Resilience and Livelihood Dynamics of Shrimp Farmers and Fishers in the Mekong Delta, Vietnam

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Tran Thi Phung Ha

Thesis

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Wageningen, April 2012

Tran Thi Phung Ha

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Abbreviations

BMP	Better Management Practices
BZ	Buffer zone
Camimex	Ca Mau frozen seafood processing import export cooperation
CARE	Cooperative for Assistance and Relief Everywhere
Coop	Cooperative
CPUE	Catch per Unit Effort
DARD	Department of Agriculture and Rural Development
DFID	UK Government, Department for International Development
DoLISA	Department of Labor – Invalids and Social Affairs
DoNR&E	Department of Natural Resources and Environment
DPFR	Division of Protection of Fishery Resources
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus group discussion
FPZ	Full protection zone
GAP	Good Aquaculture Practices
HACCP	Hazard Analysis Critical Control Point
HEPR	Hunger Eradication and Poverty Reduction
HH(s)	Household(s)
HPV	Hepatopancreas Parvovirus diseases
IMO	International Marketology Organization
ISO	International Organization for Standardization
KII	Key Informants Interview
MARD	Ministry of Agriculture and Rural Development
MBV	Monodon type Baculorvirus
RESCOPAR	Rebuilding resilience in coastal populations and aquatic resources
SIPPO	Swiss Import Promotion Program
TAT	Total Allowable Catch
UNDP	United Nations Development Program
VASEP	Vietnam Association of Seafood Exporters and Producers
WSD	White Spot Diseases
WSSV	White spot syndrome virus
YHD	Yellowhead Disease

1

Shrimp farming village in the Mekong Delta

Introduction

1. Introduction

1.1 Introduction

As a result of over 20 years of economic reform, fishery, especially aquaculture, has become an important economic sector in Vietnam. The shrimp industry has been promoted by the Vietnamese government with the aspiration to reduce poverty, increase exports to support economic development, and to provide employment opportunities. The rapid expansion of shrimp aquaculture between 1990 and 2005 has made the country the fifth largest shrimp producer, by weight and by value, in the world. From 1990 to 2009, aquatic product output increased by 547% from 0.89 to 4.87 million tons, while shrimp products rose 758% from about 55 to over 419.4 thousand tons (GSO, 2011). In the 13 years from 1995 to 2009, earnings from aquatic exports grew 6.8 times, from USD 621 million to USD 4.26 billion, to which shrimp exports contributed USD 1.3 billion (GSO, 2011). In 2010, aquatic products from Vietnam contributed as much as 4.6% of the GDP, i.e. USD 4.8 billion. The production of shrimp contributed most to this volume, and created job opportunities for over 4 million people (VASEP)[1].

Shrimp farming and fishery are the main livelihood options in Ca Mau and Bac Lieu, the two southernmost provinces of the Mekong Delta, Vietnam. The coastal area, with a dense network of canals, creeks, rivers and mangrove forest, is also considered important for forestry. In 2009, besides 227.8 thousand tons of caught fish, the two provinces produced 167.8 thousand tons of shrimp accounting for 53% of the Mekong Delta production and 40% of national production (GSO, 2011). Shrimp farming occupied 294.7 thousands ha in Ca Mau and 126.3 thousands ha in Bac Lieu, contributing to 47% and 51 % respectively of the provincial GDP (CWPDP-WB, 2004; GSO, 2011).

Certainly, shrimp pond aquaculture brings considerable financial benefits to local farmers, and provides jobs across the shrimp industry and global markets. However, hundreds of thousands of hectares of mangrove forest have been replaced by shrimp ponds, and as a result, the coastal ecosystems have dramatically, perhaps irrevocably, been altered. According to many studies, this shrimp farming boom and the correlated disappearance of mangrove ecosystems have had negative consequences, such as, salt precipitation and acidification of soil, poorer water quality due to higher contaminants (high turbidity, low levels of dissolved oxygen, and high levels of organic matter) and water pollution causing shrimp disease outbreaks. These outcomes have negatively affected the livelihoods of people dependent on forests and fishing (de Graaf and Xuan, 1998; Thong *et al.*, 2004; Thu and Populus, 2007). The livelihood risks and uncertainties are in a

[1] VASEP: Vietnam Association of Seafood Exporters and Processors.
http://www.vasep.com.vn/vasep/dailynews.nsf/homepage

complex way related to changing international market requirements, such as, food safety, quality standards and ecological feed-back mechanisms, disease and epidemics (Kautsky *et al.*, 2000; Barbier and Cox, 2004; Oosterveer, 2006; cited in Bush *et al.*, 2010).

Shrimp diseases are a major risk to farmers and particularly seriously affect the intensive farming systems. The White Spot Diseases (WSD) was the most serious disease and outbreaks usually spread very quickly when the shrimp are still young. Like WSD, Yellowhead Disease (YHD), *Monodon type Baculorvirus* (MBV), *Hepatopancreas parvovirus* diseases (HPV) are viral infection diseases; many others are from vibrio microbe, fungi and parasites. The risks factors from shrimp disease occur throughout the different stages of the shrimp production cycle and kills shrimps very quickly. Shrimp disease has a devastating economic impact on livelihood development in cases where technological, as well as financial capital are lacking at farm level. The importance of shrimp export production to major markets such as United States, Japan and EU, accounting for 90% of the total export earnings, makes it necessary to better understand market factors related to trade agreement, trade conditions, market demands, price premium, world market prices, exchange rate policies, and the competitiveness of shrimp products. Global market requirements like regulations for strict health and hygienic quality, regulations for international trade, certification for shrimp production etc. present challenges as well as risks to farmers. For future perspectives, global market integration is a main factor of vulnerability. Products might be denied access to the market chain because most of the farms are too small and not well enough organized to comply with international standards on food safety and quality (Thanh *et al.*, 2002). Market price decline related to the quality of the products and competition on the global market is another big concern especially to intensive farmers. For example, in 2008, the price of shrimp sharply decreased by nearly one third, and according to NACA (2010), this decrease was due to the economic crisis, unstable markets, the number of actors involved in the market chain (collectors, retailers, and processing traders) and overproduction.

Meanwhile, during the 1980s – 1990s the catch per unit of effort (CPUE) of small-scale fisheries has decreased significantly, undermining the sustainability of livelihoods of fishing families. Moreover, banks refuse to accept fishers´ boats as collateral for loans; therefore, the shortage of money for investment, harsh weather, CPUE decrease and competition with bigger trawlers for near-shore resources all put pressure on the livelihoods of coastal fishers. Small-scale fishers are the poorest of the poor and for that reason, fishing is considered "the occupation of the last resort" (cited in Allison and Ellis, 2001). These fishers are usually the ones blamed by outsiders for overexploiting the near-shore resources.

Concerning long-term development, the low level of education in the Mekong Delta is a major challenge. National statistics show that three-quarters of students drop out during the 6th grade (Thanh et al., 2002) and only 0.6% of the total population gets a higher education (Ca Mau People Committee, 2006). Due to low levels of education, young adults find it difficult to find better job opportunities elsewhere, and there are only low paid labour positions for them in the city. Low levels of education, in combination with limited access to credit, obstruct farmers from applying advanced techniques to aquaculture and fishery. The only jobs open to them are small-

scale capture fishery or extensive shrimp farming that do not demand technical knowledge and involve less investment.

In line with government policies and institutions for development, the national and provincial governments have issued a number of policies and established institutions to improve shrimp aquaculture and fishery practices. For example, several forestry policies and decisions have been issued to protect the mangroves while securing the livelihoods of farmers. These focus on land tenure and forestland allocation, restructuring the organization and management of State-owned forest enterprises (SFE), and improvement of the legal rights and obligations of shrimp farmers for using water and forestland. In addition, in order to protect near-shore marine resources and to encourage offshore fishing, Department of Fishery Decisions have been issued supporting the construction of large vessels at subsidized interest rates (Decision 393/TTg of July 1997) or emphasizing fishing regulations and enforcement (Decree N123/2006/ND-CP). This thesis will show that the policies that have been made to improve mangrove-shrimp aquaculture and fishery in Ca Mau may profoundly affect the social resilience of individual households in the different aquaculture and fishery systems, which in turn affects the wider social-ecological resilience of the Mekong Delta.

Many studies have focused on shrimp aquaculture. Bene (2005) summarized and distinguished the following trends: (1) In the 1970s and early 1980s the studies were related to the technical aspects of, for instance, pond management issues in shrimp aquaculture; (2) In the 1980s, the research interests expanded to the economic dimensions of shrimp farming, particularly the cost-benefit ratio of the activity. Then, (3) in the late 1980s and early 1990s a series of international NGO reports, scientific articles and national newspapers acknowledged that an exponential and unplanned shrimp farming industry was developing to the detriment of the environment and local populations. (4) In the middle of the 1990s, the criticism on shrimp development related to environmental concern reached a peak due to mangrove destruction and coastal resource degradation. A number of studies have expressed concerns on environmental degradation and social disruption that shrimp farming can cause. However, until now and despite major efforts to address the concerns, the debate about the sustainability of shrimp aquaculture is still largely unsettled (Bene, 2005).

In the Mekong Delta there have been many studies on technical, socio-economic and environmental issues of shrimp farming and fishery since the 1990s (Binh *et al.*, 1997; de Graaf and Xuan, 1998; Minh *et al.*, 2001; Clough *et al.*, 2002a; Christensen and Thi, 2008). However, there are few in-depth studies on the relationship between national and provincial policies, on the one hand, and the changes and dynamics of livelihood decisions making in the region, on the other hand. Neither is there any research on the interrelationships, interactions and feedbacks brought to bear upon the relationship between livelihood strategies and pathways created at household level and the social-ecological resilience of the system.

Resilience, vulnerability, and adaptation are important for studying the human dimensions of global environmental changes (Janssen and Ostrom, 2006; Young et al., 2006). Moreover, for a

successful and sustainable development, policies and institutional arrangements on aquaculture and fishery are important considerations for social and ecological resilience. These factors interact and directly affect the livelihood decision-making capacity of the farmers and fishers in the coastal region.

The research focuses on the livelihood dynamics as identified by Kaag et al (2004), who considered the interaction between people and their social and natural environment, and how these change over time. Studies focus on disturbances and local vulnerabilities (Blaikie, 1995; Adger et al., 2001), or on stresses and shocks that impinge upon livelihoods as the result of interactions between global forces and local contexts (de Haan, 2000; de Haan and Zoomers, 2003; Armitage and Johnson, 2006). Investigations into change processes and adaptation have included short-term (Davies, 1996) and long-term (Singh and Gilman, 1999; cited in Marschke and Berkes, 2006) responses.

This research aims to examine whether the livelihood strategies and pathways created at household level foster or enhance social resilience. Social resilience is defined as the capacity of individuals at household level to withstand the external social, political, and ecological uncertainties and changes and the impact of these changes. The social sources of resilience include social capital (trust and social networks) and social memory (experience for dealing with the change) (Olick and Robbins, 1998; McIntosh, 2000; cited in Folke, 2006). Trust and experience are used as indicators to study the ability of people to cope with external stresses and disturbances as a result of social, political and environmental changes. Because humans and the environment or the social and the ecological mutually constitute each other in non-linear, multi-faced and interactive processes, the decisions people make at one stage do necessarily predict the future directions of human - environmental interactions. Also, people can learn to live with the changes and uncertainties, nurture their memory in learning and adapting to change, and create opportunities for self-organization (Folke et al., 2003; Berkes and Seixas, 2005; adapted by Marschke and Berkes, 2006). Ecological resilience can be measured through proxies of diversity and functional integrity, while social resilience can be measured through proxies of institutional change, property rights, and demographic change (Adger, 1997).

In this context, the present livelihood approach studies: The capacity of people to make decisions in response to the uncertainties, the ways they adapt, manage (or learn to manage) change for long-term livelihood development and sustainability, and the relationship between the human capacity for social resilience at household level and the social-ecological resilience at system's level.

1.2 Research objective

The research is a part of the RESCOPAR program of "*Rebuilding resilience in coastal populations and aquatic resources*" of Wageningen (INREF). The research program focuses on the scaled interaction between the ecological, social and political dynamics that underlie the processes of change and possible threats to the resilience of mangrove forested coastal ecosystems. It concentrates on the

interactions and feedback effects between decision-making processes at different socio-political and spatial levels around shrimp culture and how these decisions affect the use, management, and conservation of natural living aquatic resources (RESCOPAR, 2004). The RESCOPAR project[2] is organized around four themes: 1. Ecosystem health and fishery productivity in coastal aquaculture practices; 2. White Spot Syndrome Virus (WSSV) disease management of aquaculture productivity; 3. Local and individual decision-making around seafood production; and 4. Governance processes related to trade in fish products (RESCOPAR, 2004).

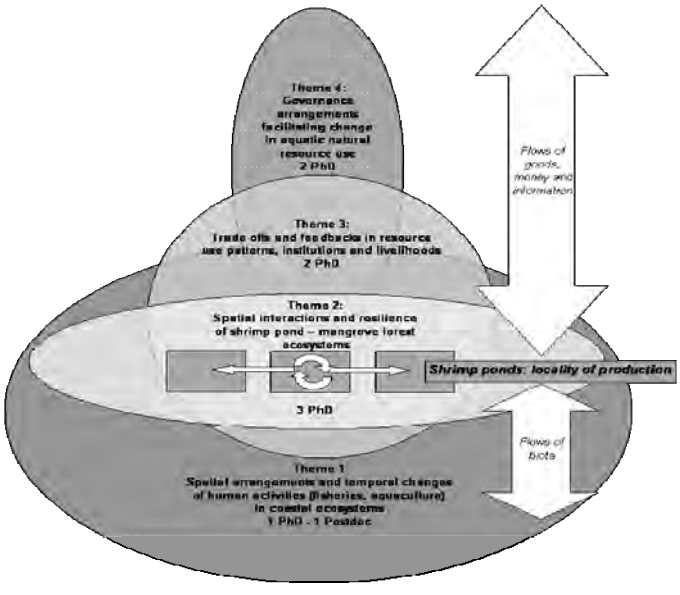


Figure 1.1: RESCOPAR research themes

This study, as part of theme 3 of the RESCOPAR program, investigating the livelihood pathways and strategies that shrimp farmers' and fishers' households develop in order to meet their basic needs and cope with adversities, as well as the ways to enhance their capabilities and to improve their livelihoods. It aims to identify the factors that affect decision-making either at the personal/household level or in the natural environment for the evolution of shrimp-based livelihoods. The analysis of the factors and drivers in the decision-making process should result in the identification of relevant policies supporting the balance between poverty reduction, economic improvement (social resilience) and sustainable use of natural resources (ecological resilience) for

[2] RESCOPAR is funded by the Interdisciplinary Research and Education Fund (INREF) of Wageningen University. The RESCOPAR program is a co-operation between several research teams at Wageningen University (The Netherlands), Can Tho University (Vietnam), Mulawarman University (Indonesia), Bogor University (Indonesia), and WWF-Indonesia, and NACA (Thailand) to study the resilience of coastal populations and aquatic resources, with an emphasis on mangrove ecosystems, shrimp culture and associated diseases, and coastal fisheries (RESCOPAR, 2004).

the region. The resilience of a household comprises a portfolio of assets and access, income streams and capacities to make decisions under conditions of uncertainty of agro-ecological and social, political and global market changes. Households cope with these uncertainties through a range of strategies including intensification, diversification, migration, and collaboration in a farm cluster, while they are supported by and believe in familial or communal support networks. Based on these considerations, the research has formulated the research question

How do the coastal fish-based livelihoods change to adapt to the uncertainties and enhance social- ecological resilience?

The research focuses upon:

- Livelihood decision-making and pathways of coastal fish-based households in the Mekong Delta who are under the stress and shocks of social, and ecological uncertainties;
- The capacity of resilience building at household level based on livelihood activities and pathways created through decision-making processes;
- The linkages and interactions of social resilience at household level to the social and ecological resilience of the system in the Mekong Delta;
- Selection and consideration of adaptive institutions and arrangements to enhance the social and ecological resilience of the Mekong Delta.

1.3 Structure of the thesis

Following this Introduction, Chapter 2 reviews the theoretical approach we have taken, introduces the key concepts used in the thesis, and provides a description of the research sites.

Chapter 3 describes the livelihood capacities and pathways of shrimp farmers to cope with risks. The identified systems are: the integrated shrimp-mangrove system, the extensive system, the intensive cluster system, and the intensive non-cluster system. The risks are significantly different across the four shrimp farming systems, and are caused by social, economic, political and ecological uncertainties. The chapter shows how farmers in these systems create their pathways to cope with the changes and adversities.

The mangrove-shrimp farming system is the most popular model in Ca Mau. Chapter 4 discusses how the changes in mangrove forest policies have affected farmers' accessibility to mangrove forests. The central government and the Ca Mau provincial government have issued several decisions and policies on mangrove forest management to protect mangroves, and to ensure the livelihoods of farmers in mangrove-shrimp farming systems. How these policies are implemented, how farmers access mangrove management and production, and the opportunity to improve livelihoods are discussed in this chapter.

Overexploitation of near shore resources and non-compliance with fishery regulations are important issues in the fishery sector. Chapter 5 presents the risk factors related to fishery livelihoods and how fishers adapt to the risks in order to sustain their livelihoods.

People engage in networks to secure access to coastal resources. Chapter 6 presents networks and human capability for building resilience in the Mekong Delta. Chapter discusses in what types of networks shrimp farmers and fishers participate, what the different features are of these networks and which (and why) certain types of networks are more important for them to access education, know-how, and financial capital.

Chapter 7 is the concluding chapter that resumes the answers to the research questions from the different chapters. This chapter discusses the need to study social resilience at the household level in order to understand the internal dynamics of the different aquaculture systems and their relevance for the social-ecological resilience of the system as a whole. Fig. 1.1 shows the relationships between the subject matter of the chapters.

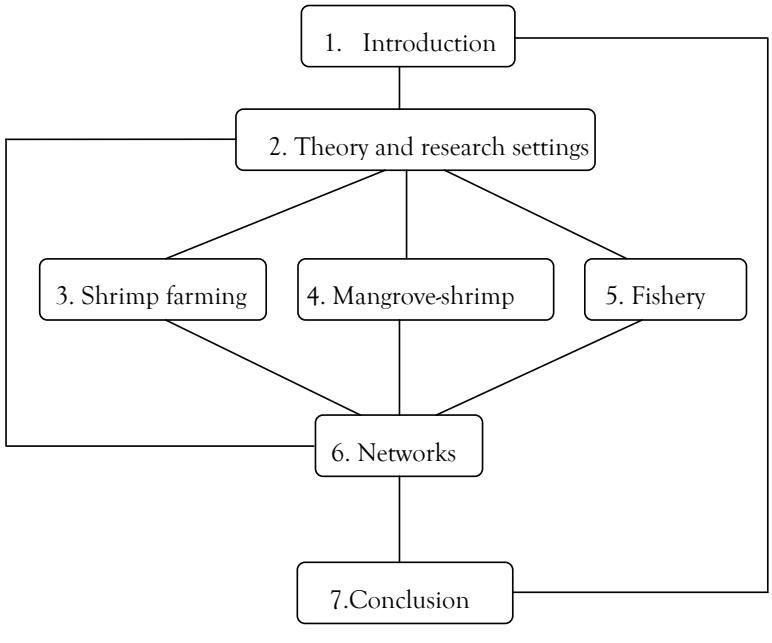
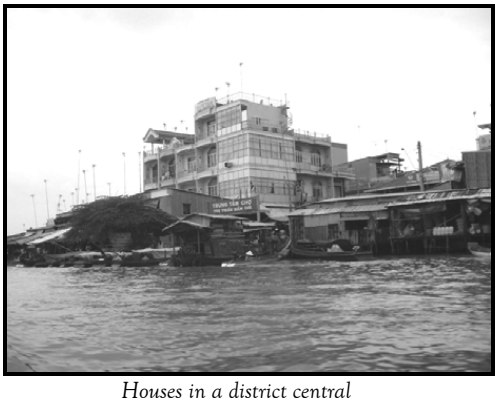
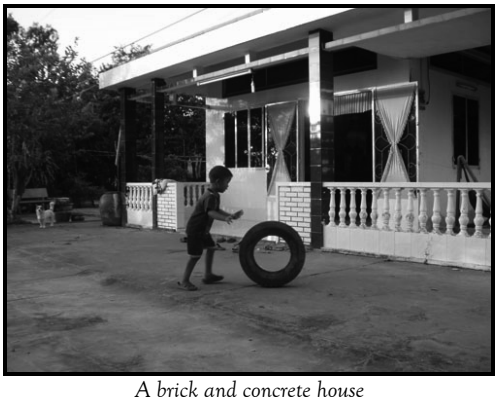


Figure 1.2: Subject matter and relationships between the chapters of this thesis.

Typical houses in research area

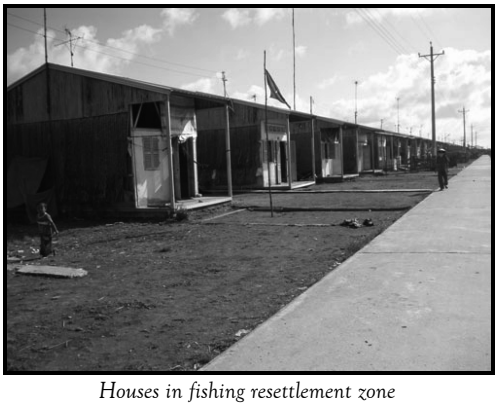


Houses in a district central

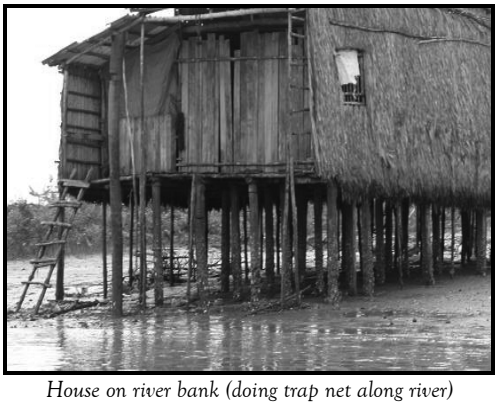


A brick and concrete house

A mangrove-wooden house



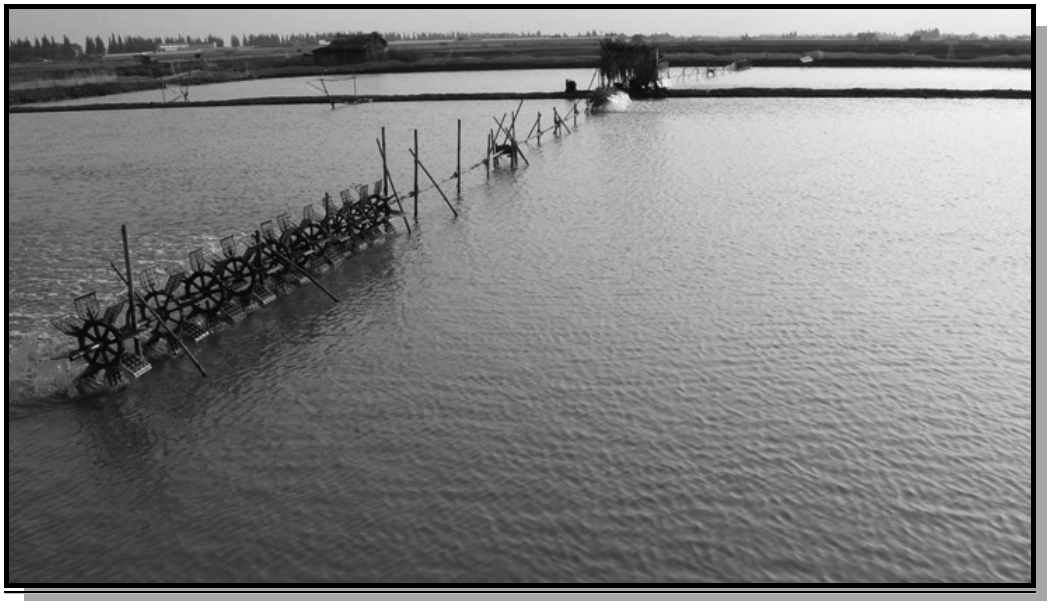
Houses in fishing resettlement zone



House on river bank (doing trap net along river)

Thatched houses

2



Intensive shrimp farming ponds

Theoretical review and research setting

2. Theoretical review and research setting

2.1 Theoretical review

Livelihood research has proliferated during the second half of the 1990s. Studies of livelihood diversification (Ellis, 2000a) and sustainable livelihoods (Carney, 1998b) have become widely known. Livelihood perspectives have proven to be an interesting topic for many scholars from different disciplines and backgrounds, dealing with a variety of themes and focusing on diverse groups of people from all over the world (Kald et al., 2004). For example, livelihood studies focus on the actions people take when coping with ecological disaster and economic and political adversity (de Bruijn and van Dijk, 1995), on the effects of resettlement (Dekker, 2002), processes of degradation (Bryceson, 1999), social-security mechanisms (Nooteboom, 2003). According to Murray (2002), approaches to livelihood research can be distinguished into 3 groups: the *circumspective, the retrospective* and *the prospective* approaches. The circumspective approach concentrates on the investigation of modes of livelihood during a specific period of time, typically six months to one year to the moment of the investigation. The key objective of this approach is to study the relationships between the different socio-economic activities. The retrospective approach aims to understand the changes that have taken place over a much longer timescale. In principle, this method aims at longitudinal comparisons by performing cross-sectional studies on the same population over time. The prospective approach is directed at analyzing the success or failure of past policies in order to build an alternative framework for improving livelihoods, or for more effective economic development.

The present study uses a combination of circumspective and retrospective approaches in order to better understand the changes of coastal fish-based livelihoods over time. In agreement with Murray (2002), the key objective of these two approaches is to analyze household pathways of accumulation or impoverishment over time, considering matrices of vulnerability.

Livelihood research captures the dynamics as defined by Kaag et al (2004), considering the interaction between people and their social and natural environment (synchronic dynamics) as well as the changes over time (diachronic dynamics). A livelihood study should be conceived as having a moving target (Zoomers, 1999), because individual and family goals and priorities do not remain constant (Kaag, 2004). Therefore, this study focuses on the character of livelihoods as the result of decision-making processes over time; decisions that are made by complex considerations and perceptions that may differ between individuals and households, and which are not necessarily rational or consistent through time.

This chapter presents a literature review to identify possible driving factors for decision-making of local actors in fish-based livelihoods of coastal southern Vietnam. When studying the drivers for decision-making a range of variables and concepts needs to be taken into account. Key issues of conceptualization of livelihood decision-making are: 1. livelihood assets and access; 2.

vulnerability, risk and uncertainty; 3. livelihood strategies, decision-making and pathways and, 4. resilience. These are the important concepts we have selected for this thesis to study the organization of livelihood decision-making, primarily at the level of shrimp farmers' and fishers' households in the Mekong Delta.

2.1.1 Livelihood assets and access

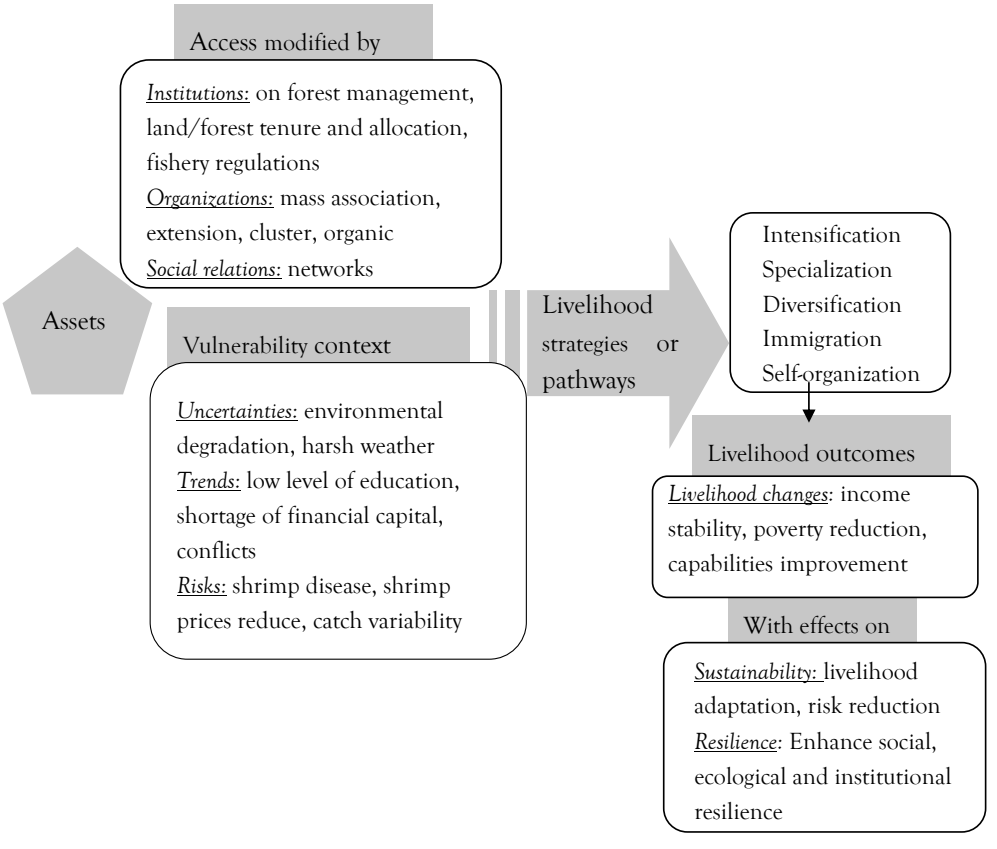


Figure 2.1: Conceptual framework on livelihood. Source: Adapted from (Carney, 1998a; Scoones, 1998; Ellis, 2000b)

Fig. 2.1 shows the assets accessed by their owners as the driving factor because the livelihood activities and outcomes are determined by access to assets. Assets are not necessarily similar to resources (Bebbington and Perreault, 1999; DFID, 1999). Access in the sense of ownership of or the right to use a single asset can generate multiple benefits. This implies that a single asset (e.g. shrimp pond) can be used to generate another asset (e.g. money). In the sustainable livelihood framework such assets are seen as social capital, human capital, physical capital, natural capital and financial capital (Ellis, 1999). For example, the ability to read and write not only enhances people's abilities to secure employment and to manage their enterprise effectively, it also enhances the capability to engage in discussion; to debate; to negotiate; to add an individual voice to the

multitude of voices influencing household, local and national discourses on development (Bebbington, 1999).

Human capital and capability are closely related to what Sen defined as entitlements (Sen, 1997). Human capital concentrates on the agency of human beings through skills and knowledge as well as effort, to augment production possibilities. Human capability focuses on the abilities of human beings to lead lives they have reason to value and to enhance the substantive choices they have (Sen, 1997). For example, personal characteristics, social background, economic circumstances, education etc. are examples of human capital that provides a person with the ability to do certain things.

Social capital can be described as the social networks and associations to which people belong. Social capital is defined by Coleman (1990) as social relationships which come into existence when individuals attempt to make best use of their individual resources. For Ellis (1999) it refers to an individual's or household's major networks, relationships of trust, and wider institutions upon which people draw in pursuit of secure livelihoods. To Moser (1998) social capital refers to reciprocity within communities and households based on trust derived from social ties. Serageldin and Grootaert (2000) distinguish three institutional-organizational forms of social capital: informal and local horizontal associations, hierarchical associations, and formalized national structures such as the government and the rule of law. In this study, we look at formal and informal networks of mainly two types: formal, state-based networks, based on authority and structured by institutions, which include government associations and service groups, and private sector networks, based on social relations including family and kinship relations, neighbors, informal organizations or social groups, commercial and trading relations and patron-client relationships.

Natural capital in this coastal fish-based research area includes the distribution of land use and property rights, access to mangrove forest, possibilities of water management, and access to marine resources. In this context, the issue of the sustainability of access to shrimp ponds and fishery, and the issue of social-ecological resilience needs to be given attention. Livelihood activities can be regarded as unsustainable if they do not preserve or enhance the natural resource base for present and future generations (Chambers and Conway, 1992).

Physical capital comprises assets that are man-made, like the availability of infrastructure, such as the road network, electricity, medical clinics and hospitals, schools, electricity, and markets. For this research, waterways, sluice gates, farm and pond size, irrigation, fishing boats and gears, and roads to markets and schools are particularly relevant.

Financial capital is one of the most important assets in the sustainable livelihood framework. It entails not only money, but also access to formal loans or personal credit. In this research, the net incomes, fixed and operational costs and market opportunities affected the financial resources of the households' livelihood options in the Mekong Delta.

The conditions and the ways in which people access assets, determine livelihood opportunities and outcomes. There is no single range or category of assets that leads to a particular livelihood, but in

general, the range of assets available to the poor tends to be much more limited in comparison with those available to the rich. As a result, in this thesis different frameworks of access were developed to analyze the policies supporting poverty elimination.

People's assets are not merely means through which they are making a living; they also give meaning to their world (Bebbington, 1999). Meaning is thus one of the factors influencing decisions people make regarding their livelihood strategies. Access to resources is not the only way, in which people deal with poverty in a material sense (by making a living). The ways in which their perceive well-being and poverty are related to their choices and strategies; and the capabilities they possess add to the quality of life and also enhance their capabilities to confront social conditions that produce poverty (Bebbington, 1999). The decision-making process is not simply based on a single driver or isolated phenomena but influenced by economic, cultural, political, and ecological conditions. How local actors sustain themselves should not only be viewed from how they exercise agency in coping with challenges in the environment, but also by including how local conditions, choices and options are shaped by factors beyond their control, such as the global market, macro-economic policies, climate and weather, and power relations at various societal levels, the so-called mediated considerations.

Different authors have labeled mediated considerations in various ways. Reardon and Vosti (1995) called them conditioning factors which included contextual economic, social and policy considerations, like in Ellis (2000b).

2.1.2 Vulnerability

Another key concept in Fig. 2.1 is the vulnerability context that refer to the seasonality, climate change, and other trends or shocks that affect people's livelihoods and decision making process (DFID, 1999). Adger (1999) emphasized that the social dimension of vulnerability is composed of two different aspects of vulnerability, which are individual and collective vulnerability. The first is determined by access to resources in terms of the social status of individuals or households within a community. The latter is determined by institutional and market structures, such as the prevalence of informal and formal social security and insurance, and by infrastructure and income. He emphasized that inequality is an indicator of collective vulnerability (Adger, 1999). Identifying factors that contribute to vulnerability can help to effectively reduce their influence and promote livelihood continuity and ecological sustainability. At individual or household levels, vulnerability can be defined as the degree of people's exposure to risk, shocks and stress, and the difficulty to cope with them. Different authors have suggested different types of vulnerabilities. For example, according to Chambers (1989) vulnerability has an external side consisting of risks, shocks and stress to which an individual or household is subjected, and an internal side which is a person's defenselessness or lack of means to cope without causing damage or loss. Sen (2002) classified vulnerability on the basis of risk and rights. The first may be called the 'risk-centric view' whereby vulnerability is typically defined as variability in the living standard. The second perspective may be called the 'rights-centric view' whereby vulnerability is caused by the lack of social and political

rights. Similarly, Glewwe and Murtaugh (1998) distinguished vulnerability on the basis of the economic and political context as market-induced and policy-induced. Vulnerabilities in this study are regarded as long-term effects, like the uncertainties of climate change and natural resource degradation, the effects of a low level of education, and short-term effects like the risks or shocks of the occurrence of shrimp diseases, or market price decline, etc.

There is a difference between the concepts of insecurity and vulnerability. Insecurity is the probability that a livelihood will be threatened. Vulnerability refers to the exposure to, and the impact of, specific risks on the livelihood conditions (Kaag, 2004; Kaag *et al.*, 2004). Not all livelihoods in the research villages are equally vulnerable to risk and equally predisposed to overcome it (idem). Also, farmers coping with the same risks could have different responses and decision-making strategies. For example, under pressure of continuous failure resulting from shrimp diseases farmers who become "afraid of shrimp" will empty their ponds and try to obtain loans to diversify their sources of income, while those believing "in the turn of unluckiness" will take loans and continue to be involved with shrimp aquaculture, dreaming of another chance for a good harvest.

2.1.3 Livelihood strategies, decision making and pathways

In order to achieve a livelihood, people practice various kinds of activities, which is sometimes called livelihood portfolio. People undertake these activities based on strategies by which the activities are structured and planned, hence the concept livelihood strategies (Niehof and Price, 2001). Zoomers distinguished four categories of livelihood strategies: accumulation, consolidation, compensatory and security. However, this categorization should not be taken as something fixed, but flexible (Zoomers, 1999). This means that, in different times and places, the same person may pursue different strategies. These are influenced not only by the results of preceding activities, but also by personality characteristics (de Haan and Zoomers, 2005).

However, in these approaches to livelihood there is an underlying assumption of rational choice. Therefore, De Bruijn and Van Dijk (2005) distinguish between a pathway and strategy. The concept of pathway refers to the result of the decision-making processes of (groups of) people who have to deal with risk and uncertainty in a vulnerability context. Decision-making is not a one-time event but a process, mostly embedded in a pathway (idem). Strategy has the connotation of trying to attain a pre-set goal, while pathway refers to an iterative process in which goals are achieved in a non-predictable way. Decisions are made in a specific context with a specific history, and potentially in a high-risk environment. Decision-making is a step-by-step process, guided by the past decisions that shaped the individual's character and contribute to her/his mental attitude in the present. Next to pathway, some authors distinguish a trajectory. De Haag and Zoomers (2005) proposed to use the concept of pathway for the observed regularities or the pattern in the livelihood of particular social groups, and to use trajectories for individual actors' life paths. Pathways are then characterized as patterns of livelihood activities which arise from a co-ordination process among actors (de Haan and Zoomers, 2005).

While studying the decision-making process we should consider the possibilities of diversification, intensification, collaboration, and migration over time. Today, it is more common for people to find an income from multiple sources and assets. To supplement a livelihood under threat of shrimp diseases or declining and variable fish catch and in general of income variability, farmers and fishers in the Mekong Delta can engage in many different but complementary activities to secure their income: changing the farming system (e.g. integrated farming), diversifying sources of incomes, collaborating in clusters to get financial support, migrating out to work elsewhere, intensify fishery. Many different drivers for such livelihood changes can be found at the household level or at the level of national or global institutions, like the following Chapters will show.

2.1.4 Social resilience

Social resilience is defined as the ability of groups or communities to cope with external stress and disturbances as a result of social, political and environmental change (Adger, 2000). This definition highlights social resilience in relation to the concept of ecological resilience, which is a characteristic of ecosystems to maintain themselves in the face of disturbance (idem).

Resilience can be defined in many ways. It is the buffer capacity or the capacity of a system to absorb perturbations (Holling et al., 1995) or the speed of recovery from a disturbance (Adger, 2000). Resilience is defined as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Walker et al., 2004; cited in Marschke and Berkes, 2006); the concept is future oriented and it is used to characterize a system's ability to deal with change. According to Adger (2000), the social and ecological systems are themselves linked. Hence, in his approach the resilience of social systems unilaterally related to the resilience of ecological systems on which social systems depend. The social units are the institutions. Ecological and social resilience are tested when upheaval and stress are placed on institutions (idem). In an earlier paper Adger (1997) stated that resilience maximizes the ability to withstand shocks and uncertain impacts of changes. Social resilience can be measured through proxies of institutional change, property rights, and demographic change (idem). Although we value his approach as a social geographer, we would like to place more emphasis on the households and individual shrimp farmers and fishers and their decision-making processes to arrive at a more varied picture of social resiliences – in plural – to indicate the differences between the various aquaculture systems in the Mekong Delta, and their contribution to the social-ecological resilience of the region (Ch. 7).

Livelihood pathways and strategies are extremely varied and complex according to place, time, context, household assets and individual characteristics. This study on the sustainability of shrimp farming and fishery and their livelihood strategies and pathways allows us to get to know the capacity of people to respond to social, economic, political, and ecological changes. We adopted Folke et al.'s three clusters of strategies: learning to live with change and uncertainty, nurturing learning and adapting, and creating opportunities for self-organization (Folke et al., 2003; cited in Marschke and Berkes, 2006) to show the capacity of resilience building at household level by

studying the ways people adapt, manage - or learn to manage - change. The first cluster consists of the coping strategies, which may have positive and negative effects on resilience depending on the production assets. The second cluster responds to the nurturing or learning and adapting and shows adaptation strategies to protect the resources, to build social and political sustainability. The third cluster relates to the capacity for self-organization of the social system (see also Tabs. 7.1 and 7.2).

2.2 Research setting

2.2.1 The Mekong Delta

This research was conducted in Bac Lieu and Ca Mau, the two southernmost provinces in the Mekong Delta, Vietnam. Geographically, the Mekong Delta lies in the southwestern region of Vietnam, where the Mekong River approaches the sea through a network of tributaries (Fig. 2.2). The Mekong Delta displays a variety of physical landscapes, ranging from mountains in the northwest to flat flood plains in the southeast. The low-level flat plain is about 3 meters above sea level, and has a dense system of rivers and canals. With covers an area of 4.05 million ha; of which 2.58 million ha is land used for agricultural production and 379 thousand ha is used for aquaculture, accounting for 70.7% of country's aquacultural area. Annually, the Mekong Delta accounts for 51% of the country's rice production, 70% of fruit production, and 80% of fish production, which includes aquaculture. Agriculture dominates the region's GDP, accounting for 43.2% (Nghiem, 2010). About 20% of the total population of Vietnam lives in the Mekong Delta, and the population continues to grow. In 1990, there were 14.656 million people, and in 2010 there were 17.272 million people, with nearly 80% living in rural areas (MDPA, 2004). In terms of ethnicity, there are four ethnic groups living in this region: Kinh, Khmer, Chinese and Cham. The Kinh people account for 92% of the population, and, along with the Chinese, they experience better living standards than the other groups. The Khmer are the most economically and socially disadvantaged group in the region (MDPA, 2004).

In these two provinces, we selected eight research sites in four districts along the eastern coast for the study, in order to cover the variability in geographic conditions. The sites (Fig. 2.3) were selected in pairs as an improved extensive shrimp aquaculture system (with and without mangroves), an intensive shrimp farming system (both with clusters and without clusters) and the fishery system (both within and outside of the resettlement area). The villages in these research sites represent different characteristics needed to cover a variety of the pathways and strategies of household adaptation to both the threats and opportunities to social and economic change.

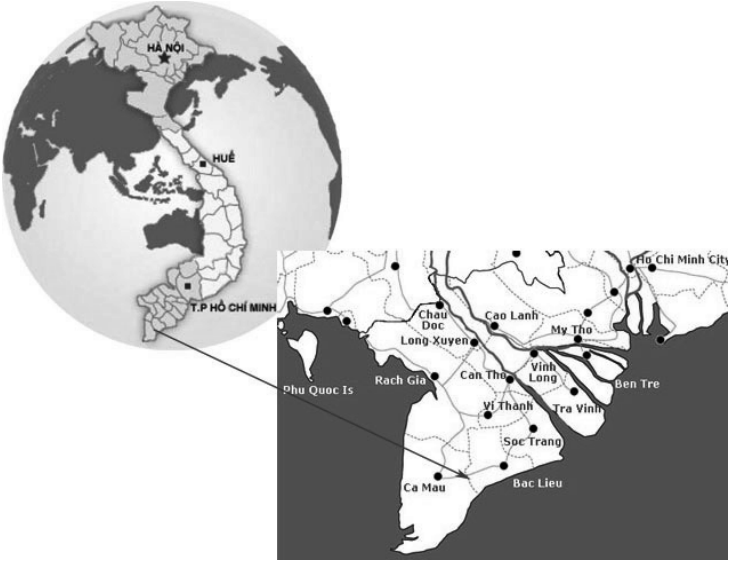


Figure 2.2: Map of Viet Nam and Mekong Delta. Source: http://www.travelfish.org/map_detail_region/vietnam/mekong_delta/17

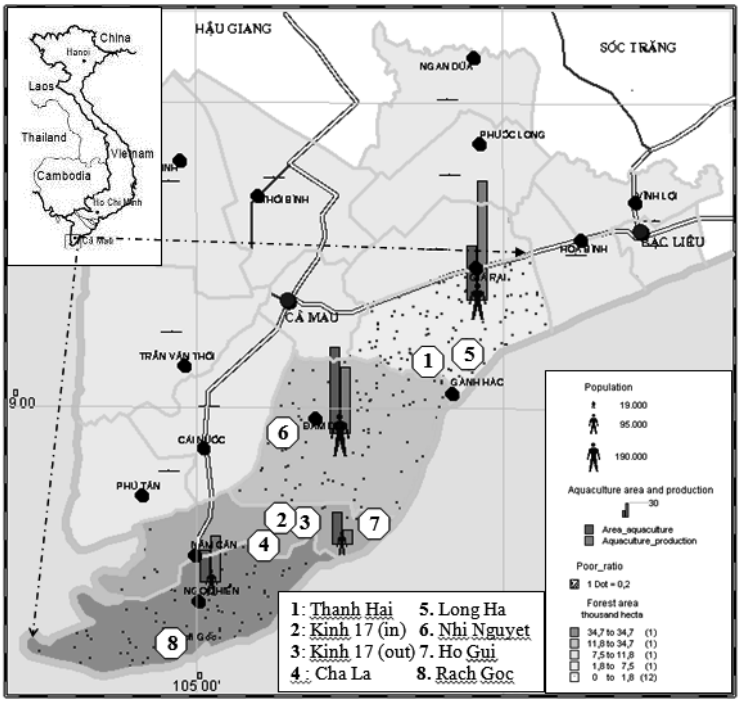


Figure 2.3: Map of Bac Lieu and Ca Mau provinces showing the study sites.

2.2.2 Characteristics of Bac Lieu and Ca Mau provinces

The contribution of Bac Lieu and Ca Mau provinces to economic development of the Mekong Delta is shown in Tab. 2.1. After the year 2000, the aquaculture area and the shrimp production of the two provinces slightly changed (Fig. 2.4). Both the aquaculture area and shrimp production increased in Ca Mau, while shrimp farming in Bac Lieu intensified. In the first years after 2000, shrimp production in Bac Lieu increased rapidly to reach a peak of 68,340 ton in 2004, and it remained stable during the following years. In recent years, the shrimp aquaculture area in Ca Mau did not change but the production slightly increased showing that more advanced techniques are applied.

Table 2.1: Aquaculture, forestry and fishery data of the two provinces in comparison with national and Mekong Delta data (2009)

	Unit	Country	Mekong Delta	Bac Lieu province	Ca Mau province
Total area	000ha	33,105.1	4,051.9	250.2	533.2
Population in 2010	000pers	86,927.7	17,272.2	867.8	1,212.1
Aquaculture area	000ha	1,044.7	738.8	126.3	294.7
Total production	000ton	4,602	2,702	198.4	287.4
Shrimp production	000ton	419.4	318.6	68.2	99.6
Forest area	000ha	13,258.7	276.3	4.2	99.2
Forest cover	%	39.1	6.8	1.7	16.5
Offshore fish boats	unit	24,990	6,341	354	1,232
Capacity	000CV	3,721.7	1,826.5	63.5	242.2
Total catch	000ton	2,280.5	925.5	82	145.8

Source: (GSO, 2011).

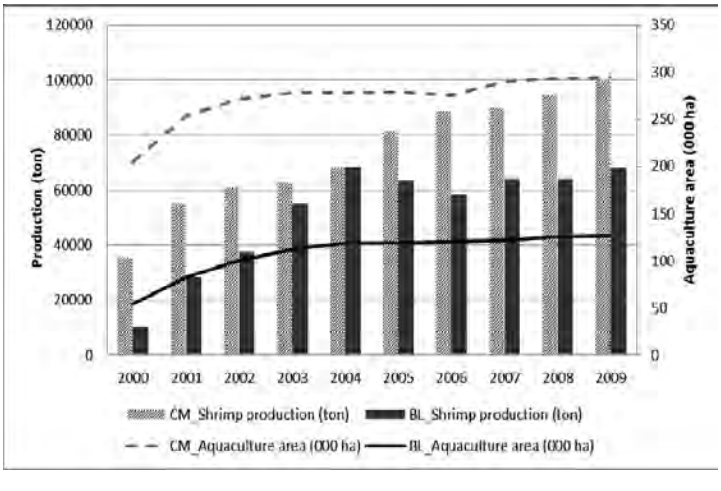


Figure 2.4: Shrimp production (ton) and aquaculture area (ha) of Bac Lieu and Ca Mau provinces

- *Bac Lieu*

Bac Lieu province is located in the south-eastern part of the Mekong Delta and belongs to the Ca Mau Peninsula. The total surface area of the province is 250,200 ha with a population of about 867.8 thousand, with a population density of 343 persons/km^2 (GSO, 2011). The total forest area of the province was 4,200 ha and the total aquaculture area was 126,300 ha in 2009 (Tab. 2.1). It also has 56 km of coastline with a large fishing ground (Exclusive Economic Zone) of over 40,000 km^2 producing a variety of valuable aquatic species such as shrimp, squid, fish, etc..

The province can be subdivided in three agro-ecological zones. First, the sweet-water region for rice, fruit trees farms, and produce, with a rice output reaching 800,000 tons per annum. Secondly, the brackish water area, with different production systems of rice – and prawn, shrimp- and crab, and of fish have brought high economic returns, where the average income equals about VND 50 million per ha per annum. Thirdly, there is the salt water area south of National Highway 1A, where mainly shrimp and other valuable aquatic species such as eel, groupers, mudskipper, fish (*ca keo*), crabs, clams, and oysters are produced. The fishery sector including capture fishery and aquaculture has helped to create export earnings of USD 192.5 million in 2009. With 4,000 ha of salt production, salt production has reached 120,000 tons per annum. Bac Lieu salt is historically famous because it is a good quality product and therefore is competitive on the market, supporting many people in the region (GSO, 2011; MDEC, 2011).

- *Ca Mau*

Ca Mau is the most southern province, on the tip of Vietnam, located at 370 km from Ho Chi Minh City and 180 km from Can Tho. Ca Mau covers an area of 533,200 ha, accounting for 1.6% of the country, and 13.6% of the Mekong Delta. The forest areas of Ca Mau are spread over 99.2 thousand ha, mainly consisting of mangroves, making the area the largest remaining mangrove forest area in Vietnam. Being surrounded by the sea on three sides, and holding a dense network of canals, creeks, rivers and mangroves, this province has considerable potential for forest, fishery and aquaculture development. Ca Mau's natural conditions are favorable and show great potential for development. The province has over 254 km of coastline, about 70 thousands km^2 of fishing grounds, and an aquaculture area of over 290,000 ha. The total aquaculture production is over 287,000 tons per year, of which shrimp makes up nearly 100,000 tons (Tab. 2.1) (CWPDP-WB, 2004; GSO, 2011).

The further to the south a region is located, the more it is characterized by many mangrove-shrimp farming models, crowded river systems, low elevation and less intensive shrimp farming. The eight research sites were selected in Ca Mau province to cover the different livelihood activities (shrimp farming or fishery), agro-ecological environments and physical aspects, like hydrological conditions, density of mangrove forests, levels of collaboration in shrimp farming, policies of mangrove forest management, and the different livelihoods within and outside of the resettlement zones.

Table 2.2: Socio-economic aspects of four districts in Bac Lieu and Ca Mau provinces

Items	Unit	District			
		Dong Hai	Dam Doi	Nam Can	Ngoc Hien
Total area	000 ha	56.3	82.6	50.9	73.3
Aquaculture area	000 ha	39.6	65.7	25.7	24.4
Forest area	000 ha	1.8	7.5	11.8	36.6
Shrimp farming production	ton	18,000	30,499	8,583	9,063
Total fish production (catch)	ton	40,000	11,830	3,186	19,105
Population	per.	143,774	182,403	66,541	78,610
Number of households	unit	27,123	41,183	16,681	19,619
Number of teachers	per.	1,275	1,415	590	587
Number of health care officers	per.	152	423	167	70
Number of communes having TV radio transition sets	unit	24	16	8	6
Poverty ratio	%	22.1	12.24	6.85	13.14

Source: Bac Lieu and Ca Mau Provincial statistics, 2009. Dong Hai statistics 2006

2.2.3 Aquaculture, forestry and fishery characteristics

a. Shrimp aquaculture

Changes within shrimp aquaculture can be divided into 3 main stages (Tab. 2.3). The first stage (1975-1990) was characterized by rapid destruction of forests for conversion to shrimp farming, which was done by using traditional extensive methods. The second stage (1990-2000) was characterized by the replantation of mangroves and allocation of forestland to farmers. Shrimp farming became more developed and diversified, and a transition took place from an extensive to an improved extensive farming system. In the third stage (after 2000), mangrove harvesting and replanting started, and new technologies in shrimp farming focused on intensive farming, the use of best management practices, and on quality and reliability.

