SUSTAINABLE DEVELOPMENT OF EXPORT-ORIENTATED FARMED SEAFOOD IN THAILAND

A thesis submitted for the degree of Doctor of Philosophy

By

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DECLARATION

This thesis has been composed in its entirety by the candidate, except where specifically acknowledged. The work described in this thesis has been conducted independently and has not been submitted for any other degree.

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ABSTRACT

Sustainable development of export-orientated farmed seafood in Thailand is a major issue which can impact local stakeholders as well as global food security. The major species taken into consideration in this research were initially the Pacific white shrimp (*Litopenaeus vannamei*), Nile tilapia (*Oreochromis niloticus*), giant freshwater prawn (*Macrobrachium rosenbergii*), and striped catfish (*Pangasianodon hypophthalmus*). After which more focus was placed on Pacific white shrimp, which is Thailand's major cultured seafood being traded for export, and tilapia, which has potential for export but also enjoying a good domestic market demand.

Actors or stakeholders directly and indirectly involved in aquaculture value chains may have their own perceptions about sustainability affecting their operations, as various factors within and outside their own systems could affect these perceptions. This could lead to different efforts in responding to these factors to make their operations sustainable.

Three major areas were covered in this study, namely a) describing the strengths and weaknesses of shrimp and tilapia production in Thailand in relation to their export potential, b) evaluating the status of compliance to global aquaculture standards of shrimp and tilapia farming (covering technical and labour aspects), and c) determining perceptions of sustainability across the shrimp and tilapia value chains in Thailand, with a focus on the production sector.

A mixed-methods approach was employed to obtain information in the study sites in Thailand. Basic field interviews were conducted among 206 shrimp producers in 6 provinces in the east and south, and 199 tilapia producers in 4 provinces in the west and east, in terms of farm operations and perceptions of factors which will affect the sustainability of their operations, including generational aspects on future shrimp and tilapia farming.

Key informant interviews were also conducted among other value chain actors (>30) such as hatchery/nursery operators, input/service providers, processors/exporters and technical/ institutional members to determine whether there are differences in their sustainability perceptions.

In addition, face to face interviews with 18 shrimp farm male and female workers were conducted (Thai and migrant workers), as well as with 14 key informants involved in shrimp farm labour issues in Thailand, specifically for well-being and working conditions.

Stakeholders cited environmental (technical), economic, social and institutional (equity) aspects of their operations as factors which will affect the sustainability of their operations. Disease, product price and water quality were the three most important sustainability factors among shrimp farmers, whereas water quality, disease and extreme weather conditions were for tilapia farmers. Product price was the most cited by input service providers, hatchery operators, shrimp and tilapia producers, and processors.

Both Thai and migrant shrimp farm workers perceived a better or much better-off quality of life working in shrimp farms in Thailand than in their previous occupations or status. Almost all shrimp farms meet more than what are required under the Thai labour law or the global aquaculture standards for human resources. With the importance of migrant labour in Thailand, much still needs to be done in terms of assessing the impact of their working in Thailand on their families left behind in their own countries, as well as on their communities, including status of social protection to avoid exploitation.

Each stakeholder group strives to achieve sustainability so they can remain in operation in the next few years, to survive on the business individually and corporately, and to be the best provider of sustainably and ethically produced seafood for the world. The compliance to aquaculture global standards and certifications may be considered to contribute to the sustainability of operations by improving farm practices thereby reducing detrimental impacts on farm and external environments, as well as strengthening human relations with in the farm and in the community. However there are some aspects of these standards which could eliminate the small players. In this study, the large scale farms were more likely to comply with all the standards, followed by medium scale, and lastly the small scale farms.

The differences in perceptions which exist among these stakeholders should be understood by every sector and efforts should be made to address them so that there is cohesiveness in giving support to achieve sustainable seafood production and trade.

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And to my Lord God, from Whom all blessings flow, for His guidance, protection, healing, and enduring love. (Isaiah 41:10).

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ACFS	Agricultural Commodity and Food Standards
AEC	ASEAN Economic Community
AHPND	Acute Hepatopancreatic Necrosis Disease
AIT	Asian Institute of Technology
ASC	Aquaculture Stewardship Council
ASEAN	Association of Southeast Asian Nations
BAAC	Bank of Agriculture and Agricultural Cooperatives
BAP	Best Aquaculture Practices
CoC	Code of Conduct
CP(F)	Charoen Pokphand (Foods)
CSR	Corporate Social Responsibility
DO	Dissolved Oxygen
DoE	Department of Employment
DoF	Department of Fisheries
DLPW	Department of Labour Protection and Welfare
EEZ	Exclusive Economic Zone
EM	Effective Microorganism
EMS	Early Mortality Syndrome
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
FCR	Feed Conversion Ratio
FMD	Fisheries Movement Document
FW	Freshwater
GAA	Global Aquaculture Alliance
GAP	Good Aquaculture Practices
GVC	Global Value Chain
HS	Harmonized System (Harmonized Commodity Description and Coding System) for traded products
IFS	Integrated Farm Survey
ILO	International Labour Organisation
IPEC	International Programme on the Elimination of Child Labour
KI	Key informant
LPG	Liquefied Petroleum Gas
MOL	Ministry of Labour
MOU	Memorandum of Understanding
NACA	Network of Aquaculture Centers in Asia and the Pacific
NET	Northeast Thailand
OECD	Organisation for Economic Co-operation and Development
PCR	Polymerase Chain Reaction
PE	Polyethylene
PFO	Provincial Fisheries Office
PLs	Postlarvae
ppt	Parts per thousand
QOL	Quality of Life
RASFF	Rapid Alerts System for Food and Feed
SEAT	Sustaining Ethical Aquaculture Trade
SPF	Specific Pathogen Free
SPR	Specific Pathogen Resistant
SSP	Sustainable Shrimp Programme
TAO	*Tambon* (sub-district) Administrative Organisation
TFFA	Thai Frozen Foods Association
WSSV	White spot syndrome virus
YHV	Yellow head virus

1. CHAPTER 1 Introduction

1.1. Rationale / Problem statement

Aquaculture is becoming more important in supplying the world's demand for seafood (FAO, 2012) and Thailand has become a major player in seafood production, processing and international trade. Strategies for aquaculture production and trade have been created through government and private sector efforts to ensure sustainable production and trade for food security. On the other hand, markets and consumers have set standards and certifications to ensure good quality seafood grown in a sustainable manner, with the aim to guide producers and make consumers confident in their choices (Bostock et al., 2010). Bush et al. (2013) have argued though that aquaculture certification is just one of the many approaches to achieve sustainable production and that it could lead to a divide between larger scale and smaller scale farms in terms of ability to comply. Similar concerns have been voiced previously for example by Belton et al. (2011) regarding Pangasius aquaculture in Bangladesh and Vietnam. In fact, third-party certification could be more of a power and politically-driven process (Konefal and Hatanaka, 2011) which could affect compliance because not all farms are homogeneous. This brings us to the issue of sustainability, and how it is defined. Bell & Morse (2008) had pointed out that even though sustainability is a popular concept there is no specific definition of the word. They further added that since people do not live in similar conditions vis-à-vis environmental, social, and economic, it would not be right to just have one definition of sustainability. The word could mean differently to various people, depending on their own value systems (Bremer et al., 2013). On the other hand, a general overview of the term was provided by Robertson (2014), saying that "sustainability refers to systems and processes that are able to operate and persist on their own over long periods of time.” Thus it is necessary that the perceptions of sustainability of various stakeholders is known and understood among themselves and between producers and consumers, and the intermediaries of the value chains that connect them.

Sustainable development of export-orientated farmed seafood in Thailand is an issue that covers various aspects. It is not just the environmental or technical aspects or impacts of the aquaculture farms that should be factored in, but also the economic and social aspects, and the impacts and interactions, including the costs and benefits of all these aspects (L. Lebel et al., 2009; Lebel et al., 2002; Whitmarsh and Palmieri, 2009). As an example, Lebel et al. (2002) suggested that Thailand’s highly intensive (black tiger) shrimp production systems as well as “complex organizational structure” could not really be considered sustainable, and called for changes in modes of production, distribution, processing and governance (Lebel et al., 2002). Furthermore, it has to be noted that the concept of needs for, and limitations of, resources are core aspects for defining sustainability (WCED, 1987). There is a question of whose responsibility it is to achieve sustainable development in aquaculture. Actors directly and indirectly involved in aquaculture value-chains may lack a broader understanding of sustainability beyond their own concerns or business interests. Individual stakeholders do not necessarily share the same perspectives, even those coming from the same value chain node. There could be many factors within and outside their own systems which could affect their perceptions leading to different efforts in responding to these factors to make their operations sustainable. Therefore an improved or shared understanding of sustainability would enhance and/or accelerate a drive to more sustainable practices.

