Vulnerability and Adaptation of Women Aquaculturalists to Climate Change

Case Study of Women in Small-scale Aquaculture in Tien Hai District, Thai Binh, Vietnam

Nguyen Thi Thu Ha

Consortium of Development Studies in Southeast Asia (CDSSEA)

IDRC | CRDI Canada

CDSSEA number 19

Consortium of Development Studies in Southeast Asia (CDSSEA)
Publication Series

About the series

The Consortium of Development Studies in Southeast Asia has drawn on primary postgraduate research undertaken for theses from the master's programs of Asian Institute of Technology's Master of Science in Gender and Development Studies (MGDS), Chiang Mai University's Master of Arts in Social Science (Development Studies) (MASS); and the Chulalongkorn University Master of Arts in International Development Studies (MAIDS). Scholarships for the students of CDSSEA has been generously provided by the International Development Research Centre (IDRC) of Canada. With a diversity of academic approaches (gender studies, political science, social sciences), the individual works of this collection have in common a focus on the increasing interconnection and regionalization of the five mainland Southeast Asian countries (Myanmar, Thailand, Laos, Cambodia and Vietnam), and examine these exchanges and encounters within the context of the Greater Mekong Sub-region (GMS).

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RCSD
The Regional Center for Social Science and Sustainable Development
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Consortium of Development Studies in Southeast Asia series
Volume 19

ISBN: xx-xxx-xxx-xxx-x

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Series Editor: Chayan Vaddhanaphuti
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Publisher: Regional Center for Social Science and Sustainable Development (RCSD)
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rcsd.soc.cmu.ac.th, e-mail: rcsd@cmu.ac.th
Printed: August 2018
Price: 250 Baht

National Library of Thailand Cataloging in Publication Data
Nguyen Thi Hong Van.
Gender Participation in Forest Resource Management:, Benefit Sharing Mechanisms in Thuong Nhat Commune, Bach Ma National Park Buffer-zone, Thua Thien Hue, Vietnam.-- Chiang Mai : Chiang Mai University Press, 2017.
xxx p. -- (Critical Perspectives on Regional Integration).

1. Pa-Oh (Asian people)--Burma. 2. Burma--Social life and customs. I. Title.
305.8958
ISBN: **xx-xxx-xxx-xxx-x**

Copy Editor: Colin Roth
Layout and cover design: Jeff Moynihan
Cover Photo: Binh Nguyen Van
Printer: Wanida Karnpim Limited Partnership

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Series Foreword

The Regional Center for Social Science and Sustainable Development (RCSD) at Chiang Mai University has extended its publication program to include Master's dissertations from The Consortium of Development Studies in Southeast Asia (CDSSEA). The CDSSEA series covers mainland Southeast Asia: Myanmar, Thailand, Cambodia, Laos and Vietnam, and regionalization, development encounters and exchanges within the Greater Mekong Sub-region (GMS).

The CDSSEA program brings together resources and expertise from three of Thailand's leading institutions offering Master's degrees in development studies: Chiang Mai University's Master of Arts in Social Science (Development Studies) (MASS); Chulalongkorn University's Master of Arts in International Development Studies (MAIDS); and the Asian Institute of Technology's Master of Science in Gender and Development Studies (MGDS). Although the Consortium's program focuses on the relationship between development studies and social sciences, each of the programs has a different emphasis. The Chiang Mai degree focuses on social sciences and anthropological perspectives, with research interests in environmental and resource management, food security and local livelihoods, labour migration and trans-border issues, ethnicity and development, health, tourism, and agrarian transitions. Chulalongkorn's program concentrates on the political dimension of development, including democratization, human rights, conflict resolution, international and civil society development organizations, community development and globalization. The Asian Institute of Technology focuses on the relationships between gender and development—including women's rights, civil society, and gender dimensions of urbanization and industrialization.

The CDSSEA program has a practical dimension, building leadership capacity in mainland Southeast Asia's regional development, bringing together postgraduate students, encouraging debate, and promoting the rethinking of development alternatives in such areas as social equality, justice and participation, environmental and economic sustainability, and community development. In this regard, a major objective is to develop the knowledge and skills of development practitioners and to enhance the quality and effectiveness of policy-making and its implementation in the region.

The publications in this series—selected from the CDSSEA Master's program—are designed to express this diverse range of interests in development studies and regionalization, and to emphasize the relationships between empirical and theoretical research, policy-making and practice.

Victor T. King, Senior Editorial Adviser,
Consortium of Development Studies in Southeast Asia series

Contents

List of Figures and Tables

Abbreviations

ADB	Asian Development Bank
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment
MCD	Centre for Marinelife Conservation and Community Development (Vietnamese NGO)
NACA	Network of Aquaculture Centres in Asia-Pacific
NGO	non-government organisation
UNVN	UN Vietnam

Glossary of Terms

Extensive fish farming	Fish farming conducted in medium- to large-sized ponds or water bodies; fish production relies on the natural productivity of water which is only slightly or moderately enhanced. Externally supplied inputs are limited; costs are kept low; capital investment is restricted; the quantity of fish produced per unit area is low.
Fingerling	a young or small fish
Fish seeds	fertilized fish eggs are known as *Fish seeds*. Simply put, they are the baby fish used for seeding new ponds in fisheries.
Intensive fish farming	fish production emphasizing maximum output per unit of rearing area. Feed, water and quality of stocked fingerlings are controlled to improve the production conditions. There is steady monitoring during the production cycle. All these controls entail high-tech practices and capital-intensive investments.
Litopenaus vannamei	a breed of shrimp
Pangasius	a breed of catfish
Red Book	land title document
Sao	Vietnamese land measure; 360m² (0.03 ha, 0.09 ac)
VND	Vietnamese currency (Dong) 1,000,000 VND = US$44

Acknowledgements

I would like to express my deepest gratitude and appreciation to my advisor Dr. Kyoko Kusakabe, Gender and Development Studies, for her useful advice and constructive guidance. Her great support helped me to find the correct direction for my work.

I am deeply grateful to Dr. Phillippe for his kind support and thoughtful advice as my thesis committee member. I would also like to take the opportunity to express my sincere appreciation to Dr. Ram C. Bhujel for his guidance and his suggestions for my work.

I am really grateful to the Asian Institute of Technology and CDSSEA scholarship for awarding me the scholarship to pursue a Masters Degree in Gender and Development Studies at AIT.

I would like to say thanks to Dr. Tuong Phi Lai & Dinh Xuan Lap, directors of my working organization, for their valuable support and encouragement to complete my study successfully. I am really thankful to my classmates and close friends who always stood by me and supported me during my studies.

I would like to acknowledge my deepest indebtedness to my parents and my sisters who always encourage and support my spirit. My special gratitude goes to my husband, who gave me support and encouragement throughout my study.

Nguyen Thi Thu Ha

Chapter 1

Introduction

Background

Small-scale aquaculture provides alternative livelihoods and income generating opportunities for many poor rural communities. Almost all (98%) of the world's small-scale fish farmers are in developing countries - mostly in rural areas. According to the FAO the livelihoods of more than 520 million people depend mainly on fisheries and aquaculture. The practice of aquaculture is long-standing, especially in coastal communities where it relies on rich seafood sources. Small-scale aquaculture produces 50-80 % of animal proteins in South Asia. Fisheries and aquaculture employ over 50 million people globally, a quarter of them in aquaculture. In Cambodia, small-scale aquaculture contributes significantly to the provision of essential nutrition, 75% of total animal protein intake coming from fish. Small-scale aquaculture contributes about 6 % of Gross Domestic Product (GDP) in Laos.

Many studies have shown that most freshwater aquaculture production in Asia is still from small-scale farms (Edwards, 2009). According to Weimin et al., (2012), small-scale aquaculture refers to low economic turn-over, informal business operations, and typically family-owned small businesses. Bueno (2009) described small-scale aquaculture as a business of few production units, communally or family run, along with low to moderate level of inputs and limited use of external labor, with farmers earning small amounts of money from the sale of aquatic plants and animals and fish products. The low level of

farming input for aquatic animals and plants allows farmers time to pursue other activities such as crop and livestock farming. Small-scale aquaculture also serves as an entry to commercial aquaculture, although small scale aquaculture is considered as less risky due to its low investment. One advantage of this pattern is that it can be adopted easily by poor farmers who have limited access to finance and credit. Shrimp culture in Thailand and pangasius culture in Vietnam play a considerable role in foreign currency earning in these countries and also in job creation for the local people both directly and indirectly. (Starting in 2007, cultivation of pangasius has contributed about US$ 1 billion per year to Vietnam's economy (Phuong et al., 2008).)

In Vietnam, fisheries and aquaculture are the second most important livelihood source after rice production. Small-scale aquaculture occurs mainly in ponds and contributes to the welfare and nutrition security of poor households through increased consumption of fish and higher incomes (Kawarazuka and Béné, 2010). The majority of the farmers (72%) are relatively small-scale (Phan et al., 2009). Aquaculture has quick growth and contributes at least 30-40% of national fishery production (FAO and NACA, 1997). Vietnam is highly dependent on the forestry, agriculture, and aquaculture sectors, which support 70% of livelihoods. It has been badly affected by climate change and is likely to be one of the most significantly impacted nations by climate change in terms of the aquaculture sector due to its geographical location. Almost all its main economic sectors depend on reliable natural resources including land and water, and are all clearly affected by climate change including storms, droughts, typhoons and related extreme weather events (GFDRR, 2011). On top of this, the country has low adaptive capacity due to low financial, technical and technological capabilities, weak institutions, lack of climate change consciousness and lack of a national adaptation policy to climate change (ibid).

Thai Binh province has an area of about 50sq km and is the biggest coastal area in Vietnam. It is situated in the Red River Delta, with low land (average height 1-2 meters above sea level) and less than 1% of slopes. The province is the country's largest centre of small-scale aquaculture. It is highly vulnerable to sea level rise and natural hazards. Frequent storms/typhoons have had direct impacts on local farmers' livelihood activities in recent years, as well as on their strategies in relation to aquaculture.

Gender is an important issue in aquaculture. Women play a crucial role in small-scale aquaculture. Aguilar, L (2002) found that in Thailand, Cambodia, Vietnam, Laos, and Philippines women have a more important role than men in aquaculture production and in harvesting littoral organisms. In most of these cases, women deal with fish hatchery operations, harvesting, grow-out production, management, and developing fish seed. Due to male migration, either seasonal or permanent, many women become household heads who have to manage the whole operation of farm production, including aquaculture. The consequences of natural disasters leading to significant losses of marine resources bear heavily on women's livelihoods which are highly susceptible to the effects of climate change.

Several research studies have shown that climate change impacts on men and women differently: "women and men have different roles, resources, rights, knowledge and time with which to cope with climate change" (Nelson, V. & Stathers, T. 2009). Hence, they have different perceptions, responses and adaptations of livelihood activities.

According to Lambrou & Piana (2006) "very poor and nomadic" women might have higher adaptive capacity than others because they have greater experience of facing climate-induced risks in their daily life. But as yet there is insufficient empirical evidence to suggest the effectiveness of their indigenous knowledge in enhancing resilience to natural disasters.

Statement of the Problem

Coastal areas in Vietnam are vulnerable to frequent typhoons, storm surges, flash floods, droughts and saline water intrusion due to the impacts of climate change (Chaudhry & Ruysschaert, 2007). Women aquaculturists rely mainly on the marine resources - seaweed, fishing, clams and shrimps – that are worst affected by climate change. Tien Hai district has the most prolific small-scale aquaculture in Thai Binh province. But small-scale aquaculture is vulnerable to natural disasters, particularly during the monsoon season when flooding results in significant losses of aquaculture outputs and income for a coastal economy based primarily on rich seafood sources. Climate variability is considered a serious threat to the livelihoods of poor people who are very dependent on climate and nature (ISPONRE, 2009) with limited income sources (World Bank, 2010 cited by Trung, 2013).

Perceptions of climate-related risk are gendered, both as to effects and responses. This is because women have different roles and responsibilities, skills, and knowledge, based on the gender division of labor and socio-cultural norms. Women are more disadvantaged in coping with climate-related risks due to their limited scope for adaptive measures: they have to handle a huge workload with limited assets and livelihood options (Nelson, 2011); they have less access to resources and information, fewer property rights, and fewer employment opportunities. They tend to be the poorest of the poor in most poor societies, and their livelihoods are more precarious and sensitive to climate change (FAO, 2011). They are often less educated than men which limits their options (Lambrou and Grazia, 2006). And lastly, they have very little engagement with disaster management and climate change adaptation, due to their limited capacity to participate in decision-making processes (FAO, 2007 cited in Nelson, 2008).

Some research has shown that women's workloads have increased because of climate change (Bäthge, 2010; Lambrou and Piana, 2006). Usually, women are responsible for collecting fuel, water, and food for household consumption. In the climate change situation, particularly in the event of flooding, these tasks have become more difficult; for example, they may have to travel longer distances and use up more time to find water. More sickness in the family, and preparations, repairs, and recovery before and after storms, all add to their workloads. In consequence they have less time for education, training programs, income-generating activities and participation in community decision-making processes. Climate change worsens gender inequalities, and creates more vulnerability for women in poor households since it brings all this extra work (Lambrou and Piana, 2006).

Adaptation to climate change has been an important research topic, since climate change has become recognized as a global issue (Bates et al, 2008). In Vietnam, some studies have been conducted to find out the impacts and identify adaptation strategies to cope (Britta H, 2009; Adger, 2003; ADB, 2013; Oxfam, 2009). Some other studies have been conducted on the coastal community to identify issues of gender in the development of livelihood and disaster management (FAO, 2011). Most of the studies were carried out to discover the impact of climate change on farmers, and to explore the ways in which they adapted their livelihood activities to take account of it. However, no studies were done on the adaptability of women in aquaculture in the coastal areas of Vietnam; most studies on natural

disasters have failed to recognize gender issues, and have not explored the different needs of women and men in relief efforts and local level planning. Misperceptions about women and their knowledge - regarded as "primitive" and "unscientific" - hold them back from playing a major role in development. Kabeer (1996) states that the cost of equity, welfare, and efficiency rises with the failure to incorporate gender awareness into the policy and planning process. The interests of males and females may enter into the process, but the perceptions of male interest get prioritized by the policy makers. Issues of gender and the representation of women, both at national and international level, are lacking in climate change policy debates (Lambrou and Piana, 2006: Kabeer and Subrahmanian, 1996 cited in Abound, 2011).

This study will focus on women's adaptation of their livelihoods to climate change, since they are more vulnerable to disasters than men (Nelson et. al., 2002) and their voices and needs are constantly ignored in disaster and post-disaster circumstances (Khondker, 1996). In many studies, there is a lack of analysis of factors that create difficulties for women in coping with climate change, including poor access to early warning information, limited credit, increased household responsibilities, lack of capacity to access and control resources, imbalanced gender division of labor, and unequal decision-making power at household and community levels. All these factors are constraints for women in adapting their livelihood activities to take account of climate change. This study aims to discover how women aquaculturists cope with disaster, and to explore their constraints in both male- and female-headed households. The women's experiences do not take place in isolation but are embedded in the social rules and norms and gender relations in the family. The understanding of these issues will provide comprehensive insights for policy-makers to devise effective policies where gender-specific considerations can contribute significantly to disaster risk reduction and climate change adaptation in vulnerable coastal communities.

Research Questions

1. How do climate change–related phenomena such as storms/typhoons affect women aquaculturists in the coastal area?
2. How do women aquaculturists diversify their income generating activities to adapt to storms/typhoons in the coastal aquaculture?

3. What are the constraints facing women aquaculturists in diversifying into new livelihood activities in adapting to storms/typhoons?

Research Objectives

Overall Objective

The general research objective is to gain an in-depth and detailed understanding of adaptation strategies by women aquaculturists, focusing on two huge storms - number 8 (2012) and number 5 (2013) - which resulted in floods that had negative impacts on local farmers' livelihoods in general and in particular on women aquaculturists' livelihoods in the coastal district. The study will explore the constraints/barriers experienced by women aquaculturists in adapting to the disasters, in both male- and female-headed households.

Specific Objectives

1. To assess the specific impacts of climate change in the shape of storms/typhoons on women aquaculturists in the coastal area.
2. To examine how women aquaculturists in the coastal area diversify their income generating activities to adapt to storms/typhoons.
3. To explore constraints/barriers affecting women aquaculturists in diversifying into new livelihood activities in adapting to storms/typhoons.

Scope and Limitation

This study focuses on the impacts of storms/typhoons on coastal livelihoods in Tien Hai district of Thai Binh province, focusing on women aquaculturists including married women but especially women in female-headed households. The study explores the adaptation strategies for coping with the impact of floods adopted by these women, who derive their main income directly or indirectly from aquaculture. The findings of this research cannot be used to provide common adaptation strategies for the whole country, due to different natural conditions, religion and socio-economies. But the adaptation strategies should be applicable for coastal areas which have similar conditions and social-economies to the research area.

Chapter 2

Literature Review

The purpose of the literature review is to describe the concepts and definitions relevant to the research topic, and to find typical examples from other countries with similar problems.

Gender and Aquaculture

In aquaculture, gender is an important issue since women and men, girls and boys, carry out distinct types of work and have distinct kinds of knowledge, familiarity, and expertise as well as different decision-making roles. There is a clear gender-based division of labor. Men usually take responsibility for small-scale capture of aquaculture species whereas girls and women deal with the activities of processing for human consumption (fermenting, pickling, drying, salting, and smoking) and marketing. The gender analysis is different depending on whether fish are raised in household ponds or in community farming systems along with crops or livestock. It is necessary to analyze women's access to and control over resources within this broader farming system. Generally, men and women take responsibility together to handle all the activities. However, men are perceived as the experts in building cages, gathering seeds, and preparation of ponds, while women concentrate on fish nurseries.

Traditionally, the aquaculture sector is considered as male dominated, perhaps because of the high level of investment and new technology application required during its development. Women have major roles in the value chains through their participation in different tasks involving crab, seaweed, shrimp,

and fish. They have very limited involvement in capturing fisheries. Women play important roles in aquaculture production in Southeast Asia: in Cambodia high yields are obtained from fish ponds mainly operated by women; in China and Thailand, women left behind by male migration take charge; in Lao PDR women are engaged pisciculture and are exclusively involved with selling fish - they are traders, buyers, sellers, entrepreneurs, and middle-women for table-sized fish, and they also control the income from the sales (Murray et al., 1998). Women in India participate in different aspects of shrimp farming, collection of seed, construction of ponds, collecting and preparing feed materials, maintenance of ponds, and handling post-harvest situations (Gopalakrishnan, 1996). Minh et al., (1996) found that women in Bangladesh were profitably involved in fish nursery activities. More women are involved in post-harvesting activities than men, including in fish smoking. Working in aquaculture is an extension task of women coordinated with household activities including child rearing (Kelkar, 2001). However, women's engagement in aquaculture is not recognized and tends to be ignored by the men (Chakrott, 1981). There are no attempts to develop women's capacity: they are regularly excluded from extension, training, and credit programs (Acharya and Bennett, 1982).

Gender imbalance in aquaculture leads to unequal distribution of labor and lower productivity. Limited access to land, assets, technology and limited decision making derive from cultural norms; and unequal structure from laws, norms and values in society. In many developing countries women usually have low status in aquaculture and agriculture.

Aquaculture and Climate Change

It is very difficult to forecast the socio-economic effects of climate change on aquaculture production, due to the unpredictability of climate-related risks. Research on the impacts of climate change has been increasing, yet little research has been undertaken into its effects on aquaculture in particular.