In this research, three systems of brackish shrimp farming were investigated: the improved extensive farming system, the mangrove-shrimp integrated system, and the intensive shrimp farming system. These three systems can be distinguished by land holding rights, pond size, mangrove area, stocking density, harvest and farming practices. Shrimp farming practices differ according to the level of investment, infrastructure conditions, production techniques and equipment, level of the farmer's practical knowledge (Long, 1992), experiences and skills, and agro-ecological conditions.

Table 2.3: Changes in shrimp aquaculture and mangrove forestry following national and provincial policies and decisions.

Year	Period 1975-1990
1976	Mangrove replanting activities started after the war. First State Forestry Fisheries Enterprise (SFFE) established in Ngoc Hien district.
1978	Free migration, mangroves reclaimed for rice, crops and fish.
1979	Economic degradation resulting in shortage of food and land use change from mangrove to rice
1980	In 1980: Extensive farming, shrimp yield of around 250kg ha^{-1} (de Graaf and Xuan, 1998)
1980	In 1980s: Nearly twenty thousand people migrated from other provinces to mangrove areas to exploit mangroves for timber, charcoal and development of shrimp aquaculture.
1984	Extensive shrimp farming expanded and mangroves destroyed for aquaculture.
1988	Decision No. 389/QD-UB (1988) of Minh Hai province (Ca Mau and Bac Lieu province now) was issued with respect to forestland allocation to farmers for forestry re-plantation in farms together with shrimp farming and land allocation to households started.
	Period 1990-2000
1990	Reforestation of mangrove forest started.
1991	Series of national and provincial decisions were issued regarding mangrove management and the integrated mangrove – shrimp farming system, especially Decision No 64/QD-UB at the provincial level.
	After the introduction of tiger shrimp (*P. monodon*) the simple traditional extensive farming changed into a more complex system: improved extensive.
1993	Shrimp disease outbreaks spread widely
1995	Introduction of shrimp seeds from hatcheries, wild crabs collection and blood cockle stocking. Aquaculture was improved and more diversified.
1997	Typhoon Linda hit Ca Mau and destroyed mangroves
	In late 1990s: Intensive shrimp farming started, especially in Bac Lieu and north of Ca Mau.
	From 2000 until now
2001	Mangrove-shrimp farms in SFEs started to harvest and replanted mangrove trees.
2002	Following the national Decision 116, CaMau province made Decision N24/QD.UB. For households, mangrove covers could be at 50%, 60%, 70% of total farm area of less than 3 ha, 3-5ha, and more than 5 ha, respectively.
2002	The integrated mangrove–shrimp system was recognized as organic by Naturland – SIPO.
	Certification on BMP (Best Management Practices), and GAP (Good Aquaculture Practices) were introduced
	Shrimp farming clusters were created and made operational.
2006	*P vanamei* introduced

Source: Interviews, 2008; (de Graaf and Xuan, 1998; Christensen, 2003; Hai, 2005)

- ***Improved extensive faming system without forest***

The improved extensive shrimp culture (without mangrove forest) is most widely practiced where people have destroyed the forest, dug ponds and broken the dikes to let the seawater in. All these farms are on higher elevation, far from the coast in an area that is unsuitable for mangrove (Tab.

2.4). Sea grass is planted to provide food for shrimps in the pond, and together with a balanced water temperature, this serves as a cradle for nurturing shrimp.

In this system, farmers receive red certificates[3] for a land holding area of an average of 2-7 ha per household. The improved extensive farming system is an aquaculture system that relies on trapping the wild larvae of shrimps at spring tide. Farmers diversify by stocking artificial shrimp seeds and mud crab from hatcheries or fish and mudskipper *(ca keo)* from the wild. During daytime, the sluice gate is opened at full tide to take in water and small natural shrimps. When the pond is full, the sluice gate is closed. During the night, at low tide, the gate is re-opened to let water flow out. The big shrimps follow the water streams and are harvested in the net installed at the sluice gate. Harvesting time (*con nuoc)* lasts for 5-6 days during spring tide, twice a month. Fish and shrimp are harvested during *con nuoc*, but mud-crabs are caught during the whole year. Famers sell *Penaus monodon* and crabs for cash and reserve fish and wild shrimps, which fetch lower price, for daily consumption. Shrimps are harvested during two different periods in a year. The *tong* season lasts from March to July. The *mua* season lasts from September to February with peak harvests from October to December (Binh et al., 1997). Farmers prefer the *mua* season because it has higher yields and shrimp prices normally increase before the New Year festivals. Men are responsible for farming techniques, decision-making on the timing of dredging and stocking, and help women to harvest the shrimp. Men attend extension trainings, share experiences with neighbors, and attend parties while the women take care of the housework, the non-farming activities, are in charge of the household expenditure and savings.

The main differences between the improved extensive system and the mangrove-shrimp farming system are the pond structure, the land tenure status and the presence of mangrove forest on the farm; the two systems do not differ much in pond management.

- ***Mangrove-shrimp farming system***

The mangrove-shrimp farming system is found mostly in Ca Mau in either integrated (mixed) mangrove-ponds or separate mangroves and ponds. Farmers receive a green certificate[4] on a contract with forest companies for shrimp farming and mangrove protection. The system has the same farming techniques as the improved extensive system. However, the pond differs much because it is part of a large mangrove plantation.

In shrimp-mangrove systems the ponds consist of long, narrow and parallel channels (600-700 m long, 3-6 m wide) that are dug either through or adjacent to forested land. In mixed systems, the levees are vegetated by mangroves, while in the system without mangroves, the ponds are located

[3] Red certificates (red books): long-term land use rights for 50 years have been given to farmers who apply land use strategies for suitable economic development.

[4] Green certificates (green books): contract-based (forest) land use rights have given to farmers who have obtained 20 years leases. The contracts will be renewed after this period if the famers did not violate the conditions of the contract.

near waterways at the front of the farm, and the mangroves are usually grown in a separate area at the back of the farm (Clough *et al.*, 2002b) (Fig. 3.2 Ch. 3). The canals provide water to permanent areas to culture fish, shrimp and crab. The forest flats are flooded intermittently as the water level changes with the tidal cycle, giving the mangroves an alternative period of inundation and exposure to air, as well as providing a nursery for shrimp to grow or escape from the heat. The dominant species of mangrove in Ca Mau is *Rhizophora apiculata*, which covers 44% of the land, and the rest are *Avicennia excoecaria, Nypa* spp and *Acacia* spp *(Hai, 2005).*

The mangrove-shrimp farming system is characterized by low investment cost, low technical input, a high level of recruitment of wild juveniles and maintenance of mangrove trees. This mangrove-friendly aquaculture system is important to poor farmers who have limited access to financial capital.

- ***Intensive farming system***

In contrast to the mangrove-shrimp system, the intensive farming system is more suitable for areas at a higher elevation in order to be able to allow the bottom of the pond to dry up for hygienic reasons. It is unsuitable for mangrove because of water seepage from the mangrove roots. Therefore, the geographical position of this system minimizes the negative effects of shrimp aquaculture on the mangrove ecosystem.

Intensive farming demands a complex technology to produce shrimp on small farms, with large populations of shrimp. The ponds in this system are less than 1-2 ha in size and they are constructed with dikes to hold the water 1-1.5 m deep. There is a high density of shrimp, and the water is not renewed by letting in seawater, so aerators are used to provide dissolved oxygen. The cost of feed constitutes a major part of the production cost, accounting for 50% to 70% of the total variable cost. Commercial feeds, medicines and chemicals are used in this farming process, which causes vast organic dregs to accumulate at the bottom of the ponds that need to be removed. The production ranges from less than 8,000 kg ha^{-1} yr^{-1} to more than 20,000 kg ha^{-1} yr^{-1} (Otoshi et al., 2009). The system is closed and does not involve exchange of the water, which allows for a better control of diseases in brood stock (Kongkeo, 1997), and against external crustacean and fish coming in. The products of the intensive system are able to meet international standards, which increases farmers' capacity and competitiveness in the global market. However, due to the high investment required, the system is inaccessible for small-scale, poor farmers.

a. Forestry

Mangroves are mostly dominated by *Rhizophora apiculata, Avicennia alba, A. officinalis, A. marina*. The natural distribution of mangrove vegetation heavily depends on topography. For example, *Avicennia alba* grows in tidal areas and *Rhizophora apiculata* grows well in inter-tidal areas (Hong, 1999). Mangrove forests, typically for coastal ecosystem in tropical countries, provide a variety of benefits to the economy. Mangrove products include various wood products as well as food and household items, such as roof thatching materials, medicinal plants and honey. Mangroves in their natural state, with coral reefs, grass fields and mudflats provide places for fish and other aquatic

species to nurture, feed and shelter. Since 80%-90% of all fishery production in Vietnam comes from coastal waters less than 30m deep, mangrove forests play a primary role for fishermen by providing breeding and nursery grounds for aquatic organisms. Through their filtering function, mangroves lessen the impact of toxic substances on surface and ground water, and soil. Moreover, mangrove forests serve as buffer zones against typhoon and flood damage and saline intrusion, and help prevent sea dike breaching and coastal abrasion (Macnae, 1974; Primavera, 1998; CWPDP, 1999; Hong, 1999; Carrere, 2002; RESCOPAR, 2004).

Deforestation of mangroves in Minh Hai province, which was divided in Bac Lieu and Ca Mau provinces) has been a serious environmental problem. Minh Hai lost 21 million m^3 of mangroves during the war (Hong, 1999). Over 26,000 ha has been converted to agricultural land during 1976-1982 and over 9,000 ha for salt pans (Hai, 2005). Between 1983-1995, over 66,000 ha was lost to shrimp ponds (Minh et al., 2001). Once all the mangroves were destroyed, the livelihoods of the inhabitants of the region become subject to serious risks because: 1. Ecosystems are degraded; 2. Reduced tidal fluctuations and soil salinization prevent the development of new mangrove trees, reducing the speed and quality of biodiversity rehabilitation and, 3. Ponds productivity often declines over time as a result of acidification, pollution and infectious diseases (RESCOPAR, 2004; Valiela, 2006).

In response to the destruction of mangroves, the Vietnamese government established the Forest Enterprises system to manage the remaining forests. In 1976, the first Forest Enterprise was established in Ngoc Hien, Ca Mau. The government promulgated several policies and regulations that focus on forest land tenure and allocation, mangrove management, protection and sharing benefits. However, the chaos in forest allocation, the conflicts among forest management actors, and land tenure became serious problems. Moreover, it takes too much time for mangroves to be harvested and this does not bring as much money as shrimp aquaculture so that people are not interested in forestry

b. Fishery

Ca Mau has favorable natural conditions that hold a great potential for a fishery economy. The number of vessels and the Catch per Unit of Effort (CPUE) defined as tons of fish caught relative to engine capacity in horse power (hp) changed over time (Fig. 2.5). After the American war ended in 1975, the number of fishing boats and engine capacity of the fleet decreased because part of the fleet left the country with the so-called "boat people". As a consequence, less fishermen were fishing on the same fish stocks and the CPUE of the remaining boats increased (Fig. 2.5). From 1983-89, the engine capacity of the fleet slightly increased, but the fishing fleet was organized into co-operatives. This reduced the incentive for the fishermen to fish and the total catch, and the CPUE decreased significantly. From 1989-95, Vietnam changed its socio-economic policy (*Doi Moi*) and the economic system became more free-market oriented. The fish industry was de-collectivized and equipment became easily available. Within this period, the total catch and the engine capacity of the fleet increased rapidly (de Graaf and Xuan, 1998), while the CPUE decreased.

The number of vessels, capacity and catch fish production have slightly changed over the past 10 years (Fig. 2.6). In 2009, Ca Mau had more than 1,200 offshore vessels registered, and 145,750 tons of catch fish (GSO, 2011).

It is known that mangrove ecosystems serve as nursery grounds for marine shrimp and fish species. There are correlative linkages between the condition of mangrove forests and coastal fishery production (Manson et al., 2005), but there is little reliable emperical evidence that a reduction in the functions of mangrove ecosystems results in lower coastal fisheries production (Mumby et al., 2003). This research will not focus on finding a correlation between mangrove sytems with fishery production, but instead focus on how the uncertainties associated with mangrove degradation, changing climate, decline of CPUE and social, economic, and political risks affect the decision-making process in shrimp farmers' and coastal fishers' livelihoods and its effect on social and ecological resilience in the Mekong Delta of Vietnam.

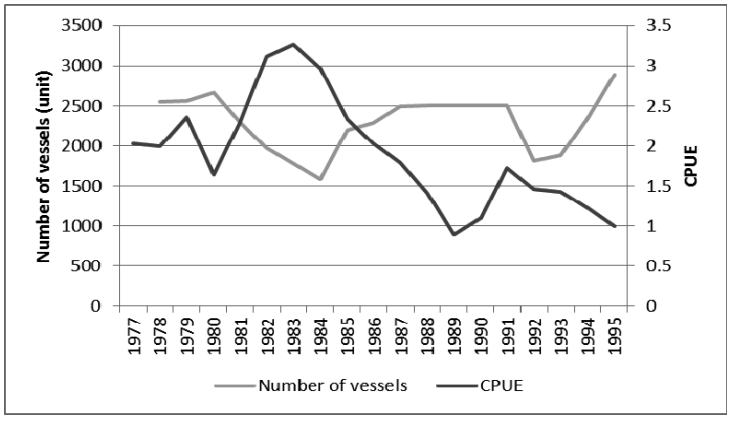


Figure 2.5: Number of vessels and Catch Per Unit Effort (CPUE) from 1975 to 1995. Source: Data from (1998)

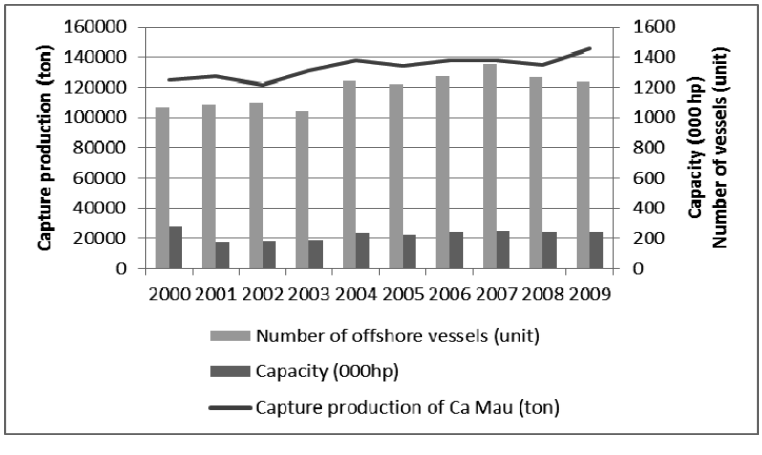


Figure 2.6: Changes in offshore fishing vessels, capacity and total catch after 2000. Source: (GSO, 2011).

2.3 Description of the study sites

Eight sites were selected with different agro-ecological and physical characteristics, like the presence of mangroves and the availability of fresh water, and with differences in settlement histories, farm size, land tenure systems, livelihood and infrastructural conditions (Fig. 2.3; Tab. 2.4).

Table 2.4: General characteristics of the research sites.

	Sites	Source of income, specification	Physical condition, main means of transportation
Improved extensive	1. Thanh Hai	- shrimp farming, market services, labor, marine-forest collection	- 60% having electricity, transport by boat, motorbike
Mangrove-shrimp (separated and integrated system)	2. Kinh17 (in resettlement zone)	- shrimp farming, market services - in resettlement	- 100% having electricity, 30% having septic tank, good infrastructure
	3. Kinh 17 (outside resettlement zone)	- shrimp farming, forest-based collection - separated shrimp ponds and forest	- 85% having electricity, transport by boat and motorbike
	4. Cha La	- shrimp farming, forest-based collection - integrated shrimp ponds and forest - organic shrimp farming	50% having electricity, transport mainly by boat
Intensive farming (non-cluster and in cluster)	5. Long Ha	- shrimp farming, salt production, marine forest collection	- 80% having electricity, near school good transportation
	6. Nhi Nguyet (in cluster)	- shrimp farming, market services - collaboration in cluster	- 85% having electricity, transport by boat
Fishery	7. Ho Gui (in resettlement)	- fishing, labor, market services - in resettlement zone	- 100% having electricity, primary school and good roads
	8. Rach Goc (outside resett-lement zone)	- fishing, shrimp farming, fishing service	- nearly 100% having electricity, near high school and market, transport by motorbikes and boats

* Kinh 17 included two systems: improved extensive farming in the resettlement zone and separate shrimp and forest farming.

1: Thanh Hai in Dong Hai district is a large village of one thousand hectares. Before the war, the village was rich in nature covered with bush land and mixed forest (*Avicennia, Excoecaria, Lumnitzera, Saccharum, Phragmites* etc). During the 1990s, roughly half of the village territory was transformed into farm land for the cropping of rice, and the rest remained forest. Land rights were allocated to farmers in Thanh Hai for two production systems: rice farming and extensive shrimp farming. In 1995 each household was given the ownership rights (red certificate) for on average 3-5 ha. Besides shrimp farming, people now have alternative sources of income such as small trade,

non-farm and off-farm wage labor, crop production, the collection of small marine products, alcohol production, and as drivers of boats and motor bikes.

2: Kinh 17 in the resettlement zone of Nam Can district, occupies 368 hectares, and is inhabited by 105 households that were moved from the Full Protection Zone (FPZ)[5] in 2007 by government policy and the Coastal Wetlands Protection and Development Project (CWPDP) (DARD, 2006). According to the CWPDP document each household was compensated with: 1. Between 1.5 and 3 ha of productive land for aquaculture; 2. Accommodation in the form of a standard house type of 50 m^2 costing roughly USD 1,030; 3. A transport allowance of USD 77 per household; 4. Subsistence for the rehabilitation period of six months (food support of 30kg rice per month); 5. Access to a vocational training course for one member of each household, costing USD 100 which amount should be paid directly to the training institution (CWPDP, 2000). However, the infrastructure provided was of poor quality and already damaged after two years.

People started reforestation since 2006, but the mangroves were so young that they could not provide good environmental services. Some villagers took up small trade, pig breeding, or became motorbike drivers, wage laborers. Livelihood earnings and opportunities were meagre in 2007; only 60 out of 105 households (57%) accepted residence in the resettlement zone. The other 43% found better opportunities elsewhere, or sold their property to start a new life outside the resettlement area. Many of the remaining families and individuals had to spend their savings to balance their livelihoods, or even go back into the buffer zone to exploit marine species illegally to make ends meet.

3: Kinh17 lies outside the resettlement zone in Nam Can district and constituted a mangrove-shrimp farming system under the management of SFFE[6] (now known as State-Owned Forestry Company TamGiang3) (TG3). In the 1980s, retired government officers were allocated 10 ha of land of 100 m wide and 1,000 m long *(trăm ngang ngàn dọc)*. Now individual farm sizes have decreased in size because this finite amount of land was divided among a growing number of household members. In the mangrove-shrimp system, State policy defines the optimal ratio of

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[5] - *Full protection zone (FPZ):* ranging from 100 m to 1000 m inland from the seashore. No settlement allowed, collection of dead tree and small marine species permitted but no shrimp cultivation or fishing allowed

- *Buffer zone (BZ):* from 1 to 4 km wide belt from full protection zone border. Settlement is allowed; mangroves covers up to 70% and the other 30% can be used for shrimp ponds, dikes and houses.

FPZ and BZ are under the management of State Forest Enterprises. They take on the tasks of reforestation, thinning, harvest and the allocation of forest to households. Farmers settled in the BZ can obtain a 20 year lease (green certificate).

- *Economic zone (EZ):* situated behind Buffer Zones, EZ are used for socio-economic development. In economic zones, land tenure and red certificates are released to owners for long-term land use right.

[6] Since 2006 SFFEs changed to State-Owned Forest Companies (FC), where the companies post their own business independently.

mangroves and ponds, depending on the land size. In Kinh17 mangroves are grown at one side of the farm and shrimps are produced in another part in a separate mangrove-shrimp system.

4: ChaLa in Nam Can district bears the name of dominant type of wetland vegetation, *Pheonix Paludosa* (date-palm), encountered when the first people opened land for farming. Cha La has a mixed system of mangroves and shrimp ponds, which is different from Kinh17. Farmers received a green landholding certificate under contract with the State-Owned Forest Company 184 (FC 184). Nearly 70% of households have shrimp ponds that are certified as producing organic quality shrimp" by Naturland. Unlike the traditional shrimp farming system, organic farming requires a specific ratio of mangrove forest to protect the ecosystem, a ban of chemicals and hygienic standards in processing. These farms were inspected by the International Market Organization (IMO), and visited by the Swiss Import Promotion Programme (SIPPO). The organic black tiger shrimp (*P. monodon)* is exported to the Cooperative (Coop) supermarket chain in Switzerland.

5: Long Ha in Dong Hai district has shrimp farming and salt production as main livelihood activities. Additional income sources are non-farm wage labor, animal husbandry, small trade, mangrove forest collection for firewood, snails and crabs. The village was established after the war. In 1978, around 5,000 people from Nam Dinh[7], many of them relatives, migrated from the North into Long Ha to claim and build the New Economic Zone. In Long Ha all households received a red certificate for landholdings of 0.9ha on average for shrimp farming[8]. In addition, a member of a salt cooperation could get a plot of 144 m^2 of salt flats per household member. If the total household share was small, the household could lease their share to a neighbor. Farming in Long Ha faces difficulties caused by the high elevation of the land and a bad irrigation system. The water system consists of many long and narrow canals meandering through the village, causing downstream wastewater pollution, water shortage in the dry season, and the risk of an easy transmission of shrimp diseases. In Long Ha, farmers get support from input suppliers through patron-client relationships. When the shrimps are 2-3 months old, the input suppliers give loans for feed, chemicals, treatment and advice until the shrimps are harvested. Almost all farmers are indebted to the traders with high interest rates.

6: The **Nhi Nguyet cluster** consists of a regrouping of 66 farms that were located in many parts of Dam Doi and Cai Nuoc districts. Besides shrimp farming, livelihoods in Nhi Nguyet were diversified by grocery trading, boat driving, non-farm labor, etc. Compared with Long Ha, people in Nhi Nguyet own larger farm lands of 3-5ha in average. Most of the farms are located along the branches of Bay Hap river, where fresh water is always available for aquaculture and transportation. In becoming a cluster member, the household can benefit from sharing experiences with other members, frequently attending extension courses, and also benefit from

[7] There was a movement of land claims and reconstruction after the war (1975). Nam Dinh is a province in the North of Viet Nam.

[8] From the survey data of 2008-2010.

applying government projects and investment opportunities. After August 2008, when input costs increased sharply the cluster started stocking white leg shrimp (*P. vannamei)* with a shorter production cycle (3 instead of 4-5 month) and a supposedly better resistance against disease. The first eight farms started in 2008 and the number had increased up to 30 in beginning of 2009.

7: Ho Gui on Bo De river mouth in NamCan district is name of a resettlement fishing village from 2005. Livelihood activities consisted of off-farm labor, services and small trading activities. At the time of research in 2009, each household owned a red certificate for a plot of 300 m^2 which was not enough for them to generate an income only by husbandry or horticulture.

8: Rach Goc is the name of a river mouth in the southern part of Ca Mau (Fig. 2.3). The fishing port of Rach Goc is famous because it provides a large amount of high quality brood stock needed to produce post-larvae shrimp.

2.4 Research methodology

This research project investigated historical changes in farming practices, institutional policies, and socio-economic drivers over time. The results identify the specific social-economic drivers that affect farmer's decision-making at individual and household levels. The research, therefore, has been conducted by applying both qualitative and quantitative methods, involving observation, semi-structured interviews and life history analysis. Focus group discussions and key informant interviews were used for qualitative data collection. The quantitative data were gathered in a household survey, and from secondary sources like government statistics. The goal of the research is to identify the livelihood pathways that have proven to be sustainable and to assess social resilience under conditions of social, institutional, and ecological stress.

The survey was undertaken from September 2008 to August 2010 in each of the 8 villages. The qualitative and quantitative research activities were carried out in a linear process of the following steps: 1. Collection of secondary data; 2. Carry out key informant interviews and Focus Group Discussions; 3. Carry out semi-structured household interviews; 4. Computation, aggregation, and analysis of the collected data (Fig. 2.7).

First, secondary data and information were collected from different government agencies in Bac Lieu and Ca Mau at both the provincial and district levels. It is important to collect and make an inventory of the statistical data from secondary sources in order to get a holistic picture of the livelihood context. Secondary sources included documents, annual reports, statistics, land-use maps, working papers and scientific reports. The data from these documents included data on shrimp aquaculture production, fish catch, shrimp markets, indicators for sustainable aquaculture, policies of mangrove management of Forest Companies, household's ownership of material and financial assets, organic aquaculture, policies supporting livelihoods in resettlement zones, loan policies and data on extension training.

The second phase consisted of primary data collection. Key informants were interviewed at provincial, district, and village levels in order to gather basic information for the household survey. Most informants were officers, managers, extension workers or researchers in the Department of Agriculture and Rural Development (DARD), the Department of Labor, Invalids and Social Affairs (DoLISA), the Department of Natural Resources and Environment (DoNR&E) and the People's Committee. They were the ones who could provide most relevant data from the perspectives of the formal decision makers on regional development. These interviews helped to understand the motivations and expectations of these policy makers from a meso and macro perspective and to contextualize the household decision-making pathways concerning the social, political and ecological changes in the Mekong Delta.

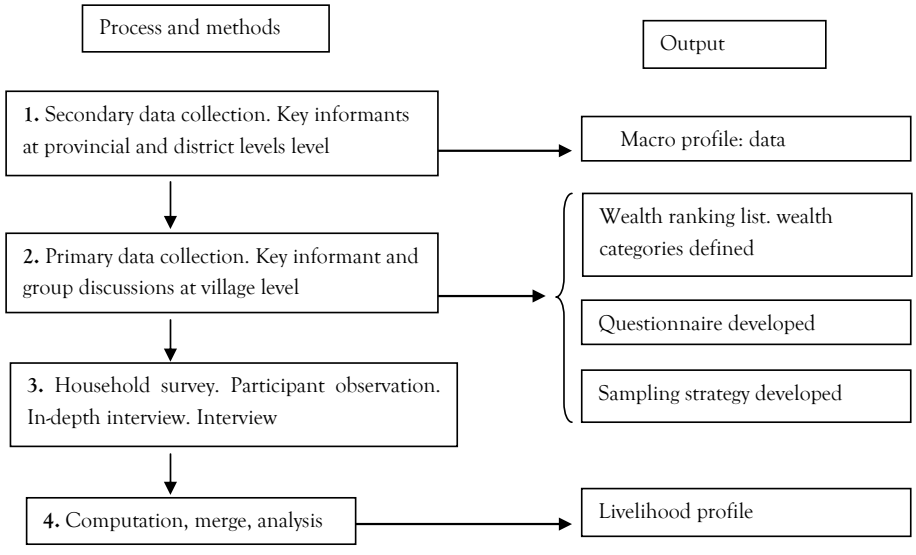


Figure 2.7: Flowchart illustrating the methodological sequence of research elements.

In each village, a Focus Group Discussion (FGD) was carried out with village leaders and elderly farmers who were well-known and respected in the community. The purpose of the FGDs was to collect data on the trends of changes over time, with respect to various livelihood activities and the participants' judgment of whether life had improved or worsened. This information helped to explain the motivation why farmers and fishers would shift from other livelihood activities to shrimp production, and to subsequently construct the history of the role of shrimp aquaculture in the livelihood strategies of the different households in each social category.

In order to notice the differences in production and livelihood strategies we decided to start with a random stratified sampling using a wealth ranking exercise (Ellis, 1994). FGDs classified each household as well-off, middle class or poor based on their own criteria in combination with the national criteria from the Ministry of Labor, Invalid and Social Affairs (MoLISA). We made sure that the criteria were the same across the eigth research sites and distinguished between monetary and non-monetary criteria. The monetary criteria were based on income, type of houses,

landholding size, access to facilities etc., while the non-monetary criteria were based on levels of education, health, and access to external social support.

Table 2.5: Total number of households and samples corresponding to the poverty ratio (N=179).

Name of village or community	Total HHs	Poverty ratio (%)	Sample size	Poor sampled (%)
1. Thanh Hai	362	38.2	27	18.5
2. Kinh 17 in resettlement	62	19.4	15	20.0
3. Kinh 17	242	23.1	15	33.3
4. Cha La	235	13.2	29	13.8
5. Long Ha	247	25.1	29	24.1
6. Cluster Nhi Nguyet	69	13	23	8.7
7. Ho Gui	205	55.4	20	50.0
8. Rach Goc (boat owners)	294	12.2	21	14.3
Total	**1716**		**179**	

Source: Survey 2008-2010.

The results from the wealth ranking process helped us to select households from different wealth categories to be interviewed. Based on a list of livelihood activities and wealth ranking, we excluded the non-shrimp based or the very rich for our samples, like traders, government officers, non-farm laborers. Then we tried to balance the number of poor households across the research sites. The higher the ratio of poor families in a village, the higher the number of poor households selected to be interviewed (Tab. 2.5).

The third step was the household survey. In order to identify the differences in decision-making options over time in different households, the research should ideally use a longitudinal survey. A longitudinal survey uses samples that are obtained at two or more different moments in time to see how conditions are changing (Ellis, 1994). Unfortunately, we were not able to repeat a research from 10 years ago, but we asked the respondents to reflect on the changes in their livelihood during the last ten years until the present. A total of 179 households in the eigth villages were interviewed based on a questionnaire (Appendix 1). The following categories were included: improved-extensive shrimp-only households (N=27), shrimp-mangrove households (N=59), intensive shrimp farming households (N=52) and fisher's households (N=41). Data were collected on the following issues:

- Demographic structure: age, type of household, occupation, education, number of children;
- Assets and living standards: family status, availability of electricity and water, access to education, health and market;
- Land ownership: size of land, land tenure, land use;
- Aquaculture and fishery: input and output costs, technology, support;
- Economic factors important to farmers: formal credit, income, expenditure;
- Production risks: ranking of issues regarding most important and risky elements;
- Farmers' perceptions, attitudes and motivations for change.

The sampled data from the survey were both quantitative and qualitative. The quantitative data provided the basic information on *what* the livelihood represents, and the qualitative helped to

explain *how* and *why,* in order to contextualize differences and changes. Qualitative data was also collected with life history interviews, which generated knowledge on historical changes of local livelihoods, and the drivers or events that shaped farmers' and fishers' social status. Life histories are useful in analysing livelihood pathways, to report on the chronology of the actor's life, the deeper layer of beliefs, needs, aspirations, limitations and the relations to power and institutions (Francis, 1992). People may have lost memory about events over longer periods of time, therefore, there should be a combination of various techniques to remind and identify the livelihood pathways over time.

The fourth step was to compute and analyse the data. We classified the 8 sites into four groups based on the types of shrimp farming: improved-extensive non-forest and with forest (mangrove-shrimp), intensive shrimp farming (with non-cluster and with cluster) and fishery. First, averages were calculated from a wide range of variables across the 8 sites which included ratio and ordinal measurements. The measurements included land size, pond size, household size, numbers of on-farm workers, hired laborers, operational cost and net profit, loans, etc. Ordinal measurements were used as a ranking to show the levels of agreement or awareness of the farmers towards the environment, policy and social support that are important to shrimp farming and fishery production. The outcomes of this research integrating quantitative and qualitative methods and techniques are the description of the different livelihoods in the Mekong Delta, the profiles of the various aquaculture and fishery systems, and their differences in social resilience. This detailed study proposes to contribute to a better understanding of household resilience to the valuation of the social-ecological resilience of the Mekong Delta.

3

Pupils on the way to school

Livelihood capabilities and pathways of shrimp' farmers

This chapter has been accepted as:

Tran H. T. P., van Dijk H., Bosma R. and Sinh L. X., Livelihood capabilities and pathways of shrimp' farmers in the Mekong Delta, Vietnam. Accepted by *Aquaculture Economics and Management* on 18 February 2012

Abstract

Shrimp farming is a major livelihood activity in the Mekong Delta, in the southernmost part of Vietnam. The Vietnamese government has promoted shrimp farming as a way to reduce poverty, provide employment opportunities and increase exports to support economic development. The shrimp farming system, however, is economically and ecologically risky and may negatively influence the environment and the sustainability of local people's livelihoods. Because very little is known about the diversity of strategies people employ to deal with these risks, a study was performed in the Mekong Delta across four shrimp farming systems: (1) improved extensive non-forest, (2) mixed mangrove-shrimp, (3) intensive and (4) clustered intensive. The risks and livelihood strategies that were encountered differed systematically across the four farming systems. It was found that the uncertainties that the shrimp farmers faced include limited access rights to the mangrove forest, crop failure due to regular occurrence of shrimp disease, high investment costs and volatile markets for shrimp. Shrimp farmers have created several strategies for coping with these uncertainties, including redesigning farms, producing salt, changing the species farmed from *Penaeus monodon* to *Penaeus vannamei*, becoming involved in a cooperative cluster, integrating aquaculture and agriculture, and farming shrimp by organic standards.

Keywords: *livelihood, shrimp, Vietnam, pathways, farm management*

3. Livelihood capabilities and pathways of shrimp farmers in the Mekong Delta

3.1 Introduction

Between 1976 and 1992, shrimp farming in the Mekong Delta (MD) increased 35 times (de Graaf and Xuan, 1998). It reached a volume of 47,121 tons in 1995 and 318,600 tons in 2009, when it made up 76% of the national product (GSO, 2011). Since 1985, the improved market for cultured shrimp has attracted thousands of people to the MD, where they clear mangrove forest to exploit timber for construction and charcoal and to start shrimp farms (Binh et al., 1997; de Graaf and Xuan, 1998; Minh et al., 2001; Christensen et al., 2008). Between 1983 and 1995, the area in Minh Hai province (at present divided into Bac Lieu and Ca Mau provinces) covered by shrimp culture increased from 3,000 ha to more than 76,000 ha, and more than 66,000 ha of mangrove forest was lost (Minh et al., 2001). According to de Graaf and Xuan (1998), the shrimp farming boom caused severe problems associated with mangrove ecosystem destruction, overexploitation of natural shrimp stocks, import of young shrimp, and self-pollution of the shrimp farms due to poor pond management, which induced massive outbreaks of shrimp disease. In addition, the market downturn, high-quality competition and shrimp price fluctuations greatly affected famers' livelihoods (Macfadyen et al., 2005).

Over the last 20 years, most studies of small-scale livelihoods in the MD have focused on management and conservation of the mangrove forest, techniques applied in shrimp farming, farmers' means of making a living, and the cost-benefit ratio of shrimp production in mangrove-shrimp farming systems (de Graaf and Xuan, 1998; Johnston *et al.*, 2000; Clough et al., 2002a; Sekhar, 2005; Primavera, 2006). Other studies have focused on integrated agriculture and aquaculture models (Brennan *et al.*, 2000; Bosma, 2006; Hoanh, 2006; Phong *et al.*, 2006; Can *et al.*, 2007; Nhan *et al.*, 2007; Joffre and Bosma, 2009), differences in shrimp farming systems across countries (Hall, 2004) or economic analysis of the value chain and market (Macfadyen et al., 2005; Nguyen *et al.*, 2005; Sinh and Khuyen, 2006; Hobbes *et al.*, 2007; Sinh and Chanh, 2009).

Surprisingly, there are few studies of livelihood strategies and decision-making among shrimp farmers (Hue and Scott, 2008; Joffre et al., 2010). This paper focuses on the diversity of farmers' livelihood strategies, how they access various sources of capital to finance shrimp farming, to what uncertainties and vulnerabilities they are exposed and the pathways they have created to mitigate these risks and sustain their livelihoods.

The study has three aims: (1) to determine households' strategies for gaining access to capital needed to pursue livelihood activities; (2) to identify the factors affecting farming households' failure or success across farming systems and wealth status; and (3) to gain an in-depth understanding of households' livelihood pathways by clarifying how shrimp farmers manage risks and uncertainty.

In the next section, we describe the study area characteristics. Then, we describe the motivation of the research approach and present the data collection methods. Subsequently, we analyze the capabilities that shrimp farmers use to ensure livelihoods and describe the pathways the farmers choose to ensure their income before discussing and concluding.

3.2 Study Area

The study was performed in Vietnam's southernmost provinces, Bac Lieu and Ca Mau, in the MD. In the two provinces, six villages on the eastern coast in three districts were selected, each with different agro-ecological, physical and socio-economic conditions. Villages were selected based on their water supply system, density of mangrove forest, level of collaboration in farming, type of mangrove forest management, type of resettlement, poverty ratio, level of education, and presence of communication and healthcare services (Tab. 3.1, Fig. 3.1).

Table 3.1: The socio-economic characteristics of Bac Lieu and Ca Mau provinces and of the research districts within these provinces.

Items	Unit	Bac Lieu province		Ca Mau province		
		Province	Dong Hai	Province	Dam Doi	Nam Can
Total area	.000 ha	250.2	56.3	533.2	82.6	50.9
Forest area	.000 ha	4.2	1.8	99.2	7.5	11.8
Aquaculture area	.000 ha	126.3	39.1	294.7	65.7	25.7
Shrimp farming production	000 ton	68.2	20.4	99.6	30.5	8.6
Population	000 pers.	867.8	143.8	1,212.1	182.4	66.5
Number of households	unit	191,567	31,924	253,836	41,185	16,681
Ratio of teachers	‰	12.4	9.4	8.7	7.5	8.1
Ratio of health care officers	‰	4.3	1.1	2.3	1.4	2.0
Poverty ratio	%	20.0	22.1	13.5	12.24	6.85

Source: Provincial statistics (2009) and (GSO, 2011)

Of the three districts covered in the study, Dong Hai has the most intensive farming systems and the most sophisticated infrastructure; all households in Dong Hai have red certificates giving them long-term land-use ownership rights[9]. Dam Doi has the largest aquaculture area and the highest shrimp production of the three districts. In this district, the Nhi Nguyet cluster[10] was selected as an example of a typical collaborative system of intensive shrimp farming. In 2008, the cluster contained 66 households, some of which are located in Dam Doi district. Nam Can district has the smallest aquaculture area but the largest mangrove forest area. In eastern Nam Can, farmers

[9] Red certificates (or red books) give farmers land use rights for 50 years and freedom to use the land as they see fit for suitable economic development purposes.

[10] Clusters of farmers are an alternative to State-initiated cooperatives. Farmers in a cluster collectively make contracts for providing inputs, marketing products, and providing training. The Nhi Nguyet cluster is a self-made organization of 15 HHs who engage in intensive shrimp farming that was established in May 2006. In 2010, the number of participating households (HHs) had increased to 80, with 270 intensive shrimp ponds with a surface area of 100 ha located in the districts of Dam Doi and Cai Nuoc in Ca Mau province.

cultivate shrimp under the mangrove forest canopy with either integrated or separated mangrove-shrimp systems (Figure 3.2).

In these systems, farmers were contracted by State Forest Companies and given green certificate land entitlements[11]. Based on contracts, farmers are allocated an area of 3-10 ha, of which 50-70% is to be reserved for mangrove forest, 20-40% for ponds, and 10% for housing. Forest management activities and shrimp aquaculture should be performed in accordance with provincial regulations (DARD, 2009). The Forest Company is responsible for implementation of government guidelines on forest management. When mangroves are harvested, farmers and the Forest Company must share benefits according to government guidelines and contracts between the stakeholders (see section 4.3.2).

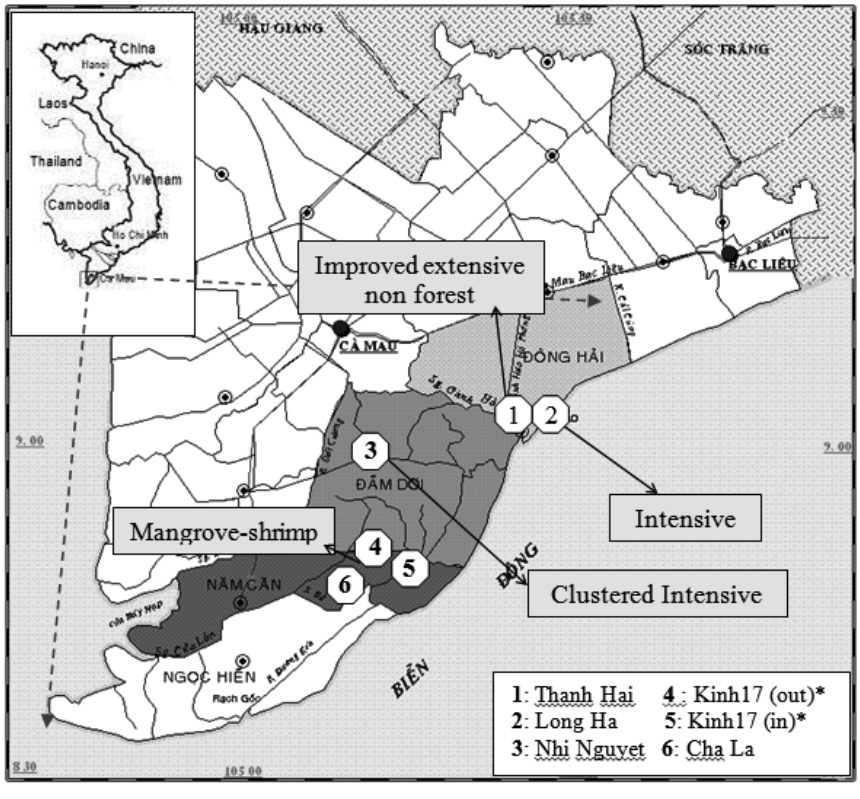


Figure 3.1: The locations of the six study sites in three districts of Bac Lieu and Ca Mau provinces. Kinh17 (out)* = outside the resettlement zone; Kinh17 (in)* = inside the resettlement zone

[11] Green certificates (or green books) conferring contract-based (forest) land-use rights are given to farmers who have leased their land for 20 years. The contracts can be renewed after this period.

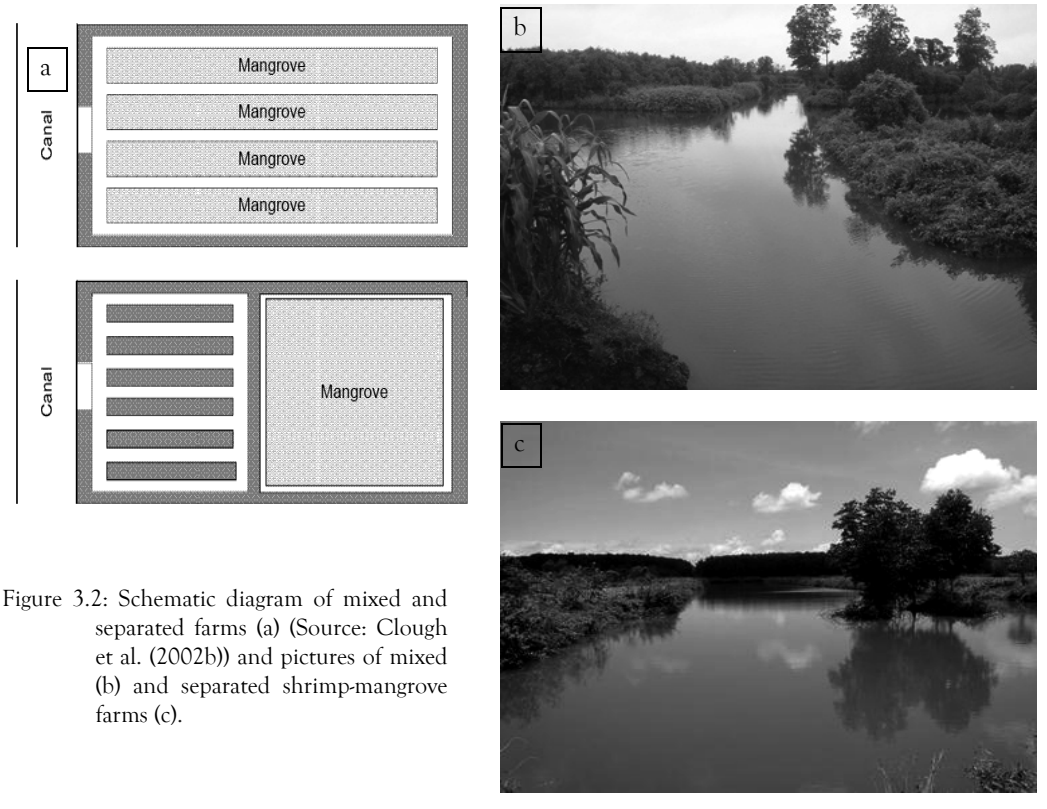


Figure 3.2: Schematic diagram of mixed and separated farms (a) (Source: Clough et al. (2002b)) and pictures of mixed (b) and separated shrimp-mangrove farms (c).

3.3 Research methods

3.3.1 Conceptual framework

To analyze decision-making regarding one's livelihood in the context of vulnerability, we used the livelihood framework developed by Chambers & Conway (1992) and modified by Carney (1998a) and Scoones (1998) to assess the factors contributing to livelihoods. Livelihood comprises *capabilities, assets* and *activities* required for a means of living (DFID, 1999). The starting point of the framework are the *assets,* described as stocks of capital (Ellis, 2000b). The study focuses on five categories of assets (natural, physical, social, human and financial); these are not simply resources that people use in building livelihoods, but also resources that give them the capability to be and to act (Bebbington, 1999). Capabilities include what people can do and what they can obtain with their entitlements (Leach et al., 1999). According to Sen (1997), (human) capability is the ability of human beings to lead lives they have reason to value and to enhance the substantive choices they have.

The *Vulnerability Context* refers to the seasonality, trends, and shocks that affect people's livelihoods. The concepts of *insecurity* and *vulnerability* are different. Insecurity is the probability that a livelihood becomes threatened. Vulnerability refers to the exposure to, and the impact of, specific *risks* to the livelihood conditions. Households approach risk differently according to their

assets and capabilities (Kaag, 2004). Farmers coping with the same risks might have different responses because they have different understandings and perceptions of the situation, which shape their risk behavior.

To sustain their livelihood and obtain income, people normally have a *portfolio* of more or less structured and planned activities; hence the concept of *livelihood strategies*. The idea of a livelihood strategy has the connotation of a *pre-set* goal. However, decision making within a context characterized by a high level of risk must be considered as an iterative process. The livelihood pathways are the result of a decision-making process in which people create a portfolio of activities and solutions to adapt, struggle for survival or improve their standard of living. *Pathways* are the trajectories arising out of decisions that actors make in the course of dealing with risks and uncertainties within an insecure environment (de Bruijn and van Dijk, 1995; de Bruijn et al., 2005). In this context, a pathway emerges out of the livelihood decisions by which shrimp farmers attempt to cope with shrimp disease, market fluctuations and poverty by diversifying activities and gaining access to assets and income.

3.3.2 Data collection and analysis

The field survey was undertaken from January 2008 to August 2009 in 6 villages inhabited by 1,217 households. The following activities were completed stepwise: (1) secondary data collection, (2) key informant interviews and focus group discussion, (3) household interviews, and (4) merging, computing, and analyzing the collected data.

A wealth ranking exercise was completed for each village with the help of key informants (the village committee and elderly farmers). They classified each household as well-off, middle-income or poor based on their own so-called community criteria (see Tab. 3.2).

These classifications are an extension of the criteria by which government sets the poverty line[12] for the hunger eradication and poverty reduction (HEPR) program. The criteria were the same across the four farming system; however, the poor in intensive system may be the non-poor in the extensive or the poor in the extensive system may have ponds with larger size than that of middle-off farmers in intensive. Moreover, if the middle-off in intensive farming had encountered 2-3 crops failure they would be poor. With different wealth status, farmers had different level of investment and thus earned different incomes.

12 The official poverty line in Vietnam in August 2005 was VND 200,000 (USD 11.4) per person per month for rural areas and VND 260,000 (USD 14.9) per person per month for urban areas. In 2009, the proposed poverty line was VND 300,000 per person per month for rural areas and VND 390,000 for urban areas.

Based on the list of wealth status classifications, a stratified sample of 138 HHs was selected, with the percentage of HHs at each income level equivalent to the ratio in the villages. This sampling approach was chosen to increase the comparability of the results across the four systems regarding their potential for investments and profits.

Table 3.2: General criteria by which key informants classified households as poor, middle income, or well-off

Criteria	Poor	Intermediate	Well-off
Land holding area (ha)	< 0.5	0.5 - 3.0	>3.0
Type of house	Thatched	Wooden walls, iron roof	Brick, enameled brick
Household facilities: TV, telephone, stove, refrigerator.	None	Yes, some	Yes, good enough
Farm equipment: pump, motor, paddlewheels	None	Yes, some	Yes, good enough
Transportation: bicycle, motorcycle, boat	None	Yes, some	Yes, good enough
Sources of income	Wage labor, gathering of marine and mangrove products	Wage labor, farming, small merchant, motorbike or boat driver, grocery owner, off-farm salary	Farming, commercial business (middleman, shopkeeper, pond excavator, well driller)
Education of children	Illiterate or elementary	Secondary	Secondary or higher
Receiving HEPR* support	Yes	No	No
Receiving remittances	No	Yes	Yes
Accumulation	No or small savings, constant indebtedness	Able to save, no debt	Save and invest in productive capital

* HEPR: hunger eradiation and poverty reduction
Source: Group interviews with households and officers, 2008

The household survey was conducted to obtain information on livelihood capital assets. Table 3.3 shows the total number of households and the number of households interviewed at each of the six study sites.

Table 3.3: Total number of households sampled and the proportion of households classified as poor in the sample

Name of village or community	Total households (HHs)	Size of sample (HHs)	Percentage of poor in sample (%)
1. Thanh Hai	362	27	18.5
2. Long Ha	247	29	24.1
3. Cluster Nhi Nguyet	69	23	8.7
4. Kinh 17 (outside resettlement zone)	242	15	33.3
5. Kinh 17 (inside resettlement zone)	62	15	20.0
6. Cha La	235	29	13.8
Total	**1,217**	**138**	**18.8**

In total, 138 households from six sites were interviewed using questionnaires. The interview collected quantitative and qualitative data. Data on income and expenses were used to calculate gross and net income. Net income was calculated as gross income minus operational costs for inputs, maintenance and operation of equipment (e.g., dredging, sluice gate maintenance, land rent, seed stocking, feed, chemicals, fuel and hired labor). Depreciation costs on investments, e.g., land purchases, excavation of ponds, sluice gate construction, purchase of pumps and paddy wheels, were not calculated; instead, only real interest payments were taken into account. For computation and analysis, we used crosstabs and analysis of variance (ANOVA) in SPSS-15® to identify the different levels of capabilities demonstrated by farmers from each of the four farm types and three wealth categories. Pearson's and Spearman's rank bivariate-correlation tests were used to test whether the variables were significantly correlated between groups. The exchange rate of VND against USD was 15,500 in 2006 and 17,500 in 2009.

3.4 Results

3.4.1 Historical changes in shrimp farming

Shrimp cultivation began in Vietnam 100 years ago (Nhuong et al., 2002) and in the Mekong Delta in approximately 1969 (Binh et al., 2005). Initially, farmers used an *extensive system* relying on wild seeds caught under the forest canopy or trapped in the ponds after high tide or flooding. Shrimp and fish were harvested continually throughout the year, and the yield was approximately 250 kg $ha^{-1}yr^{-1}$ (de Graaf and Xuan, 1998).

In the early 1990s, because of innovations in artificial shrimp seed production, increasing demand from international markets and government policies stimulating economic development, the extensive cultivation system developed into the more complex *improved extensive system*. Outside the mangrove forest, improved extensive shrimp farming began as *shrimp monoculture*, for which the Thanh Hai site was representative. Production increased to 600 kg ha^{-1} yr^{-1} (Binh et al., 1997) but rapidly declined after 3-5 years due to shrimp disease outbreaks that became widespread after 1994.

The *mangrove-shrimp* farming system developed where forestry land was allocated to households for mangrove replantation and protection. The mangrove-shrimp system was applied as either a mixed or a separated system, represented by Cha La and Kinh 17, respectively (Fig. 3.2).