In order to focus efforts to achieve sustainable seafood production and trade to benefit both producers and consumers in Thailand and abroad, it is important to determine who the key stakeholders are, what they think about the sustainability of their operations, how different or similar are these perceptions are with each other, and what they are doing to improve sustainability. Looking at sustainability with its many facets requires a transdisciplinary approach, wherein various disciplines merge together to come up with a workable solution for the society, with a combination of qualitative and quantitative methods (Brandt et al., 2013).

This study was more focused on farms, therefore it was necessary to classify farms in order to differentiate them. The main classification, aside from primary species cultured, was farm scale. During key informant interviews to determine the number of farms according to farm scales in the area, the respondents based their classification of 'farm-scale' by simply responding according to the size or area of farm. Farm scale is usually based on size or area of the farm while other factors that indicate scale of farm operations are not considered, such as labour, farm ownership and management (Murray et al., 2011). Thus for the purpose of this research, the SEAT project developed its own criteria for farm scaling to cover these factors. The details on farm scales used in this research are explained in Chapter 2.

Due to the growing importance of and interest in certification and standards especially in global trade (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification, 2012; Washington and Ababouch, 2011), the level of compliance of farms could affect their participation in trade. Compliance to standards may be affected by the scale of operation of the farms, in that larger scale farms may be more likely to comply than smaller scale farms. The direct impact of compliance to standards is improvement in the production practices of the certified entity, which could also impact positively its external environment including other stakeholders (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification, 2012). In the case of coffee, compliance to standards resulted in an "overall income impact" as well as "spill-over effects on adjacent communities", although at the same time there were also weaknesses such as hidden costs and hindrances to trade (Giovannucci and Ponte, 2005).

1.2. Labour issues

Aquaculture production and trade in Thailand is providing employment, and thus contributing to food security both domestically and globally. With sustainability being linked with human dignity and the quality of life (van Egmond & de Vries, 2011), it is also a main issue to focus on the lives involved in aquaculture operations. Recently there has been a lot of attention to labour issues in shrimp aquaculture, and the quality of life or well-being of those employed in the sector. A number of case studies and reports have been presented regarding the situation outside the fish/shrimp farming sector i.e. upstream with the capture fisheries and downstream with the pre-processing and processing sectors, with the labour abuses and exploitation, child labour, and human trafficking issues, especially with migrant workers from neighbouring countries of Cambodia, Lao PDR and Myanmar (Derks, 2013, 2010; EJF, 2013a, 2013b; ILO, 2013a; ILRF/WWU, 2013; Sakaew and Tangpratchakoon, 2009; US Department of State, 2013; Vartiala et al., 2013). In most of the cases mentioned above, writers referred to the “shrimp farming industry” as a whole. However, there is not much information being reported on the labour situation at the farm level except recently by Resurreccion & Sajor (2010 and 2011) which was specific on gender aspects. Even ILO in Thailand had mentioned that the risk of labour abuse at the farm level may be lower than that in the factories and processing plants (Toumo Poutiainen, personal communication, 2013), and acknowledged that this conclusion was based more on anecdotal evidence rather than data. A report on child labour i.e. children involved in economic activities, in selected areas in Thailand related to aquaculture was published recently by ILO/IPEC project and confirmed the existence of child labour in those specific areas, in fisheries and aquaculture (ILO, 2013a).

A total of 11.71 M workers as of early 2014 were reported in Agriculture, Forestry and Fishery sectors (MOL, 2014). In addition, the Ministry of Labour reported that there were 1,211,104 legal migrant workers, and 23,391 illegal migrant workers. The migrant to employed workers ratio was 2.93% in 2013 (MOL, 2014). This records the documented workers and does not specify how many are working in the aquaculture sector, more so in farms. Kruijssen et al. (2013) estimated less than 1% of the total workforce (Thai and migrants) are involved in the fishing, farming and processing sectors, and does not include the workforce in fish markets.

It has been estimated that there are about 1 million people involved in the shrimp industry sector (Songsangjinda and Smithrithee, 2008; Tanticharoen et al., 2008), however, there are no specific numbers of people employed in aquaculture farms. In the Department of Employment, the number of registered migrant workers in aquaculture is recorded under the agriculture and livestock category. There is a separate category for fisheries sector but this refers to work on capture fishing vessels. Thus there are no reliable figures to estimate the total number of workers in the shrimp and fish farming sector.

Species-specific global standards and certification for aquaculture farms also include the community and human resources aspects, focussing on working conditions of the workers such as worker safety, employee relations, corporate social responsibility and responsible social practices (ASC, 2014, 2012; GAA-BAP, 2013; GlobalGAP, 2012, 2011). It does not take into consideration other aspects which are not directly related to the work, such as informal work contribution by a family member or employment of couples, which are important considerations for workers living on-farm. Issues regarding the quality of life of workers and families, and relationships, therefore gender issues, and their living and working conditions in the farms need to be considered. The OECD's Better Life Initiative (OECD, 2013) may be useful if it is applicable to sectoral or value chain node evaluation of well-being. Another useful approach is that of Costanza et al. (2007) and Petrosillo et al. (2013) which suggested to incorporate aspects of opportunities, human needs and one's perceptions of well-being.

The issue on the importance of migrant labour in the shrimp sector leads us to the question of why there is such a degree of dependence and the issue of the relative absence of Thai workers (ARCM/IAS/CU, 2013; Human Rights Watch, 2010; ILO, 2013a; Resurreccion and Sajor, 2010). Whereas in the past, there was local migration mainly from northeastern provinces to work in shrimp farms in the east and south, the situation appears to have changed considerably (Resurreccion and Sajor, 2011). Local migration was common among northeastern Thais in search of better incomes to survive the poverty in their region (Ekachai, 1990) and this was the reason to drive them to work in many available occupations in other regions in Thailand. Rigg & Nattapoolwat (2001) reported the loss of labour from rice farming to more lucrative jobs in orchards and factories.

1.3. Gender issues

Value chain actors are in constant interaction with each other, to transact business, for business networking, and for family and social activities. In analysing these interactions, a gender perspective is necessary in order to guide the framework of evaluation of the impacts of international trade on gender relations among value chain actors in selected countries in Asia. Gender refers to the social differences between men and women, boys and girls, which are determined by society and may be learned and changed, and could vary between and within cultures (FAO, 2001; GGCA, 2009). As noted by Laven et al. (2009), most tools and interventions lean toward non-gender sensitiveness in working with value chains and rural livelihoods, thus they have attempted to create a trajectory on gender in value chains by combining gender and women empowerment with value chain/pro-poor development.

The export of seafood from producing countries has increased considerably over the last two decades, for selected species such as shrimp in Thailand. Despite the high value earnings from foreign trade, there remains a vibrant domestic market demand for other species namely tilapia and freshwater giant prawn. The intensity of labour use along the value chains varies between countries and among species, and although both men and women may be present in each value chain node, there are roles which have been specific to each gender based on their ability, culture and skills, and benefits could be different between genders (UNRISD, 2012). Moreover, UNRISD also reported about disparities in benefits between men and women along the value chains, not only in aquaculture but in general employment. The same trend could be seen in non-timber forest products in Africa wherein women face many obstacles to participate in economic activities (Shackleton et al., 2011). In addition, Laven and Verhart (2011) also pointed out that women worked in parts of the value chain which have lower values, thereby getting lower benefits compared to men.

In Thailand shrimp processing plants for example, women are usually involved in work needing skills and detail such as filleting and deveining, while men were delegated to heavy lifting tasks, driving and machinery work. In Bangladesh, >40% of fry catchers were women and girls and > 60% of workers in the processing plants were women (USAID, 2006). In Vietnam and Nigeria, women are more visible in growout/farming, processing and marketing, rather than in hatcheries (Veliu et al., 2009).

The gender aspect is a cross-cutting theme in this research, as this study deals with not only the physical aspects of aquaculture but also assesses the human aspects through their roles and interactions as stakeholders, value chain actors and workers. Understanding gender is also important in well-being studies (OECD, 2013). The promotion and implementation of gender equality in aquaculture are critical for any contribution of the sector to the Millennium Development Goals (MDGs) (Arenas and

Lentisco, 2011). Although implementing a comprehensive gender analysis is problematic in most research contexts, integrating gender aspects into a broader social and economic analysis can contribute to an understanding of how male and female actors' needs could be addressed and met, for e.g. finances, decision making, information, and actual tasks (Lebel et al., 2009). In this way, each actor will not lose opportunities for advancement and their access to resources to develop themselves and improve their quality of life (Pryck, 2013).