Climate change impacts on fish farming communities can be linked to the five assets that make up the livelihoods framework: human, natural, financial, social and physical. Based on the literature survey and knowledge of aquaculture systems, the following sections give examples of how these assets may be affected. The framework can be a useful tool to gauge the impact of climatic stresses on the aquaculture sector, and to provide a typology of impacts at a range of scales.

Changes in natural capital involve changes in the shallow temperature of the sea and in the quality of water that can affect costs of production and incomes. Physical capital can be lost forever due to the impact of storms, floods and famines. The result of a loss of assets and farming capacity is something which small fish farms in particular may be unable to cope with. In Florida in 2004 hurricanes Frances and Charley led to an estimated $8.7 million loss to clam and oyster farmers, counting only stock losses and not including infrastructure such as boats, buildings and hatchery facilities (Bierschenk, 2004). In Bangladesh the aquaculture sector was devastated by floods in 2004: in Chandpur district, more than 13,000 fish farms suffered damage to the tune of 35.5 million dollars (Growfish, 2004b); in Fulpur, fresh water shrimps on 30 acres of land were washed away by flood waters (Hague, 2004). It was estimated by the Bangladesh Small Fishermens' Association that 80% of water bodies of fry had been washed away in 45 flood hit districts. Most of the fish farmers did not have enough money to repay their loans.

Climate variability and change might increase conflicts over scarce resources like fresh water and coastline space. In Thailand and Taiwan, the exhaustive farming of shrimp has led to lower water tables and salination of local land since the farms used large amounts of fresh water (Braaten and Flaherty, 2001; Primavera, 1998:263). Salination decreases water availability for agriculture and domestic use as well as industrial uses (Primavera, 1998:263). Climate change can increase the frequency of droughts, and the consequent lack of fresh water can lead to conflict in the aquaculture and other sectors. Aquaculture can be a source of habitat alteration, for example by eliminating mangroves which help to control floods (Naylor et al., 2000). Between 1943 and 2000 Viet Nam lost 218,000 ha (just over 50%) of its mangroves; by 2013 another 21,000 ha had been lost. Shrimp farming played a significant role in the latter years.

Gender and Climate Change

Gender and Climate Change Vulnerability

Blaikie et al. (1994) defined vulnerability as "the characteristic of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard". Much research on vulnerability to climate change addresses not only the economic and material aspects but also the social

aspects. Adger and Kelly (1999) found that social vulnerability to climate change was affected by access and control over resources, diversity of income sources, the social status of individuals in the society, and institutional and market structures. They also demonstrated that although rich and medium-income households may experience greater losses (in absolute terms) than the poor, they are more resilient and recover more quickly because they have greater access and control over resources and social networks. At household level, the ability to adapt to climate change depends on control over land, money, credit, and tools; low dependency ratios; good health and personal mobility; household entitlements and food security; secure housing in safe locations; and freedom from violence (*Lambrou and Piana 2006*).

Due to their geographic locations, developing nations are highly vulnerable to the risks of climate change. Over 96% of disaster-related deaths in recent years have taken place in developing countries. Lamere (2013) stated that environmental degradation, extreme poverty, and limited infrastructural development increase the vulnerability to climate change risk of less developed nations. Vietnam is a developing country with around 70% of the population living in lowland, delta or coastal areas exposed to climate-change related hazards such as heat waves, droughts, typhoons, and more intense rainfall. These negative impacts may undermine human development gains (Oxfam and UNVN, 2009). Assets, infrastructure, and farms may be destroyed along with local residents' livelihoods.

A study conducted in 2003 in Thai Binh found that 75 % of the population depended mainly on marine resources and aquaculture. Floods caused the most serious damage in terms of socio-economic development. Floods and heavy rains have caused losses of livelihood assets for farmers in many provinces in Vietnam. In Thai Binh up to 95% of households lost income from aquaculture through loss of products and reduced product value. Rich households' losses including livestock were almost 7 times greater in absolute terms than the losses of the poor (Nghiem et al., 2010), although proportionally the poor suffered greater losses - 65% of their income from livestock and 70% of their income from crops, as against 35% and 33% respectively for the rich. The poor were additionally vulnerable because they had fewer options for protecting and evacuating their homes. Climate-related risks are greater for poor people as they have less diversity of income sources, and less access to credit to fill in income gaps (Nghiem et al., 2010).

Evidence from around the world suggests that women are more likely to be hurt or killed in disasters than men, due not only to the force of the disaster but also to their lower socio-economic status (Neumayer and Plumper, 2007). Women also have less capacity to cope with the impact of disaster (Nelson et al., 2002). Women accounted for 61 percent of the fatalities caused by Cyclone Nargis in Myanmar in 2008, 70–80 percent in the 2004 Indian Ocean tsunami, and 91 percent in the 1991 cyclone in Bangladesh (Aguilar, 2008: 2: Oxfam International, 2005).

The differential perception and impact of climate change on women and men is due to social norms, traditional roles and different power structures (Schalatek, 2009: 14). Women have limited access to information, lack of resources and services, and less decision-making capacity at household and community level. They also face a greater work burden, less livelihood options, have fewer assets and limited access to micro-credit (Nelson, 2011). They are responsible for child-bearing and child care. Fuel, food, and water collection – women's activities – are all affected by climate change. Due to lack of education and training, women are reduced to informal low-paid work. Their limited income limits their capacity to diversify their livelihoods to better withstand climate-change related shocks (FAO, 2011). In Nepal, women play a determinant role for food security in their families. The increased occurrence of droughts, floods, landslides, and soil erosion due to climate change is affecting food production, and threatening food security and rural people's livelihoods, particularly of women who depend largely on agricultural production and livestock raising. Although women are the main producers of food, they do not have access to the resources needed to help them perform their work better and increase their productivity. This is because their role is not properly acknowledged. In the Himalayan region, women rarely have access to land ownership, technology, extension services, and financial resources. Because their role as farmers and natural resource managers is not acknowledged, women are more likely to be sidelined in climate change adaptation strategies, rendering such strategies less effective. Omari (2008) notes that women's household and family tasks, such as food and energy supply and looking after children and the sick and the elderly, leave them no time for income generation activities. Women are thus disadvantaged in coping with disasters, environmental change, and climate variability. "Climate change, therefore, magnifies existing

inequalities, reinforcing the disparity between women and men in their vulnerability to and capacity to cope with climate change."

Gender and Climate Change Adaptation

"Adaptation is a process, by which strategies to moderate, cope with, and take advantage of the consequences of climate events are enhanced, developed and implemented". Therefore "Adaptation measures can be driven by the individual households and/or guided by political decision makers to address specific impacts and vulnerabilities" FAO (2006).

Several features of agricultural systems make them sensitive to climate and influence their reaction to climate change. Those features include cultural, social, economic, political, and institutional factors (Bryant el al., 2000). From another perspective, the characteristics of systems include stability, resilience, vulnerability, flexibility and scale (Smithers and Smit, 1997).

Adaptation responses can be affected by socio-economic factors and resources (Bryant et al., 2000; Deressa et al., 2000; Evans et al., 2000). For instance, wealth, access to extension, credit and climate information were factors affecting the adaptive decisions of farmers in Ethiopia. In South Africa, the factors were wealth, government farm support, access to fertile land and credit (Bryant et al., 2000). Demographic factors such as education level, household size, and gender were found to significantly affect famers' adaptation (Deressa et al., 2000). Information was emphasized as an influence on farmers' attitudes (Evans et al., 2000). Access to land was shown to be more clearly associated with the adaptive responses of coffee farmers to climatic and non-climatic stresses than the perception of risk (Tucker et al., 2001).

Adaptation in small-scale aquaculture can include a variety of policy and governance actions, specific technical support or community capacity building activities that reduce the negative impacts of climate change on the farmers. Adaptation activities may address short- or long-term impacts. For example, farmers in Bangladesh used a variety of locally available fish species and aquatic organisms with high-tolerant habitats and high yields. Farmers were also provided with training and technological support. Loans were provided to support individuals creating employment and self-employment with a focus on applications of advanced technologies and techniques for crab fattening and integrated fish farming. Some simple but effective techniques

were also introduced to reduce the impacts of climate change, especially from floods. For example, bamboo pens with trap doors were built next to the farmer's house, and stocked with some fish so that when the seasonal flood came, those fish were not washed away, and new fish could be introduced via floodwater. Chinese farmers promote a traditional farming technique to increase production and reduce environmental degradation (Weimin, 2010). Rice/fish farming systems were introduced. The traditional farming system involved fish (and sometimes ducks) raised in rice paddies. Farmers are provided with pest control and fertilizers, reducing the need for external inputs and costs, increasing profitability and reducing environmental impacts. The system also reduces competition for water and other resources and provides additional income and food sources, which provide another buffer against climate variability. In general, different types of approach were practiced by local farmers to adapt to the impact of the climate change including traditional and local practices, and assimilated farming systems of crop-livestock-aquaculture. The farmers also used technology driven strategies, and engaged in income generating activities to extend their livelihoods by using available resources and support from various organizations including NGOs and social networks.

Vietnam is one of the nations most affected by climate change, with a variety of adaptation approaches at household level. Adaptation strategies in aquaculture are changing farming design, by means of a diverse mixture of inputs, expanding varieties of aquatic organisms, and finding new water sources in case of scarcity (World Bank, 2010). A study in 2014 indicated that farmers' attitudes to climate change were usually "wishful thinking, climate change denial, and fatalism". Their incentive to adapt is, however, strengthened when they perceive the higher prices of electricity, water, and fuel as well as the high level of stress among their neighbors, relatives, and friends. The farmers can benefit from information regarding climate change risks and the usefulness of adaptive measures. However, wrong information can lead to misconceived adaptations, so it is important to ensure the accuracy and timeliness of the information. Sources of information such as agricultural extension services are also important in supporting farmers with technical knowledge about adaptive measures. Learning experiences from their neighbors and other local sources are also the choice of a large number of households.

A study conducted in a coastal area indicated that households in coastal zones in Nam Dinh province have taken steps to adapt to the impacts of climate

change on their aquaculture practices. Households have changed aquatic species and aquaculture techniques.

Gender, Adaptation Strategy and Climate Change

The key goals of adaptation strategies are not only to reduce vulnerability to climate change but also to sustain and enhance the livelihoods of the most vulnerable people – the ones most directly affected. According to Carney (1998) "A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base". The key definition of livelihoods has shown that livelihood assets are a primary tool for increasing the resilience of households to vulnerability. Livelihood assets include natural capital, physical capital, social capital and financial capital. These are the most important means of production available for use in livelihood activities of individuals, households and social groups, and are the basis for understanding how people will respond to climate-induced vulnerabilities.

Livelihood Diversification

A study by Ellis (2000) found that livelihood diversification can be an alternative to overcome poor living conditions and reduce the negative impact of climate change for the farmer. It involves the creation of a portfolio of farming and non-farming livelihoods. Households can diversify by complementing crop production with livestock rearing, employment on other farms or in the non-farming sector, self-employment, and gathering (Ellis, 2000:15 and Mortimore and Adams, 2001, p 55). The main purpose is to maintain and develop livelihoods through the creation of different income generation activities.

Because men and women have different knowledge, rights and responsibilities, diversification of their livelihoods for climate related risks has to proceed in different ways. Their vulnerability to the impacts of climate change is also different. The case studies show that climate change aggravates the feminization of agriculture as men are pushed into migration, thus increasing women's workload. Climate change aggravates already existing problems faced by women in developing countries whose livelihoods depend on agriculture and natural resources. Women are the first to face the consequences of natural

disasters and extreme weather conditions. In case of drought they have to travel longer distances to collect water and fodder. In case of flood, they have to look for new ways of income generation to compensate for income and assets lost. In order to cope with these situations women make use of their experience and learning. Women have always utilized knowledge gained through experience: most of the women in the aquaculture sector in India innovate to insure against unpredictable climate conditions, for example by switching to highly tolerant aquatic organisms which give an increased yield.

Migration

There are two key issues for individuals to consider in deciding whether to migrate due to climate change. What do they see as the risks associated with climate change? And how do they analyze the benefits and costs arising from migrating/staying. Individual perception of climate change risk is central to how individuals respond. Perceptions are informed by a variety of sources, not only scientific reports but what experts say, what their peers say and what the media say (Connell, 2003). An individual's risk perception is also informed by their trust in regulators and other authorities, personal experience, values, worldviews and the availability of information (McLeman and Smit, 2006).

Adger (1999) found that migrants are part of the labor force available to the household as a result of remittances, which enable the household not to have to rely so much on farming income. In this way they achieve food security and at the same time ease the pressure on their available land. Hence, it is an effective way of livelihood diversification for farmers in the climate change context. Having regard to the scarcity of current resources, migration is considered as the best approach to reduce vulnerability to climate change for defenseless households (World Bank, 2007).

In most communities, male migration is more likely than female. Women and children have to face a more difficult situation at home as they have to take on all family responsibilities when the men are absent (Thanh, 2008). Gray and Mueller (2012) found that in Ethiopia droughts and flood were the main motivations for male migration in order to supplement household income. This leads to modification of the gender division of labor, increasing women's workload, and making it necessary for women to engage in new income generating activities to secure their daily livelihoods (FAO, 2011). Male migration can provide the opportunity for women to access and control

resources and exercise decision-making in the family in relation to their livelihood diversification. However, due to cultural norms and social practices, men are considered as the breadwinners and household heads and they hold the land certificates and rights of use. This is a great obstacle for women's access and control over resources and limits their access to credit: when the men are absent the women cannot access credit as they are without land property rights and hence have no collateral to offer. In general, male migration adds to women's burdens and limits their resources, heightening their vulnerability at exactly the point at which their responsibilities increase (BRIGDE, 2008).

In a few cases, there is also the possibility for women to migrate. A powerful example of the transformative effect of such migration is provided by the Philippines, an island nation with thousands of isolated, peripheral communities. Female migration to work both overseas and in Philippine urban areas has dramatically increased in recent years. Singapore, Hong Kong, and the Arabian Gulf region are prominent destinations for Filipina overseas contract workers, often hired as live-in domestic workers (McKay, 2005). Migrant remittances sent back to home communities are regularly invested in material goods such as agricultural tools, cars, and motorcycles. Household renovations and development of home-based businesses (e.g. corner stores, tailor shops) are also fueled by migrant income. In general, female migration has become an important means of diversifying household livelihoods, funding additional diversification strategies, and, therefore, promoting overall household security (McKay, 2005).

In Vietnam many people migrate from the country to urban areas due to various factors, usually lack of land, lack of employment, and limited access to income. Male migrants are mostly engaged in construction work as well as squid catching, shrimp or sea fishing. They also work as hired fishermen. Women work as hired laborers on farms, or as domestic or factory workers (Adger 1999). Most seasonal migration is to Hanoi or the provincial capital. Remittances contribute to household income, especially in coastal communities where migration occurs regularly and continuously. Dang Nguyen Anh (2004), in a survey conducted in the villages of the Red River Delta, emphasized that the rate of out-migration, especially in the form of seasonal temporary movements, was likely to remain high. Among the key contributing factors is the low level of income from farming, which is linked to limited availability of agricultural land and risks such as flood, drought and livestock diseases. In

general, migration potentially reduces the vulnerability of local residents to climate change by increasing household livelihood resources, and the proportion of non-climate-dependent income (Adger, 1999). However, it is not denied that male migration may create problems for family members by increasing the workload of those left behind - the women who have to take charge of men's roles in addition to their existing responsibilities.

Conceptual Framework

The conceptual framework illustrates the factors to be taken into account in assessing the effects of climate change on women aquaculturists in particular, evaluating the adaptive strategies available to them, and the extent to which these strategies are adopted in practice.

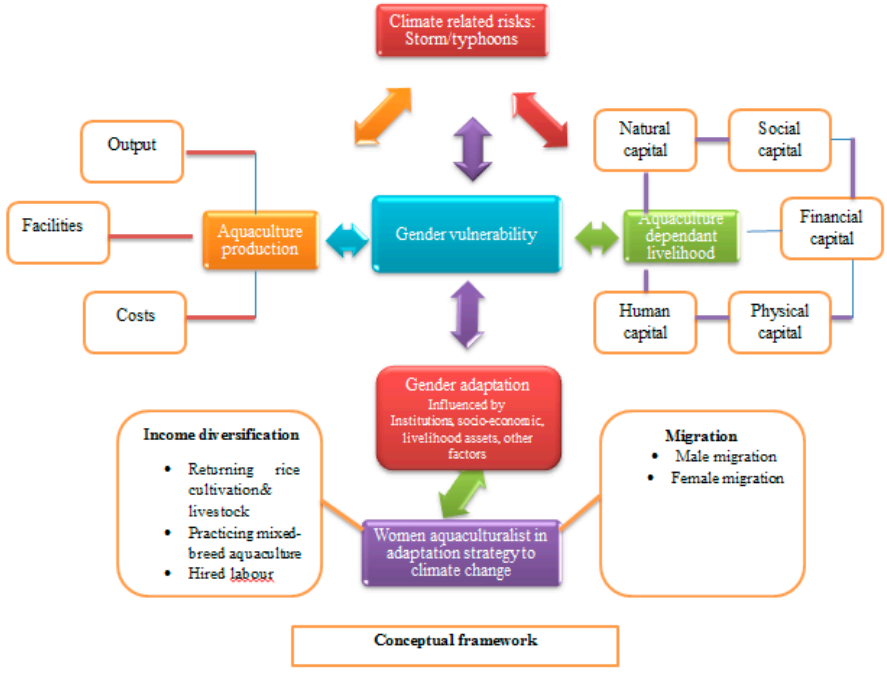

Figure 2.1: Conceptual Framework

Chapter 3

Methodology

Research Approach

The qualitative approach was used to provide an in-depth and detailed understanding of the impacts of climate change on women aquaculturists in the study area, as well as their responses to these changes. It was used to examine (1) the impacts of climate change such as storms/typhoons on social and economic situations/conditions of local residents; (2) how women aquaculturists are affected by these changes, and (3) how women aquaculturists diversify their livelihoods to cope with the negative impacts of climate change. The method is also used to investigate the social, economic, and cultural factors leading to differences in vulnerability as between women and men.

The quantitative method is a useful additional tool to explore climate variability through indicators such as the number of floods in a year. The method is also used to collect data on the demographics of women aquaculturists in both female- and male-headed households in the study area, by age group, education, income, and land size for aquaculture. Thus, this study will use a mixture of both qualitative and quantitative analysis in order to provide a rich and in–depth understanding of women's perceptions.

Criteria for Area Selection

Tien Hai, a coastal district of Thai Binh province in Vietnam's Red River Delta, is a predominantly agrarian economy, characterized by small-scale and semi-extensive agriculture. Aquaculture is considered as the most important livelihood source in the region. Extensive and improved fish and shrimp farming in both freshwater and brackish ponds with various kinds of aquatic species - crabs; oysters; small, big pelagic and sugar prawns - are the principal forms of aquaculture. The district has 34 communes with 23 km of coastline and 8 coastal communities, and lies in the country's most disaster-prone area. Due to the long coastline and weak physical infrastructure, Tien Hai district suffers physically and socially from the impact of climate change such as climate fluctuation, rising sea level, high temperature, and especially storms/typhoons and associated floods. Storms/typhoons resulting in floods appear to pose the biggest threat to the coastal communities. Recent storms impacting on Tien Hai resulted in significant loss of houses, livelihood assets, facilities, aquatic outputs and household income.