Intensive shrimp farming started in the late 1990s, especially in non-mangrove areas at higher elevations, to allow the pond bottoms to dry after the harvest. The stocking density of shrimp is high, no water is exchanged, and paddlewheels are used to increase the dissolved oxygen content of the water. Commercial feeds, medicines, and chemicals are used. The shrimp are harvested once per year after a cropping season of 4-5 months. The case of Long Ha was typical of this farming system. Since 2000, 100% of households have changed from rice farming to extensive shrimp farming. In 2008, there were 247 households in the village, of which 186 (75.3%)

households practiced aquaculture, and 53 of these households (28% of 186) practiced intensive aquaculture.

Table 3.4: Each sample site's shrimp farming system, agro-ecological conditions, settlement status and infrastructure characteristics.

Site	Sample size	Shrimp farming system (typology)	Agro-ecological conditions	Land tenure status	Electricity, main transportation
Thanh Hai	27	Improved extensive non-forest	- few mangroves - high land level - poor water system	- long standing - <5 ha - red book	- 60% HHs - boat, motorbike
Long Ha	29	Intensive shrimp farming	- few mangroves - high land level - poor water supply system	- 1978 - <3 ha - red book	- 80% HHs - motorbike
Nhi Nguyet *	23	Intensive farming in a cluster	- average mangrove cover - good water supply system	- long standing - 3-5 ha - red book	- 85% HHs - boat
Kinh 17 (outside resettlement zone)	15	Separate mangrove-shrimp farming	- dense mangrove cover - good water supply system	- long standing - 3-10 ha - green book	- 85% HHs - boat, motorbike
Kinh 17 (inside resettlement zone)	15	Separate mangrove-shrimp farming	- 1- to 3-year-old mangroves - good water supply system	- 2007 - <5 ha - red book	- 100% HHs - motorbike
Cha La	29	Integrated mangrove-shrimp farming (certified organic)	- dense mangrove cover - good water supply system	- long standing - 3-10 ha - green book	- 50% HHs - boat

* *P. monodon* is the main species in all sites except in the Nhi Nguyet cluster, where some households began cultivating *P. vannamei* in 2008.

In an attempt to combat diseases and improve profits, *P. vannamei* (white leg shrimp) was introduced in 2006. *P. vannamei* promised many benefits: resistance to skin diseases; higher stocking density (up to 100 shrimp m^{-2}) and yield (up to 10 tons ha^{-1}); shorter production cycle (below 100 days); cheaper feed due to lower protein content; more efficient feed conversion; and better resistance to adverse conditions. Moreover, the shrimp retain a good appearance at low temperature for 3-4 days after defrosting (interview, 2008). In Nhi Nguyet, 10 households started cultivating *P. vannamei* in intensive ponds in August 2008, and nearly 100% of households had begun doing so by 2010.

3.4.2 Characteristics of the farm sites

The basic characteristics of the sampled sites are summarized in table 4. The farming practices differed according to agro-ecological conditions, land tenure status, level of investment, equipment for production, level of owners' indigenous knowledge, experiences and farming skills. The four systems (*improved extensive, mangrove-shrimp, intensive and intensive in cluster*) observed across the 6

sites differ in their land holding rights, pond size, condition of the mangrove forest, shrimp stocking density, harvests and farming practices (Tab. 3.5).

Table 3.5: The farming practices of the four farming systems.

Farming systems	Improved extensive		Intensive	
	Non-mangrove	Mangrove-shrimp	Non-cluster	In cluster
Sites	Thanh Hai	Cha La, Kinh 17	Long Ha	Nhi Nguyet
Condition of mangroves	Few mangroves	Dense mangrove cover	Very few mangroves	Average mangrove cover
Land tenure	Red book	Green book/Red book	Red book	Red book
Land size	1-10 ha	2-15 ha (outside resettlement area) 1.5-7 ha (inside resettlement area)	1-3 ha	1-13 ha (including extensive shrimp farming system)
Species	Various	Various	Single	Single
Shrimp seeds	Wild + *P .monodon*	Wild + *P. monodon*	*P. monodon*	*P. vannamei**
Stocking density	Irregular	Irregular	Once per crop 15-30 fry m^{-2}	Once per crop 90-100 fry m^{-2}
Water exchange	Tidal/pumped	Tidal	Pumped	Pumped
Culture method	- No feed - Lime, pest control plant, fertilizer	- No feed - Lime, pest control plant, fertilizer	- Feeding - Probiotics - Lime	- Feeding - Probiotics - Lime
Cycle duration	120-150 days	120-150 days	120-150 days	90-100 days
Harvest	200-600 kg $ha^{-1}yr^{-1}$ (Hai, 2003)	100-600 kg $ha^{-1}yr^{-1}$ (Binh et al., 1997)	6 ton ha^{-1} $crop^{-1}$ (*P. monodon*)	5-10 ton ha^{-1} $crop^{-1}$ (*P.vannamei*)
Shrimp size	20-40 shr. kg^{-1}	20-40 shr. kg^{-1}	20-40 shr. kg^{-1}	50-100 shr. kg^{-1}

* In Nhi Nguyet, farmers cultivate both *P .monodon* and *P .vannamei*, but we mention only *P .vannamei* because the cultivation of *P .monodon* is similar to other intensive farms. In common, there are two cycles per year in intensive farming.

3.4.3 Limited access to capitals and risks

Subsequently, we analyze the capabilities and uncertainties related to the access to infrastructure and irrigation systems, mangroves, and social, human and financial capital. These factors correspond to the five categories of the livelihood framework. To illustrate the constraints of each site, we use examples based upon the differences in farmers' perceptions between sites (Tab. 3.6 and 3.7).

- ***Limitations on access to infrastructure and irrigation systems***

The two sites in Bac Lieu province had non-mangrove shrimp farming systems: Thanh Hai was typical of the *improved extensive* non-forest system and Long Ha of *intensive* shrimp farming, as

depicted in Fig. 3.1 and Tab. 3.5. Farmers in both locations were dissatisfied with the condition of both the infrastructure and the irrigation system (Tab. 3.6). Two villages were established after 1978 by clearing bushes of low-value timber, including *Avicennia, Excoecaria, Lumnitzera, Saccharum* and *Phragmites*. Mangrove forest was uncommon in the villages that stretch along the coast behind a narrow strip of mangroves in the Full Protection Zone[13].

The infrastructure of Thanh Hai was poorly developed. The two main means of transportation were motorbikes and boats, but the paths were slippery during rainy seasons and the canals shallow during low tide. Shrimp farming was made more difficult by the higher elevation of the ponds; thus, famers needed to pump water up to the ponds during the dry seasons at a high cost. Only 7% of households were satisfied with the village's infrastructure, including transportation, low-voltage electric lines, bridges and roads, schools and communication services; the villagers lacked access to education, health care, media and information sources of extension services (Tab. 3.6).

Table 3.6: The natural and physical capabilities of the four shrimp farming systems. (Mean ± SD)

Items	Improved extensive		Intensive		
	Non-mangrove	mangrove	Non-cluster	cluster	Average
Number of households	27	59	29	23	
Total area (ha)	4.3^{ab} ± 4.5	5.5^{a} ± 3.1	1.0^{c} ± 0.7	3.0^{bc} ± 2.8	3.9 ± 3.5
Pond area (ha)	3.7^{a} ± 3.9	1.8^{b} ± 1.0	0.6^{b} ± 0.3	1.1^{b} ± 0.5	1.7 ± 2.1
Satisfied with water quality (%) *	34	58	0	65	42
Satisfied with infrastructure (%)*	7	27	45	39	29
Having electricity (%)	59	54	83	61	62

Different superscripts (a, b) denote significant differences between means within rows ($p<0.05$).
(*) denotes a significant difference between the percentages within a row ($p<0.05$)

Long Ha, representing the *intensive non-cluster* shrimp farming system, had a satisfactory infrastructure and electricity network (Tab. 3.6). However, only 7% of households were satisfied with the irrigation system, and no household was content with the quality of the water. Constructed 30 years ago, the irrigation system consisted of many long, narrow canals meandering through the village, causing up-downstream wastewater pollution, water shortages in the dry season and risk of transmission of shrimp disease. Instead of dredging the mud from the canals periodically, the villagers waited for the State to invest because of the high cost; because the State was slow to address the problem, the canal beds silted up over several years. In addition, the average farm size was small (1 ha), so farmers had no room for water treatment, and they pumped

[13] - *Full protection zone* (FPZ): ranging from 100 m to 1000 m inland from the seashore. No settlement is allowed in this area; collection of dead trees and small marine species is permitted, but the gathering of shrimp and fishing are not allowed.
- *Buffer zone* (BZ): a 1- to 4-km-wide belt along the FPZ where settlement is allowed; mangroves cover up to 70% of this area, and the remaining 30% contains ponds, dikes and houses. Farmers settled in the BZ can obtain a 20-year leased tenure (green certificate).
The FPZ and BZ are under the management of state forest enterprises that allocate forest areas to families; farmers must contribute to thinning and harvesting, and they share in the benefits of the timber.

water from the canals directly into the rearing ponds. Although they treated the water with lime and various other products for several weeks before stocking shrimp, they faced the highest risk of shrimp disease among the four groups (Tab. 3.10).

Approximately 90% of HHs reported that shrimp farming today is risky for several reasons (Tab. 3.7). Water pollution was ranked as the most important risk. Farmers using the extensive system were frustrated by unpredictable weather changes and small pond size. In the intensive system, farmers mentioned risks posed by fluctuating market prices, limited knowledge of farming techniques and low-quality shrimp seeds. Obtaining high-quality shrimp seeds was not difficult for farmers in the cluster because they bought seeds through a refereed contract; in addition, they had larger farms and used both intensive and extensive systems, so they were not restricted by small farm size (Tab. 3.7).

Table 3.7: Households' perception of the risk posed by shrimp farming, now and 5 years ago, perceived causes of risks and the season during which farms of each type are affected by shrimp diseases

Items	Improved extensive		Intensive		Average
	Non-mangrove (27)	Mangrove (59)	Non-cluster (29)	Cluster (23)	
Shrimp farming is risky (%)					
5 years ago	4	16	28	17	17
Now	89	92	83	87	88
Causes of risk (%)					
Water pollution	67	76	72	56	70
Unexpected weather *	48	61	7	22	41
Low price *	0	3	17	68	16
Lack of technique *	7	8	28	26	15
Small size of land	4	20	14	0	12
Unqualified shrimp seeds	7	3	31	0	9
Seasons of shrimp diseases (%)*					
Whole year	41	15	76	65	41
Beginning of rainy season	18	49	10	0	27
During rainy season	18	27	10	4	18
End of rainy season	22	2	3	13	8
Cold weather	0	7	0	9	4

(*) denotes a significant difference between the percentages within a row ($p<0.05$)

- ***Limitations on access to mangroves***

The main sources of income in the mangrove-shrimp system are shrimp, which were harvested every 5-7 days during each tidal period, and timber, which was harvested after each 14- to 20-year cycle. Although the latter provided small amount of income, it stabilized farmers' livelihoods in terms of ecological services and income generation. Eighty percent of the households believed that mangroves played important roles in protecting wildlife, balancing the ecological environment and helping to increase the success of shrimp farming. Although the profits from mangroves were much smaller compared to those from shrimp, this system enabled farmers to increase shrimp productivity without damaging the mangrove ecosystem. Farms with mangroves had higher yields

and a lower rate of failure compared with non-mangrove systems (Tab. 3.10) (Tran et al., forthcoming-b). However, the interview data showed that the yields steadily decreased when the mangroves grew older than 7 years due to the increased shading.

Moreover, the interviews revealed a sharp conflict between farmers and Forest Company regarding the benefits from timber, forest tenure and management. Farmers who were allocated land in these forests had the right to culture shrimp and shared in the benefits from forestry with forest companies. However, until 2008, farmers received nearly nothing after 15-20 years of forest conservation due to the slow implementation of forest policies and unequal sharing arrangements. Tran et al. (forthcoming-b) reported that farmers received only VND 0.5 million ha^{-1} $year^{-1}$ (USD 30) in a 66% sharing arrangement, based on the calculation of the forest companies. Therefore, farmers complained that their share of the benefits from mangroves was too low compared to their effort or to what they could earn by culturing more shrimp (Case 1); hence, they requested more entitlements to the forestland, a higher ratio of pond area to mangrove area and more equal benefit sharing between farmers and forest companies.

> ***Case 1:*** *Mr. Liem, Cha La, 2008. Benefits from cultivating mangroves versus shrimp cultivation.*
>
> Mr. Liem, a 48-year-old man, is living in Cha La village. The family has 6.8 ha of land, of which 2.3 ha is destined for aquaculture. He settled in Cha La in 1992, when the State Enterprise started planting 4 ha of mangroves at the density of 20,000 per hectare. The mangroves were thinned after 8 years to a density of 7,000 trees per hectare. The mangroves were harvested in 2006 after 14 years. The market value was VND 300,000 per m3, containing an estimated 60 trees, and the total profit from mangroves was calculated at VND 2.5 million, or US$ 151 ha-1 yr-1. Mr. Liem actually received VND 0.6 million ha-1.yr-1 (USD 36) on average after sharing the costs for replanting, thinning and logging with the State Enterprise.
>
> In 2006, he earned VND 30 million $ha^{-1}.yr^{-1}$ from aquaculture, which was 12 times higher than his profits from cultivating mangroves. He stocked shrimp 8 times to total 200,000 fry ha^{-1} and used almost no feed, fertilizers or lime. He harvested 480 $kg.ha^{-1}$ of tiger shrimp (P.monodon), 120 kg ha^{-1} of natural shrimp and 2,000 crabs. Fish, wild mud crabs and blood cockles diversified his livelihood and provided daily food.

- ***Limitations on access to social and human assets***

Social capital consists of the networks on which people draw when pursuing their livelihood activities. Social and human capital refer to social relations, support, labor availability, level of education and ability to acquire knowledge (DFID, 1999; Scoones, 2009).

The household size did not differ significantly between the four farming systems and the six villages (with an overall average of 5), but the non-mangrove extensive system had the largest household size (7 persons). Most husbands worked on the farms, attended training courses and were responsible for making decisions about technology, investments and changes of livelihoods. The wives assisted the husbands on the farm and earned income through secondary on-farm and off-farm jobs, in addition to housekeeping and taking care of children.

In some cases, social assistance sustained livelihoods, especially for the poor. For example, after the American war (1975), approximately 5,000 people from Nam Dinh province in North Vietnam immigrated to reclaim and build the New Economic Zone in Long Ha. Thus, they had a "*dong huong*" (the same hometown) relationship with each other because they all lived far away from their hometown. The poor could acquire loans from relatives without collateral and obtain labor assistance and advice on livelihood options. Innovative livelihood strategies by one household provided examples for other households to imitate.

The Women's and Farmer's Unions were indicated as the most important mass organizations because they gave farmers access to loans with low interest, the mutual saving system ("*hun von*"), and technical advice. For people using the extensive farming system, shrimp collectors and traders in hatcheries were very important because they provided loans on advance and subtracted payments at every harvest. Normally, farmers in this system decided to which collectors they would sell their shrimps more based on social relationships than based on the price offered. People in intensive shrimp farming systems noted the importance of private input traders who provided credits for feed and chemicals when the shrimp were older than 2-3 months. In addition to supplying inputs on credit, they provided technical advice guaranteeing the health of the cultivated shrimp. Because farmers in this system harvested and sold all of their shrimp at the same time, their choice of retailer was important. The criteria they used to decide to which retailers they would sell shrimps were price, method of determining shrimp size, trustworthiness and social relationships.

Social capital can be a vehicle for creating human and financial capital (Coleman, 1988; Bebbington and Perreault, 1999) through repeated interactions in the networks. People join networks with neighbors, relatives, friends and input traders to build relationships that increase their capability to access knowledge and sources of credit.

In general, people gained more expertise from their own experiences and more advice from the input traders' services, neighbors, relatives and media than from official extension services (Tab. 3.8). Farmers using different systems had different attitudes about acquiring expertise. People practicing the improved extensive system did not perceive themselves to be profiting from expertise on new technologies: only 4-5% of HHs appreciated extension training courses, and only a small percentage recognized the value of knowledge broadcast by the media. These farmers cultivated shrimp in a traditional manner developed through their own experiences, stocked the seeds several times a year and waited to harvest during tidal periods. However, in some cases, these farmers had no income for several months because the shrimp died from disease or weather shock (Case 2).

> *Case 2: Mr. Ne, Cha La village, 2008. Extension training opportunity for a poor household using the improved extensive system.*
>
> There is no electricity here; I use recharged batteries to light up lamps for my two small children to study. There are not enough batteries for a TV, and I do not have one anyway. Neither do I attend extension courses because I am too poor. They train the rich and successful farmers because only the rich have capital to invest. But extensive

> farming is very easy; there is nothing to learn. I just stock seeds and wait for the harvest, but unluckily, I get less year after year. Sometimes I want to move my family away to find other jobs, but it is impossible: I have little capital and am afraid to take risks.

The intensive farms in the cluster had the highest motivation to acquire technical knowledge from all sources, especially technicians from input traders (78%) or extension staff (48%); farmers who were not part of a cluster relied on their own experiences and on the staff of input traders rather than on extension officers (76%, 72% and 14%, respectively; Tab. 3.8).

Table 3.8: Household (HH) size, education and age of the HH head, HHs' perceptions on acquiring know-how from 5 sources of information and future goals of the HH by farming system. (Mean ± SD)

Items	Improved extensive		Intensive		Average
	Non-mangrove	Mangrove	Non-cluster	Cluster	
HH size (persons)	7 ± 1.3	5 ± 1.7	5 ± 1.5	5 ± 2.4	5 ± 1.7
Years of school attendance of HH head	5^{c} ± 3.0	7^{ab} ± 2.8	6^{bc} ± 1.7	8^{a} ± 3.0	6 ± 2.8
Age of the HH head (years)	48 ± 10.9	49 ± 11.6	42 ± 7.9	46 ± 8.8	47 ± 10.6
Sources of know-how					
Their own experiences *	100	100	76	83	92
Input traders' services *	26	0	72	78	33
Neighbors, relatives, friends*	30	14	55	44	30
Media, TV	30	17	17	35	22
Extension staff *	4	5	14	48	14
% HHs who want their children to become farmers *	52	36	7	30	32

Different superscripts (a,b) denote significant differences between means within rows ($p<0.05$).
(*) denotes a significant difference between percentages within a row ($p<0.05$)

Overall, 40% of the households spent their savings on their children's education in the hope that their children could find better jobs, but access to higher education remained difficult. Most household heads had a low level of education (Tab. 3.8). The better-off households had more opportunities to obtain higher education for themselves and for their children. In contrast, the poor families without savings faced obstacles in sending their children to school and became trapped in poverty.

In addition, in the mangrove-shrimp system, farming families are widely dispersed, so few schools serve a large region. For instance, 2 primary schools and 1 secondary school are available in a commune of approximately 10,000 ha. Students in this area have to travel long distances to attend school, which makes it costly. A report showed that 45% of people aged 15 or above in the Mekong Delta had never been to school. Only 16.8% of the workers were professionally trained, compared to the national average of 25.4% (INFO.VN, 2011). The dropout rate in Mekong Delta is very high due to many reasons. In most cases, the children were unsuccessful, showed inferior results compared to their classmates and had difficulties passing entrance examinations to attend universities and colleges (Case 3).

Case 3: Mr. Tuan, Kinh 17, 2008. Options for children's education.

> I had two choices: let my children leave school or borrow money to support them. I chose to indebt myself. However, they failed their classes and left school because they could not catch up to the same level as students from the cities. Even if they graduated high school, they could not find good jobs or apply what they learned to their real lives. Some neighboring students were sent to the cities to study at high cost, but none was successful; some even were spoiled when they returned home, so I was scared to take the risk. I save money to buy land and will transfer it to them when they get married.

Although many people working in intensive non-cluster farming systems reported being satisfied with their well-being and standard of living, only a few wanted their children to become farmers (7%, Tab. 3.8). They stated that intensive farming was risky and unsustainable; hence, they wanted their children to have other livelihood opportunities. In addition, those children had more chances to access education and job opportunities because the intensive farming villages were usually located near a central area with a good infrastructure system.

- ***Limitations on access to financial capital***

Financial capital includes assets such as credit and savings. Physical assets are the basis of shrimp farming, and the access to financial capital is shaped by social relations, institutions and organizations (Ellis, 2000b; de Haan and Zoomers, 2005).

The percentage of indebted households was 75%. People had access to both formal and informal credit sources. Government banks provided loans for agriculture, excavation of ponds, and infrastructure, with mortgage requirements relating the maximum size of a loan to land size, type of land certificate and the payback history of previous loans. Each HH with a green certificate could borrow up to VND 20 million (USD 1,143), and a household could borrow at least twice as much when land with a red certificate was mortgaged. The poor, having no collateral for loans, had access only to subsidized loans through unions (women's or farmers' unions); they could borrow USD 200 to 500 to diversify their livelihood by raising livestock or doing another supplementary activity. The households that experienced continuous losses from shrimp farming and were unable to repay their loans in time had difficulty securing more loans from the banks, and their debt gradually increased due to the accumulating interest.

Farmers had access to loans from three sources of credit (Tab. 3.9). The lowest interest rate of formal credit was 11-18% per year. Loans from relatives or friends had a far lower interest rate than those from private lenders, which carried interest rates of up to 120% yearly. Informal credit from input suppliers was very important to farmers in the intensive system (Tab. 3.9). Almost all farmers practicing the intensive farming system received support from input traders through patron-client relationships formalized in a contract. According to this contract, farmers covered all startup costs, including pond construction and equipment acquisition (engines and paddlewheels, water pumps, nursery and surrounding nets), chemicals, and feed for 2-3 months. After this period, the private input suppliers, often through local people, provided feed and chemicals with deferred payment and advised farmers on shrimp health management. Based on trust, they provided short-term credit, which farmers were to reimburse after the harvest; they required no

mortgage, but charged a high interest rate (4-5% per month) for selling shrimp feed at approximately 10% higher prices. The farmers cannot bargain for or demand a better quality of feed. Moreover, once the shrimp are 2-3 months old, the feed costs are very high, and the probability of loss for the input suppliers is low (Thanh et al., 2002). People reported that white spot disease was the most serious shrimp disease, and outbreaks spread very quickly when the shrimp were still young; however, the risk of disease outbreaks decreased as the shrimp grew older. Farmers in the extensive farming system had a similar relationship with collectors or seed hatchery owners. If they borrowed from a collector, they agreed to sell their shrimp to the collector for a slightly lower price to maintain a long-standing patron-client relationship. They could not sell shrimp to other collectors unless they repay the collector from whom they borrowed. Most farmers had seasonal loans and paid interest, but they felt satisfied with this arrangement and were grateful to the traders. Some households in clustered-intensive system were from other provinces coming to Nhi Nguyet for intensive shrimp farming, they borrowed money to lease the ponds; therefore, this group had the highest amount of loans and variation between the households was high (Tab. 3.9).

Table 3.9: Percentage of households (HHs) in each farming system with outstanding loans and their value (Mean ± SD)

Items	Improved extensive		Intensive		Average
	Non-mangrove	Mangrove	Non-cluster	Cluster	
% HH with outstanding loans	63	85	66	78	75
Value of loans (million VND)	15^{b} ± 24	24^{b} ± 24	23^{b} ± 31(*)	83^{a} ± 204(*)	32 ± 88
% HH borrowing from bank	48	64	35	35	50
% HH borrowing from relatives	37	27	28	35	30
% HH borrowing from traders, money lenders	19	17	38	35	26

Different superscripts (a,b) denote significant differences between means within rows ($p<0.05$).
(*) short-term credits for food or daily utensils are not included

Intensive farms have the highest operational costs and the highest level of indebtedness, and they frequently failed to earn profits (24%), indicating the high risk of aquaculture (Tab. 3.10). However, farmers who collaborated in a cluster had lower chances of failure (22%), obtained the highest net income per hectare and accumulated the most profit per household. The standard deviation in net income was very high, demonstrating the large difference between failure and success. The benefit-cost ratio (annual investment compared to net income) was largest in the mangrove-shrimp farming system and smallest in the intensive non-cluster system. In this latter system, the simultaneous occurrence of declining shrimp market prices, increasing feed and fuel costs, high interest on credit, repeated crop failure, lack of secondary incomes and other concerns has heavily indebted some farmers.

In contrast, farmers in the mangrove systems carried little debt. They earned the lowest gross income, but they may have accumulated more because they spent less, and the mangrove farming system has the lowest frequency of failure (Tab. 3.10).

Although among the improved extensive groups, the mangrove-shrimp farmers made the highest net income from aquaculture per hectare (VND 14 million), the total income per HH was smaller than that of the non-mangrove shrimp farmers because farmers in the mangrove-shrimp system

had less secondary income and smaller ponds. Compared to the intensive system, the improved extensive system was less risky because the total operational cost was low and failure was less frequent. In addition, farmers using the improved extensive system complemented their income from shrimp with cash income (or daily consumption) from collected shrimp, crabs, blood cockles or fish. Their secondary incomes correlated weakly and negatively with higher wealth (rho=-0.1) and with income from aquaculture (rho=-0.22; $p<0.01$). This correlation indicated that the rich and successful shrimp farmers were not actively involved in diversification.

- ***Market downturns and price fluctuations***

In 2008, the market price of shrimp dropped by nearly one third due to the global economic downturn, whereas the production cost of shrimp increased by 20-40% due to increasing prices for fuel and feed. Farmers reported that the price of shrimp (40 shrimps kg^{-1}) decreased from VND 105,000 to 65,000 in six months in 2008. NACA (2010) reported that, during 2008, the price of shrimp decreased from VND 109,670 to 106,110 (for shrimp of size 21-30 shrimps kg^{-1}). The main reasons for the shrimp price reduction were the economic crisis, unstable markets, the number of actors involved in the market chain (collectors, retailers, and processing traders) and overproduction. In 2009, the price of shrimp was higher but fluctuated depending on the season. Farmers in different farming systems and with different levels of wealth developed various pathways to adapt to these market uncertainties.

3.4.4 Livelihood pathways

In the extensive farming group, price fluctuation was not the primary concern because shrimp were harvested year-round and operational costs were low. In contrast, farmers in intensive shrimp systems were heavily exposed to risk: at harvest time, their shrimp must be sold at any price because they cannot be stored. Normally, the price of shrimp increases in the second half of the year because the export quota was attributed to the processing companies at approximately the middle of the year (interview, 2009). Thus, farmers should consider which months are best for stocking to obtain higher profits and, in addition, when weather conditions are the most favorable for growing shrimp.

In addition, when the price of shrimp sharply reduced in 2008, at least half of households in Long Ha shifted from shrimp farming to other livelihood options: salt production and fish farming. Others emptied their ponds and found non-farm occupations as small traders or industrial workers. In 2007, Long Ha had 280 ha for aquaculture and 140 ha for salt production (33% of total area). The area used for salt production increased in 2008 because at least 10 of 133 households practicing extensive shrimp aquaculture changed to salt production (7.5%) due to the high price of salt and the low returns from extensive shrimp farming. Farmers having large farms invested VND 20-30 million to construct one ha of salt ground and paid VND 10 million to hire labor and pump water. One hectare of salt ground provided 2,000 (*gia)* (30 kg gia^{-1}) of salt in a year. Given that the price of salt in 2008 was VND 30,000-40,000 per *gia*, people producing salt ground could obtain a net income of roughly VND 50-70 million $ha^{-1}yr^{-1}$ (USD 2,857- 4,000). This

activity also became more important because it required little input, involved less risk, and was suitable for households with labor available[14].

Farmers who cultured shrimp extensively in small ponds (usually smaller than 1 ha) harvested very little; therefore, they shifted to intensive farming rather than salt production because the latter required a large area of land (Case 4). In addition, a shift to intensive fish farming (e.g., eel, goby fish) salt production on-farm agricultural activities or off-farm services was a good solution because both disease risk and operational costs were lower compared to shrimp farming (interview 2008). By the end of 2008, at least 20 out of 53 (38%) households in the village had given up intensive shrimp farming and either shifted to fish farming or just emptied the ponds to wait for a better price.

> ***Case 4:*** *Ms. Huyen, Long Ha, 2008: Livelihood diversification in Long Ha village*
>
> We received no benefits from extensive shrimp farming last year, and like many others, we started intensive farming this year. We invested our savings of VND 30 million to excavate 2 ponds with a total area of 4000 m^2 and to buy all of the necessary operating equipment. When the shrimp are 2 to 3 months old, Mr. Linh, an input trader, will give me a loan for shrimp feed and chemicals and advise me about how to culture shrimp. I will also use 0.7 ha of the pond for salt production. Although this area is small, I need to do it in case I lose the shrimp crop. Like my neighbors, I cultivate vegetables around my house. We do not need to buy vegetables for daily consumption, but instead we exchange with each other.

To cope with the lower margins on shrimp, people in the Nhi Nguyet cluster either redesigned their culture systems to reduce costs or shifted to *P. vannamei*. To reduce cost for feed and chemicals, to adjust the feed distribution better based on shrimp density and to save fuel for the paddlewheels, farmers stocked all of their shrimp-seeds in one pond and then divided them into several ponds when the shrimp grew up. Recognizing the benefits of farming *P. vannamei* (see 3.4.1), the first eight farms started growing *P. vannamei* in the middle of 2008, and the number increased to 30 farms in the beginning of 2009 despite the warning that the species might not be suitable for culture in the Mekong Delta and that Taura disease is a hazard[15] (interview, 2009).

To increase the market value of their shrimp, farmers in the mangrove-shrimp system applied for the "organic shrimp" certification from Naturland[16] in 2002. When farmers adhere to the 50:50 mangrove coverage of their farms, stop using chemicals, and start distributing organically certified feed they are eligible for organic certification of their shrimp. In Cha La village, 784 HHs obtained the Naturland organic certification in 2009. However, farmers who produce organic shrimp and fulfill the requirements of the organic certification have not benefited from it (Ha et al.,

[14] In 2009, the income from salt decreased to VND 15-20 million ha^{-1} because of imports; farmers stored the harvest and waited for higher prices.
[15] In 2010, almost all farmers in the cluster shifted to *P. vannamei* farming.
[16] The farms were inspected by the International Marketecology Organization (IMO) and visited by the Swiss Import Promotion Program (SIPPO). The organic black tiger shrimp are exported to the COOP supermarket chain in Switzerland.

forthcoming) because of their lack of bargaining power on the market, which is dominated by foreign traders[17] (Tran et al., forthcoming-b).

To generate additional income, farmers could diversify their livelihoods by doing non-farm jobs in industrial cities or off-farm activities, e.g., collection from the sea and mangrove forest or alcohol production, and those who had enough fresh water cultivate crops or vegetables and raise livestock. Those with enough financial capital worked as boat drivers, shrimp (crab) middlemen or grocery sellers, among other occupations. The income generated from these sources was different among the four systems. People in the mangrove-shrimp system earned the least (VND 7 million per HH, Tab. 3.10) due to their isolated farm locations, poor infrastructure and the long distance to the market.

Table 3.10: Operational costs and net income (million VND) from shrimp farming, secondary income, expense and the percentage of HHs with negative net income (Mean ± SD)

Items	Improved extensive		Intensive		Average
	Non-mangrove	Mangrove	Non-cluster	Cluster *	
Operational cost per hectare	7^{b}±4.2	14^{b}±8.1	254^{a}±165.9	308^{a} ±159.3	112±163.7
Net income from aquaculture per hectare	6^{b}±8.0	14^{b} ±11.9	68^{ab}±179.8	101^{a}±138.6	38±105
Benefit-cost ratio	0.86	1	0.27	0.33	34
Secondary income per HH	9^{b}±15.4	7^{b} ±12.9	18^{ab}±17.1	31^{a}±69.2	13±32
Total income per HH	40^{b}±63.7	31^{b}±26.3	60^{b}±80.4	146^{a}±161	58±90.7
Expenses per HH	28^{b}±24.2	23^{b}±11.7	28^{b}±14.4	54^{a}±28.0	30±21.1
HH with negative net income (%)	15	10	24	22	16

Different superscripts (a, b) denote significant differences between means within rows ($p<0.05$). * Samples include both *P .monodon* and *P. vannamei* farming

In 2009, forest management guidelines changed to give more benefits to farmers. For example, farmers in Cha La village who had forestland contracted with Forest Company 184 had planted the mangroves at a density of 10,000 trees per ha; no thinning was needed, and the mangroves were harvested after 10-12 years. This approach provides income more regularly and reduces the labor needed for thinning. Farmers only cut back the mangroves one meter from the pond to prevent the leaves from falling into the ponds. This approach explains the high production level of shrimp and the stability of the yield as the mangroves grew older. These farmers reported that more wild shrimp, crabs and fish were recruited and harvested in mangrove-shrimp systems and that the harvested shrimp were bigger in size and were thus sold for a higher price. In addition,

17 Retailers buy organic shrimp more cheaply than normal shrimp to avoid buying "fake" organic shrimp. The added value of certification is 20%, but 12% goes to the processing companies and 2% to the retailers. Some months, after selling organic shrimp, farmers receive 6% added value, which is just enough to cover the mentioned price difference between organic and "normal" shrimp. Therefore, only 70% of households with certificates sell shrimp to organic chain markets.

they could diversify species by stocking mud crab, fish (sea-perch, anabas), and blood cockles to generate income and mitigate the risk of shrimp production failure.

3.5 Discussion

The study aimed to determine households' livelihood strategies, to identify the factors affecting farming households' failure or success, and to gain understanding of households' livelihood pathways. In the results section we described the strategies, and here we discuss in a first section the risk factors and in a second the pathways.

3.5.1 Risks and uncertainties, factors contributing to failure

Below we elaborate on risks and uncertainties emanating from the environment and from the market to which the shrimp farmers have to confront. We discuss the factors contributing to failure relate to the transfer of know-how and to the financial and social position in which poor farmers get trapped.

Farmers cite environmental problems associated with shrimp cultivation as their main cause of failure. These problems include deforestation for extensive farming, soil degradation, pollution from sediment in the canals, sewage water from hatcheries and industrial effluent, salinization, and uncontrolled use of toxic chemicals. Commonly, the canals act as both the clean water supply and wastewater sinks; hence, the disease agents in effluents from one farm are transmitted to neighboring environments. For example, due to the deficient water system, farmers in Long Ha village ran a high risk of shrimp diseases and failure. The long and narrow canals cannot evacuate polluted water, which makes farmers highly vulnerable to shrimp diseases or low yields. It will remain very risky to develop shrimp aquaculture in this region unless the government supports a better water management system. Therefore, an environmental policy should be developed to address this problem.

The other serious problem was from the fluctuation in shrimp price. In some years, prices decline as the result of an economic downturn, trade restrictions due to anti-dumping legislation or the ban on shrimp containing antibiotic residues. Producers generate insufficient capital during these years to invest in the next production cycle. The intensive system, which requires higher investments, is thus more vulnerable to fluctuating market prices and risk on failure (see 3.4.4).

Extension officers are often responsible for disseminating technical information. However, many farmers appear to be experienced and knowledgeable in farming despite the lack of attention from extension officers, who are few in number and limited in experience. Moreover, farmers in the extensive farming system have limited education and their social welfare is restricted. Normally, lack of knowledge and of human capacity cause economic, social and environmental problems. To deal with this, the government has created programs to support the poor and minority ethnic groups with housing, clean water, school tuition remission, health insurance, vocational training

and low-interest loans. The poor in all sites, especially the Khmer community using the mangrove system (Cha La), have benefited from the national programs. However, they have limited skills to manage risks and limited options to find strategies improving their livelihoods, making it difficult for them to escape the poverty trap. Therefore, transferring knowledge and skills and providing the poor with more means to earn a living are important to consider.

Increasing landlessness and poverty, and a lack of traditional livelihood supports are social problems. In the extensive farming, the risk of failure weighs most heavily on households with small ponds. These households are often immigrants or young, newly married couples who have recently left their parents' households. Because of the small pond size, these farmers are denied access to formal credit requiring collateral and must rely on informal sources of credit that inevitably charge high interest rates. Most poor farmers have a low level of education and a low social status; they have small ponds and little savings. They stock cheap fry (unqualified shrimp or young crab) and have little or no capital for investment in pond preparation, feed, and other necessities. Therefore, the shrimp frequently die after a few weeks.

3.5.2 What pathways are sustainable?

Farmers developed several strategies to overcome the uncertainties of shrimp farming. In general, they reacted very flexibly to the challenges of market failure and shrimp disease. In response to low export prices for shrimp, they quickly shifted to products for local markets, such as eel, mudskipper and to the production of salt. These production systems were less risky and required smaller investments. In Long Ha, a considerable number of households devoted at least part of their farms to these systems. Many shrimp farmers diversified their products to ensure at least some income from other sources in case the shrimp harvest failed. However, in 2009, the price of salt sharply decreased which negatively affected farmers' livelihoods. Thus, farmers created one pathway to cope with risk but might encounter another. Therefore, livelihoods are dynamic and pathways are temperate strategies created to escape poverty and risks during people's lifetime.

To reduce the risk of shrimp mortality due to the pollution of inlet water, people in the extensive farming systems have designed the *high-yield improved extensive model*, also called the *minimal water exchange system* or the *closed* or *tranquil water shrimp farming system* (ASEAN, 2005). Some farmers devote 30-40% of their pond area to a reservoir that is filled with seawater and treated with bio-chemicals to eradicate predators and competitors. This water is used to fill the pond where shrimp are stocked at a density of up to 10-20 fry m^{-2}. However, not all households can apply this model because of the high cost of construction and the lack of money for daily needs until the harvest (after 4-5 months). Moreover, porous soils and low-lying land are unsuitable for constructing these reservoirs. Therefore, this model is suitable in the non-mangrove extensive system, where the land elevation is higher and the farm size larger. In 2010, at least four HHs changed to this model in the non-mangrove system (Thanh Hai).

The farms in the mangrove-shrimp farming system have a higher net income per hectare than those in the non-mangrove system (Tab. 3.10). However, in the mangrove shrimp system, farmers

have suffered from strict and unfair management by Forest Companies. Therefore, to make the policy on forest management effective for conservation, allocation of forestland to farmers and better distribution of income from forestry between farmers and institutions should be considered. In principle, farmers can receive up to 95% of the profit from the final harvest after deducting all investments if they planted mangroves themselves. The longer the farmers conserve the mangroves, the higher their profit becomes. However, the interviews showed that benefit sharing between farmers and the Forest Company was unequal. In agreement with Tran et al. (forthcoming-b) people might be more interested in mangroves if: (1) the time between planting and harvest were shorter so that the mangrove-related activities provided more regular income; (2) the farmers had more autonomy in managing the mangroves; and (3) the sharing of costs and benefits between farmers and Forest Company was more transparent and fair.

In addition, this result is confirmed by Binh *et al.* (1997), who showed that farmers maintaining mangroves on their farm realized a higher economic return and that shrimp farms with mangroves covering 30-50% of the pond area had the highest returns. Binh *et al.* (1997) cited that the economic value of mangrove ecosystems and their products is up to USD 11,819 $ha^{-1}year^{-1}$. This is in agreement with De Graaf's (1998) finding that 1 ha of mangroves supports approximately 0.449 ton/year of marine fish catch. Moreover, if farmers conserving mangroves are paid for their environmental services, the profits from shrimp aquaculture would become small compared to the costs of losing mangroves, and the farmers might prefer to conserve the forest (Tran et al., forthcoming-b).

Better Management Practice (BMP), Good Aquaculture Practice (GAP) and organic shrimp farming are introduced to reduce disease risk, to produce higher quality shrimp products, and to produce shrimp more sustainably. Organic shrimp farming seems a suitable model for the mangrove system as it has several advantages, e.g., higher efficiency, more diversification, lower risk, and less environmental deterioration. However, though organic certification is widely adopted in the mangrove-shrimp system, farmers gain no benefits from selling to this market (see 4.3.5). Thus, the pathways may not be sustainable when farmers directly producing sustainable products do not benefit from the market chains.

Collaboration in shrimp farming might offer farmers a solution in terms of market competition, as demonstrated by the Nhi Nguyet cluster in Ca Mau province. Cluster members include not only kin but also friends and neighbors working together voluntarily and democratically. Hence, their rights and their agreement on the plans and rules of the cluster are well recognized (see footnote 2 and 4.1). This self-help group mobilizes financial resources more efficiently and improves the sustainability of farming, including farmers' welfare, social networks and environmental responsibility. Clusters may facilitate a long-term sustainable development strategy, enable members to enter into contracts with processing companies to avoid fluctuation in prices, attract credit from government banks with low interest rates, or enable certification by national or international agencies for BMP, GAP or organic practices. In a cluster, innovative farmers combine their own wisdom and experiences with external knowledge from private partners to try

out new practices. The farmers who share knowledge with and learn from others, and create and try new techniques are mostly successful.

Livelihood diversification reduces risks and improves incomes, but successful shrimp farmers tended to diversify their livelihood less. In line with Scoones (1998), the degree of diversification may be related not only to the available capital endowments, but also to the level of risk associated with alternative options. The wealthy seemed less flexible and more hesitant to diversify their livelihoods through additional on-farm activities despite having capital. A high level of indebtedness may force farmers to pursue further intensification of their farming activities and to incur further debt to pay back their previously accumulated debts. The poor diversify their income sources to survive in the context of declining access to resources. In the extensive shrimp farming systems, farmers diversify by stocking crabs, fish and blood cockles. In addition, the government's strategy to promote agricultural diversification was based on raising crops and livestock. However, the risk of livestock farming increased recently due to avian influenza and blue ear disease in pigs. Although the farmers recognized that agricultural activities would not bring them out of poverty, these activities reduced their fear of losing their income due to a poor shrimp harvest.

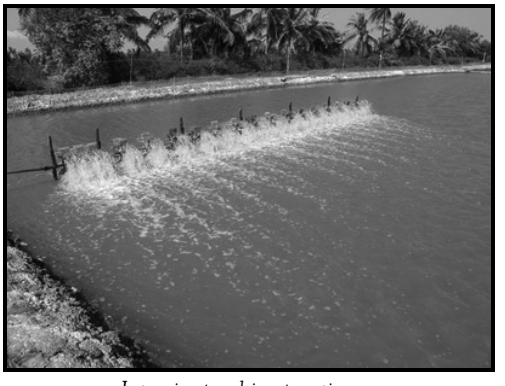
3.6 Conclusion

Capabilities and vulnerabilities differed among the four shrimp farming systems. Of the two extensive systems, the extensive mangrove-shrimp system was more sustainable and less risky because of its low failure rate, high net production, and proper irrigation system. However, people farming by this system were more isolated due to a lack of electricity and of difficulties in acquiring know-how and education. Access to markets was also problematic because of transportation constraints. Furthermore, although farmers' entitlement to the products from logging in the forest was secured in policy papers, the sharing of benefits was not transparent, so farmers were reluctant to participate in forest conservation.

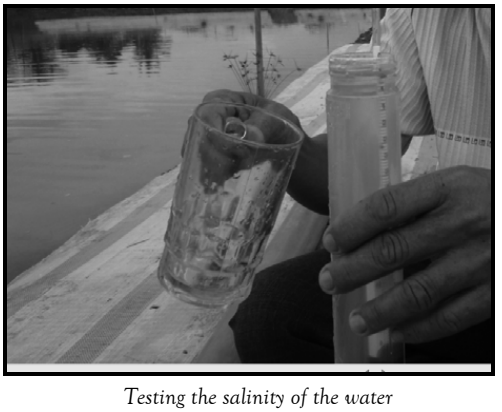
The intensive shrimp farming households suffered from a poorly functioning water management system, more frequent harvest failure and vulnerability caused by fluctuating shrimp prices and market competition. Shrimp farmers adapted to these insecurities in several ways, such as adopting new technology, redesigning the ponds, stocking in favorite seasons, diversifying their land use, earning off-farm income, joining together in clusters, integrating aquaculture and agriculture, and farming better quality shrimp to demand higher prices. Investment in infrastructure is the highest priority for the government because a good infrastructure increases farmers' livelihood options and improves their access to education and technology.

Intensive shrimp farming

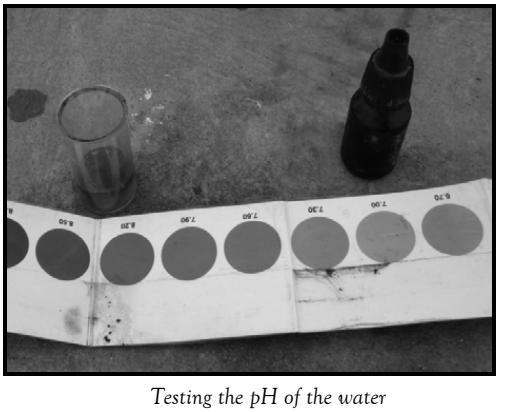
Drying up the bottom of an intensive pond



Intensive pond in operation



Testing the salinity of the water



Testing the pH of the water

Shrimp harvesting

Accessing the feed residue left on the tray

Improved extensive shrimp farming

Improved extensive shrimp farming ponds without mangroves

Water flowing out through a sluice gate. Shrimps and fishes are collected through a bag net put at this gate

A concrete sluice gate in improved extensive farms

A poorly constructed sluice gate

Crabs (and fishes) are cultured with shrimps in improved extensive farming systems

Calculating shrimp fries by comparing the density among the bowls

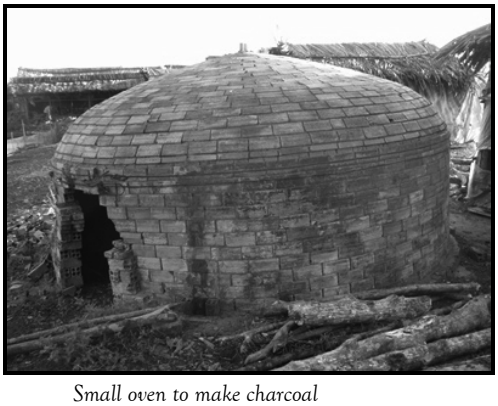
Mangrove-shrimp farming system

Mangroves and shrimp pond

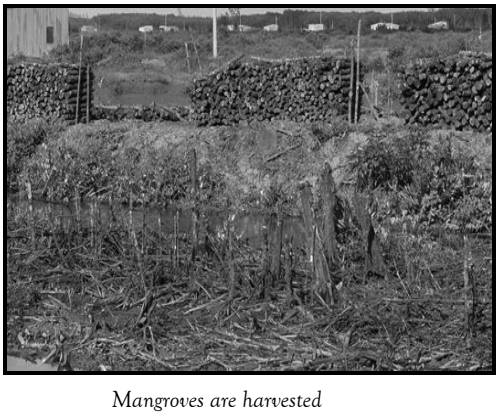
Shrimp farming in resettlement zone with low density of mangroves

Rhizophora apiculata

Avicennia



Small oven to make charcoal



Mangroves are harvested

4

Mangrove roots. Source: Han van Dijk, 2008

Forest access and livelihoods

This chapter has been submitted as:

Tran H. T. P., van Dijk H. and Visser L., Impact of changes in mangrove forest management practices on forest access and livelihoods: A case study in mangrove-shrimp farming system in Ca Mau province, Mekong Delta, Vietnam. Submitted to *Land Use Policy* on 27 September 2011.

Abstract

This paper documents how the implementation of forest tenure policy affects the decision-making of farmers in mangrove-shrimp farming systems with regard to their access to and management of mangrove forest in Ca Mau, Mekong delta, which is the largest remaining mangrove forest in Vietnam. Policies on land allocation, land tenure and use-rights are important since they potentially promote sustainable mangrove-shrimp management. Forest management policy in Vietnam has been changed to promote equality of benefit sharing among stakeholders and devolved State forest management to the household level. However, to what extent its implementation can stimulate both mangrove conservation and livelihood improvement is still being debated. We use access and its social mechanisms to investigate how State Forest Companies (FC) and farmers can benefit from mangrove exploitation. The study was conducted from September 2008 to August 2010 using both qualitative and quantitative methods and using a participatory approach. After group discussions and in-depth interviews with a wide range of stakeholders, we interviewed 86 households in four communities using structured questionnaires. Results show the imbalance in access to finance, markets, and differences in authority between the two actors, farmers and FC. The discussion focuses on the possibilities of "win-win" outcomes, i.e. land tenure regimes promoting the devolution of sustainable forest management to farm households to balance benefits of both mangrove conservation and livelihood improvement.

Keywords: *forest management, mangrove-shrimp, natural resource management, Forest Company, Ca Mau, Mekong Delta*

4. Impacts of changes in mangrove forest management practices on forest access and livelihood

4.1 Introduction

Shrimp farming is an important income earning activity in Ca Mau, the most southern province in the Mekong Delta of Vietnam. In 2009, shrimp farmers in Ca Mau produced 98,100 tons of shrimp accounting for 21.5% of national production. Between 1983 and 1995, in Minh Hai province (at present divided in Bac Lieu and Ca Mau) the area covered by shrimp culture increased from 3,000 ha to more than 76,000 ha while more than 66,000 ha mangrove forest was converted into shrimp ponds (Minh et al., 2001). According to many studies, this shrimp farming boom and the correlated disappearance of mangrove ecosystems had negative consequences such as pollution causing shrimp disease outbreaks, and it negatively affected the livelihoods of people dependent on forests (de Graaf and Xuan, 1998; Thu and Populus, 2007; Tran *et al.*, forthcoming-a). In Ca Mau, the most popular shrimp farming system is the integrated mangrove-shrimp model in which each household is allocated an area of 3-10ha, of which 50-70% should be reserved for mangrove forest, 20-40% for ponds, and 10% for housing. The government issued a number of laws, regulations and policies to manage, control and preserve mangroves in which the policies on land tenure, land allocation, use rights, and production benefit sharing are the most important for farmers with mangrove-shrimp-based livelihoods.

Several studies have focused on governmental policies on land allocation and tenure changes of agriculture and forest in the northern uplands or central highlands after the economic reforms in 1986 (Kerkvliet, 1995; Luttrell, 2001; Sikor, 2001; Do and Iyer, 2003; Sikor, 2006; Jakobsen *et al.*, 2007; Vien, 2008; Berkes, 2010) but very few studies were done in the Mekong Delta. Aquaculture studies on Ca Mau focused mainly on drivers of the changes in (or collapse of) shrimp farming from factors like market development (Raux and Bailly, 2002; Nguyen et al., 2005) or factors such as population increase, mangrove destruction, shrimp disease and management (Binh et al., 1997; de Graaf and Xuan, 1998; Primavera, 1998; Johnston et al., 2000; Minh et al., 2001; Clough et al., 2002a; Estellès *et al.*, 2002; Christensen and Thi, 2008). In recent years, very little study has been conducted on the effects of changes in forest management regimes on the livelihoods of people in mangrove-shrimp farming system in Ca Mau, the topic of this paper.

In its efforts to promote socio-economic development and enhancing environmental conservation, the Vietnamese government issued several laws and policies regarding forest allocation and land tenure. These policies were promulgated to ensure livelihood development and forest conservation, but implementation was slow and led to inequality. Because these policies were not throughout disseminated, State Forest Companies (FC) (see note 20) dominated forest management and exploitation. Local farmers faced severe obstacles in access to timber marketing

and sharing in its benefits because their forest tenure rights were limited. Sunderlin and Ba (2005) argued that forest-dependent people (in highland forests) are poor and tend to be politically weak and powerless. Whether these weaknesses apply to livelihood conditions of lowland farmers in Ca Mau and how policy changes affect their livelihoods are questions that we intend to answer here.

This study, therefore, aims to investigate how changes in land tenure policies in mangrove forest management affected the livelihood decision-making of farmers' incomes and accessibilities to sub-sectors: shrimp aquaculture and mangrove conservation in integrated shrimp-mangrove systems. We use the access framework and mechanisms (Ribot, 1998) to analyze conflicts of interests between two groups of actors involved namely the forest companies (FCs) and the shrimp farmers, and the dilemmas associated with forest conservation and economic development.

The paper begins with outlining the theoretical framework and an introduction on the history of land allocation, land tenure, legislation and stakeholders involved in forest management. The subsequent three sections report the results: land allocation and tenure; accessibilities in forestry; and aquaculture. The paper concludes with a discussion of interventions for sustainable mangrove forest management.

4.1.1 Theoretical framework

Two main subjects related to livelihood decision-making processes in mangrove-shrimp farming communities in the Mekong Delta are connected here: land (land allocation, tenure, etc.) and people (access, use-rights, decision making etc.).

