

CHAPTER 1

INTRODUCTION

1.1 General Background

Resource management functions can be practiced in many forms, including the use of active and passive resource management systems as well as local knowledge which, today, continues to play an important role in rural livelihoods across the world (Beckford and Barker, 2007). Sutton and Anderson (2010) claim that humans have colonized practically every terrestrial environment and have been able to adapt well to the enormous environmental diversity found on Earth, due to the development of cultures that have immense levels of flexibility. It seems these practices have served as a foundation for resource management activities over time, and that the cultural practices involved could clearly be understood as adaptive mechanisms. People who belong to different cultures and live in different environments have developed different biological and cultural learning patterns when adapting to them. Every environment is dynamic, so cultural practices have tended to lead to constant adjustments, in order to maintain some sort of equilibrium, and there has been a constant interplay between cultural practices and biological adaptations.

Local knowledge could be seen as part of culture and could be gained through direct observation of the environment; appears to be generally unwritten and passed down from one generation to another. A major theme of cultural ecology is the study of the classification, usage and management of biotic environments through rituals and knowledge concerned with the utilization of plants and animals.

Rambo and Sajise (1984) claim that, having been introduced to Southeast Asia in 1984, human ecology research on agricultural ecosystems is now booming. This form of research has helped both social scientists who have a particular interest in human affairs, and natural scientists who normally focus on physical and biological phenomena, to better see how their separate subject matters are deeply inter-related with in the real world of Southeast Asia farmers. Human activities significantly affect

the natural resource base and people's understanding of the interaction between social systems and natural systems, that forms the basis for the rational management and development of agricultural ecosystems.

As specialists, in different fields have tried, over the past few decades, to improve economic and human welfare, a variety of development strategies and agricultural policies have been adopted and practiced by governments. Natural resources have been appropriated, conquered and domesticated, and are now experiencing transformation in the wake of rapid economic growth and the environmental degradation associated with such change (Tanabe, 1994). In order to achieve poverty reduction and food security, in 1986, the Lao government reformed its agricultural policy by focusing on market economics and the increased and modernized production of agricultural commodities. Evidence of this can be seen in Lao's latest agricultural master plan for 2011 to 2015, and its strategy for agricultural development which covers the period 2011 to 2020 (MAF, 2010b; MAF, 2010c).

Agricultural ecosystems are full of dynamic organisms that serve as sources of biodiversity, and that biodiversity, in turn, plays an important role in local livelihoods. Biological resources feed people and provide them with shelter, herbal medicines and spiritual nourishment (MAF and FAO, 2007). According to Collins and Qualset (1998), humans have long exploited this diversity and have shaped it to meet their basic survival needs over millennia. Therefore, biodiversity has long been an integral and essential feature in the evolution of agriculture. The important sources of the Earth's biodiversity consists of the natural ecosystems such as forests, savannahs, pastures and rangelands, plus deserts, tundra, rivers, lakes and the sea. Also, farmer's fields and gardens are very important as repositories of biodiversity.

In order to manage and conserve the Earth's biodiversity and to achieve sustainable development, the International Union for Conservation of Nature's (IUCN - 1980) World Conservation Strategy has as its objective to conserve living resources by: (1) maintaining essential processes and life-support systems; (2) preserving genetic diversity; and (3) ensuring the sustainable utilization of species and ecosystems. In order to achieve these aims, the IUCN has encouraged member nations to develop national strategies aimed at the conservation and sustainable use of biodiversity resources, and to put in place national socio-economic development strat-

egy plans.

In addition, the Earth Summit (also known as the United Nations Conference on Environment and Development (UNCED)) accepted the use of traditional methods and the knowledge of local people and their communities and, in particular, emphasized the key role that women play in such systems. These initiatives, methods and knowledge centers are relevant to the conservation and the sustainable use of biodiversity resources. In addition to this, it will ensure the participation of relevant groups who will achieve economic and commercial benefits derived from the use of traditional methods and local knowledge.

Lao PDR is primarily an agricultural economy and its land is rich in biodiversity. Most Lao people are farmers and, based on their cultural and ritual values, make use of this biodiversity, and are highly reliant on natural resources for their income and food, and, in particular on the agricultural land, rivers and forests. This means that natural resources, poverty and nutrition are closely linked in the country (MAF and FAO, 2007; Fenton et al., 2010).

Aquatic animals are a key source of protein and play an important part in the diet of Laotians. Besides fish, small aquatic species such as snails, frogs, clams and crustaceans are important sources of nutrition for poor rural households, as they provide animal protein, vitamins and minerals (MAF, 2010a). Moreover, not only does this food provide essential fatty acids, a necessary source for energy that allows for the absorption of important vitamins, but it also provides for the components that are essential to neurological growth and the development of skin functions (Oller do Nascimento and Oyama, 2003 cited in Fleischer, 2004). According to Fenton et al. (2010), local Laotians have long relied on forests and rivers as regular sources of traditional medicines; food and income and become safety nets during times of crises and low agricultural production. For instance, in 2007/08 in the rural areas of Laos, 15% of people's food consumption was collected from the forests or rivers. Wild food, as a source of protein is of particularly importance. For example, over a half of all fish caught comes directly from the wild, and while wild meat makes up just 14% of overall meat consumption in Laos and is consumed by 30% of the poor.

Furthermore, wild vegetable is equally important in the diet of Laotians. Data, thus, has revealed that there is a strong dependency on wild food among the poor, in

rural communities and amongst ethnic minority groups in the more remote lowland and upland areas. Wild resources are of particular importance during the agricultural low season. Quantitative data have underestimated the importance of wild resources for household income. However, case studies have indicated that the sale of non-timber forest products (NTFPs) is an important source of income. Although a few people are engaged in fishing professionally, the sale of wild fish has provided an income of up to 9% of all households.

1.2 Research Problem

Houay Yae is located within the Nam Song watershed in Vang Vieng district, Vientiane province and, within the rice field ecosystem, is rich in natural food resources such as wild forest foods and wild aquatic animals. The village that surrounds the paddy lands adjoins the Nam Song River to the west of Vang Vieng. The Nam Song River provides a permanent habitat for a number of aquatic animals and acts as a key source of food. The majority of people who live in the village are Lao Lum (Lowland Lao), and most of them are farmers and over 84% of them are subsistence farmers who are engaged in lowland rice cultivation for household consumptions (from survey statistics collected during March 2012). People in the village grow rice in the wet season and cash crops such as pumpkins, vegetables, corn, cucumbers, and so forth, in the dry season, - for household consumption and for trade. In addition, they collect natural food products from the forests, rice fields and the river surrounding the village, and these products represent a second source of income. In 2000, Vang Vieng was launched as a global tourist destination and this has also impacted on the livelihood of the village. Facilities such as hotels, guesthouses and resorts have been built for tourists in Houay Yae village. However, natural food resources are now in decline leading to critical livelihood challenges for the local people.

In the past, livelihoods and household work in Houay Yae village were centered entirely on paddy rice cultivation, with most village activities revolving around rice. In addition to the rice fields, each household had a small vegetable garden and fruit trees in the house compound or near a stream or other water sources. Crops such as cotton, tobacco and sugarcane were planted in small quantities and for

household use only. They also raised chickens, ducks and pigs, as well as a buffalo's for plowing the rice fields. In general, traditional local households were self-sufficient, growing their own food, making their own tools and clothes, and trading any surplus for soap, kerosene, medicines, and kitchen or household items.