Dong Hai and Dong Minh are two coastal communities selected for this study, being zones with the greatest potential for aquatic organisms in the district. The basic occupations of the villagers are crop cultivation, livestock breeding, aquaculture and fishing, with aquaculture as the most important livelihood source. The area was directly and negatively affected by the impacts of storms/typhoon numbers 8 and 5 (2012 and 2013 respectively), to a greater extent than any other zone in the coastal area. There are significant differences in the adaptation strategies of women aquaculturists in the respective districts. Dong Minh has a high proportion of medium and high-income households using new aquaculture technology and new crop varieties as their main adaptation measures. In contrast, Dong Hai is one of the poorest areas of Tien Hai district with predominantly low-income households whose main coping strategies are the sale of their labor in the local community and seasonal migration to the big city.

Research Design

Sampling and Sample Size

Purposive sampling was chosen for this research study, the sample size to be determined based on the principle of systematic sampling. The study

conducted interviews with 98 respondents in total, and included a household survey, in-depth interviews, and key informants.

Data Sources and Data Collection Method

Primary and secondary data were collected.

Primary Data Collection

Primary data were collected by observation, participatory rural appraisal, key informant interviews, in-depth interviews and a household survey.

Household survey

The main purpose of the household survey was to get detailed information as follows:-

- demographic (age, literacy, marital status, household head, household size);
- aquaculture operation (land size, production, productivity, income);
- climate variability as it affected women aquaculturists (perception, how often, impacts of storms/typhoons on aquaculture production and productivity, existing adaptation strategies).

According to the population survey, there are 3,078 households in Dong Minh and 2,670 households in Dong Hai engaged in aquaculture farming: total households engaged in aquaculture farming in both districts = 5,748. The number of total sample size was calculated by using the Yamane formula. System sampling was used to select 98 households from the 5,748 aquaculture farming households.

1. Step 1: Prepare a list of households divided by household head with the assistance of the Head of Village and District Fisheries Office. The households should only be those engaged in pond aquaculture.
2. Step 2: Calculate sample fraction k=N/n while n=Sample size, N=Population size k=5748/98=59
3. Step 3: Pick a random number (r) between 1 and 59.

4. Step 4: We picked random number 10. We started from the first household with number 10. Subsequent units are chosen systematically - number 10+1.59; 10+2.59; 10+3.59 - until we chose 98 households for interview. Respondents will be taken according to 10, 69, 128, 187….

After the selection of the total of 98 respondents, we divided them into two household categories: male-headed and female-headed, as shown in Table 3.1.

	Dong Minh	**Dong Hai**	**Totals**
Total households	3,078	2,670	5,748
Proportion (%)	53.54	46.45	100
Sample (n=98)	52	46	98
Numbers of women:			
Male-headed Households	42	23	65
Woman-headed households	10	23	33

Table 3.1: Sample Size of Total Household in Selected Site
Sources: Field survey, 2014

Thus the 98 households engaged in aquaculture included 65 women in male-headed households and 33 in female-headed households. 98 respondents from the 98 households were chosen for interview using semi-structured questionnaires. All respondents were of working age between 23 to 80 years old and directly or indirectly involved in small-scale aquaculture. All of them had land and ponds for aquaculture. They were neither heads of household nor dependent members of the family. They were from the group/households who were most directly affected by the negative impact of strong storms/typhoons, particularly storm number 8 (2012) and storm number 5 (2013).

Field Observation

The study used field observation through verbal and non-verbal communication based on economic activities and the role of both genders. Field observations were applied in two zones of coastal Tien Hai and Thai Thuy district, Thai Binh.

Key Informant Interviews

Key informant interviews were conducted with Village Leaders (2 respondents), Village Elders (2 respondents), Leaders of the commune's Women's Union (2 respondents), Chief Officers of the Resources and Environmental Department (2 respondents) and the Agriculture and Rural Development Department (2 respondents). The in-depth interviewees were people with great knowledge and experience of historical changes of climate and livelihood activities affected by climate hazards, as well as gender relations in villages, communes, and districts, and how women aquaculturists diversify their livelihood activities to cope with climate change.

In-depth Interviews

20 women were selected for interview from the 98 in the household survey, 10 in male-headed households and 10 in female-headed households. The women in male-headed households were involved in domestic and aquaculture activities, sharing decisions with their husbands. "Female-headed households" in Vietnam usually means households headed by a widow or an abandoned wife. However, a further category needs to be included: women with absentee (migrant) husbands, who generally run the household on their own and in some cases take household decisions. Female-headed household was broadly defined to include households where farm-level decision-making was undertaken by women, i.e. both de jure and de facto woman-headed households. Male household members may be entirely absent, engaged in off-farm employment, too ill, too old or too young to work, or migrants working outside the village.

Because adaptation strategies are different for different types of female-headed households it was necessary to divide them into 2 groups:

Group 1: Women in female-headed households whose husbands had died, or who were divorced (called "widows" or "abandoned".)

Group 2: Women in female-headed households whose husbands had migrated to the city or to another country, and who receive remittances from their husband.

The purpose of the interviews was to provide a comprehensive understanding of (1) the vulnerability of women aquaculturists in a coastal

district to natural disasters, taking account of gender relations as in gender division of labor, access and control over resources and decision-making in reproductive, productive and community aspects; and (2) women's perception of the experience and the adaptation strategies available to them to cope with natural disasters. The interviews also explored the factors or constraints that put women at greater risk than men.

Focus Group Discussions

There were two discussion groups with 10 people in each group in each of the two zones. Firstly, focus group discussions with village elders who had retired from aquaculture were organized to obtain an overview of the general climatic conditions, the important extreme weather events, and how these have changed over the past 20 years. Mapping, social memory mapping and semi-structured interviews were used during these discussions. Mapping was used to examine the distribution of natural resources, residents, infrastructure and vulnerable locations in respect to climate change. Social memory mapping was used to understand the long-term dynamic of climate change and the behavior of the local people after these changes. Semi-structured interviews were used to investigate the loss and damage caused by these changes and their impact on local life. This helped to obtain an overall picture of how local people coped with the changes.

Two focus group discussions were organized with women in male-headed households and woman-headed households respectively. We applied mapping, social memory mapping and semi-structured interviews for the focus group discussion so that we could see the differences between the two focus groups in their perceptions of climate change, losses, and adaptive changes. Timelines with critically determined points related to the most important extreme event were used to understand how people cope with and adapt to changes. These tools were used to focus more on adaptation strategies. Livelihood analysis was used to understand the circumstances of the people in facing climate change as well as helping to identify which factors influenced their adaptive capacity. Semi-structured interviews were used during the discussions to comprehend the damages and losses due to the changes, and how people adapted.

Secondary Data

Secondary data were collected from officials at all levels (provincial, district and commune), from reports, books and articles. This was to get information about (1) socio - economic development of the districts and zones in recent years, with regard to the aquaculture sector; (2) the impact of climate change, particularly major storms and floods, on aquaculture production; (3) gender issues in climate change vulnerability and adaptation to those changes

Data Analysis

Context Analysis

Floods impact on women aquaculturists in different ways according to their different circumstances - physical, social and cultural norms, socio-economic conditions, etc. So context analyses were used to provide comprehensive understanding of the specific contexts of the coastal community, including how women aquaculturists coped with disaster, how they exercised their roles, rights and responsibilities in the family and the community; and how they adapted their livelihood strategies to climate-related risks. This provided an essential background to explore the constraints on women aquaculturists in adapting to natural disasters, and to identify the effective adaptation strategies for them to cope.

Case Studies

Case studies were applied to draw pictures of men's and women's vulnerability and adaptive capacity to climate variability in different zones/ groups based on the following criteria:-

- Marital status: married, single or widowed
- Power relation: head of household or dependent
- Income: low, medium or high
- Well-being status: well off, medium or poor
- Age: young or old
- Land/pond: owned or rented
- Livelihood strategies: farm, non-farm, off-farm, migration

Comparative and Descriptive Statistics

Comparative statistics were used to compare basic socio-economic features of the respondents between the two coastal districts by gender group, level of education, income and land area size for aquaculture; and to compare various groups of women of different marital status (married or widowed), power relation (head of household or dependent); income group (low or medium/high); and livelihood diversification (farm/non-farm activities diversification).

For the survey data analysis, descriptive and bivariate analysis was done for the relevant variable, using SPSS (Statistic Package for Social Science, version 17.0). In cases where patterned relationships were observed, tests of significance were done by using the t-test for continuous variables and chi-square test for nominal variables at P-value =0.05.

Chapter 4

Study Site Profile

This chapter provides background information on Tien Hai including Dong Hai and Dong Minh. This is essential to understand the socio-economic context and the climate situation and to get an overall picture of the study site. The chapter describes the impacts of storms/typhoons on aquaculture production and on the lives of women whose livelihoods depend on the natural resources of the two coastal communes. These zones have the highest potential for aquatic organisms in the coastal province, but have been the most directly and negatively affected by the impacts of storms/typhoons in recent years.

Study Site Profile

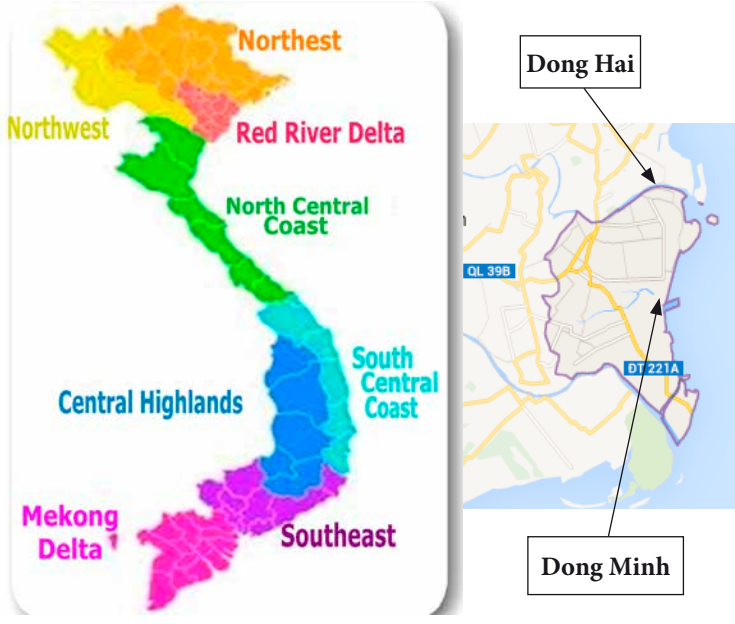

Figure 4.1: Tien Hai, Thai Binh, Viet Nam

Tien Hai is a coastal district of Thai Binh province in the Red River Delta of Viet Nam. The district has 34 communes, 23 km of coastline and 8 coastal communities. With a long coastline and weak infrastructure, the district is vulnerable to natural disasters.

Tien Hai is dynamic and developed. The basic occupation is agriculture followed by salt production, livestock breeding and hired labor. The highest percentage of annual GDP growth belongs to the industry and services sector, followed by aquaculture which has expanded both in area and productivity. Nearly 800 ha of ineffective salt production and rice cultivation has shifted to intensive aquaculture.

Semi-extensive farming of aquatic products in brackish, sea and freshwater ponds (shrimp, crab, clam, oyster, carp, grass carp, major cap, silver carp) is the principal form of aquaculture. Vegetables and fruit are other income generating activities. The crop calendar is an important tool for aquaculture, based on extensive local knowledge, and is the foundation for good harvests.

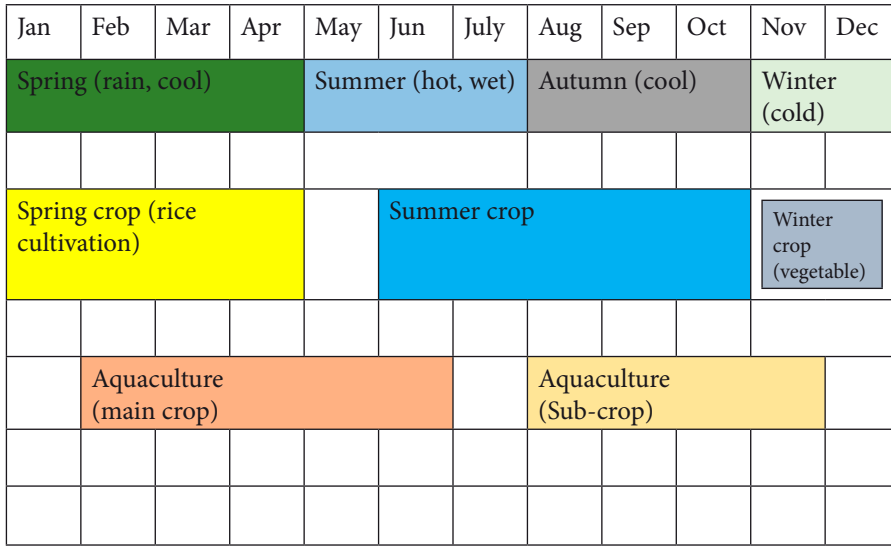

Table 4.1: Timeline of Crop Calendar in Selected Communes
Source: Key Informants and Group Discussion in Two Zones, 2014

Climate Change Situation in Tien Hai district, Thai Binh

Temperature

Tien Hai is located in the tropical monsoon zone and with a typical coastal climate. There are two main seasons in the year - dry and rainy. There have been significant changes in the weather recently, especially since 2002. The dry season is from April to August. The summer temperature is now higher than before and the hot periods last longer (for example the temperature rose to 42°C in 2008 while the highest temperature previously recorded was only 37°C). The winter is quite cold and associated with dry weather, lasting from the end of October to January. In 2007, the district suffered nearly 40 days of continuous cold with the lowest temperature at 4°. In addition, the area experienced an unusually cold weather period from December to March, as well as a prolonged extremely hot weather period between April and September. It is more difficult now to see the differences between the seasons. Climate change is becoming more complicated and unpredictable.

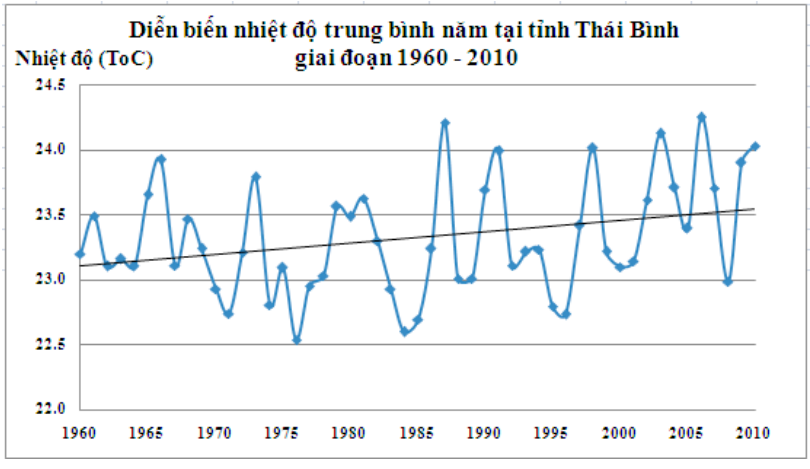

Figure 4.1: Average Temperature of Thai Binh from 1960 to 2010

From 1960 to 2010, the average temperature increased by 0.4°C, rainfall temperature by 0.9°C, and dry temperature by 0.35°C. The field survey found that when temperature increases, shrimp and crab usually eat more aquatic plants than usual but that growth of the plants slows down. In addition, aquatic plants are more likely to die in the hot season. Thus the impact of higher temperatures is negative for aquaculture.

Rainfall Variability

The rainy season is normally from July to November but this has also changed recently, with rainfall and flood coming earlier and lasting longer, often destroying infrastructure (houses, transport, irrigation, and dyke systems). Rainfall has become more variable in recent years, with heavy rain becoming more irregular and more intensive (Figure 4.2).

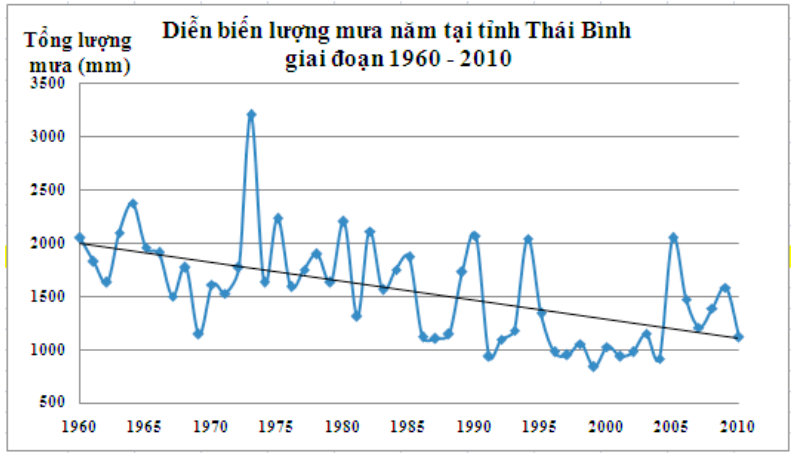

Figure 4.2: Rainfall Variability of Thai Binh from 1960 to 2010

Storms/Typhoons

Storms/typhoons are natural phenomena occurring annually, particularly in coastal areas, but recently they have become more intense and complex with greater frequency and intensity. Storms result in floods that happen quickly and cause great loss and damage to people and property. The heavy rain of up to 1500 mm caused by storm number 8 in 2013 seriously flooded the whole area for several days.

Storms become more complicated and uncertain. There are one or two storms in some years, but no storms in others. The effects depend on timing, wind and sea level. For example storm number 4 (22/8/1996) with wind level of 11 coincided with the incoming tide. As a result, the storm broke 8 dyke lines, and flooded over 5000 households totally destroying their rice cultivation and aquaculture. From 1980 until now, there have been 15 storms in Tien Hai, including 4 storms with strong winds from levels 11 to 12, causing 127,601 houses to be partially damaged, 12,376 houses totally destroyed, 588 fishing boats wrecked, 483 people injured, and 74 people killed.

Dong Minh and Dong Hai Zone's Profile

The study was conducted in the coastal communes of Dong Minh and Dong Hai, located to the North and South of Tien Hai District, with 3,078 and 2,670 households respectively engaged in aquaculture.

		Dong Hai	Dong Minh
Households			
	aquaculture farming	2,670	3,078
	poor	731 (36.7%)	313 (15%)
Labor Force			
	total	4,359	5,329
	agricultural	1,036	1,670
	aquacultural	2,256	2,906
	industry and services	318	500
	other	749	253
Land (ha)			
	total	502.43	612.26
	agricultural	259	321.7
	aquacultural	103.4	165.2
	residential	49.3	50.5
	other	90.73	74.86

Table 4.2: Dong Minh and Dong Hai at a Glance
Sources: People's Committees of Dong Minh and Dong Hai, 2012

During the last 20 years, the communes have experienced more variable weather and regular natural disasters such as extreme rainfall, severe floods and droughts, stronger cyclones, and rising sea level in the eastern sections. According to the 2012 census, there are 3,078 households in Dong Hai and 2,670 households in Dong Minh engaged in aquaculture, with 731 families (36.7%) and 313 families (15%) respectively ranked as poor. Local residents conduct extensive and semi-extensive farming of aquatic products in brackish water ponds (e.g. shrimp, crab, carp, grass carp, major cap, silver carp etc.) and in river water (clam, oyster, fish etc.).

Household Profile

This section explores the demography of typical women aquaculturists in both male- and female-headed households in the two zones - age group, education, household structure, income, household size and labor force, land size, pond size, breeding areas and marketing - basic background to better understand how women aquaculturists become more vulnerable to climate change and how the impact of climate change affects women of different marital status.

Age Group

Age has a major influence on the way farmers perceive and respond to climate change. Farming experience plays an important role in the adaptation strategies of aquaculturists. Older aquaculturists have more knowledge and experience of changes in climate conditions, and of good farming practices.