Land tenure means the legal terms on which property is held: the rights and obligations of the holders. Land tenure has to be understood in relation to the economic, political, and social dynamics which produce it and which it influences (Bruce, 1998) and is thus characteristic for a specific context. Tenure systems may contribute to sustainable land management when policies on allocation and on use rights result in devolution of management to the users. Following Brugere (2006) and Berkes (2010) we define devolution as the transfer of rights and responsibilities to local groups, organizations and local-level governments institutions that have autonomous discretionary decision-making power, while decentralization as the transfer of power to local branches of the same Ministry of the Central State. Decentralization is effective only when it is constructed of accountable institutions at all levels of government and a secure domain of autonomous decision making at the local level (Ribot et al., 2006). However, forestry laws and regulations in many countries were written to ensure privileged access of the State and/or elites to timber and wealth, and to prevent counter-appropriation by the poor (Sunderlin et al., 2005). Even when policies were neutral or seemingly fair, rural poor faced severe bias in implementation due to unequal access to capital, labor and credit that is rooted in class, identity and social relations (Ribot and Peluso, 2003; Larson and Ribot, 2007). In this study, we try to identify the extent to which land and forest tenure should be secured and implemented, i.e. which obligations the State should control, and which use-rights farmers should have to maintain livelihoods and to manage the mangrove forest in a sustainable manner.

We use the concept of access to describe and analyze changes in the distribution of benefits from forests under the different political regimes. Access in this study means the ability to derive benefits from aquaculture and mangrove cultivation. In theory, access is the freedom of ability to obtain and to make use of and the term access is closely related to property but having property rights does not automatically mean that people are able to benefit. Property refers to *de jure* rights; thus access is broader than property since it includes the *de jure* and *de facto* rights, the ability to benefit from things (Ribot, 1998; Ribot and Peluso, 2003). It is not only about rights to resources but also about webs of power and power relations that enable people to derive income from these resources (idem). Schlager and Ostrom (1992) defines *de jure* property rights as the formal legal rights enforced by legal authorities and *de facto* rights as those based on rules made among resource users. Farmers have property of forestland and ponds; based on several supportive government policies they are legally entitled to receive a share of the benefits from mangrove forest. However, until 2008 famers were still blocked *de facto* right and the dilemma and conflict associated with access right distribution between farmers and Forest Companies (FCs) still remains an issue as when the former gain the latter may lose. Several factors affect and shape the benefits that people gain, control and maintain from the access mechanisms we analyze here comparison between the four study sites shows the benefits of farmers from mangroves (see 4.3.2). We do not only focus on property rights but also on (1) authority and power determining who gains from legal channels in relation to the regulations, rules or political power on forest management and (2) capital and networks determining who has better access to finance and markets. We keep in mind that access is not a singular action but consists of complementary networks and actions.

We agree with Sunderlin (2005) that access should correspond to economic improvement and environmental protection. Sunderlin describes the win-win outcomes of integrated forest management to improve the balance between ecological (forest cover) and economic (human well-being) benefits to farmers. This paper intends to investigate in what kind of the mangrove forest management farmers in the mangrove-shrimp farming system can better balance incomes from mangrove forestry and aquaculture. Only if that balance improves, farmers are interested to invest in mangrove conservation. However, institutional constraints (FC, power hierarchies etc.) still impede them from full access to the market in order to benefit in mangrove production.

4.1.2 Forest allocation and tenure in Vietnam

It is hard to think of a more politically controversial resource in Vietnam than farms and forest land during the second half of the 20th century (Kerkvliet, 2000) including mangrove forests. Over the years, the Vietnamese government has developed a different approach to manage the forests, from centralized State control models to cooperative management models, and to private management (Vien, 2008). However, according to Marsh and MacAulay (2006) the implementation of the State policies aiming to encourage equitable distribution and efficient use of land is often inefficient.

According to Vien (2008), the policy was characterized by a centralized State control model until the mid-1980s. Forests and forest products were viewed as national assets and owned by the State. The government established a forest enterprise system to both manage and exploit the forests. By 1989, 413 State Forest Enterprises (SFEs) and State organizations were in charge of forest exploitation and plantation, and together they managed 6.3 million ha or almost 70% of total national forest land (Vien 2008). However, State forestry proved to be a disaster for Vietnamese forest resources (Sikor, 1998), as the SFEs were unable to properly manage national forest resources and 200,000 ha of forest were lost every year from 1976 to 1990 (Vien, 2008). The model therefore failed to encourage local people to sustainably manage forests and to prevent forest depletion. Since 1983, the State has begun to allocate forestland to households, communes, cooperatives, and to Forest Management Boards (FMBs) next to the State Forest Enterprises (SFEs) to deal with these problems.

After the initial success of economic reform or *Doi Moi* in 1986, the legal framework of forest tenure changed further from a State-based to a society based (Vien, 2008). For instance, the Land Law of 1993 stipulates that land is the property of the Vietnamese people, uniformly managed by the State, which allocates land to organizations, households and individuals for sustainable and long-term uses. Land users receive certificates[18] recognizing five types of rights to agricultural land: use, transfer, rent, inheritance and mortgage (Do and Iyer, 2003). Forestland was not transferable. The Law was supported by Decree 02/CP (15/01/1994), Decree 01/CP (04/01/1995) and Decree 163/ND.CP (16/11/1999); the latter guided the allocation of land for long-term contracts with forestry purposes (Tan and Sunderlin, 2008). By 1998 the government had given out 7.2 million ha of forestland to households, communes, and cooperatives, but most of which (5.4 mill. ha) was to State Forest Enterprises (SFEs) and Forest Management Boards (FMBs) (idem). In reality, the government was merely decentralizing responsibility for forests, not from the State to households but to the various State entities (McElwee, 2004) while the de-concentration as aimed for by the 1993 Law was not implemented.

The new framework formally emphasized the ownership of local people through responsibility for the protection, improvement, fertilization and effective use of forests. However, although the forest allocation program was widely implemented, it did not provide power over forest to local people. The policies and laws only recognized community right to use forests, but they did not indicate the right of ownership (Tan and Sunderlin, 2008).

[18] Red certificates (so-called red book certificates) give farmers land use rights for 50 years, and freedom to use the land as they see fit for suitable economic development. Green certificates (so-called green book certificates) are contract-based (forest) land-use rights given to farmers who have obtained a 20 years leased tenure. The contracts can be renewed after this period.

4.1.3 Forest allocation and tenure in Ca Mau

By the early 17th century, Ca Mau was a desolate territory with sparse population and was firstly named in a map of Vietnam in 1714. In the 20th century, the forests were still under-populated. In all of southern Vietnam, several land reforms and land policy changes occurred during the colonial period and the subsequent regimes of Ngo Dinh Diem and Nguyen Van Thieu (Prosterman, 1970). The land reforms of Ngo Dinh Diem allowed a landlord to have a maximum of 130 ha; any excess land was bought by the State and sold to tenants. In 1960, only 23% of households in the Mekong Delta owned the land they exploited; the others were tenants. Under the "Land-to-the-tiller" program of Nguyen Van Thieu, after 1970 each household was allowed to have only 15 ha for farming; any excess land was bought by the State. This land was offered for free to landless farmers with a maximum of 4 ha, and land use rights were certified by the State (Tuyen, 2010). This land reform resulted in 1.14 million hectares being distributed, but was stopped at the end of the war in 1975 when the southern government was ousted (Callison, 1983).

During the French and American war (known as the Vietnam War in Western literature), mangrove forests in Ca Mau were a refuge for soldiers and civilians. Mangroves were used to make trenches, facilities and fighting materials such as blind ditches. Mangroves allowed military and local people to hide and to sustain by feeding on *Avicennia* fruits instead of rice and by distilling water from seawater. More than 2.2 million hectares of land in South Vietnam of which 150,000 hectares of mangroves were heavily damaged by bombing and toxic chemical defoliants. An estimated 72.4 million liters or 100,000 tons of herbicide were sprayed over the area from the 1960s to 1971 (Westing, 1984). However, contrary to common opinion, the most serious decline in forest cover occurred after the war between 1976 and 1990 (McElwee, 2004), corresponding to the post-war economic downturn and recovery after the *Doi Moi* reforms (1986) in Ca Mau.

After the war, economic recession on the one hand, food shortages and poverty, and demand for reconstruction materials, food and fuel, on the other hand, pushed tens of thousands of people to Ca Mau to exploit mangroves. The settlers were large families who had difficulty in making a living elsewhere. Carrying only basic equipment, they started gathering and occupying land and forest, destroying mangroves for timber and charcoal burning and converting the land to rice or fish farms without official permission. During the first years after the war, forest allocation was not recognized in Ca Mau since people resettled, occupied and reclaimed free forests as much as they could. The second migration wave occurred during the years after *Doi Moi*, responding to the explosion in prices of aquatic products in national and international markets and the lack of unoccupied forestland, immigrants bought or acquired land (forest) use-rights from previous occupants. Forests were destroyed and forestland was transferred, leased, mortgaged and inherited among local people during this stage. However, farmers are not the only ones to blame for forest degradation, also the indiscriminate cutting by SFEs and inappropriate policies for forest management by the government contributed.

To respond to the destruction of mangroves, the chaos in forest allocation and the conflicts among actors in forest management and land tenure, decisions at national and provincial levels were

made to regulate allocation, control, management and forest-based production (Tab. 4.1). At provincial level, Decision 57/QD.UB (06/03/1985), 389/QD.UB (08/11/1988), 64/QD.UB (18/031991) dealt with forest allocation, use rights, forest management, tax and benefit sharing (Cited in Hai, 2005).

After the Land Law of 1993 was issued at national level, both tenure regimes were applied in Ca Mau. Red certificates were given to people having agricultural land without forest and green certificates to people owning forestland, having contracts with forest enterprises or with State-owned companies.

Table 4.1: Historical timeline of main forest land policies at provincial level from 1975

Date & Decision	Title of regulations	Implication
6/3/1985 57/QD.UB	Temporary regulations about mangrove management, protection with relation to aquaculture technical management in Forestry-Fisheries Enterprises and households.	Farmers have to cover at least 80% of the mangroves and 20% for pond aquaculture. Mangroves must be planted at a density 20,000 trees.ha^{-1}.
8/11/1988 389/QD.UB	Temporary regulations on allocation of mangrove land to households for production and protection.	
28/3/1991 64/QD.UB	Decision on implementing methods for management, protection and uses of forest, forestry land and water surface in forest land. To replace the Decision 389/ QD.UB	Households have less than 20 ha of mangrove forest or 10 ha of empty mangrove and maintain at least 80% of mangroves. Farmers were allowed to open ponds by hand and had to plant 20,000 trees per ha. The renewable land-use rights were granted for 20 years to individual HHs under contract with FEs.
12/9/2002 24/QD.UB	Decision on reforming structure and management regimes of forest and forestry lands in Ca Mau province	Converts the use-right contracts from green to red certificates. Allows farmers to gain more benefits from timber marketing, to dredge or excavate the ponds using machines. For an entire, mangroves should cover 70% of the area; however, for HHs, mangrove could covers 50%, 60% or 70% of total area of farms having less than 3 ha, 3-5ha, or more than 5 ha, respectively.
22/9/2010 10/QD.UB	Decision on implementation of policies on forest development and protection in Ca Mau province. To replace the Decision 24/QD.UB	To encourage all economic and private sectors involving in forest protection, development, production and market. Mangroves should cover at least 60% of total area.

Source: adopted from (Hai, 2005).

Table 4.1 lists the main provincial policies related to mangrove forest management and shrimp aquaculture, and the classification of zone for forest conservation and rehabilitation. Decision 24/QD.UB (12/09/2002) was replaced by Decision 10/QD.UB (22/09/2010) to further devolve forest management to farmers by transferring contract-based forestry to a long-term land use right to households in order to have farmers benefit more from both mangrove and shrimp production. Decisions acknowledge farmers' rights and authority over forest products, and provide flexible and feasible aquaculture regimes by reducing the ratio of mangroves to water in small-size farms, accepting machinery for excavation, and providing more equal benefit-sharing for farmers from Forest Company (FC)[19] mangrove logging. However, the implementation process has been slow and problematic, as will be discussed in section 3 below.

At present the forest area in Mekong Delta accounts for 2% of Vietnam forest (GSO, 2010). The percentage of forest cover in Ca Mau (16.5%) is higher than in the Mekong delta, which is with 6%, the lowest in Vietnam (Tab. 4.2).

Table 4.2: Forested areas (x 1000 ha) in Vietnam, Mekong Delta and Ca Mau

Type of forest	Vietnam	Mekong Delta	Ca Mau
Forest area (x 1000 ha)	13,259	276	99
Natural	10,339	61	9
Planted	2,920	216	90
Forest cover (%)	39	6*	16.5

Source: (GSO, 2010); * data in 2004 from (Truc et al., 2006).

Forestland in Ca Mau, as in the rest on country, is classified in three categories: production, special-use and protection forest. In Ca Mau, these forest categories are located either in the Economic zone (EZ), the Buffer zone (BZ) or the Full protection zone (FPZ). In the EZ, full land tenure rights (red certificates) are given to farmers for long-term land-use right. From the coast, BZ is a 0.5 to 4 km wide belt behind the FPZ where settlement is allowed and mangroves cover 50-70% and the remaining 30-50% may be used for ponds, dikes and houses. The FPZ is a strip of 100-500 meters wide along the western coastline and of 1,000 m wide along the eastern coastline of Ca Mau. There are no settlements allowed, collection of dead trees and small marine products is permitted in the protection forest but exploitation, shrimp cultivation or fishing is not allowed.

In Ca Mau management and production of the production forests are under several tenure institutions but mainly under the Forest Management Board (FMB) and Forest Companies (FCs), and only rarely under forest-dependent farmers (7.2%) (Tab. 4.3). FCs operate under the Business Law to manage production forest in the BZ. Land and forest in the BZ were allocated primarily to households under the 20 year green certificate contracts with FCs. Forest management activities,

[19] Before 2005, FFEs and CFMPD were State organizations responsible for forest management, protection and development. During 2005-2010, Ca Mau has converted 15 FFEs and CFMPD into 8 Forest Companies (FC) for production forest and 8 Forest Management Board (FMB) for special-use and protection forest.

like reforestation, thinning and harvesting, and shrimp aquaculture, like excavating a new pond or dredging the excess sediment should be in accordance with provincial regulations (DARD, 2009).

The special-use forest in BZ and FPZ mainly consists of two national parks and one island for scientific research and ecotourism development (Tab. 4.3). The few people living in the special-use forest have a contract with FMB restricting rights on forest exploitation for ecological conservation.

Close to 100% of the protection forest is managed by eight FMBs funded by the national budget and with 50,000 VND ha^{-1} yr^{-1} from Project 661. The earlier settlers who immigrated to FPZ for fishery and aquaculture were moved out and relocated in resettlement schemes. One of those was the Coastal Wetlands Protection and Development Project (CWPDP) aiming to restore the mangrove forest and its functions for aquatic ecosystems and coastal protection, and to improve people's access to basic infrastructure such as schools, health care, drinking water and transport (CWPDP, 1999). The project relocated 1,452 households to the BZ who were compensated for land and assets lost. Kinh 17 (in resettlement) is included in this study.

Table 4.3: Land area (ha) of three forest types and their management structures in Ca Mau.

	Types of forest (ha)			
Management structure	Special use	Protection	Production	% managed
National parks, island units	17,409			16.0
Forest Management Board (FMB)	123	26,102	15,095	38.1
Scientific research unit	272			0.2
Armed force unit		48	3,239	3.0
Forest company (FC)			38,245*	35.3
People Committee			17	0
HHs		747	7,023	7.2
Total area covered (ha)	**17,805**	**26,897**	**63,619**	

Source: Provincial report, 2009

*Probably this is overestimated as much of the land has been given out to shrimp farmers under green book certificates

4.2 Methodology

4.2.1 Research sites

The research was conducted in four communities of Ca Mau and Bac Lieu provinces (Fig. 4.1).

The four communities were selected using four criteria: agro-ecological diversity (with or without mangroves-shrimp farming), shrimp farming system (non-mangroves, integrated or separated mangrove-shrimp), settlement history (inside and outside resettlement zone), and land tenure regime (red or green certificate). Names and general descriptions of the locations are given in Tab. 4. 4.

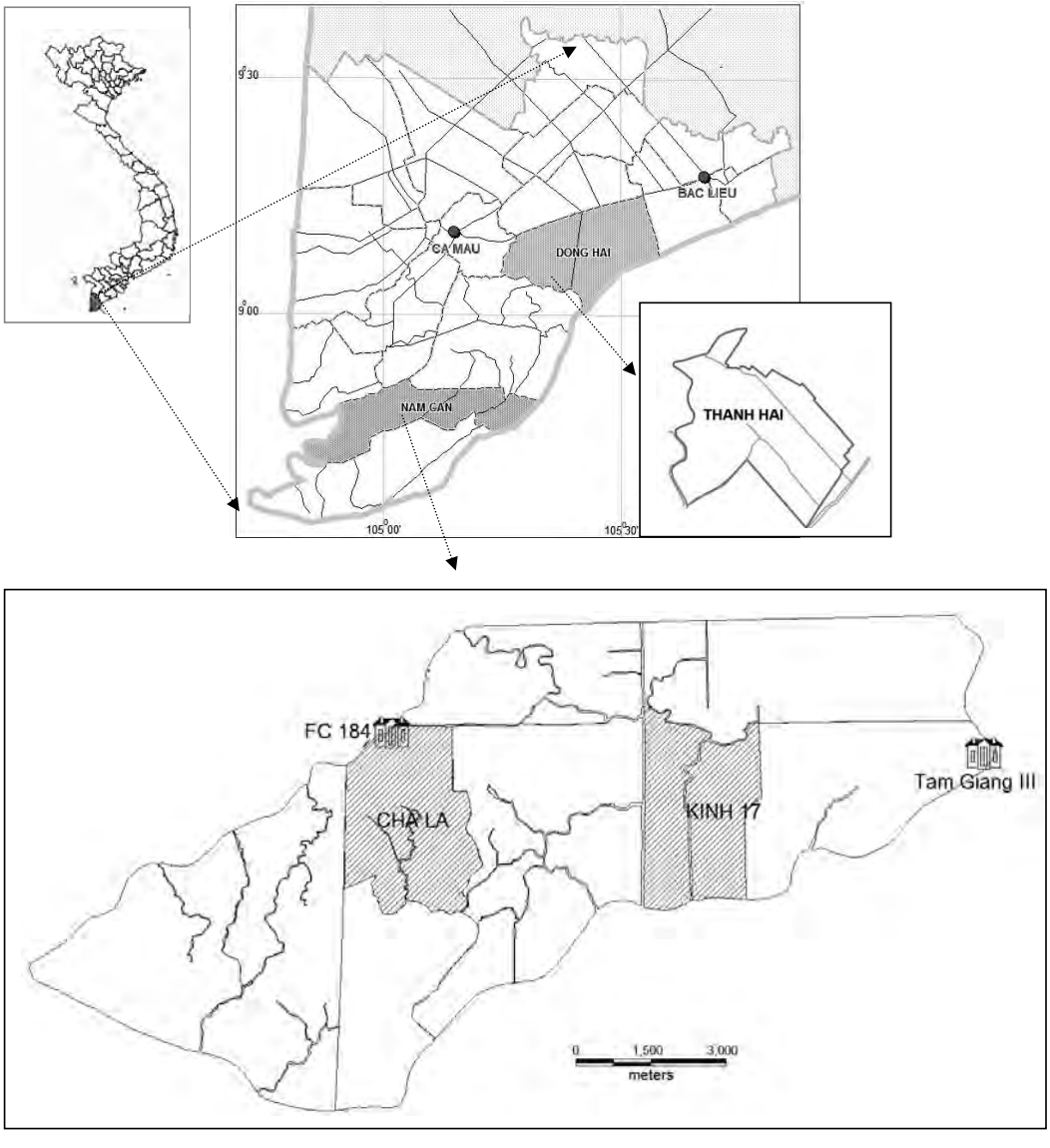


Figure 4.1: Map of Vietnam, Bac Lieu and Ca Mau province showing the location of the four study areas: Thanh Hai, Cha La, and Kinh 17 inside and outside the resettlement zone.

A control site, Thanh Hai in Bac Lieu province, was selected for its distinctness of land tenure (red certificate) and farming system (without mangroves). Before the war, Thanh Hai, a large village of more than one thousand hectares, was covered by bushes and mixed forests. After the war, people returned to their homeland, occupying and reclaiming new land for rice cultivation. Around 1993, after the Land Law was issued, all households received red certificates for long-term land holding rights. From 2000, the land-use shifted to shrimp aquaculture. Today, as there is no forest Thanh Hai is an Economic Zone.

Table 4.4: Study sites and general description

	No mangrove	Separated mangrove-shrimp system		Integrated mangrove-shrimp system
		Inside resettlement	Outside resettlement	
Village	Thanh Hai	Kinh 17 - inside	Kinh17 - outside	Cha La
District	Dong Hai	Nam Can	Nam Can	Nam Can
Province	Bac Lieu	Ca Mau	Ca Mau	Ca Mau
Mangrove presence	Non	Average, young	Rich	Rich
Type of zone	EZ	BZ	BZ	BZ
Type of forest	-	Production	Production	Production
Type of tenure	Red	Red	Green	Green
Management	Non	People Committee	Tam Giang 3 (TG3)	FC184

Kinh 17 represents the separate mangrove-shrimp scheme where we selected 15 HHs inside and 15 HHs outside the resettlement zone. The Kinh 17 resettlement zone covers 368 hectares for the 102 households who were moved from the FPZ by the CWPDP in 2007. However, only 60 households agreed to be relocated in 2007; the others leased out their homesteads, moved out and found other livelihoods. Resettled people, who accepted to be moved from their location in the FPZ to land in the BZ, were given red certificates for both aquaculture and forest land-use rights and 50% of their land was replanted with mangroves. In 2006, all mangroves were cut and several deep canals of 200-300m long and 8m wide were dug to build shrimp ponds to compensate each household with 1.5 to 3 ha. However, none of the three sections of their areas was technically appropriate: the ponds were too deep, and dikes and forest areas too dry to grow mangroves.

Besides the resettlement zone, Kinh 17 has a zone managed by FC TamGiang3 (TG3) where each household may use about 5-10 hectare of land for both mangroves and shrimp ponds. TG3 was established in 1987 to protect and re-plant forests. In 1990, land along rivers was granted to *chính sách* households, i.e. households of veterans, war invalids or well positioned government officers. They have green certificates, later some of these owners leased or transferred land to others.

Within the production forest, Cha La represents a mixed mangrove-shrimp farming system. People in Cha La have a different settlement history. They settled during or just after the war, cleared land for a homestead and a rice field that was later converted into shrimp ponds. People have contracts with State Forest Company 184 (FC184)[20] which manages 6,475ha in seven villages west of Tam Giang commune where 95% of the land was contracted under green certificate. About 70% of the 235 households in Cha La village produce shrimps certified as organic by Naturland (see Ha et al 2011)[21].

[20] From 2008, three FCs (Tam Giang3, 184 and Ngoc Hien) have merged into the General Forest Corporation Ngoc Hien.

[21] The farms are been supported by Swiss Import Promotion Program (SIPPO), inspected by the International Marketology Organization (IMO) and certified by Naturland to export black tiger shrimp to

4.2.2 Data collection and analysis

The research was conducted between September 2008 and August 2010. Both qualitative and quantitative data were collected about land tenure, on the rights and obligations in mangroves and pond management, benefit sharing, perceptions and livelihood strategies. Before focusing on the household level through structured interviews, we held about 12 in-depth interviews with stakeholders at the provincial and district level with local authorities and key informants at government agencies such as Department of Agriculture and Rural Development (DARD) and both Forest Companies 184 and TG3. Secondary data on forest and aquaculture management and production was retrieved from provincial reports. Eight focus group discussions with village leaders and elders were conducted to gain understanding of livelihood changes, decision-making, and perceptions on forest management policies. A total of 901 households in four villages were classified in three levels of well-being (well-off, middle and poor) constructed with the help of the focus group discussions. From this list, we selected 86 households in a stratified sample considering wealth status and diversity in livelihood.

In the survey held in 2008-2009 we collected data on the year of settlement, household composition, present farming areas, shrimp farming practices, and by recall shrimp yield, total income, production costs, and household expenditures. Among the surveyed HHs we selected five HHs in the shrimp-mangrove system for bi-monthly recording of stocking, harvest and yields from aquaculture per harvest during one year (October 2008-September 2009).

Primary data and secondary data were used to analyse how forest tenure changed and how these changes affected livelihood decision making of the household. To find out the relation of years of settlement and farm size, we clustered the HHs by periods of five years and calculated averages for farm size. We used Crosstab and ANOVA analysis in SPSS-15® to identify the livelihood capabilities across farming systems and wealth status as well as Spearman's rank bivariate-correlation tests to identify the correlation of variables between groups.

4.3 Results

4.3.1 Land settlement, allocation and rights

Only 14% of the surveyed households settled in Ca Mau before the war. These HHs had small plots (3.2 ha) because the land appropriated by their parents was split into smaller plots to be passed on to their children, or to transfer or lease to newcomers (Tab. 4.5). The high peek of

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the COOP supermarket chain in Switzerland. Farms have met the standards on organic farming as the mangrove covers at least 50 % of total area, no use of antibiotics is allowed, shrimp farming is in protected mangrove and in a socially and environmentally sustainable manner, etc.

immigration occurred in 1985, simultaneously with the establishment of the first Forest Fisheries Enterprises (FFE) in 1978 and Committees for Forest Management, Protection and Development (CFMPD) in 1985. Consequently, there had been sharp competition over forest owner rights and boundaries among actors, and the conflicts lessened only after forest allocation policies of 1985 were enforced. The unequal distribution of land resulted from the appropriation of land by farmers before the allocation policy was legalized and the FFE contracts were implemented. This also resulted in unequal distribution between first inhabitants and immigrants, as well as among privileged government officers and farmers. This may have increased inequity between rich and poor and enhanced the difficulty to achieve cooperation. Under such conditions, together with reduced authority on land-use or low social relationship, people are more likely to sell land and migrate when hit by shocks.

Table 4.5: Households total land area in relation to the period of settlement (Total samples = 86).

	Period of settlement							
	Before 1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	After 2001	Average[22]
Number of HHs	12	6	4	28	21	12	3	
Total area (ha)	3.2±4.0	4.7 ±4.5	8.3±4.2	5.5±3.8	6.0±2.8	4.1±3.3	4.1±3.1	5.1±3.6

Source: Survey data in 2009

Households in Thanh Hai, the control site without forests, received red certificate. They were allowed to excavate ponds, which finally occupied 86% of the land. However, in the system with forest, like in Kinh 17 and Cha La, people had to keep at least 50% mangroves depending on the farm size; this resulted in smaller pond areas (Tab. 4.6). The regulation worked in the resettlement zone where people received red certificates and where they were obliged to maintain a minimum area of forest.

Table 4.6: Year of settlement and farm/pond size of four sites (sample size). Kinh 17 (in) or (out) means inside or outside resettlement zone

	Thanh Hai (27)	Kinh17 (in) (15)	Kinh17 (out) (15)	Cha La (29)	Total	p-value
Year settlement*	1978	1986	1988	1990	1985	0.027
Land tenure	Red	Red	Green	Green		
Total area (ha)	4.3^{b} ± 4.5	3.2^{b} ± 2.1	7.8^{a} ± 3.5	5.6^{ab} ± 2.5	5.1±3.6	0.002
Pond area (ha)	3.7^{a} ± 3.9	1.1^{b} ± 0.8	2.1^{ab} ± 1.1	1.9^{ab} ± 0.8	2.4±2.5	0.003
% of pond to area	86	34	27	34	47	

Different superscripts (a, b) denote significant differences between means within rows ($p<0.05$).
* Year of settlement in Ca Mau, when separate from parents having an individual HH.

Officially, according to the land tenure regimes there are two types of certification (red and green) which are spatially and socially distinct. However, in practice, the tenure rights are more fuzzy due to spontaneous immigration and transfer of rights without registration. In many cases, the owner of a green certificate was not himself working on the farm, but someone else who either paid,

[22] Average farm size and standard deviation

hired, or bought the land from relatives and neglected to change the title deeds. Some used the farm on a tenancy arrangement. Others borrowed the land without paying, cultured shrimps for themselves and conserved the forest for the owners, or worked as temporary labourer. In these cases, their land tenure rights were more insecure because they were based on informal contracts and on trust rather than on official certificates.

Besides the 573 ha of forestland contracted with 129 households TG3 leased 1,267 ha remaining forestland to FC' staff members, state authorities, or privileged people within communities (Tab. 4.7). These leasers had better access to social networks and re-leased forestland rather than farming themselves. The tenants paid VND 3- 5 million ha^{-1} $year^{-1}$ without any certainty of the leasing period or forest use-rights. This caused livelihood insecurity, destroyed farmers' motivation for forest management and blocked incentives to invest in both aquaculture and forestry.

Table 4.7: Summary of land ownership and contracts of two Forest Companies

	FC 184 (Cha La village)		FC TG3 (Kinh 17 village)	
Classification	Total	Forest cover	Total	Forest cover
Land contracted to households (ha)	6,142	2,986	1,109	573
Land under FC management (ha)	199	143	1,679	1,267
Land under CWDDP and People Committee management (ha)			419	92
Total areas (ha)	6,341	3,129	3,206	1,931
Number of households having contracts	1,200		129	

Source: Report from DARD (2006) and WWF (2006)

Green certificates were given to HHs under contract of a FC or FMB. Farmers with green certificates believe that the contracts will be renewed in their names after 20 years and therefore they trust the green certificates in terms of the legal registration of a long-term security of their ownership rights. Having the titles; however, does not entail rights of ownership decision-making about farm design and infrastructure, on mangrove-pond ratio and forest density, on harvesting cycles, nor on the sharing of benefits with FC and FMB. Farmers also have to request permission from State authorities and FC to dredge or excavate ponds, cut mangrove stems to repair the houses (Tran et al., forthcoming-a), or even to collect crabs or use other non-timber forest products. They also have problems to access credits from banks or to bargain fair prices when they want to sell products or lease the land. Moreover, the linkages between FCs and the Commune People's Committees are weak and several conflicts have arisen over financial contributions for social welfare or infrastructure development.

> Assigning full management of forestry land to the FC makes the People's Committee powerless in implementing their political tasks on welfare, poverty reduction and ethnic minorities according to the government' guidelines. The People's Committee is responsible for social welfare but is revoked power on forest management in the commune. Land tenure in terms of having a green certificate or leasehold is not enough for HH to secure a livelihood. *(Ho Quoc Tri, Vice Head of People's Committee of Tam Giang Commune, 2008).*

The present decrees and decisions advocate the allocation of land to farmers for long-term production. In the Kinh 17 resettlement zone, people received red certificates monitored by the District People's Committee. They have to strictly follow the regulations on land use and structure of the plots, but have more authority over their forest compared to the ones having contracts with FCs. They may sell at auctions and get 95% of the product value. Their perception about mangrove forest seems to be more positive because they are involved in replanting and managing the forest, and this form of social forestry management is well appreciated in the village (see 4.3.2).

However, implementation of the Decisions 24/QD.UB has been delayed. As of 2010, only 7,298 ha were planned to be allocated to farmers for long-term use in Ca Mau (Hai, 2005). Today, almost all people working in the mangrove-shrimp farming system still have green contracts with FCs. This delay is due to several factors: (1) Reluctance from the FC who want to keep control over decision making on land use, management and benefits; (2) Green certificates issued in 1993-1995 run for 20 years and the contracts with FC are still valid; (3) Some plots of mangroves are too young to be harvested; (4) The government hesitates to allocate long-term land-use rights massively at once and aims for a gradual transfer after experimenting with land-use rights in some pilot sites, because they fear that farmers will overexploit the forestland once they own it; (5) Decisions are not fully communicated, so farmers are unaware of the benefits they can get from the forest products or believe that forestland is not their own. The practices of low and unequal benefit sharing, and the lack of use-rights and authority obstruct their interest in active involvement in forest production. We assumed that, when famers are better informed and conscious of the benefits of mangroves for aquaculture, and when they get a fair share from timber that is in balance with their income from shrimp farming, on the condition that their ownership is legally secured, they would feel more responsible for forest management and, consequently, there should be no reason for FC or government to refuse empowering them by giving red certificates for long-term use.

4.3.2 Access to mangrove forest and benefits

The dominant species of coastal mangrove forest are the planted *Rizhophora apiculata* or red mangrove and the naturally growing *Avicennia* and *Excoecaria*. *Nipa* is planted in the waterways to protect the banks from erosion and to use the leaves for roofing or selling for cash. However, people believe that the roots of most Nipa are rotting and *Avicennia* leaves cause water pollution. In ChaLa, on the other hand, people use decomposed leaves of Avicennia to feed micro-organisms as nutrient enrichment to shrimp ponds.

Rizhophora is the first choice for replanting in this area due to the high commercial value of its timber for firewood and charcoal. People on the eastern coast where these mangroves were planted experience less poverty than people on the western coast where *Melaleuca* is dominant (DARD, 2009). Due to its high caloric output and the little smoke produced, mangrove wood is much used to produce charcoal for export to Japan and Korea. Mangrove wood is rarely used for furniture due to the small diameter and abundant knots. Mangrove wood can be used for construction,

turned into pit props and walls as well as making chop sticks for tourism trade. Mangrove bark is also rich in tannins used in dying. Despite these uses, people having contracts with Forest Companies (FC) receive little benefit from mangroves while their products bring huge benefits to the FCs.

> Since FC establishment, farmers have no rights and interest regarding forest land. The landless need to rent pieces of land on the bare dikes to build small houses while the FCs hold all privileges to contract forest to themselves. Farmers who have green book contracts, protecting forest for 15-20 years get nearly nothing after subtracting costs for replanting mangroves and dredging ponds. However, the companies cannot protect forest without farmers' commitments, but the last are poorly paid. *(Ho Quoc Tri, Vice Head of People Committee of Tam Giang Commune, 2008)*

The differences in forestry benefits among households are remarkable. Income depended on when or to whom people sell products, on the quality (*Rizhophora* or mixed forest), density and age of the forest, and on the negotiation of benefit-sharing with FC. It was complicated to get information about mangrove's profit at household level. In case mangroves had been harvested a long time ago, either benefit was so low that people had forgotten how much they earned and only wanted mangroves to be cut to promote shrimp farming, or, if they could remember the final earnings, this did not include information about production, percentage of sharing, and prices. Therefore, we triangulated three sources of data collected from 2008 to 2010 to show that the benefit sharing has changed and steadily increased the benefits for farmers: The calculation of FCs, our own interview data and two cases studies from farms.

- ***Calculation of a FC***

The share in benefits for farmers before 2008 was extremely low because the FC had a monopoly to buy and market the products. The FC gave a share of 66% of gross income, after deduction of harvest costs to the famer.

Table 4.8: Farmers' incomes from mangrove wood harvested in 2008 of 7 HHs after deduction all costs ('000 VND)

	Area (ha)			Production (m^3)	Gross income	Costs for harvest	Farmers' share (66%)	Replanting costs	Farmers' net income
	Total	Mangrove	Harvesting mangrove						
1	10.0	8.5	1.0	64	26,425	8,010	12,154	800	11,354
2	2.8	1.9	0.5	20	8,750	2,706	3,989	400	3,589
3	6.7	5.5	1.3	40	19,750	5,742	9,245	1,040	8,205
4	5.7	4.2	1.8	77	32,600	10,286	14,727	1,440	13,287
5	8.3	6.7	2.5	92	38,200	12,480	16,975	2,000	14,975
6	6.0	4.7	0.6	46	17,800	5,630	8,032	480	7,552
7	8.4	7.1	3.2	260	109,475	32,104	51,065	2,560	48,505
∑	47.9	38.6	10.9	599	253,000	76,958	116,187	8,720	107,468

Source: Summary of a calculation spreadsheet of FC1 in 2008

Calculations from FC1 in Tam Giang Dong Commune shows that after a cycle 15-20 years, farmers got on average 10 million VND ha^{-1} or around VND 0.5 million (USD 30)[23] ha^{-1} yr^{-1} (Tab. 4.8). Total costs for harvest (planning, labour, transportation, cleaning, storage shed, tax etc.) counted for as much as 30% of wood gross value; then farmers had to pay for replanting. Finally they received only 42.5% on average of the market value of the wood.

Before 2008, the benefit sharing calculated by FC exposed farmers to several disadvantages and the system obviously failed to stimulate effective forest management. It provided FC special privileges and control on all forestry management and benefits. Calculation from FC, in combination with our interviews with farmers, results in the following observations:

- The mangrove area harvested was small (28% of mangrove area); however, the mangroves in a farm which were at the same age they should be harvested simultaneously to save harvesting costs;
- Production was calculated as very low ($60m^3.ha^{-1}$);
- The price was low (VND 0.42 million per m^3 on average);
- Harvest costs were very high, accounting for 72% of the farmers' final income after deductions;

The market for wood was not open and dominated by a social network of retailers and FCs, so that farmers could not negotiate higher prices, sell in auction or escape FC's interference. Wood is a very sensitive product that requires confirmation of the legitimacy for exploitation and transport. Therefore, procedures for exploitation were not accessible without the permission from FC;

Inequity was promoted because the rich or the well-connected had easier access to the market and obtained higher prices.

Although the farmers considered benefit sharing unfair, they accept their inferior position because they: 1. Lack the ability to estimate and calculate total mangrove production and benefits; 2. Have difficulty to understand the calculation from the FC; 3. Lack the opportunity to bargain a higher price independently from FCs or to find honest merchants who do not cheat farmers because they already have a deal with the FC; 4. Are satisfied in comparison with neighbors who also received low share; 5. Do not perceive they have rights to their forest. As a result, they prefer the mangroves to be cut as soon as possible to increase shrimp farming benefits and neglect the income from mangroves, and are not interested in replantation.

[23] Exchange rate of 1 USD in 2008 was VND 16,600; in 2009 was VND 17,500 and in 2010 was VND 18,800

- ***Researcher's calculation from interviews with farmers and FC staff in 2008***

Data from the focus group discussions with farmers and interviews with FC staff show other results than FC calculations. In practice, mangroves were planted at a density of 10,000 trees ha^{-1} and thinned at the age of 6-7 year, while the density of mangroves at harvest was 4,000-7,000 trees ha^{-1}. The average diameter of harvested mangroves was 0.08-0.15m and the main trunk length was 5-10m. After harvesting, 30% of mangroves were cut at 5m length for timber and the other 70% at 1m pieces for charcoal production. After 15-20 years, there was around 140-160m^3 of mangrove per ha, while the FC estimated it at 63 m^3 only. If farmers could bargain with retailers and sell in auction at the farm gate then they would not need to pay the cost for harvest as calculated by the FC. In 2008, the price of mangrove timber at auctions was VND 0.7 million[24] per m^3 at the farm gate, while the FC calculated only VND 0.42 million. Therefore, the final income to farmers (66%) could have been around VND 70 million ha^{-1} (or USD 210 ha^{-1} $year^{-1}$) if mangroves were harvested after 20 years which is at least seven times higher than what FC calculated.

- ***Data from forest harvesting of two farms by 2009***

By 2009 the Decision 24/UD.UB (Tab. 4.1) started having implications for some households. When farmers received confirmation of the legitimacy of mangrove exploitation from FC, they contacted traders directly or sold products by auctions.

> *Case 1: From an interview with Mr. Hoang in Kinh 17, having his mangroves harvested in 2009.*
>
> I find that the shift of forest management from Forest Enterprise to Forest Company in 2005 brought no benefits to farmers, but only unfairness. The FCs were given the red books, they are Government's civil agents but they behave bossily and treat us as despotic landlords to tenants in feudalism. I can't explain why I had a fine when I cut some mangroves from my farm to support my house against the storm. And why they threaten me that I am living in the wrong place (and want me to move my house away) where I have been living here for 20 years just because they want to offer that part of my land to a Community officer. Even I am frustrated I still live here since I believe in the government; they will change their policy in the near future to give equity to me.
>
> In 2009, the FC designed my forest to be harvested. We had some meetings to make decisions on three things: who will calculate the harvest (FC or external private company), to whom we will sell the products (FC or private merchants) and who will replant forest (FC or farmers)?
> I agreed to have FC to calculate the forest area to be harvested; after subtracting all harvest costs and sharing 30% with FC I would get VND 540 million for 13 ha forest.
> Finding that the FC rated the benefits very low I decided to sell in auction. A private merchant paid me VND 1.3 billion for my forest; hence, I earned more than double. Many people here earn even three times more than what FC calculated.
> Many people replanted forest themselves to get as much as 95% of produce in the next rotation but I agreed to let FC replant the forest. I believe that there will not be any FC

[24] Price of mangrove wood was from VND 0.7 to 1.5 million per m^3 in 2010

in the future to share products with me. No one looks after forest better than farmers themselves; therefore, for what purpose would the government need FCs?

Case 2: This case represents the same interview with Mr Tung in Kinh 17, who harvested his mangroves in 2010.

I received a 10.6 ha plot of land from the government and have been living here from 1986. We planted mangroves in 1990 and I just harvested in 2010. I could sell in auction among retailers with the highest prices of VND 470 million for 4 hectare for 76% of value (24% to FC). The total production was around 1,000 m^3 of wood timber and charcoal and the prices are on average VND 0.7 million per m^3. I know that in the next rotation, 95% of mangrove value comes to us then we can get more than VND 7.8 million $ha^{-1}year^{-1}$ (USD 410) that is not much lower than the income from shrimp farming. Unlike income from shrimp aquaculture, I could earn a "fortune" in one single harvest from mangroves, which would enable me to carry out some bigger financial investments plan.

4.3.3 Access to mangrove-shrimp aquaculture and benefits

For a long time people in the Mekong Delta practiced extensive shrimp farming by recruiting wild seed from nature without providing supplementary feed. Around 1993, the sources of wild seed became insufficient. Farmers then started stocking shrimp seeds provided by hatcheries, so the system shifted from traditional extensive to improved-extensive farming.

In the mangrove-shrimp farming system, ponds are connected by waterways through a single sluice gate. The sluice gates, with appropriate length and width and made of cement, are more efficient but expensive to some poorer households. Every 15 days, at spring tide, the gates are opened to recruit fish, post-larvae and juvenile shrimps with the incoming sea water; during consecutive low tides for 4-5 nights of every spring tide, the ponds are drained, the sluice gate is opened, and shrimps and other species are collected through a bag net set at the gate. Before restocking, pond sediment is excavated and piled up on the dikes or pumped off to the homesteads. People were allowed to dredge the ponds either in August or September (Tab. 4.9). No lime or other chemicals were used, only *Derris* (pest control plant, *thuốc cá*) to kill predator organisms in the ponds. Besides recruiting wild shrimps, people stocked post-larvae of tiger shrimp 5-8 times a year, with high density after dredging at a rate of 15-20 fry $year^{-1}m^{-2}$. Mud crabs, fish, and blood cockles were also stocked but in low density e.g. about 3,000-10,000 crabs for one farm of about 4ha. Prices of fry seed[25] differed depending on the quality and size of the seed, while no disease infection testing was done.

Records of five farms show the production of stocked *Penaeus monodon*, crabs and other wild species (Tab. 4.9). These farms total 23.8 ha of which 13.7 ha (57.6%) was covered by ponds and

[25] In 2008, price of a post-larvae shrimp was VND 15-40 and of crab was VND 1,000-1,500

dikes and the remaining 42.4% covered by mangroves. The harvested volume was highest in the early months and lowest in September, the month of preparing the ponds.

Table 4.9: Stocking and harvesting calendar

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Dredging								←→					
Stocking shrimp	←→		←···→							←→			
Stocking crabs	←···→				←→					←···→			
Shrimp (x1000)	fry 395	344	185	175	125	36				900	350	500	3010
Harvest (kg)													
P.Monodon	93	163	204	211	211	150	133	91	41	143	81	77	1598
Wild shrimp	180	224	242	170	182	217	199	145	72	118	111	218	2078
Fish	101	138	125	117	130	117	125	115	65	102	70	120	1325
Crab	56	59	53	95	54	80	94	49	54	0	0	42	636

Source: Bi-monthly record in one year (2008-2009)

←→ Stocking a lot

←···→ Stocking a few

In the extensive mangrove-shrimp farming system, unlike in intensive farming, a diversity of species is farmed. Besides *P. monodon* farmers stock crabs, fish (sea-perch, Anabas), blood cockles or recruited wild shrimp like *Metapenaeus ensis* (đất), *Metapenaeus lysianassa* (bạc), *P. indicus* (thẻ) and other species including fish (Tab. 4.9). The income from pond farming is therefore never calculated as purely based on shrimp farming as this is an integrated, semi-cultivation system. Diversification of resources helps to increase income, provides daily food for consumption, and reduces the risks when the shrimp population is suddenly decreased. Shrimps harvested in the mangrove system were sold at higher prices[26] because it appeared that the shrimps are bigger in size than in the non-mangrove system. Moreover, much more wild shrimps and fishes were recruited and harvested in a system with mangroves than in ponds without mangroves.

People in the non-mangrove system (Thanh Hai) have the lowest annual net returns from aquaculture per hectare: VND 6 million (Tab. 4.10), which is about one third of the income in the mangrove system of Cha La. Operating costs included cost for maintaining the sluice gate, dredging sediment, and stocking the seed. People invested differently depending on water quality, pond characteristics, and other technical parameters, level of experiences and financial availability. The annual net returns per hectare from aquaculture significantly correlates with operational costs (rho=0.43; $p<0.01$); the more people invest the higher net returns they get and the higher the net returns/cost ratio (Tab. 4.10). In extensive shrimp farming, the production and income significantly correlate with the pond size (rho=0.59; $p<0.01$). Because of having large ponds, people in Thanh Hai, the site without forest, earn a higher net returns per HH (VND 31 million). However, Thanh Hai's production per hectare of *P. monodon* and other species was lower,

[26] In 2008, the price of 20 shrimps/kg was approximately VND 130,000 per kg; of 30 shrimps/kg was VND 90,000 per kg; wild shrimp was VND 30-40,000 per kg; fish was VND 10,000-20,000 per kg; crab was VND 120,000-150,000 per kg.

compared to the Kinh 17 resettlement zone where people always complain about pond pollution and high rates of failure (Tab. 4.10).

Table 4.10: HHs average annual net returns (million VND) from aquaculture for four sites (2008).

	Thanh Hai	Kinh 17 (in)	Kinh 17 (out)	Cha La	Average	p value
Annual net returns per HH	31.1 ± 64.5	6.7 ± 11.3	20.1 ± 31.9	35.7 ± 23.3	26.5 ± 41.8	
Annual net returns per ha	6.0^{b} ± 8.0	8.9^{b} ± 13.0	8.7^{b} 10.9	18.9^{a} ± 9.7	11.3 ± 11.4	0.00
Operational cost per ha	6.5^{c} ± 4.2	12.5^{ab} ± 6.7	7.4^{bc} ± 4.5	17.6^{a} ± 8.1	11.4 ± 7.4	0.00
Net returns/cost ratio	0.92	0.71	1.18	1.07	0.99	
% of harvests lost	14.8	26.7	13.3	0	11.6	

Different superscripts (a, b, c) denote significant differences between means within rows ($p<0.05$).

People in the non-mangrove system of Thanh Hai or in a system with young mangroves (Kinh 17 in resettlement) have lower net returns from aquaculture than those in the mangrove system (Kinh 17 out of resettlement zone and Cha La) (Tab. 4.10). The aquaculture in mangrove system is characterized by higher net returns/ cost ratio and potential success (Tab. 4.10) and low farmers' consumption (Tab. 4.11). In addition, farmers in this system earned benefits from mangroves because they represent long-term savings. Contrarily, in the non-mangrove system (Thanh Hai), the high standard deviation (SD) shows that some had negative incomes when the earnings could not cover the expenditures in case of losing shrimp due to diseases. Especially, in the resettlement zone where mangroves were still small, to mitigate difficulties, farmers spent their savings, chose diversified non-farm/off-farm activities or even sold their plots to look for better livelihoods elsewhere.

Table 4.11: Savings of HHs in four sites (million VND)

	Thanh Hai	Kinh 17 (in)	Kinh 17 (out)	Cha La	Average
Total net income per HH	39.9 ± 63.7	14.8 ± 11.0	32.9 ± 32.7	38.3 ± 25.3	33.8 ± 41.6
Expenditure	27.7 ± 24.2	24.4 ± 10.2	16.6 ± 9.1	26.2 ± 12.6	24.7 ± 16.7
Savings per HH	12.2 ± 44.7	-9.6 ± 13.4	16.3 ± 31.6	12.1 ± 23.9	9.1 ± 32.7
Savings per person	3.5 ± 11.6	-1.7 ± 2.3	3.9 ± 7.3	3.4 ± 6.5	2.6 ± 8.3

4.3.4 The balance of forestry and shrimp aquaculture incomes

The Decision 24/UD.UB was promulgated in 2002 but not implemented until 2008. The FCs delayed implementation to have more revenue. They applied a strategy of "fake" calculations, in combination with blocking access to the market. As we have seen, famers could have received at least seven times more than what FC shared them (see 3.2.1). The value of the mangroves significantly changed when the Decision 24 was correctly implemented to provide farmers rights to access to market. This is very important since they have rights to sell mangroves in auction without FC interference and earned as much as VND 5.9 million ha^{-1} $year^{-1}$ (USD 310) in 2010 if sharing 72% with FC (Tab. 4.12).

Besides the higher benefits farmers can get from mangroves, their capability to access the market brings them great intangible values. Interviews held in 2010 show that they perceived themselves as owners of their forestland, independent of the FC interference, having own authority over their

forest, being more responsible and confident to invest in and manage the forest. In addition, they consider that forest benefits aquaculture as well. Eighty percent of HHs believed that mangroves play important roles in protecting wild life, balancing the natural environment and, thus, helping to increase success in shrimp farming (Tran et al., forthcoming-a). They reported that the yields are higher in the ponds with mangrove covering 30%-50% and younger than 7 years. This is proven by the fact that the non-mangrove system (Thanh Hai) has the lowest aquaculture income per ha per year (Tab. 4.12). However, the Kinh 17 resettlement zone with a young mangrove system has a low shrimp yield compared to the others. This resettlement site has other difficulties obstructing shrimp production as presented in section 4.2.1.

Table 4.12: Farmers' income per ha per year from mangrove forestry and shrimp aquaculture (mill. VND)

		Famer's share with FC			Income from aquaculture
		66%	72%	95%	
Income from forest	FC's calculation in 2008	0.5			
	Researcher's calculation in 2008	3.5			
	Farms harvested in 2010		5.9	7.8*	
Income from aquaculture	Non mangrove				6
	Young mangrove				8.9
	Rich (separated shrimp-mangrove)				8.7
	Rich (integrated shrimp-mangrove)				18.9

* The estimated income from forest in the next rotation when famers get a share of 95%

If a discount rate is not counted, the income from mangroves can be comparable with aquaculture (Tab. 4.12). However, according to Binh et al. (1997) the values of mangrove functions are difficult to quantify. Paw and Chua (1991) estimated that the economic values of the mangrove eco-system and it products are up to USD 11,819 ha^{-1} $year^{-1}$ (cited by Binh et al., 1997). This is proved by De Graaf (1998) who estimated that one ha mangrove supports approximately 0.449 t/year of marine fish catch.

Therefore, if farmers conserving mangroves are paid for these environmental services, the profits from shrimp aquaculture become small compared to the costs of losing mangrove and they might be more inclined to conserve the forest (Tran et al., forthcoming-a).

4.4 Discussion and conclusions

In this last section, we discuss the outcomes of this study in relation to changes in mangrove forest tenure regimes and the motivation of farmers to improve the balance of income between mangrove conservation and aquaculture.

Access is the ability of people to derive benefits from the forest. Access shows the webs of power made up of power relations between stakeholders taking part in forest management. Before 2009, farmers were legally entitled to use and gain benefits from forests but felt frustrated because of the lack of access to the free market and decision-making authority with respect to their own forest. Also, the People's Committee, an organization involved in socio-economic development and

worked to protect farmers' interests, shared their frustration. People's Committee is in place to firmly implement all policies and duties assigned by the Government on social welfare, poverty reduction, social laws and obligations. They are expected to meet all the diverse needs of the local people but are revoked power on forest management. Instead power on forest management is distributed among FCs who gain all the legal channels related to rules, regulations and political leverage. This increases the monopolization of FCs and inequality in access rights among these stakeholders.

Roughly in 2009, changes in national and provincial forest policies have played an important role in economic opportunities and the motivations of farmers in forest management and aquaculture development.

