Victoria University of Wellington, New Zealand under New Zealand Scholarship. As part of the University's requirements for the completion of my study, I am doing a research project titled: *"Farmer Adaptation in Laos: What role might Climate-Smart Agriculture (CSA) play in Paddy Rice Production in Luang Prabang Province, Laos?"*. The data collection process, which has been approved by the University, Luang Prabang Provincial Agriculture and Forestry Office (PAFO) and Nane District Agriculture and Forestry Office (DAFO), will be conducted during June to August 2019. Then the collected data will be used to write a master's thesis, which is expected to be finished by February 2020. Details of the research are attached to this request letter.

The data collection will consist of face-to-face interviews and participants observation conducted with Local paddy rice farmers. Their identities, participation and information will be kept confidential. Upon your approval of this request letter, participation of the villagers in this study will not lead to any losses or disadvantages of their normal rights as a villager in any way.

Therefore, with this letter I hope that your permission will be given as it is very necessary for the completion of my data collection process for the research.

Luang Prabang, 25/05/2019

Applicant's signature and full name

A handwritten signature in black ink, appearing to be 'Longlao Nyianu', written in a cursive style.

Longlao Nyianu

Attached documents:

- Support letter from Victoria University of Wellington, New Zealand (Lao and English versions)
- A summary of research proposal (Lao version)
- Full research proposal (English version)
- Research permission letter from Provincial Agriculture and Forestry Office (PAFO)
- Research permission letter from District Agriculture and Forestry Office (DAFO)

Appendix I – NAFC Request Letter to PAFO



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງກະສິກໍາ ແລະ ປ່າໄມ້
ກົມຈັດຕັ້ງ ແລະ ພະນັກງານ
ວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ

ເລກທີ 1462/ວກປໜ
ລົງວັນທີ 11-06-2019

ໜັງສືສະເໜີ

ຮຽນ: ທ່ານຫົວໜ້າພະແນກກະສິກໍາ ແລະ ປ່າໄມ້ ແຂວງຫຼວງພະບາງ ທີ່ນັບຖື

ເລື່ອງ: ຂໍອະນຸຍາດໃຫ້ພະນັກງານວິທະຍາໄລລົງເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທ

- **ອີງຕາມ :** ການສະເໜີຂອງຜູ້ກ່ຽວ ແລະ ການອະນຸມັດຂອງຄູຊື້ນຳການຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທກ່ຽວກັບການອະນຸຍາດໃຫ້ລົງເກັບກຳຂໍ້ມູນປະກອບໃສ່ບົດຈົບຊັ້ນ, ລົງວັນທີ 04 ເດືອນ 04 ປີ 2019
- **ອີງຕາມ :** ການຕົກລົງເຫັນດີຂອງຄະນະກາມະການຈັນຍາບັນມະນຸດຂອງມະຫາວິທະຍາໄລ Victoria University of Wellington, New Zealand, ລົງວັນທີ 27 ເດືອນ 05 ປີ 2019

ອຳນວຍການວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຂໍຖືເປັນກຽດຮຽນໃຫ້ທ່ານຊາບວ່າ: ທ. ລົງເລີ້າ ເຍຍນຸ່, ເປັນພະນັກງານສັງກັດຢູ່ທີ່ຫ້ອງການພົວພັນ ແລະ ການຮ່ວມມື ຂອງວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຊຶ່ງປະຈຸບັນເປັນນັກສຶກສາລະດັບປະລິນຍາໂທທີ່ມະຫາວິທະຍາໄລ Victoria University of Wellington ປະເທດ New Zealand. ປະຈຸບັນຜູ້ກ່ຽວໄດ້ຮັບອານຸຍາດຈາກຄູຊື້ນຳບົດ ແລະ ຄະນະກາມະການຈັນຍາບັນມະນຸດ ເພື່ອກັບມາເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທດ້ານການສຶກສາສິ່ງແວດລ້ອມ.

ດັ່ງນັ້ນ, ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານ ເພື່ອອະນຸຍາດໃຫ້ຜູ້ກ່ຽວໄດ້ລົງເກັບກຳຂໍ້ມູນໃນການຂຽນບົດຂອງຜູ້ກ່ຽວ ດ້ວຍ.