Women aquaculturists were classified into two categories, namely working age (from 15 to 59 years) and old age (60 years and above). In the sample, ages ranged from 23 to 69, with 95% being of working age and 5% being elderly. The average age was 40 (Table 4.3). The elderly women were all in male-headed households, where they accounted for 10% of the total. An independent-samples t-test was conducted to compare respondents' ages. There was no significant difference in average ages of women in male-headed households (M=39, SD = 10.34) and female-headed households (M=41.37, SD=11.31), with p = 0,401 in two zones.

Figure 4.3 shows the distribution by age group of women in male- and female-headed households in the two communities. 62% of women in male-headed households and 60% of women in woman-headed households were in age group 46 to 59, and 38% and 30% respectively in age group 23 to 45. Women in the middle-aged group are the main labor force in the district's aquaculture operations: because of weak health and greater responsibility for household chores, middle-aged and elderly women cannot travel far to find new sources of income generation. They have to search for hired work near home to earn money to supplement their aquaculture income.

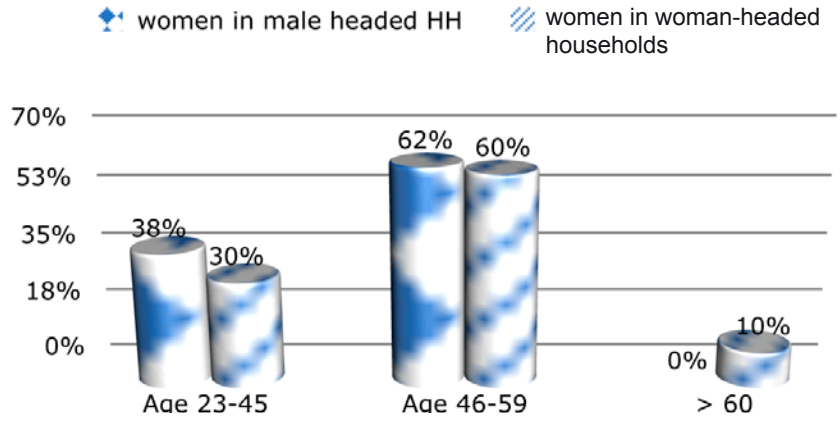

Figure 4.4: Age Pattern of Women Aquaculturists in Both Zones

In addition, many of the young men and women (under 30 years old) migrate to big cities such as Hanoi and Ho Chi Minh to engage in informal work and send money back to their families. The women interviewed from male-headed households said they normally tried to save for their children to go to school or take vocational training. They don't want their children to practice aquaculture. They believed that a high school education would help their children to get a good job and escape from aquaculture.

> I have 2 children, one girl, and one boy. My first girl studies in the University of Agriculture and the boy reached secondary school. We always encourage and create a comfortable atmosphere for my children to go to school even though my family is very poor. I hope that my children can get a high degree in education to become government or company officers. In fact, I don't want see either of them practicing aquaculture. Although we can get a lot of money for a good harvest it's risky and heavy work. Unfortunately, my son dropped out of high school. After that, he did not want to learn more and decided to go to Hanoi to get an informal job. He often sends money back to us (Woman in male-headed household, 43 years old).

Education

Education is one of the important determinants of coping and adaptation measures to deal with natural disasters. In terms of formal education, respondents had six years of school attendance on average (Table 4.3). The Table demonstrates that women in male-headed households had a year longer of formal education than those in woman-headed households.

The result of chi-square test shows that there is no statistical difference at 95% level of significance in the two zones in the education level. The education levels of respondents ranged from 0 to 12 years in the Vietnam education system. Table 4.3 shows that women in male-headed households had a better education level than women in woman-headed households, represented by the higher percentages of respondents who attained secondary school, high school and college, respectively.

	Woman-headed households	Male-headed households	total
Illiterate	4 (12.12%)	3 (4.6%)	7 (7.14%)
Primary	10 (30.3%)	7 (10.7%)	17 (7.34%)
Secondary	10 (30.3%)	32 (49.23%)	42 (42.85%)
High School	5 (15.15%)	14 (21.53%)	19 (19.38%)
College / University	3 (9.09%)	9 (13.84%)	12 (12.24%)
Total	33 (100%)	65 (100%)	98 (100%)
-test Sig=0,694; df=13			

Table 4.3: Distribution of Women Respondents by Education
Source: Field survey, 2014

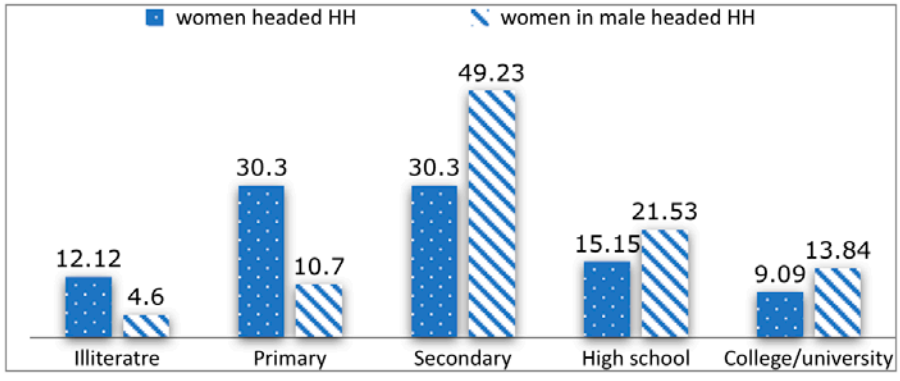

Figure 4.5: Distribution of Respondents by Education Level

There was a correlation between level of education and awareness and understanding of climate change, storms/typhoon forecasting and adaptability to climate change. Women who finished high school or secondary school were able to understand storms forecasts, whereas this ability gradually decreased in women who finished only primary school or who were illiterate.

Housing Condition and Structure

Poor housing quality was another source of vulnerability. Four types of house structure were found including flat roof, tiling roof and cottage roof. Results from the household survey indicated that 45.45% of women in woman-headed households and 12.3% of women in male-headed households lived in houses with tiling and cottage roofs. These structures are more vulnerable to climate change, particularly storms. Flat roofs were the most common pattern of house structure for women in male-headed households (87.6%) and in woman-headed households (54.54%).

Household Size and Structure

Understanding of household size and composition is important in this study in terms of relationships between the family members and the basic necessities of life to which they have access. The influence of household size on the adaptation options can be considered against a number of assumptions. The first assumption is that in large households members are more likely to diversify income by off-farm activities to earn money for consumption.

Secondly, large households have a larger labor force that plays an important role in adaptation strategies to climate change. For example, using labor to prepare well and recover quickly before, during and after storms.

Persons in Household	Woman-headed	Male-headed	Total
4 or fewer	12 (36.36%)	26 (40%)	38 (38.77%)
5 - 8	19 (57.57%)	34 (52.30%)	53 (54.08%)
9 or more	2 (6.06%)	5 (7.69%)	7 (7.14%)
Average (SD)	4.16 (1.7)	5.38 (1.8)	5.14 (1.6)
T test Sig=0.472, df=58			

Table 4.4: Household Size and Structure in household
Source: Field Work, 2014

T-test shows that there is no significant difference in the distribution of household size at 95% confidence level between the two zones. Table 4.4 shows that 5-8 member households predominated in both in both women- and male-headed households. A possible explanation is that almost all households in the two zones included an extended family with either three generations or two married couples. In this type of family, a parent usually lives with their first-born son, their daughter-in-law, and grandchildren. (In Vietnam the first-born son is responsible for taking care of the parents when they retire. This puts a great responsibility on his wife who has to take care of the elderly as well as the children.) Next came households of 4 people or less accounting for 40% of women in male-headed households and 36.36% of women in woman-headed households. Large households - 9 or more people - accounted for only 7.14 % of total households in both communes.

Table 4.5 shows numbers of workers per household. Households sampled in the two zones had a household size of 5.16 and number of workers at 3.30 on average. An independent-samples t-test was applied to compare the household size of households for both women in male-headed households and in woman-headed households. The results indicated that there was no significant difference in the number of household members for women in male-headed (M=6.74, SD = 2.81) and in woman-headed households (M=5.52, SD=2.21), p = 0.0730. Similarly, there was no significant difference in the number of workers per household in male-headed households (M=3, 63, SD=1.74) and

woman-headed households (M=3.02, SD=1.45); p = 0.131. These results suggest that marital status does not have an effect on household size and labor force.

	Woman-headed household			Male-headed household			Total
	max	min	avg (SD)	max	min	avg (SD)	avg (SD)
No. of workers							
Total	6	1	3.02 (1.45)	4	1	3.63 (1.74)	3.30 (1.64)
Female aquaculturalists	3	1	1.54 (0.62)	3	1	2.56 (0.91)	1.45 (0.84)
Household size	6	1	4.52 (2.21)	7	1	6.74 (2.81)	5.16 (2.59)

Table 4.5: Household Size and Aquaculture Workforce
Source: Field work, 2014

Field work results showed that interviewed households had on average no more than three aquaculture workers of working age per household. This could be explained by current pressures on over-exploited marine resources and the adverse impacts of climate change on the livelihood activities of farmers in general and aquaculturists in particular. As a result, aquaculture productivity tends to be lower both quantitatively and qualitatively, worsening living conditions in the village. Young men and women from Dong Hai are more likely to migrate to the cities to get good jobs in industry, services and commerce, to escape the negative impact of factors such as environmental pollution, climate-related risk and marine resource scarcity.

Income

Table 4.6 shows the main sources of income for women in woman- and male-headed households in the two coastal zones.

Income Source	**Woman-headed households**		**Male-headed households**	
	No.	%	No.	%
Crops and Vegetables	7	21	7	11
Aquaculture Production	8	27	23	35
Salt production	2	6	-	-
Livestock Breeding	2	6	4	6
Fishing	-	-	-	-
Seasonal Labor	1	3	-	-
Wage Labor (regular employment as teacher, etc.)	4	12	20	31
Small business/trade	1	3	4	6
Rents and interest	2	7	7	11
Remittance	6	18	-	-
Total	33	100	65	100

Table 4.6: Main Sources of Income *Source: Field Survey, 2014*

Over 60 % of the women in woman-headed households said that their main income was from farming including crops and vegetables (21%), salt production (6%), livestock breeding (6%) and aquaculture production (27%). Only 40% of them mentioned non-farm income such as wage labor, small business and so on. Remittances were considered as their highest form of non-farm income, although some of them said that the remittances were not regular; their husbands often sent only once or twice a year. Remittances ranged from 6,000 to 15,000 billion VND each time. 52% of the women in male-headed household said that their main income was from farming including aquaculture, crops and vegetables, and livestock; and 48% of them had income from non-farm activities such as wage labor, rents and interest etc. They also noted that a formal job produced a known amount of income at a known time. Income from aquaculture contributed three times as much as income from wages, but

aquaculture was considered as a sub-occupation in their family because of the fluctuation of prices, inputs and the negative impact of climate change. Seasonal scavenging labor was available to earn more income (they often received 150,000 VND/day); rice wine making, planting vegetables or raising poultry in their home gardens were other sub occupations. They noted that these activities provided produce for their families as well as for sale at the market. The women all believed that they had to find as many different livelihood activities as possible to meet the needs of their families. Only 6% of women in woman-headed households said that salt production contributed significantly to their income. In days gone by there was a large area for salt production, but salt production is not only hard work but is also unreliable with the irregular climate. In addition some salt land has been taken over for aquaculture.

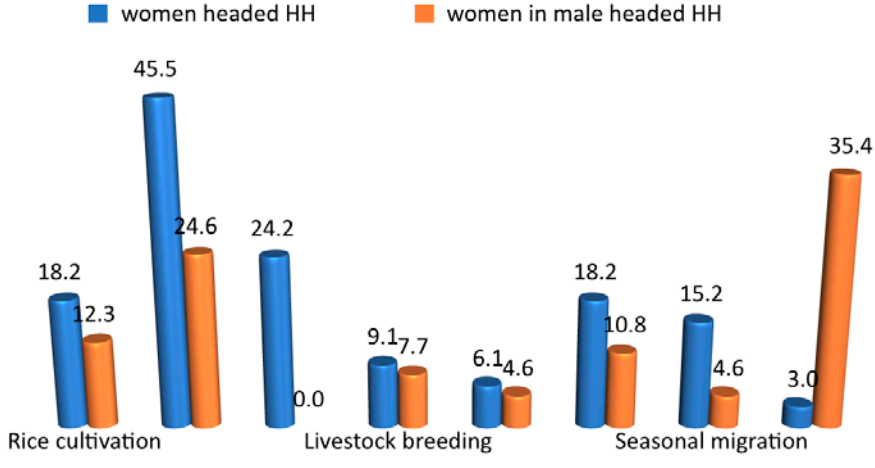

Figure 4.6: Distribution of Main Income by Respondents in Two Zones
Sources: Field survey, 2014

Besides being involved in reproductive and aquaculture operations, all the women gather oysters. Many men migrate to the city for construction work and seasonal labor. Their remittances contribute significantly to the family income.

Income source	**Woman-headed household**		**Male-headed household**	
	Avg (billions of VND)	%	Avg (billions of VND)	%
Farm Income	20.704	60	46.103	52
Crops and vegetables	2.346	21	5.356	11
Aquaculture Production	15.257	27	35.478	35
Salt Production	1.056	6	984	-
Livestock Breeding	2.045	6	3.458	6
Fishing	-	-	-	-
Non-farm Income	27.009	40	32.075	42
Seasonal Labor	793	3	-	-
Wage Labor	19.000	12	23.567	31
Small business/trade	1.538	3	2.749	6
Rent, interest	6.743	7	5.759	11
Remittance	8.000	18	-	-
Total Income	**47.703**	**100**	**78.178**	**100**

Table 4.7: Average Household Income according to respondents
Sources: Field survey, 2014

Table 4.7 shows that women in male-headed households had much higher incomes from aquaculture than women in woman-headed households (35.478 billion/year compared with 15.257 billion/year). A possible explanation is that women in male-headed households have more land and more pond area, and are thus likely to invest more in aquaculture with better species fed with better food. Remittances are an important income source in woman-headed households but this source is irregular and uncertain. Women in male-headed households can look to wage labor, rents and interest for their non-farm income – sources which are certain and regular.

Breeding Mode for Aquaculture Species

There are four main patterns of breeding for aquaculture species in the two zones, as shown in Table 4.8. The most popular mode in women headed

households was improved extensive, followed by semi-extensive. They maintain that they get low output as a result of poor food and seeds. Thus, they spend more time to collect natural or artificial food in order to promote aquatic growth and yield. Only 18% of woman-headed households depend solely on natural foods in the ponds and lakes with the extensive pattern. A possible explanation is that these households are poor and do not have enough money to buy good seeds and food inputs. They also claim that while they want to invest, they cannot access loans.

Breeding Mode	**Women in Woman-headed households**	**Women in Male-headed households**	**Total**
Intensive	5 (15%)	14 (22%)	19 (20%)
Semi-intensive	10 (30%)	27 (42%)	19(20%)
Extensive	6 (18%)	4 (6%)	10 (10%)
Improved extensive	12 (37%)	20 (30%)	32 (34%)

Table 4.8: Distribution of Breeding Mode for Aquaculture Species in Two Zones *Source: Field survey, 2014*

Semi-intensive is the main pattern for women in male-headed households, followed by improved extensive. Women in male-headed households described the benefits of semi-intensive for improving their income: they learned from their neighbors how to use fertilizers and chemicals in order to increase natural food in brackish ponds, and added more external food - fresh food, rice bran - to promote the growth of aquatic plants. Intensive patterns tend to be more used by women in male-headed households (22%) than in woman-headed households (15%). Results from household surveys show that the use of intensive patterns in both cases depends on the financial capital and land holding of the family. Respondents using the intensive pattern said that they often used external food (for example Quaxcel-40N, as pellets or combined with fresh food) to produce fingerlings and fresh plant growth. The main purpose is to provide more basic nutrition and to stimulate the growth of aquatic plants. However, this pattern demands a large amount of money for good quality seeds, food and labor.

Labor and Feed Costs

Pond culture requires both full-time and casual labor. Most women in woman-headed households (74%) said that they use full-time labor due to the high labor requirement for the daily preparation of farm-made feeds. If they need to hire labor the wage per person/day is around 4.3 USD. 15 % of women in female-headed households and 22% of women in male-headed households said that they spend less time, possibly because they buy food in the form of manufactured pellets. The unit price for manufactured pelleted feeds depends on protein levels, and averaged US$2.3/kg. Farm-made feed price was generally lower (US$0.69/kg) due to its low protein content and the use of cheap feed ingredients such as rice bran, broken rice, trash fish, and vegetables. In general, high total production costs included major items such as labor, fingerlings, feeds and others. The high level of investment in intensive farming was not open to small-scale and less capital-endowed farmers.

Land Holding Size

The study employed stratified sampling strategy in 3 groups according to farming land size suggested by local staff: small farms (less than 1 ha), medium farms (1 - 2.4 ha), and large farms (over 2.4).

Land Size	**Women in Woman-headed households**	**Women in Male-headed households**	**Total**
less than 1 ha	14 (46.67%)	8 (12.3%)	22 (22%)
1 - 2.4 ha	11 (33.33%)	39 (60%)	50 (51%)
over 2.4 ha	8 (24.24%)	18 (27.69%)	28 (27%)
Total	33 (100%)	65 (100%)	98 (100%)

Table 4.9: Distribution of Households Sampled by Land Holding Size
Sources: Field survey (2014)

Table 4.9 shows that land size area of less than 1ha was the main pattern for woman-headed households (46.67%) while land size area from 1 ha - 2.4 ha was the main pattern for women in male-headed households (60%). Land sizes of 1 ha - 2.4 ha and over 2.4 ha came next for both groups. In general, women in male-headed households had more land than women in female-headed households.

Pond size

Ponds are important for aquaculturists. For the household survey pond sizes were divided into 3 groups: small (less than 0.06 ha); medium (0.06 to 0.12 ha) and large (over 0.12 ha).

Pond Size (ha)	**Women in woman-headed households**	**Women in male-headed households**	**Total**
less than 0.06	22 (66.67%)	24 (36.9%)	46 (46.9%)
0.06 to 0.12	5 (15.15%)	15 (23.07%)	20 (20.4%)
over 0.12	10 (30.3%)	26 (40%)	36 (32.7%)
Total	33 (100%)	65 (100%)	98 (100%)

Table 4.10: Distribution of Households Sampled by Pond Size (ha)
Sources: Field survey (2014)

Table 4.10 shows that small ponds mainly belonged to women in woman-headed households (66.67%), while large ponds (≥ 0.12 ha) mainly belonged to women in male-headed households (40%).

Women's Involvement in Aquaculture Activities

There is a clear gendered division of labor in the selected households in aquaculture production. Results from the household survey (Fig. 4.6) show a higher percentage of aquaculture production undertaken by women in woman-headed households than women in male-headed households (100% as against 30.76% of total). A possible explanation is that women in male-headed households are mainly responsible for looking after the children, while their husbands are primarily responsible for aquaculture production with support from their wives with some sub-activities such as input collection and feeding. Women in woman-headed households have domestic as well as productive roles. Figure 4.6 indicates that 100% of the women in woman-headed households were responsible for manuring, feeding, seed selection and selling activities, followed by harvesting (60.6%) and stocking (36.36%). The lowest percentage of aquaculture activities undertaken by women in woman-headed households was pond excavation (15.15%), and pond preparation (30.3%). These activities demand physical strength so the women had to hire men at 50.000 VND per day.