1.4. Brief information about the SEAT project

The Sustaining Ethical Aquaculture Trade (SEAT) Project was implemented under the Framework Program 7 of the European Commission, under a research consortium of 13 institutional partners from Europe and Asia. The SEAT project was conceptualised during the period of rising global consumption of seafood and associated trade volumes due to an increasing population, increased wealth and changes in the eating habits of consumers. With more than half of the seafood traded internationally, from developing to developed countries, there has been a growing concern by markets and consumers regarding how the processes along the global value chains for seafood meet standards for sustainable food production and trading. The SEAT Project looked at the four key species groups namely the river catfish (Pangasiidae), freshwater river prawns, marine shrimp, and tilapias in Asian countries namely Bangladesh, China, Thailand and Vietnam. The development and intensification of farming systems of these species have raised serious concerns regarding the sustainability of the practices involved and the overall trade. The project aimed to establish an evidence-based framework to support current and future stakeholder dialogues organised by third party certifiers, which could contribute towards harmonized standards, helping consumers to make fully informed choices with regards to the sustainability and safety of their seafood. The project ran from 2009 to 2013, taking a highly interdisciplinary approach to address sustainability questions. Topics addressed included environmental impacts, impacts of trade on local livelihoods and public health, food safety including contaminants and traceability concerns, barriers to trade, and ethics. Life cycle analysis was used to explore energy and material costs embedded in the global value-chains, while food ethicists examined the value-laden nature of sustainability decisions i.e. who decides which qualities are significant in relation to sustainability. This thesis is concerned with the Thailand aspect of the project. The information in this section on SEAT Project was summarised from project documents (SEAT, 2009).

1.5. Research objectives

The main objective of the study was to assess the sustainability issues faced by various value chain actors, specifically shrimp and tilapia producers, based on their own perceptions.

Specifically, the study aimed to:

1. Describe the historical development of aquaculture and the status of the four commercially important seafood species (marine shrimp, tilapia, freshwater prawn, striped catfish) in Thailand and assessing the factors contributing to their importance in international and domestic markets (Chapter 3)
2. Analyse shrimp and tilapia farming systems according to the farm-level criteria of global standards and certification to determine status of compliance between farming enterprises of various farm scales (Chapter 4)

3. Assess the quality of life of shrimp farm workers according to their perceptions and investigate the status of compliance to global standards for human resources in aquaculture (Chapter 5)
4. Show the differences in perceptions on sustainability of various value chain actors, and specifically, among producers according to farm scale and other relevant variables (Chapter 6)

1.6. Key concepts/theoretical framework

The transdisciplinary nature of sustainability studies ensures that they are both complex and varied in terms of approach. Figure 1.1 shows the general framework followed by this research, namely:

- Scoping and exploratory approach to obtain an overview of the historical development and existing systems related to the four major species in this research, i.e. marine shrimp, tilapia, freshwater prawn and striped catfish in relation to the various stakeholders involved. This led to focus species that are important to and have potential for export and trade, namely marine shrimp and tilapia, respectively. This also led to identify system boundaries and stakeholders who would participate in the more detailed research;
- Integrated farm survey approach was conducted to obtain more detailed information on production systems (farm level) of the focus species, i.e. marine shrimp and tilapia, covering technical, economic, social and ethical issues. Also includes determining producers' perceptions on sustainability of their operations to contribute to the development process for sustainability indicators for the overall SEAT Project. In addition, several aspects of farm operations were

compared with the global certification standards to determine compliance according to farm scales;

- State of the system workshop approach to present preliminary findings for triangulation with a group of integrated farmer survey respondents and representatives from other relevant stakeholders (input service providers, hatchery operators, processors, institutions, local government and academe), including to obtain their perceptions on sustainability, which will also contribute to the development process for sustainability indicators for the overall SEAT Project;
- Transition survey approach to determine changes in the farm operations of a sample of respondents from the integrated farm surveys, and also to determine samples for labour face to face survey;
- Face to face surveys related to detailed issues on shrimp farm labour and workers' welfare, with particular interest on migrant labour in shrimp farms; and to measure the existing farm conditions with the labour standards as well as workers' own perceptions of their quality of life;
- Future steps stemming from this research: more information gathering on data gaps, development of the sustainability indicators, dissemination of relevant information, action research and policy advocacy, among others.

A multi-stage livelihoods approach was employed, keeping in mind the three main facets of sustainability, i.e. environmental, economic and social or institutional. In the sustainability and quality of life aspects of this research, information relied mainly on the perceptions of various stakeholders.

As a starting point to analyse sustainability of farms and the link with farm scales, various aspects of the aquaculture global standards and certifications were used as benchmarks. In addition, a simple gender dimensions framework was incorporated into the approach especially in formulating questions in the surveys to obtain gender-disaggregated data.

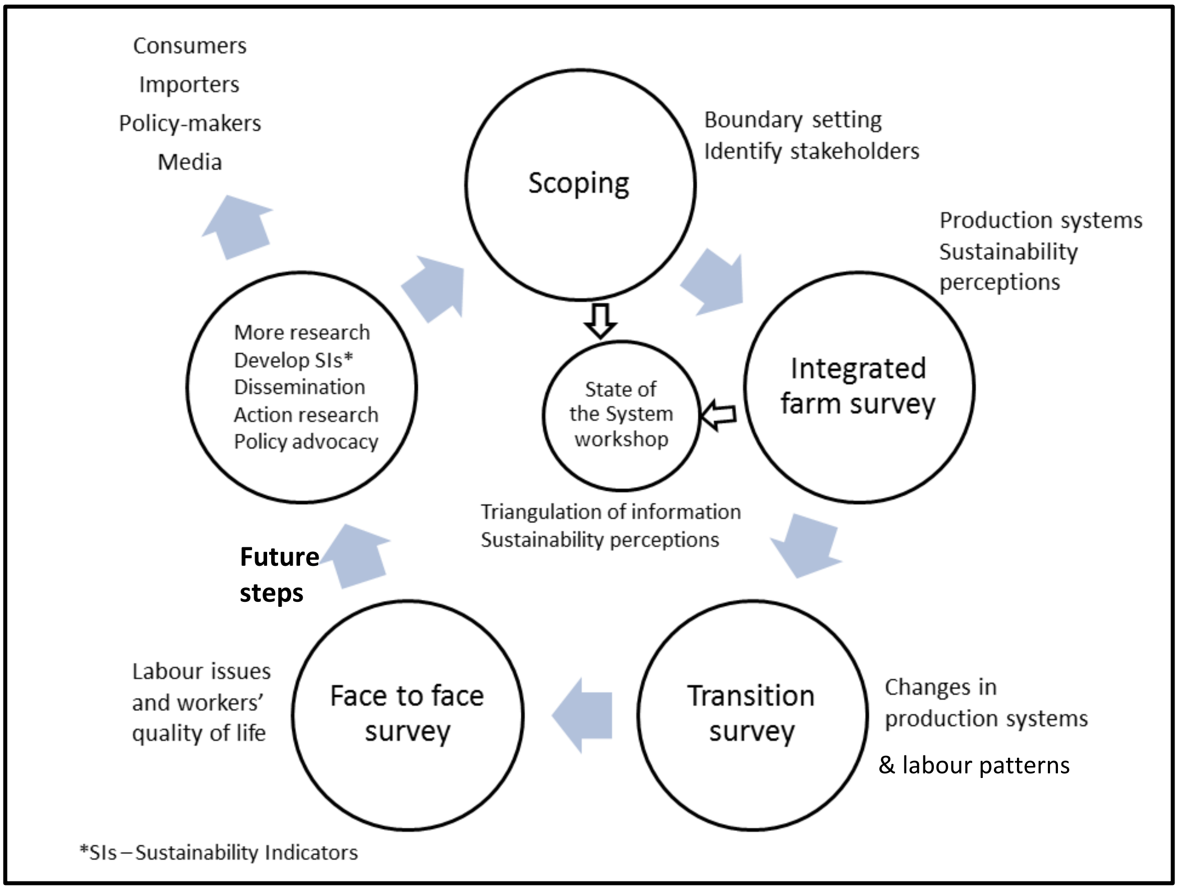

Figure 1.1 The general research framework

1.7. Structure of thesis

This thesis contains seven major chapters, the first being the Introduction, and the last being the Overall Discussion and Conclusions, and the remaining five chapters contain the main parts of the research.

Chapter 2 describes the general methodology followed in this research, especially regarding the sample frame and design to determine study sites and survey respondents. Subsets of these survey respondents were selected to provide information and interaction in the other chapters.

Chapter 3 provides a systems overview of the four commercially important farmed seafood species (marine shrimp, tilapia, freshwater prawn and striped catfish) in Thailand, assessing the factors that contribute to their emergence as internationally traded products or their restriction to domestic markets. This chapter provides the rationale for focussing on shrimp and tilapia in this research.