These traditional livelihood activities were based on local knowledge, and have continued to this day; though are of less importance than in the past. This local knowledge includes the making and use of fishing tools, the gathering of natural foods and the management of farms, all of which are activities significant to the maintenance of the biodiversity within the rice field ecosystem. Therefore, livelihoods in the village, focused on fishing and gathering activities, have a close relationship and interactions with local natural resources based on the use of local knowledge. Traditionally, these activities have played an important role in household consumption activities, as well as people's economic, cultural and ritual values. At present, the natural biodiversity provided by the rice field ecosystem is still important for the villagers' livelihoods, but resources are declining and the challenges have increased. As Phor Mainoy, the head of Houay Yae village, has said:

Biodiversity in the rice fields is very important for us, as it provides food security to the local households, especially for the poor households, and provides food for most meals. Moreover, Lao people do not necessarily need food from factories, in fact, natural food is free of chemicals, good for people's health, and there is much evidence to show that people in the past had longer life spans and a healthier lifestyle. Recently, aquatic resources has declined in importance and are difficult to obtain, and some local people have had to develop new tools plus increase the amount of time spent gathering – in order to meet their food and income requirements (March 2012).

Since Vang Vieng became a tourist destination in 2000, infrastructure development has increased rapidly, and buildings can now be found around the village and alongside the Nam Song River, including hotels, guesthouses, restaurants and resorts. This has increased employment opportunities, particularly at the tourism

sites, but has also led to population growth and a change from a largely subsistence led to a market-oriented economy. This has also led to an increase in the competition for and exploitation of natural resources, and subsequently to local livelihood changes. Moreover, most of the wastewater from these tourism facilities is discharged directly into the public drainage system and ends up in the Nam Song River (Souksakhone, 2008). This has had a negative impact on the local environment, and in particular the ecological system, leading to a reduction in biodiversity levels and aquatic resources (including in the rice field ecosystem), with the people in Houay Yae village directly affected. Helfrich et al. (2009) argue that fisheries and aquatic systems have been adversely affected by the growth in human population and human activities, and in particular aquatic life and water quality.

McLaughlin and Pierre (1995) also state that agricultural related activities such as tillage, drainage, intercropping, rotation, grazing and extensive usage of pesticides and fertilizers, have significantly impacted upon wild species of flora and fauna. Some agricultural management practices, such as drainage, create fundamental habitat change as there have been significant shifts in species compositions. For the impact of herbicide applications, Pete et al. (2011) claim that there is scientific evidence which show that glyphosate could be harmful to species at many stages along the food chain, including the aquatic food chain. The scientific evidence also show that glyphosate could have immediate and long-term, direct and indirect toxic effects on plants, and animals, including aquatic animals - from microscopic algae to fish and mussels – all of which have been found to be affected by exposure to glyphosate and/or roundup (a type of pesticide). Moreover, glyphosate could also have a direct impact on non-target plants caused by spray drift or the use of deliberate over-spraying. In addition, the replacement of a subsistence-led with a market-led economy has encouraged the introduction of commercial agricultural production activities – with goods produced for the external market. Oun- outhai, head of The Information and Cultural Office in Vang Vieng district, said:

With the growing economy, most people have ignored the conservation of natural resources and in particular the aquatic animals to be found in the rice fields, having switched to running businesses. In addition, in

response to market demands and the increased population, crops are now grown using chemicals, which had led to a decline in aquatic biodiversity (March 2012).

The population of Vang Vieng has increased from 28,415 in 2000 to 97,165 in 2007, and approximately 170,000 tourists are expected to visit the town in 2020 (Vang Vieng Statistics Report, 2007). As mentioned previously, the development of a tourism site and the booming of construction projects transformed the economy from a sufficiency-based one to a commercial agriculture oriented one. Socio-economic development has taken place at the local level, leading to a dependency on the market. Furthermore, the decline in natural food resources, resources which have been a key part of the livelihoods of local people over many years, have had serious effects on those who lack opportunities and capital and in particular the people who continue to rely on the rice field ecosystem and the natural biodiversity for their food.

Although some of the traditional practices in Houay Yae village have disappeared, many are still being practiced but have been adapted to the new situation in order to maintain basic needs, livelihoods, incomes, cultural activities and rituals, and household food security. Thus, my study community needs to be represented and discussed in the terms of their adapted livelihoods and the management of their natural food sources.

It is for this reason that I saw it as a challenge to examine the use of local knowledge in the village in the management of aquatic resources in the rice field ecosystem in the context of the development of the tourism sector and the intensification of agricultural activities. I was particularly interested in investigating how important aquatic food biodiversity is to local livelihoods, how the local community has adapted in order to manage this biodiversity and how their knowledge of aquatic animals is being employed. These practices would normally help to conserve, recover and develop biological diversity in order to ensure food security, maintain a sustainable local livelihood, and to improve levels of responsibility towards the natural ecosystem.

I firmly believe that the empirical data from this study will assist policy-makers and practitioners concerned with issues of poverty reduction; food security

and livelihood security in the planning and implementation of development policies related to agro-biodiversity. Moreover, this empirical data forms part of a knowledge-base that can help provide a way to approach conservation and sustainability within biodiversity management programs into the future.

1.3 Research Questions

My research seeks to draw on local knowledge related to the management of aquatic resources within rice field ecosystems in a situation of rapid socio-economic development and ecological system change. Therefore, the following research questions were developed:

- 1.3.1 To what extent does the aquatic food biodiversity within a rice field ecosystem play an important role for local livelihoods?
- 1.3.2 How has the local community adapted its management of rice field ecosystems to ecological system changes as a result of socio-economic developments in the Houay Yae community?
- 1.3.3 How has the local community employed local knowledge on aquatic resources within the rice field ecosystem in order to assure food security?

1.4 Research Objectives

In order to answer the above research questions, the research objectives developed were as follows:

- 1.4.1 To examine the importance of the aquatic resources found within the local rice field ecosystem to the local community.
- 1.4.2 To understand the adaptation methods used by the local community in terms of managing aquatic resources within the rice field ecosystem.
- 1.4.3 To examine the type of local knowledge regarding aquatic resources within the rice field ecosystem employed by the local community.

1.5 Operational Definitions

Biological diversity: In general, biological diversity or biodiversity refers to the diversity or variety of plants and animals and other living things in a particular area or region. Biodiversity also means the number or abundance of different species living together at one location or in one ecosystem.

Rice field ecosystem: A rice field ecosystem is an ecosystem that provides a habitat for wildlife species such as fish, plants, amphibians, reptiles, molluscs, crustaceans and insects, many of which can be captured, collected or farmed as sources of food and medicine. Rice field ecosystems include rice fields, natural ponds, and small streams and rivers. In this study, the rice field ecosystem in question is located in the central lowlands of Lao PDR¹, and production within this system is for household consumption purposes.