4.4.1 Mangrove forestry management

Forest management in Ca Mau has become more decentralized but over the last 15 years devolution of authority to farmers and non-government organizations has hardly occurred due to various institutional and political-economic obstacles. Consequently, greater access to benefits from mangroves for the farmers was hardly realized. In Vietnam, decentralization of management cannot only be executed through the vertical linkages between various hierarchical levels from central to local government but also through horizontal linkages between local government sectors, and FEs, FCs, state banks, organizations, and households who depend on FC through contracts for forest management.

Despite many efforts regarding improved forest management, up to now, the results have not met the requirements. For example: successful long-term forest management requires that linkages between stakeholders are trustful, equitable and fair. Instead, many FCs hold farmer forest management in low esteem and are reluctant to share responsibilities, interests and benefits from the marketing of mangroves with the farmers. Secondly, the property and ownership rights to forest remain in the hands of a small elite, which negatively impacts the will to invest in mangrove sustainability; some privileged people gain benefits while others loose.

We suggest that the problems can be overcome when the following measures are implemented: (1) Allocation of mangroves and forestland to households for long-term use with full responsibility and more rights to the households. This can be carried out after the green certificates expire in 2013. Once people perceive their ownership, rights and benefits from mangrove management they are better positioned than anyone to manage and conserve the forest. (2) The fuzziness of management rights between red and green certificate holders, tenants, workers etc. should be solved. Poor people or migrants who have tenancy arrangements face both tenure insecurity and problems to access social welfare and other livelihood opportunities. (3) The fact that farmers accepted inferior deals in benefit sharing might relate to that information about benefit sharing was not well communicated. Therefore, the tenure rights and obligations should be disseminated better to avoid cheating or transgression over farmers rights by FCs. (4) Social participation in mangrove management should be extended by allocating forests to different organizations e.g.

district or commune, People Committee, cooperatives etc. to lessen the monopolization of the FCs. (5) Monitoring and control mechanisms against lobbying or corruption should be enhanced to provide opportunities to the poor to increase profits from the forest.

We agree with Primavera (2000a) that overlapping bureaucracies and conflicting policies, weak law enforcement and lack of political will result in a decline of quality and quantity of mangroves. For the Philippines, she recommends conservation of remaining mangroves and rehabilitation of degraded sites using community-based mangrove-friendly aquaculture and integrated coastal zone management. Can this model work in Ca Mau?

In Ca Mau, a more realistic calculation of farmers' benefits by FCs and their recent right to access markets through independent retailers are a step toward a win-win situation where the ecological and socio-economic needs are balanced, with contributions from government, FC, and farmers to mangrove forestry and shrimp aquaculture development.

4.4.2 On mangrove forestry development

Financial improvement is a key factor determining the fates of the local people and forest. Our results confirm that when farmers' efforts and expectations on forest management and conservation are recognized, and are paying off, their perceptions change positively. Case 1 in 4.3.2 shows that they are more active in forest protection and replanting. Next to equalizing benefit-sharing arrangements with FCs, other options to maximize benefits from mangrove forestry could be considered: (1) Mangroves should be harvested when older than 10 years to meet the market demand for quality timber (or charcoal) and to ensure environmental protection. (2) Mangroves should be planted at different cycles to provide regular HH incomes. The forestland need to be reasonably designed so that the harvest of one parcel does not damage the trees of others and the cost of harvesting is minimized. (3) Prescriptions regarding where and how to plan mangroves, and the ratio and density of mangroves should be related to the structure of the aquaculture farms. (4) Even though *Rhizophora apiculata* was the first choice for replanting due to its high commercial values, various other species should be planted to match the ecological conditions, such as shallow water, un-inundated forest platforms, high accumulation of leaf litters, and low water exchange.

4.4.3 On shrimp-mangrove aquaculture development

Shrimp aquaculture is the primary and most regular livelihood source since it provides income every tidal shift; whereas mangroves can only be harvested after 15-20 years. Notwithstanding the relative uniformity regarding ratio, density and age of forest, quality of seed supply, water and soil parameters and level of investment the gap between the most and the least successful farms is wide. In this section, we discuss two short-term issues of mangrove-shrimp based livelihoods regarding pond management and market value.

Many scientists (AIoMS *et al.*, 1999; Hai, 2003) warned that in the long run, mangroves in integrated mangrove-shrimp systems will grow above the highest spring tides, if the leaf litter are not flushed by tidal water. This, together with increased sediment trapped in the ponds will reduce water refreshments, affecting the nutrition of both mangroves and shrimp ponds negatively and thus theirs yields. Therefore, a more appropriate farm layout should be designed regarding the problem of spatial management of where to plant mangroves and build sluice gates for better water exchange, flush the litter, but keep the nutrition provided by mangroves.

Regarding income from aquaculture, our results show that the annual income from aquaculture per hectare in the integrated mangrove-shrimp farming is higher than from both the separated mangrove-shrimp and the non-mangrove systems, namely VND 18.9; 8.7 and 6 million respectively (Tab. 4.12). Shrimp farming is more effective in a system with mangroves. In addition, if farmers have direct access to mangrove marketing, they can also generate income from forestry in this system and mangroves are a potential strategy for accumulation to offset negative income from aquaculture. Moreover, in order to increase the market value, government is now promoting the production of higher quality shrimp products to compete in the global market. Organic certification is introduced since 2002 in the integrated mangrove-shrimp farming system. When farmers adhere to 50:50 mangrove coverage of their farms and stop using chemicals but organic certified feed they will be eligible to obtain organic certification for their shrimps. However, up to now, farmers have produced the organic products traditionally, fulfilled the requirements of the organic rules but haven't gained benefits (Ha et al., forthcoming) because of the lack of bargaining power on the market that is decided by external partners.

In conclusion, farmers who have access to forest and aquaculture are able to maximize income. In the shrimp farming system with mangroves they have more ability to access both forestry and aquaculture. When the policy on forest management is effectively implemented and when farmers have rights to access private markets to gain higher benefits from both mangrove and shrimp markets, the incomes from forest conservation and shrimp aquaculture will be improved, which stimulates farmers to conserve the forest then the win-win situation proposed by Sunderlin (2005) will be achieved.

5

Fishing fleet in research site. Source: Han van Dijk, 2008

Fishery livelihoods and (non-)compliance with fishery regulations

Abstract

Fishery in Ca Mau, Vietnam's most southern province in the Mekong Delta, plays locally an important role for human nutrition and has great potentials for export earnings. The overexploitation of inshore fishing resources is a major problem in Vietnam's coastal areas along the Mekong Delta. As a result, the Catch per Unit of Effort of small-scale fishing enterprises has decreased, undermining the sustainability of livelihoods of fishing families. The paper focuses on livelihoods' strategies and diversification in the context of overexploitation and exhaustion of near-shore resources in relation to fishery policies. The results show that overexploitation is unavoidable in near-shore waters because of the lack of enforcement of fishery regulations for offshore vessels and the limitation of alternative sources of income and opportunities for livelihood diversification for small-scale fishers. The present policies to prevent overexploitation need to be reconciled with livelihood sustainability and fishery management, resource conservation and socio-economic goals.

Key words: *livelihood, small-scale fishery, natural resource management, Mekong Delta, Vietnam, compliance*

5 Fishery livelihoods and (non-)compliance with fishery regulations

5.1 Introduction

Vietnam has a great potential for fishing development. An estimated 90,000 motorized vessels are engaged in fishing, and 3 million people derive their livelihoods directly and indirectly from fishing (Raakjær et al., 2007). As in most tropical countries, fisheries in Vietnam are characterized by the use of different gears and an orientation to multiple species and are dominated by small-scale or artisanal fishermen (Son and Thuoc, 2003; Macfadyen et al., 2005; Raakjær et al., 2007). Small-scale fishers are defined as those operating near shore using small fishing vessels with low motor capacity. Nearly 82% of Vietnam's total catch is caught at a depth of less than 50 m (Pomeroy et al., 2009). Approximately 80% of the mechanized vessels are powered with engines of less than 45 hp (horse power) (van Zwieten *et al.*, 2002; Han, 2007) and operated in the inshore and near-shore waters, which make up only 11% of the Exclusive Economic Zone (EEZ)[27]. The number of fishing vessels and the total fleet engine power have increased steadily (12% per annum); however, the CPUE has decreased sharply, from 1.11 ton/hp in 1985 to 0.34 ton/hp in 2005 (FAO and FishCode, 2005; Boonstra and Dang, 2010).

Ca Mau, the southernmost province of Vietnam, has favorable natural conditions that hold great potential for a fishing economy. Ca Mau has a shoreline about 254 km in length, 240-km^2 tidal mud flat, 32 river mouths along the coast, and many islands where vessels can anchor (Department of Fishery, 2004). In 2009, the total number of registered vessels in Ca Mau was 5,641, among which were 1,232 vessels for offshore fishing (GSO, 2011). The CPUE has increased slightly and reached a peak of 0.5 ton/hp in 2003 and declined again to 0.38 ton/hp. In 2009, Ca Mau provided close to 146,000 tons of fish from capture fisheries, which made up 44% of the total fish production of the province (GSO, 2011).

In Ca Mau, organizations such as the Coastal Wetlands Protection and Development Project (CWPDP) and the Swiss Red Cross carry out projects to stabilize fishers' livelihoods and to conserve the mangrove ecosystem (Binh, 2009) by moving fishing families to inland resettlement schemes outside of the FPZ. The poor and near-shore fishers, living with or without projects, face several constraints due to social and ecological vulnerabilities (Adger, 1999). Over the years, the Vietnamese government has introduced several policies to make the fisheries more sustainable. However, these policies have not been successful in stabilizing the CPUE and promoting

[27] *The exclusive economic zone (EEZ)* of Vietnam extends to 200 nm (nautical mile) from the coastline, and the area of the EEZ amounts to about one million km^2, including the Hoang Sa (Parcel) and Truong Sa (Spratly) Islands.

livelihood sustainability of small-scale fishers. Compliance with these fishery regulations is a major problem.

Oostenbrugge et al. (2004) argue that the sustainable management of tropical fisheries often fails because of a narrow sector approach that disregards the livelihoods of small-scale fishermen. According to Allison and Ellis (2001), most studies on small-scale fisheries emphasize that both resource dependence and the open-access nature of small-scale fisheries lead to overexploitation, resource degradation, marginalization and poverty. The poor and small-scale fisheries are often accused of violating regulations and overexploiting near-shore resources. However, whether the poor violate the rules and why they do so is unknown. Therefore, this paper focuses on the livelihood strategies of fishers in the Ca Mau province in the Mekong Delta of Vietnam and how these relate to policies and programs of the Vietnamese government and whether these programs are able to address the challenges these fishers have to face in securing the sustainability of their livelihoods. In the rest of this paper we will firstly develop a framework for the analysis of fishery livelihoods (section 5.2), subsequently discuss the research sites and methods (section 5.3). Next, we will present an analysis of fishers' livelihood dynamics in relation to fishery policies (section 5.4) and analyze the reasons for non-compliance with fishery regulation (section 5.5)

5.2 Fishery livelihoods and compliance with fishery regulations

- *Sustainability of fishery livelihoods*

Livelihood analysis seeks to examine factors that affect individuals or households income and survival. In the livelihood framework adapted from Carney (1998a), Ellis (2000b) and Scoones (1998), the livelihoods comprise the links between three dimensions: the individual or household assets, the activities in which households can engage with a given asset profile, and the mediating processes (institutions, regulations etc.) that govern access to assets and to alternative activities (Ellis, 2000a). Assets of fishers can be categorized as physical (boats, gears, and houses), natural (fish stock, fishing ground), human (labor, education, experiences), social (kinship, network, association) and financial (savings, credits). Differences in asset holding can determine the capability of families to cope with risk factors in the vulnerability context. Vulnerability has a dual aspect: external threats to livelihood security due to external risk factors such a climate, markets or sudden disaster, and internal coping capability determined by assets, food stores, support from kin or community, or government safety net policies (Allison and Ellis, 2001). Factors determining vulnerability comprise not only climate stress but also other forms of environmental and social pressure, such as social vulnerability which is the exposure of groups or individuals to stress as a result of social change (Adger, 1999; Kelly and Adger, 2000).

A livelihood is sustainable "when it can cope with and recover from stress and shocks and maintain or enhance its capacities and assets both now and in the future, while not undermining the natural resource base" (Carney, 1998a; DFID, 1999). The concept of sustainability includes

ecological, social, economic and institutional components (Charles, 1994; Charles, 2001) which are all important to fishery (Allison and Horemans, 2006), and thus looks broadly at ecological sustainability, while the livelihoods approach addresses socioeconomic and community sustainability (Charles, 2005).

According to many authors, small-scale fishers are "the poorest of the poor," and near-shore fishing is their "occupation of the last resort" (Panayotou, 1982; McGoodwin, 1990; Pauly, 1997; cited in Allison and Ellis, 2001; and Pollnac *et al.*, 2001); and the poor are often accused for overexploitation natural resources, because they have no other options. However, it has been argued that it is not so much the fishers' level of poverty that is a problem (Pollnac et al., 2001), but the fact that they are vulnerable. Their income is highly variable, and they are often dependent on a single source of income (fishing) and on market access to trade the fish they catch (Béné, 2009). Small-scale fisheries in general are characterized by an extreme variability in CPUE (Oostenbrugge et al., 2001). This issue makes fishing an uncertain livelihood. It has been argued that fishers have developed a risk-averse attitude. Others have argued that risk is part and parcel of fishing and that fishers rather try to avoid losses such by limiting the time they spend at sea, and fishing near shore in order to reduces operational costs (Nguyen & Leung 2009)

Similar to on-farm, non-farm, and off-farm diversification, in marine fishing, a distinction must be made between "within-fishing" (fishing with different gears, adapted to target species) and "outside-fishing" diversification, such as agriculture or the provision of specialized services and labor (Brugere, 2006). Diversification is a household strategy to cope with risks. Diversification, defined as the process in which people construct a diverse portfolio of activities and social support capacities in their struggle to survive and to improve their standard of living (Ellis, 1998), is often fundamental to achieving sustainability in fisheries (Charles, 2005), and is potentially an important strategy for dampening the effects of catch variability.

Catch variability can be reduced by focusing on multiple species and by fishing with multiple gears (Oostenbrugge et al., 2002). Yet, the resulting catch variability remains high. Béné (2009) showed that families specializing in fishing were more vulnerable and poorer compared to families that combined fishing and farming. Those fishers who specialized in one species, in turn, were more vulnerable than those fishers who targeted multiple species. However, the latter were the poorest (Béné, 2009). Several sources present evidence of successful diversification in tropical countries (Oostenbrugge et al., 2004; Brugère et al., 2008). Though diversification is a potential pathway out of poverty and vulnerability, it carries no guarantee of success (Brugère et al., 2008). The poor involve themselves more actively in diversification; however, the revenues from their alternative income sources usually remain low, unstable, and dispersed (idem).

- *Fishery policies and (non-) compliance*

Many studies show that multiple factors push people to overfish, such as ineffective fishery management, a rapid change in fishing technologies, a high demand for fish in domestic and international markets, and an increasing population of poor people in coastal areas (Long, 2003;

FAO and FishCode, 2005; Pomeroy et al., 2009). These findings tend to emphasize the technical aspects of fishing/fishery and planning strategies (e.g., changing technologies, the conservation of ecosystems, marine resources and species, decreasing CPUE, and fishery regulations and management) rather than the characteristics of fishers' livelihoods (e.g., assets, investments, risks, variability in income and savings, conflicts, and diversification). Fishery policies in general aim to regulate fishing to ensure the sustainable management of fishing resources, to limit over-fishing and ensure the sustainability of the livelihoods of fishers.

To protect near-shore fisheries and restore coastal marine resources the Vietnamese government encouraged offshore fishing in the mid-1990s, by supporting the construction of large vessels at subsidized interest rates (Decision 393/TTg of July 1997). However, this program was not very effective due to many reasons and a large number of offshore vessels has performed poorly and repayment rates on loans have been very low (see FAO and FishCode, 2005).

In order to protect inshore and near shore small-scale fisheries Decree N123/2006/ND-CP assigned fishing grounds according to boat capacity and distance from the coastline as follows: boats with engines below 20 hp must operate 1-6 nm from the coast (coastal route); boats with capacity from 20 hp to 89 hp must operate inshore at 6-24 nm (inshore route); and boats with a capacity of more than 90 hp must operate more than 24 nm off shore (offshore route) (Decree N123/2006/ND-CP, Article 4).

Following, the ordinance on the Conservation and Management of Living Aquatic Resources promulgated in 1989 (FIC, 2009), the Fishery Law was approved in 2003 comprising 10 chapters and 62 articles of which many are relevant to small-scale fishery[28] (Parliament, 2003; Pomeroy et al., 2009). The Fishery Law details the species forbidden, allowed mesh-sizes, and the fishing seasons for different species. However the fishery agencies have limited staff and budgets for effective enforcement while enforcement remains the main tool in conventional top down fisheries management (Pomeroy et al., 2009). Thus, enforcement is infeasible and non-compliance to regulations is common practice.

Besides the lack of enforcement, non-compliance is the result of the fact that the economic needs of fishery communities, where poverty is often widespread are not taken into account (Béné, 2009; Hauck, 2009). Fishers' compliance or non-compliance with fishery regulations may also be linked to these communities' livelihood characteristics and strategies to deal with risk and avoid losses (idem). Other authors have argued that policies must be perceived as legitimate by fishers and should also reflect the norms and values of the fishers to ensure compliance (Dietz et al., 2003; Jentoft, 2004). Recently, Hauck (2009) has drawn attention to the fact that the law itself needs to

[28] For example: Article 6 bans specific fishing activities such as using destructive fishing gear. Under article 8, the Ministry periodically issues lists of prohibited species for capture; closed seasons and areas, banned fishing gear, and measures or information on the rehabilitation and conservation of aquatic resources and their habitat.

be questioned because, as she argues, the law is ultimately the reflection of relations of power. Small-scale fishers have in general very little political representation. Lastly, the nature of the fishery resources should be taken into account because the seasonality and the availability of fish are often difficult to predict, and fishers have to respond to these dynamics to maintain the viability of their enterprise (Oostenbrugge et al., 2001). These dynamics cannot be easily captured by straightforward policies.

5.3 Research sites and methods

Approximately 30,000 people in Ca Mau derive their livelihoods directly from fisheries; they are captains, steersmen and crewmembers. Since 1975, after the war, Ca Mau received immigrants from many provinces; they came mainly for three reasons: to access the mangrove forest for shrimp aquaculture, to collect aquatic products on estuaries or to fish in the Full Protection Zone (FPZ)[29]. They arrived usually in large families, used low-cost fishing gear and did not have access to alternative livelihood options. The majority of the fishers are poor and have a low level of education: 3-4% are illiterate, and only 10% finished secondary school (Department of Fishery, 2004). The communities in which the research was performed were selected for their diversity of fishing techniques, gears and vessels, as well as their history of settlement and type of livelihood strategy. The first site is Ho Gui, a resettled fishing community in the resettlement zone in Nam Can district. It is located 50 km southeast from Ca Mau city along the Dam Doi River. The second site is Rach Goc, located in Ngoc Hien district, 80 km south of Ca Mau city along the Bay Hap River (Fig. 5.1).

The resettlement of Ho Gui was sponsored by the Swiss Red Cross. The project supported the building of 205 houses in 2005 (and another 150 houses in 2009) in combination with essential infrastructure (e.g., roads, schools, water, electricity) (Binh, 2009). Among the 205 households that were resettled first, only 65 had vessels. Hence, 68% of the households needed to earn a living by other activities and became collectors of mangrove-marine products, crewmembers with or without fishing gears, small traders or service providers. Respondents for the study were selected among the fishers and the crewmembers who owned gears.

Rach Goc is a small town located at a river mouth comprising a fishing community, school, market, and trade center, a famous fishing port, providing the best shrimp brood stock and having a large number of vessels. There are 294 vessels in Rach Goc, and many households own 2-3 vessels and several gear types. In this study, we only selected fishing HHs for interviews. The

[29] *Full protection zone (FPZ):* Area of protected mangrove forest ranging from 100 m to 1000 m inland from the seashore. No settlement is allowed; collection of dead trees and small marine animals is permitted, but shrimp collection or fishing is not allowed.

average wealth is higher than Ho Gui and many households can afford a vessel with which to fish offshore. The general information on the two communities is summarized in Tab. 5.1.

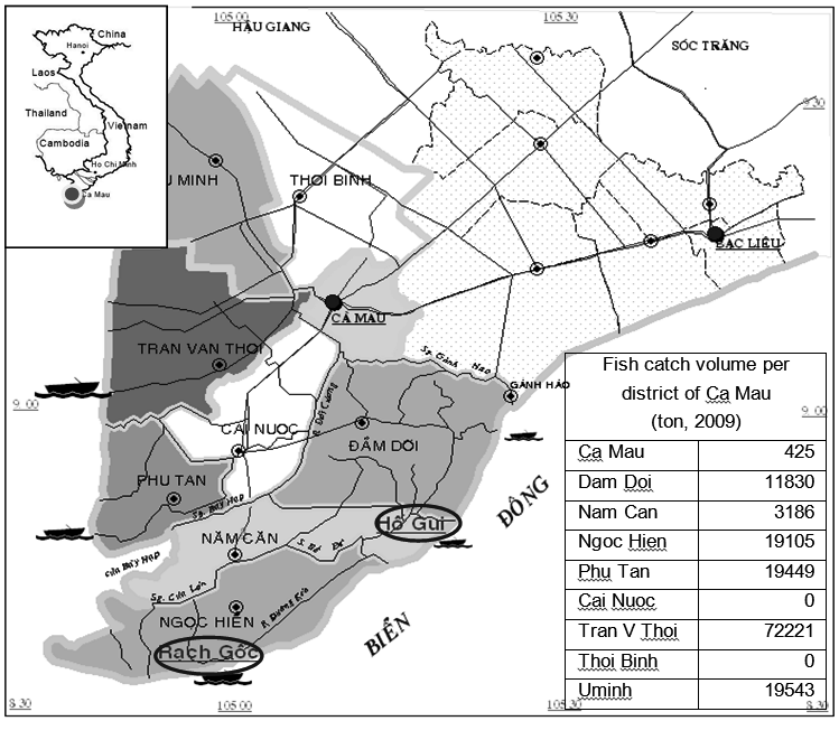


Figure 5.1: Map of Ca Mau showing the research sites and the fish catch volume of districts in the province (Ca Mau Province statistics, 2009)

Table 5.1: General information on the study sites

Sites	Ho Gui	Rach Goc
District, commune	Nam Can, Tam Giang Dong	Ngoc Hien, Tan An
Villages (units)	1	8
Type of settlement	Clustered in resettlement	Scattered
Vessels (number)	65	294
Level of fishing, engine	Traditional, small engine	More modern, powerful engine
Sample size (N)	20	21

Source: Group discussion, 2008

This research was conducted between September 2008 and June 2009 sing quantitative and qualitative methods. Quantitative information was gathered on household composition, vessels and gears, financial capital, land property, and income. Net income was calculated as total gross revenue minus variable costs, wages of crewmembers, and fixed costs (tax, repair equipment, interest on loan etc.). The secondary incomes from non-fishing activities (e.g., salary, labor payment, earnings from trade or service) were collected to determine the fishers' capabilities of engaging in outside-fishing diversification and to determine correlations between this and households' social and financial situation. The qualitative data were used to analyze the relations

between livelihood adaptation, diversification and noncompliance with fishery regulations in the two fishery communities inside and outside the resettlement zone. These qualitative data were collected to gain a better understanding of fishing practices, conflicts over fishing and compliance regulations, threats and opportunities, and livelihood changes and adaptations. For this purpose, different PRA[30] tools, such as the time line, seasonal calendar, and SWOT[31] matrix, were used (Chambers, 1994; Czech, 2002; Conroy, 2002 ; de Zeeuw and Wilbers, 2004).

Key informants interviews were conducted with officers of the Division of Protection of Fishery Resources (DPFR) and the Swiss Red Cross. The interviews provided data from the perspective of government officers on the fishery management and resettlement project. Group discussions were conducted with the village leaders and with union-group members who had in-depth knowledge about the villages. Sampling was based on type of livelihood and diversification, differences in wealth status and income, fishing technologies, vessel types and gear types. The 204 HHs in Ho Gui and 65 HHs in Rach Goc having boats were classified in terms of three levels of wealth (well-off, middle income and poor) and four occupational groups (labor, non-fishing jobs, fishing only, and fishing combined with non-fishing occupations). Households from different wealth categories were sampled proportional to their distribution over the wealth categories in the research sites.

For the statistical analysis, crosstab analysis and analysis of variance (ANOVA) in SPSS-15® were used to identify differences in livelihood capabilities across fishing systems (and wealth status). Spearman's rank bivariate correlation tests were used to determine the correlations of variables between groups.

5.4 Results

5.4.1 Livelihood opportunities

Fishing in Ho Gui is artisanal and performed on a small scale; nearly 90% of the vessels were powered by engines of 20-40 hp, and no boat had an engine of more than 90 hp. In Rach Goc, offshore vessels with engines above 90 hp accounted for 23% of all vessels (see Tab. 5.2).

The boats are made of wood and are equipped with inboard secondhand diesel engines, ice tanks, and life-saving and communication tools ranging from very basic (e.g., a radio or mobile phone) to more sophisticated (e.g., walkie-talkies, GPS, navigation and telecommunication equipment); their length varies from 10 to 20 m and width between 3 and 8 m.

[30] PRA: Participatory Rural Appraisal

[31] SWOT: Strength Weak Opportunity Threat

People used different gears in accordance with the boats' capacity, availability of capital, preferred fishing grounds and seasons, and targeted fish species. From the coastline to the outer sea, the main gears used were scoop and dredge net (*te cào*), gillnet (*lưới rê*), portable trap net (*lợp*), barrier trap net (inshore/offshore) (*đáy*), long-line (*câu*), brood-stocks fishing and transporting (*mua tôm mẹ*).

Table 5.2: Number of vessels at the two sites, classified by engine capacity

	Horsepower				Total
	< 20 hp	20-39 hp	40-90 hp	>90 hp	
Ho Gui					
Number of vessels (units)	6	57	2	0	65
Percentage (%)	9.2	87.7	3.1	0	100
Rach Goc					
Number of vessels (units)	55	134	37	68	294
Percentage (%)	18.7	45.6	12.6	23.1	100

Source: Interviews, 2009

- *Investment costs*

The investment cost for a fully equipped vessel (hull, engine, gears, and equipment) ranged from VND 80 to 500 million. The cost for the hull was the highest, and the cost of gear varied from VND 10 to 200 million[32] depending on the choice of near-shore or offshore fishing. The inshore scoop/dredge net was the cheapest kind of gear, whereas the long-line and barrier trap net with wooden pillars and watchtowers on the open sea were the most expensive[33] (Tab. 5.3). The investment cost for boats and gears is much higher than the maintenance costs. The rich inherit boats or secure loans from relatives (with low interests) to invest in boats and gears, whereas, the poor spend their savings or take small loans for repairing equipment. Diversifying by varying gears is also more difficult for the poor.

Variable costs include costs for fuel, ice, bait, minor repairs and provisions and vary by the length of a fishing trip and the crew size.

The payment of crewmembers is a complex arrangement between the owner and crewmembers and depends on the type of gears, the fishes caught and the length of the trip. Voyage duration varied from half a day to 2 weeks. For a one-day voyage, the share for one person was 7% of the total revenue. This was the total gross income minus variable costs except for labor payment. For longer

[32] In 2008, VND 17.5 thousand equaled USD 1.0.

[33] The barrier trap can be operated in rivers and inshore and offshore grounds. Offshore barrages have watchtowers, and someone must stay there to protect the gears. The nets are fixed in the open sea, and the boats are used to transport products from the sea 15 days per month when the tide is rising.

offshore fishing voyages, the payment for a whole crew (4-5 members) was about 20-30% of the total revenue.

Table 5.3: Number of crew, length of a fishing trip, variable cost per trip and investment cost of gears according to fishing gears

Types of gears	Number of crew	Days for a trip	Variable cost (million VND/trip)	Cost of gears (in million VND)
Scoop/dredge net	3	1	0.3	5-7 per unit
Portable trap	4-5	3-5	1	25 per km
Barrier trap (inshore)	3-4	1	0.3	5 per section of 10 meters
Barrier trap (offshore)	6-10	1	1.5	20 per section of 10 meters
Gillnet (inshore)	4	3-5	3-5	9 per km
Gillnet (offshore)	6-8	5-15	7	30 per km
Long-line	6-8	7-10	7	6 per set of 1000 fish-hook
Buying brood stock	5-7	5-15	5-8	10 per unit

Source: Interviews, 2008-2009

Fixed costs included costs for depreciation, repair, interest on loans and taxes. Taxes were paid annually by the owners and amounted around VND 1 million depending on the engine capacity of a boat. The depreciation period of a boat varied from 15 to 22 years, that of an engine from 7 to 10 years, and that of a gear from 2 to 8 years according to whether the fishing method was active or passive. Brugère, Holvoet et al. (2008) classified "passive fishing" as set and wait gear and "active fishing" as chasing gear. Today, because the costs of fuel and labor continue to increase and near-shore fish stocks continue to decline, fishers tend to operate further from the coast and to fish passively to save fuel; hence, the portable trap net, gillnet and *Loligo* long-line are the most preferred gears in these sites.

- *Income and financial capital*

Nearly 90% of households had loans, in most cases from entrepreneurs to buy gears, equipment or boat maintenance. The maximum value of a loan in the surveyed villages was VND 95 million. Nobody could access sufficient credit for investing in an entire vessel without financial assistance from families or relatives; therefore, the distinction between small-scale and large-scale fishers is evident from their social and economic status, and handed down from generation to generation.

Wealth status (poor, middle income, wealthy) was correlated significantly with engine power (rho = 0.276, $p<0.05$, in Ho Gui and rho = 0.712, $p<0.01$, in Rach Goc). In general, net income from fishing was not high, and it has declined in recent years. Around 17% of the households considered themselves financially better off than 5 years before, whereas 29% said nothing had changed and 54% reported themselves to be worse off. Some secondary income was earned outside of fishing, but this was generally low (Tab. 5.4), especially in Rach Goc, where each sampled household had at least one boat and fishing was the main livelihood activity.

The poor and near-shore fishers face several constraints to survive, such as limited access to formal credit. Banks hesitate to take risks and refuse to accept boats as collateral for loans. The poor

borrowed from moneylenders for operational costs and accepted selling their catch at a lower price (about 10-20%). The decline in fish stocks has caused lower catches so that the revenues are sometimes not enough to cover operational costs for the fishing trip.

Table 5.4: Economic status of surveyed households: credit, incomes from fishing and secondary sources, and expenses. (Mean ± SD). Sample sizes for each location are given in parentheses

	Ho Gui (20)	Rach Goc (21)	Significance
Number of HHs having credit	18	19	
Value of credit (VND mil.)	16.3±15.6	22.9 ±22.5	
Net income from fishing (VND mil.)	32.6 ±17.2	43±37.5	
Non-fishing income (VND mil.)	5.1±6.2	0.4±1.0	0.002
Consumption expenses (VND mil.)	22.3±11.9	33.2 ±19.5	0.038

- *Human capital*

The educational level of household heads was low (grade 4). Household heads differed in the number of years they had been fishing. Fishers engaging in offshore fishing in Rach Goc should have more experience because of the high operating costs and danger of this work. However, in Rach Goc, the owners have fewer years of experience fishing individually than those in Ho Gui because fathers and sons fish together longer in Rach Goc (Tab. 5.5).

Table 5.5: Household size, education level, years of fishing of household heads.

Items	Ho Gui (20)	Rach Goc (21)	Significance
Household size (units)	4.8	6.4	0.031
Education of the head of household (grade)	4.2	4.3	
Years of individual fishing experience	22.2	13.3	0.001

Sixty-five percent of the parents did not want their children to become fishers because they believed that fish stocks were declining, costs were increasing and fishing was not a promising option for the future. However, due to the demand for labor on their father's boat and the difficulty of obtaining education, many young men dropped out of school to go fishing. Fishing expertise was transmitted from father to son. Traditionally, parents handed boats and gears over to their son when he created his own household. If the parents had nothing to hand over, their sons had to work as crew members or as laborers in the cities.

Women were forbidden to go fishing, enter the boats, stand on the landing site to say goodbye and welcome their relatives. Especially for fishing offshore, these taboos were strictly respected. Women were indirectly involved in fisheries by sorting, marketing, drying or fermenting fish, repairing nets, and preparing provisions for fishing trips.

5.4.2 Risks and risk management

All respondents were asked to list the risk factors that affected their production. They mentioned different external and internal sources of adversity in natural-environmental, socio-economic and institutional factors. All fishers reported that the fish stock declined very quickly, and the reasons

mentioned were environmental degradation, an increase in the number of fishing boats and overfishing by double trawler vessels from elsewhere. A fisher in Ho Gui stated that

> Before, we caught enough in one year to support us for three years; today, we spend in one year what we catch in three.

In Rach Goc, many offshore fishers were concerned about the harsh and irregular weather (95.3%), whereas only 75% of HHs in Ho Gui complained about the weather. Television weather broadcasts are the most popular means of getting information about irregular weather; on the sea, weather information is transmitted via walkie-talkie or mobile phone. Small-scale fishers decided when to fish mainly on the basis of previous experience; therefore, experienced captains played a very important role.

From the social perspectives, they reported that life in fishing villages is isolated because of poor road networks and health care services. It is difficult for the youth to attend school and for adults to find opportunities for alternative jobs besides fishing.

Table 5.6: Perception of risks in the two villages (% of HHs) and how people adapt to the risks

Risks	Ho Gui	Rach Goc	How to adapt
Natural and environmental			
Fish stock decline	100	100	Fish more intensively
Harsh weather	75	95	Stay ashore
Social			
Few chances for adults to upgrade skills and knowledge	100	100	Television is the only channel for information
Conflicts with external boats for resource exploitation	75	80	Report to state or negotiate with boat owners
Few educational opportunities for children	50	81	Send them to live away from home to attend school in town
Danger	50	81	Weather broadcast, walkie-talkie
Few job opportunities	60	80	Working as crew members
Shortage of available labor	45	71	Contract with the same hired laborers
Lack of health care services	65	43	Have to travel long distances
Lonely on the sea	25	38	Not stressful, fishing in groups
Political			
Rules and regulations from government are irrelevant	65	52	Have no voice to higher authority
Economical			
Lack of investment capital	100	100	Have to accept
Increased gasoline costs	95	100	//
Low price of fish	85	90	//

Although the fishers were satisfied with their jobs and social environment. they were worried the about fish stock decline. Mr. Sach in Rach Goc stated that

> I am not alone on the open sea, we have friendships, if something happens to me the others will rescue me. In the evening, there are as many fishing boat lights as stars in the sky. Fishing brings me strength and health; I can fish for many more decades, but I am afraid that there will be nothing to catch by then.

Most people reported that the rules and regulations imposed by the government are irrelevant (65% in Ho Gui and 52% in Rach Goc) because they are not intended to help the poor (Tab. 5.6).

Financial constraints were experienced as the most stressful by all respondents in the two villages. This problem was caused by the lack of capital for investments, debts, low prices of fish, and the high price of gasoline, among other concerns. Two fishermen in Ho Gui discussed the constraints regarding the operational costs and debts as follows.

- Mr. Cho: Last year (2007), the price of one kilogram of fish was enough to buy 1 liter of fuel; this year, it is just enough for ¾ liters.
- Mr. Tung: No money to upgrade my boat is my worst fear. I received a loan of 2 pieces *(cây)* of gold many years ago that I could not repay. I do not know how I can pay money back while the price of gold is rapidly increasing. After saving a little, I have to spend a lot of money on maintaining my boats, engine, and gears. The gear net is only "sharp" for 3-4 years; then it deteriorates, and the fish slip through the mesh rather than being caught. I do not have enough money to upgrade my gear completely, so I upgrade part of it yearly. I wish I could diversify by fishing with a portable trap net, as many people do, but I cannot. No one will give me another loan if I cannot repay the last one.

Because of all of these pressures, most fishers are trapped in a vicious circle of debt and poverty. The solution for small-scale fishers is the low-cost exploitation of near-shore resources, but this behavior is not in accordance with the law.

5.4.3 Outside-fishing diversification

Table 5.7: Net income from fishing and secondary sources by wealth status group (Mean ± SD).

Income (million VND)	Poor	Middle	Well-off	Significance
Ho Gui (20)				
Number of HHs	10	9	1	
Net income from fishing	21±21.6	33.7±13.2	50	
Non-fishing income	8.4±6.9	2±3.3	0	0.049
Rach Goc (21)				
Number of HHs	3	12	6	
Net income from fishing	20^{b}±10	30.2^{ab}±14.1	75^{a}±57.9	0.025
Non-fishing income	2^{a}±2	0^{b}±0	0.3^{b}±0.8	0.004

Different superscripts (a,b) denote significant differences between means within rows ($p<0.05$).

The secondary income in Ho Gui was higher than that in Rach Goc, with households in the former showing more "outside-fishing" diversification. After moving to the resettlement zone,

many people diversified their livelihoods to non-fishing sources: small trade, services, government employment or remittances from relatives. Having non-fishing income negatively correlated with wealth status (rho=-0.58, p<0.01). The well off and the middle-income groups were hesitant to engage in non-fishing activities because the income from these jobs was low (Tab. 5.7).

5.4.4 Within-fishing diversification

To deal with variations in catch, weather, fish species, tides and currents, and characteristics of fishing grounds, fishers invested in different sizes and types of gears and boats. Choosing the correct equipment required a high level of skills and financial capabilities. There were two diversification strategies: the first was to have one boat fit for various types of gears to suit different seasons, and the second was to have different boats with different gears to exploit different fishing grounds. Table 5.8 gives some examples of combinations for coastal, inshore and offshore fishing and their respective benefits.

Table 5.8: Within-fishing diversification and adaptation

Combination of gears		Fishing characteristics	Benefits of combination
Coastal fishing	Scoop and dredge combined	Low investment and low variable costs. Scoop (push gear): good from January to April (little wind and gentle current, high stock of small scratch fish), used very near shore, in shallow and clear water.	Affordable for poor households. Switch between species, tide, fishing ground and seasons.
Inshore fishing	Scoop/ dredge, in combination with portable trap and barrier trap (inshore)	Average investment and variable costs. Barrier (stationary trap on the sea), 1-day trip to transport catch from the sea. Portable trap: move to richer fishing grounds based on weather forecast.	To increase number of fishing days: Barrier trap catches fish in upcoming tide only, the others on the remaining days. More flexibility: change from moveable to stationary and from passive to active (scoop/dredge net) fishing.
Offshore fishing	Gillnet and long-line	High investment and variable costs. Long-line fishing requires bait. The season runs from January to September. More labor and crew members needed. Gillnets: two seasons per year, from January to April and from August to November.	Reduce variable costs: fish caught by gillnet are used as bait for long-line fishing. Switch among species, seasons and fishing grounds To adapt to availability of fish: if catch is good with gillnet, then continue fishing; if not, stop fishing and return home.

Fishers diversify to adapt to the weather; that is the most important external factor, and influences the decision to go fishing or stay ashore. In seasons with favorable weather, they try to fish offshore or more intensively to compensate for the smaller catch in the harsh seasons; therefore, they preferred powered vessels with several gears to exploit as many species and fishing zones as possible. They fish 10 to 25 days per month depending on weather condition and volume of fish. Fishers agreed that weather has become harsher in recent years and that this causes difficulties, especially for the poor who have to spend their savings when staying ashore. When poor fishermen take the risk of fishing in bad weather, they often have to return early and do not even recover the operational costs.

Because the fishers have to adapt to weather conditions they have to diversify; they cannot rely on a single season, gear or species to sustain their livelihoods. The following two cases in Rach Goc show how people move between fishing gears and fishing techniques and demonstrate their adaptive capacity to sustain their livelihoods.

Case 1 represents the successful case of gear diversification of Luu Minh Duong, 38 years old:

I inherited a boat, scoop and dredge net and started fishing independently in 1995. At that time, there was a boom of shrimp hatcheries supplying shrimp seeds for aquaculture, and Rach Goc was famous for providing the best brood stock. From 1998 on, there was a chain of buying brood stock caught by other boats, then transferring and selling them to hatcheries, and this type of business yielded huge profits. With the support of my parents, I bought a well-equipped vessel and was one of the first people here buying brood stock. I made one trip per week and bought about 20-200 mother shrimps depending on the season. However, by 2003, the net income per trip steadily declined from 10 to 5 million VND because of competition from many other vessels. Now this type of business is only profitable for people who have their own hatcheries or who sell brood stock directly to the hatcheries instead of through middlemen. Recognizing that this activity had no potential anymore, I decided to change to gillnet fishing in 2008. Some others changed to long-line offshore fishing because they had more crew members. I fish alone, and my son is still very young (and I do not want him to go fishing with me when he grows up). I invested 140 million VND to buy the gillnet and had high revenues; today, I have repaid all of the loans. In 2009, I started investing 40 million VND in a *Loligo* long-line. With both gear types, I can fish intensively and use more fishing grounds. Offshore fishing is profitable, but only for those who can afford to invest in it themselves; therefore, it is an opportunity only for the rich because the poor either cannot borrow money or do not have the capability to repay their loans.

Case 2 presents the unsuccessful case of Ly Thi Gang, 68 years old, in Rach Goc:

I spent my entire life here with my family. During the war, we hid in the forest to escape the bombings. We caught wild fish and crab and exchanged them for rice to pay other household expenses. Life was so hard that during some months in each year, we were hungry and ate whatever was edible. After the war (1975), we decided to settle near the river mouth to fish; therefore, we appropriated 4,000 m^2 for the homestead only. Our assets included a small boat, an old net, a modest house, a small piece of land and 9

> children. We tried to do everything besides net fishing, such as raising pigs and livestock, drying and reselling fish, and exploiting the mangroves for charcoal and timber. None of the children finished school. Today, some have their own families but are even poorer than I was. Some do seasonal wage labor, rearing egg crabs, recuperating brood stock, etc., but irregularly. In some months, they catch goby fingerlings and crab eggs at the estuaries using a very small mesh-size net. This practice is being criticized, but we need to survive. With our boat and fishing net, we catch very little because there is nothing to catch near shore. The net is very old, but we have no money to repair it. We borrowed 30 million VND with interest many years ago but are having trouble repaying it. We are waiting for a chance to sell a piece of land behind the house to repay the debt next year. It would be good if the government gave a group of poor families a loan to invest in offshore fishing or to start a service that would give my children stable jobs as crew members or workers, regardless of the level of pay.

These two cases show clearly how fishers, even those who are relatively well off, have to adapt continuously to changing conditions and make use of different opportunities and niches over time to sustain their livelihoods. Even when a fisher is able to invest a lot of resources, he needs to employ a variety of fishing techniques to earn a good return on his investments. Case two also shows that, in order to survive, the poor have to resort to livelihood activities, which are commonly regarded as unsustainable and damaging for the marine and mangrove ecosystems.

- *Fishery policies and (non)compliance behavior*

A major problem for small-scale near-shore fishers in Ca Mau is competition with commercial fisheries. They should be protected by Decree N123/2006/ND-CP assigning fishing grounds, However, instead of maintaining distance from near-shore fishing grounds, offshore fishermen intentionally fish near shore to limit operational costs. The trawlers, mainly from Central (Binh Thuan province) and Southwest (Kien Giang province) Vietnam, with engines up to 350hp, use pair bottom trawl nets inshore to catch both pelagic and demersal fish species included trash fish. This method of fishing not only damages the seabed, causing exhaustion of marine resources, but also destroys the fishing gears of the local fishers. Fishing gears are lost every day, which is a major concern for most small-scale fishers. It is especially threatening to the poor because the gears are their only means of earning a living. Small-scale fishers cannot do anything except request compensation or file a claim with the state. In both instances, the poor are at a disadvantage because they lack the capacity to negotiate with the rich "invaders" or to be heard by the state.

Local offshore vessel owners, when chasing fish shoals, also ignore the zonation of fishing grounds, but this caused little conflict within the communities. In addition, for many reasons, these fishers prefer fishing offshore to competing with local small-scale fishermen for near-shore resources, as reported in the following case.

> Case 3: Bui Van Sach, 41 years old, in Rach Goc
>
> I have two boats: one of 35 hp for catching inshore by long-line and another of 175 hp using gillnets to fish offshore. Instead of catching offshore, sometimes I follow the fish shoals rather than pay attention to the limitation on inshore fishing. However, I prefer

> having a gillnet and fishing offshore to fishing inshore because: (1) the offshore species (e.g., mackerel, pomfret, threadfin) usually fetch higher prices; (2) the inshore fish stock soon becomes exhausted, leaving nothing to catch; and (3) the offshore gillnets with bigger mesh size are made of stronger materials, so they last longer and cost less to maintain. Moreover, there are still plenty of fish offshore, and they have a higher value; thus, I get higher revenues. All people want to invest in fishing offshore, but only the well-off can afford to do so (about VND 300-400 million). In my case, even though I am not poor, I had to take out a loan to buy a secondhand vessel in 2005 and am still in debt; however, I was luckier than others because someone agreed to lend to me.

In 2003, the Fishery Law was approved, comprising 10 chapters and 62 articles that detail the species that may not be fished, allowed mesh sizes, and the fishing seasons for different species, many of which are relevant to small-scale fisheries[34] (Parliament, 2003; Pomeroy et al., 2009). The fishery regulations for the minimum mesh size are set according to both fishing gear and fish species. For example, the standard mesh size of the scoop and dredge net should be larger than 18 mm, the trap net (barrier) more than 20 mm and the gillnet over 28 mm. The mesh size for fishing anchovy should be larger than 10 mm; the sardine drag net more than 60 mm; the prawn drag net more than 44 mm, and so on.

However, in practice, one type of gear is used for catching multiple species, and specific species can be caught with different gears. This makes it impossible for fishers to comply with these detailed fishery regulations. They bought a net with a specific mesh size according to the gear they used rather than the species they wanted to catch. From the market, they bought nets called "net 1", "net 3", and "net 5" according to how many fingers one can put in the mesh, e.g., net 3 has a diagonal mesh of around 5 cm. Mostly, the size of mesh used was smaller than was allowed by the regulations. In addition, some people used nets of very small mesh size (5-7 mm) to catch goby fingerlings and crab eggs in the estuaries. To preserve the marine biodiversity, catching seeds is illegal and forbidden by the state. These activities bring fishers temporary income for a few months each year. The authorities find it hard to stop this activity because it is the only source of earning for those who engage in it.

- *Minimum fish size*

The fishery regulations also define minimum sizes of various fish species. However, the interviews show that people pay more attention to the volume and value of the fish than to the minimum size permitted by the law. How can they categorize and exclude the small-size fish swimming into nets with small mesh size, which are freely sold in the market?

[34] For example: Article 6 bans specific fishing activities, such as using destructive fishing gear. Under article 8, the Ministry periodically issues lists of prohibited species for capture, closed seasons and areas, banned fishing gear, and measures or information on the rehabilitation and conservation of aquatic resources and habitats.

The regulation also defines protected fish species and the period during which they are protected. However, interviews show that these regulations are not respected. The fishers catch all fish species during the whole year except in May, not because fishing is forbidden in this month, but because of the bad weather.

5.5 Discussion

5.5.1 Fishery livelihood sustainability

Small-scale fishery livelihoods are economically hardly sustainable on the long run and have difficulties meeting the four key dimensions of sustainability (social, economic, environmental and institutional (cf. Charles 2001).

From the socio-economic point of view, fishers themselves regarded fishing as uncertain and unpromising. Sixty-five percent of the parents did not want their children to become fishers, and 54% of households considered their livelihood worse than it was ten years ago. Although the mean annual net income per household of approximately VND 40 million (USD 2,300) was not lower and even higher than that from aquaculture (VND 34 million) (Tran et al., forthcoming-a), fishers were not satisfied with their job because of the high risks and uncertainties. Fishing villages are usually located in distant areas with little access to education and alternative job opportunities. Fish stock sharply declined and 90% of households had outstanding loans, mostly from moneylenders charging high interest rates.

From the environmental point of view, fishers maintain (or improve) livelihoods and reduce the vulnerabilities from catch decline by overexploitation thus disturbing the marine resources and negatively affecting ecological resilience or environmental sustainability in long term. The data showed very few opportunities for outside-fishing diversification (Tab. 5.4 & 5.7) but enormous variety in the combinations of fishing technologies (Tab. 5.8). Fishers constantly adapt their fishing strategy and gear types to market demands (trash fish, brood stock), availability of species, seasons, and weather.

From an institutional point of view, it seems that dilemmas and contradictory policies affect the control of overexploitation of the near-shore resources in the research sites. Large-scale vessels come to near-shore to compete with near-shore fishing which lead to conflicts and exacerbate the overexploitation of the near-shore resources. On the one hand, the State regulates fishing ground, seasons and fish species, mesh size, and type and number of fishing gear. Because small-scale fishers need to secure livelihoods (by diversification), they have to exploit the near-shore resources and fish multiple species, and by consequence violate the Fishery Laws. On the other hand, its implementation practices are inadequate, because it does not enforce the regulations with respect to the ban on the exploitation of near-shore resources by large-scale vessels.

5.5.2 (Non) compliance with fishery regulations

The problem of compliance is mostly approached from a law-enforcement perspective, and non-compliance is defined as a crime. Compliance is seen as finding the right balance between deterrence and incentive.

Firstly, law enforcement neglects the economic needs of small-scale fishers. According to Dang (2008), the most important factors that motivate fishers' non-compliance behavior, besides the weak law enforcement, are the economic conditions. They violate the laws by catching intensively to compensate for catch variability, to fulfill family obligations and to repay their debts. We agree with Berkes et al. (1998) that middle-income households are often the ones that can "afford" conservation, whereas the poorest households cannot. Therefore, the adequate policymaking needs to reach an optimal balance between social-economic sustainability and ecological resilience. The institutional interventions, firstly, focus on balancing household economic improvement with marine resources conservation. Strategies to improve household economics are non-fishing diversification, aquaculture, improvement of infrastructure, market and post-harvest technologies, and development of offshore fishing (Tab. 5.9).

Table 5.9: Fishery management issues

Objectives	Risks	Interventions
Socio-economic improvement	Few chances for non-fishing diversification Lack of credit Input/output price fluctuation Small/large scale conflicts	- Enhance non-fishing diversification, e.g. aquaculture; - Improve marketing and post-harvest technologies; - Develop offshore fisheries; - Limit entry of large scale to near-shore; - Temporary gear/area restrictions; - Enhance stakeholder participation, strengthen community management; - Institutional improvement.
Environmental development	Fish stock decline Overexploitation Production inefficiency	
Institutional effectiveness	Non-compliance Law's weakness Institutional weakness/constraints	

Secondly, regulations are themselves unfeasible, too detailed and impractical for small-scale fishers to abide by. The ways in which people respond to fishery regulations reflect the fact that they are hard to implement. In addition, according to Pomeroy et al. (2009), fishers do not comply because fishery agencies have limited staff and budgets for effective enforcement. Reports on Vietnamese fisheries also emphasize that fishery management capacities and enforcement of existing legislation should be improved (FAO and FishCode, 2004). However, the capacity to enforce or control fishing activity is highly infeasible, extremely expensive, and inadequate. In other ways, more responsibility and rights for managing coastal and inshore fisheries should be given to local communities. The community-based management, enhancing participation in resource management, need to be a coordinated effort of both the state and the local people because either top-down management or enforcement by the local community alone does not work effectively. In

addition, laws should be oriented at protecting small scale fishers from competition with the large offshore vessels rather than focusing on preventing the poor from fishing inshore.

5.5.3 Diversification

To guarantee the long-term sustainability of small-scale fishery, policy should aim to provide non-fishing diversification opportunities especially for small-scale fishers who more strongly depend on near-shore resources. Table 5.10 lists a number of policy options in relation to type of fishery (from near-shore to off-shore) and diversification strategies.

Diversification outside of fishing should be promoted to prevent overexploitation because once people begin to engage in activities other than fishing, they may move away from dependency on marine resources. The diversification strategies are different for the various categories of fishers determined by wealth status and endowments. The poor lack financial capital to upgrade their fishing gears for within-fishing diversification and have to engage in non-fishing jobs earning low incomes and remain trapped in debts. "Safety nets" such as "food for work" or subsidies can support the poor on the short term. These programs protect the poor from exploitation by patrons because they no longer have to borrow money to finance short-term consumption needs, and reduce poverty and conserve resources (Smith et al., 2005). The long-term solution is the education of fishers' children so that the next generation can look for employment outside of fishing.

