School of Geography, Environment, and Earth Sciences
Victoria University of Wellington
New Zealand

Examining the Xayabouly dam: Impacts of hydropower dam construction on downstream communities

Yia Yang

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Abstract

Hydropower power dam development is a booming industry in Laos and it has the potential to tackle poverty in an environmentally sustainable way. However, currently there is a lack of research that thoroughly analyses the negative impacts of a hydropower dam's construction phase. This research explores some of these negative impacts of hydropower dam construction on downstream villagers by using the Xayabouly hydropower dam on the Mekong River as a case study. Understanding the impacts of the construction phase is vital in forming policy and developing effective strategies to mitigate future negative impacts from dam construction.

This thesis employs a qualitative approach and semi-structured interviews were conducted with downstream villagers about these negative impacts. This research is based on a pragmatist epistemology and employs the matrix conceptual framework to guide this thesis. The results from this study show that the Xayabouly hydropower dam's construction phase has many negative impacts on downstream villagers' daily lives. For example, the construction phase has caused irregular flooding, which has destroyed downstream villagers' agricultural gardens and riverbank erosion has also occurred. Moreover, the results from this thesis show that the construction phase of this dam significantly reduced villagers' income and nutrition consumption. The construction phase also created significant problems with regards to daily commuting and damaged fishing gear. These results offer important recommendations and implications, which have the potential to inform government policy in the future and to help develop strategies to mitigate the social and economic impacts from future hydropower dam construction in Laos.

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Yia Yang
Master's degree in Environmental Studies
Victoria University of Wellington
New Zealand

Acronyms

EDL	Electricité du Laos
FDI	Foreign direct investment
GDP	Gross domestic product
GoL	Government of Laos
IDAM	Integrative Dam Assessment Model
IRR	Impoverishment Risks and Reconstruction
MDG	Millennium Development Goals
MoUs	Memorandum of Understanding
MTOE	Million Tons of Oil Equivalent
MW	Megawatts
NGPES	National Growth and Poverty Eradication Strategy
NSEDP	National Socio-Economic Development Plan
PAC	Portland Cement Association
RF	Relocation Framework
SL	Sustainable Livelihoods Framework
USD	United States Dollar

Table of Contents

List of Figures and Tables

Chapter 1 Introduction

1.1 Research background

Since the 1960s, the Mekong River and its tributaries (the Lower Mekong Basin) have been identified as a valuable source of hydroelectricity generation (Mekong River Commission, 2017). With its vast, complex network of water bodies, it is estimated that the Lower Mekong Basin has the potential to generate 30,000 megawatts (MW) of electricity for the Southeast Asian region (Mekong River Commission, 2017). Owing to an increase in energy demand because of intensified economic development, some countries in this Mekong Basin territory (Thailand and Vietnam) have exhausted most of their hydropower dam potential. Therefore, Laos is in a position to export hydropower to these neighbouring countries because of its natural capacity for hydropower operation (Mekong River Commission, 2017). Hydropower then, has the potential to address poverty eradication in Laos in an environmentally sustainable way (Bartlett et al., 2012; Geheb et al., 2015; Grumbine and Phonekeo, 2014).

The exploration of hydropower resource development in Laos began in the 1990s, ostensibly a 'golden age' for Laos' hydropower ambitions (International Rivers, 2008). During this period, the Government of Laos (GoL) signed a Memorandum of Understanding (MoU) with the Thai and the Vietnamese government to export a total 5,000 MW. This led to a rush of hydro-development in order to seize this export opportunity (Mekong River Commission, 2017). From 1990 to 1995, about twenty-three MoUs had been signed with Korean, Australian, European and North American corporations to build 6,676 MW of new hydropower capacity (International Rivers, 2008). These MoUs went ahead despite the fact that existing hydropower projects in Laos had already created "a legacy of uncompensated losses and unmitigated impacts. Poor planning and implementation, combined with a lack of capacity and will on the part of the Lao government and dam developers, have meant that dams have exacerbated poverty amongst affected villagers" (International Rivers, 2008, p. 11). This quote demonstrates the enormity of loss that occurs for affected villagers as a result of the development of hydroelectric power in Laos. Villagers often end up poorer with the advent of such projects and can lose their land, house and farm.

Unmitigated floods also often cause livestock losses from flood related diseases. Nevertheless, the GoL still believes that the development of hydroelectric power is the best way to achieve sustainable social and economic development in Laos (International Rivers, 2008).

In fact, according to the Lao government's economic transformation during the five years of the 6th National Socio-Economic Development Plan (NSEDP) (2006 - 2010), a key contributor to economic growth was an increase of foreign direct investment (FDI), particularly in hydropower development (Creak, 2011). Thus, hydroelectric development has played a key role in the recent economic boom in Laos, contributing more than 7 % of Gross Domestic Product (GDP) growth per annum (Lintner, 2008). Given this success, based on the approval of the National Assembly of the 7th NSEDP (2011-2015), the GoL intends to continue exploiting these opportunities (Creak, 2011). The government in Laos considers the exploitation of hydroelectric development as a key to reducing poverty, which is a vital component for fulfilling the Millennium Development Goals (MDG) (Jönsson, 2009). Hence, in promoting economic and social development and overcoming the country's comparative disadvantages, hydroelectric development has become a national strategy, which aims to create an affordable, reliable and sustainable electricity supply (Jusi, 2011). In doing so, the GoL has set up a goal to expand the generation, transmission, distribution and off-grid development of hydropower to increase the national electrification ratio for the country to a target of above 90 % by 2020 (Jusi, 2011).

In accordance with this ambition, on 31 July 2019, the GoL officially notified the Mekong River Commission Secretariat of its intention to undertake the formal process of Prior Consultation on Luang Prabang Hydropower project, the third largest hydropower dam on the Mekong River in Laos. Despite large dams being promoted as an important means of boosting economic growth (Smits, 2012), the World Commission on Dams (2000) reports point out that while there have been "substantial benefits" from hydropower development, "in too many cases an unacceptable and often unnecessary price has been paid to secure those benefits especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment" (World Commission on Dams, 2000, p. xxviii). Furthermore, the report states that "lack of equity in the distribution of benefits has called into question the value of many dams in meeting water and energy development needs when compared with the alternatives" (World Commission on Dams, 2000, p. xxviii). The findings of this report highlights how hydropower development does not always boost economic growth for many of the people affected by dam construction. Furthermore, this report underscores the major social and environmental impacts experienced by people affected by dam projects. Insightfully, the World Commission on Dams report makes the point that any benefits from dam construction do not go to the people who need it the most.

Furthermore, although the GoL refers to hydroelectricity as renewable and therefore a 'green' or sustainable form of energy (Mekong River Commission, 2017), there is some criticism of this notion. For example, according to a report by the United Nations: "with these hydropower projects, villages disappeared under the reservoir - and tens of thousands more living downstream have been affected. Not everyone considers these exports sustainable without thorough environmental assessment as well as sufficient resettlement and adaptation support" (United Nations Conference on Trade and Development, 2011, p. 1).

The Lower Mekong Basin countries (Laos, Thailand, Cambodia and Vietnam) are members of the Mekong River Commission. This commission which grew out of the 1995 Mekong Agreement, is the only inter-governmental body tasked with facilitating dialogue between all private and public stakeholders in the region related to water governance, (Mekong River Commission, 2017). Despite the promise of such a cooperative body the commission is not required to reach a consensus among Mekong River Commission members to approve, plan or construct a dam project (Mekong River Commission, 2017). This fact has led to several trans-boundary disputes between the public-private dam builders and the people who live downstream from hydropower dam developments that are most likely to be affected by their construction (International Rivers, 2008).

1.2 Research aims and questions

The central aim of this research is to explore the socio-economic impacts of a hydropower dam's construction phase on downstream communities in Laos. Specifically, this thesis seeks to understand how a hydropower dam's construction impacts on the social and economic life of downstream villagers. I will identify these social and economic impacts by using a matrix conceptual framework developed by Kirchherr and Charles, (2016) to structure and make sense of this study. As an outcome, this research proposes several recommendations for future dam construction. This project is important as currently there is a gap in the literature concerning the social and economic impacts of a hydropower dam's construction phase on downstream communities in Laos. Therefore, this research contributes to the literature by offering insights from a particular case study focused on downstream villagers.

There are two central questions and five sub-questions that this thesis is investigating. The questions were developed based on the components and dimensions of the Matrix framework (Kirchherr & Charles, 2016) that I use in this research. The questions are shown in the following table (Table 1).

Main research questions	**Sub-research questions**
1. How does the Xayabouly hydropower dam's construction phase impact on downstream villagers?	1.1 How has the construction changed the livelihoods of downstream villagers? 1.2 Have the impacts of the construction been more positive or negative?
2. What are the social and economic impacts of the Xayabouly hydropower dam's construction phase on downstream villagers?	2.1 How has construction impacted on land and housing? 2.2 How has construction impacted on income generation and employment? 2.3 How has construction impacted on the health and nutrition of villagers?

Table 1 Research questions and sub-questions.

1.3 Research approach and methodology

This research employs a pragmatist approach to investigate the social and economic impacts of hydropower dam construction. Specifically, this research employs a qualitative approach using semi-structured interviews to collect data. Using this methodology, I examine how the construction phase impacts downstream communities by focusing on the Xayabouly hydropower dam's construction phase as a case study. Details of this research methodology are provided in chapter 4 of this thesis.

1.4 Research significance

Despite the fact that Laos has been developing hydropower dams for over five decades now - the country currently has nearly a hundred hydropower dams in operation - there are many unknown impacts and consequences of these projects. For example, to the best of my knowledge, there is no research to ascertain the impacts of a hydropower dam's construction phase on downstream villagers in Laos. Furthermore, the nation's most important river, the Mekong, is becoming intensely fragmented as a result of relentless hydropower dam construction. Two hydropower dams, the Xayabouly hydropower dam and the Don Sahong hydropower dam are currently under construction. A third hydropower dam proposal, the Luang Prabang Hydropower dam, was recently put to the Mekong River Commission in July 31, 2019. Eight more dams aside from these are also planned to be built on the Mekong River. Therefore, I contend that research needs to be conducted to gauge the impacts of this construction. As relatively little is known about the impacts of dam construction on downstream villagers during the construction phase, I maintain that this is an important study for present dam projects. Millions of people heavily rely on the Mekong River for food, income and irrigation. Therefore, this research will contribute empirically-based findings to the ongoing discussion of any future dam projects and their impacts on affected villagers.

1.5 Thesis outline

This research consists of six chapters. The following table provides an overview of its structure and contents of each chapter.

Chapter	Outline
1. Introduction	This chapter provides an overview of the background information of hydropower development in Laos and future dam development. This chapter also includes my research aims and questions, approaches and methodology, as well as the thesis' outline and structure.
2. Literature review	Chapter two offers an in-depth review of the effects of hydropower dam construction on local communities, drawing on many case studies globally. This chapter then identifies the research gap of this thesis and explains the rationale for the conceptual framework employed in this research.
3. The context and construction of the Xayabouly hydropower dam project	This chapter explores the importance of hydropower construction in terms of Laos' economic development. Chapter three then explores the potential of hydropower dam development on the Mekong River, with a particular focus on the Xayabouly hydropower dam in Laos.
4. Research methodology	Chapter four provides an overview of the research methodology and research design used in this thesis. This chapter includes a discussion of epistemology and research reflexivity, and then moves on to explain this project's research methods, research location and a description of how participants were recruited. I also discuss in chapter four some ethical considerations important for this research.
5. Presentation of findings	This chapter provides the empirical findings of this study. The chronological order of the findings was presented based on the components and dimensions used in the Matrix framework.

6. Discussion	Chapter six discusses themes that arose from my findings. This discussion chapter also links the data found to relevant literature by comparing and contrasting. Chapter six then discusses the implications of this research's findings and points to policy recommendations. Finally, I will also make some suggestions for future research and end this thesis by considering alternative explanations of the findings in this research before concluding.

Table 2 Thesis outline.

Chapter 2: Literature review

2.1 Introduction

This chapter explores the effects of hydropower dam construction on local communities, drawing on many case studies globally and locally (to Laos). The purpose of this chapter is to link existing information on the impacts of hydropower dams to the main exploratory objectives of this research, which will be discussed at the end of this chapter. More broadly, this literature review gives a context to the objectives of my study: The negative effects from dam construction on downstream villagers. The chapter begins with an exploration of some of the large hydropower dam projects and their purpose. I then explain how impacts from dam construction can be both positive and negative. The next section of this literature review will then analyse some of these impacts from different countries around the world, including from Asia, where my research is based. After examining the livelihoods of farmers who live up and downstream from large dam construction, I then move on to outlining the research gap, which I intend to address by focusing on the Xayabouly hydropower dam in Laos. Before presenting my research questions, I will explain the rationale for the conceptual framework I will use to explore the livelihoods of villagers who live downstream from the Xayabouly dam construction

2.2 The context of large hydropower dam development

Large hydropower dams have become essential instruments for economic development in many developing nations. The International Commission on Large Dams defines a large dam as "a dam with a height of 15 metres or greater from lowest foundation to crest or a dam between 5 metres and 15 metres impounding more than 3 million cubic metres" (International Commission on Large Dams Constitution Status, 2002, p. 3). From 1950 to 1986, around 36,226 large dams were constructed globally (McCully, 1996). In 2019, the World Commission on Dams found that the construction of large dams had increased from 45,000 in 2000 (World Commission on Dams, 2000) to 55,000 at present (World Commission on Dams, 2019). Most hydropower dams are used for electricity generation (International Commission on

Large Dams, 2019). In total, the world's hydroelectric power plants have the capacity to produce over 675,000 megawatts that generates over 2.3 gigawatt hours of electricity each year (International Commission on Large Dams, 2019). Today, REN21 (2020) estimates that hydropower is 15.90% of global total electricity production.

Many countries heavily rely on hydroelectric power as their national source of electricity (International Commission on Large Dams, 2019). For example, in Norway and the Democratic Republic of Congo, hydropower dams provide 99 % of the country's power (International Commission on Large Dams, 2019). In Brazil, 91 % of total used electricity comes from hydropower dams (International Commission on Large Dams 2019). Notably, hydropower dams are the largest renewable energy source globally and currently generate more than 90 % of the world's renewable electricity (International Commission on Large Dams, 2019).

2.3 Introduction to socio-economic impacts

This thesis discusses the socioeconomic impacts of hydropower dam construction. Socio-economic impacts may be understood as an impact from organizations, businesses or individuals' actions on the wellbeing of surrounding communities (The Centre for Social Impact Strategy n.d; Vanclay, 2003). Social impacts may be intentional or unintentional, direct or indirect and can be either positive, negative or both (The Centre for Social Impact Strategy n.d; Vanclay, 2003). Vanclay helpfully elucidates on what are considered social impacts. The author suggests a social impact is something experienced or felt in a bodily sense or emotional sense, or both. Vanclay points to how impacts can also be felt individually or by a group such as families, households, neighbourhoods, communities, social networks or places of employment. Vanclay, 2003, p. 2).

According to Vanclay (2003, p. 8) socio-economic impacts comprise of many that things that can include how people live their life every day, their habits, customs, employment and recreation. An important part of villager's life in Laos for example are locals' spiritual beliefs and sites of worship. Language too is a necessary part of living day to day in Laos as there are many different languages and dialects that are linked to people's culture. Vanclay (2003, p. 8) argues that these things, along with stable community and political bodies, are important and any unsettling of culture, language or community is a negative socioeconomic impact. For example, if social cohesion or a lack of resources occurs in a village, this Vanclay (2003, p. 8) argues is a seriously negative socioeconomic impact on that village.

Other social impacts that are pertinent to this research that Vanclay (2003, p. 8) describes is effects on one's milieu, sense of wellbeing, living situation and anxieties and ambitions. To elaborate, negative socio-economic impacts may be a worsening condition of the water air and food available in the village. Lack of sanitation, general resources and welfare are also negative socio-economic impacts. Related to this is an overall sense of wellbeing that includes not just biomedical health but spiritual, mental and emotional health. A major contribution to being negatively impacted, Vanclay (2003, p. 8) also argues, is when living in one's own home becomes untenable because of natural disaster such as flooding or fire, or man-made situations such as dam constructions, the focus of this research. Moreover, Vanclay (2003, p. 8) argues, disruption such as just described can also lead to anxieties and uncertainties over people's future and their families' future'.

In Laos, there are 47 distinct ethnicities which are sub-divided into 160 subgroups which speak a total of 82 living languages. Suffice to say, Laos has diverse cultural practices and ways of life. Most of the population live in valleys by the Mekong River and its tributaries. One of the biggest impacts of hydropower dam construction on the people of Laos is the displacement of villagers from their homes and their sites of cultural practice. Most affected villagers in dam projects are minority sub-ethnic groups who live along river valleys. They are mostly very poor and uneducated. In cases of villagers are forced relocated wherein these people are moved to other existing villages that do not practice the same culture. This often leads to a loss of cultural practice and way of life including a loss of language. As a result, younger generations grow up displaced not knowing culture or language.

Manorom (2018) argues that hydropower dam construction is a major global issue causing socioeconomic impact because of the way these projects displace and disrupt communities' ways of life. The World Commission on Dams estimates that hydropower dams have displaced round 40-80 million people worldwide due to the reservoirs created by dams. They also argue more than 472 million people downstream have been affected due to changes in water flows (World Commission on Dams, 2000). Tortajada, Altinbilek and Biswas (2012) argue that resettlement mostly makes the lives of affected people worse off than before the hydropower dam construction.

An example of these impacts from dam displacement is the construction of the biggest hydropower dam in the world, the Three Gorges Dam in China, where the dam's reservoir has flooded over a thousand city and over a hundred thousand acres of fertile farmland (Ferraro, 2012). Over half of the affected farmers ended up in an extremely poor life, living just under USD 1 per day (Tortajada, Altinbilek & Biswas, 2012). It is estimated that over 1,300 archeology sites were flooded, with some of the sites holding important religious and cultural significance, such as being locations for ancestor worship for the local people (Allin, 2004). Moreover, Gleik (2008) argues that fishermen and farmers suffered from the construction of the Three Gorges Dam. In particular, the population of fish species in the river has rapidly decreased, which led to an estimated 60% reduction in fish catch compared with the fish catch levels before the dam construction in 2003 (Cheng et al., 2018; Gleik, 2008). When fishermen catch less fish, this means that fishermen make less food and income for their families and this leads to less money to support their family member's education (Cheng et al., 2018). Furthermore, in 2011, downstream of the Three Gorges Dam, the Yangtze River was considered to have experienced the worst drought in 50 years (Qiu, 2011). It was estimated that around 3 million hectares of farmland had suffered from chronic water shortages and nearly 10 million people in 87 cities and counties suffered from prolonged drought and millions of livestock suffered from a shortage of drinking water (Qiu, 2011).

In addition, the socioeconomic impacts of the Aswan High Dam hydropower construction are on the world longest river, the Nile River in Egypt, have also been enormous. Even though it was believed that the Aswan High Dam was the dam that would change Egypt's economic development, it also came with huge costs (World Commission on Dams, 2000). The Aswan High Dam displaced over 100,000 Nubians (indigenous Egyptians) and around 70,000 Sudanese Nubians (indigenous Sudanese)

(Tortajada, Altinbilek & Biswas, 2012). Most of the affected indigenous peoples from Egypt and Sudan ended up living an extremely poor life in their resettlement sites (Tortajada, Altinbilek & Biswas, 2012). Furthermore, the giant reservoir of the dam also flooded over 22 archaeology sites, despite the fact that some of these sites had been awarded as United Nations Educational, Scientific and Cultural Organization (UNESCO) sites, with many being important for religious and cultural practice, such as places to worship ancestors (Tortajada, Altinbilek & Biswas, 2012). Moreover, it was estimated that in just a period of 5 years after the dam had been completed, the dam significantly reduced fish catch from 37,000 Kilogram (Kg) to 9,000 Kg per trip (Tortajada, Altinbilek & Biswas, 2012). A rapid decrease in fish catch downstream directly affected fishermen, and many were unable to continue their business and were unable to make enough money from selling fish to support their family needs (Tortajada, Altinbilek & Biswas, 2012). Furthermore, hundreds of farmers downstream had to abandon their farm due to a shortage of nutrient-rich sediment from seasonal flooding of the Nile river as the dam completely blocked the movement of sediments (Tortajada, Altinbilek & Biswas, 2012).

A Laotian example of the social and economic impacts from hydropower dam construction is the construction of one of the biggest hydropower dams in Laos, the Nam Theun II Hydropower Project. Delang and Toro (2011) point out that the development of the Nam Theun II displaced over 100,000 indigenous people from their highly productive crop and grazing land. According to Scudder (2019) these impacts have caused damage to local people's traditional lifestyles, cultural identity and living standards, especially for poorer residents who tend to have a stronger cultural attachment to land and other environmentally based resources. Scudder (2019) argues that the GoL and dam operators had no interest in the cultures of affected indigenous villagers given how they relocated people into villages where they only spoke the language of the resettled people. The author points out too, how young generations of resettlers now do not speak their mother language, only the languages of the place where they were resettled, Hmong and Khmer languages (Scudder, 2019).