Chapter 4 provides a detailed analysis of shrimp and tilapia production practices in Thailand as well as the changes and trends. The chapter focusses on how the production sector operates in order to fulfil both local and global demand for Thai seafood, including the changes the sector has to face to achieve this. Current practices are presented using the technical and legal aspects of international standards and certifications as a framework. Changes and trends in the sector are assessed to understand likely threats to sustainability of farming and the sector as a whole.

Chapter 5 focusses on the human resources and gender aspects of shrimp farming in Thailand. The analysis focusses on how shrimp farms comply with the human resource aspect of the global aquaculture standards and certifications, to determine whether these standards are suitable in assessing the quality of life of shrimp farm workers, and to compare them with the workers' own perceptions of their quality of life.

Chapter 6 is about the sustainability perceptions of shrimp and tilapia stakeholders, particularly the producers, analysing how different their perceptions are according to farm scales and other variables, and how these producers are managing or changing their operations to make the most of the situation. Having said that, there could be differences in sustainability perceptions by the various stakeholders, or even by different types of farmers, this may also mean that the definition of sustainability may be different from one person to another, depending on the context and situation.

2. CHAPTER 2 General Methodology

This research involved connecting and interacting with actors/stakeholders across the value chains of shrimp and tilapia production, processing and trade. The majority of the data obtained were from the production node, i.e. the producers or farmers. Various sources of information were used to build the general sample frame, on which selection of survey respondents were based for subsequent field work. The general sample frame of the whole study was based on census data obtained from local fisheries offices, subdistrict administration offices, village chiefs, shrimp club offices and informal data from key informants within individual communities, and additional secondary literature from national government statistics, associations and company information.

This research was part of a bigger collaborative project called Sustaining Ethical Aquaculture Trade (SEAT) funded by the European Commission under its FP7 Programme. I have been actively involved in the design, planning and implementation of the various phases of the research mentioned below which concerned the data collected for this doctoral dissertation.

2.1. Research activities

This study involved four major research activities in connecting and interacting with stakeholders from 2010 to 2013, which provide the data and information for the various chapters of this thesis (Figure 2.1). This chapter presents the main sample frame, study site selection and farmer selection which formed the basis for all the other subsequent research activities involving the same sets of respondents. The various chapters in this thesis will detail relevant methods to obtain data for that specific chapter.

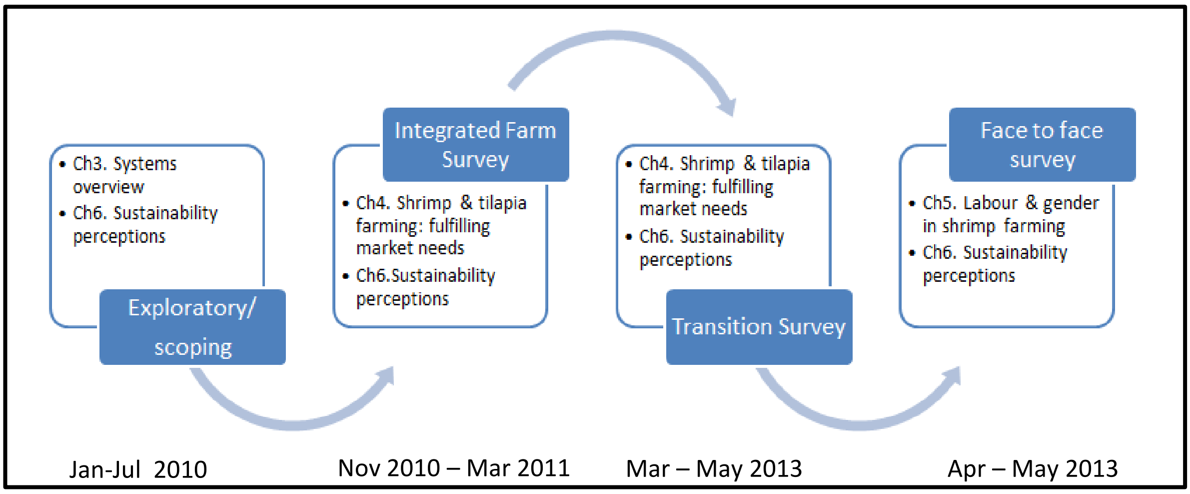

Figure 2.1 Major research activities and timeline undertaken to collect field data

The first activity was an exploratory scoping exercise to assess the export potential and domestic market status of the four cultured seafood commodities (marine shrimp, tilapia, freshwater prawn, and striped catfish) in Thailand. This was done mainly through key informant interviews and secondary literature search. In addition, both methods were also used to identify key stakeholder groups and obtain a general overview of the situation of each, including their perceptions on sustainability. This was conducted from January to July 2010 using a checklist of questions (Appendix 2) covering issues which SEAT Project was interested in. The results contributed to both the systems overview (Chapter 3) and sustainability systems (Chapter 6) sections. Key informant interviews were done through individual field visits and meetings with identified stakeholders, attendance to producers' seminars, and organising workshops attended by various stakeholder groups. The scoping stage was also used to define system boundaries for focus species to be used for subsequent research works.

The second activity was an integrated farm survey (IFS) focusing on producers of shrimp and tilapia from major production areas in Thailand, with more detailed questions on operations and practices, sustainability, generational factors, including socio-economic information related not only to their aquaculture operations but also to their household circumstances (Appendix 4). This provided information to all the work packages of the SEAT project. The survey itself was conducted from November 2010 to March 2011, with the sample design and selection of sites guided by the results of the scoping stage to set system boundaries. A multi-stage sampling process was followed, starting from larger (province) then progressing to smaller (district, sub-district, village) administrative units (Murray et al., 2011). Furthermore, various datasets on farm locations, farmer names, farm scales and farming systems, from key informant interviews and secondary literature research during the scoping period were used to derive the location for study sites and farms (see Section 2.2 for detailed description). Preparation for the survey started in July 2010 until November 2010. The methodology on selection of sites and respondents is explained in this chapter (Chapter 2). More detailed descriptions relevant to the chapters utilising data from the integrated survey are described in specific chapters i.e. current practices and trends in Chapter 4, respondents' background in Chapter 5, and sustainability perceptions in Chapter 6.

A state of the system workshop was conducted as a continuation of the IFS, expanding to include a sample of other value chain actors. The information from this activity also contributed to the sustainability perception in Chapter 6. Details of the SOS workshop are reported in Satapornvanit et al. (2011).

The third activity was a transition survey (Appendix 5) conducted by phone in March 2013 for shrimp farmers, and in April to May 2013 for tilapia farmers, i.e. 2-3 years after the baseline integrated farm survey was conducted. The purpose was to assess key changes that had occurred in farming operations and in the general situation of the farm business operations and personal status of the integrated survey respondents. A detailed methodology is presented in Chapters 4 and 5.

The fourth activity was a face to face survey of shrimp farmers, workers and key informants on labour patterns from April to May 2013 based on the results of the transition phone survey among shrimp farmers (third activity) (Appendix 6, Appendix 7). A detailed methodology is explained in Chapter 5.

2.2. Sample frame

Definitions of farm scales were developed together with the other members of the SEAT project team and formed part of a regional four country exercise. My involvement was to provide inputs and information based on local conditions that were relevant to country-specific criteria. The information came from previous scoping research and general industry information. The definitions of the criteria used are explained below.

Shrimp farm samples were based on production scales, i.e. small, medium and large (Table 2.1).

For tilapia, sampling was based on containment system (cages in river, ponds) at the first instance, and under each system, tilapia ponds were divided into production scales, i.e. small, medium and large (Table 2.2). The production scale for tilapia in cages was difficult to determine as the scoping study indicated that a single farming household, or individual within it, can manage the whole operation by themselves over a very large range of production containment systems (from 1 to 100 units). The farmer interviewed during scoping phase who had the most number of cages (100 units @ 9 m^2 x 1.5 m/unit) was producing around 600 T/year, hiring labour only for harvesting the fish. Whereas the farmer with only one cage (25 m^2 x 2.5 m) was producing 3.8 T/year. During this research all farms with cages were not subjected to scaling. The criterion for large farms i.e. registered company with vertical integration was still applied, and there was only one tilapia farm (ponds) in the study area which fit this criterion, and none for cages.

Farm scaling for cages needs a different set of criteria which was not covered in this research, maybe based on production intensity/levels per unit area.