Table 5.10: Diversification in various fishing livelihoods

Livelihood strategies	Livelihood characteristics	Livelihood options and strategies
Coastal fishing (mainly by poor people for survival, subsistence)	- Small vessels - Little investment - Landless, poor, little capital	- Crew member labor, "safe nets" - More outside-fishing diversification: small trade, migration labor
Inshore fishing (semi-subsistence, coping with shocks) Offshore fishing (wealthy fishers aiming for accumulation)	- Owners of boats or gears - Middle income or wealthy - Medium or large-sized vessels - Offshore but self-regulated	- Within-fishing diversification: upgrading offshore fishing technologies (boats and gears, skilled skippers and crew, supplying information on offshore resources, post-harvest technologies) - Outside-fishing diversification: tourism, aquaculture, market trading, fishing processing, supplying input and onshore services.

Policy instruments to enhance fishery for middle-sized fishers should aim at providing credit and better marketing channels because most of them are in debt. To enhance off shore fisheries, the intervention should consider fleet modernization and techniques to increase post-harvest quality for added value in the market. Lastly, more emphasis on community management should be the first priority to reduce conflicts among fishers.

5.6 Conclusion

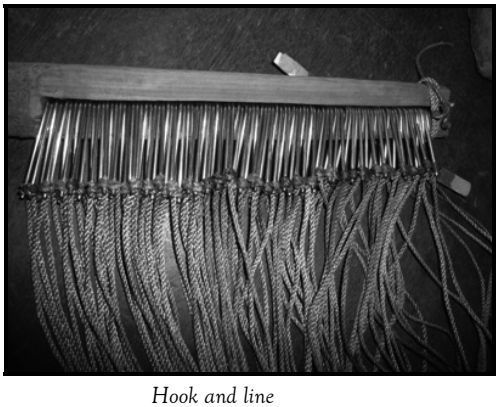
The livelihoods of many small-scale fishers are unsustainable. To secure livelihoods and reduce vulnerability, they fish more intensively causing resource decline and ecological disturbance, and violating the regulations. Opportunities other than fishing diversification and more effective fishery management are therefore urgently required to lessen the pressure on inshore fishing resources and to protect small-scale fishers.

Fishing boats and gears

Small and large fishing vessels

Inshore barrier trap net

Portable trap net



Hook and line

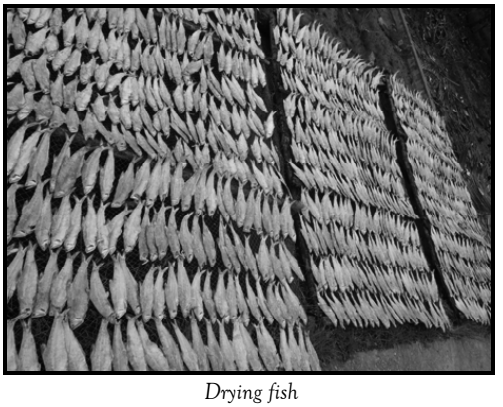
Gillnet

Fish-based livelihood activities

Making a new boat

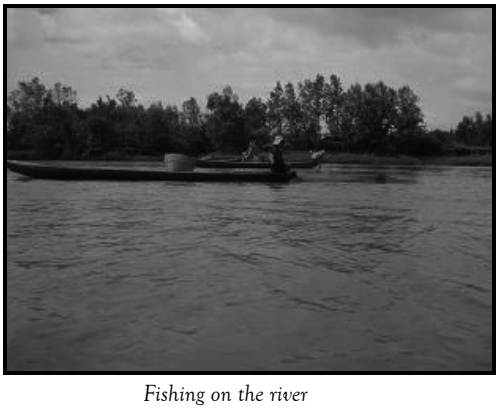
Making fishing gear (scope)

Sorting fish



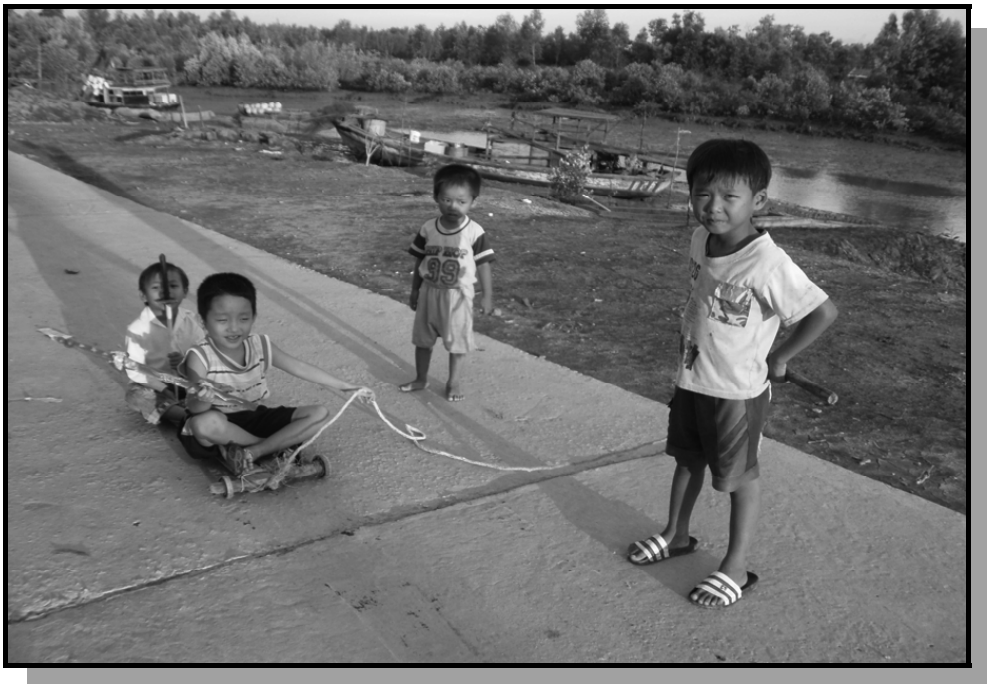
Drying fish

Mending net



Fishing on the river

6



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Networks and human capability for building resilience

This chapter will be submitted to *The Journal of Asian Studies* as:

Tran H. T. P., van Dijk H., and Visser L. Networks and human capability for building resilience in the Mekong Delta.

6 Networks and human capability for building resilience in the Mekong Delta

6.1 Introduction

Shrimp farming and fishery are the two main livelihood strategies in Ca Mau and Bac Lieu, the two southernmost provinces of the Mekong Delta, Vietnam. In 2009, besides 227,800 tons of caught fish, the two provinces produced 167,800 tons of shrimps equal to 52.7% of the Mekong Delta's and 40% of the national production (GSO, 2010). Shrimp aquaculture and fishing have been promoted by the government in order to increase export earnings for bolstering economic development and providing job opportunities for millions of people who derive their livelihoods from these sectors.

However, fish-based livelihoods are still coupled with poverty. The farmers and fishers producing shrimp and fish are greatly affected by the depletion of natural resources, degradation of the environment, socio-economic power imbalances and by limitations in access to resources. This situation is said to undermine the ecological and social resilience of the region. In order to promote economic development, the Vietnamese government has promulgated a number of policies and organized support services with the objective to develop more sustainable aquaculture and fishery. A series of policy reforms were implemented to open up and renew the economy in which organizations and services, such as mass associations, extension services and credit facilities, were established and transferred from central to local state agencies. These state-based organizations and services, which work under official control and management of government, aim to promote socio-economic development. In addition, with the opening up of the economy, the farmers and fishers have developed private (non-state) trading, credit and support networks themselves in which they voluntarily participate to get support for their livelihoods. These private-sector networks include relationships of famers with local moneylenders, patron-client relations, kinship relations, neighbours, and local elite.

In order for fish-based livelihoods in the Mekong Delta to be sustainable in the long run, natural resources need to be protected from destructive exploitation by people in order to preserve ecological resilience. The more intensive natural resources are exploited the more potential harm the living environment and ecosystem might incur (Pretty, 2003). Besides natural resources, non-material capital, such as human and social capital embedded in social and economic networks, are needed to help farmers and fishers sustain their livelihoods and to be able to withstand external ecological and economic shocks. In this paper, we want to investigate how social and economic networks (both state-based and

private sector) support and provide access to important sources of capital to sustain livelihoods and contribute to the resilience of the region.

The paper will focus on the question to what extent social and economic networks support fish-based livelihoods in acquiring credits, knowledge and education, and contribute to the sustainability and resilience of these livelihoods. In the next section, we will discuss the theoretical notions underpinning the contribution of social and economic networks to social and human capital needed to ensure livelihood sustainability, followed by a short overview of the research area and research methods used (section 6.3). Then we present the different characteristics and functions of two types of networks (state-based and private) in the coastal Mekong Delta. In the discussion (section 6.5) we will highlight how access to these networks differs in relation to networks' characteristics (ties, size, intensity etc.), culture (trust, homogeneity, reciprocity, negotiation etc.), and the socio-economic context of people in the villages. Lastly, we will show how networks yield short-term benefits to overcome current risks to livelihoods and more long-term investments in social and human capital, such as educational opportunities for children and how membership of a farming cluster underpin livelihood sustainability.

6.2 Conceptual framework

Sustainable and resilient livelihoods not only depend on access to natural resources and financial capital, but also on a range of other capitals which are social, cultural and political in nature, in order to ensure that people are able to secure resources such as financial capital and knowledge and to make productive use of them. Pretty (2003) suggested that households with greater connectedness tend to have higher income, better health, higher educational achievements, and more constructive links with government. Ensminger (1992) pointed out that social connections and social networking (in terms of including familiar actors) can contribute to economic benefits. Networks in terms of shared identities, institutions, and organizations can have a vital impact on the economic performance and profits. In this regard, Bebbington (1999) used the concepts of social capital and capabilities to analyse the ways in which people combine, transform, and expand their assets through engaging in relationships with other actors. He believes that social capital is an asset through which people are able to widen their access to resources and other actors, and to deploy and enhance their capabilities in order to make living more meaningful and their livelihoods more sustainable. These capabilities are not only located in networks and relations but also embodied by the personal capacity of individuals to engage in a meaningful way with the outside world. Education for example, not only enhances people's capacity to get better jobs and higher incomes, but also enables them to participate better in discussion, negotiation and public life and become 'agents of change' (Sen 1997) and increases their capacity to deal with adversity and shocks.

Social resilience is defined as the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change (Adger, 2000). According to Folke et al (2003) there are three clusters of strategies for promoting social resilience: learning to live with change and uncertainty, nurturing learning and adapting, and creating opportunities for self-organization (Folke et al., 2003; cited in Marschke and Berkes, 2006). Potentially, government policies and services, as well as private sector networks, help households to adapt to and manage (or learn to manage) change, because they may help people to acquire assets, knowledge and buffer capacity to deal with change and adversity.

Within livelihood studies social capital embedded in people's networks and relationships, has become a central concern over the past decade. In Bourdieu's (1985) view, social capital is about the revenues, actual or potential, that individual people can elicit from networks of which they are members. However, having relations is a necessary, but by no means a sufficient condition, for having access to resources (Finsveen and Oorschot, 2008). Putnam viewed social capital as a set of horizontal associations between people which fosters cooperation for the mutual benefit of the community (Putnam, 1995).
Networks have been defined in many ways. According to Weenig (2004), a network is an aggregation of individuals who are tied by patterned flows of information. However, relations within networks are neither homogenous nor reciprocal only and may have many different, characteristics (tie, size, intensity), features (trust, reciprocity, common rules, norms and values), connectedness (bounding, bridging, linking) and power differentials. Ties can vary in strength, depending on the frequency of use and on the degree to which the ties are used for multiple message contents. A strong tie is more likely in cases of homogeneity with respect to norms, values, important beliefs, socio-economic status, and demographic characteristics (Weenig, 2004). People's own perceptions on the strength of the ties and the importance of these networks form an indication of the importance of these networks for their livelihood activities. Similarly, Finsveen and Oorschot (2008) state that networks can be characterized by the size and intensity. Size refers to the number of relations and networks in which people participate, the number of friends, relatives with whom they maintain contact and the frequency of interaction and time devoted to participation.

Secondly, social capital embedded in networks and relations cannot be dissociated from power (DeFillipis 2001). Power is an intrinsic part of the social relations in which a firm and other economic institutions are embedded (Granovetter, 1985). Power is an important aspect of a patron-client relation defined as a vertical dyadic alliance between two people of unequal status. Although such a relationship is based on inequality, it also rests on reciprocity and face-to-face contact between the parties (Powell, 1970), and rights and obligations acquire a moral force of their own (Scott, 1972).

The power distribution in networks is very important. Power plays a role in relations between for example, rich-poor, landlord-tenants, boat owner-crew member, host-labourer, patron-client, and officer-citizen. The actors embedded in networks have unequal possibilities to influence others in decision-making processes and outcomes. However, power differentials and the delegation of power within networks need not be negative and can be considered as positive, when superior skills and knowledge, control of specific assets can be mobilized (Moulaert and Cabaret, 2006).

In addition, attention has to be given to a number of quality features of relations and networks like trust, reciprocity and exchange, common rules, norms and sanctions, and connectedness in networks and groups. The three aspects of connectedness (bonding, bridging, and linking) have been identified as important for the networks within, between and beyond communities (Pretty, 2003). Some authors identified *trust* as the central concept because under trust people evolve in neighbourhood interactions and contact with strangers (Macy and Skvoretz, 1998), or share sets of moral values to create expectations of honest behaviour (Fukuyama, 1995). Trust lubricates co-operation, it reduces transaction costs between people and the investment for monitoring processes that take money and time (Pretty and Ward, 2001). Rose (1995), argues that high trust and reciprocity is characteristic for immediate social networks while in contrast higher levels of distrust and disconnectedness are associated with higher-level institutions.

In the rest of this paper, we will focus on the role of institutions and services established by the Vietnamese government to support coastal people to promote livelihood sustainability such as credit providers, extension services, and mass associations. These state-based institutions have established a solid top-down organizational structure, connection and control over local actors, and have defined clear targets for political and socio-economic development. The membership in formal organizations is arranged and specified for the members involved.

However, after *Doi Moi*, an increasing role is played by private sector networks. There cam more maneuvering space for networks arising out of friendships, kinship, neighbourhoods, commercial relations or service provision and they may contribute significantly to the sustainability of livelihoods. People in these networks maintain different types of relations in order to share information and resources for a common goal. For example, fishermen and shrimp farmers can learn advanced technology through relationship with other economic actors, relatives and neighbours. In addition, they obtained credits and other financial services from different sources forms of formal institution (banks) or informal sector suppliers of family members and traders or moneylenders.

6.3 Research sites and methods

The research was conducted in four districts located in the two southern most provinces of Vietnam, namely Ca Mau and Bac Lieu provinces (Fig. 6.1). The socio-economic characteristics of the two provinces are shown in Tab. 2.4 in Ch. 2. In these districts eight villages were selected with different production models (fishery or shrimp aquaculture), intensity of shrimp farming (intensive or extensive), agro-ecological conditions (with or without mangroves and water exchange), and level of investment (low or high). These villages were clustered into four groups of shrimp aquaculture (improved extensive with or without forest and intensive farming system, cluster and non-cluster) and one of fishery. Sample size, names and a general description of the locations are given in Tab. 6.1.

Key informant interviews were carried out with representatives of government agencies (Department of Agricultural and Rural Development (DARD), the Department of Labour - Invalids and Social Affairs (DoLISA), the Provincial Extension centre, and the District and Commune People's Committee). Group discussions were carried out with elders, village leaders and association members in order to understand the general socio-economic conditions, social networks and aid initiatives, and the role of government institutions.

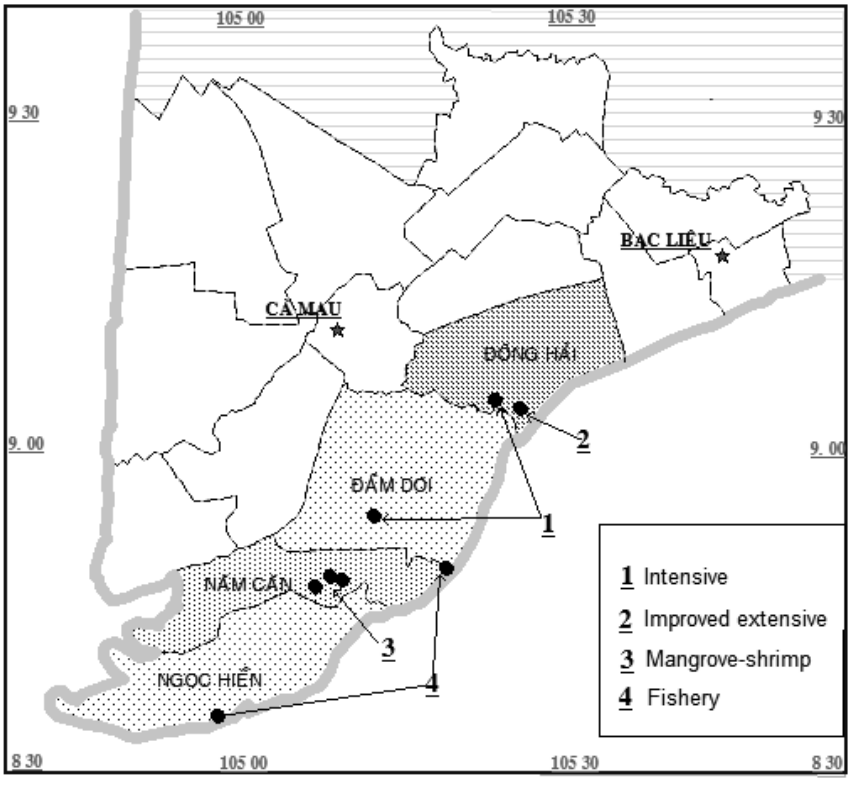


Figure 6.1: Map of Bac Lieu and Ca Mau showing the research sites

Table 6.1: Study sites and general description

Items	Improved extensive		Intensive		Fishery
	non-mangrove	mangrove	non-cluster	cluster	
HHs samples	27	59	29	23	41
Villages	Thanh Hai	Kinh 17, Cha La	Long Ha	Nhi Nguyet	Ho Gui, Nhi Nguyet
District	Dong Hai	Nam Can	Dong Hai	Dam Doi	Nam Can
Province	Bac Lieu	Ca Mau	Bac Lieu	Ca Mau	Ca Mau
Mangrove presence	Non	Rich	Non	Average	Non
Level of investment	Low	Low	High	High	Average, high

Both qualitative and quantitative data were collected between September 2008 and August 2010. Key informant interviews were done with representatives of government agencies. Group discussion, in-depth interviews and household survey interviews using questionnaires were held to investigate the relations with state-based organizations and private sector networks. Also the types of networks and associations in which people were involved and their perceptions about their connectedness, in terms of ties and power distribution, were investigated. The differences in access to resources; especially with respect to education, extension and credit of farmers in the aquaculture and fishery sectors were identified. The results are used to discuss the differences between two forms of networks, state-based and private, and to show their influence on farmers' access to resources. Methods used to collect and analysis data described in detail in Ch. 2.

6.4 Results

Figure 6.2 gives an overview of the complex networks in which fish-based livelihoods in the Mekong Delta in Vietnam are embedded. Shrimp farmers and fishermen have access to two forms of networks, formal institutional networks related to state agencies and social relations with private sector agencies, middlemen and networks with friends and kin (Fig. 6.2).

In the rest of the paper, we will label organizations and services related to the government as state-based organizations, which are set up with a specific goal, and are characterized by hierarchical relations and communication channels. The private sector networks consist of local actors and private sector agencies. The links within these networks vary with respect to, intensity, dynamics, and distribution of power/hierarchy.

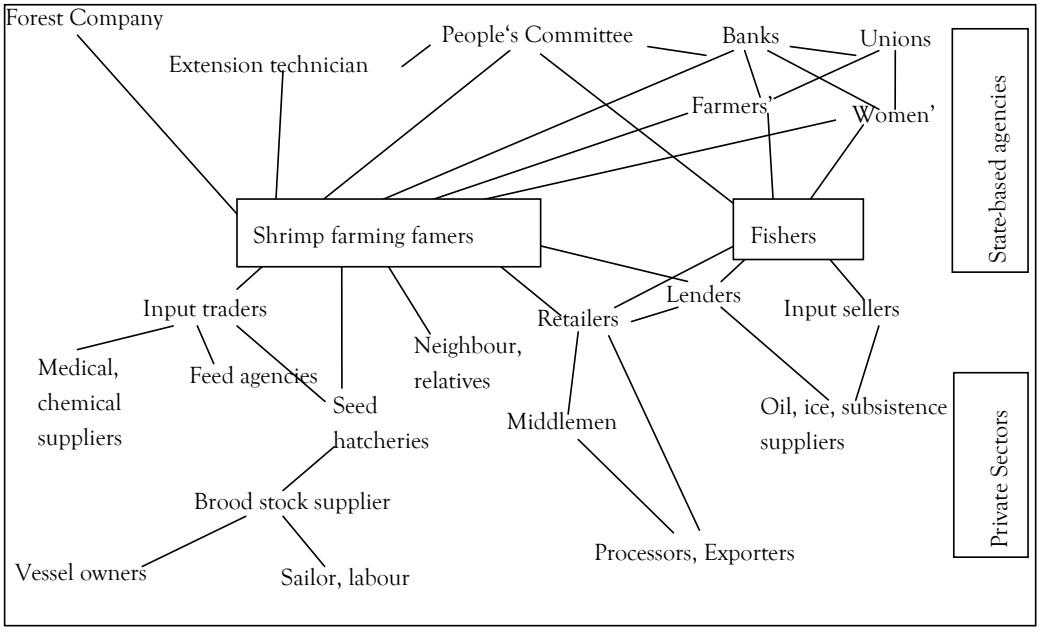


Figure 6.2: Formal networks established by institutional agencies and informal social networks from local actors in aquaculture and fishery production.

6.4.1 Credit

Almost all households were indebted. People had access to financial capital through both state agencies (banks and associations) and private sector networks (friends and relatives, input traders, shrimp collectors, fish buyers, and moneylenders) of financial credits. The interest rate of loans from banks was 1-1.5% monthly in 2008, and from moneylenders much higher (10-15% monthly). Therefore, loans from private agents were usually small and taken in time of emergency only. The more people take out in these private loans the more risks they face. Loans from relatives and friends were usually in gold and were with or without interest.

People in the cluster of intensive farming system had the highest average loan (VND 83 million). The variation in size was high because some of the respondents were immigrants who obtained loans to lease the ponds and to start business. The maximum loan was VND 1 billion (USD 57,000) borrowed from many sources including formal and informal credits. In the intensive farming system, the annual operational cost per HH was very high (Tab. 6.2) and this was partly lent from the banks but mostly from input traders. The amount of credit in table 6.2 is in general much less than the operational costs. This is due to the fact that credit for inputs was not counted by the shrimp farmers, since the input traders automatically supplied the inputs, and were paid back at harvest time.

Table 6.2: Loan situation and operational cost per HH per year in aquaculture and fishery system

Items	Improved extensive		Intensive		Fishery
	non-mangrove	mangrove	non-cluster	cluster	
Loans (mill.VND)	$15^{b} \pm 24$	$24^{b} \pm 24$	$23^{b} \pm 31$	$83^{a} \pm 204$	19.7 ± 19.5
HHs having credits (%)	63	85	66	78	75
Difficult to have loans (%)*	4	56	17	26	71
Operational cost (mil.VND)	$25^{bc} \pm 27$	$21^{c} \pm 13$	$118^{b} \pm 67$	$374^{a} \pm 339$	(na)

- Different superscripts (a,b) denote significant differences between means within rows ($p<0.05$). Short-term credits (for food or provision) and credits from input traders in intensive farming are not included
- (*) denotes significant difference of percentages within row ($p<0.05$)
- (na) Operational cost for fishing was different depending on which fishing gear people use (Tran and van Dijk, forthcoming).

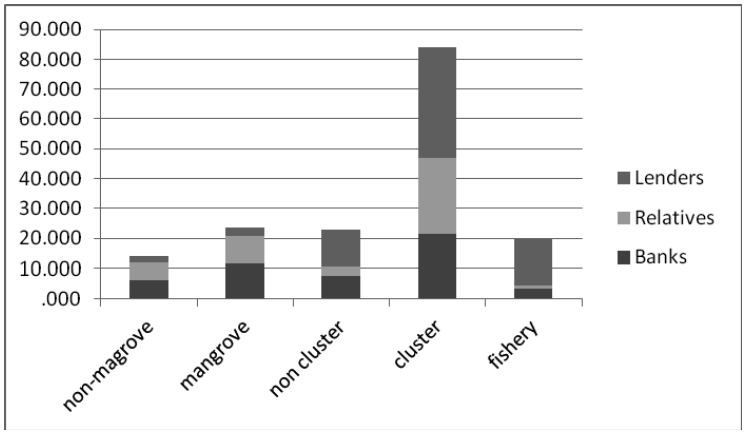


Figure 6.3: Loans of HHs in aquaculture and fishery divided over three sources of credits (mill. VND)

- *The formal credit system*

The formal credit system consists of government banks, the Bank for Agriculture and Rural Development (Agribank), and the Bank for the Poor. They provide loans with standard interest rates (11% in 2008, 16% in 2010). To obtain credit farmers have to meet five conditions: using loans effectively, having feasible production plans, having the financial potential to repay, being a trusted customer, and holding a guarantee by an organization. This policy made it difficult for farmers to access new loans because the conditions are rather vague and open to various interpretations and make the clients dependent on political connections. If someone already had loans, but lost a shrimp harvest and thus failed to repay the debts as scheduled, he cannot access a new loan, except when taking both the principal loan and the interests, leading to further indebtedness.

Access to formal credit also depended on the type of production system and land rights people had. In the non-mangrove system shrimp farming system, people use red book land titles as collateral for the loans. People in the improved extensive mangrove system having no red book but a green book contract with the Forest Companies (FCs), could borrow on average only VND 20 million per household from the banks through the FCs' guarantee (Fig. 6.3). Banks also provide small loans for emergency or short-term expenses, such as payments for shrimp seeds, dredging the ponds (VND 15-20 million per pond per ha per year).

Only few fishers had access to formal credits, because banks refused to accept boats as collateral, and provided only small loans (VND 5-10 million, maximum VND 20 million) to people with a guarantee of a mass association to repair nets, or start pig husbandry and petty trading in order to diversify activities and alleviate poverty. They can also get small loans from mass unions.

- *Patron-client relations*

In fishing villages, patrons were private lenders and traders (fish buyers) provided loans with high interest rates for daily needs or for fishing operational costs; in return for the right to buy the catch at lower prices (around 20%). On the one hand, fishermen accepted to sell their catch at lower prices to maintain the trust and relationship, and to fulfill obligations to cover the interests of the loans. On the other hand, the patron has to buy the catch at a reasonable price to avoid conflicts, and guarantee a secure input supply and maintain the relationship. The reciprocal and negotiated character of this relation helped to build long-term obligations and trust. For example, in Ho Gui village, the three fish-buyers adapted prices to avoid conflicts and competition amongst themselves and to avoid clients going from one patron to the other. The patron-client relationships therefore have both a horizontal and vertical component. The horizontal component plays a role between people of the same status (e.g. among patrons) and this benefited clients in cases when there was competition between patrons in the same business.

Many fishery households borrowed money from fish-traders (patrons) many years ago to repair boats, upgrade gear or maintain fishing nets but were having problems to repay. When they had to add loans to cover operational costs for fishing trips the poor fishermen particularly, were caught in a debt trap. The operational cost included costs for ice, fuel, bait, minor repairs and provisions. They varied from VND 0.3 to 20 million per trip according to the size of the boat, length of fishing trip and the number of crew. They had to sell caught fish at low prices (10%-15%) to their credit providers in order to get subsequent loans. Despite the high interest, three-quarter of them relied on this source of credit (Fig. 6.3). All respondents in the fishery group stated that lack of money for investment was the largest problem in building livelihoods.

Input traders play an important role in the intensive farming systems and acted as patrons for shrimp farmers, by giving credits without collateral. Due to high production costs, most intensive farmers needed credit through a patron (input supplier) who provided feed and bio-chemicals on credit when the shrimp were older than two months, charging a high interest rate, 4-5% per month (Tran et al., forthcoming-a), and farmers must be known by the lenders as having a satisfactory credit-worthiness (Clough et al., 2002a).

How much services, provision and money the patron provided depended on the mutual trust, relationships and loyalty of the client. The patrons withdrew their support when they felt the client was no longer creditworthy; in contrast, the client refused to be supported when they believed the patron exploited them. In both situations, the (poor) client was the most disadvantaged.

In the improved extensive system, patrons included traders from hatcheries selling the shrimp seeds on credit, shrimp collectors giving credits in return for secured supply of shrimp from farmers, pond owners, moneylenders, and wholesalers. In all patron-client relationships, the patron was more powerful and used his influence and property to provide protection to the client; therefore, the client was more dependent and needed the patron rather than the patron needed him.

Other sources of credit through private sector networks were tontine (*hui)*, group savings, relatives or friends, and vendors for household necessities. These sources of capital were rather flexible, and provided small loans in a simple and fast manner and were appropriate for common people. *Hui* is a form of mobilizing money with or without interest among, usually, a group of women, which is known in literature as a revolving fund (Lont and Hospes, 2004). At weekly or another regular time interval of the meetings, every member in their turn receives the money contributed by all group members. It is like a rotating fund from group savings without interest. In case of interest, the first receiver of *hui* would get less money than the last. Sometimes this form of credits does not meet the urgent needs of the poor due to the limited capacity to participate in these revolving fund groups; hence, many of them have to contact private lenders at high interest rate.

6.4.2 Knowledge

- *The networks*

Access to knowledge and technology was very important to sustain and enhance livelihoods. With the same agro-ecological and material resources, the ones who had good technology and experiences in farming practices had more success. Aside from formal extension services, shrimp farmers obtained knowledge and technology from patron-client relations, neighbours, friends and relatives.

Table 6.3 gives an overview of the importance attached to different (state-based as well as private sector) sources of knowledge and know-how by fishers and shrimp farmers. The nature and intensity of knowledge exchange within these networks differed considerably. For instance, farmers in intensive cluster highly appreciated the knowledge on farming techniques acquired from input trader technicians (78%); whereas famers in extensive non-forest cultured shrimp based their decision primarily on their own experiences or and that of their neighbours.

Table 6.3: Perception of households regarding the importance of formal and informal agencies for acquiring knowledge and technology for shrimp farming and fishery system (N=179).

Items	Improved extensive		Intensive		Fishery
	non-mangrove	mangrove	non-cluster	cluster	
From extension training*	4	5	14	48	0
From traders' services*	26	0	72	78	36
From neighbors, friends, relatives*	30	14	55	44	26

(*) denotes significant difference of percentages within row ($p<0.05$)

Figure 6.4 shows the perception of households in the four shrimp farming systems and fishers system regarding the importance and influence of different networks to acquire know-how and farming technology.

The formal networks were relationships of farmers with government agencies or organizations (extension service, media, mass associations, banks and NGO project) and informal networks with local actors (private lenders, traders, neighbours, friends, relatives and kin) (Fig. 6.2).

In general, contacts with private sector networks (input traders, patrons, cluster) was considered more important by both shrimp farmers and fishers, though it is difficult to assess the nature and the contents of the knowledge exchange and the advice with these different knowledge providers. Extension training provided advanced techniques during the workshops while technician from input traders provided frequent assistance, and support. A farmer in an intensive system compared the two:

> Extension workers rarely came to my pond but were "sitting" at the stations, while the "engineer" from the input supplier came to visit my ponds weekly. He was greatly concerned about my shrimp health because he was paid for that. He felt responsible so he knows every detail about my ponds and suggests to me the ways to manage the ponds correctly. When something happened to the shrimp, I just called and he came immediately. I learned the ways to manage my ponds mostly from him. *(Mr Chuc, Long Ha village, 2008)*

- *The government extension services*

The government extension service is responsible for support to farmers to enhance productivity and maximize the investments in the shrimp ponds, and should provide knowledge for farming techniques and create awareness of the need for environmental protection.[35] The service is responsible for the following tasks: (1) Organizing courses or programs to transfer technology, from central extension to work-station staff and down to farmer level; (2) Constructing and maintaining farm demonstrations; (3) Organizing seminars, fairs, exhibitions, forums and study tours to exchange experiences related to aquaculture; (4) Disseminating the publications, technological information, market information about advanced models and their application; (5) Collaborating with other organizations to organize training courses with respect to sustainable aquaculture and environmental protection.

However, the scope and efficiency of extension services supporting shrimp aquaculture is limited and therefore the shrimp farmers attached limited value to the services of the extension service. The main reasons mentioned were: (1) The small number of extension officers who are responsible for a large region and have at their disposal inadequate means of transportation; (2) The staff at the level of the local communes had limited skill and experience were not updated with new trends in aquaculture development; (3) The training is geared towards intensive and large-scale shrimp farming; (4) and therefore does not meet poor farmers' needs who lack capital and land for these investments; (5) The social, cultural and attitudinal distance between extension workers and the farmers was too big; and (6) The frequency of contacts was low.

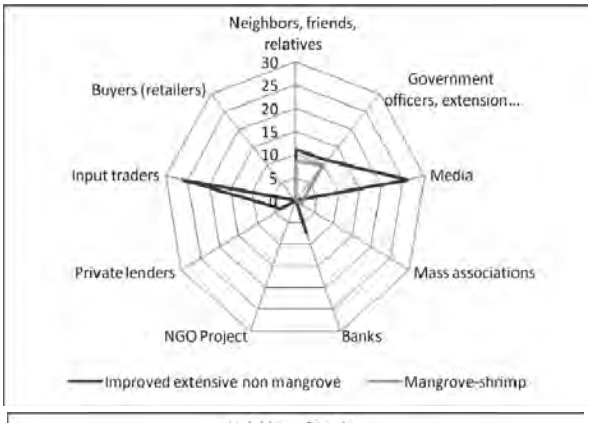
In contrast to shrimp farmers, fishermen did not receive any support from the formal extension system. Fishing technology and experience are transferred from generation to generation by family or neighbours. Formally, the Division of exploitation and protection marine resources is responsible for fisheries but has no responsibilities for transferring fishing technology only to control, manage and enforce fishery regulations (Tran and van Dijk, forthcoming).

- *Patron-client relationships*

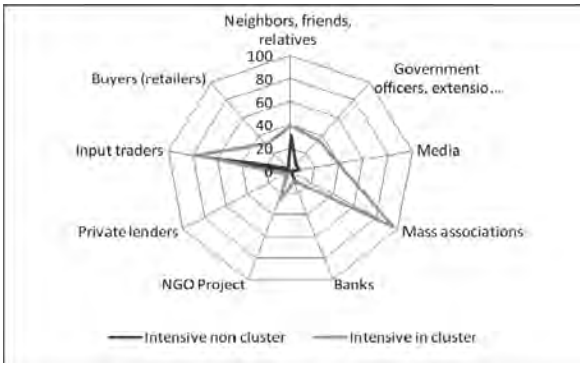
The private sector networks were so important to people in the (improved) extensive farming system that they did not appreciate the linkages with any formal network and

[35] The extension system was established by Decision 13/CP (02/03/1993). Statistics from 2008 show that the extensive systems focused mostly on agriculture and aquaculture. There were 22 aquaculture extension staff at the provincial centre, 8 in the district station and 1 worker in each commune (DARD, 2006)

relied only on input traders and relatives, neighbours and friends, who provided them both technical advice and financial support (Fig. 6.4a).



(a)



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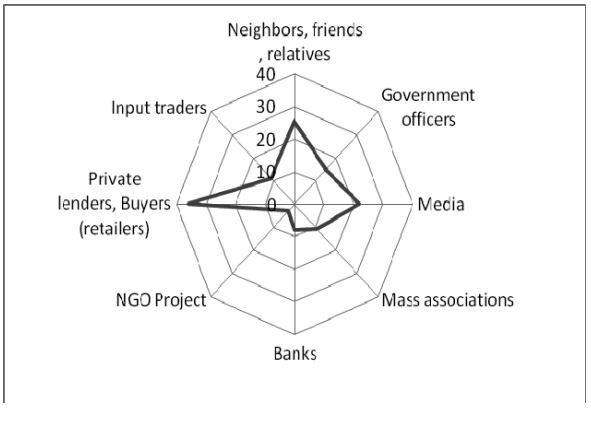


(c)

Figure 6.4: Farmers' and fishers' perception on the importance of different state-based and private sector networks for their production (% HHs) in (a) improved extensive farming system, (b) intensive farming system, and (c) fishery

Farming technology was most important for people in the intensive farming system. Three quarter of them highly appreciated the technical advices from input traders' technicians,

about one third appreciated the advice from relatives and neighbours, but very few esteemed the role of the government extension service (Tab. 6.3.). These relations often took the form of patron-client relationships. Input traders provided shrimp feed and chemicals on credit and sent technicians to guarantee shrimp health during the shrimp farming cycle; therefore, they greatly believed, appreciated and strongly connected with technicians from input traders, (Fig. 6.4b). This form of network brought benefits to both farmers and traders: farmers gained security through better shrimp health, learned and applied knowledge from technicians; while traders received the prestige, attracted customers and attached them to their business.

The patron-client linkages derived their strength from a combination of trust and common rules. For example, people in Long Ha village were related through both kinship and "*dong huong*" (people having the same homeland) relations. Mr Linh, an input trader in Long Ha recalled:

> I am the youngest of a large and "well-known" family and we all are living here. I started my business as an input supplier firstly for my own family from 2005. Today the number of customers is up to 50 HHs even though I do not have any advertisements. The most important rule in business is not only profit but also trust in each other. I have to borrow money from banks and feed agencies and I will get into serious trouble if farmers do not pay me back; on the contrary, they believe I provide quality goods for reasonable prices. They trust my advice on farming practices because I am successful and experienced in shrimp farming for many years, and most importantly, I am their kin. I send skilled technicians to them for technical advice to promote for shrimp's health. I want them to succeed and am responsible for making them succeed because they are my kin. *(Mr Linh, an input trader in Long Ha village, 2008).*

6.4.3 Farming clusters

An example of recent organizational innovation consists of networks of shrimp farmers, who get together to organize all kinds of services in a collective manner. In this way, they are able to negotiate better terms with input suppliers and shrimp processors

Nhi Nguyet was a cluster of 72 intensive farming HHs producing mostly *P.Vannamei* on close to 96 ha in 2010. Cluster members were not only kin but also friends and neighbours working closely together. The chair of the cluster, an ex-member of Parliament, is very powerful and maintains good relations with higher government authorities. His power and role as an intermediary for assistance and support brings success to the cluster and advantages to its members. Through this network the members of the cluster created bonding and bridging linkages between four stakeholder groups: cluster's farmers, entrepreneurs (both input traders and processing companies), scientists, and the

government. The cluster offers them links with external agencies and enhances their capability to have access to advanced knowledge and farming technology through extension. For example, the relations with the processing companies stabilize the supply of shrimp to avoid extortion of farmers and market price fluctuations. The cluster has contracts with reliable hatcheries to secure high quality shrimp seeds. The linkages promote a common interest among stakeholders in the shrimp business and provide a buffer for farmers against the influence of input and output price fluctuations. The linkages enable farmers to use advanced bio-farming techniques to meet the market requirement with respect to traceability and hygienic quality. In addition, people joined the cluster voluntarily and decided democratically on common plans and rules of the cluster.

6.4.4 Education

A large number of the 17 million people in the Mekong Delta have a low level of education and literacy (INFO.VN, 2011). Access to education in Ca Mau and Bac Lieu is limited. Education in the coastal region faced several difficulties due to the isolation of many areas, socio-cultural attitudes, and economic conditions. A lack of education was a big hindrance for people in Mekong delta to escape poverty and sustain livelihoods. The opportunity to access education was regarded as key for developing a sustainable livelihood not related directly to natural resources. Interviews showed that, despite the high cost for children's education, shrimp farmers were eager to support their children's study as much as they could. One of the successful students in the research area recalled:

> I deeply thank my parents who supported my study and handed me a job. I do not remember how much they paid for me because they never calculated but it must be a fortune. I have never forgotten the day I came back to ask them money for school fee and accommodation for me and my younger brother. My mother drove me in a small boat in light rain to the city to sell a necklace she was wearing; that might be the last wedding gift from my father. The money was just enough to cover some months. On the way back, sitting a front of the boat I silently wept with the rain. My heart was full of my love for them, feelings of "guilt" and of self-responsibility to my future *(Mr. Nhan. Dong Hai district, 2009).*

The eagerness to support education was also related to their ambitions and satisfaction with their way of life. Although people in intensive farming system (non-cluster) were satisfied with their quality of life (e.g. economic situation, standard of living, neighbourhood etc.) not many of them wanted their children to become farmers (Tab. 6.4).

They found that intensive farming was risky and unsustainable and wanted children to have other livelihood opportunities. In addition, the intensive farming villages are usually near a central area with a good infrastructure system that gave children more possibilities to obtain education and job opportunities.

Table 6.4: Satisfaction with quality of life and ambition for the children's future (N = 179)

Items	Improved extensive		Intensive		Fishery
	Non-mangrove	mangrove	non-cluster	cluster	
Satisfaction with quality of life	74	17	72	48	37
Want children to become farmers	52	36	7	30	29
Savings for children's study	41	37	31	52	17

Parents only gave up when children lacked the ability to follow the same education programs as urban schoolmates because of the social and cultural distance. Mr. Tung in Kinh 17 recalled:

> Even though I have enough money to support my son's study, I asked him to drop out of school since I recognized that when he lived away from me without my control he became spoiled, played games, and made friends with bad guys. To him, life outside school was too impressive while study was too difficult; he could not study as well as his friends and failed. I thought carefully and accepted this with feelings of regret, disappointment and even shame with neighbours. Now I have given him a farm and ask him to work beside me. *(Mr. Tung, Kinh 17 village, 2009)*

A large number of households (31-52% in the shrimp farming villages) also set aside savings to invest in their children's education. In fishing villages, only 17% of HHs spent savings for children's study; thus, children dropped out of school very early to go fishing. If parents had fishing gear and boats to hand over their children could become boat owners; otherwise, they had to work as crewmember or low paid labourer in the cities because of their limited skills and education. Therefore, the future of children certainly would depend on their parents' assets and their capability to find non-farm jobs.

The interviews showed that social networks played an important role in supporting children to have access to education. People created "bonding" and "bridging" connections with other people inside and outside their communities for their children to have access to education. Two famers in mangrove-shrimp farming system recalled:

> Instead of driving my daughter alone to school (by boat) I collect some other children around here to go with her. It takes time but I really want to follow her studying by meeting and talking with her teachers and friends. It is better to go in a group rather than alone because we (parents) can save engine cost, communicate daily to know how children study, while students can get to know each other through small talks during a trip. *(Mr Ne, Ho Gui village, 2008).*

> My children started living far from home when they were very young. We agreed to send them to Ca Mau to live with my relatives for their future benefit. Hopefully, they can reach a better educational level and facilities in the city. I trust my siblings for their advice and their care for my children's life and

> behaviour. We have visited or called them frequently to make sure they are in good shape. I created this relationship for many years; without this it would be hard to afford a study for my children. (*Mr. An, Thanh Hai, 2009).*

Networks between stakeholders in schools in provinces, cities or villages are formed, either formally encouraged and approved by the state and schools or informally created by parents themselves.

6.4.5 Support relations

- *Kinship and relatives*

In all research sites, kinship relations played a key role in sustaining livelihoods. The supporting role of parents is more important than of brothers and sisters, uncles, aunts, and cousins. Young people prefer to build their house next to parents or relatives or at least in the same village to get assistance and support. The children usually live with parents until getting married. The transfer of capital assets such as land or boats from parents to children is important for children to start their own household. Often poverty transmits from one generation to the other because poor parents (or those with many children) have nothing or little to transfer to their children, and have less opportunity to send their children to school or start with alternative income generation activities.

People in Long Ha were related through kinship before they immigrated from the North to this village. The combination of the "*dong huong*" relationships (of people having the same hometown), and sharing religion (80% of them are Christian) provided this network with strong ties, trust and homogeneity in socio-economic, religious and normative terms that effectively supported people in their livelihoods. Kinship ties provided moral and monetary supports as well as technical advices and know-how.

> I know all people in the village since most of them are either my or my husband's kin. It is hard to imagine how I could manage to live without my relatives' supports. In the first years of settling here, my husband went away with them to do seasonal jobs while I stayed at home to take care of the children and work on my farm. My children grew up with my parents' food and hands. I borrowed food and money from them, and most importantly, followed their advice in production, in diversification of activities and in instruction of my children. I am lucky that I have good family relations but not all people were in the same situation. Some conflicts break down the relationship mostly due to the property sharing and this may deteriorate the relationship and extend in to the next generation. *(Mrs. Huyen, Long Ha village, 2009)*

- *Neighbours and friends*

When people immigrate or build houses in a new village they live next to neighbours or friends. Vietnamese saying "*Ba con xa khong bang lang gieng gan*" (A near neighbour is better than a far-away relative) emphasizes the important and supportive roles of near neighbours and close friends who are better than kin living far away or having no common interests. People share know-how through daily conversation with neighbours and friends. They may travel long distance to acquire new techniques from friends or visit a farm nearby to get advices. They try to maintain the relationships with neighbours because of the social obligations as well as the supportive benefit the relationship may generate.

6.5 Conclusion and discussion

As we have seen in the preceding section networks and social relations are crucial elements in supplying important assets and promoting sustainability of fish-based livelihoods in the Mekong Delta in Vietnam. Credit is not only obtained from and through official agencies such as banks and mass organizations, but from a variety of other sources such as input traders, relatives, local networks and moneylenders. Knowledge can be obtained from many sources, including extension services, traders, relatives and media. Even for access to education, which is offered exclusively by the government, people are making use of their private networks to access to. The way in which households mobilize these assets through these networks varies across productions systems, across the types of organizations, and the way in which these networks and relations are organized.

- *State-based versus private sector networks*

As the results of the study indicate there is a large difference between the way in which state-based and private sector agencies are functioning and in which they are perceived by the fishers and shrimp farmers in the Mekong Delta. In the relations with state-based agencies power has a legal base and flows from central to local or from government officer to citizen. Participants in these mass organizations have less interaction and receive services passively since there is no reciprocal process. Power in this network is based on legitimacy, enforcement and compliance rather than mutual obligations and shared beliefs. If the mass organizations are large with loose ties and connectedness people do not have personal relationships. The supply of formal credit is considered to be insufficient especially to fishers who cannot use their boats for collateral. Moreover, access of the poor to formal credits seems more difficult; they cannot use simple and dilapidated houses, boats or other traditional assets to match the requirements of the formal credit systems that mostly supply business-related rather than consumption loans. Even if banks offer loans at concessional interest rates, rural producers are not able to access these, because of the formal requirements they have to meet and the political approval they have to get. For obtaining a loan from a bank a guarantee is needed from a third party to ensure the pay-back, which is

often a cumbersome procedure, and not open for the poor who have difficulties obtaining such a guarantee. For instance, in the mangrove-shrimp farming system, people had to accept a complicated procedure to get agreement from various agencies to get permission for the excavation of their ponds every year again (Tran et al., forthcoming-b). In contrast, obtaining a loan from private sector networks was based on a dyadic relation in which mutual trust plays a larger role, despite the fact that higher interest rates have to be paid, because of the risks involved.

Compared to formal credits, access to informal credits provided four complementary possibilities:

- While the formal credits provide loans for production, the small-scale farmers and fishers require small loans for operation or consumption only. Thus the complicated procedure for loans with collateral and high transaction costs is not suitable for small loans.
- Farmers are perceived as clients rather than as beneficiaries. The perception is that formal credits with low interest rates are subsidized credits. The farmers having such loans are viewed as beneficiaries. They should have a feasible and appraised financial plan, confirm to respect the terms/periods of reimbursement, a guarantee by organizations, and accept high transaction and administration cost.
- Clients for informal loans are served quickly and can negotiate interest rate, volume and duration of the loans. Since the clients have a social linkage they can negotiate on the interest rate or the potential of defaults.
- The repayment is high and punctual because lenders know very well the purpose of the money being lent and they have inside information or even power to channel the money streams, through control over the trade of shrimp and fish

With respect to knowledge and information, the *linkages or relations* in informal networks are characterized by stronger ties and higher intensity of interaction since people in these networks are more homogeneous in norms and values, socio-economic status, beliefs and culture. These stronger ties foster involvement and participation of people in collaborative and joint actions, and promote understanding between actors through exposure to new ideas and information. The content of ties is different between actors in different networks. For example, ties within a network with close kin are different from those of a Women's Union or patron-client network. Ties in informal networks are more direct and cohesive than in formal networks. People directly contact friends or traders to satisfy their demands instead of accessing subgroups of mass associations through lengthy procedures to get information from institutions.

The government extension service is considered less relevant and efficient because of (1) the distance between the extension agents and farmers and (2) little relevance of their technological advice and knowledge for the smaller farmers. They acquire knowledge more effectively due to the following five reasons.

- They can improve collaboration, and exchange knowledge and skills among a wide range of stakeholders: technician from input traders, friends, relations, neighbours, parents, etc.
- The technician from input traders in the village experience homogeneity in economic conditions, common interests and social perspectives and beliefs.
- They are interested in relevant topics or specific demands and they are more concerned about what they want to know.
- They have more frequent opportunities to enhance knowledge, upgrade information and increase the amount of ideas, because contacts and conversations in informal networks are daily.
- They need smaller networks but receive stronger linkages with higher intensity. They access relationships with a few actors having common interests and more participation and involvement.

- *Differences between various livelihood strategies*

However, there are large differences between, on the one hand, shrimp farmers and fishers, and on the other hand, between different types of shrimp farmers. It seems that fishers are hardly in touch with state-based agencies as there are no possibilities for them to obtain credit from government banks, since they cannot use their boats as collateral. In a similar way, those shrimp farmers having a Green Book contract for their land are also at a disadvantage. There is no extension service providing advice and knowledge to fishers. Likewise the know-how provided by the government extension service seems to be oriented at those shrimp farmers operating intensive farming systems.

In the same way, a distinction must be made between the poor and the wealthier households. In general, the poor have to face more problems in accessing state-based services as it will be more difficult for them to meet official requirement for obtaining loans and the know-how provided is of less relevance. In this way they also run higher risks as they obliged to turn to private sector money-lenders and have to borrow money at higher interest rates. This increases the likelihood of further indebtedness and a downward spiral into poverty, loss of assets such as equipment, and especially in the case of fishers, of gear and boats and increasing dependence on petty activities, temporary labour and dependence on patron-client relations

- *Long-term versus short term*

A clear distinction must be made between long-term and short-term investments in livelihood sustainability. Relations with state-based agencies and private sector networks primarily serve to cover the short-term risks in the form of small credits for emergency spending, the supply of inputs, the coverage of operational costs in the case of fishing, and the diversification of income sources through the start-up of new activities. For the poor these roads are inaccessible so they often have to rely on family and neighbours to cover immediate needs such as food, shelter and the like.

When it concerns long-term investments such as the education of children, the replacement of a fishing boat, or the modernization of a shrimp pond, single sources of credit are not sufficient. Households either have to set aside money in the forms of savings, mostly in the form of gold, or have to resort to close kin to provide them with the necessary capital or support, in addition to government banks.

An innovative form of a long-term investment in social and economic relations was offered by the organization of the shrimp farming cluster.

- *Trust and power*

In both the state-based organizations and the private sector networks, power and trust play an important, if not a decisive role, in the organization of the relations and the mobilization of assets. However, they play these roles in different ways. In the relations with state-based agencies, power is a prime aspect of the relations. This power is primarily used to steer economic development in a specific direction and is less directed towards the needs and concerns of the shrimp farmers and the fishers. As a result the aspect of trust plays a relatively small role, also because the state agents have less of a direct interest in the well-being of the clients who receive their services. This is fundamentally different in private sector networks and relations. Even in patron-client relations, which are marked by power differences between patron and client, and to a lesser extent in relations between shrimp farmers and input traders, trust plays an important role. These relations can only be to the mutual benefit of both parties when there is a certain level of trust between the two parties, to ensure a predictable outcome and to ensure the absence of cheating. However, also here the poor are at the receiving end of the power chain, since they have fewer possibilities to negotiate the term of the relation between patron and client, and are often in a spiral of debt and impoverishment.