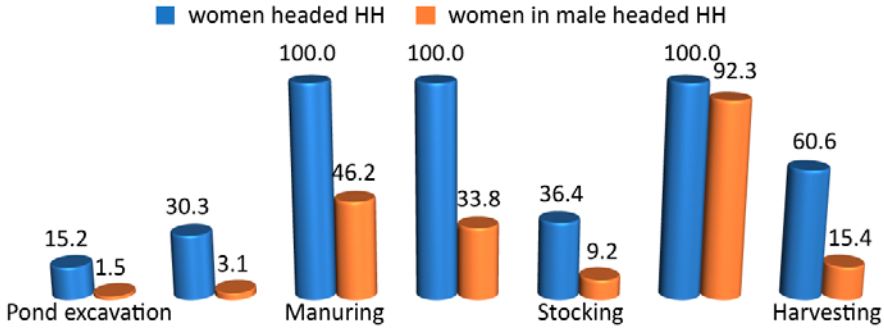

Figure 4.7: Women's Involvement in Aquaculture Activities
Source: Field survey, 2014

Feeding (92.3%) was the main aquaculture activity undertaken by women in male-headed households, with manuring (46.15%) and seed selection (33.84%) as second most important. Their lowest participation was in pond excavation (1.5%) and pond preparation (3.07%) - activities more suited to their husbands.

Breeding Area and Model for Aquaculture Species

There are three main breeding areas for aquaculture: brackish water, salt water and fresh water.

Breeding	**Women in woman-headed households**	**Women in male-headed households**	**Total**
Fresh Water	20 (60%)	25 (38%)	45 (46%)
Brackish and salt water	13 (40%)	40 (62%)	43 (54%)
Total	33 (100%)	65 (100%)	98 (100%)

Table 4.11: Distribution of Breeding Area by Respondents in Two Zones
Source: Field survey, 2014

Table 4.12 shows the main breeding areas for aquaculture species for the respective selected households. Fresh water was the main breeding area for women in woman-headed households (60%). There are two types of fresh water breeding areas: small freshwater ponds and lakes; and big reservoirs or natural lakes.

Aquatic breeding in small freshwater ponds and lakes was the main pattern for women in woman-headed households, with many traditional aquatic species such as jilapia, butterfish, black carp, carp, mud carp, and cuttlefish. Some women in both household categories tended more to fish breeding in big reservoirs or natural lakes, using big cages or floats. This is an appropriate mode for high-value fish species such as pangasiidae, pangasius court, steno pharyngotome, but it requires a lot of money to buy good quality seeds and invest in the necessary infrastructure and facilities. Breeding in brackish and salt water was the main pattern for women in male-headed households (62%). Brackish and salt water areas are good for high economic value species such as lobster, sea fish, oyster, snail, mussel, clam, and prawns (including tiger prawns).

Breeding Objectives	**Breeding Method**	**Breeding Crop**
Prawns	Semi-intensive, Intensive	Crop 1 (Mar-Aug)
Metapenaeus & M. Joyneri (shrimp varieties)	Semi-intensive, Improved	Crop 2 (Sept-Feb)
Oyster, Arca, Mussel, Barnacle,	Extensive, Semi-intensive, Improved Extensive	All year
Traditional Fish	Extensive & Improved Extensive	All year
High-value Fish	Intesive & Semi-intensive	All year
Sea Crab	Extensive & Improved Extensive	Mar-Aug; Sept-Feb

Table 4.12: Common Pattern of Breeding Method for Aquatic Species in Selected households *Source: Field survey, 2014*

Marketing of Aquatic Species by Selected Households

The majority of women respondents (85%) said that they were directly involved in retail sales of aquatic products, with their husbands usually taking care of transport and deliveries. The men are also involved in wholesale activities. Sales are of three main aquatic products: fresh fully grown fish etc., fingerlings, and processed fish. The first category accounted for by far the biggest volume of sales, with processed fish products a distant second, possibly because the production of processed fish requires capital for infrastructure, facilities and technology.

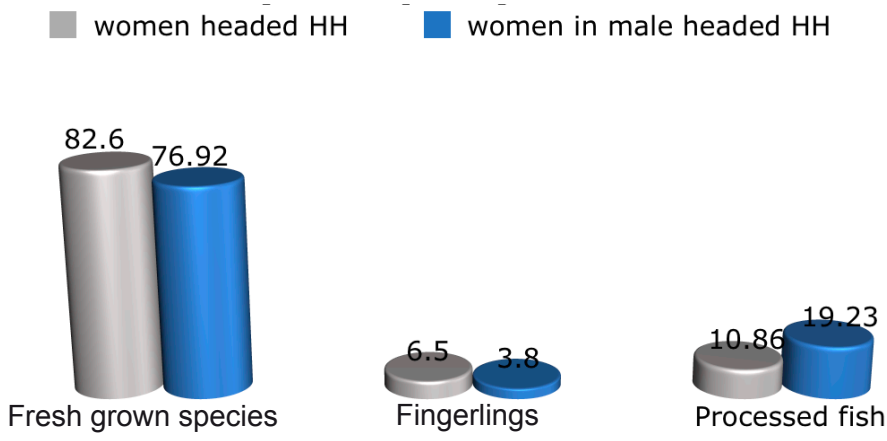

Figure 4.8: Aquatic Products Marketed by the Selected Households *Source: Field survey, 2014*

The Table 4.13 shows points of sale for aquatic species. The most usual site for women in woman-headed households was the farm gate (57.57%). Most sales were to middle men or traders. Women complained that the buyers drove hard bargains - they can get 55,000VND/kg for fresh fish in the market but only 40,000VND kg at the farm gate.

	Women in woman-headed households	**Women in male-headed households**	**Total**
Farm Gate	19 (57.57%)	17 (26.15%)	36 (36.73%)
Local Market	11 (33.33%)	40 (61.53%)	51 (52.04%)
Seafood Processing Company	3 (9.09%)	8 (12.3%)	11 (11.22%)
Total	33 (100%)	65 (100%)	98 (100%)

Table 4.13: Distribution of Selling Place for Selected Households
Source: Field survey, 2014

Due to time pressures and transport costs women in woman-headed households have problems getting their products to market. They also lack male labor to help them with deliveries. In contrast, for women in male-headed households (61.53%), most sales were at the local market. Respondents

highlighted that local markets are promising places for their sales: customers look for fresh, locally grown products and pay premium prices for quality. They can bargain with their customers to get a high price. The lowest percentage of sales was to seafood processing companies (only 11.12%). This is a popular route for middlemen, traders and big farmers who can negotiate reasonable prices and commissions with the company. 11 women aquaculturists - 3 from woman-headed households and 8 from male-headed households - are employed by a local processing company.

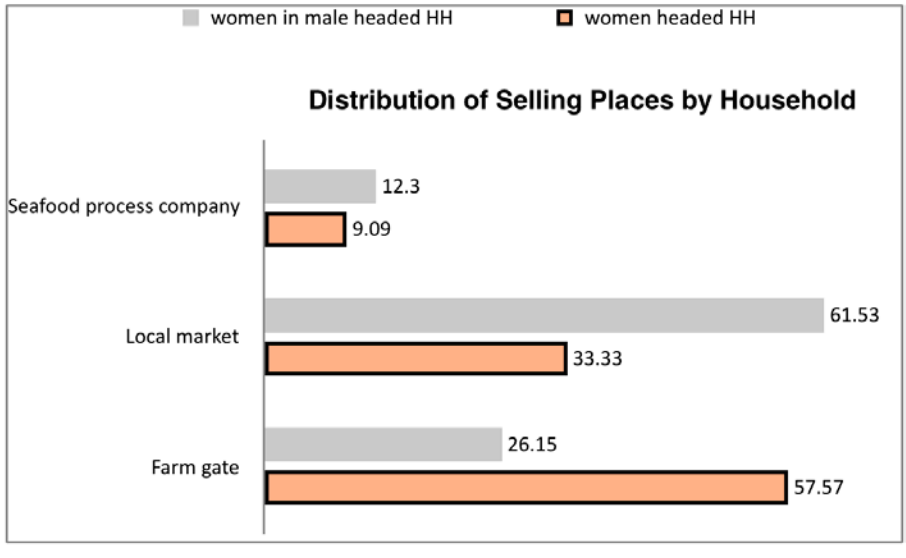

Figure 4.9: Distribution of Selling Place by Household
Source: Field survey, 2014

The Perception of Women Aquaculturists on Climate Change

Timeline of Significant Climatic Events and Severe Weather in the Two Zones

Past experience of climate change can provide insights into possible future events. Table 4.14 provides a timeline of significant climatic events, based on recollections of respondents and key informants.

Time	Event	Effect on Farming
22/8/1996	Heavy Floods	Broken trees and crops; crops buried by sand
23-26/8/1997	Flood	Excessive rainfall destroyed crops
9-13/7/2004	Intensive Rains, Flood	Crops submerged and destroyed
20-24/7/2008	Storm/Flood	Excessive rainfall destroyed crops
8/2012	Strong Floods/Flood Tide	Agriculture crop totally destroyed; Aquatic plants died and swept away
7/2013	Storms/Strong; Heavy Rain and Floods	Aquatic outputs losses; destroyed and damaged rice crop and facilities

Table 4.14: Timeline of Events and Severe Weather in Tien Hai
Source: Key Informants and Group Discussion in Two Zones, 2014

Women Aquaculturists' Perceptions of Climate Change

Women aquaculturists were asked whether they had heard or read about climate change and whether they had observed any changes in temperature and rainfall in the area over the past 20 years. The purpose of the latter question was to explore their level of awareness of climate change since a perception of climate variability is the first step in the process of adaptation. All respondents in both zones mentioned that they had experienced – and indeed currently suffered from - climate variability in the shape of storms/typhoons, flood, saline intrusion, erosion, sea level rise, extremely hot weather, and shortage of fresh water. Figure 4.10 shows the climatic problems that affected their production and their livelihoods.

All respondents considered that storms/typhoons, flood and shortage of fresh water had the most negative impacts on their livelihood activities. A high percentage of women aquaculturists have experienced increased frequency, intensity and duration of storms, floods and rains in recent years. Powerful storms result in floods that can sweep away houses and aquatic products as well as damaging and destroying facilities. Floods have also changed the water environment and decreased the salinity level of brackish water ponds, leading

to the death of numerous aquatic animals and increased incidence of disease. Some storms/typhoons (number 8 in 2012 and number 5 in 2013) resulted in heavy flooding with serious negative impacts on aquaculture. Over 90% of fishponds were flooded and many facilities and machines damaged and destroyed; tons of fish, shrimp and crab were totally lost.

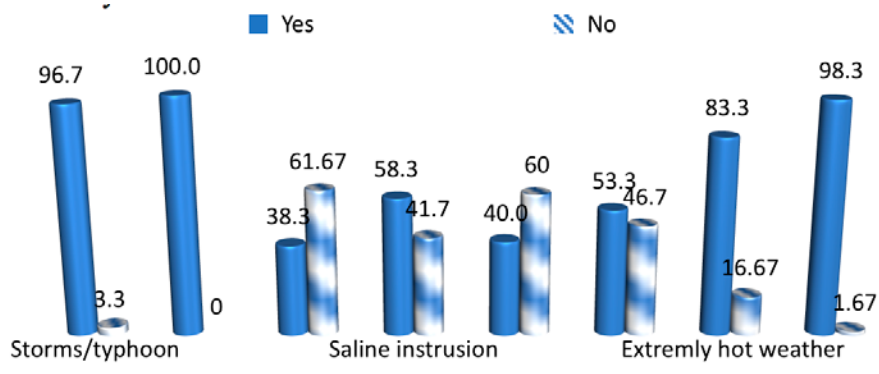

Figure 4.10: The Level of Climatic Problem Affected on Women's Livelihoods *Source: Field survey, 2014*

Figure 4.10 shows that 93% of the women aquaculturists in the two zones have become aware of significant changes in the frequency and duration of storms/typhoons and floods pattern over the past 20 years.

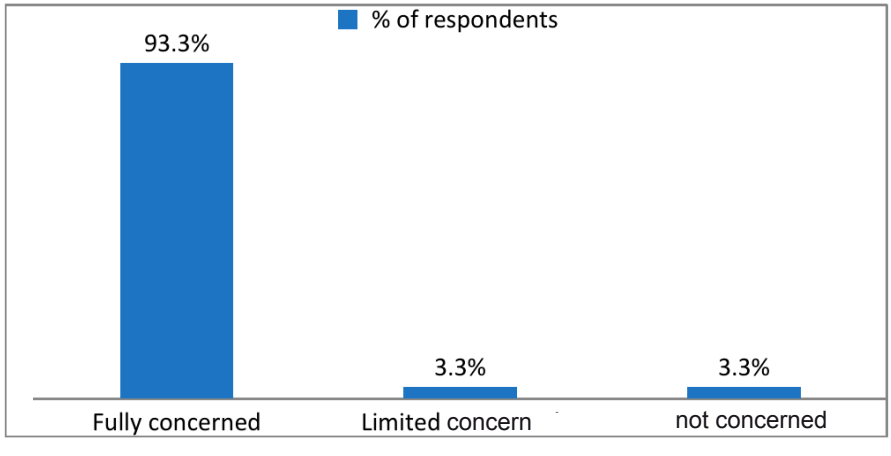

Figure 4.11: Perception of Women Aquaculturists to Storms Related Risks *Source: Field survey, 2014*

A few women respondents indicated that they did not know or did not notice changes in storm related risks (3.33 %), but none of the respondents thought that the level of storms/typhoons was likely to decrease over the next 20 years. Respondents did feel that there had been significant increases of temperature in both summer and winter. Respondents generally agreed about changes in rainfall pattern. Only 23% of respondents noticed a decrease in the volume of rainfall or a shorter rainy season while 14% observed that the timing of rainfall fluctuates from year to year. The majority of the respondents (60%) had noticed both an increase in rainfall and changes in the timing of the rains. Only 7% of respondents reported that there were no changes in rainfall where they lived. Most of the respondents (84.57%) noted that the rainfall was more erratic with seasonal changes in the pattern and unpredictable starts and stops. They also maintained that the length of the aquatic breeding season had decreased, and that there was an increase in the volume of rain resulting in floods. Some women said that they used to undertake aquatic breeding from January to May, but that in the past few years they had been unable to determine when to start their aquatic farming season because of the unpredictable rains.

Perceptions Regarding Causes of Changes and Variability in Climate

Most respondents interviewed (93.33%) had noticed at least a change of frequency and intensity of storms/typhoons, floods and rainfall pattern. They were subsequently asked to indicate what they perceive as the causes. Their responses are illustrated in Figure 4.11. Roughly one-third of the women perceived the changes as purely a natural phenomenon without any human intervention being responsible.

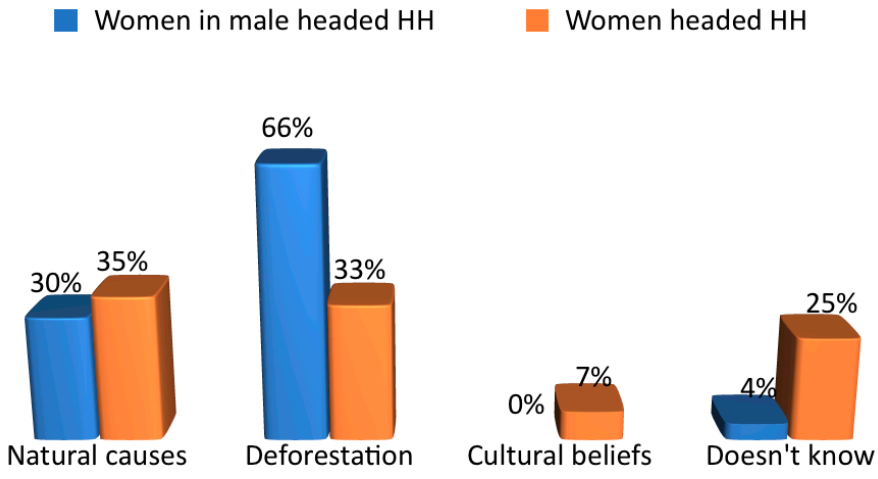

Figure 4.12: Causes of Climate Variability and Change
Source: Field Survey, 2014

The women were not aware that their land degradation activities were also contributing factors to changes in climate. There were a few women in woman-headed households (7%) who believed that God was responsible for the changing climate. They asserted that the changes were a punishment from God because of the sins of the world, disobedience and unfaithfulness.

Human induced causes of climate change such as deforestation were mentioned, particularly by women in male-headed households (66%) and to a lesser extent in woman-headed households (33%). They thought that the cutting down of trees for firewood and the expansion of cultivated areas were the main reasons contributing to the erratic storms and rainfall. 30 % of respondents claimed no knowledge of what was responsible for the changes. These findings suggest that it is essential to create awareness for women in understanding the concept and causes of climate variability and change.

Summary

Tien Hai coastal area has a high potential for aquaculture, but due to its geographical position, with a 27 km long coastline, the district is also one of the most disaster-prone areas as regards climate change, and is frequently affected by storms/typhoons, floods, droughts, rising sea level and saline water intrusion. The majority of respondents (60%) have noticed both an increase

in rainfall and changes in the timing of the rains. An even greater number - 84.57% - noted that there is more erratic rainfall with seasonal changes in the pattern and unpredictable starts and stops.

The changes are a great challenge for aquaculturists and others. In Tien Hai district, local residents are facing many problems related to climate variability. The storms damage crops as well as aquaculture. Many areas of corn, potato and winter crops have been damaged or lost. Rice output has decreased considerably because of loss of paddy to salinization. Aquaculture nurseries have been seriously impacted, and many fishing facilities destroyed. Local incomes have inevitably suffered.

A lower level of education and limited access to information make women in woman-headed households more vulnerable than women in male-headed households to climate change. Household size and labor force, land size, gender division of labor, breeding areas available for aquatic species and marketing capacity are other relevant factors which help to explain how women aquaculturists become more vulnerable and how the impacts of climate change impact on women of different marital status.

Chapter 5

The Impact of Climate Change on Women Aquaculturists

Women are primarily responsible for housework and taking care of family members. But they also take charge of some work related to aquaculture farming, crop cultivation, home-based work such as knitting, small business, and raising poultry, and seasonal paid work. In other words, they have multiple roles and workload burdens. However, their situation becomes worse when there are storms, which have negative consequences on women aquaculturists - increased workload; health issues and indebtedness; loss of houses, aquatic outputs and income.

Increasing Women's Burden and Workload under the Impact of Storms /Typhoons

The field study indicated that aquaculture was a full-time activity for 75% of the women in woman-headed households and a part-time activity for women in male-headed households.

In male-headed households both men and women are economic agents directly or indirectly involved in livelihood activities such as crop cultivation, animal husbandry, aquaculture and hired labor. The men are dominant in tasks that require physical strength and the adoption of high technology, while women are mainly responsible for sub-tasks in aquaculture such as feeding and harvesting. They also have domestic tasks such as taking children to school

and supervising children's studies. After storms, repairs to houses and facilities and aquaculture ponds, and replacing dead species, were carried out by men and women in male-headed households, although the women focused mainly on their domestic duties, sometimes with help from their husbands e.g. with fetching water. By contrast, women in woman-headed households had to cope with these problems on their own. In addition they had to pay for hired labor for activities demanding physical strength such as pond excavation, pond preparation and stocking. Widows and other women in woman-headed households were the most badly affected by the negative impact of storms.

> My family has 2 sao of land for aquaculture and no land for crop cultivation. My husband migrated to Taiwan to find paid work in construction. He rarely comes back to visit due to his full-time job, but he often sends me money. I live alone with my two children and take charge of all the household chores and the aquaculture. Sometimes, I also do a paid job in the village for extra income. I and my husband have to work hard to maintain our daily consumption and pay education fees for the children. When storm number 5 struck, my house, garden and aquaculture farm were totally lost. My husband could not come back as he is far away and the air fare is expensive. I had to rebuild the house and farm alone. I also had to find some way to feed the family. It was a big challenge for me to handle all these tasks without the support of my husband. (Woman in female-headed household, 53 years old).