Table 2. 1 Shrimp production/farm scales

Criteria	Small	Medium	Large
No. of ponds	Up to 2	3 and above	N.A.
Business ownership	Household/extended family	Household/extended family/external owner	Company/corporate
Farm management	Household/extended family	Household/extended family/external owner /hired manager	Hired manager
Labour relations	Up to 2 hired full-time labour	3 and above hired full-time labour	Hired employees/ full-time labour

Source: Murray et al. (2011)

Table 2. 2 Tilapia pond production/farm scales

Criteria[1]	Small	Medium	Large
Area of farm	Up to 2 has (12.5 rai)	> 2 has.	N.A.
Business ownership	Household/extended family	Household/extended family/external owner	Company/corporate
Farm management	Household/extended family	Household/extended family/external owner /hired manager	Hired manager

Source: Murray et al. (2011)

2.3. Definition of farm scale criteria

As stated in Murray et al. (2011), the farms were categorized by scales according to indicators which relate to their market orientation rather than production output alone. During farm selection and surveys, these indicators were considered and were confirmed with key informants and the farmers themselves.

Business ownership: The majority of farms are owned by individual persons, who assume full-time management of the aquaculture operations and/or hire an external individual to handle the management. Corporately owned farms are registered as a company with the Department of Business Development, Ministry of Commerce. A number of "traditionally large farms" based on farm size and operations, fall under the medium scale criteria since they are not registered as a company. Major reasons cited by respondents for not registering as a company include the paperwork and documentation required, as well as tax level payments.

Farm management: Depending on scale, farms are managed by the owner herself/himself or household member, i.e. partnership with the married couple owners or with the adult children, or by external person hired as a manager.

Full-time waged labour: Even those considered small farms may also hire full-time labour, especially if the owner is considered an absentee owner, or have other livelihood activities or business interests. Workers are usually assigned responsibility for one pond, workers employed as a couple typically manage two ponds. Nowadays, due to mechanisation i.e. paddlewheel aerators and autofeeders, a worker may be able to handle two ponds on his own, especially if experienced.

In tilapia farms, labour requirements are lower. For cage farms, a single person can handle up to 100 cages (usually 9 m^2 in area) and would just hire part-time workers to help in harvesting.

Registered trading name: In Thailand, any aquaculture farm can register with the Department of Fisheries. Registration is prerequisite for the traceability system involving the Fisheries Movement Document (FMD) which is needed for exporting product. Other types of aquaculture farms are also registered for the Thai Good Aquaculture Practices (ThaiGAP) certification, as well as for annual fisheries statistics and disaster or welfare benefits. Thus when disaster such as flooding occurs, farms registered with DoF can seek government financial support. In addition, farms may register with the Department of Business Development to be recognised as a corporate entity.

Vertical and horizontal integration: Vertical integration occurs when the different stages/processes (i.e. from production to delivery) in the value chain is coordinated/controlled/owned by one lead company or entity, which results in increased efficiency and market power for that company. This could also be achieved through agreements and written contracts with various actors/owners of processes, or being involved in several activities in the value chain (GTZ, 2007; Laven et al., 2009). Larger farms tend to have more integration of the production chain in order to minimise cost and improve quality of production. This improves traceability of processes and inputs into the production. Whereas horizontal integration in the farming sense occurs when one is involved in the management issues including decision making in the chain (Laven et al., 2009).

2.4. Selection of study areas

There were two major steps in the selection process for the study areas, namely the selection of provinces and then the sub-districts (*tambon*). This process utilized secondary data from the Department of Fisheries (DoF) and the Provincial Fisheries Offices (PFO). The provinces were selected based on the number and area of registered farms including accessibility from the Bangkok research base and the availability of support from local Government offices, farmer groups and individual key informants.

Information from the DOF national fisheries statistics showing major areas of production was also used as reference. Due to limitations in resources, time and accessibility, only tilapia production areas in the central region were considered. Based on the DoF statistics, the most productive provinces were Nakhon Pathom, Chachoengsao and

Petchburi for freshwater pond polyculture systems, and Suphanburi for monoculture cages in river systems.

In contrast the most productive areas for shrimp were in the two major coastal regions, i.e. the east and the south. For the eastern region, two provinces namely Chachoengsao and Chanthaburi were chosen, while in the south, Surat Thani was chosen. These provinces ranked among the top for production levels, number and area of farms as well as accessibility considering resources of the project for those particular regions (Figure 2.2). Other southern provinces, namely, Nakhon Sri Thammarat, Songkhla and Satun were later included as additional large farms were needed.

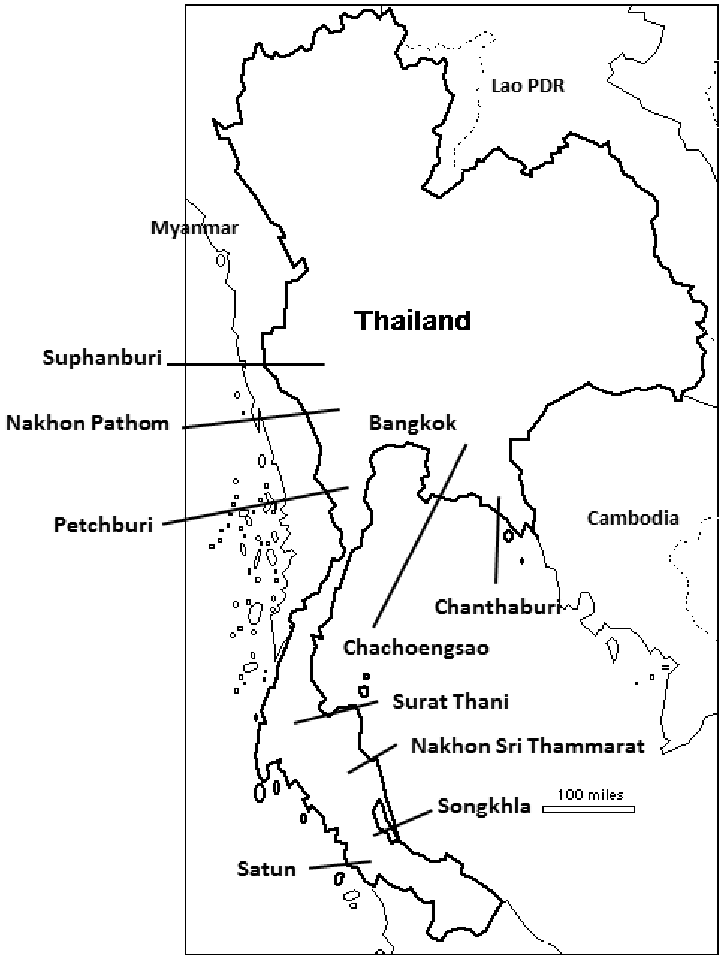

Figure 2.2 Provinces where the surveys were conducted

After selecting the provinces, the number of farms in the sub-districts (based on information obtained from local Department of Fisheries) was sorted from highest to lowest, and only those with more than 50 farms were subjected to a randomisation process (Gentle, 2003) using the equation in MS Excel: = RAND( ) * (MAX($cell_1$:$cell_n$)-1) + 1, where, $cell_1$ is the first value in the column and $cell_n$ is the last value in the same column (Murray et al., 2011). The values are the cumulative number of farms in each sub-district (after ranking from highest to lowest).

2.5. Farmer sampling

Obtaining a complete list of producer households/farm owners was not possible as this information was subject to the Official Information Act, B.E. 2540 (1997) of Thailand (Thai Royal Gazette, 1997), whereby any personal information requested required a written request and written permission of all farm owners/operators whose information was accessed.

An initial list was obtained from published farmers' lists from DoF websites, local fisheries offices and key informants from the areas sampled randomly (see Section 2.4). An initial categorisation was based on these lists, after which farms were categorised according to scale to ensure adequate numbers of small and medium farms, based on the available information. However information especially on labour, was not enough to completely categorise them using the classification given above (Tables 2.1 and 2.2).

The second categorisation was based on key informant interviews (KIIs) in the field. Key informant interviews were conducted to obtain a more detailed overview of the situation of shrimp and tilapia farms in specific areas (Appendix 3). The initial categorised farmer lists were validated by going to at least three key informants (sub-district administrative organization (TAO) offices, the local farmer club and the village heads) in each selected sub-district. Missing farmers' names were identified and added to the list, while farmer names from the secondary data were removed if they were no longer farming shrimp or tilapia. However, if the farm itself still existed but had a different business owner, it was still included in the list. Contact information of each identified farm was also obtained from the KIs. In cases where the contact information could not be given by the KIs due to confidentiality, the KIs were requested to contact the farms if ever they were randomly selected. In most cases the KIs could not provide information on hired labour status of the farms (which was one of the criteria to determine farm scales).

From the KIIs, new lists were drawn up and clusters were identified based on sub-districts to ensure enough numbers of farms for selection. A randomised sample of households was then applied with the scale independent variable strata to achieve the sample design numbers. Randomisation using the Excel RAND formula was run on enterprise data after farms were categorised into their production/farm scales. The randomisation programme from MS Excel (= RAND( ) * (C1 - B1) + B1, where B1 is 1, and C1 is the highest number of farms) was run to determine the farmers to be interviewed (Murray et al., 2011).