2.4 The impacts of large hydropower dams

2.4.1 The positive impacts

Globally, hydroelectricity generation is self-evidently the main reason for hydropower dam construction (Altinbilek, 2010). It is estimated that around 20 % of the total electricity supply and use in more than 150 countries in the world comes from hydropower dams (National Hydropower Association, 2019). The total energy produced by hydropower dams in the world provides around one-sixth of the world's total electrical energy (REN21, (2020)). Electrical energy is vital for municipal usage and economic development in any modern society (Altinbilek, 2010). For example, in New Zealand, there are 1,720,000 residential consumers, 175,000 commercial consumers, and there were 123,000 industrial consumers in 2017 (Electricity Authority, 2018). Residential uses include cooking, lighting, refrigeration, water heating, clothes washing and drying, space heating and cooling and using various electrical devices include computers, which are vital in any developed economy (Electricity Authority, 2018).

Aside from electricity generation, irrigation is the most important positive impact from hydropower dam construction. In fact, over half of the world's large dams were built not only for electricity generation but also for irrigation (World Commission on Dams, 2000). It is estimated that 30 % to 40 % of irrigated lands worldwide rely on water from hydropower dams (Altinbilek, 2010). Resultantly, hydropower dams contribute around 12 to 16 % of food production globally (Altinbilek, 2010). This means over 1 billion people worldwide depend on food produced by hydropower reservoir-related irrigation (Altinbilek, 2010). In Turkey, irrigation from hydropower dams contributes to the production of US 6.15 billion dollars, which not only supports Turkey's economy but creates jobs for more than 22 million farmers (Altinbilek, 2010).

A further positive impact from the use of hydropower dams is municipal water supply. According to the International Commission on Large Dams (n.d), around 13 % of the world's supply of clean water for municipal use comes from hydropower dams. According to Our World in Data (n.d) access to clean water is essential for the health, well-being and prosperity of humans. Regarding consumption, we (humans) worldwide need 10 billion tons (10,000 Cubic metres) of freshwater for daily usage (The World Counts, 2014). In the United States of America, around 62 billion gallons of water per day are used by the public municipal, and industrial services (Maupin et al., 2014). For example, in New Zealand, household water utilisation makes up 22 % of the country's total water use (Water New Zealand, 2017). However, in Laos, in contrast, domestic water supply from hydropower dams only accounts for 8 % of the total water used (United Nations in Lao PDR, 2019).

2.4.2 The negative impacts

2.4.2.1 The impacts on sediment transportation

One of the negative effects of dam construction is sediment transportation. However, when discussing sediment, there is no single term that fully explains what this is exactly. Put differently, sediment can mean different things to different people. The substance is variously known as 'mud', 'dirt' or 'sludge' – common descriptors used by the public including some certain groups from within and outside of the scientific community (Salomons & Brils, 2004; Heise, 2007). However, according to Owens (2008, p. 2), sediment is defined as "suspended or deposited solids, of mineral as well as organic materials, acting as the main component of a matrix which has been or is susceptible to being transported by water".

Sediment is one of the key parts of river and stream ecosystem makeup (Heise, 2007). Its function in the river and stream ecosystems includes denudation and biogeochemical cycles, creating and forming aquatic habitats and landforms and providing soil nutrition (Owens, 2008). These benefits exist only when sediment deposits flow naturally though (Owens, 2008). Therefore, when the sediment deposit rates are too much or too small, it can cause environmental issues. According to Czuba et al., (2011), human influence is one of the key factors that alters the sediment transport rate. In fact, Sevy, Wright-Stow, Kin, Davies-Colley and Stott (2019) claim that hydropower dam construction is one of the most severe anthropogenic factors that impacts sediment transportation because dams alter the flow of water by either detention or restriction.

Elaborating on how hydropower dams affect sediment transportation, Provansal et al. (2014) conduct a study by using the morphosedimentary reach units to analyse sediment transportation changes before hydropower dam construction and post-hydropower construction using the case study of the Génissiat dam construction on Rhône River, France. On the one hand, the authors found that hydropower dams trapped significant amounts of sediment and severely reduced sediment transport downstream to the Rhône delta (Provansal et al., 2014). On the other hand, the dam transported a huge amount of sediment downstream when water was discharged from the dam in an emergency (Provansal et al., 2014).

Zaimes and Emanuel (2006) claim that too little transport of sediment, or a "sediment starved" river cannot support aquatic habitats and can alter the ecosystem to the point that loss of sensitive and native species may occur. Apart from the effects on river ecosystems and aquatic life, a sediment starved river also leads to a recession of riparian zones and wetlands (United States Environmental Protection Agency, 2012). However, it is the loss of land due to downstream riverbank erosion that is the biggest issue when not enough sediment is transported downstream (United States Commission on Ocean Policy, 2004). In contrast, too much transported sediment can affect water dissolved oxygen levels and loss of aquatic species (United States Environmental Protection Agency, 2001). Chesapeake Bay Program (2012) explains how this happens. They point to how suspended sediment blocks sunlight from reaching submerged water plants which leads to a decrease in the photosynthesis rate and results in a drop in dissolved oxygen levels (Chesapeake Bay Program, 2012). As a consequence, sensitive aquatic species will migrate or potentially die which leads to a negative impact on river ecosystems (Alabama Department of Environmental Management, 2013).

Besides decreased dissolved oxygen levels in rivers, high levels of suspended sediment also impacts on fish in various ways. Ryan (1991) and Wood and Armitage (1997) found that too much suspended sediment can damage fish gills by clogging the gills, which leads to a reduced respiration rate and a vulnerability to infection or disease. This makes fish very susceptible to predators or parasites which can lead to a decrease in fish populations (Ryan, 1991; Wood & Armitage, 1997). Furthermore, Sutherland and Meyer's (2007) findings show that high levels of suspended sediment significantly reduces the growth rate of native fish species because sediment reduces the fish feeding rate and puts fish in stressful conditions, such as slow movement. Newcombe and MacDonald. (1991) also found that younger fish including sac fry, smolts and juveniles are vulnerable to high levels of suspended sediment. As a result, this can reduce their survival rate, causing decline in fish populations which then affects population structure (Henley et al., 2000).

2.4.2.2 The impacts on fish migration

Fish migration is an important biological phenomenon in fish life cycles (Dingle, 2014) but can also be impacted by hydro dam construction. Migration allows fish populations to take advantage of temporary predictable foraging and breeding conditions in discrete habitats that cannot be used simultaneously (Dingle, 2014). Seasons indicate migration time. Specifically, the river temperature, flow and turbidity rate all influence the fish's decision to migrate (Dingle & Drake, 2007). Migration makes up the bulk of a fish's life, as it is migration that helps them search for suitable environments for reproduction, production of juveniles, growth and sexual maturation (Larinier, 2001). Larinier states quite simply; "fish need to move from one environment to another in order to survive" (2001, p.1).

However, hydropower dams prevent fish from migrating between upstream and downstream river areas which are feeding and breeding zones respectively (Larinier, 2001). In other words, hydropower dams prevent fish from continuing their life cycle, which can lead to a decrease in their population and a change in population structure (Larinier, 2001). Meyers (1994) claims that dams in France prevent Atlantic salmon in the Rhine, Seine and Garonne rivers migrating upstream for spawning and there is no spawning ground downstream. The consequence has been the extinction of the Atlantic salmon downstream in these rivers (Meyers,1994). Similarly, in Russia, the construction of hydropower dams on the Volga, Don and Caucasian Rivers has led to a decrease in over half of the sturgeon fish population downstream in these rivers (Meyers, 1994). Comparable problems also occur in the United States of America's rivers due to hydropower dam construction. For example, the construction of hydropower dam on the Connecticut, Merrimack and Penobscot Rivers has led to the extinction of salmon and American shad downstream in these rivers (Meyers, 1994). Furthermore, Larinier (2001) claims that the hydropower dam construction on the upper reaches of some Latin American rivers has resulted in the extinction of the Potadromous fish species in the rivers' upstream areas.

In China, Zhong and Power's (1996) findings show that the construction of the Xinanjiang hydropower dam has caused a decrease in the number of fish species in the river from 107 species to 83 species. This decrease is because of the Xinanjiang hydropower dam that prevents the fish's seasonal migration between upstream and downstream (Zhong & Power, 1996). In Thailand, Amornsakchai, et al. (2000) observed how the Pak Mum dam on the Mum River also prevents fish from migrating downstream which has resulted in the extinction of 50 well known fish species. As a consequence, downstream fish catch has reduced by over 80 % since the Pak Mum hydropower dam construction (Amornsakchai et al., 2000). This reduction in fish catch has had a severe impact on fishermen's income and food supply (Amornsakchai et al., 2000).

2.3.2.3 The impacts on upstream communities

The economic development that relies on hydropower projects has long been understood as harmful for the people who are forcibly resettled (Chidmany, 2016). Before a dam's construction phase begins, upstream communities must relocate (Herbertone, 2013; Sayboualaven; 2005; Saychai & Shi, 2016). There is no doubt that leaving behind one's land is the most challenging issue for upstream communities. Newton (2008) points out that between 2001 and 2008, hydropower reservoirs had displaced over four million villagers around the world. In fact, the author states that reservoirs have become the largest single contributor of forced resettlement (Newton, 2008). Schaap (1974) found that the Nam Ngum 1 hydropower project - the first biggest dam in Laos- displaced in total 23 villages and 570 households, totalling 3,242 people. The project inundated about 2,840 hectares of land and 1,840 hectares of paddy rice fields (Chidmany, 2016). More recently, the Xayabouly hydropower dam (on which this thesis is focused) has inundated, with water from the Mekong River, agriculture land upstream of around 5,221.97 hectares (International Rivers, 2011;

Xayabouly Hydroelectric Power Project, 2014) and affected 2,100 people from thirteen villages (International Rivers, 2011; Stone, 2017).

The developers for the Xayabouly hydropower dam did not plan thoroughly enough for the resulting lack of sustainable food supply either (Herbertson, 2012). Loss of agricultural productivity severely destabilized many people's livelihoods (William & Smith, 2012). More importantly, tens of thousands of affected villagers experienced a lack of clean water and a loss of income to meet basic needs (Delang & Toro, 2011; International Rivers Network, 2004). The main issue with the dam resettlement was that the new relocation sites have limited farmland, fertile soil or irrigation (Saychai & Shi, 2016; Jusi, 2010; Seunkham & Xayphone, 2013). A comparable example of this lack was the case of the Nam Leuk Hydropower Dam project which was constructed in 1999 whereby villagers experienced severe food insecurity issues when more than 9,500 villagers were relocated (Delang & Toro, 2011; International Rivers Network, 2004). Studies later found that affected villagers from the Nam Leuk Hydropower Dam project faced severe food insecurity issues (Sayboualaven, 2004). Similarly, 95% of forced relocated villagers from the Houay Ho Hydropower Project also experienced severe rice deficiencies (International Rivers Network, 2004).

Hydropower dam projects also affect fisheries in downstream communities. Changing the way rivers flow has sizable negative impacts on fishing, water-based livelihoods and aquatic ecosystems (Collier, House & Park 2004; McCully, 2001; Moore, Dore & Gyawali 2010). Richter et al., (2010) agree and argue that changing river flows due to dam construction causes disruption to freshwater goods and services that sustain river-dependent communities, particularly fishing.

2.4.2.4 The impacts on downstream communities

Hydropower dam projects also affect fisheries in downstream communities. Changing the way rivers flow have sizable negative impacts on fishing, water-based livelihoods and aquatic ecosystems (Collier, House & Park 2004; McCully, 2001; Moore, Dore & Gyawali 2010). Richter et al., (2010) agree and argue that changing river flows due to dam construction causes disruption to freshwater goods and services that sustain river-dependent communities, particularly fishing. Moreover, the irregular switching off and on of turbines within dams, which suddenly change water levels, can lead to a major decrease in the availability of fish (Koungpalath et al., 2016).

A major impact of hydropower projects on downstream communities is prolonged flooding. Sparkes (2013) states that the Theun-Hinbon Expansion Project releases around 100 m^3 of water during wet season into the Hinbon River, contributing to an increase in flooding of both villages and paddy rice fields. Furthermore, Koungpalath et al., (2016) found that each time the Nam Mang 3 hydropower station makes an emergency discharge of water, more than 3000 households, 500 hectares of paddy fields, grasslands, roads and fishponds downstream, are flooded. After the Theun-Hinbon dam construction many farmers were only able to harvest 8 rice sacks per 0.64 hectares, whereas previously they were able to get 20 sacks from the same size area (Koungpalath et al., 2016). The authors conclude that the frequent and prolonged flooding caused many farmers to abandon their paddy rice fields and gardens (Koungpalath et al., 2016).

Downstream river communities, their livelihoods are very much dependent on river flow patterns and fish (Richter et al., 2010). For example, the quality and levels of water, floods, and droughts that occur in natural states are necessary to sustain the rivers' ecosystem equilibrium for these river-dependent people (Richter et al., 2010). Most importantly, for downstream river-dependent communities, fish is their main protein and income source (Richter et al., 2010). For instance, in the lower Mekong basin, around 60-70 million people rely on fish as their primary protein source and use the river flood-plains for agriculture (Mekong River Commission, 2005; Baran et al., 2007). For downstream river-dependent communities, disruption of river patterns can mean a disruption in the freshwater goods and services that sustain their livelihoods (Richter et al., 2010).

According to Richter et al. (2010), hydropower dam construction is the most common cause of altering river flows presently - river flows which benefit downstream river-dependent communities (Richter et al., 2010). These authors observe that since the completion of the Itezhitezhi dam in Zambia in 1987, the dam has caused poor water flow which has severely impacted the livelihoods of downstream communities

(Richter et al., 2010). As a result, there is now less protein sources available such as fish and water birds for villagers who live downstream (Richter et al., 2010). Furthermore, the dam has impacted on the fish trading business between local villagers and towns because there is less dried and fresh fish available for selling (Richter et al., 2010). Repercussions of this shortage has led to a doubling of food prices, in particular fish, which means in both the villages and towns many poor families cannot afford to buy food (Richter et al., 2010).

In Zambia, for many ethnic groups' cattle is seen, traditionally, as a symbol and source of wealth of (Richter et al., 2010). However, the unpredictable water conditions induced by the Itezhitezhi dam has resulted in less nutritious grasses available for cattle, leading the animals to damage neighbours' crops (Richter et al., 2010). The lack of sufficient nutritious grass also causes cattle to become vulnerable to ticks and diseases (Richter et al., 2010). The authors found that in a period of ten years after dam construction, downstream river-dependent communities' cattle had decreased to over 10 % due to tick-borne issues (Richter et al., 2010). Richter et al (2010) also state that without flooding to flush ticks out of the cattle feeding area, cattle will continue to be afflicted by a high population of ticks.

Similar to the issues found in Zambia, Owusu, Obour and Nkansah (2016) claim that the construction of Ghana's Kpong Dam has resulted in severely decreased floodplain agricultural lands. The authors point out that 90 % of Amedika and 70 % of Natriku tribes lost their floodplain agricultural lands (Owusu et al., 2016). Less floodplain agricultural lands means less money for families who have children's education and health care to pay for, given that agriculture production are the tribe primary income source (Owusu et al., 2016). Okuku et al., (2016) investigated the impacts of dams on the Tana River in Kenya and argue that the recession of agricultural lands on the floodplains has triggered social disorder and conflicts between pastoralists and agriculturalists because of the competition over the shortage of floodplain resources. These authors also point to the unpredictable way water is released from the dam's reservoir, resulting in the flooding of downstream agricultural farms and fish cages (Owusu et al., 2016). Adams (1993) argues that it this type of flooding that increases poverty and even hunger for downstream river-dependent villagers. The consequences of poverty and hunger can also influence marriage break-ups and family members involved in illegal activities such as drug, robbery and crime (Owusu, et al., 2016).

2.5 The research gap

Even though there are important issues for these downstream river-dependent communities during the construction phase of dams, the literature focuses either on the post construction phase, or on upstream communities during the construction. Given the immense upheaval of people's lives in downstream communities during the construction phase, as each dam takes approximately ten years to build, this research is interested in examining the impacts of a hydropower dam's construction phase on downstream river-dependent communities. This research will focus on a hydropower dam that was built on the Mekong River as a case study. The dam's name is the Xayabouly hydropower dam. This research is significant because it is the first case study of a hydropower dam's construction phase effects on downstream river-dependent communities in Laos. Moreover, there are nine more dams to be built on the Mekong River so this research could be beneficial in helping those affected downstream villages during subsequent dam constructions.

2.6 The conceptual framework

To better understand how the construction phase of the Xayabouly hydropower dam impacts downstream communities in Laos, this research will use the matrix framework developed by Kirchherr and Charles in 2016. The researchers developed this conceptual framework based on reviewing journal articles, grey literature, book chapters, books and also interviewing many experts in the field. The authors reviewed over a thousand existing articles and interviewed more than a hundred experts from different countries. Kirchherr and Charles (2016) claim that the matrix framework is designed specifically for understanding the social impact of dams and on multiple levels. This framework addresses the limitations of many existing frameworks by aggregating these perspectives, producing a wide-ranging analysis of the social impact of dams (Kirchherr & Charles, 2016). Therefore, this matrix approach also creates a compendium of dam impacts aiding future scholarly analysis (Kirchherr & Charles, 2016).

There are several reasons why I am adopting this framework in my research. Firstly, I chose the matrix framework over other existing frameworks because of the limitations of spatial perspectives relating to the social impact of dams. To elaborate, Scudder (2012) argues that the Relocation Framework (RF) and the Impoverishment Risks and Reconstruction (IRR) were specifically designed to study the resettlement impacts of hydropower dams, not overall spatial impacts. Similarly, the Sustainable Livelihoods Framework (SL) does not spell out any spatial perspectives regarding social and economic impacts (Kirchherr & Charles, 2016). Therefore, Kirchherr and Charles (2016) argue that the IRR does not explicitly account for the social impacts of hydropower dams as it was developed to explore the impacts of hydropower dams on displacement. Facing a very similar critique, the World Commission on Dams Framework only explored the spatial impact of hydropower dams in its overall report, not in its seven strategic priorities (Kirchherr & Charles, 2016). Consequently, most frameworks focus on actual displaced people rather than villagers who are still living downstream. However, the matrix framework helpfully includes a review of the social impact on those people who have not been forcibly moved but are still negatively affected by dam construction.

The second reason I chose Kirchherr and Charles's (2016) approach is because of temporal perspectives. Discussing the social impacts of hydropower dams, Kirchherr and Charles (2016) argue that the World Commission on Dams approach only addresses the social impacts of planning and designing phases. In contrast, the RF model only takes into account the social and economic impacts of hydropower dams during the operation phase (Kirchherr & Charles, 2016). Similar to the World Commission on Dams Framework approach, the Integrative Dam Assessment Model (IDAM) tends to focus more on the social and economic impact of planning and designing phases (Kirchherr & Charles, 2016). Similar to the RF, the authors also argue that the SL method focusses mostly on the operation phase whereby impact from development phases are largely neglected (Kirchherr & Charles, 2016). Usefully though, the matrix framework includes a review of the social impact of dam construction after the initial development and when it is in operation, which is the area I am interested in researching.

Another reason I chose Kirchherr and Charles's (2016) model is that they appear to not have any bias or a one-sided view regarding the social impact of hydropower dams. Kirchherr and Charles (2016) argue that the IRR model solely focusses on the negative social impacts from hydropower dams. Furthermore, McDonald and Webber (2010) argue that World Commission on Dams Framework lean more towards the negative impacts of dams and obscure possible benefits. In contrast, the FR and SL seem to largely focus on the positive impacts of dams and downplay the negatives (Kirchherr & Charles, 2016). Therefore, on balance Kirchherr and Charles's (2016) approach seemed to be the most impartial approach as they explore both positive and negative impacts from dam construction.

The fourth reason I have chosen Kirchherr and Charles' (2016) model is because of their comprehensive list of social impact as shown in figure 1. Contrastingly, Kirchherr and Charles (2016) argue that World Commission on Dams Framework does not take into account the impacts on affected communities' social interaction and interpersonal ties and their importance. For one, a social network being disrupted can lead to social isolation and a loss of cultural identity. Furthermore, Scudder (2012) also argues that the RF and IRR approaches fail to take into account the issues of human rights, which includes: the right to self-determination; the right to life; the right to equality; equal protection under the law; the right to freedom of speech; the right to water and sanitation; the right of freedom of movement; the right to freedom of assembly; and the right to food and housing. Fortunately, Kirchherr and Charles's (2016) approach incorporates these rights into their impact assessment.