Storms and floods create further impacts on women's roles in the household. Traditionally, women are responsible for water, food and fuel for family consumption. Scarcity of fresh water, fuel and food are among the consequences of storms and floods and to find them women need to spend more time and travel long distances. Together with the increased burden of domestic work – caring for the sick, repairs – this leaves them with less time for income generating activities and participation in the community.

Food Collection

More than 40% of women aquaculturists noted that in the past they engaged in rice cultivation (two annual crops provided enough rice for around

3 to 6 months of the year) and livestock breeding along with aquaculture production. They could also grow some other crops and vegetables to supplement their diets. Some households began to engage in small scale pond aquaculture. At first, this provided a small profit from the sale of aquatic species, but over time profits increased significantly; aquaculture became three times as profitable as growing rice. At the same time increased saline intrusion due to climate change has seriously impacted on agricultural activities: crop production has decreased by more than a third. In consequence over the last 5 years many women have changed their economic activities from rice cultivation to aquaculture, which provides money to buy rice in the market. Aquaculture has become the main income source for women in both woman-headed and male-headed households.

Most of the women note that the availability of food for their families has decreased over the last 10-20 years. This was blamed mostly on storms and floods. Climate change not only results in saline intrusion into farmland, but fresh water from the heavy rains reduces the salinity in pools and lakes. Shrimp, fish and crab require an appropriate salinity level to survive. Sudden changes in water quality in shrimp ponds puts aquaculture species in danger. Large numbers of shrimp and fish died. Besides this, shrimp, crab and fish can escape over the pond bank if the water level outside rises sufficiently, leading to further stock losses. 44% of women in woman-headed households and 65% of women in male-headed households took steps to prevent flood water getting into their ponds: when they get warning of storms they close water inlet sluices to retaim the salt water the aquatic species need. They can also build up the pond edges to stop species from escaping.

Aquaculturists face food insecurity as a consequence of the great loss of crops and aquatic outputs due to storms and floods. Sales and hence income are greatly reduced; but at the same time they need to buy in food to replace the food that they can no longer produce. This is very expensive for them and they have to redouble their efforts to seek alternative activities to help them earn the money they need.

> I have 2 sao of crop cultivation land, 1 sao of aquaculture land and 0.5 sao of vegetable garden. Before the storms, we sold our aquatic species to earn money to buy food for our family. At harvest time we gathered rice and vegetables for our

> consumption. Thus, we needed only to buy meat. Suddenly, storms came, with floods that swept away crops and vegetables. Most of the aquatic species in our pond died due to water contamination. Now we have to buy rice, meat and vegetables from the market. Before the storms I could get 1 kg meat and vegetables and other ingredients for only 50,000VND, but now I need to pay twice as much. We spend a lot of money just for food. (Woman in male-headed household, 38 years old).

Increasing food prices are another consequence of the negative impact of climate change. After the storms food prices including vegetables, rice and other food became expensive. Vendors tried to increase prices as much as possible as food was scarce and demand was high. This limited access to food for poor women in woman-headed households.

> Flooding really made great trouble for us. My husband could not work due his weak health. Before storms, I could collect some marine creatures to sell and buy rice for my family. My family has a little land for rice cultivation, and a small fresh-water pond, and I utilized some land behind my garden to grow vegetables. The storms swept everything away. Food become expensive and I could not afford to buy it. I don't know how can I manage and maintain my family to overcome this bad situation. (Woman in woman-headed household, 56 years old).

The degradation of natural and marine resources as a consequence of the negative impact of climate change impacted particularly on women whose livelihoods depend primarily on those resources and their ecosystem. 76% of women in female-headed households and 56% of women in male-headed households noted that ensuring food security for their families added new burdens to their workload. Opportunities for paid work in the district are limited, apart from work based at home with low wages and instability. This is a great problem for them in terms of earning income for food.

> Until 15 years ago, it was easier to capture shrimp and fish and crab near the shoreline. I remember we could easily collect and glean and get around 150.000VND/kg from sales. However, numbers of marine creatures have significantly

> decreased in recent years. They are no longer easy to find and we can spend a long time to catch a few fries[1]. In 2009, we saw masses of fish and shrimp and other species dead on the shoreline. Most people claimed that this was due to climate change, others argued that it was environmental pollution and over-exploitation. Anyway, for whatever the reasons, this really made it hard for us to get more income and food for our family. After last year's storms I cannot manage three daily meals for my family. I am thinking of increasing my working hours and trying to find a local job to get money for food. (Woman in woman-headed household, 49 years old).

Water Collection

Results from the household survey reveal that drinking water and water for daily consumption can come from a dug well, bore well, tap water, rainfall, or pond/river. Most of the women (81%) said that water security was a key challenge in the coastal area as a whole as a consequence of storms and floods. Fresh water was less readily available, and new sources of water for drinking, consumption and production had to be found.

Results from the household survey show that dug wells were used to access water for drinking and consumption by 45% of women in woman-headed households but only 15% of women in male-headed households. As a result of the floods, saline water invaded the wells and ponds, and these women experienced great difficulty in accessing water for drinking and consumption if there were no bore-wells, tap water and/or connection to a water distribution network. 60 % of households who used dug wells complained that they could not afford to buy water from vendors. Water collection became a heavy burden, demanding a lot of patience and physical strength.

> Storms are not a new phenomenon in our community – they often happened in the past. But last year's heavy storms resulted in dangerous floods. We faced many problems. The primary problem is the water supply. The water table is very deep; there is a lot of salt in the water and overall the water in our wells

1 baby shrimp

> and rivers/ponds is of bad quality. So we had to travel long distances to reach fresh water. We are all very tired. Sometimes, we had to spend half a day looking for water. It was a burden for me to fetch water after the storms.

Time required to fetch water is also an important factor in the vulnerability of women to climate change. Figure 5.1 shows the distance travelled for domestic water collection by women in male- and woman-headed households before and after storms/typhoons. The figure gives a comparison of distances travelled in normal conditions and post-disaster. In normal times the majority of women (60%) needed to travel from 500m to 1km; post disaster 60% of women needed to travel from 1 -5km.

> The last year, storm number 5 resulted in a heavy flood. Sadly, my husband is not at home at the moment. The flood caused a lot of trouble for my family as the pond was filled with saline water. Most of the aquatic plants were swept away. Loss of aquatic outputs and the big increase of work to fetch fresh water, food and fuel put me under great stress. We had to fetch more water for consumption so that we could wash and be clean. I had to go a long distance to carry water. To be honest, it is a really heavy task for me to take water from a long distance to fulfill our family demands during the flood without any support from my husband. (Woman in woman-headed household, aged 56 years old).

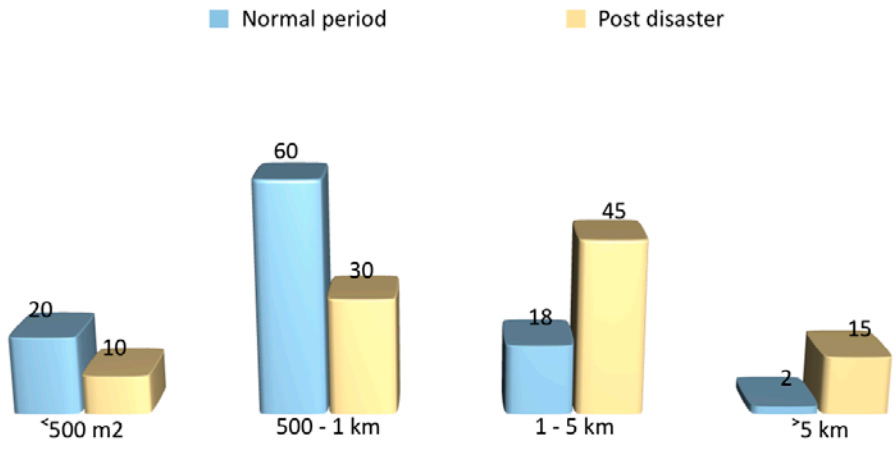

Figure 5.1: Distance Travelled for Consumption Water Collection in Selected Households *Source: Field survey, 2014*

Bore wells and tap water were the main sources of water for 55% of women in woman-headed households and 85% of women in male-headed households. These women suffered a less negative impact from the storms in terms of fetching water. However, contamination of water in bore and tap wells remains a threat after storms.

Water for aquaculture production in both types of household is pumped from rivers and ponds. In normal circumstances the pump system provides enough water for production. In male-headed households, men are mainly responsible for operating the pumps, while in woman-headed households the women are responsible. It takes 40 to 60 minutes to provide enough water for production.

Fuel Collection

Fuel collection, like water collection, is considered a task for women. As many as 55% of women in woman-headed households use charcoal or wood as fuel for cooking. They also use straw and timber due to the availability of these materials around the area after crop harvesting. After storms they needed to walk long distances each day to obtain enough fuel to meet their household's needs.

Most of the women in male-headed households (64%) use gas and coal, which they find convenient and time-saving. They too collect straw and firewood to reduce the cost when they have spare time. They complained that after storms they had to pay more for gas and coal, even twice as much, due to increased prices.

Increasing Burden of Health Issues

Poor nutrition and the physical demands of water and fuel collection contribute to health problems for women. Women are influenced by Confucian ideology which determines their role as tied to four "virtues" – hard work, beauty, fidelity and passivity – and three "obediences" - to fathers, husbands, and sons. It seems embedded in women's minds to put the interests of their husbands and other family members first, and their own interests last. This unequal gender relationship is exacerbated by the impact of climate change. Specifically, women in poor households are more vulnerable to climate change in terms of food insecurity due to insufficient rice supply and insufficient money to buy food in the market. They prioritize their husband and children, and often skip their own meals to feed husband and children first. Poor nutrition, exacerbated by the extra physical effort required to fetch water, food and fuel, makes women vulnerable to infection and disease, in an area where there is little social provision and limited access to medical care,.

> I remember storms resulting in heavy floods in 2000. It was a really difficult time for my family. We did not have enough rice to eat. Rice, vegetables and meat became scarce and expensive after the storms. I had to sell some property, cut out one meal a day or even borrow rice from our neighbor to provide a meal for my children. I ate one meal a day to save food. (Woman from woman-headed household, 53 years old.)

Natural disasters have negative impacts on people's health. Due to their low resistance elderly people and children are more susceptible to health problems such as headache, sore throat, flu, colds. As women have to care for the sick, the impact of climate risks on older people and children has increased women's workload. 45% of women in male-headed households and 60% of

women in woman-headed households reported that they had at least one family member who suffered from illness after the storm.

> My mother-in-law is 70 years old and my father-in-law is 74 years old. They don't have enough strength to work and sometimes they become sick. My responsibility is to take care of my parents-in-law and my children and to engage in some sub-activities in aquaculture such as preparing food, daily care and selling aquatic plants in the market to help my husband. However, we have had to face so many troubles and problems since storm number 5 struck in 2013, resulting in a flood. Our crops and aquaculture were completely destroyed, resulting in a shortage of food and fuel for family consumption. Family members got sick and we had to take them to hospital to check their health. To be honest, I feel under great stress and pressure to maintain our life and take care of our family, even though my husband helps me sometimes. (Woman in male headed household, 54 years old).

However, women in woman-headed households with illness are more susceptible to hazards, especially when they don't have enough money to access local emergency medical facilities.

> My husband died in a car accident. Becoming a widow is a great challenge for women including me who are responsible for taking care of a family and engaging in aquaculture farming. My situation became worse when aquaculture output was totally lost due to storm number 5. I could not get money from aquaculture farming so I had to find seasonal paid work. I had no time to relax. My child got sick, but I did not think it necessary to take her to hospital due to the long distance and the expense. I can take care of her and do my work as well. It is very hard for me to balance my life and I often feel tired, hopeless and depressed. (Woman in woman-headed household, 46 years old)

Women's Vulnerability to Limited Access to and Control over Means of Production

Limited Access to Capital

Financial capital is necessary for aquaculturists to meet their up-front costs - purchase of seed, feed, fertilizers, chemicals, and fuel, paid labor, equipment, etc. Results from the household survey show that aquaculture farmers need big loans to meet farm fixed financial obligations, as most of them do not have the requisite financial reserves. Loans may also be needed to purchase or rent land, machinery and equipment including boats, vehicles, and aerators; to build ponds and/or cages as well as storage facilities; and, for vertically integrated farms, hatcheries, feed mills and processing plants. But then they are vulnerable to climate change when storms and floods can cause loss of outputs and facilities, threatening their livelihoods and leaving a burden of debt which they can't repay.

Results from in-depth interviews have shown that shortage of finance is very common in both woman- and male-headed households before and after storms/floods. Before storms, aquaculturalists need to take loans to cover investment in breeding, inputs, machines and facilities. According to the study, the majority of women in woman-headed households were not able to fund the investment by themselves. The situation of women in both types of household became worse after the floods. Storms with heavy rain in the harvesting season have considerable negative effects on aquaculture. Shrimp ponds are made from stone and soil, and are easily destroyed by strong waves and currents. Aquaculturists have to repair their ponds if they want to start a new breeding cycle. As stated by a woman aquaculturist in a male-headed household:

> We have to spend at least 9 million VND every year to repair our shrimp ponds. This is a large sum of money for us, especially in a situation when harvests have failed.

These costs have increased due to increased costs of building materials and labor – outside the control of the aquaculturists.

> Building a dam is the only solution to reduce shrimp pond erosion and destruction. This work costs a lot of money – it can be several billion VND. How can we build it by ourselves? (Women aquaculturists in the focus group discussion).

Women aquaculturists asked for support from the local authority. The chairman of the commune replied:

> We know that dam building plays a very important role for local residents in general and for aquaculturalists in particular. But the commune budget is very limited; we do not have enough to build a dam. What we can do for our people is to find funding from a government project or an NGO. We called for investment in the district 3 years ago. However, we have not heard from them since. (Key informant, 2014).

The losses of livestock and damage to infrastructure caused by the floods reveals the high risk for aquaculturists in investing to repair and recover damaged facilities and shrimp ponds, and finance new production.

> My family has 5 sao of aquaculture land. We borrowed money from the Agriculture Bank to buy inputs and machines/ facilities 2 years ago. We hoped that after a couple of years' good harvests we could repay the loan. Sadly, aquaculture outputs, machines/facilities, and labor were totally lost due to storm number 5. We still have not repaid the loan, and now we need to borrow more money from the bank to recover and repair all the damage. I am not sure when we will be able to repay the money. (Woman in male headed household, 47 years old).

The situation is worse for widows and women heads of household.

> My husband died when my youngest child was four years old. There are four members in my family including me, my mother-in-law and my two children. We have only 2 sao of land for agriculture. As we are poor we got a loan with interest at 0.5%/month from the Bank for Social Policies to repair my

> house and aquaculture farm that were totally destroyed by storm number 5 last year. However, I am really worried about repaying the money even though I try to work hard and find local jobs. To be honest, it is so hard for me due to family workload and the heavy debt burden. (Woman in woman-headed household, 50 years old).

However, not all women aquaculturists want to access credit. A woman in a male-headed household mentioned irregular and unstable climate change as the main reason which stopped them from borrowing money for new production investment.

> My family has 4 sao of aquaculture land. Last year, aquaculture outputs and facilities were totally lost because of storms and flood. We really want to take a loan to invest in new production with the expectation of good harvests, since aquaculture production is the main source of income for my family. However, the changes in climate are very irregular in recent years. This makes me confused about my decision. If I take a loan and invest for new crops, climate-related risks may occur again. I don't know what will happen. (Woman in male-headed household, 47 years old).

Limited Access to Credit

In Viet Nam, men are generally heads of household with the power to take decisions about the family economy. Women heads of household are generally widows. Under Vietnam law, heads of household have land ownership and their name is in the "Red Book". Land ownership is important in determining a household's economy. It is not only a means of earning a living e.g. from agriculture, but it can also be bought and sold and used as collateral for loans. Access to commercial banks is thus easier for male-headed households.

The survey has shown that lack of land ownership makes women aquaculturists more vulnerable to climate change by reducing their access to finance which could facilitate adaptation through livelihood diversification. 45% of women in male- headed households and 57% of women in woman-headed households mentioned that lack of land ownership limited their capacity

to apply new technologies and choice of aquatic species. They also claimed that it excluded them from agricultural services, so they miss out on agricultural extension and information on new techniques and technologies such as species diversification, including the introduction of aquatic species with higher heat, flood and salinity tolerance, recommended as adaptation options to climate change. It is more difficult for women to adapt their aquaculture practices to a changing climate.

> We had 4 sao of aquaculture land. We built pond aquaculture to raise some aquatic species such as shrimp, crab, and sugar pawn. The problem of irregular climate change always creates pressure on our family when the growth rate and yield of aquatic species has been decreasing over time. 2 years ago, I heard some information from my neighbor that they adopted a new shrimp species - liopenaus. This new species is good quality with good resistance and a shorter breeding seasonal. I was glad of this useful information and came back to discuss it with my husband. He did not agree with my opinion as he did not believe what I said. (Woman in male-headed household, 52 years old).

Results from key informants and the household survey reveal the banks' perception that commercial aquaculture is high risk, because of the many aquaculture farmers who could not repay money on time due to crop failure. The banks have serious doubts about the repayment capacity of aquaculture farmers. This is also of concern to the farmers themselves: to get a loan they need to provide collateral to guarantee repayment; if they can't repay they can lose the collateral, which usually means their land and buildings. Loan agreements are not something to be entered into lightly.

Results from the household survey have shown that there is a difference in accessibility to the credit system as between women in male-headed households and women in woman-headed households. In male-headed households 45% of the women, via their husbands, could obtain loans from the Agriculture Bank with interest at 0.8%/month. They found it convenient to take a big long-term loan to finance their production process. 28% of the women could access loans from the Women's Union or Farmer's Union, due to their membership of one or other organization, while 11% of the women

were poor enough to qualify for loans from the Bank of Social Policy (loans for poor households over one to two years with low interest at 0.3%/month). 6% of the women borrowed from money lenders and relatives.

In woman-headed households 30% of women accessed credit from the Women's Union and other community organizations. Respondents explained that they had joined these organizations specifically to be able to access their loans - from 4 to 12 million VND, from 6 months to 1 year, with preferential interest at 0.5%/month. As a result of land ownership and collateral issues, 24% of the women were more likely to access informal credit from moneylenders; that way they could get a loan quickly in an emergency without any complex procedures and collateral. However, they were not happy about the moneylender's attitude and behavior to them. They felt that the moneylender viewed them as risky clients, and therefore imposed high interest.

> When I went to ask a moneylender for credit, he said: "how will you pay, what have you got from which I can get my money back?"

10% of the women whose husbands were unable to work or were sick, were restricted to informal types of credit under strict conditions (small loans with high interest). As one of them said:

> I borrowed money from a moneylender but since my husband is sick and I had nothing to mortgage, the interest rate was higher. I borrowed 5million with interest at 10% per month.

22% of the women had access to loans from the Bank for Social Policies. Bank loans were the least used option for women in woman-headed households. One woman whose husband had emigrated explained her case:

> My husband is head of my household and his name is in the "Red Book". I didn't think this of any importance until I wanted to take loan for investing in a large pond and building infrastructure. My husband had migrated to Hanoi as a construction worker. I went to the Agricultural Bank for a loan. The people in the bank said that I needed to bring my husband with me because I am not the land title holder and the "Red Book" as collateral is not in my name but his. So I

> had to wait nearly a week for my husband's return. Sometimes, I really feel that without my name in the land certificate, I have no benefits and no rights since my husband alone has the right to decide to do this or not to do that – and even not to allow me to do this or that. It means that my husband alone has rights to access financial capital. (Woman in woman-headed household, 51 years old).