Local knowledge: Local knowledge is held by most groups of people in Laos, including the Lao Lum, who represent the majority of the Lao population² and who possess knowledge in respect of lowland rice production in central Lao PDR. This knowledge is used by both the local community and individuals, and is based on experience and learning, particularly in relation to farming, and the management and gathering of natural foods within the rice field ecosystem, practices that have been passed down from generation to generation.

Aquatic resources: Aquatic resources refer to wild aquatic animals residing within rice field ecosystems, such as fish, frogs, molluscs, crustaceans, insects and

¹Agro-ecosystem landscapes in Lao PDR can be divided into four regions: (i) the northern region, which includes Laoungprabang, Phongsaly, Bokeo, Louangnamtha and Oudomxay provinces, (ii) the eastern region, which includes Houaphan, Xiengkhouang, Bolikhamxay and Khammoune provinces, (iii) the central region, which includes Vientiane province and Vientiane city, and (iv) the southern region, which includes Savannakhet, Salavanh, Champasak, Sekong and Attapau provinces.

²There are three ethnic groupings in Lao PDR: Lao Lum, Lao Theung and Lao Sung. Lao Lum is the majority group.

other aquatic animals. In this study, I focused specifically on those aquatic animals by the local community for household purposes, for income generation and so forth.

1.6 Literature Review

The topic I chose for this study is the investigation of local knowledge on the management of natural food biodiversity within a rice field ecosystem, with a specific focus on the adaptation methods and knowledge used by the local community and the importance of the natural foods produced by the rice field ecosystem for local livelihoods. I have used three concepts, namely, cultural ecology; local knowledge as situated knowledge and household food security. These concepts are used as a framework for my analysis, in order to understand and help analyze this issue. What follows is a detailed analysis of studies I reviewed related to three areas: biological diversity in an agro-ecosystem in Lao PDR; local knowledge and resource management; and biodiversity and household food security.

1.6.1 The Concept of Cultural Ecology

Rambo (1983) claimed that the concept of cultural ecology was first described in the 1950s when it emerged from Julian Steward's experience among the Shoshone hunters and gatherers of the Great Basin of North America. Ecological adaptation had played a significant role in the formation of Shoshone culture, and the concept of cultural ecology has since proved to be a powerful and effective strategy to use in human ecological research. This concept offered a new level of understanding on how traditional societies have adapted to their environments. In 1968, Clifford Geertz, an American anthropologist, applied Steward's concept of cultural ecology to explain the great demographic disparity that exists between Java and the outer islands of Indonesia. He stated that the varying population densities reflect the differing agricultural adaptations employed in the two regions, which in turn are related to their differing environments.

According to Sutton and Anderson (2010), cultural ecology was a concept that studies the ways in which culture is used by people to adapt to their environment. All environments are dynamic and change over time, so humans adapt to them both biologically and culturally. The relationship between humans and nature is said to be

a dynamic one in which both culture and the environment continue to adapt and re-adapt as each changes in response to the other's influence. Cultural practices could be understood as adaptive mechanisms, because they represent the potential methods of adaptation available to humans in order to adapt to their environments. These include technological and organizational forms, such as the structure of economic, political and social systems. Culture is also seemed as an extremely flexible and adaptive mechanism, because behavioral responses to external environmental forces can be acquired, transmitted and modified within the lifetimes of individuals. However, each culture also has a distinct ecological adaptation and interaction framework within the natural and cultural environments, one that includes biotic and cultural aspects.

A variety of cultural practices could mitigate the impact of environmental change – presenting a variety of solutions to various problems. As solutions became obsolete or unavailable, so did others present themselves. Each society has, somehow, been able to solve the problems faced by its culture and its individual members by using institutions, rules, principles, laws, social contracts and organizations to keep things working and to maintain a balance between its various needs. Local knowledge which is largely unwritten, is a part of culture and is obtained through direct observation from the environment. Within such systems, studies concerned with the utilization of plants and animals with particularly reference to the rituals and knowledge of the classification, usage and management of the biotic environment, are of major concern to cultural ecology. Basically, there are three influencing factors behind humans adapting their activities and evolving as their environments change. This could be seen as follows:

1) *Organization*: Culture is a system that is organized into a variety of components, including economic, political, religious and social components. Each of these components has a different organization with different cultural aspects, and these components appear to be separate, but are also inter-related. For instance, religion is, in fact, intertwined with economics and could be considered a part of environmental adaptation.

2) *Technology*: Technology is seen as a factor separating humans from other animals. Technology could generally be designed and used for very specific tasks which are based on needs, available materials, innovation and the influence of other

cultures. If one of these conditions change, the technology will change and the environment and culture will be affected.

3) *Storage*: Storage means saving for later use. The scale of use and the technology itself has led to human storage practices that differ from other animals; for example, agriculturalists could utilize storage on a large scale. For humans, technology plays an important role in the storage of resources, meaning some resources can be stored for a long period of time. Another way that resources could be stored is to control the area in which the resources are found and prevent others from accessing them.

This concept is useful for analyzing the relationships and interactions between the environment and culture and, in terms of cultural ecology, helps to explain the relationship between local communities, the natural food biodiversity present in rice field ecosystems, and the ways in which cultures have adapted to change.

DeWalt (1988) has used a cultural ecology concept called the “cultural ecology of development approach” to critique, not only the existing models of development, but also those which run counter to ecological and biological imperatives and has placed an over-emphasis on growth as the solution to development, since it has resulted in considerable cultural wastage. He argued that many attempts to construct an alternative development paradigm could be grouped within this approach. Likewise, Head (2010) stated that adaptation is a core part of cultural ecology in the twenty-first century, particularly in the context of debates on climate change that are taking place within public discourse and policy. He argued that, in recent years, geographers and other researchers have used the concept of adaptation, tracing both continuities and discontinuities with earlier heritage. Three differences that warranted attention were the new mitigation/adaptation binary; the deliberate and conscious nature of climate change adaptation; and the fact that the motivation for adaptation has been backed by complex assemblages which comprise of more than just climate.

Lapka, Vavra and Sokolikova (2012) have also used the concept of cultural ecology and a scientific approach to reflect the relationship between human society and the natural environment. They focused on the link between cultural ecology and landscape ecology; the interdisciplinary study of biophysical and societal driven

processes; as well as patterns in landscapes. Their research paper argued that the four constitutive principles of today's cultural ecology included: (i) a focus on current problems instead of those from the past or the future, (ii) an integrative approach which is awareness of the pitfalls of inter- or trans-disciplinarily, (iii) the cultural core of society-environment relationships, that is, a reflection on the society-environment relationship through culture, and (iv) a dialogue between human (society) and the environment (nature). Moreover, they argued further for the inclusion the landscape as an object of study within cultural ecology. It could be concluded that cultural ecology is seen as a broad approach with stimulating discussions among various academics rather than emerging as a well-defined and rigorous scientific discipline.

1.6.2 The Concept of Local Knowledge as Situated Knowledge

According to Nygren (1999), local knowledge as situated knowledge was introduced as a concept in 1999. He argued that knowledge production was recognized as a process of social negotiation, one that involved multiple actors and complex power relations. Local knowledge is situated knowledge because it is happening all the time and changes in response to the changing situation in a community, from era to era. Moreover, it could be viewed as a continuous process of change, adaptation and contestation, and combines the traditional and modern, the situational and the hybrid, and local and global knowledge – all integrated together to create a complex local life (Nygren, 1999; Beckford and Barker, 2007).