- *Sustainability and resilience*

The networks and relations of shrimp farmers and fishers contribute in myriad ways to the sustainability of their livelihoods as they offer all kinds of opportunities to obtain credit,

knowledge, support, and open avenues to ensure more long-term investments, such as those in education. It is hardly possible to quantify these contributions as they work sometimes in indirect and contradictory ways. It is even more difficult to say something conclusive about the contribution of these networks and relations to the ecological and social resilience of the Mekong Delta. It is clear that the relations and networks help to shield livelihoods of farmers and fishers against shocks on the short run. In that sense they contribute to the sustainability of livelihoods and the social resilience of coastal communities. However, the relation with longer-term sustainability and resilience is much more difficult to specify. A number of the relations definitely contribute to learning and learning to adapt to shock and changes. However, when these changes lead to further development of intensive shrimp farming and further pressure on natural resources ecological and social resilience will be undermined in the long run, and this will have a negative impact on the sustainability of livelihoods. In this regard a careful reconsideration of the role of government, both in the ways in which organizations and services are organized, and in the way private sector networks are being steered and managed, is warrante

7

Replanting of mangrove trees

Discussion and conclusion

7. Discussion and conclusion

7.1 Introduction

The main objective of this final chapter is to relate the findings of this research to the wider discussion in the RESCOPAR project about the social resilience of the shrimp farmers and fishers and the resilience of the marine ecological system. We do so by drawing conclusions about the social resilience at household level in the four shrimp farming systems and the fishery system and the resilience of the social-ecological system of the Mekong Delta.

Adger (1997) stated that social resilience can be measured through proxies of institutional change, property rights, and demographic change. In the literature there is an increased emphasis on adaptive governance and transformability to improve social-ecological resilience at the level of the system (Folke *et al.*, 2005; Folke, 2006). However, we will argue that the resilience of the coastal system cannot be well understood if we do not firstly provide data on the social resilience at the level of households, and consequently relate household level resilience to system level resilience.

Social resilience is defined as the capacity of households to withstand external social, economic, political and ecological uncertainties and changes and the capacity to decide on the (potential) impact of these uncertainties and changes. The concepts of resilience, vulnerability, and adaptation are therefore important to study the human dimensions of global environmental change (Janssen and Ostrom, 2006; Young et al., 2006). The results of this thesis show that shrimp farming and fishery livelihoods in the Mekong Delta suffer from ecological degradation, mangrove decline, shrimp diseases, market price decline, and misguided government policies and programs. Human capability to cope with risks or uncertainties can be studied through the livelihood decision-making process. Here we have applied the concept of pathways as non-teleological strategies in high-risk conditions. Pathways are patterns of livelihood activities arising from the individual strategies embedded in environmental changes, global forces, and involve social differentiation, power relations and institutional changes.

The primary sources of resilience also include social capital, especially trust and social networks and social memory, as well as historical experience with change (Olick and Robbins, 1998; McIntosh, 2000; cited in Folke, 2006) which are essential for the capability of households, who make up the social grid of the social-ecological systems, to adapt to and shape change. Humans and the environment, the social and the ecological, mutually constitute each other in a non-linear, multi-facetted and interactive process. The decisions people make at one stage do not only influence the livelihood activities in a particular environment, but they also nurture the memory of learning to adapt to the changes, to self-organize and manage their lives for the long-term. The livelihood activities observed at household level can be clustered into the three categories of livelihood resilience building: learning to live with change and uncertainty, nurturing the learning

and adapting, and creating opportunities for self-organization (Folke et al., 2003; Berkes and Seixas, 2005; adapted by Marschke and Berkes, 2006).

The following section discusses livelihood activities and pathways created through decision-making processes of shrimp farming households, both in the intensive farming and the improved extensive farming systems, and of households engaged in shrimp fishery. The third section presents the capacities of resilience building at household level. The data from the chapters are brought together in Tab. 7.1 showing the frequency of observation of specific livelihood activities, pathways, and strategies that contribute to the building of resilience at household level in the different aquaculture systems. The next logical step is to show how social resilience at household level is related to the resilience of the social-ecological system in the Mekong Delta. Finally, the discussion taken up is how institutional and formal organizational support by the Vietnamese government could strengthen the social resilience of shrimp farmers and fishers' households, in order to enhance the social-ecological resilience of the region.

7.2 Livelihood decision-making and pathways under social and ecological uncertainties

All activities, pathways and decisions of shrimp farmers and fishers in the Mekong region appear to aim at increasing their shrimp pond productivity and their income. This thesis has identified several different livelihood pathways created under social, economic, political, and ecological uncertainties and institutional processes reinforced by different policies.

Decision-making in shrimp farming, risks and uncertainties because of changing climate conditions, water pollution and shrimp diseases caused by mangrove degradation all negatively affected shrimp farming. Results show that approximately 90% of the households reported that shrimp farming today is much riskier than 5 years ago due to several factors. Farmers cited environmental problems associated with shrimp disease as their main cause of failure. To them, shrimp diseases are caused by deforestation, soil degradation, and pollution from sewage water and sediments in the canals, by salinization, and the use of unqualified shrimp seed. The water pollution is because the canals act as both clean water supply and as wastewater sinks. Consequently, the disease agents in the effluents from one farm are transmitted to neighboring farms. This problem is observed both in the aquaculture systems with and without mangroves, in both extensive and intensive farming (Ch. 3).

The climate has changed considerably and unpredictably in recent years, which has made shrimp farming more vulnerable to failure. Chapter 3 showed that in all farming systems shrimp diseases occur during the whole year but mostly in May-June, when the dry and rainy seasons are shifting. Shrimp diseases affect 22% of the households in the intensive non-cluster farming system where the pond environment is mostly damaged. Mangroves were totally destroyed after 1975, and the irrigation system consisted of narrow canals causing downstream wastewater pollution, water shortages in the dry season, and risk of transmission of shrimp disease with water shortages. Farm

density here is too high, exceeding the carrying capacity of the environment to function as bio-filter for the wastewater flushes from the ponds.

During interviews, several strategies were presented to prevent shrimp diseases, but the farmers saw no way to better manage the ponds, treat or cure shrimps or stop the disease from spreading once it manifeted itself. Farmers in the different farming systems developed different social and ecological pathways to "prevent" shrimp diseases from occurring:

In the improved extensive system, farmers exchanged water during the low and high tides of 5-7 days during every spring tide. They would decide on how long and what day they should open or close the sluice gates. Decisions were made according to their experiences with "seeing" the watercolor in their ponds and in the canals. In addition they decided to stock low price fries from local hatcheries, because they stocked during a year with low density. The purchase was normally based on the price of fries, their confidence in the hatchery branch, their relationship with traders, and advice from others. They also diversified by recruiting or stocking mud crab, fish (sea-perch, anabas), and blood cockles to generate an income and to mitigate the risk of shrimp production failure. Moreover, to reduce the risk of shrimp mortality due to the pollution of inlet water, they applied the new models of improved extensive farming, for instance, the high-yield improved extensive model (ASEAN, 2005).

In the intensive system, pond management during the cropping cycle was very important to "prevent" shrimp disease from the beginning. For instance, farmers would clean and dry the pond completely, remove the debris and elevate the water pH and salinity. Selection of good quality fry for stocking into a pond was the first important step of shrimp growth management. Farmers preferred to get healthy fry by purchasing them from reliable hatcheries after carefully testing for diseases. However, this good preparation would not secure success. More than 20% of the households interviewed using the intensive system dealt with shrimp diseases (Ch. 3 Tab. 3.7). Disease from virus infections like White Spot Disease Virus (WSSV) killed all shrimp quickly in a very early stage. Yellow Head Disease Virus (YHD), *Monodon Baculo* Virus (MBV) and many others from microbes, fungi and parasites occurred during a crop. The only strategy farmers had was to empty the ponds for several seasons or change to fish or mud skipper (eel) farming. However, the unsuccessful farmers found it difficult to access financial credit to be able to continue farming if they could not repay earlier debts.

7.2.1 Livelihood decision-making in shrimp farming households under market uncertainties

Chapter 3 also showed that in 2008, the shrimp price sharply dropped by one third, while input costs increased by 20-40%. For example, the price of shrimp (40 shrimps kg^{-1}) decreased from VND 105,000 to 65,000 in six months in 2008. NACA (2010) reported that during 2008, the price of shrimp decreased from VND 109,670 to 106,110 for shrimp of size 21-30 shrimps kg^{-1} (see Ch. 3). The same report mentioned that the shrimp price decline was caused by the global economic crisis, by unstable markets, the large number of actors involved in the market chain, such as collectors, retailers, and processing traders, and overproduction.

In the improved extensive farming system, price decline and fluctuation was not the primary concern because shrimps were harvested all-year-round and operational costs were low. In addition, in the mangrove-shrimp system, in order to increase the market value and to produce higher quality shrimp products to compete in the global market, farmers choose organic shrimp farming or other models, like Better Management Practice (BMP) and Good Aquaculture Practices (GAP) that were introduced in 2002. One example is the integrated mangrove-shrimp farming system where farmers applied the organic shrimp system to obtain certification from Naturland (Ch. 3). Several stakeholders are involved in the organic shrimp network, from farmers, the Forest Company, the processing company, the staff of the Internal Control System (ICS), the International Marketology Organization (IMO) and retailers. To comply with this certification the farmers had to protect the mangroves, not use chemicals and organically certified feed. If the system were correctly implied, famers could get higher benefits from the production of organic shrimps, as well as the protection of mangroves. Farmers in intensive shrimp systems were heavily exposed to the risk of shrimp market decline, especially since at harvest time, their shrimp must be sold at any price because the harvest cannot be stored. Moreover, the system required higher investments, is thus more vulnerable to fluctuating market prices, hence a higher risk of failure. The only way to control the negative effect of shrimp price fluctuation on the market was that people chose which months they thought were best for stocking to obtain higher profits. For example, they guessed that the price of shrimp might increase in the second half of the year because of the export quota already assigned to the processing companies approximately in the middle of the year. Or around the Vietnamese New Year holiday due to the bigger consumption of shrimps in the domestic market. Unexpectedly however,, in 2008 the price of shrimp slumped dramatically and many farmers emptied their ponds and found non-farm occupations as small traders or industrial workers instead. Moreover, at least half of the households in Long Ha shifted from shrimp farming to other livelihood options: salt production and fish farming (eel, mudskipper) because these production systems were less risky and required smaller investments. However, price of the salt again sharply was reduced at the end of 2008 due to overproduction and over-importation from India and Australia. From 2003-2007, Vietnam imported an average of more than 200,000 tons of industrial salt but in 2008, besides the import of industrial salt, the country decided to import 40,000 tons of edible salt due to the shortage of salt in 2007 (Baomoi, 2008). The salt market decline strongly effected households' livelihood in Long Ha; even up to l today, 2011, many households have half-heartedly produced salt, and decided to store and wait for the price to increase again. In Nhi Nguyet, farmers confronted with the shrimp price decline developed another pathway. They decided to minimize operational costs by redesigning the ponds and applied new ways for pond management. They stocked all of their shrimp-seeds in one pond and then divided them among several ponds when the shrimp grew. This activity allowed them to reduce cost for feed and chemicals and to save fuel for the paddlewheels. They also decided to change to *P. vannamei* farming which promised a higher yield and more net income. The first eight farms started growing *P. vannamei* in the middle of 2008, and the number increased to 30 farms in the beginning of 2009, while at the end of 2010 all farms in the Nhi Nguyet cluster had shifted to the new system .

In conclusion, the social and ecological uncertainties of water pollution, insufficiency of water, a bad irrigation system, shrimp diseases and market decline affected the farmers in the intensive system more severely (see Ch. 3).

7.2.2 Livelihood decision-making of fisher's households under social and ecological uncertainties

Chapter 5 showed that the ecological uncertainties seriously affect the coastal fishing livelihood. All fishers reported that the fish stock declined very quickly and mentioned as the reasons of the decline the environmental degradation and the increase in the number of fishing boats. The harsh and irregular weather conditions caused seasonal variation in catch and income. Moreover, 90% of the fisher's households have debts, mostly from moneylenders who demand a high interest. In addition, the catch variability, the increase of gasoline cost, especially in 2008, the cost of gear and damaged boats did not balance with the lack of capital for investment, in combination with poor education, a lack of assets and oppotunities for non-farm jobs. These combined factors made fishery livilihoods more stressful. Many households cannot escape from the poverty trap, which means that the intergenegrational transfer of poverty is commonly observed in the fishing villages.

Chapter 5 also showed that coastal fishers have few opportunities to engage in non-fishing livelihood diversification, but that diversification of fishing gear and techniques to catch more intensively is remarkable. People diversify the fishing gear to catch more intensively in order to cope with the unpredictable variations in catch, and to compensate for the days they lose because of bad weather, to fulfill family obligations and to repay their debts. The more small-scale fishers diversify their fishing techniques, the more intensively they exploit the near-shore resources and violate fishery regulations. Wealthier fishers with large vessels also decided to operate in the near-shore zone and compete with small-scale fishers. In addition, the poor used nets of very small mesh size (5-7 mm) to catch goby fingerlings and crab eggs in the estuaries. All these activities pressured the near-shore resources and negatively affected near-shore marine resources protection. Thus diversification is an appropriate strategy to obtain secure short-term benefits, but it may be disadvantageous and put more pressure on the resources in the future. In other words, increased household social resilience negatively affects the ecological resilience of the coastal marine system.

7.3 Capability to build resilience at household level

Table 7.1 summarized several different livelihood activities, pathways and strategies people have developed to build resilience at household level in the Mekong Delta. These pathways and strategies were quite varied and complex depending on place, time, context, society and individual choices.

Some options taken might be considered part of a short-term coping strategy, like livelihood diversification, intensification of production, and outmigration. Other strategies, such as specialization and self-organization might serve to enhance household capacity to survive when

faced with unpredictable changes. The variability of options and conditions for decision- making only become visible at household level, and not at system level. Therefore, in order to get a proper understanding of the social resilience it is necessary to study the decision-making process, livelihood strategies and pathways at household level first, before one can understand their consequences, and the internal dynamics of the wider social-ecological system.

This paragraph discusses which pathways are stable, sustainable, robust and resilient in the face of social and ecological changes and uncertainties. The social and ecological mutually constitute each other in an interactive process. Decisions people made at one stage do not only involve interactions between humans and the environment, but they also nurture the memory of learning, adapting and self-organization in social systems that are necessary for transformation and innovation (Walker et al., 2004). I apply these three clusters of resilience building strategies (Folke et al., 2003; cited in Marschke and Berkes, 2006) the households in the different aquaculture and fishery systems in the Mekong Delta to compare how people manage change. Tab. 7.1 shows the livelihood activities and pathways as observed in our research, and organized according to the three clusters by frequency of observation, and whether they provide short or long-term benefits.

The first cluster includes the livelihood activities, which bring benefits mostly in the short-term through risk mitigation and adaptation strategies, such as livelihood diversification, out-migration, labour exchange, emptying the ponds, and catching fingerlings. Perhaps these strategies for the short-term are less sustainable, less flexible and less resilient. For example, people adapted to declining shrimp prices by moving into salt production, but also that system broke down in 2009. In this case, coping strategies to reduce poverty may perpetuate poverty, which often happens when there are no or few transformative formal institutions to support the poor.

Diversification was a popular strategy in all research sites. Shrimp farmers and fishers diversified their livelihoods by doing non-farm jobs in industrial cities or off-farm activities, for example, diversifying land use, engaging in husbandry and crop cultivation, collecting shrimp from the sea, small-scale trading, and providing services. The poor were more involved in diversification activities. Marschke and Berkes (2006) stated that diversification is a strategy to accumulate wealth for those who are well-off, but our cases show that this is as much a survival strategy of the poor in the context of decreasing access to resources. Therefore, we agree that diversification may be an important strategy of poverty reduction (Ellis, 2000b), a strategy for risk mitigation (Turner II et al., 2003) , or a coping or survival strategy (Reardon et al., 2001).

Migration was common in these villages, in the form of skilled or unskilled labour migration, out-migration or in-migration, movements within or out of the province or international migration, permanent or temporary migration. Although there is no separate chapter in this thesis about migration in the Mekong Delta, we recognize that it is a very important part of the livelihood strategies of coastal people because in many cases it represents an exit-strategy from poverty. Although the data from the survey are limited, other sources show that permanent migration out of the Mekong region has increased. . Data from the Population and Housing Censuses show that the number of out-migrants doubled from 187,126 people in1984-1989 to that of the period 1994-

1999 (Phan and I. Coxhead, 2007; cited in Nghiem, 2010). During the period 2000-2005 more than 3,000 workers left the Mekong Delta to work in foreign labour markets, and remittances increasingly play a role in shaping household incomes (Minh, 2008). Apart from male outmigration, women married foreigners, mostly from HoChiMinh city but also from the Mekong Delta. (Loi, 2011). We found that this strategy is not encouraged, but accepted in the Mekong Delta. For example, there are 8 cases in Ho Gui fishing village of women marrying foreigners, mostly Korean and Taiwanese.

Table 7.1: Livelihood activities, pathways and resilience building

Livelihood activities, pathways and strategies	Observation frequency			Response**	
	Aquaculture*		Fishery	Short-term	Long-term
	Ext.	Int.			
Learning to live with the changes and uncertainty					
Borrowing from moneylenders	x	x	xx	+	
Borrowing from patrons	x	xx	xx	+	+
Labour exchanging	x	x	xx	+	+
Catching fingerlings,	/	x	xx	+	
Illegally cutting mangroves for wood, fire and charcoal	x	x	x	+	
Changing the gear to fish more	/	/	xx	+	+
Out-migrating for labouring	x	x	xx	+	+
Empty the ponds after several times of failure	x	xx	/	+	+
Deciding to stay onshore due to bad weather	/	/	xx	+	+
Raising livestock, cultivating	x	x	x	+	
Salt producing	/	xx	/	+	+
Non-farm diversification: small traders, workers, servicers	x	x	x	+	+
Nurturing learning and adapting					
Planting the mangroves outside the ponds	xx	/	/		+
Conserving mangrove in their farm	xx	/	/		+
Applying organic, BMP farming	xx	x	/		+
Changing to *P.vannamei* farming	/	x	/	+	+
Applying "high yield improved extensive" farming	xx	x	/	+	+
Attending extension trainings	x	xx	/	+	+
Learning, improving know-how, knowledge and experiences	x	xx	x	+	+
Saving money, spending less	x	x	x	+	+
Buying more land	x	x	/	+	+
Maintaining boats, gears	/	/	x		+
Sending children far away from home for higher education	xx	xx	/		+
Creating opportunities for self-organization					
Building good relationships with neighbours	xx	xx	xx	+	+
Accessing the external networks for help	x	xx	x	+	+
Engaging in farming cluster	x	xx	/	+	+

* Ext.: Improved extensive; Int.: Intensive

** Response: Those strategies are created for long-term or short-term benefits.

/: no case observed; x: observed; xx: many cases observed

The second cluster of pathways of Tab. 7.1 is on nurturing the capacity for learning and adapting. These livelihood strategies served more long-term benefits. For example, people decided to protect the mangrove forest, apply new technologies in farming, improve their know-how, learn and do more skilful jobs, or send children to school. The livelihood outcomes are more flexible, more specialized and highly professional. In this stage, formal institutions were important to foster the

process. Government arrangements like an extension system and mass associations would help farmers to apply more advanced techniques in production to provide higher quality and safer products, and to protect the environment. The adaptive policies with respect to forest management would help people get involved in replanting and conservation of mangroves. When people recognized their rights in forest management, they decided to replant and conserve the mangrove forest voluntarily. In this way, the adaptive institutions fostered social resilience at household level.

The third cluster of Tab. 7.1 shows the pathways responding to the creation of opportunities for self-organization. Self-organization shows people's social capacity in response to change to monitor the emerging problems, which can be observed by the degree of farmers' engagement in establishing trust-based relationships and networks, participation in farming clusters, and enhanced connectedness to external networks. Formal institutions might foster social resilience at household level if, for example, they acknowledged farmers' role in the political debate to secure their legal rights and equity, and curb the monopoly of the industry in accessing the market for mangrove wood. This would increase household's social resilience and stimulate mangrove conservation at integrated farm level.

Collaboration and self-organization are very important to sustain livelihoods. Chapter 6 showed that shrimp farmers preferred to participate in informal rather than formal networks for help and support. The informal networks are more important and accessible than the formal institutional networks that are imposed on them to participate. The research also showed that farmers and fishers decided to have loans from informal sources, such as traders, patrons, and moneylenders with high interests when they found it impossible to access other sources. They organized their lives by joining informal networks, collaborating with neighbours and relatives, solving conflicts and building external networks were important for them to access to credit, know-how, support, and services. The example of the cluster Nhi Nguyet showed that farmers could benefit from collaborating and participating in a farming cluster (see Ch. 3).

7.4 Linkages of the social resilience at household level to the social-ecological resilience of a system

There have been many examples where conservation policies need to go hand in hand with livelihood improvement. Sunderlin (2005) stated that a win-win outcome of integrated forest management can be gained only in case of improvement of the balance between ecological (forest cover) and economic (human well-being) benefits to farmers (Ch. 4). Berkes et al. (1998) concluded that middle-income households are often the ones that can "afford" conservation, whereas the poorest households cannot. Also, it has been convincingly shown in the literature that that income stability or improvement alone does not contribute to social resilience or well-being. Apart from economic resilience in incomes, access, assets etc., social resilience also involves the capacity of households to protect the natural resources, such as mangrove forest and marine resources, and to have the know-how and know-who of relationship building for self-organization.

Considering these aspects of social resilience, let us now discuss the social resilience of the different shrimp aquaculture and fishery systems.

Tab. 7.2 shows the four indicators of economic stability, resource protection, knowledge and relationship building that are used as proxies of social resilience. The economic stability represents the capability of accessing the resources for increased productivity and income, and maintaining income stability and risk reduction. The information in the first column of Tab. 7.2 is retrieved from the quantitative data in earlier chapters of this thesis. Responses presented in the other three columns have been retrieved from qualitative data obtained through PRA methods. These data represent the household capacity and consensus in attitude and activities regarding resource management, increase of education and know-how, knowledge on adaptation to change, relationships and networks building, and the capacity for self-organization.

Table 7.2: Social resilience indicators observed between systems

Systems	Economic stability	Resource protection	Knowledge building	Relationship (self-organization)
Non mangrove	x	/	x	x
Mangrove-shrimp	xx	xx	x	x
Intensive non cluster	x	/	xx	x
Intensive in cluster	xx	x	xx	xx
Fishery	x	/	x	x

/: no case observed; x: observed; xx: many cases observed

Mangrove forests serve as buffer zones against typhoons and flood damage or saline intrusion, and help prevent sea dike damage and coastal abrasion (Macnae, 1974; Primavera, 1998; CWPDP, 1999; Hong, 1999; Carrere, 2002; RESCOPAR, 2004). Chapters 3 and 4 show that between the two improved extensive systems, the mangrove-shrimp integrated system is more effective in shrimp production and protection of the environment. From an economic point of view, the mangrove-shrimp system had lower failure rate of households as compared to the system without mangroves (10% and 12%, respectively), a higher benefit-cost ratio (1 versus 0.86), higher net income (VND 18.9 versus 8.7 and 6 million), and households in the mangrove-shrimp integrated system appreciated the proper irrigation system more than households in the non-mangrove system (58% and 34%, respectively). In addition, people in the first case received benefits from shared selling of mangrove timber with the FC industry. After a production cycle of 12-15 years and after deduction of all the costs for plantation, harvest and taxation, farmers received VND 5.9 million ha^{-1} $year^{-1}$ (USD 310) in 2010 if they shared 72% with the FC and if they had a right to sell products in auction. Besides *P. monodon* farmers stock crabs, fish (sea-perch, anabas), blood cockles or they recruited wild shrimp and other species including fish. Many more wild shrimps and fishes were harvested in a system with mangroves than in ponds without mangroves. Shrimps harvested in the shrimp-mangrove integrated system were sold at higher prices because it appeared that the shrimps were bigger in size than in the non-mangrove system. In conclusion, considering the economic and social aspects of resilience, the mangrove-shrimp farming system is the most resilient system due to the social resilience of the households in this system.

The system puts less environmental pressure on the mangrove forest since mangroves cover 50%-70% of the pond area, this ratio must be maintained after mangrove trees have been harvested. The system performs better from an eutrophication point of view because no feed and only a small amount of fertilizers are added, while the mangrove ecosystem continues to serve as a nursery ground for marine shrimp and fish species.

Of the two intensive farming systems, farmers in the cluster farming system have larger farms and better access to irrigation water. From an economic point of view farmers in the cluster in intensive farming are better off; the net income per household is VND 146 million which is twice as much as that of in non-cluster intensive farmers. Their net income per hectare is VND 101 million. The cost-benefit ratio in the cluster system is higher than the non-cluster system (0.33 versus 0.27), and fewer farms are failing (20% versus 22%) due to shrimp diseases, showing that the intensive cluster farming system is more sustainable and less risky. Cluster members may build relationships with external agencies such as banks, processing companies, input agencies, shrimp seed hatcheries, and governmental associations for support (Ch. 6). They applied advanced bio-farming technology to produce higher quality shrimp to meet market standards. After the new shrimp species, *P. vannamei* (white leg shrimp) was first introduced in 2008 in Nhi Nguyet cluster, it resulted in higher net incomes. Moreover, the farmers built networks with processing companies to enhance access to credit and stabilize the supply of raw shrimp material, avoiding distortion of the market price. From an environmental point of view, the system is interesting because of its low density of the ponds that are scattered over a large area. With the better water regime and existence of mangroves nearby, there seems to be a good environmental balance. As the ponds are situated in a non-mangrove area they do not cause any destruction of the mangrove habitat. All in all, with the present density of intensive shrimp farming it seems that there is a sustainable link, but if more ponds are opened the ecological resilience of the system may be jeopardized. However, the social resilience of intensive shrimp farming is low because poor farmers cannot benefit from the system. The system may provide benefits for the whole province or country through increased foreign currency earnings. However, the system fails in terms of the social resilience at the level of the household: in the case of shrimp diseases or market decline it is the farmers who are the ones most strongly affected. The livelihoods of the farmers involved in this intensive system are not sustainable under conditions of high risks of incomes instability and environmental degradation.

The poorer fishers in Ca Mau province are usually the near-shore fishers who have only small land holdings and limited access to financial and technical means for fishing. Economically fishers themselves regarded fishing as uncertain and unpromising. Although the annual net income per household of approximately VND 40 million (USD 2,300) was even higher than that from extensive aquaculture (VND 34 million), fishers were not satisfied with their job because of its high risk and uncertainty. Most fishers had debts: 90% of households had outstanding debts, mostly from moneylenders charging a high interest rate because the banks refuse to acknowledge fishing boats as collateral. Chapter 5 showed that fishing villages are usually located in distant areas away from the urban centres and government services with little access to education and alternative job opportunities. Our survey showed that 65% of the parents did not want their

children to become fishers and 54% of the households considered their livelihood to be worse than ten years ago. Out of economic pressure, these fishers decided to fish as intensively as they could to repay their debts and to compensate for the loss of production costs, thus putting pressure on near-shore resources. Moreover, they are confronted with heavy competition from the off-shore fishery resulting in even more pressure on the coastal natural resources, affecting the income of the small-scale fishers and decreasing the annual CPUE (Ch. 5).

Tab. 7.1 above shows that learning to adapt to change the capacity of shrimp farmers and fishers differs. Farmers in the intensive cluster farming system are more active, flexible, and professional in their adaptation to manage and shape the changes. Collaboration in social networks made them stronger in acquiring their legal rights and equity that strongly enhanced their social resilience.

7.5 Discussion on adaptive institutions for social resilience building

Social resilience can be measured through proxies of institutional change, property rights, and demographic change (Adger, 1997). Adaptive governance institutions are important in transforming and improving social resilience. This section discusses which adaptive institutions and organizations in the Mekong Delta can help foster the social resilience and livelihood improvement.

The development of mangrove-friendly aquaculture has been proposed as an important strategy to conserve mangrove forest (Luu, 2000; Primavera, 2000b). Primavera (2000a) also stated that overlapping bureaucracies and conflicting policies, weak law enforcement and lack of political will, result in a decline of quality and quantity mangroves. For the Philippines, she recommends conservation of remaining mangroves and rehabilitation of degraded sites using community-based mangrove-friendly aquaculture and integrated coastal zone management. Armitage (2002) described policy and management approaches aiming at mangrove forest conservation and alleviating the ecological and socio-economic impacts of aquaculture development in Indonesia are not simply a matter of the government formulating, enforcing, monitoring, and regulating. Rather, there is a need to formulate, propose, implement and monitor strategies that contest existing policy narratives and challenge entrenched economic interests and power relationships (Hai, 2005). This critical reflection is certainly needed concerning mangrove forest management policies in Ca Mau. Therefore, we need to distinguish between household-level social (including economic) resilience and social-ecological resilience of an aquaculture or fishery system.

Farmers in the mangrove-shrimp farming system in Ca Mau have been encouraged by the Government of Vietnam to replant and protect mangroves following a series of policies and regulations to promote the integrated mangrove-shrimp farming system and to enhance farmers' benefits from mangrove and shrimp production. Chapter 4 described several policies at provincial level dealing with forest allocation, use rights, forest management, taxation, and benefit sharing. Decision 24/QD.UB (12/09/2002) was replaced by Decision 10/QD.UB (22/09/2010) to further devolve forest management to farmers by transferring contract-based forestry to a long-term land

use right, allowing farmers to obtain more benefit from both shrimp farming and forestry. Although the decision was issued in 2002, it was not implemented until 2009. Mangrove forest management is dominated by the FCs who control the legal channels to the formulation of rules and regulations, and who have the political leverage, contributing to the monopolization of the market by the FCs at the expense of free market access of the farmers-protectors of mangrove. Although the policies on integrated shrimp-mangrove management are meant to enhance the ecological resilience of the system, so far it does not stimulate household social and economic resilience, which may in the end negatively affect the social-ecological resilience of the system.

In addition, the ecological sustainability of the intensive aquaculture system is based on the present relatively low density of farms. However, to increase shrimp productivity, provincial policy makers have set the target to raise the total area of intensive shrimp farming from 1,500 ha in 2010 to 10,000 ha in 2015. This trend increases the risks of social tension and decline of ecological resilience. We discussed in this thesis that the intensive system is already exposed to the risks of shrimp diseases, hence the target to raise production needs to be well considered especially regarding financial investment. For example, a report from the Agribank of September 2008 said that Agribank supported roughly 95% of the loans farmers needed, for 86,000 households with the loans of 2,000 billion VND (Ca Mau online, 2011). It is estimated that if Ca Mau wants to implement the plan of having 10,000 ha for intensive farming in 2015, Ca Mau banks together with national banks and enterprises need to invest another loan of about VND 6,000 billion in the next 5 years (Online Report, 2011) - and that is a large investment. Besides, sources of technology supports, qualified shrimp seeds providers, guaranteed contracts for input and output markets and, most importantly, the maintenance of ecological resilience need to be well considered. In other words, the trade-off between economic development for a few rich elite and the decrease of the social resilience for a whole community needs to be seriously addressed.

The Vietnamese Government established a strong institutional system to support rural development including an extension system, mass associations and financial credit systems. However, current institutions in the fields of aquaculture and fisheries are still weak and inadequate (Ch. 6). Particularly the farmers involved in the improved extensive system are being neglected in the knowledge transfer from the extension service, while those in the intensive system very much depend on the patron-client relationship dominating the technological advice and financial credit. The dependent farmers often are unwilling to participate in formal institutional organizations like mass organizations and prefer their own informal networks, even if these sometimes include exploitation.

Coastal marine resources are traditionally accessible to local fishers who using a variety fishing gears “following the fish tail”. Their livelihood is characterized by small-scale and multi-gear fishing activities. Fishing near the shore is the only means of earning a living to these poor fishers. They also need to diversify their livelihoods to target different species with multiple gears, and they lack the working capital to cover operational costs and investments in larger-scale activities. The distinction between small-scale and large-scale fishers is evident from their social and economic status, and handed down from generation to generation. It seems that there are the contradictory

policies concerning the control of overexploitation of the near-shore resources in the research sites. Compliance to State regulations about access to fishing grounds, fishing seasons and fish species, limitation of mesh size, reduction of the type and size of fishing gear used near the shore is inadequate (Ch. 5). Large vessels come near the coastline competing with the small-scale fishers, which leads to social conflict and overexploitation. Instead of policies encouraging off-shore fishing or enhancing rule enforcement; State institutions should promote non-fishing livelihood diversification for the poor to enable them to be less dependent on near-shore marine resources.

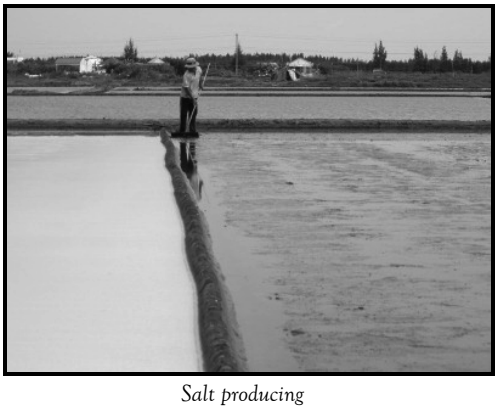
7.6 Conclusion

Livelihood decision making and pathways emerge in interaction with social and ecological dynamics in the coastal area of the Mekong Delta. We have studied the interdependences between human action, social dynamics and ecological change from the perspective of the social resilience of households in shrimp aquaculture and fishery. Social resilience indicators are the capacity to adapt to social and ecological change, social learning and memory, integration of (new) knowledge (know-how and know-who), leadership, social network development, participation informal networks or self-organization, and the inertia to engage in formal institutions and associations.. Livelihoods in the Mekong Delta are vulnerable and under social-ecological pressure, and farmers have created pathways to adapt, and to learn to manage the changes in the short-term and the long-term (Tabs. 7.1 and 7.2). This thesis has shown the need to first describe and understand social resilience at the household level in the four different aquaculture systems, to understand how and why they differ, and then relate social resilience at household level to the social-ecological resilience of the coastal system of the Mekong Delta. This approach enables us to better understand that social resilience has more than one form, and that it is differently related to resilience at a system's level. Such more detailed understanding about the different aquaculture systems in Ca Mau is a necessary basis for adequate policymaking and implementation in order to reach an optimal balance between the socio-economic sustainability of farmers' households and the ecological sustainability of the Mekong Delta.

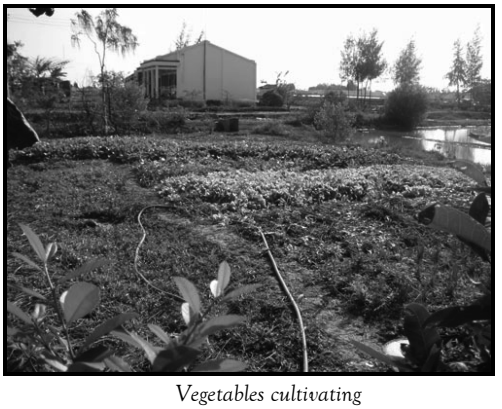
Other ways of earning living beside shrimp aquaculture and fishery

Small trading

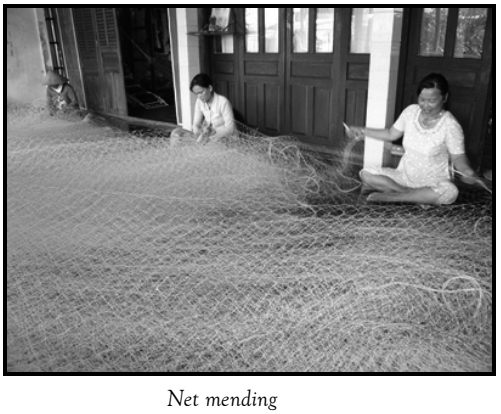
Boat driving



Salt producing



Vegetables cultivating



Net mending

Shop owning

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Annex

Household survey questionnaire used for the study

Project RESCOPAR, "*Rebuilding resilience in coastal populations and aquatic resources: habitats, biodiversity and sustainable use options*" is the collaborative project between Wageningen University (The Netherlands) and Can Tho University. The project investigates the dynamics and decision making of livelihoods in the coastal zone and looks for the methods of sustainable aquaculture, therefore we would like to have your support and participation in answering this questionnaire. Thank you very much.

Date: ...../...../200

I. GENERAL INFORMATION Interviewer: .....

1	Commune, Village, District, Province		Code:	
2	Name of interviewee		Tel	
3	Sex	1. Male 2. Female	Age	
4	Relationship with household head	1. header 2. spouse of header 3. child 4. other		
5	Education	Grade:		
6	Married status	1. married 2. single 3. other:.....		
7	Religion	0. none 1. Buddhism 2. Christian 3. other		
8	Ethnic	1. Vietnamese 2. Chinese 3. Khmer 4.other		

II. HOUSEHOLD INFORMATION

1. **Members inside household** (only people living together in the household, relatives(or not relatives) or wage-earners or the people who live with in a short period time in a year)									
1	Household size	Household size: ..... Male: ..... Number of elder:							
	Number of children on school age:	Elementary: .... Secondary: ... High school: .... Higher education:							
2	Number of people working and non-working (Elderly >= 60 yrs old Children<= 18 yrs old)		Elderly non-working	Elderly working	Adult working on-farm	Adult working off -farm	Children working on-farm	Schoolchil-dren non working	Wage-labors
		Male							
		Female							
2. Member outside the household but having the economic relation									
3	Family frequently supports to whom and how much?	to whom ..... how much in a year:							
4	Family gets support from								

	whom and how much?	from whom: ..... how much in a year:.....	
3. History of residence			
5	How many years (since now) have you settled in this village?		
6	If having moved from another village, please give the reason (mention 3 most important reasons)	1. self reclaiming 2. base to the reclaim of the national projects 3. for aquaculture 4. for fishery 5. married/separated 6. resettlement of the government projects 7. close to the family, relatives 8. for higher income 9. because of the war 10. others:	
7	When you resettled here how did the people earn their living?		
8	When did you change your occupation?	Year	
		Main job	

9	Comparing with the other households, please rank your economic status from the past till now	Period	Rich	Well-off	Average	Poor	Poverty
		10 years ago					
		5 years ago					
		Now					

3. HOUSEHOLD ASSETS AND ABILITY TO ACCESS TO RESOURCE

1. Household assets						
1	Area of land and ponds (don't count for renting land)	Piece 1: Total area:..... Ponds:..... Piece 2: Total area:..... Ponds:..... Piece 3: Total area:..... Ponds:.....				
2	Type of land certificate		no	contract	green certificate	red certificate
		Piece 1				
		Piece 2				
		Piece 3				
3	Land use	Piece 1				
		Piece 2				
		Piece 3				
4	Did you rent land over the past 5					

	years? If yes, what for?		
5	Did you sell or mortgage a piece of land in the past 5 years? If yes, give the reason		
6	House building materials	Roof:	1. thatched 2. tiled 3. corrugated iron 4. cement
		Wall:	1. thatched 2. wooden 3. iron 4. brick
		Floor:	1. soil 2. wooden 3. cement 4. samel-brick 5. Enameled brick
7	Electricity		1. no 2. yes/high price 3. yes/not frequently 4. yes/low price
8	Water use		1. well 2. river 3. raining water 4. pipe
9	Toilet		1. no 2. fish pond 3. river 4. yes/good
10	Consumer durables		1. lack of many 2. lack of something 3. just enough 4. sufficiently
11	Farm, pond and fishery facilities		1. lack of many thing, want to buy :..... 2. lack of something, but don't need to buy, just renting (borrowing) in case we need: . . . . 3. just enough, don't need to rent 4. full, even for rent
2. Infrastructure (distance, level of access and frequency)			
12	Nearest market		- how to go:.... ..... how long to get: ..... - how many times in a month: .....
13	Nearest secondary and high school		- how to go to elementary and secondary schools : ..... - how long to get ..... - how to go to high schools..... - how long to get: .....
14	Nearest medical station		- how to go:.... .....how long to get: ..... - how many times in a year: .....
15	Province's hospital		- how to go:.... ....how long to get: ..... - how many times in a year: .....
16	Commune's committee		- how to go:.... .... how long to get: ..... - how many times in a year: .....
17	Districts bank		- how to go:.... ..... how long to get: ..... - how many times in a year: .....
3. Financial assets			
18	Do you have a loan? If yes, how much?		1. yes 2. no How much (VND): .....
19	If yes, source of credit		1. Agriculture bank Interest: ..... 2. Mekong Delta bank Interest: ..... 3. Policy bank Interest: ..... 4. Budget credit Interest: ..... 5. Union, Club Interest: ..... 6. Private lenders Interest: ..... 3. relatives Interest: .....
20	Do you find difficult to get a loan		1. easy 3. difficult 2. average don't know. 4. I haven't got it
21	If having a loan. Where would you	investment	low /average/ much investment low /average/ much

	invest in? (multiple choices, ranking investment and stick √ in the next boxes)	reproduction				Education			
		Buy land				Health caring			
		House rebuilding				Small trading			
		Lending to other				Other: (specify)			
22	Investment and profit (estimate in million VND/year)	Source	Invest.	Profit		Source	Invest.	Profit	
		Aquaculture (shrimp, fish, crab....)				Near shore (by boat), inland fishing			
		Input trading				Collecting (forest)			
		Hatchery				Grocery trading			
		Salt producing				Machine renting			
		Rice, crop, livestock				Salary			
		Wage labor				Other (specify)			
		Specify others:							
23	Household expenses in a month								
24	Type of saving	1. cash keeping 2. gold buying 3. bank-saving 4. lending to others				5. tontine taking 6. real estate investing 7. school tuition 8. others: specify:			

4. Human and social assets		
25	What is your job and what are sources of income (ranking 3 most important)	Aquaculture a. Inten/semi-intensive b. extensive c. shrimp-forest d. ecological Fishery a. off shore b. near shore c. inland d. collecting Hatchery a. shrimp b. crab c. fish Trading a. seed b. medicine c. feed d. products Cultivating Livestock raising Grocery trading Salt producing Salary Others:

26	How long have you had these jobs?	Job 1: ..... Job 2: ..... Job 3:							
27	How many people in HH working on-farm and how good are they?	Number:..... How good? Education: ..... Experience:							
28	Hiring labor	Number of people?: .....How long hired in a year? : ..... F or what?							
29	Do you receive any assistance (help), advice from outside? (respondent may have more options: click √ in the appropriate boxes).	Source	Information	Technique	Capital	Seed	Feed, medicine	Production	Level of importance
		Neighbor, relatives, friends							
		Village officers, extensive workers							
		Extension materials, TV, newspaper							
		Club, collaboration, Union							
		Forest company, fishing agency							
		Bank							
		Private lender							
		Input trader: seed, feed, chemical							
		Output trader							
		NGO project							
		other:.....							

After ticking the boxes ask farmers to ranking the categories for 5 levels of importance in the last column. The higher number the more important:

1 ——————————— 5

Least important *Most important*

V. FARMING ACTIVITIES 1. Aquaculture household (only answered by farmers)		
1	Which aquaculture system do you apply?	intensive/semi-intensive extensive/semi-extensive (crab, fish, claim...) shrimp-forest aquaculture + trade aquaculture + industry (salt production) aquaculture + agriculture (rice, farm..)

		other (specify)				
2	Why did you decide to start an occupation (job / business) in aquaculture? (multiple choice)	By the local movement By the decision of the government project In order to increase the income Create job for household's members Provide food for family Water body is available Salty water Other (specify):.....				
3	How is the current aquaculture situation in comparing with the past and predict in the future? (click √ in appropriated box)		Good, easy	Not easy	Difficult	Very difficult
		10 years ago				
		5 years ago				
		Now				
		Future				
4	If having any change please give the reasons	1..... 2..... 3.....				
5	How frequently has shrimp disease happened in your pond for over the past 3 years?		How many time?	In which month?		
		Year 2005				
		Year 2006				
		Year 2007				

		Technique	yes	no	solution	**Importance**
6	Please give your ideas about pond management and environ-mental protection (in the last column rank for 5 levels of importance. The higher number the more important as for question 29 above)	- Depositing sediment, filtering and treating water before to the pond				
		- Treating water before discharge to the river				
		- Having place for keeping discharge soil when cleaning ponds.				
		- Having clean (input) water source				
		Having large enough sluice, canals, rivers...				
		- Having good ratio mangrove-shrimp or plantation				
		- Having good seed, feed				
		- Having good ratio of density				

		- Identifying and treating diseases by chemical				
		Having advice from extension workers				

2. Fishery households (only answered by fishers)		
7	Where do you catch?	1. inland, river bank 2. near shore, how far:..... 3. off shore, how far:..... 4. along the coast, in the protective forest 5. other, specify: .....
8	How do you catch fish?	1. boat, gross tonnage: ..... 2. net 3. trap. 4. rake 5. rake (on the front) 6. hook and line 7. ..... 8. other:
9	Which kinds of fish do you catch? (ranking for the 4 most important species)	species 1: (most important): ..... species 2: ..... species 3: ..... species 4: (least important): .....
10	Average catch volume and price per species in each trip	species 1: Volume: ..... Price/kg: ..... species 2: Volume: ..... Price/kg: ..... species 3: Volume: ..... Price/kg: ..... species 4: Volume: .....Price/kg: .....
11	How many trips in a year?	which months is the high season? ... ... how many trips ? ..... which months is the low season? ... ... how many trips ? .....
12	Gross revenue in a year	
13	Total cost (fixed and variable cost)	cost of boat, engines, net, gear: ..... Maintenance cost: ..... oil, ice, tax: ..... cost of labor: ..... others: .....
14	How many days in last month and how many months in last year your HH have insufficient amount of seafood due to lack of availability?	- No of days in a month:..... - No of months in a year: .....
15	Beside catching fish do you have other (secondary) incomes?	1. aquaculture 2. farming 3. shrimp/fish processing 4. fish/shrimp marketing 5. do labor 6. remittances 7. others: .....

16	Total secondary incomes	
17	Comparing with 5 years ago, do the mix of fish species and the quantity change or not? Explain the reasons	0. no change reasons:..... increase ..... decrease .....

VI. PARTICIPATION IN DECISION MAKING PROCESS

In production and market In your household who makes decision and do the following activities		male	female	both	other
1	Knowledge and being responsible for technique				
2	Spending for expenditure and equipment				
3	Changing the farming systems, diversifying occupations				
4	Working directly: pond preparing, daily taking care, pond managing, fishing offshore...				
5	Selling the products				
6	Keeping money				
7	Spending money more				
2. Decision on household activities					
8	Being responsible for children's education and career				
9	Taking care and instructing the children				
10	Temporary wage-laboring (if yes)				
11	Doing the secondary jobs: small trading, raising poultry, cultivating ..				
12	Doing the housework: cooking, washing, picking up the children....				
13	Participating in community activities				

VII. PERCEPTIONS

Please answer these questions by scaling 5 level (n a = no answer)

1 2 3 4 5

Fully disagree/dissatisfy/ very bad — Average — Fully agree/very satisfy/ very good

(i.e. The higher the number the higher agreement)

I. Information and technique Scale the level of source of information about technique in aquaculture and fishery		1	2	3	4	5	n a
1	By own experience						
2	From the neighbors, other farmers, friends						
3	Extension workers, document from training courses						
4	TV/Radio/newspaper						
5	Demonstration models						
II. Marketing , institution and Government support To which degree do you agree with the following statement.		1	2	3	4	5	n a
6	Input cost (oil, seed, feed, medicine ...) is higher compared with the past						
7	Output price (shrimp, crab, fish..) is low compared with the past						
8	Low price of out put has much affected our income						

9	Our production is qualified and safe. We don't use chemicals						
10	I have trouble with the demand for high quality of product						
11	Government has invested enough in facilities: electric, road, school, clinic...						
12	It is easy to get a loan from the bank at a reasonable interest rates						
13	I want to get loan from the bank for farming investment						
14	Joining a club/organization (such as farmer club, union...) is useful for aquaculture farming or fishery						
15	The rules and regulations from Government are relevant						
16	I feel satisfied with the advice and support of Government officials in aquaculture or fishery						
III. Environment To which degree do you agree with the following statement.		1	2	3	4	5	n a
17	For farmers: Our farm land, ponds are large enough. For fishermen: Our boat, gear, net ... are good enough						
18	We produce on our farm (fishing facilities) effectively						
19	In general, my life has remarkably improved, since . . . . . I am happy with my life, family income and community surrounding.						
20	I want my children to be farmers (or fishers) like me in the future						
21	I believe mangroves can bring success for shrimp farming						
22	Loss of mangroves negatively affects the water quality						
23	Loss of mangroves negatively affects the catch rates of fish						
24	Water supplied to my shrimp pond is of good quality						
25	In future shrimp/fish diseases will be more serious and difficult to prevent						
26	The decline in the quantity of wild fish makes fishing more difficult						
IV. Threats in education, health life To which degree do you agree with the following statement.		1	2	3	4	5	n a
27	Fishers are under physical pressure. This job requires energy.						
28	Fishers feel difficult because of being out at sea away from home.						
29	Fishery is a challenging and adventurous job.						
30	Fishery is an unstable job.						
31	In general, there is insufficiency of sanitary condition here (bad road, contaminated drinking water, mosquitoes, dirty toilet etc..)						
32	Health of family member has declined due to the sanitary condition						
33	The quality of health services is bad (quality of treatment, distance to health centre)						
34	There are few study opportunities for children (not good enough qualified schools and far from home)						
35	Children have less time for studying. Adults pay less attention to their education						
36	Mature children living far away from home for studying, parents have less time to take care and instruct						
37	There are few chances for the young to improve their skill and knowledge						

38	There are few job opportunities for the young						
39	Poaching and conflicting in the village still exist						
40	Conflict and unfair competition in aquaculture and fishery still exist						
41	Having no time and money for recreating, traveling, for TV watching or newspaper reading						
42	Life here is isolated, not enough means for communication: newspaper, TV, Internet						
43	The social evils such as gambling, drinking, lottery, theft still exist						
44	Women are heaped up with the housework and earning a living						
45	Women have been paid lower than men						
46	Others:						
V. Vulnerabilities in aquaculture (only to be asked to / answered by farmers) Do you agree with the following causes for vulnerability in aquaculture. (The higher number the higher agreement, na: no answer)		1	2	3	4	5	n a
47	There is not enough money for investment						
48	No red certification						
49	Climate change (increasing water level)						
50	There is a lack of technology to stabilize or increase incomes						
51	There is lack of high quality seed						
52	There is lack of clean water						
53	There are not sufficient irrigation infrastructure (rivers, canals...)						
54	The land is contaminated						
55	Market fluctuates, low price/polluted						
56	Shrimp diseases threaten aquaculture						
57	Others:						
VI. Vulnerabilities in fishery (only to be asked to / answered by fishers) Do you agree with the following causes for vulnerability		1	2	3	4	5	n a
57	There is not enough money for investment: boat, gear, net						
58	Cost for gasoline increases						
59	Wild fish has declined						
60	Disaster by storm and weather changes						
61	There is lack of labor						
62	There is lack of health						
63	The market fluctuates, low price are a threat						
64	High taxes, handling cost and other fees are a threat to continuity						
65	Others:						

Thank you very much for your answering

Summary

After more than 20 years of economic reform, fishery and aquaculture have become important economic sectors in Vietnam. Shrimp aquaculture has been promoted by the Vietnamese government to reduce poverty, promote exports, and to provide employment opportunities. The rapid expansion of shrimp aquaculture between 1990 and 2005 has made the country the fifth largest shrimp producer, by weight and by value, in the world. From 1990 to 2009, output increased by 547% from 0.89 to 4.87 million tons, while shrimp production rose 758% from about 55 to over 419.4 thousand tons. Between 1995 and 2009, export earnings from the fishery sector grew from USD 621 million to USD 4.26 billion, to which shrimp contributed USD 1.3 billion. In 2010, aquatic products from Vietnam contributed 4.6% of the GDP, i.e. USD 4.8 billion. The production of shrimp contributed most to this volume, and created job opportunities for over 4 million people.

As a part of the RESCOPAR program of "*Rebuilding resilience in coastal populations and aquatic resources*" of Wageningen University (INREF), this study focused on fish-based livelihoods in the Mekong Delta of Vietnam. Shrimp farming and fishery are the main livelihood options in Ca Mau and Bac Lieu, the two southernmost provinces of the Mekong Delta, Vietnam. The coastal area, with a dense network of canals, creeks, rivers and mangrove forest, is also considered important for forestry. In 2009, besides 227.8 thousand tons of caught fish, the two provinces produced 167.8 thousand tons of shrimp accounting for 53% of the Mekong Delta production and 40% of national production. Shrimp farming occupied 294.7 thousands ha in Ca Mau and 126.3 thousands ha in Bac Lieu, contributing to 47% and 51 % respectively of the provincial GDP.