The final reason I follow Kirchherr and Charles's (2016) model is because of how the authors make interlinkages between the different impacts of hydropower dams. Kirchherr and Charles (2016, p. 104) point out that IDAM miss the interconnectedness of the different impact components. They explain how IDAM: "[c]onsiders flood control impacts as a domestic shock within geopolitical impacts, while impacts on roads and transportation are listed within social cohesion". Furthermore, the authors point out that the IRR model does not discuss the relationships between hydropower dam impacts such as landlessness, joblessness, homelessness and food insecurity (Kirchherr & Charles, 2016). According to Bui and Schreinemachers (2011), the SL method also fails to take into account the interlinking of different components of the social impacts from these dam constructions such as the impact on livelihoods as a result of cultural change in communities. In addition, Chen (2013) argues that the World Commission on Dams Framework is not a framework that actually guides practitioners and research scholars. Rather, Beck et al argue, World Commission on Dams Framework is just a complex and long report which "promotes the use of three global norms, five core values, five key decision points, seven strategic priorities, 33 associated policy principles, and 26 guidelines in implementation and advocacy of dam-related activities" (2012, p. 2). These methods I suggest lie in comparison to Kirchherr and Charles (2016) methods that exhaustively link the many impacts from dam development.

In sum, I selected the matrix framework because it includes the various dimensions, components and interactions of the social impact from hydropower dam development fairly. The matrix model also includes the spatial and temporal gaps that current research on dam development does not address. Kirchherr and Charles (2016, p. 105) claim that the matrix framework will "ensure a more holistic and succinct perspective specifically addressing the social impact of dams". The matrix framework consists of three dimensions, nine sub-dimensions, three components and nine sub-components as shown in figure 1. Thus, this framework has all the dimensions and components that I am interested in addressing throughout this research. Therefore, this thesis will use Kirchherr and Charles' (2016) model by focusing on the negative impacts of dam construction on downstream villages. In particular I will focus on three sub-components within Kirchherr and Charles' (2016) model under the heading livelihood impacts namely: Land and housing, income and employment and health and nutrition. For the sub-dimensions, I will focus on downstream, construction and negative.

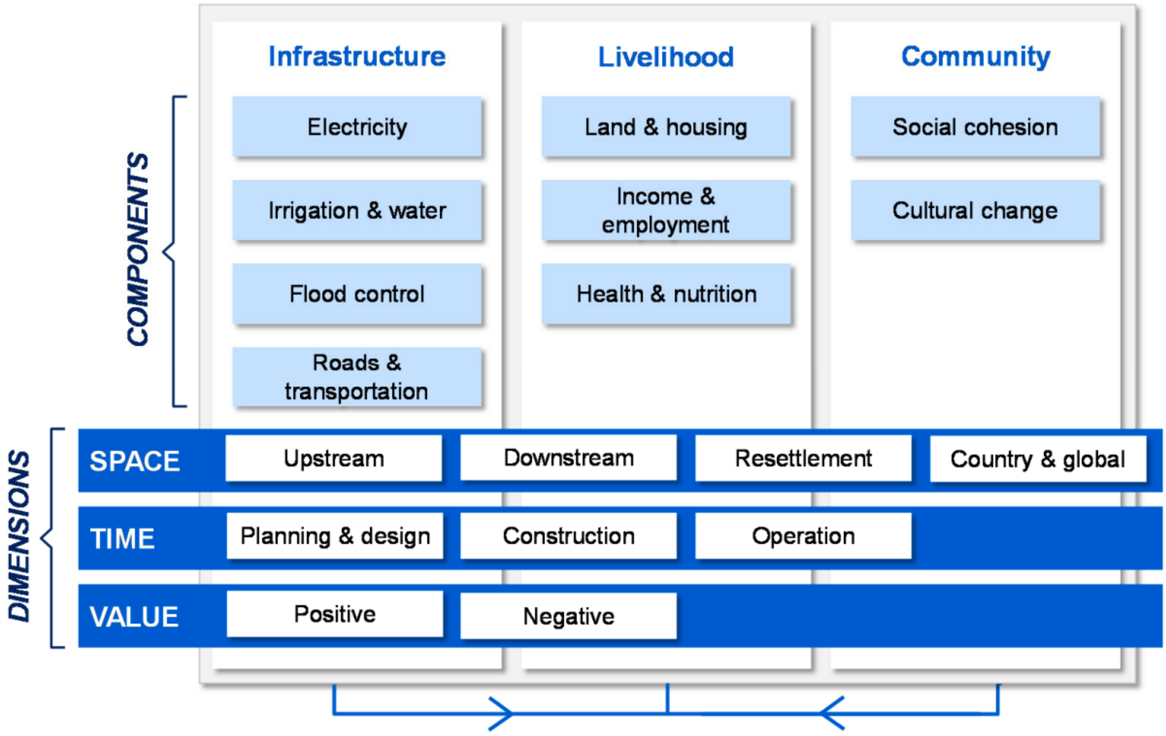

Figure 1 The Matrix framework. Source: *Kirchherr and Charles (2016, p. 20)*

Chapter 3 The context and construction of the Xayabouly hydropower dam project

3.1 Introduction

This chapter explores the context and background regarding the construction of the Xayabouly hydropower dam in Laos. Thus, the chapter begins by surveying the hydropower potential within Laos. I then describe the physical geography of Laos, which will ultimately point to why hydro power has become an attractive option for the Lao government. From this context I elaborate on the energy supply and income that the hydropower sector can potentially generate. Accordingly, the third section of this chapter focusses on the commonly known aspiration of Laos as being the 'battery of Southeast Asia'. Following this section, I explore the way in which Laos's economic situation has developed through the production of hydropower. Laos' laws and regulations that are used to regulate or not regulate the hydropower sector will then follow this section. From there I will also explore the physical geography, location and importance of the Mekong River in terms of hydropower potential and ecological services. Finally, I explore the potential of hydropower dam development on the Mekong River, with a particular focus on the Xayabouly hydropower dam in Laos.

3.2 Physical geography of Laos

Laos is a mountainous landlocked country in Southeast Asia, bordering China, Vietnam, Cambodia, Thailand, and Myanmar (Figure 2). Laos is ranked as one of the poorest or least developed countries in the world, sitting at 138th out of 196 countries due to low economic and human development (United Nations Development Programme, 2018). With about 6.8 million inhabitants and a total area of 236,800 km^2, the density of population is very low compared to other Asian nations (Suntikul, Bauer & Song, 2009). Although the overall poverty level in Laos has declined substantially since the economic reforms of 1986, a high level of poverty still exists throughout the country particularly in remote areas (Andriesse & Phommalath, 2012). Over 70 % of the population lives under USD 2 per day (UNDP, 2007). These people are mostly nestled on river flats where they rely on subsistence living. Their livelihoods are directly dependent on natural resources such as rice-based agriculture, aquatic resources as well as wild-capture fisheries (Bowden, 1998; Pholsena & Phonekeo, 2004).

Even though Laos is ranked as one of the poorest or least developed countries in the world, the nation is rich in natural resources such as water (United Nations Development Programme, 2018; International Finance Corporation, 2018; Seumkham & Xayphone, 2013). Some time ago the government of Laos decided to use this resource and pursue the development of a hydro-electric power industry as a nationalized economic enterprise which, in turn, laid pathways for the country to achieve its sustainable development goals (United Nations Development Programme, 2018).

3.3 Energy supply and income from hydropower dam schemes

Energy is essential in today's world and demand is rising. It has become a part of contemporary life and one cannot think of a world without it. In 2018, it was estimated that the global electricity demand rose by 4% which is double the rate of overall energy demand at its fastest pace in 2010 (International Energy Agency, 2019).The most probable reasons for the increase in demand are due to the rapid increase in the world's population, current energy dependent lifestyles and industrial expansion (Kaldellis, 2008; Yüksel, 2009). For example, in just a decade (1990-2000) the total energy consumption in the world increased from 800 Million Tons of Oil Equivalent (MTOE) to 1,000 MTOE (International Energy Agency, 2013). In 2011, the world's total energy consumption reached 1, 600 MTOE (International Energy Agency, 2013).

Although there are many energy sources globally such as oil, coal, gas, nuclear, wind and solar, hydropower is considered a particularly appealing source of energy because it is cheap to produce (Jusi, 2010; Smits & Bush, 2010). Moreover, hydropower is considered an efficient energy source with present hydropower plants being able to convert kinetic energy into electrical energy to more than 90 % efficiency (Kaldellis, 2008). Importantly, hydropower is also a form of clean and renewable energy (Kaunda & Mtalo 2013).

For these reasons, hydropower is a major source of domestic electricity for countries like Norway (95 %), Brazil (81 %) and Canada (59 %) (International Energy Agency, 2013). In fact, hydroelectricity is used in over 150 countries worldwide (World Commission on Dams, 2000). Laos currently exports two-thirds of the 3000 megawatts that has been developed so far to Thailand (International Finance Corporation, 2018; Ministry of Energy and Mines, 2014). In financial terms, from 2005 to 2008, the Lao government's revenues from hydropower projects reached a total of USD 190 million (MacGeorge, Stewart, & Vostroknutova, 2010). This substantial income has the potential to make significant contributions to economic development and poverty reduction within Laos (Pholsena & Phonekeo, 2004; Phomsoupha, 2009).

3.4. The hydropower potential of Laos

The government of Laos's aim is to become 'the battery of Southeast Asia' by producing hydropower electricity through dam construction and then exporting it to neighbouring countries such as Thailand, Vietnam, Cambodia and Malaysia (Phanvilay, 2010). In this sense, the Lao government wishes to revision its status of being perceived as 'landlocked', to being seen as a 'landlink' for the Southeast Asian region. Being a 'landlink' would include opening up direct overland transport routes between its seaboard neighbours (Phanvilay, 2010). By taking this 'landlink' position, the government of Laos is also able to harness its vast hydropower potential and export the electricity to its neighbours, including Thailand, Vietnam and Cambodia (Phanvilay, 2010).

Laos's hydropower production has huge potential that is currently not being fully exploited. It is estimated, for example, that electricity production varying from 18,000 megawatts to 30,000 megawatts per year could be achieved. However, only 3000 megawatts have been developed so far (International Finance Corporation, 2018; Ministry of Energy and Mines, 2014; Jusi, 2010). In particular, the Mekong River itself has the potential to generate up to 18, 000 megawatts of electricity, which has the potential to earn billions of US dollars for the government of Laos (International Finance Corporation, 2018; Ministry of Energy and Mines, 2014; Jusi, 2010). If hydropower could be further exploited then, Laos could achieve its vision of becoming the 'battery of Southeast Asia' (Wedekind, 2008).

There are several reasons why this vision for Laos could be accomplished. Sivongsay (2015. p.13) expands on this idea by pointing out three main arguments that would support Laos becoming a major exporter of electricity: Firstly, Sivongsay (2015, p.13) points to the ready obtainability of water given the nation's high rainfall especially in the monsoon season, rain which then collects into the Mekong River. Secondly, Sivongsay (2015, p.13) points to how Laos has geography which is amenable to the construction of hydropower dams. Thirdly, Laos is located in a place that is very close to countries that require a lot more energy than they themselves can produce.

3.5 Laos's economic growth through hydropower production

In 2003, the government of Laos adopted the National Growth and Poverty Eradication Strategy (NGPES) which aimed to eliminate the country's poverty by fostering sustained and equitable economic growth (GoL, 2003). The government of Laos also maintains the objectives of achieving sustainable development targets and reaching the United Nations Millennium Development Goals through the use of the country's natural resources (Barney, 2007). Natural resources can include rivers, forests and minerals (for instance, gold, silver, copper) (Delang & Toro, 2011).

In the past few decades, export of tropical hardwood timbers has been the major national economic earner in Laos (Pholsena & Phonekeo 2004). Recently however, the government has realized that deforestation is unsustainable, causing long term environmental degradation (Pholsena & Phonekeo 2004). Being a 'landlocked' nation Laos is also greatly disadvantaged in the general goods export sector because of the high transportation costs which makes this option unfeasible for sustained economic development (Tshering & Tamang 2004).

Therefore, the government of Laos maintains that hydropower production is the key to improving the wellbeing of its citizens and achieving the country's Millennium Development Goals (Barney, 2007; Pholsena & Phonekeo, 2004). Currently, Laos has 60 hydropower plants in operation and plans to have one hundred hydropower dams constructed by 2020 (Ministry of Energy and Mines, 2019). About 90 % of hydroelectricity is exported to neighbouring countries like Thailand and the rest is for domestic usage (Ministry of Energy and Mines, 2019). Currently, the GoL has a number of memoranda of understanding that regulates the sale of hydroelectricity to neighbouring countries including Thailand, Vietnam and Cambodia (Department of Energy and Business, 2014). Government revenue from hydropower exports grew from USD 17 million per annum in 2009 to USD 100 million in 2012 (MacGeorge et al. 2010). Laos' GDP also grew from USD 5.8 billion (2009) to USD 9.1 billion (2012) (United Nations, 2014). Hydropower exports are the third largest source of income for the government and account for 30 % of all export earnings. In dollar terms, current hydropower dams generate an income of more than 1 trillion US dollars per year (Ministry of Energy and Mines, 2019).

3.6 Lao hydropower regulations

Laws and regulations relevant to Laos' hydropower sector were enacted concurrently with the country's pursuit of hydropower expansion in the 2000s. Within these regulations there are specific laws that were instituted to recognize and provide safeguards, rights and entitlements for those who are adversely affected by hydropower dam constructions and operations. For example, there is the Electricity Law 1997 (GoL, 1997), the National Environmental Impact Assessment Regulation 2000 (GoL, 1997), the Regulation on Implementing Environmental Assessment for Electricity Projects 2000 (GoL, 2001) and the Environmental Standard for Electricity Projects 2001 (GoL, 2001), all of which are designed to provides some protection to those affected by dam constructions and operations.

These legal instruments state that affected people are entitled to receive direct or indirect benefits from hydropower dam construction and subsequent operations (GoL, 1997; Souksavath, 2011). Accordingly, the purposes of these legal instruments were to establish systematic standards in the hydropower sector in Laos. For example, the Electricity Law 1997 states that a license is required for any engagement in an electricity enterprise anywhere in Laos (GoL, 1997). Despite these laws though, entitlements for those affected tend to be agreed upon at the project level and can therefore vary significantly (Milattanapheng, 2006). One reason for such a variation may be because part of the legal framework also requires protecting the rights and interests of both investors and consumers too and this can lessen the focus on those affected by construction and ongoing operations (GoL, 1997).

3.7 The Mekong river

The Mekong River is one of the world's largest, most diverse and unique rivers, and its flood pulse drives an extensive and productive ecological system (Campbell, 2009). The Mekong rises in Tibet and flows through six countries including China, Myanmar, Laos, Thailand, Cambodia and Vietnam (Figure 2) (Mekong River Commission, 2014). At the end of its journey the river spreads into the Mekong Delta in southern Vietnam, which is one of the largest deltas in the World (The Mekong Delta System, 2012). The mean annual discharge of the Mekong River is 14, 500 m^3/s (Wang et al., 2017) and its drainage is 795, 000 km^2 which makes it the 25th largest in the world (Mekong River Commission, 2005). The Mekong River consists of two basins, the Upper Mekong Basin in Yunnan province of China and the Lower Basin lies in the Southeast Asian countries (Mekong River Commission, 2005).

Among the four countries in the Lower Mekong River Basin, Laos has the largest area of country along the river at around 202,000 km^2 (World and Agriculture Organization, 2011). The river in total is 4,909 km long and has a mean annual volume of 475 km^3 (Mekong River Commission, 2005; Shaochuang et al., 2007). The Mekong River in Laos possesses huge hydropower potential, specifically over 30,000 MW, including 13, 000 MW on the mainstream and another 13,000 MW in the river's tributaries (CH. Karnchang Public Company Limited, 2010).

However, the Mekong River also supports an exceptionally diverse and productive freshwater ecosystem that provides livelihoods and food for millions of people

(Mekong River Commission, 2014). In fact, according to the World Wildlife Fund (2012) the Mekong has the richest fish biodiversity on the planet, an estimated 1,000 fish species. This makes it the world's most productive inland fishery (Ziv et al., 2012), and has subsequently been able to sustain people's livelihoods, provide food security and ecosystem services for millennia (Grmbine and Xu, 2011). On average, every second, there is around 15, 000 m^3 of water that flows into the Mekong mainstream from the surrounding basin area (Mekong River Commission, 2014). Vast amounts of water also overflow the main riverbanks and create many and varied wetlands that perform wide-ranging functions and which sustains key social, economic and cultural values (Mekong River Commission, 2014). In particular, these wetlands play a significant role in supporting the livelihoods of local people, providing a productive environment for agriculture, aquaculture, capture fisheries, non-fish aquatic goods and tourism revenue (Mekong River Commission, 2014). Thus, the river is very important for the people who live near its banks. The basin also supports agriculture and accommodates around 12,500 irrigation schemes for farmers, who produce two or three rice crops per year, making up 7% of Laos's total irrigated agricultural land (World and Agriculture Organization, 2011).

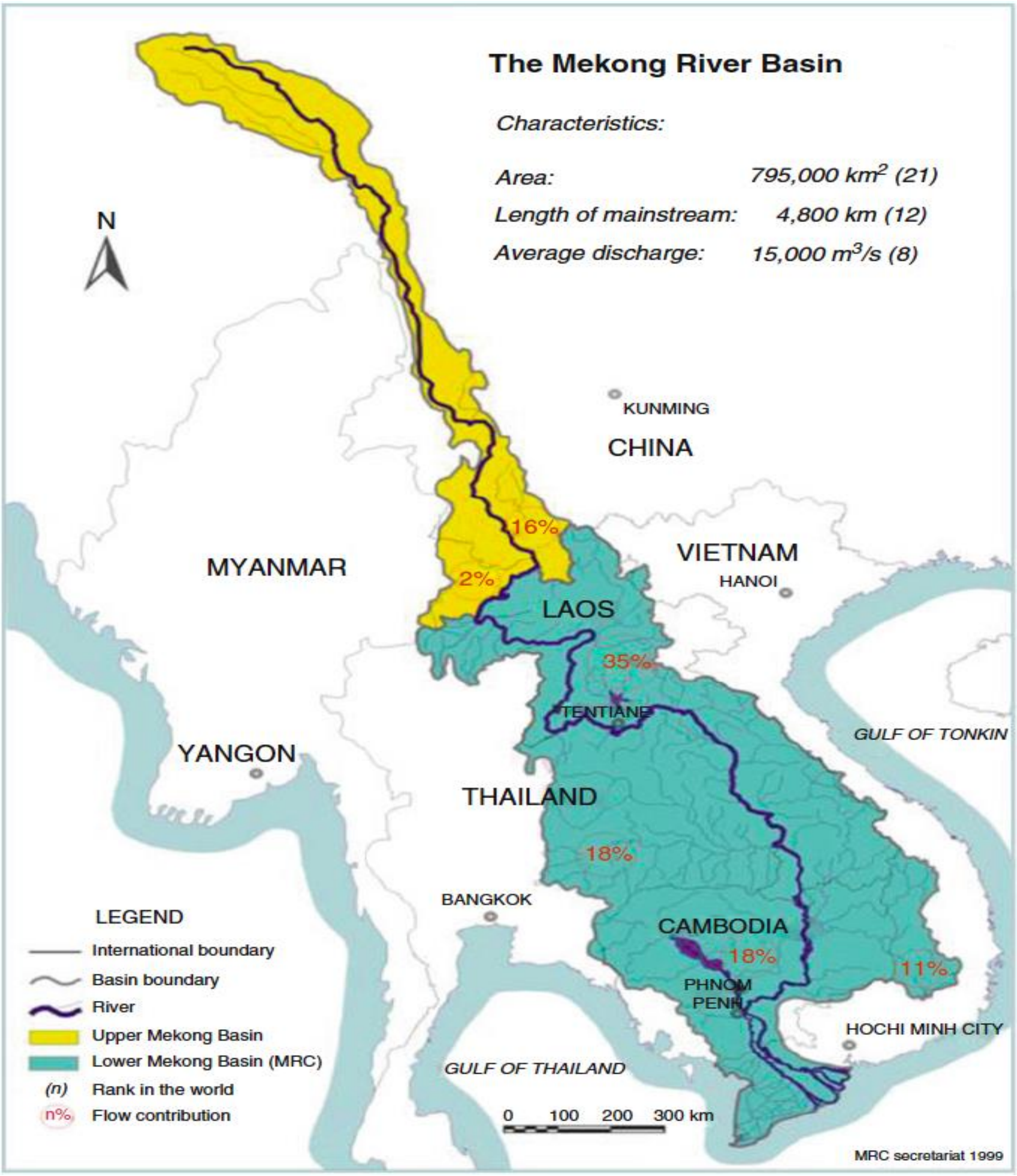

Figure 2 The Mekong River Basin. Source: The Mekong Delta System, 2012

3.8 The Xayabouly hydropower dam project

The Mekong River Basin is one of the world's hotspots for hydropower dam construction. In total, there are nineteen hydropower dams on the Mekong River, operating, under construction and proposed (Mekong River Commission, 2010). Eight hydropower dams are in China and eleven hydropower dams are in Laos (Figure 3) (Mekong River Commission, 2010; World Wildlife Fund, 2007). On the 4th of May 2007, the government of Laos signed a MoU with the Thai company, CH. Karnchang Public Company Limited (Mekong River Commission, 2010) that set out the conditions and practicalities of building the Xayabouly hydroelectric dam. A feasibility study under the name of 'the Xayabouly Hydroelectric Power Project' was then conducted by two companies from Thailand and Switzerland. The Thai organization was TEAM Consulting Engineering and Management Co., Ltd and Colenco Power Engineering Limited was from Switzerland (CH. Karnchang Public Company Limited, 2010). Under the Build-Operate-Transfer agreement, CH. Karnchang Public Company Limited was granted a 30 years concession including construction time (CH. Karnchang Public Company Limited, 2010).