Anan (2001) argued that the learning process should be conducted continuously and that it is complex in nature. Local knowledge is not only controversial in relation to scientific knowledge, but is also connected to power relationships in terms of the management of natural resource and development projects. Currently, development relies on local knowledge because it is a method of thinking and a learning process that requires the participation of people in society or in a community in respect of resource management. In addition, Yos (2003) asserts that local knowledge is not only idealistic and essential, but is also a situated knowledge practiced through cultural diversity. Local knowledge in terms of resource management is seen as part of the relationship between human beings and nature. It is a development process based on learning from the truths found when experiencing

livelihoods, selections, ceremonies and facsimiles, and passes continuously from generation to generation. It is this which become the traditions, beliefs, ceremonies, methods of thinking and valuable systems required to manage a livelihood.

Houay Yae community uses the local knowledge held therein to manage its farming system and collect aquatic resources, and this involves an interaction and relationship with the community's livelihoods, society, and cultural and ritual activities. Local knowledge on the utilization of aquatic resources includes knowledge about making tools, on the gathering methods used, and the cooking and food processing activities carried out in relation to aquatic resources, and this knowledge is used extensively. In fact, many traditional tools, such as the *ka tong pa* (fishing net), *ka tong kob* (frog collecting tool) and *dang kuad pa* (also a fishing net) have emerged and have, subsequently, been adapted in response to the given situation, as has knowledge on the rotation of time and space in order to exploit aquatic resources. The adaptation of these traditional tools can be considered a new form of knowledge.

From the above, one might conclude that human beings have a basic knowledge that is situated and flexible – a facsimile and a long-term collective knowledge. Therefore, the concept of local knowledge as situated knowledge is useful when trying to explain how a local community manages natural food resources within a rice field ecosystem, as this involves adapting tools and gathering resources in a timely manner in order to maintain a living and satisfy basic needs - especially in terms of household food security.

Furthermore, indigenous knowledge research is a recent development in the sociological and anthropological domains (Raj Pramukh and Palkumar, 2006), and this form of knowledge has been identified as a form of adaptive management by Berkes, Colding and Folke (2000). They argued that indigenous groups introduced alternative knowledge and perspectives based on their own locally developed resource use practices. This knowledge included multiple species management, resource rotation, succession management, landscape management, and other ways of responding to and managing environmental changes and ecological shocks. The social mechanisms behind these traditional practices included a number of adaptations used for the generation, accumulation and transmission of knowledge, the use of local institutions to provide leaders/stewards and rules for social regulation, mechanisms for cultural

internalization of traditional practices, and the development of appropriate world views and cultural values.

In addition, local knowledge and local community participation play an important role in the management and maintenance of natural resources. Carvalho and Moreira-Fraza (2011) claimed that local knowledge provided new insights and opportunities for the sustainable and multi-purpose use of resources, and offered contemporary strategies for preserving cultural and ecological diversity which were the main purpose of and challenge faced by protected areas. To be successful, it was absolutely necessary to have active participation and not simply to integrate and validate people's knowledge and expertise. Local knowledge also acted as an effective tool for use in educational and promotional programs.

In Acre, Brazil, local knowledge regarding natural resource use is a form of resource management found particularly among women who employed this knowledge to develop the production systems needed to balance ecological, economic and cultural concerns in the newly formed extractive reserves. Kainer and Duryea (1992) found that the most common species used in a study in forest communities in Brazil were identified by women who documented specific information on the management, collection and processing of these plants. They demonstrated sophisticated botanical knowledge and plant management skills, exploiting over 150 wild and domesticated species in their communities. They also possessed a particular proficiency in processing plants, especially species used for food, spices, beverages and medicines. Women in these areas also displayed a great desire to enter the market economy, and had begun to test potential market products on a small scale. As a result, they played a key role in the production, diversification and development of economically valuable plant products, and, ultimately in the success of the extractive reserves.

1.6.3 The Concept of Household Food Security

Food security was introduced as a concept in the mid-1970s as the global food crisis focused attention on national and global food supplies. The concept of household food security was introduced in the 1980s and it addressed access to food at the household and individual level. The household food security concept was

developed to take into account the parallel developments of other key concepts such as: (1) food sufficiency - defined as the calories needed for an active, healthy life, (2) access to food - defined as the entitlement to produce, purchase or exchange food, or receive it as a gift, (3) security - defined as the balance between vulnerability, risk and insurance, and (4) time - where food insecurity can be chronic, transitory or cyclical (Maxwell and Smith, 1993; Young et al., 2001). In this context, in 1996, the World Food Summit defined household food security as:

[The] ability [to] access...adequate food....[by] ...all people at all time [s] and [have] control over sufficient quantities of good quality food for an active and healthy life (Vyas, 2005: 29; Maxwell and Smith, 1993: 4).

In the context of Asian countries, food security was integrated into plans and policy documents after the World Food Summit in Rome in 1996 and its aim being to reduce hunger and food insecurity. In addition, in 2000, United Nations (UN) member countries adopted the Millennium Declaration at the Millennium Summit held in New York, its aim being to improve human well-being. One of the goals of this initiative was to eradicate extreme poverty and hunger, while another was to reduce the proportion of people suffering from hunger by 2015 and to focus on the local and individual levels (Vyas, 2005).

Maxwell and Smith (1993) have identified several issues related to household food security. This included, firstly, that the household itself is a problematic concept and that individual members of the household experience different food security risks and strategies at different times. Secondly, that food security and health are closely related issues. Thirdly, that food security is a fundamental need and is related to livelihood security. Fourthly, that the sensitivities, resilience and sustainability of livelihood systems are crucial and, once addressing food security, one should support the adaptability and flexibility of vulnerable livelihood systems. Fifthly, in order to remove the fear of vulnerability and risk, cultural values are important in determining the quality of food entitlements. Sixthly, that people's own perceptions, efficiencies and cost effectiveness are legitimate objectives of the household and the state. Finally,

the right to access food imposes obligations on nation-states to respect, protect, fulfill and promote food security. By using the concept of household food security, it helps me as a guide to examine how important the aquatic resources contained within the study rice field ecosystem are to the local community and local households, and the ways in which access to natural food can contribute to household incomes.

In the Lao context, the concept of food security is primarily associated with people having on an adequate supply of foodstuff. Rice is the main food item consumed, and, having a sufficient quantity all year-round is considered by many to be the key to achieving food security. However, food security is a complex concept that involves economic, social, cultural, environmental and political aspects. Therefore, the definition of food security, as applied in the Lao case, is:

To ensure enough food and foodstuffs for every person at any time, both in material and economic aspects with increasing demand on nutritional quality, hygiene, and balance so as to improve health and enable normal development and efficient work (NAPP, 2000 - cited in Vathana, 2011).

In addition, food security in Laos also depends on four key conditions being met, these being: (i) food being available, (ii) food being accessible, (iii) stability of the food supply chain, and (iv) adequate food utilization (Vathana, 2011). For practical and cultural reasons, the concept of household food security in Laos is highly complex. Gansberghe (2013) suggested that, in reality, food security in Laos involved more than just rice since many other food products are consumed by upland villagers - some are produced on the home farm, others collected from the wild, and some are purchased.