However, this expansion of fishing and aquaculture has also had negative effect. Hundreds of thousands of hectares of mangrove forest have been replaced by shrimp ponds, and as a result, the coastal ecosystems have dramatically, perhaps irrevocably, been altered. According to many studies, this shrimp farming boom and the correlated disappearance of mangrove ecosystems have had negative consequences, such as, salt precipitation and acidification of soil, poorer water quality due to higher contaminants (high turbidity, low levels of dissolved oxygen, and high levels of organic matter) and water pollution causing shrimp disease outbreaks. These outcomes have negatively affected the livelihoods of people dependent on forests and fishing.

Therefore, this research focused on the pathways and decision-making of shrimp farmers and fishers to analyze how they meet their basic needs and cope with risks and uncertainties to sustain livelihoods. In doing so, it aims to identify the factors that affect decision-making at the personal and household level and at the level of the natural and social environment. Pathways are patterns of livelihood activities arising from the individual strategies embedded in environmental changes, global forces, and they involve social differentiation, power relations and institutional changes. The research concentrates on the question: how do the coastal fish-based livelihoods change to adapt to uncertainties and enhance social- ecological resilience.

According to many authors vulnerability, adaptation, and resilience are key concepts in the study of the linkages, interactions, and feedbacks between human activities at household level and environmental changes. These linkages and interactions can be found in decision-making processes at different social, economic, and political levels as these decisions affect the use, management, and conservation of natural resources and the social-ecological resilience of a farming system.

In this study four shrimp farming systems and a fishery system were distinguished,which show a different resilience at household level: the improved extensive system, the mangrove-shrimp farming system, the intensive shrimp farming system with and without clusters promoting collaboration between farmers, and the fishery system. The results of this study show that farmers exhibit remarkable social and economic resilience at household level under declining ecological conditions. All shrimp farming and fishery livelihoods in the Mekong Delta had to deal with ecological degradation, mangrove decline, shrimp diseases, market price fluctuations, and misguided government policies and programs, albeit in different ways and grades. Farmers who practiced the improved extensive system were isolated due to a lack of electricity and of difficulties in acquiring know-how and education. Access to markets and health care was also problematic because of transportation constraints. In the mangrove-shrimp farming system, although farmers' entitlement to the products from logging the forest was formally secured in practice the sharing of benefits was not transparent, so farmers were reluctant to participate in mangrove conservation. The intensive shrimp farming households suffered from a poorly functioning water management system, more frequent harvest failure and vulnerability caused by fluctuating shrimp prices and market competition. Finally, the fishery in the coastal Mekong Delta is commonly small-scale and fishers regarded fishing as uncertain and unpromising. Fishing villages are usually located in distant areas with little access to education and alternative job opportunities. Fish stocks sharply declined and 90% of the households had outstanding loans, mostly from moneylenders charging high interest rates.

Coastal Mekong shrimp farmers and fishers cope with these vulnerabilities through a wide range of livelihood pathways and strategies including intensification, diversification, migration, specification, and collaboration. They are also supported by and believe in the force of familial or communal support networks.

Chapter 3 shows that farmers in different farming systems have created different livelihood pathways including the adoption of new technology, redesigning the ponds, stocking in favourite seasons, diversifying their land use, earning an off-farm income, joining together in clusters, integrating aquaculture and agriculture, and farming better quality shrimp to demand higher prices. For example, farmers in the mangrove-shrimp system choose organic shrimp farming or other models, like Better Management Practice (BMP) and Good Aquaculture Practices (GAP) in order to increase the market value and to produce higher quality shrimp products to compete in the global market, especially the organic shrimp system in integrated mangrove-shrimp farming system. When the price of shrimp slumped dramatically, farmers practicing the intensive farming system shifted from shrimp farming to other livelihood options: salt production and fish farming

(eel, mudskipper) because these production systems were less risky and required smaller investments. Many others emptied their ponds and found non-farm occupations as small traders or industrial workers instead. They minimized operational costs by redesigning the ponds and applying new ways for pond management or changing from *P.monodon* to *P.vannamei*shrimp species.

In Chapter 4, the issue of environmental sustainability is addressed through an analysis of livelihood strategies of shrimp farmers in relation to government policies with respect to the management of (mangrove) forest. Over the past decades, the Vietnamese government has allocated most of the forest to private forest companies or to households in order to promote more sustainable management of forests. In many cases these companies on their turn gave enthrusted the management of mangrove forest to shrimp farmers. Focusing on the access shrimp farmers have to income from mangrove forests, the chapter highlights that despite the fact that farmers are legally entitled to most of the benefits from the mangrove forests under their management on their farms allocated by the forest companies, they are not able to enforce their claims. This is due to the fact that the management and marketing of mangroves has been under control of the forest companies, who manipulate the process in their favour. By consequence, the farmers have few incentives to manage the mangrove sustainably and contribute to their conservation.

Chapter 5 shows how small-scale fishersdiversified their gear and boats to fish more intensively to secure livelihoods and reduce vulnerability, which caused near-shore resource decline and ecological disturbance, and violated fishery regulations. Small-scale fishers have difficulties ensuring the large investments needed to ensure continuity of their enterprise. There are only few opportunities for diversification outside fishing. In addition, they are threatened by a decline in Catch per Unit of Effort (CPUE) because large vessels compete for fish in near-shore waters. Lastly, they have to deal with very detailed and often contradictory fishery regulations, which do not address their need for diversification of gear and species.

Chapter 6 focuses on the role of institutions and social networks in building human capability and social resilience. It shows that private sector networks and state-based agencies differ largely in their functioning and that they are perceived differently by local shrimp farmers and fishers. It is more difficult to access state services because of cumbersome procedures and in general there is more distance than with private sector partners. The degree of trust within private sector networks is higher even in case of patron-client relations and the knowledge exchanged in these networks is in general more relevant. Though collaboration with private sector networks increases social resilience because they help to overcome shocks, it also promotes more intensive farming of shrimp and exploitation of the environment endangering ecological resilience.

The human and the environment, the social and the ecological mutually constitute each other in a non-linear, multi-facetted and interactive process. The pathways people make at one stage do not only influence the livelihood activities in a particular environment, but they also nurture the process of learning to adapt to the changes, to self-organize and manage their lives for long-term resilience building. The livelihood activities observed at household level can be clustered into the

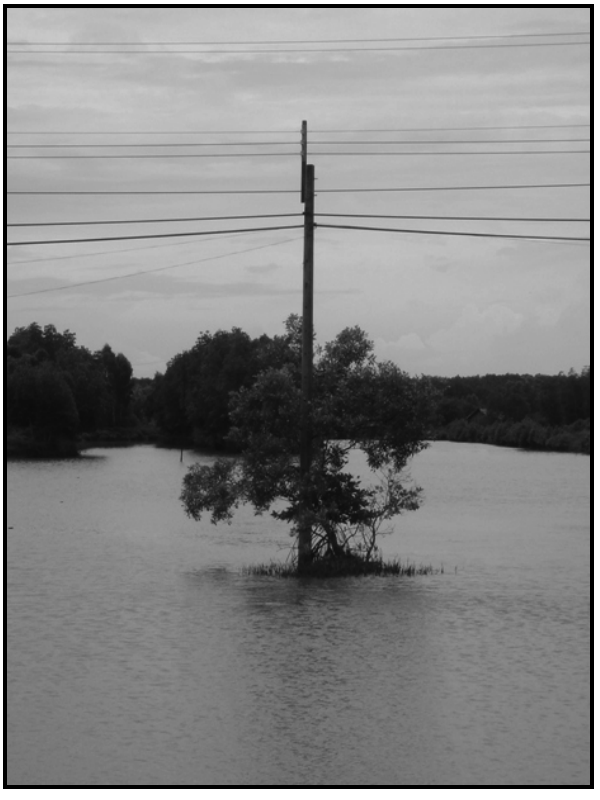
three categories of livelihood resilience building (Tab. 7.1). The firstcluster includes the livelihood activities, which bring benefits mostly in the short-term through risk mitigation and adaptation strategies, such as livelihood diversification, out-migration, labor exchange, emptying the ponds, and illegal activities such as catching fingerlings. The second cluster of pathways addresses the nurturing of the capacity for learning and adapting. These livelihood strategies served more long-term benefits. For example, people decided to protect the mangrove forest, apply new technologies in farming, improve their know-how, learn and engage in skilled labour, or send children to school. The livelihood outcomes are more flexible, more specialized and highly professional. At this stage, formal institutions appeared to be important to foster the process. The third cluster shows the pathways responding to the creation of opportunities for self-organization. Chapter 6 showed that households involved in self-organization in response to emerging problems, through engagement in trust-based relationships and networks, participation in farming clusters, which improved connectedness to external networks.

This study identified used the four indicators that are used as proxies of social resilience: economic stability, resource protection, knowledge and relationship building. Of the two improved extensive shrimp farming systems, the extensive mangrove-shrimp system was more resilient and less risky due to its low failure rate, high net production, and proper irrigation system. Compared to the system without mangroves, the mangrove-shrimp system showed a lower failure rate of households, a higher cost-benefit ratio, and higher net income per household. In addition, people in the mangrove system have received benefits from the shared selling of mangrove timber with the FC. Moreover, the system does not put environmental pressure on the mangrove forest since it needs to conserve a part of the mangroves that would serve as a nursery ground for marine shrimp and fish species.

Of the two intensive farming systems, the intensive farming system with clusters is more resilient. From an economic point of view, farmers in this system are better off, the net income per household is twice as much as that of in non-cluster intensive farmers, the cost-benefit ratio is higher, and fewer farms fail due to shrimp diseases. Farmers in the clusters applied advanced bio-farming technology to produce higher quality shrimp to meet market demands. They applied new shrimp species, *P. vannamei*, which brings higher net incomes. Cluster members may build relationships with external agencies for support. They are more active, flexible, and professional in their adaptation are able to direct and shape the changes as a groupin order to acquire a stronger legal and equity position that increases their social resilience.

The Vietnamese Government has established a political and institutional system to support aquaculture and fishery. For instance, Decision 24/QD.UB (12/09/2002) was replaced by Decision 10/QD.UB (22/09/2010) to further devolve forest management to farmers by transferring contract-based forestry to a long-term land use rights, allowing farmers to gain more benefit from both shrimp farming and forestry. In addition, to protect near-shore fisheries and restore coastal marine resources the Vietnamese government encouraged offshore fishing in the mid-1990s, and issued a Fishery Law which gives a detailed description of which species are forbidden, which mesh-sizes allowed, and which fishing seasons are open for different species.

Moreover, institutional systems including an extension system, mass associations and financial credit systems have been established from central government to the local level. However, the implementation of the current policies and institutions in the field of aquaculture and fisheries is still weak and inadequate. The institutional interventions, firstly, need to focus on balancing between household economic improvement and natural resources conservation. Socio-economic improvement through poverty alleviation programs is important particularly for low-income households, since the middle-income households are often the ones that can already 'afford' conservation, whereas the poorest households cannot. Although the policies on integrated shrimp-mangrove management and fishery are meant to increase the social-ecological resilience of the system, they do not necessarily stimulate an increase of the social and economic resilience of the households, which may negatively affect the social-ecological resilience of the systemin the end. Therefore, it is not enough to emphasize only the government's capacities of control and enforcement to make farmers and fishers comply with the regulations for the conservation of the resources without emphasizing, at the same time, the need to promote socio-economic improvement at household level. One solution could be to enhance non-farm or non-fishing livelihood diversification, to promote farmers collaboration and shrimp certification. Yet, the most important is to devolve the responsibilities and rights for the management of the mangrove forests and the coastal inshore resources to local individual farmers and communities.



"Light" comes across shrimp ponds and mangrove forest

Mangroves keep growing and ....

"Brightness" is there on the horizon

Samenvatting

Na meer dan 20 jaar van economische hervormingen zijn visserij en visteelt belangrijke economische sectoren geworden in Vietnam. De teelt van garnalen werd door de Vietnamese overheid gestimuleerd om armoede te bestrijden, de export en werkgelegenheid te bevorderen. De snelle expansie van garnalenteelt tussen 1990 en 2005 maakte Vietnam tot de vijfde producent van garnalen op wereldschaal, bij gewicht en naar toegevoegde waarde. De totale productie van visproducten groeide met 547% van 0.89 to 4.87 miljoen ton tussen 1990 en 2009. Daarin groeide het aandeel van de garnalenteelt van 55,000 naar 419,500 ton. The exportinkomsten uit visproducten stegen tussen 1995 en 2009 van 621 miljoen naar 4.26 miljard dollar, waaraan garnalen voor 1.3 miljard dollar bijdroegen. In 2010 droeg visteelt 4.6% bij aan het BNP van Vietnam (4.8 miljard dollar). Garnalenteelt droeg hieraan het meeste bij en creëerde voor meer dan 4 miljoen mensen werkgelegenheid.

Als onderdeel van het RESCOPAR onderzoeksprogramma (*Rebuilding Resilience in Coastal Populations and Aquatic Resources*) van het INREF programma van Wageningen Universiteit, richtte deze studie zich op huishoudens die van visserij en visteelt bestaan in de Mekong Delta van Vietnam. Visserij en visteelt zijn de voornaamste middelen van bestaan in de twee meest zuidelijke provincies van Vietnam, Ca Mau en Bac Lieu. Dit kustgebied in de Mekong Delta wordt gekenmerkt door een dicht netwerk van kanalen, kreken, rivieren en mangrove bossen en is ook van belang vanuit het oogpunt van bosbouw. In 2009 werd er in deze twee provincies, naast 227,800 ton vis 167,800 ton garnalen geproduceerd, wat 53% is van de totale productie van de Mekong Delta en 40% van de nationale productie van garnalen. Garnalenteelt legde beslag op 294,700 ha land in Ca Mau en 126,300 ha in Bac Lieu en droegen respectievelijk47% en 51% bij aan het binnenlands product van deze provincies.

Echter, deze enorme expansie van visserij en visteelt heeft ook negatieve effecten. Honderdduizenden ha mangrove bos zijn omgezet in garnalen kweekvijvers en als resultaat hebben zich enorme veranderingen in het kust ecosysteem voorgedaan. Volgens vele studies heeft deze boom in visteelt en de gerelateerde verdwijning van mangrovebossen tot verzilting en verzuring van de bodems geleid, slechtere water kwaliteit vanwege de hogere concentraties van vervuilende stoffen (hogere turbiditeit, lagere niveaus van opgeloste zuurstof, hogere niveaus van organische stof), die ook uitbraken van ziektes in de garnalen hebben veroorzaakt. Deze veranderingen hadden ook negatieve gevolgen voor de huishoudens die afhankelijk zijn van visserij en visteelt.

Daarom richtte dit onderzoek zich op de ontwikkeling en beslissingen van garnalentelers en visserijhuishoudens om te laten zien hoe die voorzien in hun basisbehoeften en omgaan met de risico's en onzekerheden. Hierdoor hoopt deze studie de factoren te identificeren die de beslissingen van huishoudens beïnvloeden, niet alleen op het niveau van het huishouden zelf, ,aar ook op het niveau van de natuurlijke en sociale omgeving. Hiervoor gebruikt deze studie het concept 'ontwikkelingspad' dat verwijst naar patronen van activiteiten van huishoudens die ontstaan uit individuele strategieën die ingebed zijn in veranderingen in de omgeving en mondiale

ontwikkelingen, waarbij sociale differentiatie, machtsrelaties en institutionele veranderingen een rol spelen. Het onderzoek richtte zich op de vraag hoe huishoudens die leven kustvisserij en visteelt veranderen om zich aan te passen aan deze onzekerheden en hun sociale en ecologische veerkracht vergroten.

Volgens vele onderzoekers zijn kwetsbaarheid, aanpassing en veerkracht kernbegrippen in de studie van relaties, interacties en terugkoppelingsmechanismen tussen menselijke activiteiten op het niveau van het huishouden en veranderingen in de (ecologische) omgeving. Deze relaties en interacties kunnen worden geanalyseerd door te kijken naar beslissingen op verschillende sociale, economische en politieke niveaus, vanwege hun invloed op het gebruik, beheer en behoud van natuurlijke hulpbronnen en de sociale en ecologische veerkracht van het landbouwsysteem.

In deze studie worden vier verschillende systemen van garnalenteelt onderscheiden en een systeem van visserij, die een verschillend niveau van veerkracht laten zien. De garnalenteelt systemen zijn: het verbeterde extensieve system, het mangrove-garnalenteelt systeem, en het intensieve garnalenteelt systeem met en zonder samenwerkingsgroepen die samenwerking tussen garnalentelers bevorderen. De resultaten van deze studie laten zien dat garnalentelers een opmerkelijke sociale en ecologische veerkracht hebben ontwikkeld onder verslechterende ecologische omstandigheden. Alle huishoudens van garnalentelers en vissers hebben te maken met ecologische degradatie, verdwijning van de mangrovebossen, ziektes in de garnalen, fluctuaties in de marktprijzen and overheidsbeleid en –programma's die verkeerde prioriteiten adresseren, zij het dat zij deze omstandigheden in verschillende mate het hoofd moesten bieden. Garnalentelers in het verbeterde extensieve systeem, waren geïsoleerd vanwege het ontbreken van elektriciteit, problemen met het verkrijgen van kennis en opleiding. Toegang tot markten en gezondheidszorg was ook problematisch, vanwege het ontbreken van transport. Hoewel telers binnen het mangrove-garnalenteelt systeem formeel toegang hadden tot inkomsten uit het oogsten van mangroves, werd hun aandeel in de opbrengst op zodanige wijze berekend dat zij terughouden waren om te participeren in het beheer van de mangrovebossen. Binnen het intensieve garnalenteelt systeem hadden de meeste telers te maken met gebrekkig waterbeheer, frequente uitbraken van ziektes en daarmee samenhangende oogstverliezen, fluctuerende prijzen en heftige concurrentie. De visserij in de Mekong Delta is in het algemeen kleinschalig, en de meeste vissers beschouwden visserij als een onzeker bestaan en weinig belovend voor de toekomst. Dorpen van vissers waren meestal geïsoleerd, met weinig toegang tot onderwijs en alternatieve bronnen van inkomsten. De visstand was enorm gedaald en 90% van de huishoudens had schulden, meestal van private kredietverschaffers, die hoge rentepercentages eisten.

Vissers en vistelers passen zich aan deze omstandigheden die hen kwetsbaar maken aan door verschillende ontwikkelingspaden te kiezen, variërend van intensivering, diversificatie van inkomstenbronnen, migratie, specialisatie en samenwerking. Zij worden hierbij ondersteund en geloven in de kracht van verwantschappelijke en communautaire hulpnetwerken.

In Hoofdstuk 3, wordt getoond hoe garnalentelers in verschillende systemen verschillende ontwikkelingspaden hebben gekozen, variërend van de adoptie van nieuwe technologie, herontwerpen van kweekvijvers, het vernaderen van de timing van de garnalenteelt, diversificatie

van hun land gebruik, tijdelijk werk buiten de landbouw, het samenwerken in groepen, de integratie van landbouw en garnalenteelt, en het telen van hogere kwaliteit garnalen om een hogere prijs te krijgen op de markt. Bijvoorbeeld de telers in het mangrove-garnalen systeem kozen voor een organische productiewijze of andere modellen zoals verbeterde beheerspraktijken (Best Management Practices) en Good Aquaculture Practices (GAP), teneinde de marktwaarde en de kwaliteit van hun product te verhogen en beter te kunnen concurreren op de wereldmarkt. Toen de marktprijs voor garnalen inzakte gingen telers in het intensieve systeem over op andere productiesystemen, zoals het produceren van zout of het telen van vis zoals aal en modderkruiper, omdat deze systemen minder risico met zich mee brachten en kleinere investeringen vereisten. Anderen leegden hun kweekvijver en gingen over op niet-agrarische activiteiten zoals kleinschalige handel of werk in de industrie. Zij probeerden de kosten voor garnalenteelt te reduceren door hun vijvers anders te beheren en in te richten en over te gaan naar een andere garnalensoort (van *P. Monodon* naar *P. Vannamei*).

In hoofdstuk 4 wordt het vraagstuk van ecologische duurzaamheid nader uitgewerkt door een analyse van de strategieën van de garnalentelers in relatie tot overheidsbeleid met betrekking tot het beheer van mangrovebossen. De laatste decennia heeft de Vietnamese bijna het gehele bosareaal overgedragen aan private ondernemingen en boerenhuishouden om duurzamer beheer van bos te bevorderen. Deze ondernemingen hebben het beheer vaak ook weer aan garnalentelers gecontracteerd. Door te kijken naar de toegang tot inkomen van garnalentelers uit mangrovebossen die zij onder hun beheer hebben, laat dit hoofdstuk zien dat niettegenstaande het feit dat de boeren recht hebben op het grootste deel van de inkomsten uit bos onder hun beheer, zij niet in staat zijn hun aandeel in de inkomsten op te eisen. Dit is het gevolg fan het feit dat het toezicht op het beheer en de vermarkting van bosproducten nog steeds onder controle staat van de private ondernemingen, die dit proces in hun voordeel beïnvloedden. Hierdoor worden de garnalentelers niet aangemoedigd het mangrovebos duurzaam te beheren en bij te dragen aan het behoud hiervan.

Hoofdstuk 5 laat zien hoe kleinschalige vissers hun visgerei en boten hebben gediversifieerd om intensiever te kunnen vissen om hun inkomen te garanderen en hun kwetsbaarheid te verminderen. Dit heeft de afname van de visstand en ecologische verstoring veroorzaakt alsmede overtredingen van de visserijwetgeving. Kleinschalige vissers hebben grote moeite om de noodzakelijke investeringen te doen om de continuïteit van hun bedrijf te garanderen. Er zijn geringe mogelijkheden voor diversificatie buiten de visserij. De vangst neemt af in relatie tot hun investeringen in arbeid en operationele kosten, omdat grote vissersschepen concurreren in de kustwateren. Tenslotte hebben zij te maken met zeer gedetailleerde en soms tegenstrijdige wetgeving, die geen rekening houdt met hun behoeftes om te diversifiëren naar visgerei en soorten vis.

Hoofdstuk 6 gaat nader in op de rol van instituties en sociale netwerken in het opbouwen van menselijke capaciteit and sociale veerkracht. Het laat zien dat netwerken in de privésector en overheidsdiensten enorm verschillen in hun functioneren en ook anders worden gezien door de lokale garnalentelers en vissers. Het is moeilijker om toegang te krijgen to diensten van de

overheid zoals krediet vanwege lastige procedures en in het algemeen is de afstand groter dan die tot partners in de private sector. De mate van vertrouwen binnen de privé sector is hoger, zelfs als er ongelijke patroon-client relaties in het spel zijn en de uitgewisselde informatie in de private netwerken wordt in het algemeen als relevanter ervaren. Hoewel samenwerking in de privé sector sociale veerkracht bevordert, omdat het helpt om tegenslag te overkomen, bevordert het ook de intensievere teelt van garnalen en exploitatie van de natuurlijke omgeving die de ecologische veerkracht in gevaar brengt.

Mens en milieu, het sociale en het ecologische constitueren elkaar wederzijds in non-lineaire, veelvoudige en interactieve processen. De ontwikkelingspaden die mensen ontwikkelen in een bepaald stadium beïnvloeden niet alleen hun huishoudens in een specifieke omgeving, maar bevorderen ook het leerproces zodat men zich aan veranderingen kan aanpassen, om zich zelf te organiseren en hun leven te beheren om op lange termijn veerkracht op te bouwen. De activiteiten om inkomen te verwerven op het niveau van het huishouden kunnen worden onderverdeeld in drie categorieën die veerkracht bevorderen (tabel 7.1). De eerste cluster bestaat uit activiteiten om inkomen te verwerven, die meestal inkomen opleveren op de korte termijn door risico's te voorkomen en via aanpassingsstrategieën, zoals diversificatie van inkomstenbronnen, arbeidsmigratie, uitwisseling van arbeid, het vernaderen van het beheer van visteeltvijvers en illegale activiteiten zoals het vangen van ondermaatse vis. De tweede cluster van ontwikkelingspaden betreft het bevorderen van de capaciteit voor leren en aanpassen. Deze strategieën hebben betrekking op de langere termijn. Voorbeelden hiervan zijn beter beheer van mangrovebossen, nieuwe technologieën in de garnalenteelt, of het bevorderen van hogere opleidingen voor de kinderen. De derde cluster betreft het vergroten van de mogelijkheden voor zelforganisatie. Hoofdstuk 6 laat bijvoorbeeld zien dat huishouden betrokken raken in samenwerking binnen groepen van garnalentelers om aan nieuwe problemen het hoofd te bieden door relaties netwerken te ontwikkelen op basis van onderling vertrouwen, waarmee verbindingen met externe netwerken versterkt kunnen worden.

Dit onderzoek identificeerde vier indicatoren die een maat zijn voor sociale veerkracht: economische stabiliteit, bescherming van hulpbronnen, kennis en het bouwen van relaties. Van de twee verbeterde extensieve garnalenteelt systemen was het extensieve mangrove-garnalenteelt systeem het meest veerkrachtig, vanwege de lagere risico's, hoge netto productie, en beter waterbeheer. Vergeleken met het systeem zonder mangrovebos, had dit systeem een lager afbreukrisico, een beter verhouding tussen kosten en opbrengsten, en een hoger netto inkomen per huishouding. Daarboven op hadden deze huishoudens extra inkomen uit het gezamenlijk verkopen van mangrove met de private bosbouw ondernemingen. Bovendien oefent dit systeem geen extra druk uit op het mangrove bos, omdat voor het productiesysteem het behoud van het bos noodzakelijk is als kraamkamer voor de garnalen en de vis in de vijvers.

Binnen de intensieve garnalenteelt systemen was het systeem met samenwerkingsgroepen het meest veerkrachtig. Vanuit economisch oogpunt waren de telers in dit systeem beter af met een netto inkomen dat bijna twee maal zo hoog was als bij boeren die geen deel uit maakten van een samenwerkingsverband, de verhouding tussen kosten en opbrengsten was beter en minder oogsten

mislukten vanwege ziektes. Telers in de samenwerkingsverbanden pasten geavanceerde bio-farming technologie toe om hogere kwaliteit garnalen te produceren voor de wereld markt. Zij gebruikten ook een nieuwe garnalensoort (*P. Vannamei*) die hogere netto opbrengsten opleverde. Telers in samenwerkingsverbanden creëerden als groep betere relaties met private partners die hen ondersteunden. Zij zijn flexibeler en professioneler en beter toegerust om zich aan te passen, omdat ze als groep een sterkere juridische en economische positie kunnen verwerven die hun sociale veerkracht vergroot.

De Vietnamese overheid heeft een systeem van institutionele ondersteuning voor visteelt an visserij opgezet. Hierbij werd bijvoorbeeld het beheer van bos verder uitbesteed aan boerenhuishouden, door hen contracten aan te bieden met lange termijn landgebruiksrechten, die het mogelijk maakten voor boeren om meer inkomsten te verwerven uit zowel garnalenteelt als bosbouw. Om kustvisserij te beschermen moedigde de Vietnamese overheid zeevisserij aan vanaf het midden van de jaren 90 en vaardigde gedetailleerde wetgeving uit met beschrijvingen van vissoorten en toegestane maaswijdtes en toegestane visseizoenen per soort. Voorlichtingsdiensten, massaorganisaties van boeren en vissers, en kredietfaciliteiten werden ingesteld vanuit de centrale overheid tot op het lokale niveau. Echter, de uitvoering van dit beleid en het functioneren van de instituties die met de uitvoering waren belast op het terrein van visteelt en visserij is nog zwak en inadequaat. Deze interventies dienen namelijk het evenwicht te zoeken tussen het bevorderen van inkomen op het niveau van het huishouden en het behoud van natuurlijke hulpbronnen. Sociaaleconomische verbetering via armoedebestrijdingprogramma's is vooral voor huishoudens met lag inkomens van belang, omdat middeninkomen huishoudens zich het behoud van natuurlijke hulpbronnen 'zich al kunnen veroorloven', terwijl de armen dat niet kunnen. Hoewel het beleid op het gebied van het geïntegreerde beheer van mangrovebos en visserij bedoeld zijn om de sociale en ecologische veerkracht van het systeem te bevorderen, doen zij dat niet automatisch ook op het niveau van de huishoudens. Dit kan uiteindelijk een negatief effect hebben op de veerkracht van het hele systeem. Daarom is het niet genoeg om de nadruk te leggen op het vermogen van de overheid om het gedrag van boeren te beïnvloeden en gehoorzaamheid af te dwingen aan de regels voor het behoud van natuurlijke hulpbronnen, zonder tegelijkertijd sociaaleconomische vooruitgang te bevorderen op het niveau van het huishouden. Oplossingen zijn gelegen in het diversifiëren van bronnen van inkomsten buiten de garnalenteelt en de visserij, het bevorderen van samenwerkingsverbanden, het certificeren van garnalen. Echter de belangrijkste is om het beheer van mangrovebos en de kustvisserij meer toe te vertrouwen aan lokale individuele boeren en gemeenschappen.

Tóm tắt

Sau hơn 20 năm cải cách kinh tế, đánh bắt và nuôi trồng thủy sản đã trở thành hai ngành kinh tế quan trọng tại Việt Nam. Chính quyền Việt nam khuyến khích nuôi tôm nhằm xóa đói giảm nghèo, thúc đẩy xuất khẩu, và để cung cấp cơ hội việc làm cho người dân. Sự tăng trưởng nhanh chóng của ngành thủy sản từ giữa năm 1990 đến 2005 đã đưa Viết nam trở thành nước xuất khẩu tôm đứng thứ năm trên thế giới về sản lượng và giá trị. Từ năm 1990 đến 2009, sản lượng thủy sản tăng 547% từ 0,89 đến 4,87 triệu tấn, trong đó sản lượng tôm tăng 758% từ khoảng 55 đến trên 419,4 nghìn tấn. Từ năm 1995 đến 2009, kim ngạch xuất khẩu từ thủy sản đã tăng từ 621 triệu USD đến 4,26 tỷ USD, trong đó tôm đóng góp 1,3 tỷ USD. Trong năm 2010, ngành thủy sản đóng góp 4,6% GDP cả nước, tức 4,8 tỷ USD. Trong đó ngành công nghiệp tôm đóng góp nhiều vào sản lượng, thu nhập và tạo cơ hội việc làm cho hơn 4 triệu người.

Đề tài là một phần của dự án RESCOPAR "*Xây dựng khả năng phục hồi các quần thể ven biển và nguồn lợi thuỷ sản"* của Đại học Wageningen (INREF), Hà lan. Đề tài nghiên cứu sinh kế của cư dân đồng bằng sông Cửu Long, Việt nam. Nuôi tôm và đánh bắt là hai lựa chọn sinh kế chính ở Cà Mau và Bạc Liêu, hai tỉnh cực nam của đồng bằng sông Cửu Long, Việt Nam. Đây là vùng ven biển có mạng lưới dày đặc của các kênh, lạch, sông ngòi và rừng ngập mặn. Trong năm 2009, bên cạnh 227,8 nghìn tấn cá đánh bắt, hai tỉnh cung cấp 167,8 nghìn tấn tôm chiếm 53% sản lượng của đồng bằng sông Cửu Long và 40% sản lượng cả nước. Diện tích nuôi tôm ở Cà Mau chiếm 294,7 ngàn ha và ở Bạc Liêu là 126,3 nghìn ha, tương ứng đóng góp 47% và 51% GDP của hai tỉnh.

Tuy nhiên, sự mở rộng đánh bắt và nuôi tôm ảnh hưởng xấu đến môi trường. Hàng trăm ngàn hecta rừng ngập mặn đã bị thay thế bởi các vuông tôm, và kết quả là hệ sinh thái ven biển thay đổi nghiêm trọng. Theo nhiều nghiên cứu, sự bùng nổ nuôi tôm và suy thoái hệ sinh thái rừng ngập mặn đã mang đến hậu quả tiêu cực đến môi trường. Đất bị nhiễm mặn và axit hóa, chất lượng nước giảm sút (độ đục cao, nồng độ ôxy hoà tan thấp, và mật độ chất hữu cơ cao), ô nhiễm nước dẫn đến bệnh dịch tôm tràn lan. Những hậu quả tiêu cực hiện nay ảnh hưởng đến sinh kế của người dân đang sống phụ thuộc vào rừng và tài nguyên biển.

Đề tài sử dụng khái niệm "lộ trình sinh kế" (pathways)[36] và "ra quyết định" để tìm hiểu phương cách mà người dân nuôi tôm và đánh bắt ven biển dùng để đối phó với rủi ro nhằm duy trì sinh kế. Đề tài xác định các yếu tố ảnh hưởng đến quá trình ra quyết định của người dân ở cấp hộ gia đình. Các quyết định để thích ứng với sự thay đổi kinh tế, xã hội, tự nhiên và môi trường sinh thái. Lộ trình sinh kế khác nhau ở mỗi hộ gia đình khác nhau, lộ trình phụ thuộc vào mối quan hệ của cá nhân, vào sự khác biệt vai trò xã hội, của quyền lực cá nhân và thể chế xã hội. Câu hỏi

[36] Khác với chiến lược sinh kế (strategy), lộ trình sinh kế (pathway) được hiểu là sự thay đổi nhỏ của phương thức kiếm sống mỗi khi người dân đối mặt với khó khăn. Lúc ấy người dân chưa vạch định mục tiêu rõ ràng nên họ xây dựng lộ trình đơn giản, ít có khả năng và thời gian theo đuổi mục tiêu to lớn, lâu dài và vì vậy có thể mức độ thành công cũng ít hơn. Lộ trình sinh kế có đặc điểm là dễ uyển chuyển, dễ thay đổi và đáp ứng nhanh sự thay đổi của môi trường và kinh tế xã hội.

nghiên cứu của đề tài được đặt ra là: Người dân dân ven biển thay đổi sinh kế để thích ứng với sự bất ổn của môi trường và để tăng cường khả năng phục hồi sinh thái-xã hội như thế nào?

Theo nhiều tác giả, khái niệm về sự rủi ro (vulnerability), khả năng thích ứng (adaptation) và khả năng phục hồi (resilience) là ba khái niệm quan trọng trong nghiên cứu các mối liên kết và tương tác giữa các hoạt động con người và sự thay đổi môi trường xung quanh. Mối liên kết và sự tương tác này có thể tìm thấy trong quá trình ra quyết định ở cấp hộ gia đình dưới tác động của điều kiện kinh tế, chính trị, xã hội khác nhau. Các quyết định sinh kế liên quan đến việc quản lý, sử dụng và bảo tồn tài nguyên thiên nhiên và những quyết định này cũng sẽ ảnh hưởng đến khả năng phục hồi sinh thái-xã hội của cả hệ thống canh tác.

Đề tài nghiên cứu so sánh các cấp độ phục hồi sinh thái-xã hội của bốn mô hình nuôi tôm và đánh bắt khác nhau: nuôi tôm quảng canh cải tiến, rừng-tôm kết hợp, thâm canh (theo và không theo tổ hợp tác) và đánh bắt. Kết quả nghiên cứu cho thấy dưới điều kiện của sinh thái suy giảm, cấp độ phục hồi kinh tế-xã hội ở hộ gia đình trong các mô hình là rất khác nhau. Sinh kế người dân nuôi tôm và đánh bắt ở đồng bằng sông Cửu Long đang chịu rủi ro do sự suy thoái môi trường, suy giảm diện tích rừng ngập mặn, dịch bệnh tôm thường xuyên xãy ra, giá cả thị trường biến động, các luật lệ và chính sách thiếu khả năng thực thi. Người dân nuôi tôm quảng canh cải tiến gặp khó khăn vì thiếu điện sinh hoạt, điều đó cũng ảnh hưởng đến việc thu thập thông tin, kiến thức. Hơn nữa, điều kiện tiếp cận thị trường và chăm sóc sức khỏe cũng khó khăn vì giao thông trắc trở. Trong mô hình rừng-tôm kết hợp, quyền hưởng lợi từ sản phẩm cây rừng của người dân lẽ ra được đảm bảo chính thức, nhưng trong thực tế việc chia sẻ lợi ích này không minh bạch, vì vậy người dân còn miễn cưỡng trong việc tham gia bảo vệ rừng. Các hộ nuôi tôm thâm canh gặp khó khăn vì thiếu nước sản xuất, tỉ lệ hộ thất bại cao và mô hình này bị rủi ro nhiều nếu như giá cả thị trường biến động. Bên cạnh đó, ngư dân đánh bắt ven bờ với qui mô nhỏ lẻ ở đồng bằng sông Cửu Long có cuộc sống không ổn định, tương lai mù mịt. Làng chài nằm ở nơi xa xôi nên việc đi lại khó khăn. Ở đây có rất ít cơ hội việc làm cũng như tiếp cận giáo dục. Nguy cơ cạn kiệt tài nguyên ven bờ, trữ lượng cá giảm mạnh những năm gần đây và 90% các hộ ngư dân có vay nợ, chủ yếu từ các nguồn vay có lãi suất cao.

Người dân nuôi tôm và ngư dân đánh bắt ven biển đối phó với khó khăn bằng hằng loạt các lộ trình sinh kế khác nhau bao gồm nuôi thâm canh hoặc đánh bắt triệt để hơn, đa dạng hóa sinh kế, ra đi tìm cơ hội khác, tích cực áp dụng các biện pháp kỹ thuật hoặc hợp tác lại với nhau trong sản xuất v.v… Mặc khác, họ tự xây dựng mối quan hệ xã hội và dựa vào mạng lưới hỗ trợ từ phía gia đình hoặc cộng đồng.

Chương 3 cho thấy người dân nuôi tôm ở những mô hình khác nhau đã vạch ra những lộ trình sinh kế khác nhau từ việc áp dụng kỹ thuật canh tác tiên tiến đến thiết kế lại các ao nuôi, lựa chọn mùa vụ thả tôm, đa dạng hóa sử dụng đất đai, tìm kiếm thu nhập phi nông nghiệp, tham gia vào tổ hợp tác, kết hợp nuôi tôm và làm nông nghiệp, nuôi tôm chất lượng cao để bán được giá cao hơn. Ví dụ, người dân canh tác trong mô hình rừng-tôm chọn hình thức nuôi tôm sạch hữu cơ, các mô hình thực hành quản lý tốt (BMP) hoặc thực hành nuôi tôm tốt (GAP) để tăng giá trị tôm thành phẩm trên thị trường, đặc biệt là mô hình tôm sạch hữu cơ trong rừng-tôm kết hợp. Trong khi đó, khi giá tôm thành phẩm sụt giảm nhanh chóng, người dân nuôi tôm thâm canh đã chuyển sang các phương cách kiếm sống khác: sản xuất muối hoặc nuôi cá (cá chình, cá kèo).

Đây là mô hình sản xuất ít rủi ro và không cần nhiều vốn đầu tư. Một số hộ khác "treo" ao và chuyển sang hoạt động phi nông nghiệp như mua bán nhỏ hoặc công nhân ở các xí nghiệp. Bên cạnh đó, để giảm chi phí sản xuất, một số người thiết kế lại ao vuông, áp dụng cách thức mới để quản lý ao hoặc chuyển đổi từ nuôi tôm sú sang nuôi thẻ chân trắng.

Trong Chương 4, vấn đề môi trường bền vững được giải quyết thông qua việc phân tích các chiến lược sinh kế của người dân nuôi tôm liên quan đến chính sách quản lý rừng (rừng ngập mặn). Trong những thập niên qua, chính phủ Việt Nam đã giao rừng cho các công ty lâm nghiệp tư nhân hoặc cho các hộ gia đình để thúc đẩy việc quản lý rừng bền vững hơn. Các công ty lần lượt ủy thác việc quản lý rừng ngập mặn cho người dân nuôi tôm, để phân chia lợi ích, người dân nuôi tôm có được thu nhập từ rừng ngập mặn. Chương này nhấn mạnh rằng lẽ ra người dân có quyền hợp pháp đối với hầu hết những lợi ích từ mảnh rừng họ quản lí thông qua hợp đồng giao khoán với công ty lâm nghiệp, nhưng thực tế họ không thể thực thi các yêu cầu của mình. Việc quản lý và tiếp cận thị trường của rừng ngập mặn đã được đặt dưới sự kiểm soát của các công ty lâm nghiệp, các công ty thao tác mọi quá trình để có lợi cho công ty. Kết quả là người dân không có động lực để tham gia quản lý rừng nhằm góp phần bảo tồn rừng ngập mặn.

Chương 5 chỉ ra rằng ngư dân đánh bắt nhỏ lẻ ven biển đang đa dạng hóa các loại lưới và tàu thuyền để đánh bắt triệt để nguồn lợi thủy sản ven bờ nhằm duy trì cuộc sống. Chính điều đó gây ra sự suy kiệt tài nguyên, làm xáo trộn hệ sinh thái ven biển và vi phạm những quy định nghề cá. Vấn đề ở đây là vì ngư dân đánh bắt quy mô nhỏ, họ không có khoản đầu tư lớn để đánh bắt xa bờ và ít có cơ hội đa dạng hoá sinh kế ngoài việc đánh bắt triệt để ở ven bờ. Ngoài ra, họ đang bị đe dọa bởi sự suy giảm lượng cá đánh bắt cho mỗi đơn vị công suất (CPUE) bởi vì các tàu lớn cạnh tranh với họ ở vùng biển gần bờ. Cuối cùng, họ phải đối phó với các quy định nghề cá rất chi tiết và mâu thuẫn lẫn nhau mà các qui định này lại bỏ qua nhu cầu của họ khi họ cần đa dạng hoá các thiết bị và loài cá đánh bắt.

Chương 6 nghiên cứu vai trò của các tổ chức và mạng lưới xã hội trong việc xây dựng năng lực và khả năng phục hồi sinh kế của người dân. Ta thấy rằng các mạng lưới ở khu vực tư nhân và cơ quan nhà nước có hoạt động khác nhau và được đánh giá khác nhau bởi những người nuôi tôm địa phương và ngư dân. Họ cho rằng tiếp cận dịch vụ nhà nước rất khó khăn do các thủ tục rườm rà so với tiếp cận các đối tác ở khu vực tư nhân. Mức độ tin tưởng trong mạng lưới tư nhân cao hơn, ngay cả trong quan hệ chủ - khách hàng thì việc trao đổi kiến thức trong các mạng này thích hợp hơn. Mặc dù hợp tác với các mạng lưới tư nhân làm tăng khả năng phục hồi xã hội và người dân có thể giúp đỡ lẫn nhau để vượt qua những cú sốc, nó lại thúc đẩy nghề nuôi tôm thâm canh và khai thác triệt để môi trường, gây nguy hiểm cho khả năng phục hồi sinh thái.

Con người và môi trường, xã hội và hệ sinh thái được hình thành từ quá trình tương tác phi tuyến tính và đa dạng. Lộ trình sinh kế người dân đang theo đuổi hiện nay không những chỉ là những hoạt động sinh kế trong hoàn cảnh hiện tại, mà qua đó người dân đang nuôi dưỡng nhận thức và kinh nghiệm để họ có thể thích ứng với những thay đổi sau này, lúc đó họ sẽ tự tổ chức và quản lý cuộc sống để xây dựng khả năng phục hồi dài hạn. Các hoạt động sinh kế ở cấp hộ gia đình có thể được nhóm thành ba cấp bậc phục hồi sinh kế (Bảng 7.1). Cụm đầu tiên bao gồm các hoạt động sinh kế mang lại lợi ích chủ yếu trong ngắn hạn nhằm giảm thiểu rủi ro. Đó là các chiến lược thích ứng chẳng hạn như: đa dạng hóa sinh kế, di cư, làm dần công, "treo" ao, đánh bắt cá

con v.v… Cụm thứ hai bao gồm những chiến lược tích lũy kiến thức, nuôi dưỡng nhận thức và năng lực, đó là những chiến lược sinh kế phục vụ lợi ích lâu dài. Ví dụ người dân quyết định bảo vệ rừng ngập mặn, áp dụng công nghệ mới trong nuôi trồng, nâng cao kiến thức và kỹ năng, theo đuổi những ngành nghề tinh xảo đòi hỏi chuyên môn cao, hoặc đầu tư cho việc học tập của con cái sau này. Kết quả sinh kế linh hoạt, chuyên biệt và chuyên nghiệp hơn. Ở giai đoạn này, sự có mặt của các tổ chức chính trị và chính sách hỗ trợ là rất quan trọng. Cụm thứ ba là lộ trình sinh kế hướng đến việc tự tổ chức và quản lí cuộc sống. Chương 6 cho thấy rằng những người tham gia tổ hợp tác một cách tự nguyện đối phó tốt khi gặp khó khăn đột xuất nhờ vào hoạt động trong tổ hợp tác, vào mối quan hệ đáng tin cậy và điều đó giúp mở rộng mối quan hệ của họ đến các tổ chức khác.

Đề tài sử dụng bốn chỉ tiêu đại diện cho khả năng phục hồi sinh thái-xã hội, đó là: sự ổn định kinh tế, việc bảo vệ tài nguyên, nâng cao kiến thức và thiết lập mối quan hệ. Trong hai hệ thống nuôi tôm quảng canh cải tiến, hệ thống rừng-tôm kết hợp thể hiện tính tính bền vững và ít rủi ro do tỷ lệ thất bại thấp, có hệ thống thủy lợi phù hợp, có lợi nhuận cao hơn. Ngoài ra, những người trong mô hình này được chia sẻ lợi nhuận từ việc bán gỗ rừng với công ty lâm nghiệp. Hơn nữa, hệ thống rừng – tôm không gây áp lực cho môi trường vì mô hình này phải gìn giữ khoảng rừng ngập mặn như là mảnh vườn ươm cho các loài tôm và cá biển.

So sánh hai mô hình nuôi tôm thâm canh, mô hình thâm canh trong tổ hợp tác mang hiệu quả hơn. Từ góc nhìn kinh tế, người dân trong mô hình này khá giả hơn, lợi nhuận ròng trên đơn vị diện tích gấp đôi các hộ thâm canh không tham gia tổ hợp tác, tỷ lệ lợi nhuận so với chi phí sản xuất cao hơn, và ít trường hợp tôm bị bệnh hơn. Hơn nữa, người dân trong tổ hợp tác áp dụng nuôi thẻ chân trắng mang lại lợi nhuận cao. Các thành viên trong tổ hợp lại thiết lập mối quan hệ với các cơ quan, tổ chức bên ngoài để được giúp đở. Họ hoạt động sinh kế tích cực, uyển chuyển, chuyên nghiệp hơn để thích ứng với tình huống. Họ có thể định hình và điều khiển được sự thay đổi để giành được quyền lợi hợp pháp và vị trí bình đẳng để tăng cường khả năng phục hồi xã hội.

Chính phủ Việt Nam đã thiết lập một hệ thống các qui định, chính sách và thể chế rõ ràng để hỗ trợ nuôi trồng thủy sản và đánh bắt. Ví dụ, Quyết định 24/QD.UB (2002/12/09) được thay thế bởi Quyết định 10/QD.UB (22/09/2010) hướng đến việc tăng cường phân cấp quản lý rừng ngập mặn bằng các chính sách giao đất giao rừng và chuyển một số hợp đồng đất lâm nghiệp sang giấy chứng nhận sử dụng đất lâu dài, điều đó cho phép nông dân đạt được lợi ích nhiều hơn từ nuôi tôm và lâm nghiệp. Ngoài ra, để bảo vệ và phục hồi nguồn lợi thủy sản ven bờ, chính phủ Việt Nam khuyến khích đánh bắt xa bờ vào giữ thập niên 1990, và đã ban hành Luật Thủy sản trong đó qui định chi tiết loài thủy cấm đánh bắt theo mùa, kích thước mắt lưới, mùa vụ khai thác, loài thủy sản được phép đánh bắt v.v… Ngoài ra, hệ thống các tổ chức khuyến nông/ngư, tổ chức chính trị quần chúng, hệ thống tài chính tín dụng đã được thành lập từ trung ương đến địa phương. Tuy nhiên, việc tổ chức thực hiện các chính sách quản lí rừng và tài nguyên biển trong lĩnh vực nuôi trồng thủy sản và đánh bắt vẫn còn yếu và không thỏa đáng.

Sự can thiệp của các chính sách, trước hết cần chú ý đến việc cân bằng giữa hai mục tiêu: cải thiện kinh tế ở hộ gia đình và bảo tồn tài nguyên thiên nhiên. Kinh tế hộ gia đình được cải thiện thông qua các chương trình xoá đói giảm nghèo, đặc biệt đối với những người có thu nhập thấp,

bởi vì chỉ những hộ có thu nhập trung bình mới có khả năng bảo tồn tài nguyên, trong khi các nghèo thì không thể. Mặc dù các chính sách quản lý rừng-tôm và đánh bắt nhằm tăng khả năng phục hồi sinh thái-xã hội của hệ thống, chính sách này lại không quan tâm đến kích thích tăng trưởng kinh tế của hộ gia đình, đó là lí do các chính sách không thành công trong việc phục hồi sinh thái của hệ thống. Vì vậy, chỉ nhấn mạnh vào tăng cường năng lực của chính quyền trong kiểm soát, quản lí và ép buộc nông dân và ngư dân thực hiện các quy định để bảo tồn các nguồn tài nguyên là không đủ, mà đồng thời cần phải thúc đẩy việc cải thiện kinh tế - xã hội ở cấp hộ gia đình. Một trong những giải pháp để phát triển kinh tế nông hộ có thể là đa dạng hóa sinh kế phi nông nghiệp, thúc đẩy sản xuất hợp tác và tăng cường kỹ thuật nuôi tôm. Ngoài ra, quan trọng nhất vẫn là phải phân cấp trách nhiệm và quyền quản lý rừng ngập mặn và tài nguyên ven biển cho người dân địa phương, cá nhân và cộng đồng.

About the author

Tran Thi Phung Ha was born in 17 July 1961 in Cantho, Vietnam. She completed her Bachelor degree in Cartography at Moscow State University of Geodesy and Cartography (MIIGAiK, Russia) in 1985 and graduated Master of Science in Educational and Training Systems Design in 2002 at Twente University in Enschede, the Netherlands.

She started her carrier in 1985 at Cantho University (CTU) as a lecturer on courses related on Cartography, Geodesy and Instructional Design. She participated in the MHO (Dutch programme on international university co-operation) collaboration with Can Tho University, in the SHELL project conducted by MSU (Michigan State University) and the VLIR project in cooperation with the Belgian Universities. Aims of these projects were (1) environment protection via education, (2) poverty alleviation, and (3) innovation in teaching methods by implementing Information and Communication Technology (ICT). During this time she was staff member of CTU' School of Education.

In 2007, she obtained a PhD sandwich fellowship from the RESCOPAR project *(Rebuilding resilience of coastal populations and aquatic resources: habitats, biodiversity and sustainable use options)*. She started her PhD program with Rural Development Sociology group in Wageningen University, the Netherlands under supervision of prof. Leontine Visser and Prof. Han van Dijk. Currently, she is working as senior lecturer at the newly created Department of Sociology, School of Social Sciences and Humanities at Cantho University, Vietnam.

Completed Training and Supervision Plan

Name TRAN THI PHUNG HA

PhD candidate, Wageningen School of Social Sciences (WASS)

Name of the activity	Department/ Institute	Year	ECTS
A) Project related competences			
Complexity in and between social and ecosystem	CERES	2007	3
Competencies for Integrated Agricultural Research	CERES	2007	1
Action research action learning	WUR	2009	4
Techniques for Writing and Presenting Scientific Papers	WUR	2007	1.2
B) General research related competences			
Orientation courses (Research school CERES)	CERES	2007	5
Presentation tutorials	CERES	2007	5.5
Summer school	CERES	2011	3
Chairgroup seminar + seminar from WASS	WUR		1
C) Career related competences/personal development			
RESCOPAR research seminar	RESCOPAR	Yearly	3
Presentation "Factors effecting livelihood capabilities and diversification of shrimp' farmers in the Mekong Delta"	MARE Conference	2009	1
Poster presentation "Factors affecting livelihood capabilities and strategies of shrimp farmers in a region of Mekong Delta, Vietnam"	Conference on Aquaculture in Phuket	2010	1
Presentation "Mangrove forest management and farmers' livelihoods in shrimp-mangrove system in Ca Mau province, Mekong Delta of Vietnam"	Asian fisheries and aquaculture forum, Shanghai	2011	2
Presentation "Fishery livelihoods and compliance with fishery regulations – a case study of small-scale fishery communities in Ca Mau, Vietnam"	Colorado Conference on earth system governance	2011	2
Teaching, tutorial and supervision BSc & MSc students	CTU		2
TOTAL ECTS			34.7

*One ECTS on average is equivalent to 28 hours of course work