The Xayabouly hydropower dam is the first of eleven planned on the Mekong River in Laos (Mekong River Commission, 2010). It is located in Xayabouly province in Northern Laos, approximately thirty kilometers east of the Xayabouly district (International Rivers, 2011; Nature, 2018). At full capacity the Xayabouly dam can produce up to 1, 280 MW, of which the government of Laos will sell 95 % off to Thailand (International Rivers, 2011; National University of Singapore, 2012). The remaining 5 % of electricity will be sold to the Electricité du Laos (EDL) for domestic usage (National University of Singapore, 2012).

The construction cost of the Xayabouly hydropower dam was estimated at USD 3.8 billion (Mekong River Commission, 2010). The approval process of this dam construction took nearly a year because ministers from the four countries who would be affected by the construction could not agree on how it was to be built (International Rivers, 2011; National University of Singapore, 2012). Consequently, based on their concerns, in December 2011, the four countries agreed to conduct further studies that were to investigate the impact of the dam on the Mekong ecosystem (International Rivers, 2011; National University of Singapore, 2012). However, in December 2012, the Lao government approved the dam construction regardless without notifying its neighbouring countries who were to be affected by this development (International Rivers, 2011; National University of Singapore, 2012). Furthermore, the project developer plans to have this dam fully operational by 2020 (International Rivers, 2011; National University of Singapore, 2012). It is expected that the Xayabouly hydropower dam will generate around USD 3 billion to USD 4 billion a year in profit. It has been agreed that the developer will receive 70% of this profit, with the remaining 30% going to the Lao government (International Rivers, 2011; Nature, 2018).

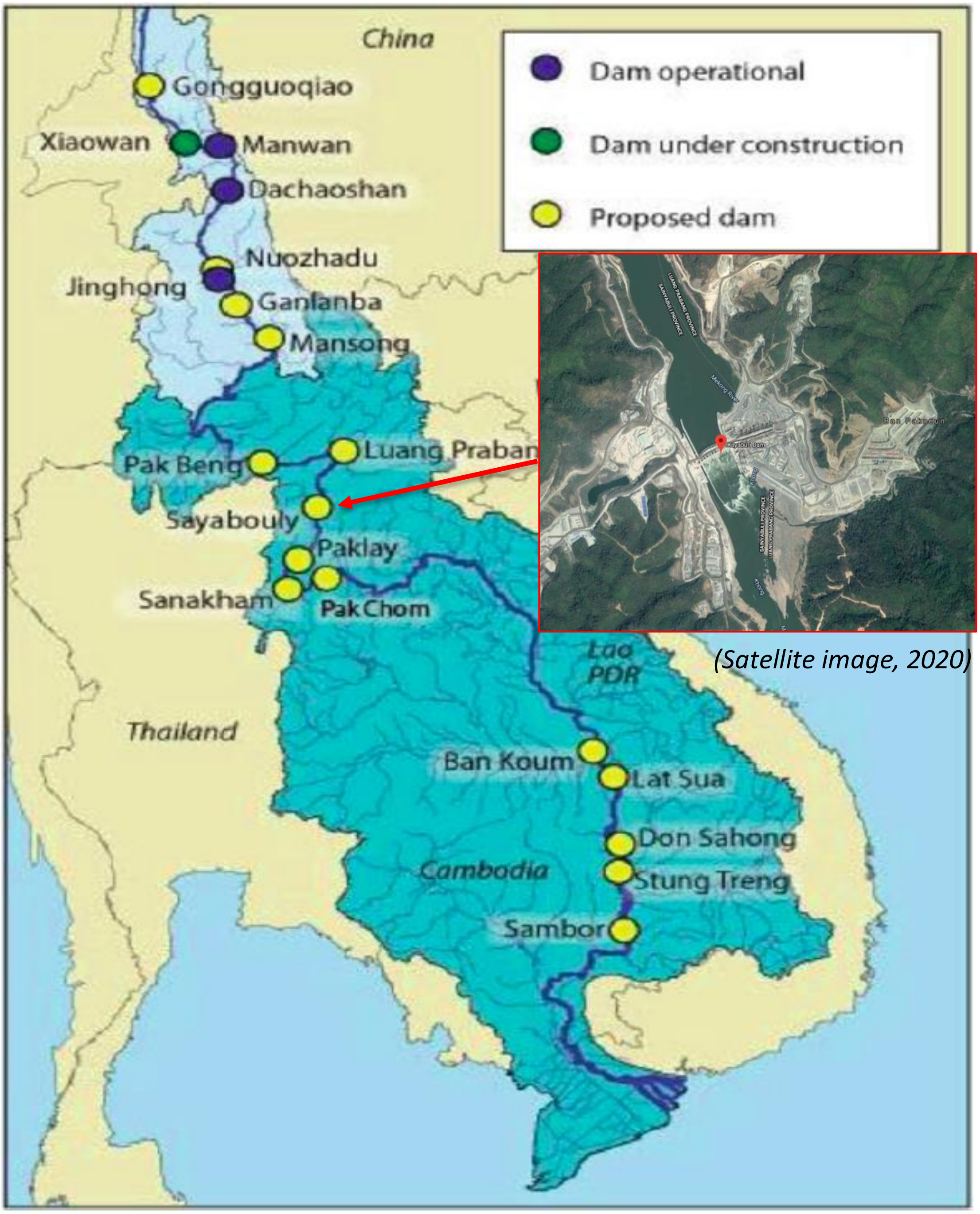

Figure 3 Map of the locations of dams on the Mekong River. Source: The Mekong Delta System, 2012

Chapter 4: Research Methodology

4.1 Introduction

This chapter provides an overview of the research methodology and research design used in this thesis. It starts by explaining what a pragmatist epistemology entails, an important part of the thesis which I use as a basis for data interpretation and knowledge construction. Following this section is a note on researcher positionality and reflexivity. Then I detail the research location and how participants were recruited. In line with a pragmatist epistemology, this research employed a qualitative methodology to collect data principally using the technique of semi-structured interviewing. Following an explanation of the qualitative interviewing I performed, I explain how I prepared, analysed and interpreted the data that was collected. Finally, I discuss some ethical considerations important to this research.

4.2 A pragmatist epistemology

The word pragmatism comes from the Greek word, pragma "Πράγμα" which means "action" from which the English words "practice" and "practical" are derived (Giacobbi, Poczwardowski & Hager, 2005). The term pragmatism comes from William James' publication, *Pragmatism: A New Name for Some Old Ways of Thinking* (Giacobbi, Poczwardowski & Hager, 2005). For James, pragmatism was an attempt to provide practical solutions to contemporary problems experienced by people and society (Trohler & Oelkers, 2005). In terms of research, pragmatists believe that researchers should base their methodological approach on something that works for the particular research problem that is being investigated (Tashakkori & Teddlie, 1998). Pragmatist philosophy refuses to endorse an ideology or proposition of truths and realities that are impractical. Owing to the 'practicality' of pragmatist thinking, this epistemology believes that there can be multiple truths to reality. From this perspective, pragmatist thought is a method that encourages change within existing realities if and when it is needed (Giacobbi, Poczwardowski & Hager, 2005). Therefore, pragmatist philosophy may be seen as an epistemology focused on experimentation and thereby advocates that when we do wrong, further discussion and investigation can identify and eliminate the errors we made (Hannes & Lockwood, 2011). Therefore, pragmatist philosophy emphasizes a 'trial and error' approach to projects, more than fixed beliefs, which is an attractive feature in the context of my qualitative research (Hannes & Lockwood, 2011).

This research then, uses a pragmatist approach for exploring the social impacts of the Xayabouly dam' construction phase on downstream communities in the villages of Pak-houng, Houaykhoualuang, and Khokfak, Laos. In particular, I will follow five steps developed by pragmatist problem solver Dewey (1910). These five steps are: 1) encountering and then recognizing a problem, 2) Contemplating the aspects of the issues, 3) Proposing resolutions to the issue, 4) Considering the efficacy of the resolutions, and 5) Implementation (in Morgan, 2014, p. 7). By referring to the five steps of a pragmatist problem solving methodology, this research has proposed some possible solutions to address the impacts of Xayabouly dam's construction phase on downstream communities as well as future dams on the Mekong River. Thus, using a pragmatist approach to this research has helped me write my literature review, develop my research questions, help me to stay focused during interviews, and helped me to organize and analyse the findings gathered. Pragmatism is an epistemology that resonates with me personally, as I believe in the effectiveness of experimentation, problem solving and execution, which is a process that can be adapted if it is not serving those in question (researcher or research participants) effectually or equitably.

4.3 Positionality of the researcher

According to Malterud (2001, p. 483) "a researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions". To me, as a researcher with a background in biology, biosystems and bio-engineering, and as student studying toward a master's degree that is science-based, I knew that I needed to avoid constructing questions that may elicit 'yes' or 'no'. I learnt through reading qualitative research to produce constructive questions begging with words such as 'how..?', ‘why..?’. I chose a qualitative research approach as the complexity of issues at hand I soon realized raised complex questions and, I presumed, complex answers.

Positioning my research this way worked well. Participants, when asked open-ended questions, provided me with rich and interesting story-like answers that helped enormously in terms of addressing my research questions. Contemplating on the efficacy of research processes, like the one just described, is part of being critically reflective.

Qualitative research argues that researchers have to acknowledge their social position and critically examine the way in which their positionality and social interactions can influence the information they collect as well as the interpretations they make (Hay, 2010). While conducting interviews, I was aware of my positionality as someone who is from Laos, but also someone from a Western education. Acknowledging this position enabled me to be very clear to participants at the beginning of fieldwork. I explained to them in the language we shared that I had university qualifications from a New Zealand university at an undergraduate level. I then let my interviewees know that I was not an expert on hydropower dam impacts, and was not a government officer, and that I was still studying towards a master’s degree. Once these introductions were completed, I was able to explain to each participant that the focus of my study was to try and understand, in-depth, what happened to downstream villagers during the construction phase of the Xayabouly hydropower dam. I think acknowledging my positionality helped me forge good research relationships and I am pleased I integrated this approach into my research.

4.4 Reflexivity

As inferred, identifying one’s research positionality requires self-reflection. During fieldwork I reflected on the ways in which my own aspirations, character, education and background, working experiences and social identities, could influence data collection. I have learnt that trying to understand things from a villager perspective, helps create a friendly and welcoming interviewing environment. Furthermore, I also pondered about how the data collection process may have touched, affected and possibly transformed me, as a researcher and as a Lao person. After all, Reay (2007, p. 611) argues that reflexivity is “about giving as full and honest an account of the research process as possible, in particular explicating the position of the researcher in relation to the research”. To the best of my recollection and reflection I don’t think that my aspirations or character negatively influenced the data collection process as the rapport I experienced during interviews was genuine. What did affect my interviews, in a positive way, was the fact that I myself am Laotian and could talk to participants in their own language and easily follow their customs even if I am from the city and they were rural dwellers. I think if I was not Laotian, especially if I was Western, then I may not have been able to form such good relationships. For example, interviewees may have felt nervous about what they were going to say or afraid they might be perceived as ‘incorrect’ or ‘wrong’ if speaking to someone from a Western culture. Moreover, participants may have felt worried that they would be misunderstood if being interviewed by a Westerner.

Another possible reason why interviewees were so actively engaged in my research was that - because of my educational background - they may have hoped that the findings of this research could help influence the Laos government’s decisions about the Xayabouly hydropower dam. Participants’ lives are very much dependent on the Mekong River for food and income. Importantly though, the Mekong River is more than just the practicalities of sustenance and earnings, it is a vital part of these villagers’ cultural lives. In sum, by being open and honest from the outset I noticed during interviewing that interviewees were very open and honest with me in return and were very engaged in the research process. Therefore, reflecting on this process I think the approach of positioning interviewees as possessing very important knowledge helped me forge good relationships and ultimately led to me finding out very useful information regarding the impact of the construction phase of this dam on downstream villagers. Conversely, villagers’ openness provided me with in-depth detail on recommendations that will hopefully help my interviewees at some stage.

4.5 Qualitative Research

4.5.1 Location, participant recruitment and research timeline

4.5.1.1 Research location

The Pak-houng, Houaykhoualouang and Khokfak villages in the Xayaboury province of Laos were chosen as research locations. According to the village chiefs, all three villages were located less than 20 kilometres downstream of the Xayabouly hydropower dam construction. Pak-houng village was the closest, followed by Houaykhoualouang and Khokfak villages respectively. Houaykhoualouang village was the largest village among the three. In total Houaykhoualouang village was made up of 103 households. Comparably, Pak-houng village had, in total, 94 households and Khokfak has only 54 households.

These three villages are located along the Mekong River bank and are surrounded by mountains. Therefore, there are only very small pieces of flat land (that are located very far away from the villages) that are suited for rice paddy production in the Houaykhoualouang area. Consequently, almost all of the people throughout these three villages are dependent on the Mekong River for their livelihoods. For example, people practises fishing for food and income as well as participating in riverbank gardening for food and income. From what the village chiefs said to me when I discussed with them these issues, about 99 % of the villagers belong to the Lao Lum or low land ethnic group. Only 1 % of the people in the area were Khmer, which are people who prefer to reside in the mountainous areas of Laos.

4.5.1.2 Recruitment of participants

Before recruiting participants for research in Laos, especially villagers, researchers are required to have an informal meeting with the relevant village chief, this is an unavoidable custom. Therefore, I conducted informal meetings with the three village chiefs who presided over each of the places I wanted to conduct my research. Whilst talking with the village chiefs I discussed my research purposes and the details and demographics of potential participants that would be useful for me. Afterwards, each village chief held a town meeting with villagers to explain in detail my research purpose. From this meeting villagers were recruited to participate in the interviews.

Snowball sampling was also utilized for helping me recruit participants. Snowball sampling is defined as a technique for finding research subjects. As the name implies, once a person is recruited the researcher then hopes to gain the name of another person, who is turn provides the name of a potential third person, and so on (Vogt, 1999). Through the recruitment process, 5 participants in each village were asked to participate and they all agreed. So, in total, 15 participants were recruited and interviewed. Interviews were conducted at each participant's place of residence at a time convenient for them. I chose to interview the heads of families because I assumed they would be the ones most likely to be engaged in fishing and the hard-physical work on their riverbank gardens and that they would be the leaders of their family in other outdoor activities. Furthermore, all participants I recruited were male because they seemed to be the one who could give me the most information as in Lao culture most decisions depend on the husband. Moreover, because I am a male, I figured female participants may be reluctant to open up to me in the interview, which is a limitation of this research (see chapter 6). In terms of age, participants ranged from 32 to 63 years old. A breakdown of participants' demographics from each village is shown in Table 3.

Villages	Number of interviewees	Gender	Place of interview	Age range (Years)
Pak-houng	*5*	*Male*	*Participant's own home*	*35-63*
Houaykhoualouang	*5*	*Male*	*Participant's own home*	*32-55*
Khokfak	*5*	*Male*	*Participant's own home*	*34-62*

Table 3 Participants' demographics.

4.5.1.3 Research timeline

This research took a year to complete. From March to May 2019, I spent most of the time preparing my research proposal and my ethics application for the Human Ethics Committee at my university. During this time, I also began preparing documents such as interview questions, letters to Lao government authorities and letters to local village authorities. Alongside this preparation I arranged international travel as well, so I was fully prepared for fieldwork when it was time to depart. Once in Laos, I spent approximately four weeks interviewing for my data collection in Xayabouly province, a northern province of Laos. The remaining time was spent data transcribing, data analysis, thesis writing and editing. An overall research timeline is shown in figure 4.

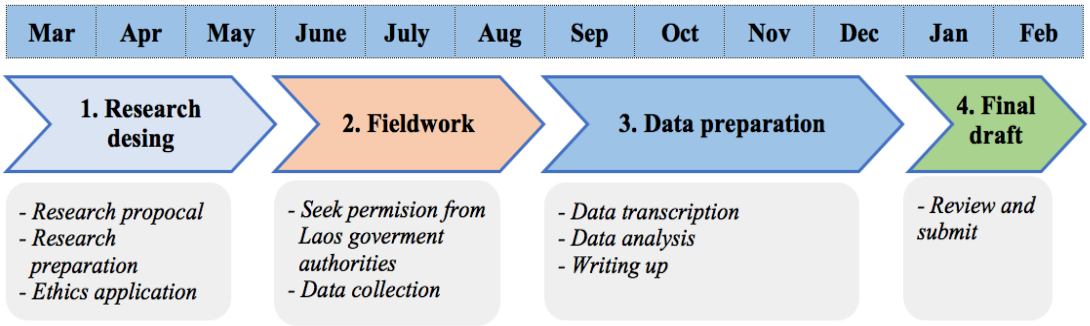

Figure 4 Research timeline.

4.6 A qualitative research approach: Semi-structured interviewing

A qualitative approach was used in this research which aligns with my pragmatist epistemology. Qualitative methodologies are commonly used when researchers want to explore subjectivities and are therefore more inclined to be interested in collecting small sample sizes, which allows the researcher to explore each participant's data set deeply (Corin & Strauss, 2008; Creswell, 2007). Such an approach to research analysis seemed beneficial to use whilst examining the complexity of livelihoods impacted by dam construction (Rhodes, 2014). Therefore, this research used semi-structured interviewing as the qualitative method to collect data.

Semi-structured interviewing is the most common form of data collection within qualitative research (Oaley, 1998). Semi-structured interviewing provides an opportunity for the interviewer and interviewee to hold in-depth discussions around the topic in question (Fylan, 2005). Semi-structured interviewing also allows individuals to disclose thoughts and feelings and points of view in participants' own terms (Dawling, Lloyd & Suchet-Pearson, 2016). Consequently, semi-structured interviewing can deepen the understanding of the relationship between livelihoods of people and places for the researcher (Dawling et al., 2016). Semi-structured interviewing also provides an opportunity for identifying new ways of seeing and understanding the topic at hand (Oaley, 1998). Furthermore, this kind of interviewing allows a space for researchers to comment on what is not said (Christopher & Lee, 2004). Importantly, semi-structured interviewing also provides a structure for the researcher, in the form of set questions, which allows the researcher to direct the interview and also compare data when it comes to analysis (Oaley, 1998).

4.6.1 Data collection

To collect the data I needed, I took an informal approach common within qualitative research (Oaley, 1998). Specifically, I arranged fairly casual meetings with interviewees, which resulted in face-to-face conversations. In total, I asked 18 questions which were arranged under 5 categories: Introductory questions; the impacts on land and housing; impacts on income and employment; impacts on health and nutrition; and future expectations. Overall, I conducted 15 interviews, broken down into 5 interviews per village by using open-ended, semi-structured questions. All interviews began with the introductory questions I had formulated in order to establish rapport and trust with the participants. I then began interviewing participants with the rest of the questions so as to explore with them more deeply the issues of dam construction. All interviews were conducted in the Lao language and the duration of interviews ranged from 30 minutes to 1 hour. All interviews took place within participants' own residence because this is where they felt most at ease and comfortable talking about the issues at hand. Interviews were recorded with a voice recorder. This allowed me to focus on what participants were saying rather than all my time having been taken up writing notes. Voice recording is also an important component in qualitative research as it preserves information collected during interviews (Gall et al., 1996). For example, if interviews are recorded, it not only makes it easier for researchers to focus on the interview content, but also take intermittent, complementary, notes whilst also ensuring verbatim transcription can be conducted when back at the researcher's office (Jamshed, 2014).

4.6.2 Data preparation, analysis and interpretation

Broadly researchers use either a deductive approach or inductive approach to data analysis (Burnard et al., 2008, Hammersley & Atkinson 2007). A deductive approach involves developing a new hypothesis based on existing theory, then developing a research strategy to test the hypothesis (Burnard et al., 2008). In contrast to a deductive approach, an inductive approach involves analysing data to search for patterns from observation and uses the actual data itself to develop explanations for those patterns through a series of suppositions (Burnard et al., 2008). As I have used the matrix framework developed by Kirchherr and Charles (2016) to analyse the social impacts of dam construction (refer to Figure 1), an inductive approach to analysis is therefore the focus of this research. An inductive approach to research is also what qualitative researchers focus on. I also suggest using an inductive approach is the most sensitive way to gain insights from the voices of downstream communities that are at the centre of this research.