Lao PDR's Food Security Strategy was adopted by the Ministry of Agriculture and Forestry in 2000 and ran until 2010. The key objective of this strategy was to produce more rice to meet the necessary calorific intake of the entire population. This objective, which was aligned to the Lao government's ambitious goals on economic development and poverty eradication, was intended to improve the national food security situation. However, the government's implementation plan was not clear with

regard to food security and the nutritional interventions needed to attain these goals. Although food security has been listed as a top priority for the 47 poorest districts in the country, the focus on the government's strategy is on rice availability and not on food security as should be the goal. Even though attempts to diversify agricultural production are progressing, albeit slowly, forestry (wildlife and NTFP management), fisheries and natural resource management are still not considered key sectors in relation to household food security. Furthermore, there is a need to expand the narrow definition of household and national food security indicators (WFP, 2006).

The forests and wild plant food products contribute significantly to the diversity of household consumption patterns, and represent essential substitute food sources during shortages. In terms of gender roles, women generally play an important role in household food security across the globe. Ibnouf (2009) argued that in most rural areas in Sudan, women were more capable than men in terms of using and allocating the resources available to improve food security for their families. Women were more likely than men to use available resources and to develop the skills needed to further improve the welfare of their families, especially with regard to nutrition and health. Moreover, the food security condition in Laos has been studied by the World Food Program (WFP), which found that chronic malnutrition levels in rural Laos are alarmingly high. In most rural families' the second child was chronically malnourished, affecting not only their physical development, but also their cognitive capacity. The steady economic growth that Lao PDR has experienced over the past fifteen years has not been translated into an improved nutritional status for the rural Lao population. Chronic malnutrition is; therefore, common today as it was ten years ago. It is found that more than 13% of rural households have poor food consumption levels (even at harvest time) and two-thirds of rural households have a livelihood portfolio that puts them at risk of becoming food insecure should one or more shocks occur in a given year. Having access to wild meat and aquatic resources (animal protein) is critical for ensuring food security among vulnerable groups, as these are the biggest sources of animal protein in rural Lao PDR (WFP, 2006).

1.6.4 Overview of Biological Diversity within Agro-ecosystems in Lao

PDR

Lao PDR is ecologically diverse and hosts globally significant levels of biodiversity – biodiversity that is a result of the convergence of three mega-diversity centers – India, China and Southeast Asia, and is also a primary place for the origin for the diversity found in cultivated rice (*Oryza sativa* L.) and other crops. While the country has among the highest biodiversity rates in the world - harboring 8,000 to 11,000 plant species, 166 reptile and amphibian species, 700 bird species, over 500 fish species and over 100 species of large mammals, over 1000 globally threatened species can be found there also.

Lao PDR has suffered from a lack of information on biodiversity, and this has greatly impaired the use, development and management of such resources. Certain reports have pointed to problem that has arisen in recent years as a result of this, including a diverse range of threats coming from different sources. These threats include illegal poaching, destructive fishing and the collection of forest products due to market demands. Some of the threats also include forest encroachment for timber and land due to unclear boundaries; the conversion of land for commercial cash crop cultivation and tree plantations; infrastructure developments (for hydropower and roads); community growth and aspirations for economic improvement (due to the increasing incomes of urban residents); and finally high levels of cross-border demand. Reductions in biodiversity levels have been the inevitable result of such pressures (Nieman and Kamp, 1999).

Fisheries in Laos have played an important economic role, and most rural people have relied on aquatic resources as their main sources of protein, fat, vitamins and minerals, including iron and calcium. The Mekong River is one of the most species-rich river systems in the world. It has 1,300 species of fish and includes the largest freshwater fish in the world. Native fish fauna in Lao PDR is known to include 47 out of a total of the 91 families recorded in the Mekong Basin (WWF, 2009 cited in MAF, 2010a). In 2006, the Lao government integrated its National Growth and Poverty Eradication Strategy (NGPES) and the Millennium Development Goals (MDG) into the sixth five-year National Socio-Economic Development Plan (NSEDP). The NSEDP included targets related to biodiversity, as detailed in the

Forestry Strategy and National Biodiversity Strategy and Action Plan (NBSAP). The aim of the NBSAP is to maintain the country's biodiversity as a key to poverty reduction, and to protect the current asset-base used by the poor to support the implementation of the government's priority programs (MAF, 2010a).

However, the biodiversity that is found in rice field ecosystems has been overlooked as evidenced in the poverty reduction and food security development projects. In 1986, the Lao government introduced the New Economic Mechanism (NEM) at the Fourth Party Congress, and, as a result the agricultural sector became a top priority in terms of development and poverty reduction. This strategy covered reforms based on the development of a market economy, plus increasing and modernizing the production of agricultural commodities, as reflected in both the Agricultural Master Plan 2011 to 2015, and the strategy for Agricultural Development 2011 to 2020 (MAF, 2010b; MAF, 2010c).

Intensive agriculture has become a major driver of changes in the environment since it has reduced natural food biodiversity. Modern agriculture has used higher levels of inputs due to the purchase of hybrid seeds and the use of fertilizers and pesticides (Yos, 2003). Moreover, intensive agriculture has represented a significant shift in the scale and scope of this activity, and has reflected a fundamental change in the relationship between people and the environment. Intensive agriculture also increases social and economic inequality and disrupts traditional village welfare institutions. It has decreased the autonomy of local communities and has increased their dependence on imported farm inputs, particularly petroleum, fertilizers and pesticides. In addition, impacts on the environment have included the loss of irreplaceable genetic resources and locally adapted cultivars. These are replaced by a few improved varieties which greatly increase pest and disease problems and the level of contamination of soil and water with chemical pesticides (Rambo and Sajise, 1984; Sutton and Anderson, 2010).

McLaughlin and Pierre (1995) have stated that agricultural related activities such as tillage, drainage, intercropping, rotation, grazing and the extensive usage of pesticides and fertilizers, have significantly impacted wild species of flora and fauna. Some agricultural management practices such as drainage have created a fundamental habitat change, leading to a significant shift in species compositions. Regarding the

impacts of herbicide application, Pete et al. (2011) have claimed that there scientific evidence exists which shows that glyphosate is harmful to species at many stages along the food chain including the aquatic environment food chain. This scientific evidence also shows that glyphosate can have immediate and long-term, direct and indirect toxic effects on plants and animals, including aquatic animals - from microscopic algae to fish and mussels –all of which have been found to be affected by exposure to glyphosate and/or round-up. Moreover, glyphosate can also have a direct impact on non-target plants in the environments while it is being used, because of spray drift and/or deliberate over spraying.

1.6.5 Local Knowledge and Natural Resource Management

Local knowledge is instrumental and idealized, and consists of factual knowledge, skills and capabilities. In addition, it is situated knowledge that is best understood through social products and local culture, spirits, and social and ethical norms. These facets are possessed by local people as a social capital and play a significant role in the conservation of biodiversity (Antweiler, 1998).