Initially, 200 shrimp and 200 tilapia farmers were sampled. However, due to reasons such as availability and willingness to participate, the final number of respondents for shrimp was 206 and for tilapia, 199.

2.6. Integrated farm surveys (IFS)

Farmers who were randomly selected from the above processes were contacted by either field staff or KIs, depending on the availability of information and on the situation in each site. In most cases, it was the key informant or KI (such as the village headman, subdistrict head or his technical staff, or the local shrimp club head or his representative) who assisted in contacting the respondents. The KI would arrange for the respondents to come to a central place for the interviews to be conducted. Typically a local venue where farmers already met informally was chosen for such interviews. After the interviews, the farms were visited, and after permission was sought and given, GPS coordinates and photographs were taken to characterise location and key characteristics. A few interviews especially those organised directly by field research staff, were conducted in the farms depending on the respondents' preferences.

There were cases when some of the farms, especially large farms, requested an official letter from the Faculty of Fisheries, Kasetsart University. This has become standard protocol in Thailand and the SEAT project management assisted in preparing and procuring these letters to be sent to the farms/companies in the time period required by the respondents.

Whereas the main target to interview were the farmers or farm owners, there were instances when only the farm managers of shrimp farms were available to be interviewed, especially in the case of some medium-scale farms and in all cases for the large (corporate) farms.

The interviews were conducted by a team of Thai field research assistants who were recruited and trained for several weeks prior to the scheduled interviews to familiarise themselves with the questions, aquaculture terminology, and coding of responses, as well as to have a basic understanding of shrimp and tilapia farming. Not all of the enumerators had fisheries or aquaculture backgrounds but they all had field survey experience with other non-aquaculture projects. Training sessions were conducted for either the whole day, or half-day (morning or afternoon) depending on other work load of the staff. Prior to the training, meetings related to questionnaire development were conducted, wherein the enumerator team was also present to observe and/or participate in the discussions (see Section 2.7). The final version of the translated (from English to Thai) questionnaires was used for the training, which was conducted in the Thai language. In addition, the accompanying notes developed by the SEAT project team (Murray et al., 2011) were also used as reference to explain the questions and choices of responses. The Thai training facilitator would clarify aquaculture specific topics or terms with me during and outside the training sessions. The team would go through each question and the meaning was explained, including the choices for responses, if any. In addition, the way to ask and record the responses was also explained and practiced. The team also did role plays as interviewers and respondents, and practiced recording responses into the questionnaires.

2.7. Survey instruments

A set of questions was developed by the SEAT project interdisciplinary team to gain a holistic view of farm operations and farmer perceptions on various topics related to their operations (Murray et al., 2011). Table 2.3 shows the various topics covered in the questionnaires (Appendix 4).

Table 2.3 Topics covered in the IFS questionnaires

Main subject areas	Topics in questionnaire	Remarks
Respondent's background information	• Personal details • Household details	Data used in Chapters 4, 5 & 6
Sustainability	• Children's future • Sustainability perceptions • Ranking	Data used in Chapter 6
Aquaculture farm details	• Infrastructure • Production data • Labour information • Feed and Feeding management • Stock losses and disease • Water management • Other inputs • Energy use	Data used in Chapter 4
Other farm information	• Value chain networks • Financial assets • Personal values	
Trends and changes over the last 5 years	• Land holding and use patterns • Farm infrastructure • Aquaculture production patterns • Labour patterns • Feed management • Water management • Chemical use & management	Data used in Chapter 4
Others	• Visual observations • Willingness to participate in future research	Data used in Chapters 4 & 5

The questionnaire was designed to be as gender-sensitive as possible in order to obtain gender disaggregated data although it was not possible to ensure a sample frame with equal numbers of male and female respondents, as the sample frame was based on farms and not by gender. Being gender-sensitive in this case meant that when asking questions related to people, questions should lead to responses which would provide information on men, women, boys and girls, so we could obtain gender disaggregated data. For example, background data about the respondents, their children, members of household and their responsibilities in relation to farm operations, labour force, and their tasks. However a comprehensive gender analysis of farming was outside the scope of the research.

At the end of the survey, the farmers were asked if they were willing to participate in future research activities, especially for subsequent surveys. Farmers' responses to this question were considered when selecting respondents for future surveys and meetings.

Pilot testing of questionnaires was conducted among shrimp and tilapia farmers a few weeks prior to actual surveys to further refine the sequence as well as the framing of the questions. After the pilot testing, it was attempted to reduce the questions but compromise had to be made to balance representations of the different aspects of the SEAT project. The resulting questionnaire was still lengthy, taking around 1.5 to 2 hours to complete. The original version of the questionnaire was in English and it was translated into Thai, and then translated back into English to ensure that the meaning was captured in the translation. Detailed accompanying survey notes were also developed to give guidance to the whole survey activity including subsequent data entry (Murray et al., 2011).

2.8. Data analysis

Data collected from the integrated farm survey were entered in an ACCESS database (Murray et al., 2011). The database was designed to allow entry of data from the four project countries to enable comparative analysis later at the project level. Prior to data entry into ACCESS, every enumerator had to review the responses at the end of each day of the survey, and complete other data which were already known, but were not noted before the interview, for example details such as village, sub-district, province, and GPS coordinates. The data noted on the questionnaire were also checked or cleaned. For example, notes written illegibly, and in Thai, were re-written next to them in a clearer handwriting, and translated into English when necessary. As the team returned to the project base, the questionnaires were collected and were assigned survey codes to identify each respondent.

A team of researchers entered data into the MS ACCESS database, using an assembly line approach. Thus one questionnaire would pass through 3 to 4 persons to enter data on specific sections of the database. Main data entry took about 3 months to complete. Then database checking and cleaning went on for a few more weeks initially. Months later, more cleaning and checking had to be done as the database was circulated to other research project partners, and questions and issues which needed clarification were raised to understand the data.

Descriptive statistics were used to determine trends, and statistical analysis of non-parametric data was used to analyse significant differences and correlations among variables when necessary. Statistical analyses to determine significant differences of relevant data were conducted using SPSS ver. 19-21, MS Excel 2010 and Minitab, when necessary. Independent variables used were primary species cultured i.e. shrimp or tilapia, farm scale, gender of respondents and children, geographical location of farms and stakeholder groups. Whereas the dependent variables considered in this study were the various aspects of farm operations such as farm, feed, water and environmental management, infrastructure and production data, labour data, respondents' preference for their children's future occupation, sustainability factors, and importance of sustainability factors according to ranking.

As part of the analysis of farm data collected, they were benchmarked against the standards of the most common aquaculture certification schemes, to assess the level of compliance of farms according to farm scales. The analysis is expounded in more detail in Chapter 4. However, it is understood that certification is not a requirement for sustainability, as there are many other aspects of sustainability such as economic efficiency and social equity which are not covered by certification standards. Measures such as life cycle costing and sustainable livelihoods index are not fully integrated in the standards. The certification schemes used in this research focus mainly on environmental aspects and some social aspects such as community interactions and labour relations. In addition, the standards also do not cover other environmental dimensions such as those measured through life cycle assessments, and carbon and water foot printing. Thus, compliance to standards may not be equated to the sustainability status of a system or operation, but could contribute to assessing the areas in the farm which need to be improved for better farm management.

3. CHAPTER 3 A systems overview of four commercially important farmed seafood species with an export focus in Thailand

3.1. Introduction

Since the recent expansion in aquaculture globally beginning in the early 1980s, Thailand has quickly established and maintained a high profile on the strength of both domestic demand and developing export market.

Thailand has become a major player in terms of seafood production and processing in the global seafood trade, making her one of the main suppliers of aquatic foods in various forms. Innovation in the agricultural sector is well known and has been demonstrated in fruit, rice and orchid farming as well as aquaculture (Falvey, 2000; Kongkeo and Davy, 2010). Furthermore, long experience particularly in freshwater and extensive marine shrimp farming, gave a firm basis for rapid development in the last three decades, reaching a 2.6% share of global production by 2008 (FAO, 2008).

Thailand has been practicing aquaculture since the introduction of carp farming by Chinese immigrants in the early 1900s (Edwards et al., 1983). Resilience and adaptability of Thai producers and entrepreneurs, together with institutional support and collaboration, have played a major role in bringing Thailand to its current status even as producers and entrepreneurs strive for sustainability (Kongkeo & Davy 2010).