Before I began the transcription process, I transferred the audio recordings from my voice recorder to my personal computer where electronic folders were separately created for each village. In terms of the process of transforming oral speech into written words, I followed the six-step procedure developed by Azevedo et al (2017). The six-step procedure includes 1) preparing a backup copy of the audio and save it into a safe place, 2) getting to know all materials and information such as field notes and repeated listening of the recording several times, 3) writing everything word for word from the recorded audio, 4) editing the written text to incorporate grammar, punctuation, uppercase and lowercase letters, 5) reviewing the transcription text by comparing to the audio to avoid missing data, and 6) finishing the research by deciding which data will be destroyed and which will be stored in a safe place to ensure interviewee confidentiality. As all interviews were conducted in the Lao language, oral speech from interviews were translated into English during the transcribing as I am a native Lao speaker. To prevent any exclusion of important data I transcribed participants' words verbatim, as much as the translation allowed. Interestingly, the field notes I took were also very helpful for clarifying interviewees' actions and feelings. Once all translations and transcriptions were completed, I followed the analysis and interpretation process developed by Creswell (2014) as shown in figure 5.

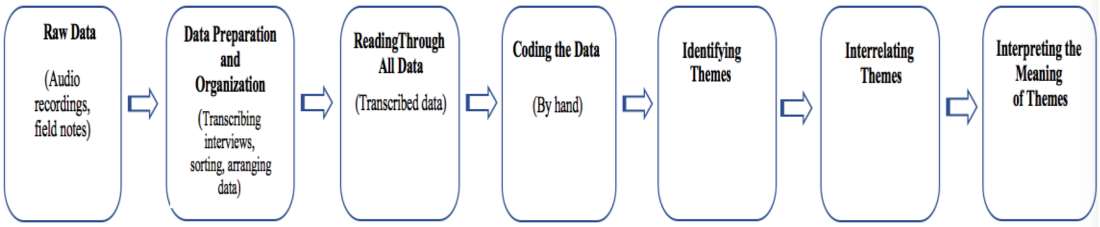

Figure 5 Data preparation, analysis and interpretation process. Source: Adapted from Creswell (2014).

Once fieldwork had been completed, I organized my field notes and audio recordings in a systematic manner as suggested by Thiel (2014). I then followed the process outlined by Creswell (2014), who suggests compiling all the raw data, including the recordings and field notes. I then listened to all the audio I had several times over by comparing this to my field notes. Next, I transcribed the audio in the Lao language into a special Excel sheet which I created. After transcription, I read these documents several times as to understand the main idea of each answer. I then translated the transcription from Lao to English. After finishing the translations, I compared the English version to the Lao version to ensure I had maintained the central idea in each answer. Next, I carefully read through the typed transcripts several times. Crang and Cook (2007) state that repeated reading through transcript data can enable critical thinking and analytical strategies. Therefore, once I had read through the transcripts many times, I then began the process of coding that entailed categorizing data into themes. I carried out coding based on Crang and Cook's (2007) advice that entails forming themes based on the interview questions used. Once this was finished, I then compared and contrasted each theme, which revealed identifiable patterns in the data (Braun & Clarke, 2006). Key themes from my data analysis are shown in Table 4.

4.7 Ethical considerations

Throughout this research I was aware that I had a duty to protect the dignity, right to self-determination, privacy and confidentiality of personal information of participants.

For these reasons, I paid attention to the needs and wants of all research participants and towards everyone who was involved in this research. According to Fisher and Anushko (2008), semi-structured interviews are exploratory and open-ended and therefore can raise a range of different ethical concerns, for example, participants' confidentiality and anonymity. Therefore, codes, using the English alphabet A, B, C, D, and E were allocated to participants to protect their identities and privacy. To further protect participants privacy, I am the only person who knows who 'A' and 'B' are, for example. Furthermore, the data obtained in this research has only been accessed by myself and my supervisor. Prior to face-to-face interviews, participants were presented with an information sheet which explained their rights as research participants. It also described the aims of the project and how the information obtained from them would be used (refer to Appendix C). Following this, participants who agreed to take part in this research were asked to sign a consent form, which they all did (refer to Appendix D). Once I have finished this research, a summary of the findings in Lao language will be distributed to participants in case some participants would like to read them. The findings will also be sent to each village chief via email and they have agreed to make the summaries available to participants.

Key themes	Sub-themes
The impacts on agriculture land	→ *Flood* → *River bank erosion*
The impacts on income	→ *Income from fish* → *Income from river bank gardens* → *Income from river bank's frog and dragon flies larvae*
The impacts on nutrition	→ *Nutrition from fish* → *Nutrition from vegetation*
The impacts on daily commuting	→ *Commute to and from riverbank gardens* → *Commute to and from between villages*
The impacts on fishing gears	→ *Damage to fishing nets* → *Damage to fishing boats*

Table 4 Key themes from data analysis.

Chapter 5: Presentation of findings

5.1 Introduction

This chapter provides the findings of this study. It begins by discussing the impacts of the construction of the Xayabouly hydropower dam. For example, floods and erosion on downstream villagers' agricultural lands or riverbank gardens that grow rice, chili peppers, cucumbers, long beans and sweet corn were important issues for interviewees to discuss. In this chapter I also present the impacts on downstream villagers' incomes such as the decline of revenue earned from fishing, dragonfly larvae, frogs and agricultural products like rice or vegetables. Subsequent to this I reveal the impacts on downstream villagers' nutrition intake such as the decline of essential nutrient consumption usually gained from fishes, dragonfly larvae, vegetables, pulses and grains. The following section shows the impacts on daily commuting to and from the riverbank gardens and between villages. Finally, in the last section of this chapter, I present the negative and costly impacts on fishing nets and boats the construction of the Xayabouly hydropower dam has caused, according to my participants. I structured these findings based on the chronological order recommended in the matrix conceptual framework.

5.2 The impacts on agriculture land

5.2.1 Floods

Participants were asked about the economic impacts they experienced from the construction of the Xayabouly hydropower dam. In particular, I asked about the impacts on people's agricultural lands and especially their riverbank gardens. The reason I chose to ask about riverbank gardens was because riverbank gardens are mostly used for everyday livelihoods, or subsistence production. Participants mostly used these riverbank gardens for growing rice, maize, chili peppers, cucumbers, long beans and soybeans – the staples in people's diets. Participants overwhelmingly spoke of the irregular flooding during the Xayabouly hydropower's construction phase. Interviewees also mentioned how irregular flooding meant that flooding could occur at any time and not just during the rainy or wet season (June to September). For example, the following excerpt from participant A, Houaykhoualouang village, discusses how his riverbank gardens were flooded during the Xayabouly hydropower dam's construction phase:

> *"My rice garden was destroyed by non-rainy season flooding. It has begun happening more frequently since late 2015, the last flood occurring in mid-October 2018. The floods can happen at any time of the year, but the last flood occurred during the harvest season. So, some rice that I had harvested and had laid down to dry was flushed away. I had to scuba dive to harvest the remaining crops before they turned rotten………....I used to get more than five tons of rice, but I only got 8 sacks (around 400 kg) of rice last year…..The flood was unpredictable, so I decided not to grow rice in my garden this year because I am afraid that the flooding may destroy it again"*- (Participant A)

Rice is the main staple food in Laos. Lao rice farming systems are divided into five main types: lowland rainfed farming; lowland irrigated farming; upland farming; plateau farming; and highland farming. In Houaykhoualouang village, highland farming is the only option for growing rice because the geography is so mountainous with no flat land for other types of rice growing agricultural systems. Highland rice farming commonly uses the practice of Swidden agriculture (Slash-and-burn agriculture). However, the practice of Swidden agriculture is prohibited in Laos, so the only option for the people of Houaykhoualouang village is to grow rice on the riverbank. Participant A's comment illustrates the issues that this involves as the Xayabouly dam's construction has made this kind of farming very risky. Yet the Xayabouly hydropower dam project was designed with the hope that it would make Lao people's life better, but instead it has now caused many severe problems for downstream villagers.

Besides growing rice, cultivating maize gardens is very important to many of the villagers I interviewed. In conjunction with rice, maize is a very important food in Lao culture. It can be eaten either as the main staple food, like rice, or used as an ingredient in local cuisine. This was evident for participant B as he explained in the following excerpt the importance of maize for his family:

> *"Maize is everything to my family because it can be both food and money...... I have two maize gardens and in the past I used to harvest more than five tons of maize per year ………. However, in the past three years, irregular flooding has begun to occur more frequently. Sometimes the floods destroy the seedling stage, at other times, it destroys the flowering and fruit stages. Life became very hard last year when I could only harvest less than 10 % of the maize that I usually grow grew in my gardens"*- (Participant B from Pak-houng village).

Participant B expressed the impacts that he experienced during the Xayabouly hydropower dam's construction phase on his riverbank farm, the only viable area for cultivation. This is a widespread issue owing, as mentioned, to the mountainous terrain where participants lived. Therefore, when frequent irregular flooding occurs, villagers struggle to grow any kind of crops. As a consequence, people are forced to buy food from Xayabouly city, which is very costly. To illustrate the impact of the Xayabouly construction phase on his riverbank garden where he grows many crops, participant C from Houaykhoualouang village explained that:

> *"Irregular flooding frequently destroys my riverbank gardens where I grow chili peppers, cucumbers and long-beans and soybeans..... Although buying chili peppers, cucumbers and beans from Xayabouly city's markets is costly, this year, I decided not to grow any crops on my two plots of riverbank land because of the irregular flooding. Because if it does flood, all my crops may be destroyed"*- (Participant C).

For Lao people, chili peppers, cucumbers and long beans are eaten in most everyday meals. They are the main ingredients in many types of Lao cuisine. Moreover, they can be cooked in a variety of ways, which makes them even more important. Generally, these crops can only grow during one season per year during dry season (November to February). From the data I collected, it was revealed that the Xayabouly hydropower dam's construction phase has had an adverse impact on growing chili peppers, cucumbers and long bean gardens. As a result, many villagers have chosen to not grow these crops and instead buy these foods from Xayabouly city. This is a big issue for villagers who live in remote areas wherein they are dependent on what they can grow for food, given they cannot afford to buy these foodstuffs from the markets.

5.2.2 Riverbank erosion

As mentioned above, riverbank gardens are generally the only pieces of land that may be used for agriculture production within the villages I interviewed. However, there are more consequences that have occurred from the dam construction phase. One of these effects is severe riverbank erosion, which means villagers' riverbank gardens are eroded as well. The following quote from participant C illustrated the riverbank erosion issue that he had experienced.

> *"My rice garden has experienced severe erosion. I have lost nearly half of it now…..I have been told by The Xayabouly hydropower dam's staff to move up to a higher area for gardening, but there is no land for me to grow rice up there, it is just mountainous landscape"*- (Participant C from Houaykhoualouang village.)

My data from fieldwork revealed that the Xayabouly hydropower dam's construction phase caused erosion of the riverbank and therefore people's riverbank gardens. The severe riverbank erosion discussed by participants means villagers will have less agricultural land for growing food, and sometimes none at all. As a consequence, villagers will have to buy expensive food from the city. In fact, what I found from interviews was that the construction of the dam has permanently changed the way villagers are able to perform agricultural activities and people fear what will happen in the long-run in terms of food security.

To further illustrate this point, particularly in relation to growing chili peppers, cucumbers and long beans, a participant from Khokfak village explained to me that:

> *"Even when the Mekong water levels are very high, they can quickly lower to five meters and the riverbank soil will hold water in it. This leads to landslides that cause severe erosion…… I lost more than ten meters of my two gardens that grows chili peppers, cucumbers, beans and papaya"*- (Participant D)

Participant D's excerpt here illustrates how the erosion of the Mekong River's bank dramatically reduced the physical size of his gardens. This means that he will have less area for growing food for the foreseeable future. Another participant from Pak-houng village became very concerned over a similar situation regarding his gardens and the impact from the Xayabouly hydropower dam's construction phase:

> *"I have lost nearly twenty meters of my riverbank garden over the past years due to severe riverbank erosion. It is the only garden that I have, and my family rely on this garden for food"*- (Participant B).

This erosion is caused by the manipulating of the Mekong River water levels which would fall substantially, and that this unexpected variation could be problematic. Another participant explained that in a period of four years, he too has lost a significant amount of his garden. However, this participant was not just growing food he was also growing Teak trees for commercial use, as he explained:

> *"Over seventy percent of my Tectona grandis (teak) garden was destroyed by erosion. I planted those trees twelve years ago and I planned to sell them over the next few years. I*

spent 1,200, 000 Lao Kip (USD 150) on the teak seedlings. I do not know what to do now"- (Participant E).

This data revealed that the Xayabouly hydropower dam's construction phase not only caused severe erosion on food gardens, but also negatively affected commercial operations such as teak tree production. Teak possesses excellent properties and, as such, has a very wide range of uses, including flooring, decking, framing, cladding, fascia and barge boards. In the decorative line it can be used for lining, panelling, turnery, carving, furniture (both indoor and outdoor) and parquetry. The consequence of losing teak trees like this could mean a family loses their main source of income that is necessary to pay for their children to attend higher education. To further illustrate how great the erosion was participant E also added that:

> *"a giant rosewood tree (Dalbergia latifolia), a hard wood and very expensive wood tree, in my teak tree garden was flushed away from erosion. I have no idea where the tree is gone. And how that is possible with such a giant tree". -* (Participant E)

5.3 The impacts on income

Aside from irregular flooding and riverbank erosion, the Xayabouly hydropower dam's construction phase also negatively impacted villagers' income. The participants I interviewed all experienced very similar income shortages regarding the selling of fish which they catch in the Mekong River. For example, to elaborate on these impacts, a participant from Pak-houng village stated that:

> *"The Mekong water levels rise and fall very irregularly in just one day. They can rise up to six meters in the morning and fall down to six meters in the evening, all in the same day. When the water levels rise, my fishing nets and hooks get flushed away. When water levels are low, the fishing nets and hooks just lie on the ground, with no fish on the*

> *nets or hooks. It is now hard to catch fish, so I only make a small amount of money from selling fish"*- (Participant D from Pak-houng village)

Participant D suggests the Xayabouly hydropower dam's construction phase has significantly impacted his income from fishing. He claimed that constructing the dam has altered the Mekong River water levels making it very hard to catch fish. This means that now, as participant D says, he makes less money from fishing. This story was similar to another participant that I talked to about the fishing situation in Houaykhoualouang village. He mentioned that:

> *"Rapidly rising waters and then low river water levels makes it very hard to set fishing nets and fishing hooks. When the waters rise and fall so drastically, most of the time I either don't catch any fish or my fishing gear is lost. This makes a big difference in terms of my income from fishing, compared to prior this dam construction"* - (Participant B)

Aside from the water levels impacting income from fisheries, a shortage of fishing baits such as Khai woodworms and dragonfly larvae makes it harder for villagers to catch Mekong's big fishes such as the Mekong giant catfish (*Pangasianodon gigas*), the giant dog-eating catfish (*Pangasius sanitwongsei*), the giant barb (*Catlocarpio siamensis*) and the giant devil catfish (*Bagarius yarrelli*). As a consequence, a big difference can be seen in terms of villagers' income from catching fish. A participant from Houaykhoualouang village explained exactly why there is no longer the bait around that is required to catch the big fish which in turn significantly impacts the money from fishing he used to make before the Xayabouly hydropower dam's construction phase.

> *"I make a very small amount of money from selling fish now. This is because I have caught less than three giant catfish in the past 4 years. Before the dam construction, I used to catch more than 5 giant catfish per year. Khai's wood worms are excellent baits for catching the Mekong*

giant catfish. Khai (Polyalthia corticosa) is a kind of shrub that grows in the water and along the riverbank. Khai is very similar to the Mangrove plant and in there are woodworms that feed on and live in the aging Khai. However, Khai in and along the Mekong river's bank have all died. I have never seen a phenomenon like this in my life. Khai live in water and never died, so I do not know what caused this. No Khai means no woodworms for giant catfish's baits. I only caught two giant devil catfish in the past three years. But before the dam construction, I sometimes caught 2 giant fish per trip. 1 kg of giant catfish is worth 140,000 Lao kip (15 USD). This makes a big difference in terms of income because ten kilograms of small fish is equal to just 1 kg of the big fish"- (Participant D)

Khai wood worms are precious baits for catching giant catfishes including the giant catfish the giant dog-eating catfish, and the giant devil catfish. The woodworms can only be found inside the Khai tree. However, the Khai shrub (tree) in the Mekong and along its bank have all died according to participant D. In addition, participant C from Pak-houng village also explained that:

"I was born in this village and have been living here for 63 years and I never experienced this situation of all Khai having died. Khai lives in water and they are great habitats for fish".

To further elaborate on the impacts the Xayabouly hydropower dam's construction phase has had on villagers' ability to earn an income, a participant from Pak-houng village told me:

"The aquatic beetle larvae (Hydrophilus triangularis) are excellent baits for catching the Mekong's giant catfish such as the giant dog-eating catfish, and the giant devil catfish.

> *Prior to the dam construction phase, I used to catch more than three giant catfish per year, but in the last four years they have been very hard to catch because I can't find the aquatic beetle larvae for bait. I do not know what has happened, and why they are all gone"*- (Participant C).

According to participant C from Pak-houng village, the Xayabouly hydropower dam's construction phase not only destroyed plants that grow in the water and along the riverbank, but also caused the disappearance of some water beetles and dragonflies. The shortage of dragonflies and water beetle larvae has a significant impact in terms of income from fish because they are the most effective baits to use for catching giant catfish. Furthermore, dragonfly larvae can also be cooked for many restaurants, so collecting larvae is not only for bait, but also for selling to make money. As another participant further explained:

> *"Prior to the dam construction phase, I used to make money around 50, 000 Lao kip (USD 6) from selling dragonfly larvae each collection time. However, in the past four years, I have not been able to make any money from dragonfly larvae. They have all gone from the Mekong River, including the adult dragonflies"* (Participant C from Khokfak village).

Further elaborating on the impacts from the Xayabouly hydropower dam's construction on downstream villagers' income, a participant (C) from Khokfak village expressed that:

> *"Before the Xayabouly hydropower dam's construction phase, I used to make at least 800, 000 Lao kip (USD 100) per year from selling the Mekong river bank's frog, or the Chinese edible frog (Hoplobatrachus rugulosus). Nearly four years now, and I have not made any money from selling frogs because they have disappeared from the Mekong River"*- (Participant C from Khokfak village).

In Laos, the Chinese edible frog can be cooked in many kinds of dishes. In addition, the price per kilogram is high, around 45, 000 Lao kip (USD 6) compared to other types of meat or fish. Therefore, from my data it appears there are several related impacts from the Xayabouly hydropower dam's construction phase on ecosystem services in the Mekong. Moreover, the impacts not only negatively affect fisheries income but also agricultural production as even though most villagers grew vegetables for subsistence living some used to grow vegetables at the market as a participant from Pak-houng village explained to me:

> *"Prior to the Xayabouly hydropower dam's construction phase, I used to make around 2,500, 000 Lao kip (USD 280) per growing season from my sweetcorn, chili peppers and beans that I grew in my garden. However, in the past three years, I have only made around 800, 000 Lao kip (USD 100) per growing season because I lost nearly half of my garden due to erosion and irregular flooding which kept destroying my crops"*- (Participant D from Pak-houng village).

Therefore, riverbank gardens are not only vital for downstream villagers for growing their food for their families but are also an important source of income for some people. However, participants expressed how little yield that they can now procure from their gardens from not only flooding, but from the erosion of their land. Less agricultural yields lead to less income for villagers and this negatively affects people's ability to buy other food items and necessary provisions.

In summary, from the perspective of interviewees, there is no question that the impacts of the Xayabouly hydropower dam's construction phase has been very negative in terms of downstream villagers' income generation capacity. From my fieldwork data most participants lost at least half of their usual income that they usually procured prior to this dam construction phase. With this is mind I now turn to the issue of nutrition to further explore the Xayabouly hydropower dam's construction phase impacts on downstream villagers.

5.4 The impacts on nutrition

5.4.1 Nutrition from fish, frogs and dragonfly larvae

Aside from the initial impacts of the Xayabouly hydropower dam's construction phase on downstream villagers, such as irregular flooding, severe riverbank erosion, and the reduction of income the construction phase has also led to a decrease in essential nutrition intake by downstream villagers. From what I gathered during interviews it became clear that protein, vitamins and carbohydrates were the main issue for downstream villagers. In fact, I found that all participants in this case study experienced similar nutrition deficiency issues in these areas. Elaborating on the impact, one participant from Pak-houng village explained that:

> *"My family and I eat fish as our daily protein intake. However, I have caught significantly less fish in recent years. Many times, I have only beg able to catch just enough for 1 or 2 meals, at other times I have returned home from fishing with empty hands"*- (Participant A)

A participant from Houaykhoualouang village experienced a similar protein intake deficiency which he explained to me:

> *"Many times, I have returned home with empty hands from fishing or only catch very few fish, I have had to catch the Mekong river bank's frogs (Chinese edible frog) for food. Unfortunately, in the past few years, the frogs have disappeared from the river as well"*- (Participant A).