ດ້ວຍຄວາມເຄົາລົບ ແລະ ນັບຖືຢ່າງສູງ.

ອຳນວຍການວິທະຍາໄລ

ທ. ທອງຄະນຸດ ພູມມະສອນ



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງກະສິກໍາ ແລະ ປ່າໄມ້
ກົມຈັດຕັ້ງ ແລະ ພະນັກງານ
ວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ

ເລກທີ...../ວກປໜ 1462
ລົງວັນທີ 11-06-2019

ໜັງສືສະເໜີ

ຮຽນ: ທ່ານຫົວໜ້າຫ້ອງການກະສິກໍາ ແລະ ປ່າໄມ້ ເມືອງນານ ທີ່ນັບຖື

ເລື່ອງ: ຂໍອະນຸຍາດໃຫ້ພະນັກງານວິທະຍາໄລລົງເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທ

- **ອົງຕາມ :** ການສະເໜີຂອງຜູ້ກ່ຽວ ແລະ ການອະນຸມັດຂອງຄູຊີ້ນຳການຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທກ່ຽວກັບການອະນຸຍາດໃຫ້ລົງເກັບກຳຂໍ້ມູນປະກອບໃສ່ບົດຈົບຊັ້ນ, ລົງວັນທີ 04 ເດືອນ 04 ປີ 2019
- **ອົງຕາມ :** ການຕົກລົງເຫັນດີຂອງຄະນະການຈັນຍາບັນມະນຸດຂອງມະຫາວິທະຍາໄລ Victoria University of Wellington, New Zealand, ລົງວັນທີ 27 ເດືອນ 05 ປີ 2019

ອຳນວຍການວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຂໍຖືເປັນກຽດຮຽນໃຫ້ທ່ານຊາບວ່າ: ທ. ລົງເລົ່າ ເຍຍນຸ່, ເປັນພະນັກງານສັງກັດຢູ່ທີ່ຫ້ອງການພົວພັນ ແລະ ການຮ່ວມມື ຂອງວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຊຶ່ງປະຈຸບັນເປັນນັກສຶກສາລະດັບປະລິນຍາໂທທີ່ມະຫາວິທະຍາໄລ Victoria University of Wellington ປະເທດ New Zealand. ປະຈຸບັນຜູ້ກ່ຽວໄດ້ຮັບອະນຸຍາດຈາກຄູຊີ້ນຳບົດ ແລະ ຄະນະການຈັນຍາບັນມະນຸດ ເພື່ອກັບມາເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທດ້ານການສຶກສາສິ່ງແວດລ້ອມ.

ດັ່ງນັ້ນ, ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານ ເພື່ອອະນຸຍາດໃຫ້ຜູ້ກ່ຽວໄດ້ລົງເກັບກຳຂໍ້ມູນໃນການຂຽນບົດຂອງຜູ້ກ່ຽວດ້ວຍ.

ດ້ວຍຄວາມເຄົາລົບ ແລະ ນັບຖືຢ່າງສູງ.

ອຳນວຍການວິທະຍາໄລ



ທ່ານ ທອງສະມຸດ ພູມມະສອນ

Appendix K – NAFC Request Letter to Village Head



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງກະສິກໍາ ແລະ ປ່າໄມ້
ກົມຈັດຕັ້ງ ແລະ ພະນັກງານ
ວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ

ເລກທີ...../ວກປໜ
ລົງວັນທີ.....
1462
11-06-2019

ໜັງສືສະເໜີ

ຮຽນ: ທ່ານນາຍບ້ານ ບ້ານທົ່ງພຽງວິໄລ, ເມືອງນານ, ແຂວງຫຼວງພະບາງ ທີ່ນັບຖື

ເລື່ອງ: ຂໍອະນຸຍາດໃຫ້ພະນັກງານວິທະຍາໄລລົງເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທ

- **ອີງຕາມ :** ການສະເໜີຂອງຜູ້ກ່ຽວ ແລະ ການອະນຸມັດຂອງຄູຊື້ນຳການຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທກ່ຽວກັບການອະນຸຍາດໃຫ້ລົງເກັບກຳຂໍ້ມູນປະກອບໃສ່ບົດຈົບຊັ້ນ, ລົງວັນທີ 04 ເດືອນ 04 ປີ 2019
- **ອີງຕາມ :** ການຕົກລົງເຫັນດີຂອງຄະນະກາມະການຈັນຍາບັນມະນຸດຂອງມະຫາວິທະຍາໄລ Victoria University of Wellington, New Zealand, ລົງວັນທີ 27 ເດືອນ 05 ປີ 2019

ອຳນວຍການວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຂໍຖືເປັນກຽດຮຽນໃຫ້ທ່ານຊາບວ່າ: ທ. ລົງເລົ່າ ເຍຍນຸ່, ເປັນພະນັກງານສັງກັດຢູ່ທີ່ຫ້ອງການພົວພັນ ແລະ ການຮ່ວມມື ຂອງວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຊຶ່ງປະຈຸບັນເປັນນັກສຶກສາລະດັບປະລິນຍາໂທທີ່ມະຫາວິທະຍາໄລ Victoria University of Wellington ປະເທດ New Zealand. ປະຈຸບັນຜູ້ກ່ຽວໄດ້ຮັບອະນຸຍາດຈາກຄູຊື້ນຳບົດ ແລະ ຄະນະກາມະການຈັນຍາບັນມະນຸດ ເພື່ອກັບມາເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທດ້ານການສຶກສາສິ່ງແວດລ້ອມ.

ດັ່ງນັ້ນ, ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານ ເພື່ອອະນຸຍາດໃຫ້ຜູ້ກ່ຽວໄດ້ລົງເກັບກຳຂໍ້ມູນໃນການຂຽນບົດຂອງຜູ້ກ່ຽວ ດ້ວຍ.

ດ້ວຍຄວາມເຄົາລົບ ແລະ ນັບຖືຢ່າງສູງ.

ອຳນວຍການວິທະຍາໄລ



ທ່ານ ທອງສະມຸດ ພູມມະສອນ



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງກະສິກໍາ ແລະ ປ່າໄມ້
ກົມຈັດຕັ້ງ ແລະ ພະນັກງານ
ວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ

ເລກທີ...1462.../ວກປໜ
ລົງວັນທີ...11-06-2019

ໜັງສືສະເໜີ

ຮຽນ: ທ່ານຫົວໜ້າພະແນກຊັບພະຍາກອນທຳມະຊາດ ແລະ ສິ່ງແວດລ້ອມ ແຂວງຫຼວງພະບາງ ທີ່ນັບຖື
ເລື່ອງ: ຂໍອະນຸຍາດໃຫ້ພະນັກງານວິທະຍາໄລລົງເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທ

- **ອົງຕາມ :** ການສະເໜີຂອງຜູ້ກ່ຽວ ແລະ ການອະນຸມັດຂອງຄູຊີ້ນຳການຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທກ່ຽວກັບການອະນຸຍາດໃຫ້ລົງເກັບກຳຂໍ້ມູນປະກອບໃສ່ບົດຈົບຊັ້ນ, ລົງວັນທີ 04 ເດືອນ 04 ປີ 2019
- **ອົງຕາມ :** ການຕົກລົງເຫັນດີຂອງຄະນະກາມະການຈັນຍາບັນມະນຸດຂອງມະຫາວິທະຍາໄລ Victoria University of Wellington, New Zealand, ລົງວັນທີ 27 ເດືອນ 05 ປີ 2019

ອຳນວຍການວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຂໍຖືເປັນກຽດຮຽນໃຫ້ທ່ານຊາບວ່າ: ທ. ລົງເລົ່າເຍຍນຸ່, ເປັນພະນັກງານສັງກັດຢູ່ທີ່ຫ້ອງການພົວພັນ ແລະ ການຮ່ວມມື ຂອງວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຊຶ່ງປະຈຸບັນເປັນນັກສຶກສາລະດັບປະລິນຍາໂທທີ່ມະຫາວິທະຍາໄລ Victoria University of Wellington ປະເທດ New Zealand. ປະຈຸບັນຜູ້ກ່ຽວໄດ້ຮັບອານຸຍາດຈາກຄູຊີ້ນຳບົດ ແລະ ຄະນະກາມະການຈັນຍາບັນມະນຸດເພື່ອກັບມາເກັບກຳຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທດ້ານການສຶກສາສິ່ງແວດລ້ອມ.