Several factors have been critical to Thailand's strategy to achieve a balanced and sustainable aquaculture to meet domestic and global demands for its aquaculture food products (Yamprayoon and Sukhumparnich, 2010). Furthermore, specific strategies for aquaculture production and trade, initially with shrimp and tilapia, and expanding to other species, have been created in line with these considerations. This shows that the Thai Government has developed an open and holistic view, to adapt and to work in coordination with other sectors as aquaculture grows rapidly in Thailand. This reflects on Thailand's historic openness to trade, geographical location, and contact with other cultures to expand its reach through building trust and delivery of quality products (Belton and Little, 2008; Falvey, 2000; Kagawa and Bailey, 2006; Rigg, 2012).

Aquaculture in Thailand is much diversified, with production systems in both freshwater and brackishwater/coastal areas, farming both domestic and exotic species. One example is the farming of Pacific white leg shrimp, a non-native marine species, which is also farmed in inland freshwater areas (Briggs et al., 2005; Kongkeo and Davy, 2010). Another is tilapia, an exotic freshwater species, but also commonly raised in brackishwater ponds (Pongthana et al., 2010; Stickney, 1986).

The role of agribusiness in Thai aquaculture development story has been central, going even beyond Thailand through trade and investment expansion (Goss et al., 2000; Lebel et al., 2010, 2002; Tanticharoen, 2000). As one company considers to make themselves and Thailand as "the kitchen of the world", another grooms themselves to be "the chef of the world" (CPF, 2012; Thai Union Group, 2014, 2012). This shows the progressive outlook of Thai producers/entrepreneurs, who always look out for opportunities within and beyond their own backyards, innovating and aligning themselves with market trends to be able to meet requirements and supply demand (Kongkeo and Davy, 2010; Lebel et al., 2002).

As Thailand continues to play a major role in the global arena of seafood trade, the stakeholders have become more aware of what are required, and are attempting to streamline corporate activities and efforts, to reduce costs as well as to ensure quality of inputs which go into the production system. For example, companies which have major stakes in processing and export have tended to vertically integrate their operations to maximise resources, have more control in the quality of inputs and production, and ensure good traceability, aiming to achieve sustainability (CPF, 2012; Mariojouls et al., 2004; Thai Union Group, 2014).

Thailand's early adoption of farming has not always resulted in any continued dominance as demonstrated by the shrimp industry. Thailand pioneered the culture of tilapia, freshwater prawn and striped catfish in the region and, while production levels have typically been maintained or increased to meet domestic growth, they have long been eclipsed by production in neighbouring countries i.e. tilapia in China, striped catfish in Bangladesh and Vietnam, and freshwater prawn in Bangladesh (Ahmed et al., 2010; Edwards and Hossain, 2010; Phan, 2014; Zhang, 2014).

In focusing on these four aquaculture species in aquaculture, namely penaeid shrimp (*Litopenaeus vannamei*), Nile tilapia (*Oreochromis niloticus*), freshwater prawn (*Macrobrachium rosenbergii*) and striped catfish (*Pangasianodon* and *Pangasius* spp.), several research questions were identified:

- What are the differences among the four species in terms of their development along the supply chains, their successes in domestic and export markets, and potential for export?
- Why do these differences exist and were these differences considered opportunities or constraints?
- Who are the stakeholders in the Thai seafood industry and what are their roles in establishing and sustaining the industry?

The use of the terms shrimp, tilapia, prawn and striped catfish is defined as follows:

Shrimp – may refer to black tiger shrimp (*Penaeus monodon*) and/or white shrimp (*Litopenaeus vannamei*), depending on the specified time frame. Historically, shrimp production before 2000 was mainly *P. monodon*, while after 2000 production declined rapidly and substituted with mainly *L. vannamei* (Briggs et al., 2005; Kongkeo and Davy, 2010). Where possible, reference to either species will be specified. At the same time, shrimp production refers to production coming from both coastal and inland (as low salinity areas) unless otherwise specified.

Tilapia – is a collective term referring to both *Oreochromis niloticus* and its hybrid, ruby or red or tabtim tilapia, unless otherwise specified. FAO and DOF records do not specify the sources whether from freshwater or brackishwater areas, although there are separate records from ponds, ditches and paddy fields, and cages.

Prawn – refers to the giant freshwater river prawn, *Macrobrachium rosenbergii*. However in other literature elsewhere, it is common to use the term prawn to refer also to shrimp.

Striped catfish – refers to the local species of *Pangasianodon hypophthalmus* formerly known as *Pangasius sutchii* in older literature. DOF data provides production information from ponds, ditches and paddy fields, and cages. FAO reports only production data of striped catfish but no export data. However FAO reports on catfish export data from Thailand (FAO, 2014).

In Thailand, shrimp is by far the most important aquaculture species in relation to trade and foreign earnings, according to volume produced and exported, and the revenues gained. In 2005, shrimp production and value were higher by more than 50% than the combined production of tilapia, freshwater prawn and striped catfish, respectively. By 2008, shrimp production was nearly double that of the other three species combined (FAO, 2014). Export volumes followed the same trend.

Among the top freshwater species, records of the Thai DOF and FAO have shown that since the 1980s, freshwater fish production has gradually become dominated by Nile tilapia (DOF, 2013a; FAO, 2014). Production of native freshwater species such as walking catfish (*Clarias* spp.), Thai silver barb (*Barbonymus gonionotus*), snakeskin gourami (*Trichopodus* or *Trichogaster pectoralis*), striped catfish (*Pangasius* spp.), snakehead (*Channa striata),* giant gourami (*Osphronemus goramy*) and common carp (*Cyprinus carpio*) were much lower despite their popularity among Thai consumers (Figure 3.1). This could imply the comparative suitability for cost effective culture of tilapia compared to these species but also changing tastes of Thailand's urbanizing population, and declines in the availability of wild stocks.

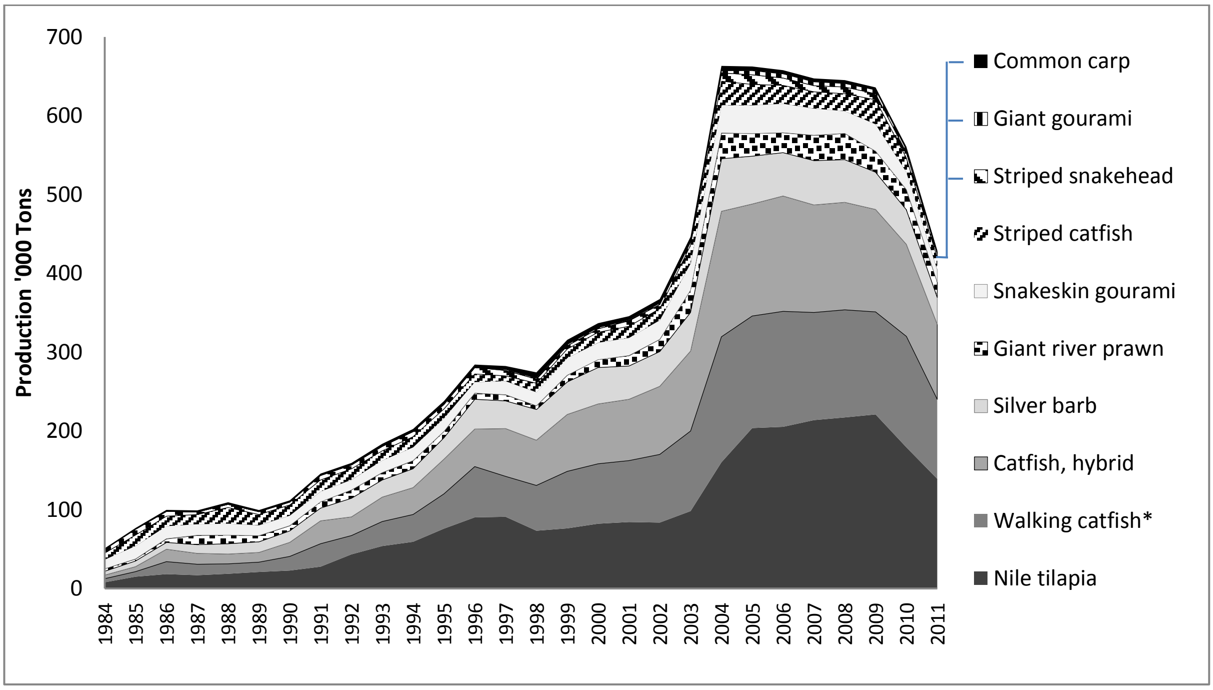

Figure 3.1 Production of freshwater species from culture systems

Source: DOF, 2013a, 2010a; FAO, 2014. *Walking catfish data from DOF references only

The four main sources of data for Thai seafood exports are the Thai Customs Department, Department of Fisheries, Thai Frozen Foods Association and FAO's FishStatJ programme. The data presented by each source vary according to level of detail, for e.g. the Customs Department provides more specific information in terms of species, product forms and countries of destination according to HS codes, whereas the DoF and TFFA provide general information on fish and shrimp with specific information on shrimp and tilapia product forms, and importing countries. FAO provides minimal data on some species only in terms of product forms, and have grouped fish and shrimp species.