These comments reveal how both fish and frogs from the Mekong River (Chinese edible frog) are an important protein source for downstream villagers. Catching less fish and the disappearance of frogs directly negatively impacts these people's protein intake. This has become a severe problem for downstream villagers because there is no market in any of the three case studies' village. Therefore, if villagers cannot source protein from subsistence means, then they will go without daily protein.

Eating lesser forms of protein has also become an issue. For example, many villagers I spoke to eat dragonfly larvae as a supplementary source of protein but as one interviewee said, this is also becoming very difficult:

> *"I sometimes eaten more dragonfly larvae than fish or frog. However, the dragonfly larvae simply disappeared from the Mekong River four years ago"*- (Participant B).

In this section, these anecdotes show how the Xayabouly hydropower dam's construction phase has caused a loss of dragonfly larvae, frogs and fish from the Mekong River. Also illustrated is that these are the villagers' main source of protein and therefore has created serious nutrition deficiency.

5.4.2 Nutrition from vegetables, grains and pulses

In addition to the negative impact of protein intake from fish and dragonfly larvae, the Xayabouly hydropower dam's construction phase has also caused a severe decrease in the essential nutrients from vegetables, grains and pulses. All participants I talked to shared very similar stories about the impact on the nutrition they would normally receive from rice, beans, sweet corn, and chili peppers. For example, a participant from Pak-houng village explained how he has faced a decline in nutritional intake because he has not had enough rice to eat:

> *"I have been facing nutritional insufficiency from rice nearly 4 years now. Prior to the Xaybouly dam's construction phase, the rice yield from my garden was about 1 ton (1000 kg) which was enough to feed my family for nearly a year. In the past 4 years though, I have only harvested around 350 kg because of irregular flooding and riverbank erosion caused by the Xayabouly hydropower dam"*- (Participant D).

Moreover, a participant from Houaykhoualouang village shared with me the negative impacts from the construction phase explaining that: “Last year I only got 8 sacks of rice, around 400 kg which was definitely not enough to provide the right nutrition for my family - a family of 5 people” (participant E). Furthermore, a participant from Khokfak village told me how: “Prior to the Xayabouly hydropower dam’s construction phase, rice from my garden was enough to feed my family the right nutrition for over nine months……….. Life with not enough rice has been very hard. I was very concerned about my next daily meals and meals for next week and next month. I spent most of my income on rice, but still did not have enough to feed a family of 6 people”- (Participant B).

These statements show that the Xayabouly hydropower dam’s construction phase has not just had negative impacts on downstream villagers’ rice production for satiating hunger, but that this can also cause nutrition deficiency. This is largely because rice is such a staple food for these villagers to maintain ongoing health. In addition to the negative impacts on rice production, the Xayabouly hydropower dam’s construction phase has also consistently reduced downstream villagers’ bean, sweet corn, and chili pepper production. To elaborate a participant from Pak-houng village explained these impacts: “For three years, I have only harvested around one third of the sweet corn that I usually grow in my garden. It was a very hard choice to make whether to sell what sweet corn I had, or keep them for food” (Participant D). Similarly, another participant from Houaykhoualouang village shared the negative impacts he has experienced with his bean production during the construction phase which he explained thus:

> *“In the past few years, I have only managed to grow a few plots of long beans for food in my garden. And the last two years I decided not to grow beans at all because of irregular flooding caused by the Xayabouly hydropower dam constantly destroyed my bean patches. I need to eat beans for health but recently I have not eaten enough because buying it from the city’s markets is too expensive”*- (Participant B)

One other essential product for villager's health is the chili pepper. One participant related to me how regarding the chili pepper, he has struggled to grow this nutritious vegetable on his land.

> *"Before the Xayabouly hydropower dam construction, I used to have enough chili peppers for my family's consumption. However, the construction phase of this dam has had a severe impact on my chili pepper growing……..*
> *I have to buy chili peppers for eating now, but it is very expensive, so I have to reduce my consumption"*- (Participant D).

Participants in this section illustrate a decline of the nutrition villagers usually gain from a range of vegetables, grains and pulses such as rice, sweet corn beans and chili peppers. They show how the Xayabouly hydropower dam's construction phase has caused this waning which has resulted in an overall deterioration in nutrition intake among people in these affected villages. In sum, on the issue of nutrition then, the Xayabouly hydropower dam's construction phase has reduced downstream villagers' nutrition intake from fish, dragonfly larvae, sweet corn, rice long beans and chili peppers, all foods that provide ongoing nutrition, satiation and overall health. Participants identified that this decline was directly caused by the irregular flooding and river bank erosion that the dam construction triggered.

5.5 Impacts on daily commuting

5.5.1 Commute to and from riverbank gardens

Another impact villagers also discussed with me was how the Xayabouly hydropower dam's construction phase created huge problems for necessary daily commuting. Because the roads in these village areas are not in good condition, with many sharp curves and hills, daily commute by boat from village to village and to and from people's gardens is the most reliable method. However, all participants that I interviewed explained to me how the construction phase has changed this reliability and made their daily commute very much harder. To elaborate, a participant from

Houaykhoualouang village discussed the impact on daily commuting to and from his riverbank gardens:

> *"The Xayabouly hydropower dam's construction phase has made the way I commute to and from my gardens very difficult. I need to work in my garden very frequently, so I park my boat on the riverbank. Once when I left my garden to return home in the afternoon, I found that my boat was not on the water surface, it was stuck on the ground where the water level had been lowered to around 6 meters. My boat was not the only one either. One of my neighbor's boat also faced the same issue. My boat was too heavy for me and my wife to lift it down to reach where the water level was. I decided to turn home on foot. It took over an hour to get home"- (Participant B)*

In contrast to these lowered water levels, a rapid and substantial rise in the Mekong's water level also causes huge problems during daily commutes to and from the riverbank gardens. For example, a participant from Pak-houng village explained the impact on daily commuting that he experienced: "I went to work in one of my gardens, so I parked my boat at the bank. When I want to return home, I found that my boat was under water because the water level had been raised too high. So, I had to walk home (participant E). Another participant from Khokfak village also shared his experience about daily commuting difficulties caused by the Xayabouly hydropower dam's construction phase:

> *"Many times my boat was flooded because the water was raised too high. The last time was mid-June 2019. I planned to go to my riverbank garden for work, but I found in the early morning that my boat was under water. It took me and my wife over an hour to walk to the garden. Daily commuting is very hard because you do not have the information about when the Mekong water levels will rise and when it will they will be lowered"*- (Participant D).

5.5.2 Commute to and from between villages

Another commuting issue that arose during interviewing was the villagers' ability to commute to and from nearby villages. For instance, a participant from Houaykhoualouang explained the negative impacts on his ability to socially interact with other villages because of the issues now involved in commuting:

> *"I went to Khokfak village by boat to attend a special event. I went there in the early morning and planned to return home around 6:00 pm. After the event, I found that my boat was under water. My boat was not the only one either. In fact, many villagers' boats were under water too. So I had to spend over two hours walking to get home"*- (Participant D)

Another participant also shared the difficulty he experienced on his commute to visit family in KF village:

> *"Last May, in 2019 I visited my cousins in Khokfak village. I went there by boat and I parked my boat at the Mekong River's bank. After a half day in Khokfak, I decided to return home around 5: 00 pm. When I went down to the riverbank, I found that my boat was under water. The Mekong water level had been raised up to around 6 meters. So, I had to leave my boat behind and walk home instead of taking my boat"*- (Participant C)

These excerpts indicate that the Xayabouly hydropower dam's construction phase has caused frequent and abrupt changes to the Mekong water levels. As a result, downstream villagers are directly affected as they rely on the Mekong River for their daily commute to and from their gardens and also for commuting between villages for social engagements and cultural interaction. Therefore, villagers' work and social life have been much harder to maintain.

5.6 The impacts on fishing gear

5.6.1 Damage to fishing nets

The intermittent rising and lowering of the Mekong water levels triggered by the Xayabouly hydropower dam's construction phase has not only impacted on agricultural, income, nutrition and daily commuting regarding downstream villagers, it has also had a severe impact on people's fishing gear including, fishing nets, fishing hooks and fishing boats. All participants I talked to from the three case study villages in question faced these issues similarly. Elaborating on the impact on downstream villagers' fishing gear, a participant from Pak-houng village explained that:

> *"I lost six new fishing nets in just one night. I had just bought them from the city. The rapid rising of the Mekong water levels flushed all of my fishing nets away. I spent 750,000 Lao kip (USD 90) on them. I did not get a single fish from these nets"*- (Participant B).

Fishing nets are one of the most important pieces of equipment for downstream villagers. The nets are able to catch many fish per net and can also catch a large variety of fish size and species. Moreover, if they are properly maintained they can last as long as a year or more. One participant from Houaykhoualouang village shared his experience of losing his fishing nets:

> *"Prior to the Xayabouly hydropower dam's construction phase, most of my fishing nets lasted for a year or even longer. Since the dam changed the Mekong water levels though, I have to buy many finishing nets in the space of just one month. Some of the fishing nets I bought have been lost just two days later. At present, every time I set my fishing nets, I have to take the risk because I have no information*

> *on when the Mekong water levels will rise or fall. I just lost four of my newest fishing nets yesterday. Three nets were flushed away and one net got caught under mud because of the riverbank erosion. Fishing is very hard these days, but I have no other choice"*- (Participant C).

Such observations point to how the Xayabouly hydropower dam's construction phase has had a severe impact on downstream villagers' fishing nets. Instead of buying only a few nets per year prior to the dam construction, at present villagers have to buy many fishing nets per month. This results in a loss both in terms of fishing gear and money which leads to a daily economic burden.

5.6.2 Damage to fishing boats

The other very important piece of fishing equipment for downstream villagers are boats. The Xayabouly hydropower dam's construction phase has also caused significant damage to this vital fishing tool. Most of the participants I talked to experienced fishing boat damage caused by inconsistent rapid rising and falling of the Mekong water levels induced by the dam. To elaborate on this impact a participant from Pak-houng village explained:

> *"I lost my boat late April 2019. The Mekong water level was raised to 6 meters and my boat sank under the water, then it was flushed away. It happened during the night time. I had utilized that boat for nearly 8 years. It was the only boat that I have which was used for daily fishing and commuting. It will cost me around 12, 000, 000 Lao kip (USD 1200) to get a new boat. It cost me a lot, but I have no choice I have to buy a new one. If you do not have a boat, it means you do not have your legs. A boat is essential for me and my family"*- (Participant E).

Besides being flushed away a further concern about fishing boats, is that they simply sink due to the rapid rise of water levels. A participant from Houaykhoualouang village shared his experience with this:

> *"My boat has sunk many times with the very high and rapid rise of the Mekong water levels. The last time was late March 2019. Each time the boat sinks I have to clean the entire machine and change the engine oil which cost 150,000 Lao kip (USD 18). At present, I am having to regularly check the Mekong water levels every two hours so I can move my boat up or down with the water levels. However, it is very hard to keep this check on this during night time"*- (Participant B).

Apart from the water level rising falling water levels also puts strains on fishing boats. In particular, when the water level rapidly falls, boats become stuck on the ground and are cast far from the water. For example, a participant from Khokfak village explained how this was a problem for him:

> *"My boat and its engine were broken. It happened during the night early 2019. First it sank because of the Mekong water levels rising very high and then the water levels rapidly falling early in the morning in the same day. So, the boat become stuck on the top of a pile of sharp riverbank rocks. With the boat full of water, it flipped over and hit the rocks causing the boat's body to become broken. The engine also hit some sharp rocks and broke too. It cost me around 2, 000, 000 Lao kip (USD 240) to fix both the boat's body and the engine. I was lucky that my boat had not flushed away because my neighbouring villagers told me that some people's boats were flushed away in the same night"*- (Participant D).

These comments by participants illustrate how the Xayabouly hydropower dam's construction phase has had a direct negative impact on downstream villagers' boats. It can be inferred that this has led to a significant economic burden due to either the loss of a boat entirely or the expenditure paid out to fix the boats. In summary, the Xayabouly hydropower dam's construction phase has had multiple direct negative impacts on downstream villagers' tools for making a livelihood such as fishing boats and fishing nets.

Chapter 6: Discussion

6.1 Introduction

This thesis has explored the impacts on livelihoods from the construction of the Xayabouly hydropower dam. I have focused on downstream communities that live particularly close to the dam. I have set out an objective to fill the current gap in the literature, which is to better understand the impacts dams can have on downstream villagers during the construction phase. This chapter will attend to this gap by discussing the main findings of this research and will be arranged in sections based on the conceptual framework used in this research (see Figure 1). It begins with a discussion of the impacts on agricultural land which is the main social activity of downstream villagers. Subsequent to this I discuss the impacts on income the dam construction has caused. Following this section, I examine the implications of this research's findings and point to policy recommendations. Then I use the space left in this thesis to document the limitations of this study and make some suggestions for future research. Finally, this chapter ends with a consideration of alternative explanations of the findings regarding this research.

6.2 The impacts on agriculture land

6.2.1 Floods

The findings from this research showed that irregular floods and riverbank erosion are some of the main physical impacts with social and economic implication on downstream villagers. Specifically, the Xayabouly hydropower dam's construction phase has negatively impacted villagers' agricultural lands. Every participant I talked to had experienced significant losses in terms of agricultural crops as a result of irregular flooding and the destruction of land because of riverbank erosion. An interesting conclusion I have found is that the impacts that this dam's construction phase caused for people align with what Kirchherr and Charles (2016) noted in their matrix framework (see Figure 1).

Irregular floods on downstream villagers' agricultural lands inevitably led to the conclusion that the construction phase impacted on villagers' way of life negatively, and made day-to-day living very difficult, a point that resonates with Vanclay's (2003) argument about livelihoods being an interconnected system. To elaborate, the consequences of irregular floods is not an isolated matter. Flooding impacts on local villagers' lived environment in many ways. Perhaps most importantly, flooding causes severe erosion of villagers' lands which then leads to a loss of being able to agriculturally produce food. Flooding caused by the construction phase of the dam then seems to have disrupted villager's day to day living environment and their ability to grow food. Less food production also has more than one repercussion. For one, villagers grow food for subsistence living, in that they rely on their lands to feed their family. The villagers I talked too also grew food to sell so other essential commodities can be bought and children's education can be paid for. This situation also resonates with what Vanclay (2003) has argued, in that when less food is available for a family, this can lead to other social consequences, such as a decline in health, wellbeing and aspirations and a rise in anxiety and fear over such things as food security, finances and family employment education (see Vanclay, 2003).

These findings correlate with the growing knowledge that it is not only the operation phase that impacts on downstream villager's agricultural lands in Laos, as documented by Sivongsay (2015), but it is also the construction phase that impacts people. I argue that these findings are significant because they are the first examples that I know of that may be used to improve the understanding of the impacts of the construction phase of hydropower dams on agricultural lands of downstream villagers' in Laos. During interviews, all participants I talked to were very concerned about the irregular flooding on their agricultural lands which happened more frequently during the Xayabouly hydropower dam's construction phase. These findings are consistent with Sivongsay's (2015) recent study in Laos. She used six existing hydropower dams as case studies. Her research revealed that irregular floods and erosion were major issues induced by the dams which also impacted on downstream villagers. However, her findings were drawn from the dam's operational phase which is different from my own research that focusses on the construction phase of hydropower dams.

The results of my analysis showed that agricultural land was flooded due to the rapid rise of the Mekong River's water level. Participants also told me that flooding has occurred more frequently since late 2016 which was when some of the dam's turbines were installed. This frequent flooding then seems to be the consequence of turbine testing, commonly employed before hydropower dams begin electricity production in full, (in this case early 2020). Participants' views about flooding correlates with a number of studies conducted in the past few years, which concluded that irregular flooding occurs downstream when a reservoir is released in a sudden and sometimes uncontrolled way (Diman & Tahir, 2012; Shakibaeinia & Jin 2011; Carrivick, 2010). For example, a case study in China conducted by Chen et al., (2015) studied downstream water levels induced by the Gangkouwan hydropower dam. The authors collected hourly water levels and daily flow data and found downstream flow levels rapidly changed in a short time period when the hydropower plant's turbine operation was turned on and off (Chen et al., 2015). In fact, the authors point out that in less than an hour, downstream flows fluctuated from 1 m^3 /s, to 70 m^3 /s at base flow. However, when the turbines were turned on, flows were measured up to 145 m^3 /s when at full capacity.

Although most hydropower dams are built with the promise of downstream flood control, Vogholikar and Das (2010) argue that downstream floods occur anyway because most hydropower dams today are designed primarily for power generation, not for flood control. Moreover, these authors point out that most large hydropower dams make downstream rivers narrower and deeper than they would naturally be because of this intense flooding (Vogholikar and Das, 2010). Analysis of my data also revealed that irregular floods were powerful enough that they flushed villagers' crops and fishing gear downstream. This finding correlates with a study by Marris (2018) in which the author argued that due to rivers downstream becoming narrower and deeper, dam discharge can easily overflow onto riverbanks, which results in a faster, bigger and more powerful flow. This point was reflected during my interviews as well. Specifically, participants explained how the Xayabouly hydropower dam's construction phase induced floods that were bigger, and that they had a more powerful flow, than any floods they had experienced before the dam construction.

Huang, Gao,Yang and Xi(2018) have also conducted similar research and used the same (matrix) conceptual framework I used for this project. Their studies also focused on the social and economic impacts of flood induced by hydropower dam. However, they concentrated mostly on comparing the impacts before and after hydropower dam construction of many dams. This is quite different from my study in that I am only focused on the socioeconomic impacts of the dam's construction phase and my project is only centered on downstream communities. Despite the differences of focus, the floods that occurred during the construction of the Xayabouly were very similar to Huang et al.,'s (2018) findings that rapid floods were because of dam construction. In another dam case, Owusu, Obour and Nkansah (2018) studied the impacts of Kpong hydropower dam in Ghana on downstream communities. These authors' focus was the operational phase of dams though and mostly paid attention to the way in which hydropower dams induce waterborne diseases and drought that poses many challenges to farmers. Owusu et al., (2018) found that prolonged drought induced by the dam construction caused large losses financially for famers in terms of fertilizers. Owusu et al., (2018) also point out that the dam construction not only increased the outbreak of waterborne diseases but also contributed to the emergence of new waterborne diseases. Therefore, even though Owusu et al (2018) concentrated on different issues than me, their research reflects the extent of problems that flooding from dam constructions can have on people who live downstream, particularly for those who practise agriculture.

6.2.2. Riverbank erosion

The loss of agricultural lands was a significant issue for participants when talking about flooding but also when talking about erosion. In particular, villagers spoke to me about the loss of their riverbank gardens due to erosion. Erosion of these lands had a big impact on participants, personally, and financially. What's more, the erosion that had already occurred has the potential to get worse given the precarious state of villages' riverbanks. I suggest this erosion impacts on people's civil liberties outlined by Vanclay (2003). The consequences of these impacts could also result in a fear of villagers' futures and their children's futures (Vanclay, 2003). This is not just a material loss either as Vanclay notes, this kind of loss can lead to a decline in mental and spiritual wellbeing (2003).

My findings were consistent with Hupp, Schenk, Richter, Peet, and Townsend's (2009) study in which the authors spent two years researching three cases of dam-induced downstream riverbank erosion in the United states by installing bank-erosion pins on 66 transects. These authors found that the dam induced downstream riverbank erosion were severely comparing to natural induced erosion. Hupp et al., (2009) further argued that it was the rapid raising and lowering of water levels that was the main cause of erosion. Hupp et al.'s (2009) study is interesting in the context of my research as participants pointed to how the erosion they experienced was because of the Mekong water levels rising and lowering very quickly. Another study conducted by Liaghat, Adib and Gafouri (2017) examined the effects of the Karkheh hydropower dam on downstream river's morphology. These authors found that the downstream river's width had increased over 78 % from 60 meters to 273 meters.

My data analysis revealed that most of the participants I interviewed had lost up to half of the agricultural lands they owned due to riverbank erosion. However, these findings were different from the research conducted by Khan et al., (2014) where the authors assessed the impacts of the Kariba hydropower dam construction on the Zambezi River's morphology. The Kariba hydropower dam has very similar power production capacity as the Xayabouly hydropower dam and the distance of villages downstream of these dams are very similar as well. However, the authors compared the data during the construction phase and the operation phase of the dam and concluded that the Kariba hydropower dam has not significantly changed the Zambezi River's downstream morphology and, in particular, did not induce significant riverbank erosion.