Loss of income, aquaculture outputs and properties are considered a great threat by women in both types of household, with increasing indebtedness and lack of capacity to repay. The latter problems are a bigger threat to women in male-headed households, 45% of whom have made large investments with money borrowed from the Bank.

> 2 years ago, my husband wanted to extend into large scale aquaculture. He told me how much he wanted to borrow. It was a huge sum for my family at this time. I tried to convince him that if something happened suddenly, we could lose our home. But he still decided to borrow. We got a loan of around 60 million VND for 4 years with interest at 0.8%/monthly. To take the loan, we had to follow the procedure and leave the "Red Book" as a deposit. We expected to be able to repay the money if we got good harvests from the pond. To be honest, it makes me really worried all the time because this is really big money. My concern became real with last year's big storms. Everything was destroyed, putting us in a dangerous situation. How can we pay the money back to the Agriculture Bank? (Woman in male-headed household, 57 years old).

Limited Access to Information

	Women in woman-headed households	**Women in male-headed households**
Heard about climate change	25 (75.75%)	63 (96.92%)
Source of information:		
Television	7 (28%)	15 (23.8%)
Commune public radio	10 (40%)	25 (39.68%)
Internet	1 (4%)	10 (15.87%)
Announcement from local staff	2 (8%)	3 (4.76%)
Word of mouth (from relatives & neighbors)	5 (20%)	10 (15.87%)

Table 5.1: Perception and Information Sources on Climate Change by Selected Households *Source: Field survey, 2014*

The study asked the 98 interviewees whether they had heard about climate change. 96.92% of women in male-headed households and 72.72% of women in woman-headed households replied affirmatively. There were about 10 respondents (9.8 %) who did not understand what climate change was, because they had not heard about it, while 5 % were not sure or had forgotten. Yet they all felt that the weather had changed a lot compared with previous times.

For women in woman-headed households the main sources of early warning were the commune's public radio (40%) and television (28%). Likewise for women in male-headed households (39.68% and 23.8%). 15.87% of women in male-headed households but only 4% of women in woman-headed households used the internet to get climate information. In a family-oriented economy with small-scale production, discussing experiences with neighbors must be important. Information about climate change is also available from books, newspapers, meetings and training programs but these sources are less mentioned. There is a national program on television and a local weather forecast program early in the morning which are popular official sources of information about climate change.

Results from the household survey indicated that the persons from whom they first heard about upcoming disasters were family members, for example husbands in male-headed households. Usually it was the husband who watched or heard the weather forecast as the wives were busy cleaning the house, preparing breakfast for the family and taking the children to school. Many women in woman-headed households did not get time to hear about disasters/ climate change due to their heavy family responsibilities. Lack of early information leaves women more vulnerable to climate change and storms, and less prepared to cope.

The government in collaboration with the local media gave some general early warning prior to storm number 5, via television and local radio, but these warnings had little effect in the study area: approximately 47% of the total survey respondents expressed lack of trust in the government. Respondents had got wrong warning information from local media many times in the past - in 1999 they got warning information only after the storms had arrived and done their damage. Another reason for dismissing the flood warning was the lack of alternative shelters: emergency shelters are part of an enabling strategy to guarantee the safety of vulnerable groups during flood disasters. Without such provision interview participants said that the flood warning made no difference to them since they had nowhere else to go. Some participants even referred to the warning as 'unnecessary' serving only to create more anxiety for them and their family. Early warnings alone are never enough to save lives and properties in disaster situations.

Limited Access to Aquaculture Knowledge/Skills and Training Programs

Aquaculture training includes pond preparation, natural and supplementary feeds and feeding, fish seed rearing and table fish production practices, fish identification, water quality monitoring and fish health management. This is the crucial context for aquaculturists for good pond management. Women aquaculturists said that there was a limit to aquaculture training in their district. Training takes place 2 or 3 times a year but the household survey and in-depth interviews showed that all training sessions and extension services were conducted by and for men. This may be because aquaculture is considered as 'man work", and indeed some aspects of aquaculture production do require physical strength (and it is not safe for women to guard ponds at night). All in all women's role in aquaculture is not well recognized. Many women thought that men were better

and faster at learning than them. Shortage of time and limited mobility were perceived as inhibiting factors by 19% of women in woman-headed households and 10% of women in male-headed households. Other factors included trainers discouraging women from participating or not taking them seriously, and inconvenient training venues and times.

Limited Women's Participation in Decision-Making

Lack of Women's Participation in Community Organization

According to the leaders of the Women's Union in both communities, most of the members of the farmers' and young persons' unions were male, as were the staff of the political and management structures. Even the leaders of the two People's Committees were men. The leader of the Women's Union said that through women's participation in the Union they were participating in the local political and management structure and the commune's decision-making process.

30% of women in woman-headed households and 28% of women in male-headed households were members of their commune's Women's Union. They noted that as members they became more confident and more active in decision making at the commune and household level, including about climate change. But 70% of women in woman-headed households and 72% of women in male-headed households were not involved in any community organization at all. 24% of women in woman-headed households but only 6% of women in male-headed households said that they didn't want to join because of the membership fee. 15% of women in male-headed households saw no benefit from joining. 34% of women in woman-headed households and 20% of women in male-headed households claimed lack of time because of their domestic obligations.12% and 31% respectively of the women had full-time jobs so could not join. Limited participation in the organization meant lack of access to climate information, and exclusion from disaster planning and management in the community.

Lack of Women's Voice and Participation in Disaster Preparedness Program

Gender analysis has not been included in preparations for adapting to climate change, neither in adaptation programs nor in mechanisms for implementation at the central and local level. It would seem that those

responsible lack the skills to integrate gender issues into their disaster management plans and policies, despite women often being more vulnerable to the negative impacts of climate change than men.

Only 21% of the officials in the Environment and Natural Resources Department in the district are women. There is a lack of basic knowledge exacerbated by the absence of women's participation in disaster program preparations. Women's influence in decision making in disaster planning and disaster preparedness programs should be crucial. It is not just a matter of involving women in decision making but of how and whether women represent their interests and whether they raise their voices at appropriate levels. Lack of female representation means that women's interests, needs and voices will not be adequately taken into account in project implementation. Most projects and programs have not addressed gender issues. Factors that exacerbate women's difficulties in coping with climate disasters and climate change - limited access to early warning information, lack of access to health care, increased household responsibilities - have not been analyzed. Lack of women's participation in disaster preparedness and management make women more vulnerable in terms of losses and damage before and after storms/floods.

Limited Access to Social Networks

External assistance from government and NGOs is important in enhancing households' capacity to cope with shocks and disasters. Most of the aquaculturists faced serious problems after the storms. Assistance with money, food, clothes and low interest loans can be crucial in determining the effectiveness of coping strategies.

Assistance provider	**Women in woman-headed households (% of households / assistance)**	**Women in male-headed households (% of households / assistance)**
Government	30% / 20,000 VND/sao	12% / 20,000 VND/sao
NGO	24% / clothes, food	6% / clothes, food
Relatives / other	36% / food, money	82% / food, money

Table 5.2: Distribution of Assistance for Households after Storms
Source: Field survey, 2014

Government policy is to offer assistance only to households designated as poor. Women in poor households received a small amount of money from government - around 20,000 VND per sao of land damaged by the storms. They complained that this was not enough for them to do the repairs. Some households received 4 million VND from an NGO to repair and renovate their ponds after contamination following the storm.

Summary

Women are more vulnerable and disadvantaged than men in coping with climate change. The gender division of labor is unequal, women have limited access to resources, and they are absent from decision-making on disaster plans and management. Women are primarily responsible for domestic and care work in the home, and some work related to aquaculture farming and crop cultivation. They undertake home-based work such as knitting, small business and raising poultry. They take on seasonal paid work locally. All this provides extra income for the family but it leaves women with multiple roles and workload burdens. The situation becomes worse after storms and floods, when women need to spend more time and travel long distances to collect water and fuel, and at the same time have to look for alternative work to earn money to compensate for storm damage.

The impact of storms on women aquaculturists differs according to their economic, social and marital status. Women in woman-headed households have a greater work burden than women in male-headed households as they are primarily responsible for everything without sharing and support from a husband. They are more vulnerable to water shortages as they mostly rely on dug wells, and more susceptible to water intrusion into aquaculture ponds. They cannot afford to buy water from vendors.

Women are the main providers of food for their families. Following storms food became scarcer and more expensive. Food scarcity was the main problem for 30% of women in woman-headed households but only 8% of women in male-headed households. Increased health problems following storms - headaches, sore throats, flu, colds and so on – added care for the sick to women's workload, with women in woman-headed households more vulnerable with no husband to share the load. The extra work, and poor nutrition because of food scarcity and expense, make women more vulnerable to infection and disease.

Lack of finance is a common problem after storms and floods, particularly for women in woman-headed households because of their limited access to credit. Women in male-headed households have a different problem: they can get loans from the bank, but are then left with a big debt and inadequate funds to repay if their harvests are lost to the floods.

	Women in woman-headed households	**Women in male-headed households**
Storm damage losses	Time and money spent on repairs	Bigger loans; bigger debt incapacity risk.
Domestic burden	Increased - see below	
Lack of fresh domestic water	Heavy carrying, long distances	Costs of purchasing domestic water; more costs for water filtration
Water contamination of ponds	Time spent modifying or repairing Costs of male labor	Time spent preparing for storms
Fuel for cooking	Long distance to find fuel	Gas and coal more expensive
Food shortage	High food prices. Degradation of marine resources	
Health	Poor nutrition + increased physical effort finding water and fuel Skin diseases, colds, flu Children and elderly vulnerable post-storm – need looking after	
Credit and financial issues	Limited access to formal institutions for credit – depend on moneylender with high interest and strict conditions. Debt incapacity; unfair compensation for working off debt.	Big loans needed to invest in aquaculture production; concerns about repayment – risk of debt incapacity

Table 5.3: Women's Vulnerability to Climate Change in Different Marital Circumstances

Chapter 6

Adaptation of Women Aquaculturists to Climate Change

Adaptation Strategies of Women Aquaculturists to Impact of Storms/Floods

Women in woman-headed households are more likely to take up adaptation options than women in male-headed households. A possible explanation is that most small-scale aquaculture farming in the coastal area is carried out by women in woman-headed households, who had to take charge of the work when their husbands either died or migrated to get a job. They became responsible for productive as well as domestic work. The pressure of this heavy workload gave them an incentive to learn from their neighbors and other sources how best to deal with negative impacts from the external environment. Thus, they have more experience and information on how best to cope with climate change.

Coping strategies for water insecurity

Lack of fresh water for domestic and aquaculture production is a threat for all households. 55% of women in woman-headed households and 85% of women in male-headed households use bore wells and tap wells for domestic water. Nearly 75% of all households had water filtration facilities. 65% of households purchased water from private vendors in times of shortage; the

price was around 50,000VND/tank. They mentioned that they spend large amounts of money for water during and after floods and storms.

45% of women in woman-headed households and 15% of women in male-headed households used dug wells as their main sources of domestic water. Results from the household survey indicated that only 10% of women in woman-headed households and 8% of women in male-headed households renovated their fresh water ponds after the storms, relying largely on their own or their relatives' resources. The main method was to deepen the ponds by more than three feet by removing the bottom soil, and to raise the pond dykes by 2 feet. The average cost was 4 to 5 million VND per pond. Others dewatered the ponds and sun dried them. This method helped recover fresh water from the contaminated saline water in the pond.

With regard to water for aquaculture production, 44% of women in woman-headed households and 65% of women in male-headed households took steps to protect their ponds before storms: by closing the water inlet sluice they could stop water getting in, to preserve the appropriate saline content required by the aquatic species; they could also build up the edge of the pond to prevent water flooding in that way and to stop species escaping over the edge. However, due perhaps to lack of early information, 56% of women in woman-headed households and 35% of women in male-headed households failed to take these precautions and faced serious losses, leaving them to resort to post-storm water treatment. When strong storms and heavy rains cause flood, water often separates into two layers, with fresh water on top and salt water below. Based on women's knowledge and experience, they let out some of the fresh water to keep the required degree of salinity. Alternatively they can add powdered lime, minerals and salt. The main purpose is to maintain mineral content, stabilize alkali and make oxygen available for the aquatic organisms in the pond, balancing pH. However, these measures demand time and labor, adding an extra burden for women in woman-headed households.

Adaptation to Food Insecurity

Scarcity of food and higher prices during and after storms/flood are common phenomena in flood affected areas. Results from the household survey and in-depth interviews show that 40% of women in woman-headed households and 57% of women in male-headed households used a reduction of daily consumption expenditure as their main measure against food insecurity. 60%

of women in woman-headed households and 43% of women in male-headed households were more seriously affected. Among them, 10% of women in woman-headed households and 12% of women in male-headed households resorted to selling assets in order to buy food in the disaster period, while 12% and 6% respectively relied on cutting down expenditure. The survey also indicated that reducing the number of meals per day, skipping meals and borrowing rice from neighbors were other steps mainly undertaken by women in woman-headed households. 24% of women in woman-headed households and 6% of women in male-headed households said that they had to take emergency loans to deal with food security, illness, and purchasing education materials for their children.

Preparedness to Save Human Lives and Household Items

		Women in woman-headed households	**Women in male-headed households**
Before storms			
	Cut trees near the house	92.85%	93.33
	Buy and store food and other necessities	100%	100%
	Collect fresh water and fuel for consumption	89.28%	83.33%
	Keep radio and TV on to listen to weather forecast	85.71%	96.67%
	Buy large timber for pigpen and henhouse in stable	64.28%	46.67%
	Inform and meet neighbors	57.14%	73.33%
	Prepare a means of evacuation	50%	56.67%
	Protect tube dwell from polluted water intrusion by covering with big plastic bag or large piece of wood	64.28%	50%
	Buy and prepare medicine for family members	100%	100%
	Keep jewellery and important documents in safe place	100%	100%
	Reduce unnecessary spending and save money as much as possible	92.85%	93.33%

	Cover with high bank and spillway dam to prevent flood from flowing into pond	53.57%	76.67%
During Storms			
	Try to maintain enough food, fuel and water for family	100%	100%
	Protect elderly and children from going outside	100%	100%
	Take care of sick persons	100%	100%
After Storms			
	Take care of sick family members	71.42%	50%
	Collect fresh water, food and fuel for comsumption	78.57%	50%
	Borrow money for recovering damaged houses, facilities	89.28%	50%
	Learn experiences from neighbors and other local sources	67.85%	73.33%

Table 6.1: Strategies to Save Human Lives and Household Items in Selected Households *Source: Field survey, 2014*

Table 6.1 illustrates the preparations women aquaculturists made in response to storms/typhoons. Most of the listed measures were adopted by the majority of women in both categories of household. Some post-storm measures were adopted by only 50% of women in male-headed households: they were less likely to be affected by these problems than women in woman-headed households.

Adaptation Strategies of Income Diversification

Diversification of income is an effective response to income losses due to the negative impact of storms and floods on aquaculture.

Diversification of Income in Aquaculture Farm Activities

The majority of women aquaculturalists do not want to give up aquaculture farming even though yield failures put them in a difficult situation. Results from the household survey and in-depth interviews found that 62% of women in woman-headed households and 35% of women in male-headed households said that aquaculture was a main occupation and contributed significantly to their income.

> We already made a big investment – more than 100million VND - to build the shrimp and fish ponds. The storms last year swept away everything we have. The failures leave us more than 50millions VND in debt. We have to continue to cultivate with the expectation that we will get some profit to pay off the big debt and regain our investment. (Woman in male-headed household, 52 years old.)

Women have adopted different coping strategies to protect their crops from the impact of storms and floods. These include the selection of appropriate varieties that best suit the local climate and the time frame of floods. A significant number of respondents used "adjusting aquatic techniques" i.e. changes in breeding prawn species, in particular from sugar prawn to *litopenaeus van* and *litopenaeus vannamei*. Good results were achieved by some households in the district and the news spread quickly. Household survey data show that both woman- and male-headed households (24% and 38%) used changes in breeding species. They mentioned that *litopenaeus vannamei* is a good quality species with good resistance, high yields and shorter breeding season.

	Women in woman-headed households	Women in male-headed households	Total
Early harvesting	4 (12%)	8 (12%)	12 (12%)
Adjusting aquatic techniques	8 (24%)	18 (28%)	26 (27%)
Application of technology	3 (9%)	7 (11%)	10 (10%)
Adjusting breeding calendar	7 (21%)	12 (18%)	19 (19%)
Alternative breeding	8 (24%)	14 (22%)	22 (22%)
Non adapt	3 (9%)	6 (9%)	9 (10%)

Table 6.2: Adaptation Strategies of Women Aquaculturist in Aquaculture Practices *Source: Field survey, 2014*

Alternative breeding was adopted by women in woman-headed households (24%) and in male headed households (22%). This breeding pattern combined different kinds of aquatic species in the pond to utilize all available

food, as different species have different habits and eat different food. Thus, alternative breeding increases the productivity of aquatic species and helps to cope with climate change. Adjusting the breeding calendar was another popular approach. In this method, aquaculture farmers can adjust the breeding crop as they can chose to stop breeding and harvesting before the storms arrive. The application of technology is adopted by 11% of women in male-headed households and 10% of women in woman-headed households. This is an effective method leading to high yields, but it needs a large surface to apply and demands good understanding of the strict rules and processes needed to get good results. In general, diversifying within aquaculture improves efficiency, reduces losses and brings some profit to the aquaculturists. It is noteworthy that 10% of households adopted no measures to cope with climate change. These are poor households that either have no money to invest or who believe that God is responsible for storms and irregular climate.

Diversification Income in Non-farm Activities:

Hired Labour

Aquaculturists sell their labor to make up for the loss of aquacultural income due to the negative impact of storms. Informal jobs such as oyster collection on the ground/lagoon area might pay 150,000VND/day. However, the availability of this sort of work is limited and depends on seasons and crops. Rice wine making, growing vegetables and raising poultry in their home gardens are other options, providing produce for their families as well as for sale. All the women believed that they had to find as many different livelihood activities as possible to meet the needs of their families.

Migration

The failure of aquaculture two years running has led aquaculturists' husbands to migrate to the cities to look for jobs. Due to a combination of over-exploitation of the natural resources of the coastal area, environmental pollution and the negative impact of climate change, many people, including many young, unmarried people, and male heads of household, cannot find jobs locally and move to Ho Chi Minh or Hanoi city to work as laborers. They work in the informal service sector, for example in housekeeping, trading, construction, tailoring and small business. They often have no contract, a low wage and long working hours. They lack the benefits or rights prescribed by

labor law. Experienced workers are paid from 300,000 VND to 400,000 VND/day; inexperienced workers often get around 100,000 to 300,000 VND/day.

Of the 98 women covered by the study, 23 are female heads of household, 10 of whose husbands have migrated to the city or overseas. Women aquaculturists cannot migrate themselves because they have to take care of their family, their rice fields and pigs, as well as their ponds.

> I can get some money in the flood season, instead of nothing. My husband is employed harvesting coffee since 2000. He sends money for me every month around 5-6millions VND. This money can help me repair aquaculture and rice cultivation when I cannot get a loan from the banks or local lenders.

In general, migration, both temporary and permanent, provides a significant income for the aquacultural households, which can compensate for aquacultural yield failures. It is considered as the best strategy to help them reduce their dependence on aquaculture.

Constraints/Barriers to Women Aquaculturists to Diversify into New Income Generating Activities in Adapting to Storms/Typhoons

Lack of Employment

As noted earlier, opportunities for hired work are limited: demand from prospective employers is low, while demand from job-hunters is high. Home work is an alternative: women can earn money from knitting, sewing, rice wine making, growing vegetables and raising poultry. Migration to find work in the city or overseas was an option often taken up by husbands, but was not open to wives because of their family responsibilities.