ດັ່ງນັ້ນ, ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານ ເພື່ອອະນຸຍາດໃຫ້ຜູ້ກ່ຽວໄດ້ລົງເກັບກຳຂໍ້ມູນໃນການຂຽນບົດຂອງຜູ້ກ່ຽວດ້ວຍ.

ດ້ວຍຄວາມເຄົາລົບ ແລະ ນັບຖືຢ່າງສູງ.

ອຳນວຍການວິທະຍາໄລ



ທ. ທອງສະມຸດ ພູມມະສອນ

Appendix M – NAFC Request Letter to Nane NREO



ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງກະສິກໍາ ແລະ ປ່າໄມ້
ກົມຈັດຕັ້ງ ແລະ ພະນັກງານ
ວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ

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ລົງວັນທີ..... 11-06-2019

ໜັງສືສະເໜີ

ຮຽນ: ທ່ານຫົວໜ້າຫ້ອງການຊັບພະຍາກອນທໍາມະຊາດ ແລະ ສິ່ງແວດລ້ອມ ເມືອງນານ ທີ່ນັບຖື
ເລື່ອງ: ຂໍອະນຸຍາດໃຫ້ພະນັກງານວິທະຍາໄລລົງເກັບກໍາຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທ

- **ອີງຕາມ :** ການສະເໜີຂອງຜູ້ກ່ຽວ ແລະ ການອະນຸມັດຂອງຄູຊີນໍາການຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທກ່ຽວກັບການອະນຸຍາດໃຫ້ລົງເກັບກໍາຂໍ້ມູນປະກອບໃສ່ບົດຈົບຊັ້ນ, ລົງວັນທີ 04 ເດືອນ 04 ປີ 2019
- **ອີງຕາມ :** ການຕົກລົງເຫັນດີຂອງຄະນະການຈັນຍາບັນມະນຸດຂອງມະຫາວິທະຍາໄລ Victoria University of Wellington, New Zealand, ລົງວັນທີ 27 ເດືອນ 05 ປີ 2019

ອໍານວຍການວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຂໍຖືເປັນກຽດຮຽນໃຫ້ທ່ານຊາບວ່າ: ທ. ລົງເລົ່າ ເຍຍນຸ່, ເປັນພະນັກງານສັງກັດຢູ່ທີ່ຫ້ອງການພົວພັນ ແລະ ການຮ່ວມມື ຂອງວິທະຍາໄລກະສິກໍາ ແລະ ປ່າໄມ້ ພາກເໜືອ ຊຶ່ງປະຈຸບັນເປັນນັກສຶກສາລະດັບປະລິນຍາໂທທີ່ມະຫາວິທະຍາໄລ Victoria University of Wellington ປະເທດ New Zealand. ປະຈຸບັນຜູ້ກ່ຽວໄດ້ຮັບອານຸຍາດຈາກຄູຊີນໍາບົດ ແລະ ຄະນະການຈັນຍາບັນມະນຸດ ເພື່ອກັບມາເກັບກໍາຂໍ້ມູນເພື່ອປະກອບຂຽນບົດຈົບຊັ້ນປະລິນຍາໂທດ້ານການສຶກສາສິ່ງແວດລ້ອມ.

ດັ່ງນັ້ນ, ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານ ເພື່ອອະນຸຍາດໃຫ້ຜູ້ກ່ຽວໄດ້ລົງເກັບກໍາຂໍ້ມູນໃນການຂຽນບົດຂອງຜູ້ກ່ຽວດ້ວຍ.

ດ້ວຍຄວາມເຄົາລົບ ແລະ ນັບຖືຢ່າງສູງ.

ອໍານວຍການວິທະຍາໄລ



ທ. ທອງສະມຸດ ພູມມະສອນ