One possible explanation as to why my findings are so different to Khan et al.,'s (2014) is that my study sites had mostly riverbank gardens that did not have plants or trees to prevent any riverbank erosion. In contrast, Khan et al.,'s (2014) study sites were inside a national park, the Mana Pools National Park. Therefore, these sites were mostly covered with trees and riparian zones which would help prevent riverbank erosion. My explanation for these differences in findings is based on Krzeminska et al.,'s (2019) conclusions; they studied the effectiveness of different vegetation types that could potentially prevent riverbank erosion and increase riverbank stability. These authors found that the riverbanks covered with trees had the highest soil stability, while the uncovered soil or banks with grass cover had the weakest stability. Every participant I talked to was very concerned about the consequences of their riverbank gardens being eroded. This was because these lands are the only pieces of land wherein, they can grow their food, as mentioned in chapter 3. Supporting this argument are other studies that attend to the consequences of agricultural land loss due to riverbank erosion.

For example, Dragicevic et al., (2013) examined the consequences of the Kolubara river bank erosion and its effect on downstream villagers in Serbia. These authors found that downstream villagers' crop production losses steadily increased over time and made poor farmers poorer. A similar study was conducted in China with regard to the Three Gorges dam in China and the impacts on the Yangtze downstream villagers. Gleick (2009) found that the Yangtze river bank erosion has made poor farmers poorer, and that they have faced significant food insecurity and joblessness, problems that can often lead to social marginalization. For example, another study in Bangladesh showed how the number of children who had dropped out of school increased every year due to their families' lands' poor conditions which were the consequence of riverbank erosion (Rahman, 2013).

6.3 The impacts on income

Income was a significant theme in my findings. For example, my data analysis showed that the lack of giant fish baits due to the destruction of the Khai tree severely impacted villagers' ability to earn money. In addition, the disappearance of the Mekong River's frogs and dragonfly larvae due to the Xayabouly hydropower dam's construction phase has also significantly and negatively impacted downstream villager's income.

Based on these findings, it is possible to argue that the water quality of the Mekong River has degraded during the construction phase, a reasonable explanation as to why there are no longer certain species around. Further evidence was also found from my data analysis wherein participants revealed that these phenomena only began occurring since the dam construction. Therefore, I argue these findings are significant, as they for the first time indicate some of the negative impacts of a hydropower dam's construction phase on downstream villagers' income in Laos. The results of this study showed that without the Khai tree worm, dragonfly larvae, or water beetle larvae, it was very hard to catch the Mekong River's giant catfish. Every participant I talked to explained during interviews that the giant catfish can usually only be caught by fishing hooks with the aforementioned bait. Very rarely were fishermen able to catch fish using fishing nets. Participants also told me how catching fewer giant fish meant less income generation from fishing.

This research was the first case study of the socioeconomic impacts of a hydropower dam's construction phase in Laos or in the Southeast Asian region. Therefore, I found very little literature to support my findings and the discussion of the impacts on agricultural lands and income for downstream villagers during interviews. Nevertheless, one possible explanation for the decline of fish bait for the villagers I interviewed was the usage of a massive amount of cement in the Xayabouly hydropower dam's construction phase. According to Portland Cement Association (PCA) (2019) the chemical composition of cement includes CaO: 62%, SiO_2: 22%, Al_2O_3: 5%, $CaSO_4$: 4%, Fe_2O_3: 3%, MgO: 2%, S: 1%, and Alkali: 1%. Among these ingredients, Al_2O3 and Fe_2O_3 are believed to be harmful for living organisms when they are present in high concentrations, usually at Nano-size level.

In addition, $CaSO_4$, S and Alkali are believed to play a key role in changing the pH level in water. Auffan et al., (2019) and Tiloke, Phulukdaree and Chuturgoon, (2016) argue that Nano-sized particles are fine materials which have at least one dimension <1000 Nanometre (nm) in diameter. At this level, the particles can penetrate through living organisms' cells. Past studies have also showed that the harder surfaces are, the more toxic they are (Auffan et al., 20019; Robertson et al., 2016).

During interviews, nearly all participants mentioned to me that before all the Khai trees had all died, the tree leaves started to turn yellow and would fall from the tree. Participants pointed out to me that it was not normal for the Khai tree to do this. Other participants also noted that the bark of the Khai trees was rotten and it smelt bad when they went to harvest Khai worms for fishing bait. One possible explanation for the decline of Khai trees is based on the research findings by Mazumdar and Ahmed (2011) and Mirzajani et al., (2013), who studied the effect of Nanoparticles on a model organism in plant biology, the *Arabidopsis thaliana*. The authors found that when plants were exposed to high concentrations of these particles by penetrating through plant cells, it caused cell and plasma damage which led to a disruption of the plants biological function. Rastogi et al., (2017) came to similar conclusions, that Nanoparticles penetrate through plants' cell wall and damage the cell and plasma which could lead to the death of plants.

In sum, these studies could be an explanation as to why there was rotten bark on the Khai trees which was noticed by participants when they went to harvest their fish bait. In fact, there are many more examples to elaborate the effects of Nanoparticles on wild plants. For example, Sparling and Lowe (1996, p. 3) studied the effects of Nano-sized aluminium particles, in North America, on wild plants. These authors state that after being exposed to Nano-sized aluminium particles "forest died in North America involving red spruce, Fraser fir, balsam fir, loblolly pine, slash pine, and sugar maples have been ascribed to aluminium toxicity".

Gostomski (1990) also conducted research focused on the toxicity of nano-sized aluminium particles. Gostomski (1990) examined the toxicity of aluminium particles regarding aquatic species in the United States of America. The author's findings showed that nano-sized aluminium was the cause of death in 17 aquatic plant species in the country. Similar findings were also documented by Barabasz et al., (2001) where the authors studied the toxicity of aluminium particles on bird and plants in Poland. The authors found that the higher the amount of accumulated aluminium there was in plants the faster the plants died. I suggest these cases could be used as research evidence to possibly explain the decline of Khai trees at the study sites of this project.

A similar issue to that of nano-sized aluminium particles is nano-sized iron oxide particles that also effects plants when present in high concentration (Bombin et al., 2015). For example, Bombin et al., (2015) elaborate on how the effects of nano-sized iron oxide particles effect on plants. To conduct this experiment, the authors examined that the effects of nano-sized iron oxide particles on a model organism, the

Arabidopsis thaliana. The authors' findings showed that the effects significantly reduced plant growth and shoot elongation. Notably, the higher the concentration of nano-sized iron oxide particles that the plant was exposed to, the more damage to plant roots became evident (Bombin et al., (2015).

Similarly, Hazeem et al., (2015) studied the impact of nano-sized iron oxide particles on the aquatic plant, *Picochlorum sp*. The authors found that 200 milligrams of nano-sized iron oxide particles per liter significantly reduced the growth of the plant. Moreover, at this level, it also severely reduced the concentration of chlorophyll a (Hazeem et al., (2015). Hartel and Grimm (1997) studied the consequences of chlorophyll a deficiency in wild tobacco and suggested that a severe deficiency of chlorophyll a could lead to the death of the plant. These findings could be an explanation for the Khai tree's leaves turning yellow before falling from the tree. Another study by Martinez-Fernandez et al., (2016) investigated the effect of nano-sized iron oxide on the common sunflower and discovered that accumulating nano-sized iron oxide leads to severely decreased nutrient uptake in the plant such as Ca, K, Mg and S. The authors further suggest the long term effects of high accumulation could lead to the death of the plant (Martinez-Fernandez et al., 2016). By gathering these various studies, it can be argued that the death of Khai trees may be caused by nano-sized aluminium and nano-sized iron oxide particles which were frequently used during the ten years of the Xayabouly hydropower dam's construction phase.

The disappearance of the Mekong River's bank frog, dragonfly larvae, and water beetle larvae that participants talked about also may be linked to the decline of Khai trees, based on the existing academic literature I have read. Like the Khai tree, the river's bank frog, dragonfly larvae, and water beetle larvae have simply disappeared from the Mekong River which according to participants occurred a few years after the Xayabouly hydropower dam's construction phase commenced. Therefore, it seems reasonable to suggest that the construction phase not only destroyed the Khai tree, but also killed some of the Mekong River's aquatic species. Once again, scientific explanations show how toxic the massive use of cement used in the construction phase is, on life forms. As mentioned above $Al2O_3$ and $Fe2O_3$ properties are believed to harm living organisms when they are present in high concentrations and CaO, S and Alcalie are believed to play a key role in changing the pH level in water. Aluminium is the third most abundant element on earth which can be found in most soil and rocks (United States Environmental Protection Agency, 2017). Aluminium is considered a non-essential element for most living organisms because they do not need it to function (United States Environmental Protection Agency, 2017). It can enter the water body by both natural process and by human made release of Aluminium (United States Environmental Protection Agency, 2017).

The toxicity of aluminium on living organisms has been studied for many decades. One study that could potentially explain the sudden disappearance of the Mekong River's bank frog, dragonfly larvae, and water beetle larvae in the Mekong River is research conducted by Sadinski and Dunson (1992). The authors studied the effects of low pH combined with aluminium contamination in the early stages of frog development and found that only one third of the embryo survived when high concentrations of aluminium were present in a low pH water. Similarly, Bantle, Fort and James (1989) studied the toxicity of aluminium on the Xenopus frog in the Central and United States of America. These authors found that over half of the embryos died and those that did survive were severely malformed. Similar to the effects of aluminium on aquatic species, nano-sized iron oxide particles are also well known to be toxic for living organisms.

For example, research conducted by Zhu, Tian and Cai (2012) found high toxicity from the Iron oxide Nano-size particles on Zebrafish early life stages (larvae stage). To elaborate, the authors found that around 10 mg/L of iron dioxide Nano-size particles caused a delay in Zebrafish's embryos hatching. The authors also found many hatched larvae were malformed and died. Although Zhu at al.,'s (2012) study was a laboratory based experiment, it seems to be one possible answer as to why the Mekong River frogs and dragonflies so suddenly disappeared. Frogs and dragonflies breed and lay eggs in streams as they tend to breed and lay eggs where they live, so the consistent use of massive amounts of cement on the Xayabouly dam construction phase may have directly affected these species' eggs and larvae. The result has been in the loss of downstream participants' income from frog and dragonfly larvae harvesting.

Another demonstration of how nano-sized iron oxide particle affect the early life stages of aquatic species in the wild was research conducted by Cadmus, Brinkman and May (2018). These researchers studied the toxicity of Iron on North American aquatic organisms including "including brown trout (*Salmo trutta*), mountain whitefsh (*Prosopium williamsoni*), boreal toad tadpoles (*Bufo boreas*), the oligochaete worm (*Lumbriculus variegatus)*, the mayfy (*Hexagenia limbate*), and the planarian (*Dugesia dorotocephala*)" (Cadmus et al., 2018, p. 605). The authors found that Iron contamination significantly reduced the growth and development of boreal toad tadpoles and the reproduction of mayflies and earthworms (Cadmus et al., 2018). These findings resonated with what was talked about during my interviews, when some participants pointed out that they spent many hours only to find one riverbank frog. The evidence from this above literature then, could explain why riverbank frogs, dragonfly larvae and water beetle larvae have disappeared from the Mekong River since the construction phase of the dam commenced

A further possible explanation for the disappearance of riverbank frogs and dragonflies on the Mekong River is the pH level of the river water which seems to have changed to a very harmful level during the construction phase. I base this reasoning on the fact that 62 % of cement is Lime (CaO) (Poland Cement Association, 2019). This means that, the more lime there is dissolved in water the more acidic the water will be (Healthline, 2016). Similar studies have supported this possibility. For example, Spyra (2017) studied the impact of pH levels on freshwater ponds' snails in Poland. The author found that the ponds with the lowest pH (very strong acidity levels) and the highest pH (basic) had the lowest diversity and lowest population of snail species, while the natural pH ponds had the highest diversity and population of snails. Furthermore, Boyer and Grue (1994) conducted research on water quality criteria for frogs and pointed out that frogs are more sensitive to water contamination than other aquatic species. In particular they argued water contaminated with nano-sized particles significantly reduces the survival of frog larvae.

Aside from water contamination, Beattie and Jones (1992) studied the impacts of pH levels on frogs. The authors found that low pH levels significantly reduced egg fertilization and embryonic development of the common frog (*Rana temporaria*). These researchers also found that acidification of a frog's natural environment can change the physiological ionic balance in the animal which results in a reduction of larvae growth and survival. This scientific evidence helps support the claims by villagers that there has been a severe decline of not only good fishing bait, such as the Khai wood worms but also frogs and frog larvae. These issues are directly related to income loss as catching the giant catfish and other types of aquatic species are key to these villager's income capacity.

In conclusion, the evidence presented in this section points to how the large amounts of cement during the construction phase of the dam could be the main cause of the decline of the Mekong River's bank frog, dragonfly larvae, and water beetle larvae. As a result of these disappearances, participants' income was severely eroded. Compounding this situation was also the disappearance of the water beetle larvae and dragonfly larvae bait which resulted in less income because of the fact that participants were unable to catch and sell the giant catfish. Suffice to say, the impacts noted here on villagers' income could lead to uncertain futures in terms of food security, income and the raising of children, points that Vanclay (2003) says need to be attended to during projects such as dam construction Less income to support one's family could also result in poor physical and mental health of villagers and even a lack of cohesion or community stability (Vanclay, 2003).

6.4 Implications and policy recommendations

The results of this research have implications for the hydropower dam sector in Laos. The first significant contribution of my research is that it has made visible the kinds of socio-economic impacts of a hydropower dam's construction phase on downstream communities in Laos. These impacts have yet to be brought to public attention or recognition by the Lao government authorities. A further implication of my findings is that this is the first analysis of socio-economic impacts on downstream communities which may help future plans for building the nine more hydropower dams planned on the Mekong River in Laos. By raising an awareness of the downstream impacts, it makes the impacts visible for future policy development in Laos.

The results are clear that the socio-economic impacts on downstream villagers have been largely ignored (Richter et al., 2010). This point was reflected during interviews as participants were told that they were considered not to be ‘‘directly” impacted.

Future policy should clearly address this gap and define types of livelihood improvement programs that are consistent with the impacts downstream villagers experienced. For example, the closer villages are to the hydropower dams, the more livelihood improvement programs there should be. My own analysis showed how electric generation is the main cause of irregular floods, which leads to agricultural land loss – also causing riverbank erosion. Moreover, nutrition deficiency can follow, and daily commuting and economic losses such as through damaged fishing gear and boats were all issues that affected participants. Therefore, future policy should clearly address these issues by, for one, regulating water discharge according to the river's natural cycle.

The results I gathered from the interviews also showed that the impact on income was a serious issue for downstream villagers. For example, income from the river's ecosystem services included fish, frog and dragonfly larvae. Therefore, future policy should seriously take into account employment opportunities for downstream villagers as well as prevent the degradation of the river's ecosystem services during the construction phase. The decline of the Khai tree, the disappearance of riverbank frogs and dragonfly larvae has led to the reduction in downstream villagers' income, and this is an issue that needs remedying.

A final point for policy developers to take into consideration is the compensation of economic loss such as crops, teak trees, fishing nets and boats. There were severe losses in this regard that were raised within interviews whereby participants pointed out that neither the GoL nor the dam operator provided downstream livelihood improvement programmes and compensation for their losses (Sivonzgsay, 2015). This is a serious issue as downstream livelihood improvement programmes and compensation offers are dependent on the hydropower operators' obligations under their contract. Therefore, I argue that new policy should clearly address this lack and ensure that all stakeholders including the GoL, loan providers and export credit agencies are aware of the situation and fulfil their legal obligations (Sivonzgsay, 2015).

6.5 Limitations of this study

They are four main limitations in this research. The first limitation is that the participants recruited in this research are not representative of the total population of villagers who live downstream from the Xayabouly hydropower dam. It is important in research that the sample of participants recruited is large enough to obtain enough data to sufficient describe the phenomena of interest and address the research questions. The sample sizes will then, vary from scholar to scholar. For example, Creswell (1998) argues in order to obtain sufficient data, the sample size should cover at least 10 % of the total population. More (1994) suggests around 30-50 participants and Guest et al., (2006) suggests that 15 is the smallest sample sizes that are acceptable in research. Moreover, Marshall et al., (2015) and Robison, (2013) suggest that the larger the sample sizes, the more data will be available to describe the phenomena in questions. In this research, I recruited five participants per village out of over two hundred villagers in each village, so my findings only represent a small proportion of the population's point of view.

The second limitation of my study was that this research recruited only male participants or head of family for interviews. The reason for this was because in Laos culture men are, mostly, the people who carry out the hard physical work and outdoor activities such as fishing and land cultivation whereas women mostly do housework. However, during fieldwork, I heard that some women in the villages I was in do also carry out work related to fishing and cultivation. Because I only recruited male participants, the findings in this study can only talk about male perspectives and not female perspectives.

Another limitation of my research was geographical or location constraints. This research only interviewed downstream villagers from one side of the Mekong River. There are villages on the other side of the river too, but these are extremely difficult to access via the road. It is a hilly road and in very bad conditions it takes a whole day to access those villages from the city. Moreover, it can only be accessed during the dry season, October to March. Therefore, it was not feasible to interview people from these villages.

The final main limitation in this study was that people from the Khmer ethnic group were not represented in this study. About 99 % of the population in the three case study villages belong to Lao Loum, the ethnic group that makes up over 68 % of the total population in Laos. However, there are two Khmer villages across from Pak-houng village and Huaykhoualuang village which are not included in this study. Over 90 % of villagers in these two villages are Khmer, an ethnic group in Laos that makes up about 11 % of the total population in Laos. Therefore, it is important to mention that the findings of this research only incorporate the views of Lao Loum people.

6.6 Future research

This is the first case study examining the socio-economic impacts of a hydropower dam's construction phase on downstream villagers in Laos. Therefore, there are some avenues for future research that I recommend that follow on from my initial research in this area. For one, my data analysis showed that the deaths of many Khai trees, the disappearances of riverbank frogs and dragonflies in the Mekong River results in income loss for participants dependent on the river's ecosystems. Future research should use both qualitative and quantitative methods to obtain more data to improve this situation. For example, collecting water samples during the entire construction phase would provide the scientific evidence needed for policy change and using a survey technique to gain a wider sample of participants, I think, would help in building more robust research outcomes.

Furthermore, this project only involved a few participants from each village for interviewing and only males were recruited. In order to extend the findings of my work, future research should recruit both male and female participants for interviewing and recruit more participants. A final gap that future research could fill is to recruit participants from both sides of the Mekong River to gain, obtain more accurate data as suggested by Marshall et al., (2015) and Robison (2013) who argue that the larger the sample sizes are, the more accurate the information gathered will be.

6. 7 Alternative explanations of the findings

The socio-economic impacts of hydropower dam construction in Laos are issues that have been very well known to Lao people for many decades. The socioeconomic impacts of dam constructions appear on social media such as Facebook and TV channels and so villagers have a fairly good understanding about these issues. The most notable impact has been the collapse of a saddle dam in Attapeu province, Southern Laos, in late July 2018. It was a devastating human-made disaster which costed many villagers' lives and over 6,600 people were displaced.

Because of the media attention of dam-induced harm then, it is possible that some of the impacts that participants talked about in this research were exaggerated. Maybe the impacts they talked of were not personal experiences, but taken from what they saw on the news or their social media 'feeds'. By exaggerating the impacts, downstream villagers may also draw more attention to both the government and dam operators. This, in turn, could lead to better offers of livelihood improvement programs and compensation grants from the dam's operators.

Therefore, if I was to design this study again, they are some changes I would like to make. Firstly, I would recruit participants to interview that covered at least 10 % of the total village population (Creswell, 1998). This would be to ensure the consistency and accuracy of my data. The second change that I would like to make is to interview downstream villagers from both sides of the river. This would be to ensure that the obtained data more broadly related to the social impacts that the Xayabouly hydropower dam's construction phase has on downstream villagers. The final change that I would make is to interview villagers who live further downstream to compare the impacts on those who are close and those who are distant from the dam. This could help future policy making and development.

7.8 Conclusion

The construction of the Xayabouly hydropower dam has had significant impacts on the social and economic life of downstream villagers. Hydropower dam development in Laos is important for poverty eradication and ‘green’ economic development. However, hydropower dam construction also comes at a cost for villagers who heavily rely on rivers in their daily lives. This research has explored one case study to investigate in-depth, the costs of one hydro dam’s construction phase. This research found 5 main negative impacts experienced by villagers and therefore discussed: 1) the impacts on downstream villagers’ agricultural lands, 2) The impacts on downstream villagers’ income, 3) The impacts on downstream villagers’ nutrition intake from fish and vegetable, 4) The impacts on downstream villagers daily commuting, and 5) The damage of fishing gears. These results showed that there is a need for carefully forming and developing policies and strategies for future hydropower dam construction in order to minimize the negative impacts on villagers. This research also highlights the usefulness of the matrix framework as a way to guide this kind of qualitative research. Finally, hydropower dam development may be a way for Laos to address poverty and an environmentally sustainable economy, but it continues to be sector that does not provide many benefits for those who are negatively impacted. Given there is little chance that the hydro dam economy is going to ease in Laos, measures need to be put in place so that villagers who live in remote areas will not be so negatively affected.