Lack of Land Ownership and Credit

Bank loans require collateral which normally means land. This is normally vested in men, as heads of household. Women heads of household whose husbands have migrated cannot normally access bank loans. Women in male-headed households can gain access only through their husbands, who may not agree with their plan – for example to set up a small business. More

fundamentally, people are hesitant about mortgaging their land when they risk losing it if they cannot afford to repay the loan.

Social Norms

Confucius rules, but not entirely: there is some blurring of the rule that women are expected to focus on domestic duties, leaving productive work to the men. The rule does not work at all, of course, in woman-headed households, where all responsibilities fall on the women. In male-headed households women undertake sub-works in aquaculture such as feeding and harvesting and as explained above do many other types of work to earn money for their families. Men do the heavy work in aquaculture and work involving technology. After storms and floods the men sometimes help women to fetch water and look after the sick, and they are responsible for repairing houses etc. But in woman-headed households all these responsibilities fall on the women, hiring male labor where physical strength is required.

> My family has 2 sao of land for aquaculture and no land for crop cultivation. My husband migrated to Taiwan to find paid work as a construction worker. He rarely comes back to visit due to his full time job but he often sends money back to me. I live alone with my two children. I take charge of all the household chores as well as the aquaculture. Sometimes, I also do paid work in the village. I and my husband have to work hard to maintain our daily consumption and to pay tuition fees for the children. After storm number 5 my house, garden and aquaculture farming were totally lost. My husband could not come back because of the long distance and expensive air-fare. I had to recover house and farm by myself. At the same time I had to find ways to ensure food security for my family. It was very challenging for me to handle, control and balance all my tasks without my husband's support. (Woman in woman-headed household, 53 years old)

Summary

Gender inequalities shape the way men and women respond to climate change (Nelson et al., 2009). Women adapt to mitigate the negative effects of climate change, and to maintain livelihoods and increase household income.

Women adapt differently depending on whether they are in woman-headed or male-headed households. Women in woman-headed households are more vulnerable to fresh water shortages; they rely on dug wells and ponds which they have to renovate after storms, relying on their own resources, relatives and NGOs. They cannot afford to buy water from vendors – a solution usually open to women in male-headed households. And they tend to be less well prepared, for want of information and labor.

Lack of preparedness also leaves their aquaculture ponds more vulnerable to flood damage. They have to repair the damage after the event by finding ways to restore the ponds' salinity, while their colleagues from male-headed households take preventive measures to keep flood water out.

To adapt to food shortages, women from woman-headed households turn to cheaper foods, reduce the number of meals per day, and borrow food from neighbors. Women from male-headed households reduce expenditure but also sell assets. Some women in both categories borrow money to pay for food. Women from woman-headed households have limited access to credit and often have to resort to money lenders at high interest – or repayment by working off the debt at a below standard wage rate.

Diversification of income is another coping strategy. Women in male-headed households tend to increase their aquaculture activities, which they see as their economic mainstay. Women from woman-headed households are more likely to look for paid labor off the farm.

Chapter 7

Summary of Findings, Conclusion and Recommendation

Summary of Key Findings

Women play a crucial role in aquaculture. They may have higher adaptive capacity to climate change than men, but they are more vulnerable to its negative effects. They have less access to and control over resources, and face an unequal gender division of labor and unequal decision making. Climate change adds to women's already heavy workload. Omari argued that climate change magnified existing inequalities, reinforcing the disparity between women and men in their vulnerability to, and capacity to cope with, climate change (Omari, 2008).

Climate change impacts differently on women of different marital status, education, and socio-economic class.

Women in woman-headed households are more vulnerable than women in male-headed households. With sole responsibility for looking after the family and its economy they have little time to engage in higher education, training programs or local politics. Their supply of drinking water is more likely to suffer pollution because of flood, as is the water in their aquaculture ponds. They may have to spend more time and go long distances to fetch domestic water and also fuel, as they rely mainly on wood and charcoal, unlike women in male-headed households who mostly use coal and gas.

Most women in male-headed households have access to bore wells and tap wells for domestic water – but water contamination after storms is a threat and they invest more in water filtration. They are also able to buy water from private vendors although this is expensive.

Scarcity of food during and after storms/flood is a common phenomenon. Women in woman-headed households were most vulnerable. Their main adaptive measures were relying on inexpensive food, fewer meals per day, skipping meals, borrowing food from a neighbor and taking an emergency loan. Women in male-headed households cut down on daily consumption and sold assets.

Scarcity of credit is another problem. Women in woman-headed households mostly have no collateral for a bank loan. Some of them can borrow from local unions but only if they are members. Moneylenders offer harsh terms.

Diversification of income is an effective response to income losses from aquaculture due to negative impact of climate related risks. Women in male-headed households are more likely to adapt by diversification of their aquaculture activities, whereas women in woman-headed households are more likely to look for paid work off-farm. Migration is an option for husbands, enabling useful remittance income.

Recommendations

Secure Land Rights for Women Aquaculturists

It is important for state and non-state actors to raise awareness in communities of women's rights to inherit and buy property. A woman's access to property can increase her bargaining power within the household, and even her control over agricultural income. Even if women cannot acquire land rights, there are other ways for them to access the means of production to provide a source of personal income.

Effective Use of Microcredit through Training and Education

Microfinance can offer opportunities for women's empowerment to facilitate livelihood diversification. Programs should be integrated with

appropriate training and extension for productive activities, to equip women with the necessary skills and knowledge to become independent in their productive role. Training programs should include regular visits by the extension services and officers of the local Department of Fishery and Aquaculture, who also need to facilitate the participation of women in training programs by providing them with a better understanding of how these programs can improve their livelihoods. Program designers should listen to women's voices to ensure that programs deal with women's needs, and are timed and located conveniently for women's participation.

Promote Program for Creating Jobs for Women

Lack of employment opportunities is one of the main problems confronted by women. Possible remedial measures could include:

- assistance in creating small businesses, particularly for women in woman-headed households
- training programs to enhance women's skills in setting up profitable businesses and finding better paid work.

A Fairer Gender Division of Labor

It is clearly necessary to design adaptation measures that will have a more comprehensive gender perspective in order to impact gender relations. This goes beyond the scope of this study. There should for example be further research into ways of relieving the time pressures on women to allow them to take on new responsibilities should they wish to do so - for example childcare facilities.

Action in the Community

It would be useful to establish a local aquaculturist club where everybody, particularly local women, can share information and knowledge about techniques of aquaculture breeding and ways to counter the negative impacts of climate change.

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Index

Appendices - Questionnaires

Appendix 1

Check List for Key Informant: Village Council, Commune and District Offices

I. General Information/Demographic Information

1. What total populations do you have in the village/commune/district? How many men and how many women?
2. How many households in the village/commune/district?
3. How many households working in aquaculture and fishing farming? (Figure or percentage (%))?
4. What is the total area of the village/commune? Land for aquaculture and fishing farming (ha)? Land for other uses (rice, forest) (ha)?

II. Livelihood in Small- Scale Aquaculture

5. What are the major occupations of village/commune/district? What percentage for each occupation?
6. What are the main sources of household income in the village/commune/district? □ Crop cultivation □ Livestock □ Aquaculture and fishing □ small business □ others
7. How do farmers sell their aquatic production to the market?
8. What kind of social network/organization is there to help farmers sell their products in this village/commune/district? □ Women's union □ Farmer's union □ Youth association □ other .....
   .....

III. Climate Change Information & Impacts on Small- Scale Aquaculture

9. What kind of weather variability has happened commonly in recent years in the village/commune/district? □ Storms □ Droughts □ Flood □ Saline intrusion □ Coastal Erosion □ Sea level
10. Is the impacted level of disasters in recent years different compared with previous years? □ Yes □ No □ Fairly different □ I don't know (If the answer is "yes" or "fairly different", please explain how different it is)

11. How do the storms affect your village/commune/district in recent years? Compared to the past? □ The same □ More frequent □ Less frequent □ I don't know
12. Which year had the biggest storms in the village/commune/district?
13. Which year did had least storms in the village/commune/district?
14. How did storm number 8 (2013) affect your village/commune/district?
    - In terms of social and economic conditions
    - In terms of aquaculture production (how many plots/areas/yields were destroyed, threatened, affected by storm number 8 (October, 2012)
    - In terms of people's health issues
    - Quantity & quality of water (drinking water, consumption water, aquaculture production water)
    - Infrastructure
    - Livelihood activities (land affection, yield, and aquatic consumption income)

IV. Climate Change Adaptation in Small- Scale Aquaculture

15. What did the men and women often do in coping with storm number 8 (October, 2012)? Before and after the occurrence of storm number 8 (October, 2012) (Please, explain more specifically!)
16. Besides farming and off farming activities, what other income generation activities did they do? (Please, explain more specifically!)
17. Did any local resident migrate to work out of the village after the storm number 8 (October, 2012) occurred? Yes No (If "yes", continue question below?)
18. Do you have any statistical data or reports about migration which occurred after disaster?
19. Who normally migrates? Women or men Elders or young people
20. For how long do they migrate?
21. Are there any social networks for job creation in the village/commune?

22. How did village/commune warn farmers in the area, particularly about storm number 8

    □ Through meeting

    □ Loudspeaker

    □ others (specify)

23. Is there any assistance service from government to help vulnerable men and women who are suffering serious damage from climate hazard in the village/commune/district?

24. Does your village/commune have funds from any organization for:

    Productive activities

    Recovery from climate risks/disaster

    Women/men only

    Other

25. How many health centers in your village/commune/district?

26. What kind of livelihood patterns do farmers usually engage in to increase income after disasters.

    □ Farming □ Non - Farming □ Off - Farming □ Migration

    (If respondent chooses any answer from the above, please explain more specifically!)

27. Can you give some suggestions/ideas to reduce negative effects of storm and drought in your area?

Appendix 2

Check list for in-depth interview

I. General information

Name of interviewer:

Number of questionnaire:

1. Name of respondent:
2. Sex: □ Male □ Female
3. Age: ……years old
4. Schooling year:
5. Marital status: □ Single □ Married □ Widow □ Widower
6. Household head: □ Male □ Female
7. Religion: □ None □ Christian □ Buddhist
8. Number of members in the household: ……

II. Respondent's information

Gender division of labor at household level

9. Do you engage in domestic tasks?

If yes, what do you do? And how much time does it take?

Domestic tasks	Times (hours)	Done by*
Collect water for daily consumption		
Food collection		
Fuel collection		
Washing and cleaning		
Take care children and elders		
Other……		

* Done by male head of household, female head of household, other male, female and so on

10. Do you engage in productive work in your family?

If yes, what do you do?

Aquaculture	**Time (hours)**	**Done by***
Pond preparation		
Cage/pen/tank construction and repair		
Fish stocking		
Feeding		
Daily care		
Net mending		
Processing (Cutting, cleaning, drying, smoking, boiling..)		
Marketing (specific: collect, retail, seller...)		
Other…		

* Done by male head of household, female head of household, other male, female and so on

11. Do you engage in off - farm and non-far activities work in your family?

If yes, what do you do?

Off - farm and non - farm activities	Time (hours)	Done by*
Hire labor		
Construction in the village		
Small business		
Fishing boating		
Migrate for paid work		
Other…		

*Done by male head of household, female head of household, other male, female and so on

12. What kind of activities were you involved in in community management?

13. How many members in your household were involved in community activities?

14. Is there any kind of social network in the village/commune/district? □ Women's union □ Farmers' union □ Youth association □ other
15. How many members in your household were involved in those organizations?

III. Climate Variability Information and Vulnerability in Small- Scale Aquaculture

16. What do you know about climate change/variability in your are in recent years?
17. How often have storms happened in recent years in your village? □ The same as previous years □ Slightly increased compared to previous years □ Increased compared to previous years □ Decreased compared to previous years □ I don't know
18. What kind of weather variability happened in recent years in your village/commune/district? □ Storms □ Droughts □ Flood □ Saline intrusion □ Coastal erosion □ Sea level
19. Is there a difference in the impact of this disaster in recent years compared to previous years? □ Yes □ No □ Fairly different □ I don't know (If the answer is "yes" or "fairly different", please explain more specifically!)
20. How have the storms occured in recent years in the village/commune/district? Compare to the past? □ The same □ More frequent □ Less frequent □ I don't know
21. In term of storms how did your tasks change? Please list specific change? Who is responsible?

Domestic tasks	Before storms*	After storms*
Collect water for daily consumption		
Food collection		
Fuel collection		
Washing and cleaning		
Take care children and elders		
Other……		

Aquaculture		
Pond preparation		
Cage/pen/tank construction and repair		
Fish stocking		
Feeding		
Daily care		
Net mending		
Processing (Cutting, cleaning, drying, smoking, boiling..)		
Marketing (specific: collect, retail, seller, ..)		
Other…		
Off - farm and non - farm activities		
Hire labor		
Construction in the village		
Small business		
Fishing boating		
Migrate for paid work		
Other…		

*Done by male head of household, female head of household, other male, female

IV. Climate change adaptation of livelihood activities in small- scale aquaculture

22. What kind of livelihood patterns did you usually engage in for income diversification in the village/commune/district before and after the occurrence of storm number 8 (October, 2012)? □ Farming □ Non-Farming □ Off - Farming (If respondent choose any answer above, please explain more specifically!)
23. What did you do to generate other income, besides farming and off farming? (Please, explain more specifically!)

24. Did any member of your household migrate to work outside the village after storm number 8 (October, 2012) occurred? Who? Yes No (If "yes", continue question below?)
25. How often did they migrate? For how long did they migrate? (Seasonal or long term)
26. In case of male migration, who is responsible for workload left behind?
27. In case of female migration, who are responsible for workload left behind?
28. What do you think are "the main barriers/constraints for you to diversify into new generating income to cope with storms? Why?

Appendix 3

Check List for Household Survey

I. General Information

1. Name of respondent: ……..
2. Sex: □ Male □ Female
3. Age: ……years
4. Education level: □ Primary school □ Secondary School □ High school □ College
5. Marital status: □ Single □ Married □ Widow □ Widower
6. Household head: □ Male □ Female
7. Religion: □ None □ Christian □ Buddhist
8. Number of members in the household: ……..
9. What kind of house structure do you have? □ Flat roof □ Tiling roof □ Cottage roof

II Household information (Gender division of labor)

10. How many members in your family? What do they do?

Number of member	Gender	Age	Level of education	What do they do	Household income* (per year)
Member 1					
Member 2					
Member 3					
Member 4					

*Households sources of income:

·Aquaculture · Hired labor ·Fishing boat ·Remittance ·Other

11. Which is the main income in your family? ·Aquaculture · Hired labor ·Fishing boat Remittance Other

12. Total average income/ year in your family? (VND/year)

Total average income from	VND/year	Note
Aquaculture production		
Crops and vegetable		
Salt production		
Livestock breeding		
Fishing		
Wage labor		
Seasonal labor		
Small business/trading		
Interest from rents and loans		
Remittance		

13. What kind of breeding model does your family use? What is the benefit and limitation of the breeding model?

·Intensive · Semi intensive ·Extensive ·Improved extensive · other

14. What kind of aquatic breeds does your household raise in the pond?

15. What is the main breeding area and mode for aquaculture species in your family?

·Fresh water · Brackish and salt water · other

16. How does your household sell aquatic production to the market? Who sells?

17. What kind of aquatic product do you sell?

III. Access & control over resources

18. Land area for aquaculture practices in your family? (m^2 or ha)? Who control? Who access?
19. Pond size for aquaculture practices in your family? (m^2 or ha)? Who controls? Who has access?
20. How did you get water for drinking and consumption? How long does it take for you to get water? (Minutes)
21. How did you get water for your pond aquaculture?
22. Which kind of fuel did you used for cooking?

    □ Charcoal & wood □ Gas & coal □ other
23. How long does it take for you to get fuel? (Minutes)
24. Has your household enough money for productive activities?

    If not, where does your household prefer to borrow? Why? Do you face any problems to access to those resources?

- Borrow from bank
- Borrow from relatives/neighbors
- Borrow from village's/commune's funds
- Other

IV. Climate information, Climate vulnerability and Climate Adaptation Access to Climate information

25. What do you know about the climate, particularly storms, changing in recent years/decades in your area?
26. How often do storms happen in recent years/decades in your area?
27. Do you feel the current climate situation is different from the past? □ More frequent storms □ Change in seasonal rainfall □ other
28. How does your household access climate change information? □ TV □ Communes public radio □ Internet □ Relatives/neighbors □ other

29. Is it useful for your household to avoid negative impacts of climate risk? Why?
30. In your household, who first gains access to the climatic information? Why?
31. Is there any barrier to access climatic information for other members of your household?

V. Impact of Storms on Livelihood of Women Aquaculturists and Adaptation Measures of Households

32. Did your household face any problem in terms of food consumption because storm number 5 (2013)?

    If yes, how did your household solve this problem?

    □ Selling assets □ Relying on inexpensive food □ Borrow money from neighbor/relatives □ Skip meals □ Reduce meal/day □

    □ Other……
33. In terms of shortage of food for daily consumption, who is prioritized to eat first? Why?
34. Did your family face any problem with water sources for domestic and production due to storm number 5 (2013)? If yes, how did your family solve this problem?

	Drinking water	Consumption water	Water for production
No effect			
Polluted			
Shortage			
Other			

35. Does your household face any problem in terms of fuel shortage due to storm number 5 (2013)? If yes, how does your family solve this problem?
36. Did any household member get injured, sick or suffer any disease after storms occurred?
37. Who is responsible for taking care of sick people in your family?

38. What kind of activities did your family undertake to protect your property and assets?
39. What kind of livelihood patterns did you use for income diversification in the village/commune/district before and after the occurrence of storm number 5? □ Farming □ Non - Farming □ Off - Farming

    (If respondent chooses any answer above, please explain more specifically!)
40. What kind of activities does your family do in aquaculture farm to cope with storms?

    lease explain more specific?
41. What kind of activities does your family do in aquaculture farm to cope with storms? Please explain more specifically?
42. What did you do for other income, besides farming and off farming? (Please, explain more specific!)
43. Did any member of your household migrate to work outside the village after storm number 5? Who?
44. Did your household get any assistance at the time of storm number 5 (2013) or floods? □ Yes □ No

    If yes, where did you get it from?

    □ Relatives □ Neighbor □ Government sector □ Organizations □ Charity □ others
45. What kinds of assistance did you get?

    □ Cash □ Kind □ others
46. Are there any self-help groups in your village/commune?

Vulnerability and Adaptation of Women Aquaculturalists to Climate Change

Case Study of Women in Small-scale Aquaculture in Tien Hai District, Thai Binh, Vietnam

Nguyen Thi Thu Ha

In Vietnam, fisheries and aquaculture are the second most important livelihood source after rice production. Women play a crucial role in small-scale aquaculture. Vietnam has been badly affected by climate change and due to its geographical location is likely to be one of the most significantly impacted countries going into the future. Coastal areas in Vietnam are vulnerable to frequent typhoons, storm surges, flash floods, droughts and saline water intrusion. Climate change is making these phenomena more acute. Women aquaculturists rely on marine resources—seaweed, fishing, clams and shrimps—that are worst affected by climate change. Facilities are destroyed. Saline intrusion into drinking water sources means women have to spend more time fetching water. They also have to spend more money— on repairs, re-stocking, and food for the family. They have problems obtaining credit, and worries about repaying loans if repaired facilities are destroyed by the next storm.

This report looks at how well informed and prepared these women are for the effects of climate change, and what steps are available to them to mitigate their vulnerability.

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