Many research studies on local knowledge and natural resource management have been concerned with biodiversity conservation and sustainable use, focusing in particular on forests and the use of plants. Singh et al. (2006) have stated that local knowledge plays an important role in food security and resource management and have described how the *Monpa* people have a detailed knowledge-based on location and use of *pai sang* leaves and *pin* trees to increase soil fertility, protection from soil erosion and conserving soil moisture. These are all based on their observations and have, ultimately, helped to diversify local cropping systems and reduce risk. Yos (2003) has argued that local knowledge, in terms of resource management, is a key part of the relationship between human beings and nature and has developed based on learning from the truth in relation to livelihoods, the selection of crops, ceremonies, facsimiles and the collection of knowledge over generations. This has become the tradition, belief, ceremonies, and methods of thinking used to develop livelihoods.

Berkes, Colding and Folke (2000) have claimed that indigenous people develop practices with regard to resource use, based on their knowledge and perspectives, using traditional ecosystem management practices which included multiple

species management, resource rotation and succession, and landscape management. The various practices used under traditional knowledge and management systems are seen as follows: (i) adapting for the generation, accumulation and transmission of knowledge, (ii) the use of local institutions to provide leaders/stewards plus rules for social regulation, (iii) mechanisms used for the cultural internalization of traditional practices, and (iv) the development of appropriate world views and cultural values.

Cliggett et al. (2010) explained that the Gwembe Tonga people who live in southern Zambia have faced both climate change uncertainty caused by droughts and floods, as well as political and economic fluctuations at the local, regional and national levels and, as such, have had to adapt and develop the ability respond to opportunities and adversities within different ecosystems around their plateau and valley home. Moreover, Dijk, Oguene and Kuiper (2003) have pointed out that indigenous people have held knowledge on the utilization of natural foods and herbal medicine for a long time. In southern Cameroon, indigenous knowledge in relation to edible fungi and their utilization has long been used by the local population. The major ethnic groups here include the Bantu - who are farmers and the Bagyeli - who are hunter-gatherers. Both groups' knowledge of mushrooms has been extensive, for the Bantu harvested mushrooms in secondary forests, while the Bagyeli collected them mainly in primary forests. Therefore, the apparent gap between extensive mushroom knowledge and rather infrequent mushroom consumption relates to the social valuation placed on mushrooms.

In addition, Peloquin and Berkes (2010) claimed that the indigenous people in his study adjusted their day-to-day activities based on changes in the biophysical and socio-economic processes that take place on multiple scales. They relied on the constant monitoring of these changes, through social memory, to construct an understanding of the expected range of observations that may occur; for example, the success of goose hunting and the timing of the spring thaw. They also exchanged observations of specific events, with a focus on unusual occurrences and anomalies at a particular time and place, rather than on central measures such as those used by climate change models.

1.6.6 Biodiversity and Household Food Security

Shiva (1997) has argued that the age of enlightenment and the theory of progress such as modern scientific knowledge and economic development have destroyed diversity. She asserted that industrialism has created a limitless appetite for resource exploitation, while modern science has provided the ethical and cognitive license to make exploitation possible, acceptable and even desirable.

With the destruction of forests, water and land, we are losing our life-support system. This destruction is taking place in the name of “development” and progress but there must be something seriously wrong with a concept of progress that threatens survival itself...[and] is also associated with violence to women who depend on nature for drawing sustenance for themselves, their families, and their societies (Shiva, 1997: xvi).

Thus, natural resources are being destroyed and removed from local communities - especially among women, who depend on nature for sustenance for themselves, their families and their societies - by modern scientific knowledge and economic development. However, in terms of the food security status in Asian countries, Vyas (2005) has claimed that in Nepal, Cambodia, Indonesia, Thailand and India, some sections of the population face food insecurity in lean agricultural seasons. For instance, in Cambodia, between the harvest and the lean season, most rural households face a 3% to 5% reduction in their rice intake. Even in parts of Thailand, there is different level of food intake between the wet and dry seasons, especially in the mountainous regions, plus calorie and protein intake per day is not regular.

Natural food resources have played an important role among local communities, and especially non-timber forest products (NTFPs) and aquatic foods. A field survey by Foppes and Sounthone (2004) has showed that gathered forest products make up a high proportion of the daily diet among rural Lao families. From the study, it was found that over 450 of these NTFPs have contributed to food security such as edible shoots and vegetables, fruit, tubers, mushrooms, small aquatic animals and other wildlife. NTFPs contributed indirectly to food security, as they can be sold in

order to buy rice during lean periods. NTFPs are also estimated to contribute 40% to 50% towards cash incomes among rural Lao households. A similar amount, 50% of average household cash income, is used to buy rice (more for poorer families). Therefore, NTFPs appears to be the most important safety net or coping strategy used by the rural poor in Lao PDR.

In a similar vein, there is a suggestion that a traditional coping strategy for poor people in rural areas in times of crises is to collect plant and animal products from the wild. Foppes (2008) discussed the role of wild products in terms of human nutrition and food security in Lao PDR, particularly those from the forests, rivers and wetlands, and has said that they are key sources of natural food especially for poor families. Despite the fact that investing in the preservation of such resources would seem to be a cost-efficient nutrition strategy, the more prevalent food production from fishponds and farms has relied on external inputs and has required more labor and capital investment per unit of food produced. However, strategies that strive for healthy and diversified nutrition based on local food resources have contributed significantly to food sovereignty in rural areas. This raising of awareness on the nutritional value of natural food can become a powerful incentive for local communities to manage local wild food resources sustainably.

Bush (2003) compared what matters with what is done among the fisheries and aquaculture activities in Savannakhet province, Lao PDR. Natural fish are more important for the poor but, instead, what is actually focused on by the study population is aquaculture. When a comparison was made of the consumption patterns of local people in terms of overall protein intake of fish raised from small-scale rural aquaculture (SRA) and those caught naturally (including other aquatic animals), it was found that SRA fish are eaten less. However, on larger scales, then conversely the average portion size of the naturally captured fish is smaller, but overall more important for daily consumption.

Moreover, wild aquatic resources have played an important role in the food security of rural poor people. Resources such as fish and other aquatic animals have become an important source, not only of protein, but also essential fatty acids which are high in energy, allow the absorption of important vitamins, and provide the components that are important for neurological growth and the development of skin

functions. Bush has shown that fish is a very common food and that consuming aquatic animals and aquatic resources also provides an important source of nutrition for children between the age of four and twelve months old. However, the economic value of wild resources is often ignored when quantifying rural economies and livelihoods (Oller do Nascimento and Oyama, 2003 - cited in Fleischer, 2004).

Meusch et al. (2003), has shown that a diverse amount of aquatic plants and animals are frequently accessed and used by villagers in Attapeu province, Lao PDR, an area where fish and other aquatic animals represent the key sources of animal protein in people's diets. Typical rural diets are insufficient in terms of quantity and quality, being low in protein and fats, and so various strategies such as the rural development, food security and poverty reduction strategies in these areas need to pay special attention to aquatic resources management in order to ensure the health and well-being of rural people. Therefore, the integrated management of freshwater and wetland resources becomes necessary to meet the objectives of increased rice production, whilst maintaining the viability and productivity of the aquatic resources which rural livelihoods depend. In addition, Nurhasan (2008) has claimed that the aquatic animals found in rice field ecosystems (more than 200 species) potentially supply most of the vitamins (A and B), Calcium, Iron, Sulphur, and essential fatty acids and amino acids are considered important for villagers' health and well-being. Also, Gregory, Thongdam and Somboun (2007) found at least 78 species of aquatic animals and more than 22 species of aquatic plants in upland communities in Xiengkhoung and Luangprabang provinces in Lao PDR, where all the aquatic foods are eaten by upland communities. Fish is the most important aquatic animal, after which frogs and crabs are also important. Furthermore, aquatic resources were found to be keys in helping people meet basic food security requirements, and women and children play an important role in their collection.