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Appendices

Appendix A Ethics Approval

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA UNIVERSITY OF WELLINGTON

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

MEMORANDUM

TO	Yia Yang
FROM	Dr Judith Loveridge, Convenor, Human Ethics Committee
DATE	30 May 2019
PAGES	1
SUBJECT	**Ethics Approval** **Number:** 0000027469 **Title:** Examining the Xayabouri dam: Impacts of hydropower dam construction on downstream communities

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,

J. A. Loveridge

Judith Loveridge

Convenor, Victoria University of Wellington Human Ethics Committee

Appendix B Letter to Lao Ministry of Energy and Mines

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

To: Permanent Secretary Office of Ministry of Energy and Mines

Subject: Data collection on the impacts of the Xayabouri hydropower dam's construction phase on downstream communities for the completion of a master's thesis

My name is Yia Yang, a Lao student under the New Zealand Scholarship Program. I am studying a master's degree in Environmental Studies at the School of Geography, Environment and Earth Sciences, Victoria University of Wellington, New Zealand.

As a part of the requirement from Victoria University of Wellington to complete a master's degree, I am conducting a research project titled "Examining the Xayabouri dam: Impacts of hydropower dam construction on downstream communities". The objective is to investigate the impacts of Xayabouri hydropower dam's construction phase on the livelihood of downstream villagers from Pak-houng, Houaykhoualuang and Khokfak villages. For more information about my research project, a summary of the research project proposal is attached to this letter.

The data collection will be on June 25, 2019 to July 28, 2019. Face-to-Face interview is the main method to get information from selected villagers. The identities and information of the participants will be kept confidential. The data from the field will be used in this master thesis, future publication in academic or professional journals and dissemination at academic or professional conferences only.

I am writing this letter to request your approval as well as notify local authorities about the objective of my research.

Wellington, 09/06/ 2019

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Yia Yang
School of Geography, Environment and Earth Sciences
Victoria University of Wellington
New Zealand

Appendix C Information Sheet for Participants

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

Examining the Xayabouri dam: Impacts of hydropower dam's construction on downstream communities

INFORMATION SHEET FOR PARTICIPANTS

You are invited to take part in this research. Please read this information before deciding whether or not to take part. If you decide to participate, thank you. If you decide not to participate, thank you for considering this request.

Who am I?

My name is Yia Yang and I am a master student in Environmental Studies at Victoria University of Wellington. This research project is to work towards my thesis.

What is the aim of the project?

This project will study the impacts of the Xayabouri hydropower dam's construction phase on downstream communities particularly those who live very close to the dam and more specifically those whose daily life depend on the Mekong River for food, income, drinking and daily usage.

This research has been approved by the Victoria University of Wellington Human Ethics Committee *[Approval number 27469]*.

How can you help?

You have been invited to participate because your villages are the closest to the dam and potentially you are the most affected. If you agree to take part, I will interview you at your house or at a place you feel comfortable. I will ask you questions about the impacts of the construction phase on your daily life.

The interview will take around an hour. I will audio record the interview with your permission and write it up later. You can choose to not answer any question or stop the interview at any time, without giving a reason. You can withdraw from the study by contacting me at any time before 28 August 2019. If you withdraw, the information you provided will be destroyed or returned to you.

What will happen to the information you give?

This research is confidential. This means that the researchers named below will be aware of your identity, but the research data will be combined, and your identity will not be revealed in any reports, presentations, or public documentation. You will not be named in the final thesis.

Only my supervisors and I will read the notes or transcript of the interview. The interview transcripts, summaries and any recordings will be kept securely and destroyed on 30 September

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2020. This research has been approved by the Ministry of Energy and Mines and its departments at local levels. Therefore, it will not raise any ethic issues with you.

What will the project produce?

The information from my research will be used in my master thesis. The findings will be shared with the Ministry of Energy and Mines.

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 do 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 before 30 September 2019;
- ask any questions about the study at any time;
- be able to read any reports of this research by emailing the researcher to request a copy.

If you decide to withdraw after this interview, you can contact me directly by phone call: 020 77948795. If you would like to read the finding summary, I will prepare Lao version and mail it to you directly or send it to your email and Facebook.

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:	**Supervisor:**
Name: Yia Yang	Name: Wokje Abrahamse
University email address:	Role: Senior lecturer
yangyia@myvuw.ac.nz	School: Geography, Environment and Earth Sciences
	Phone: 64 044635217
	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.

Appendix D Interview Consent Form

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

Examining the Xayabouri dam: Impacts of hydropower dam construction on downstream communities

CONSENT TO INTERVIEW

This consent form will be held for 3 years.

Researcher: Yia Yang, School of Geography, Environment and Earth Science, Victoria University of Wellington.

- 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.
- I agree to take part in an audio recorded interview.

I understand that:

- I may withdraw from this study at any point before 28 August 2019, and any information that I have provided will be returned to me or destroyed.
- The identifiable information I have provided will be destroyed on 30 March 2020
- Any information I provide will be kept confidential to the researcher and the supervisor.
- I understand that the results will be used for a master's thesis.
- My name will not be used in reports, nor will any information that would identify me.
- I would like a summary of my interview Yes ☐ No ☐
- I would like to receive a copy of the final report and have added my email address below. Yes ☐ No ☐

Signature of participant: ______________________________

Name of participant: ______________________________

Date: ____________

Contact details: ______________________________

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Appendix E Interview Questions

ແບບຟອມສອບຖາມ

ການສຶກສາ: "ຜົນກະທົບຂອງການກໍ່ສ້າງເຂື່ອນໄຟຟ້າພະລັງງານນໍ້າໄຊຍະບູລີ ຕໍ່ປະຊາຊົນທີ່ຢູ່ລຸ່ມເຂື່ອນ"

ວັນ, ເດືອນ, ປີ: .... ສະຖານທີ່ ບ້ານ: ....ເມືອງ..................ແຂວງ.................
ຊື່ ແລະ ນາມສະກຸນຜູ້ໃຫ້ສໍາພາດ: ....,ອາຍຸ.........ປີ, ເບີ
ໂທ:.......................
ສະຖານະພາບ: ☐ ໂສດ ☐ ແຕ່ງງານແລ້ວ (☐ ຫົວໜ້າຄອບຄົວ ☐ ສະມາຊິກ)

ຄໍາຖາມສໍາລັບການສໍາພາດຄັ້ງນີ້ ໄດ້ແບ່ງອອກເປັນຫົວຂໍ້ຍ່ອຍຄື: ຂໍ້ມູນທົ່ວໄປ, ຜົນກະທົບຕໍ່ທີ່ດິນ ແລະ ເຮືອນຊານບ້ານຊ່ອງ, ຜົນກະທົບຕໍ່ລາຍຮັບ ແລະ ການປະກອບອາຊີບ, ຜົນກະທົບຕໍ່ສຸຂະພາບ ແລະ ໂພສະນາການ ແລະ ຄວາມຄາດຫວັງໃນຕໍ່ໜ້າ.

1. ຄໍາຖາມທົ່ວໄປ:

1.1 ທ່ານອາໄສຢູ່ບ້ານນີ້ມາດົນປານໃດແລ້ວ ?

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1.2 ຊີວິດການເປັນຢູ່ຂອງທ່ານ ກ່ອນການກໍ່ສ້າງເຂື່ອນເປັນແນວໃດ ?

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1.3 ໂດຍລວມແລ້ວ ຊີວິດການເປັນຢູ່ຂອງທ່ານມີການປ່ຽນແປງແນວໃດ ນັບຕັ້ງແຕ່ເລີ່ມມີການກໍ່ສ້າງເຂື່ອນ ? (ເລົ່າໂດຍຫຍໍ້ ມີຫຍັງແດ່ດີຂຶ້ນ ແລະ ມີຫຍັງແດ່ຫຍຸ້ງຍາກກວ່າເກົ່າ)

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ຂໍ້ຫຍຸ້ງຍາກ: ....

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1.4 ທ່ານມີສ່ວນຮ່ວມຫຼາຍຫຍັງແດ່ ໃນການປຶກສາຫາລື ແລະ ຕັດສິນໃຈ ກ່ຽວກັບ ການກໍ່ສ້າງເຂື່ອນດັ່ງກ່າວ ?

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2. ຜົນກະທົບຕໍ່ທີ່ດິນ ແລະ ເຮືອນຊານບ້ານຊ່ອງ:

2.1 ໃນໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ທີ່ດິນກະສິກຳ ລວມທັງສວນຄົວຂອງທ່ານ ?

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2.2 ຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ຊັບສິນຂອງທ່ານ ໂດຍສະເພາະເຮືອນ ແລະ ດິນປຸກສ້າງ ?

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2.3 ທ່ານໄດ້ຮັບການຊົດເຊີຍຫຍັງແດ່ ຈາກການກໍ່ສ້າງເຂື່ອນ ແລະ ຄິດວ່າເໝາະສົມຫຼືບໍ່, ຖ້າບໍ່ໄດ້ຮັບ ຍ້ອນຫຍັງ ?

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3. ຜົນກະທົບຕໍ່ລາຍຮັບ ແລະ ການປະກອບອາຊີບ:

3.1 ຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ລາຍຮັບຈາກການຫາປາຂອງທ່ານ ?

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3.2 ຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ລາຍຮັບຈາກການປູກຜັກຕ່າງໆ ຂອງທ່ານ ?

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3.3 ທ່ານໄດ້ປະກອບອາຊີບຫຍັງແດ່ ໃນຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ?

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3.4 ຜົນກະທົບທາງບວກ ແລະ ທາງລົບ ໃນຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ຕໍ່ລາຍຮັບ ແລະ ການປະກອບອາຊີບຂອງທ່ານ ມີຫຍັງແດ່ ?

ຜົນກະທົບທາງບວກ:..
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ຜົນກະທົບທາງລົບ:..
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4. ຜົນກະທົບຕໍ່ສຸຂະພາບ ແລະ ໂພສະນາການ:

4.1 ໃນຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບຫຍັງແດ່ ຕໍ່ສຸຂະພາບຂອງທ່ານ ?

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4.2 ທ່ານຄິດວ່າ ໃນການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ຄຸນນະພາບນໍ້າ ແລະ ສິ່ງຜົນກະທົບແນວໃດ ຕໍ່ສຸຂະພາບຂອງທ່ານ ?

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4.3 ຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ການຫາປາມາປະກອບອາຫານ ? (ຫາໄດ້ເທົ່າກັນກັບໄລຍະກ່ອນການກໍ່ສ້າງເຂື່ອນ ຫຼື ຫາໄດ້ໜ້ອຍລົງ ຫຼື ຫາໄດ້ຫຼາຍຂຶ້ນ)

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4.4 ຜົນກະທົບອື່ນໆ ທີ່ທ່ານໄດ້ຮັບໃນຊ່ວງໄລຍະການກໍ່ສ້າງນີ້ມີຫຍັງແດ່ ?

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4.5 ໃນຊ່ວງໄລຍະການກໍ່ສ້າງເຂື່ອນ ມີຜົນກະທົບແນວໃດ ຕໍ່ປະລິມານ ແລະ ຄຸນນະພາບຂອງອາຫານ ເຊັ່ນ: ປາ ແລະ ຜັກສວນຄົວ? (ດ້ານບວກ ແລະ ດ້ານລົບ)

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ດ້ານລົບ:...
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5. ຄວາມຄາດຫວັງໃນຕໍ່ໜ້າ:

5.1 ທ່ານຕ້ອງການຄວາມຊ່ວຍເຫຼືອຫຍັງແດ່ ຈາກລັດຖະບານ ແລະ ເຈົ້າຂອງໂຄງການ ?
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ທ່ານຕ້ອງການຄວາມຊ່ວຍເຫຼືອຫຍັງແດ່ ຈາກລັດຖະບານ ເພື່ອບັນເທົາຜົນກະທົບທີ່ທ່ານໄດ້ຮັບ ?
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ທ່ານມີຄຳເຫັນ ແລະ ຂໍ້ສະເໜີແນະອື່ນໆ ຕໍ່ໂຄງການດັ່ງກ່າວ ?

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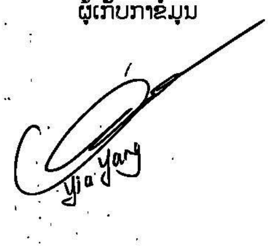
ຜູ້ເກັບກາຂໍ້ມູນ



Appendix F Approval Letter from Ministry of Energy and Mines

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ

ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງພະລັງງານແລະບໍ່ແຮ່
ຂາເຂົ້າ ເລກທີ 3354
ວັນທີ 24.6.19

ພະລັງງານແລະບໍ່ແຮ່
ENERGY AND MINES

ກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່

ກົມທຸລະກິດພະລັງງານ

ເລກທີ: 1140 /ກທພ.ພພ

ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ 24 JUN 2019

ໜັງສືສະເໜີ

ຮຽນ: ທ່ານ ຫົວໜ້າຫ້ອງການ ກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່, ທີ່ນັບຖື

ເລື່ອງ: ການລົງເກັບກຳຂໍ້ມູນ ຂອງນັກສຶກສາປະລິນຍາໂທ ກ່ຽວກັບ ຜົນກະທົບຂອງການກໍ່ສ້າງເຂື່ອນໄຟຟ້ານ້ຳຂອງໄຊຍະບູລີ ຕໍ່ປະຊາຊົນ 3 ບ້ານທີ່ຢູ່ລຸ່ມເຂື່ອນ.

- ອີງຕາມໜັງສືສະເໜີ ການລົງເກັບກຳຂໍ້ມູນ ເພື່ອປະກອບການຂຽນບົດຈົບຊັ້ນຂອງຜູ້ກ່ຽວ ສະບັບລົງວັນທີ 09 ມິຖຸນາ 2019.

ກົມທຸລະກິດພະລັງງານ (ກທພ) ຂໍຖືເປັນກຽດຮຽນລາຍງານມາຍັງທ່ານຊາບວ່າ **ທ້າວ ເຢຍ ຢ້າງ** ນັກສຶກສາປະລິນຍາໂທ ປີທີ 2 ສາຂາການສຶກສາຜົນກະທົບຕໍ່ສິ່ງແວດລ້ອມ ຈາກມະຫາວິທະຍາໄລ ວິກຕໍເຣຍ ແຫ່ງນະຄອນຫຼວງແວລິງຕັນ (Victoria University of Wellington), ປະເທດນິວຊີແລນ ເຊິ່ງໄດ້ຮັບ ທຶນການສຶກສາຈາກລັດຖະບານນິວຊີແລນ ໃນສົກສຶກສາ 2017-2020 ມີຈຸດປະສົງ ສະເໜີຂໍລົງເກັບກຳຂໍ້ມູນຢູ່ 3 ບ້ານ ລຸ່ມເຂື່ອນ ໄດ້ແກ່ ບ້ານປາກຮຸ່ງ, ບ້ານຫ້ວຍຂົວຫຼວງ ແລະ ບ້ານຄົກຟາກ ເມືອງໄຊຍະບູລີ ແຂວງໄຊຍະບູລີ ໃນລະຫວ່າງວັນທີ 25 ມິຖຸນາ ຫາ 28 ກໍລະກົດ 2019 ເພື່ອເປັນຂໍ້ມູນປະກອບໃສ່ການຂຽນບົດນິພົນ ໃນຫົວຂໍ້ສຶກສາ "ຜົນກະທົບຂອງການກໍ່ສ້າງເຂື່ອນໄຟຟ້າພະລັງງານນ້ຳໄຊຍະບູລີ ຕໍ່ປະຊາຊົນທີ່ຢູ່ລຸ່ມເຂື່ອນ".

ດັ່ງນັ້ນ, ຈຶ່ງຮຽນສະເໜີມາຍັງທ່ານ ພິຈາລະນານຳສົ່ງໜັງສືທາງການແຈ້ງໄປຍັງອຳນາດການປົກຄອງທ້ອງຖິ່ນແຂວງໄຊຍະບູລີ ຮັບຊາບ ແລະ ເອື້ອອຳນວຍຄວາມສະດວກ ໃຫ້ຜູ້ກ່ຽວ ສາມາດລົງໄປເກັບກຳຂໍ້ມູນດັ່ງກ່າວ ຕາມເຫັນສົມຄວນດ້ວຍ.

ດ້ວຍຄວາມນັບຖື,

ຮັກສາການຫົວໜ້າກົມ

ສົມພົດ ແກ້ວວິຈິດ

ພະແນກພັດທະນາໂຄງການ, ກົມທຸລະກິດພະລັງງານ, ກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່, ໂທລະສັບ 021 415 268, ແຟັກ: 021 415 626.

Appendix G Letter from Ministry of Energy and Mines to local authorities

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ

ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່

ຫ້ອງການກະຊວງ

ເລກທີ 1886 /ຫກ

ນະຄອນຫລວງວຽງຈັນ, ວັນທີ 27 JUN 2019

ຮຽນ: ທ່ານ ຫົວໜ້າ ພະແນກພະລັງງານ ແລະ ບໍ່ແຮ່ ແຂວງ ໄຊຍະບູລີ ທີ່ນັບຖື

ເລື່ອງ: ການລົງເກັບກຳຂໍ້ມູນຂອງນັກສຶກສາປະລິນຍາໂທ ກ່ຽວກັບຜົນກະທົບຂອງການກໍ່ສ້າງ ເຂື່ອນໄຟຟ້ານ້ຳຂອງ ໄຊຍະບູລີ ຕໍ່ປະຊາຊົນ 3 ບ້ານທີ່ຢູ່ລຸ່ມເຂື່ອນ.

- ອີງຕາມໜັງສືສະເໜີການລົງເກັບກຳຂໍ້ມູນ ເພື່ອປະກອບການຂຽນບົດຈົບຊັ້ນຂອງທ້າວ ເຢຍຢາງ ລົງວັນທີ 09/6/2019.
- ອີງຕາມໜັງສືສະເໜີ ຂອງກົມວິຊາການ(ກົມທຸລະກິດພະລັງງານ) ສະບັບເລກທີ 1140/ພບ.ກທພ-ພພຄ, ລົງວັນທີ 24/6/2019.

ຫ້ອງການກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່ ຂໍຖືເປັນກຽດຮຽນສະເໜີແຈ້ງມາຍັງທ່ານຊາບວ່າ: ທ້າວ ເຢຍ ຢາງ ນັກສຶກສາ ປະລິນຍາໂທ ປີ 2 ສາຂາການສຶກສາຜົນກະທົບຕໍ່ສິ່ງແວດລ້ອມ ຈາກມະຫາວິທະຍາໄລ ວິກຕໍເລຍ ແຫ່ງນະຄອນ ແວວລິງຕັນ (Victoria University of Wellington) ປະເທດ ນິວຊີແລນ ເຊິ່ງໄດ້ຮັບ ທຶນການສຶກສາຈາກ ລັດຖະບານ ນິວຊີແລນ ໃນສົກປີ 2017-2020 ມີຈຸດປະສົງສະເໜີຂໍລົງເກັບກຳຂໍ້ມູນ ຢູ່ 3 ບ້ານ ລຸ່ມເຂື່ອນໄດ້ແກ່ບ້ານ ປາກຮຸ່ງ,ບ້ານຫ້ວຍຂົວຫລວງ ແລະ ບ້ານຄົກຟາກ ເມືອງ ໄຊຍະບູລີ ແຂວງ ໄຊຍະບູລີ ໃນລະຫວ່າງວັນທີ 25 ມິຖຸນາ ຫາ 28 ກໍລະກົດ 2019 ເພື່ອເປັນຂໍ້ມູນປະກອບຂຽນບົດນິພົນ ໃນຫົວຂໍ້ສຶກສາ ຜົນກະທົບຂອງການກໍ່ສ້າງເຂື່ອນໄຟຟ້າພະລັງງານນ້ຳໄຊຍະບູລີ ຕໍ່ປະຊາຊົນທີ່ຢູ່ລຸ່ມເຂື່ອນ.

ດັ່ງນັ້ນ, ຈຶ່ງຂໍແຈ້ງມາຍັງທ່ານ ເພື່ອປະສານໄປຍັງອຳນາດການປົກຄອງທ້ອງຖິ່ນ ເພື່ອຊາບ ແລະ ອຳນວຍຄວາມສະດວກໃຫ້ນັກສຶກສາຂໍລົງເກັບກຳຂໍ້ມູນດັ່ງກ່າວ ຕາມເຫັນສົມຄວນດ້ວຍ .

ຫົວໜ້າຫ້ອງການ

ເພັດສະຫວັນ ລັດຕະນະທົງໄຊ

ເບີຕິດຕໍ່ພົວພັນຜູ້ກ່ຽວ
+64 04463 5217
ເມວ: Wokje.abrahamse@vuw.ac.nz

ພະແນກເລຂານຸການພິທີການ ແລະ ສັງລວມ (ຫ້ອງການກະຊວງ) , ກະຊວງພະລັງງານ ແລະ ບໍ່ແຮ່ ໂທ:021 413009, ແຟັກ 021 413005