Cocks (2010) has argued that local communities are directly dependent on the local natural resources available, and that these communities can be referred to as representing a socially and geographically defined group of people which has customary rights over use, plus distinctive knowledge and skills. However, the current and rapidly changing nature of rural conditions has led to local livelihood strategies becoming increasingly integrated into a cash-based economy.

1.7 Conceptual Framework

This study intends to examine the level of local knowledge held on the management of aquatic resources within rice field ecosystems, and in the context of rapid socio-economic development. Resource management could be practiced in many forms and could be active or passive. As humans have colonized practically every terrestrial environment, they have been able to adapt to the environmental diversity present through their culture. Culture is seen as an adaptive mechanism which acts as a function of resource management, and since all people belong to a specific culture, so groups share similar but differentiated biological and cultural patterns of learned behavior as a form of adaptation. Moreover, local knowledge, which is generally unwritten, is a part of culture and is obtained through direct observation from the environment (Sutton and Anderson, 2010).

As mentioned before, I have used the concepts of cultural ecology, local knowledge as situated knowledge, and household food security, to describe situations involving the management of aquatic resources within the rice field ecosystems to be found at the study site. These concepts have helped me to understand the importance of such resources to the study community; the activities practiced by them, and in particular, the ways in which they have adapted their knowledge on the aquatic resources. In order to examine the relationship and interaction between the local community and natural food resources, I have used cultural ecology as the primary concept.

During my research, I first examined how important aquatic resources are to the local community studying the community's history with regard to its utilization of aquatic resources within the rice field ecosystem for household food security, income generation, cultural/ritual, plus medicinal and other purposes. Next, I examined the adaptation methods used in relation to the management of aquatic resources at the Houay Yae community, focusing on the use of fishing tools and time, food diversity and the purpose of any adaptations. Finally, I examined how this knowledge is employed by the local community in terms of their culture and rites; the gathering, classifying and processing of food and the use of medicines.

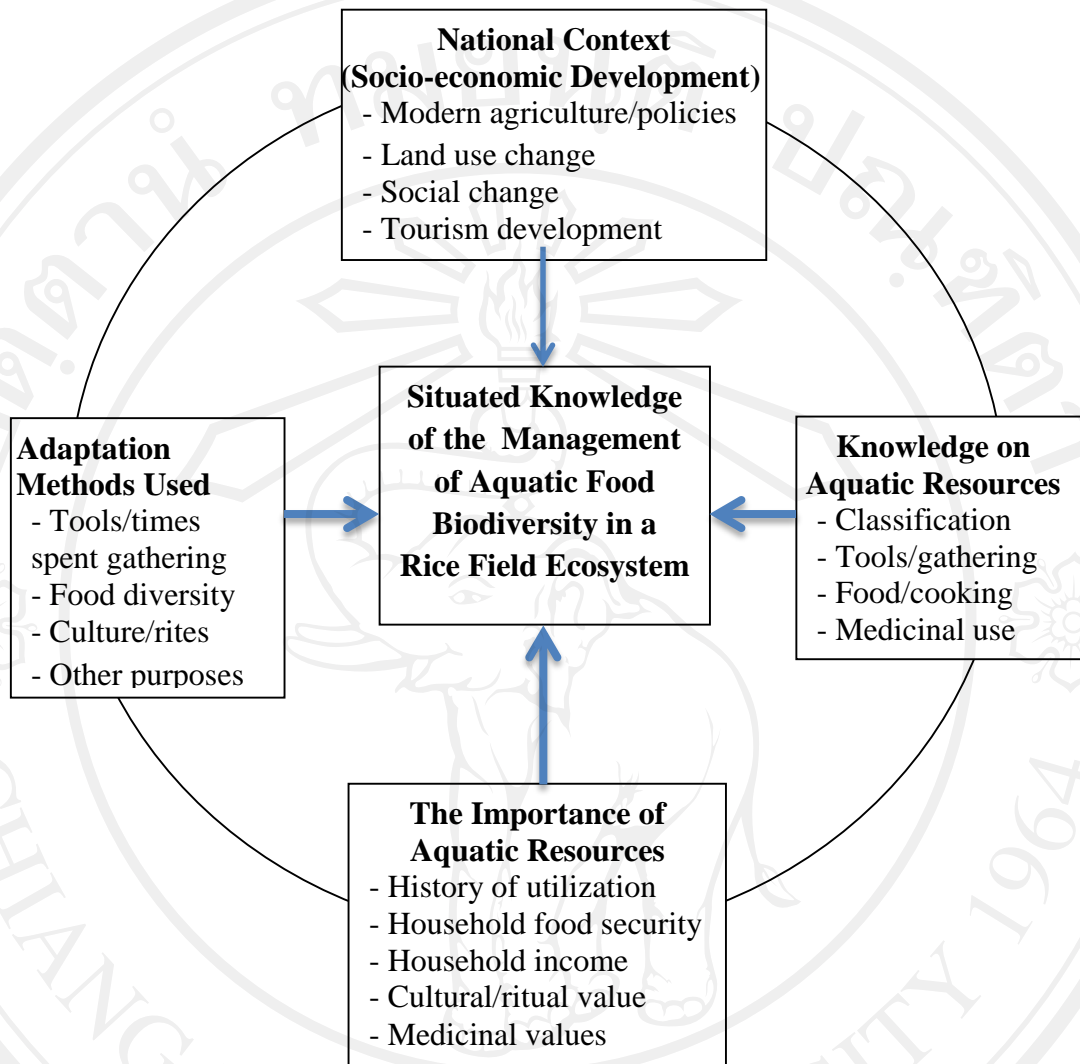


Figure 1.1: Conceptual Framework

1.8 Research Methods

1.8.1 Research Site

The research area I selected to study is Houay Yae village, Vang Vieng district, Vientiane province in central Laos. This village is located within a paddy land, close to the Nam Song River to the west (between 18°55'00" and 18°56'00" north, and 102°26'00" to 102°27'00" east). The total population of the village is 591, of which 284 are women, all of who live across 109 households. Most of the villagers are farmers (84.62%), while only 5.13% are traders and 19.23% wage laborers (field survey, March 2012). People in Houay Yae village are Lao Lum, and most are native

to the area (56.41%), while the rest are from Houaphan and Xiengkhouang provinces. They have much experience and knowledge on farming and the gathering of natural foods and the knowledge is passed down from generation to generation. A part from their traditional livelihood practices, there are also tourism facilities in the village and the surrounding areas such as caves; bungalows; resorts and restaurants; and tourism activities including tubing/rafting and canoeing. Moreover, the traditional gathering of aquatic resources are continue to be practiced and helps those in the village maintain their basic needs and their livelihood security, particularly with regard to their food and income security. It is for this reason that I chose this village to be my field research site, as it represents a context within a local community where livelihoods are linked to natural food management adaptation practices.

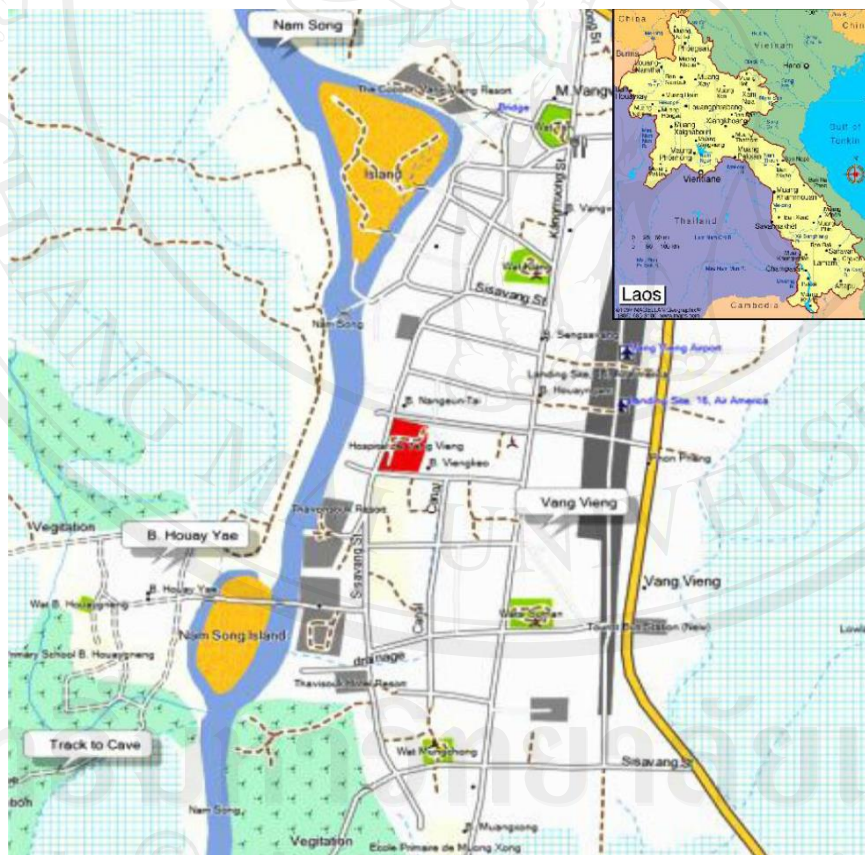


Figure 1.2: Map of Houay Yae Village, Vang Vieng District, Vientiane Province in Central Lao PDR.

(Source: <http://www.laosgpsmap.com/detailed-city-information/vang-vieng-map/>).

1.8.2 Unit and Level of Analysis

The study's unit of analysis was based on a collection of individuals', households' and community narratives in relation to local knowledge on the management and utilization of aquatic resources. It was also based on the adaptation methods used regarding the management of aquatic resources within a rice field ecosystem by the study community, at the individual, household and community level.

1.8.3 Data Collection Methods

The data collection methods used included documentary research and field research. For the documentary research, I reviewed the existing literature and public journals related to my topic, as well as documents published by the National Agriculture and Forestry Research Institute (NAFRI), the Ministry of Agriculture and Forestry (MAF) and the Vang Vieng government office, among others. During my field research, I attempted to find answers to my research questions using in-depth interviews, participant observation, focus group interviews and a household survey. The details of these activities are as follows:

1. In-depth Interviews

An in-depth interview is a face-to-face interaction between human subjects, and is one of the most popular tools used for gathering information. The interviews I carried out were focused on people who were knowledgeable on the study issue such as practitioners (including men, women and elders). The intention was to investigate the importance of aquatic resources to the local community, the adaptation methods used plus to uncover the knowledge held on the use of aquatic foods. I used key informant and semi-structured interviews that contained open-ended questions.

2. Participant Observation

Participant observation was important for my data collection activities in order to gather the information needed from individuals with regard to community practices, based on local knowledge, that are related to the utilization of aquatic

resources, the conventions surrounding their use, the use of fishing tools, and the gathering and cultural/ritual activities carried out, as well as the food cooking and processing that takes place. Moreover, in order to gather data on the adaptation methods used by individuals and the community, I spent time within the community to observe their practices, while taking notes, recording comments and taking photographs.

3. Focus Group Interviews

Focus group interviews are useful for capturing people's responses, feelings and experiences; therefore, I used these to investigate the history of aquatic resources utilization and the use of gathering tools at the study site. For this, I selected people who were known to be knowledgeable on this topic and divided them into three groups: men, women and elders, in order to gather their experiences on these issues.

4. Household Survey

A household survey was carried out in order to gather basic information about the geography of the study area; the household food security and income situation; as well as gender roles in relation to the utilization of aquatic resources. I conducted interviews with 109 households in total focusing on their different financial statuses (rich and poor households) and how these link to their utilization of aquatic resources while practicing household food security, household incomes, and cultural and ritual activities. I also analyzed trends with regard to the use of aquatic resources within the rice field ecosystem.

1.8.4 Data Analysis

The collected data was analyzed, described and discussed using the conceptual framework shown above. I also coded, categorized and identified the collected data. In addition, I recorded all the interviews, took notes and kept a diary. I used a narrative analysis by adopting descriptive and interpretive narratives in order to analyze and compare the ideas and issues raised.

1.9 Thesis Organization

This thesis consists of five chapters. The first chapter has introduced the background to the study and explanation of the aims and objectives linked to it. It has provided details about the research questions and the theoretical framework the research methodology used and has discussed the literature review carried out. The second chapter deals with the importance of aquatic resources in Houay Yae, focusing on the how aquatic resources play an important role in the livelihoods of people in the study area. This chapter is composed of four sections; the first provides an overview of Houay Yae community, the second focuses on the important role aquatic resources play within local livelihoods, the third looks at levels of access and gender roles, while the last section highlights the factors and trends present in terms of the utilization of aquatic resources.

The third chapter focuses on socio-economic transformation in Houay Yae community that led to the need for adapting their livelihoods to a new situation. The chapter consists of four sections, namely, an overview of socio-economic transformation in Laos; livelihood transformation in the Houay Yae community; and adaptation methods used in aquatic resource management in the Houay Yae community. This section consists of four sub- sections including farming practices as aquatic resource management functions, the fishing tools and their revolution as an adaptation method as well as time and space rotation and food culture and livelihood adaptations. The last section describes the impacts of modern agricultural practices and tourism development on local aquatic resources.

The fourth chapter is comprised of six sub-chapters and focuses on local knowledge regarding the aquatic animals residing within the rice field ecosystem. The first sub-chapter focuses on local knowledge and fishing tools, while the second looks at the local knowledge and beliefs held regarding aquatic resources. The third sub-chapter looks at the local classification of aquatic animals, and the fourth at local knowledge in terms of the cooking and processing of foods. The fifth section describes local knowledge and beliefs regarding the collection of aquatic animals. The last section concludes local knowledge as situated knowledge. The last chapter is the conclusion, and includes key findings, a theoretical discussion of the findings plus the recommendations I make for future research.