Figure 3.2 shows the latest figures on exports of freshwater fish. Tilapia is an important species not only in domestic markets but also in export markets, evidenced by the higher volume exported compared with other freshwater fish i.e. chilled, frozen, and fillet forms.

Since striped catfish is an important species in the global market as an export commodity from Vietnam, it is still a question why Thailand has been unable to compete. Thailand's production of striped catfish preceded the rise in Vietnam as it was one of the earliest species for which the life cycle was closed, and culture became possible without use of wild seed. In fact, in the export statistics, striped catfish is aggregated with other catfish species as the volumes exported were minimal and only recorded recently by the Thai Customs Department (2012 to 2013).

FAO has trade records until 2013 only of tilapia and catfish exports, again not specifying what species but only the form such as fresh, chilled, frozen, steaks, and fillets.

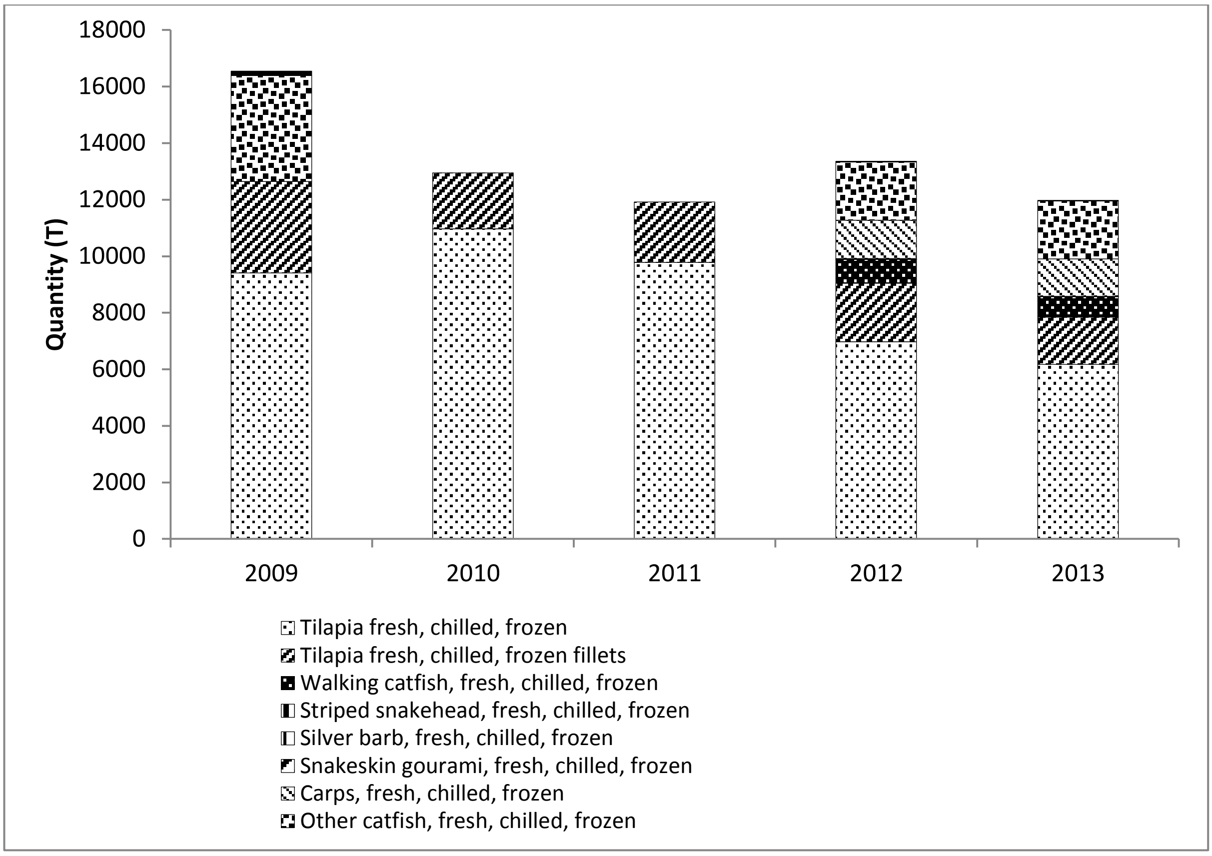

Figure 3.2 Volume of exports of freshwater aquaculture species, 2009 to 2013

Source: DOF, 2013a; FAO, 2014; TFFA, 2014; Thai Customs Department, 2014

The latest production data of tilapia from official records i.e. Department of Fisheries and FAO FishStatJ, was that of 2011, with the 2012 production and 2013 projection mentioned in a news article on fisheries trade by Towers (2013). The latest tilapia export data was in 2013, which shows that less than 10% of production was exported, owing to the stronger demand in the local market, driving up tilapia prices which motivated farmers to sell to local traders more than to processors. Tilapia production data divided into domestic and export markets are shown in Figure 3.3. Export data is for various product forms such as chilled and frozen whole fish and fillets. Since tilapia fillets are only about 30% of the total fish, the volume of whole tilapia entering export channels would be thrice more than the reported volume of exported fillets.

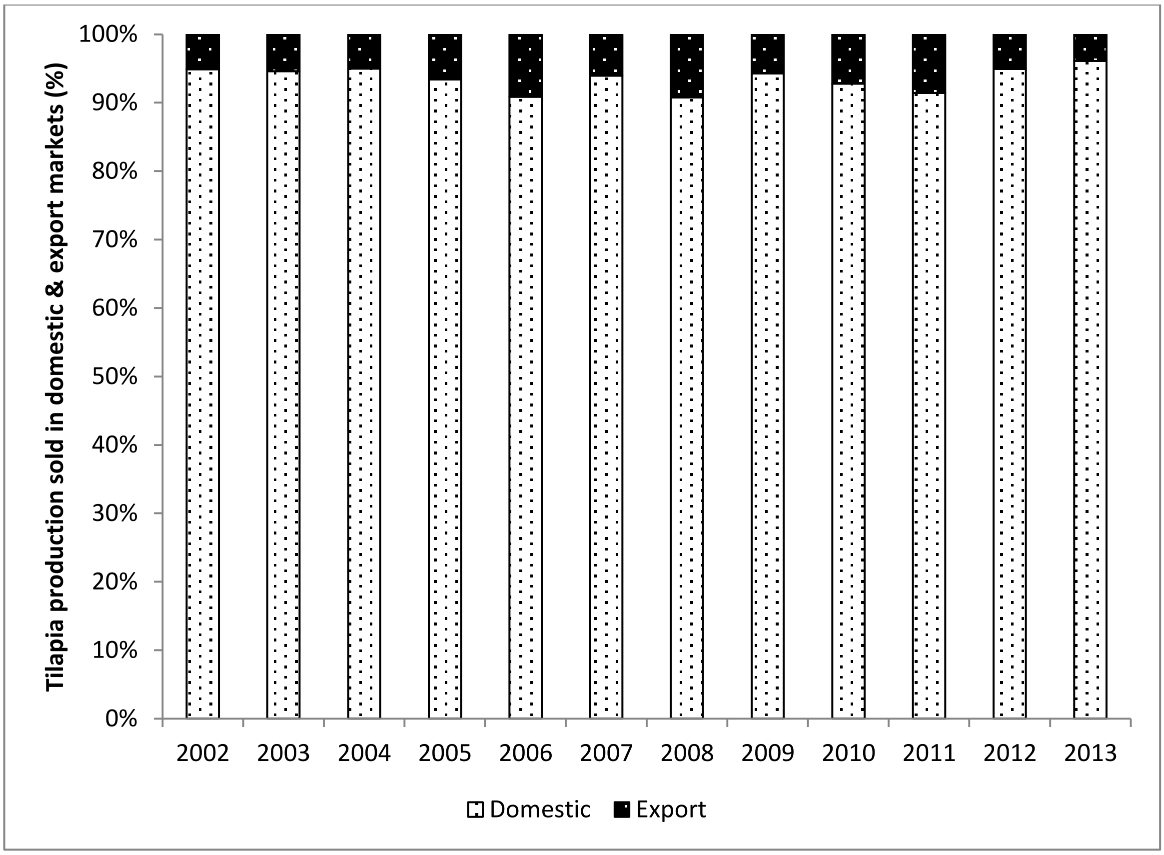

Figure 3.3 Production and export of tilapia, 2002 to 2013

Source: DOF, 2013a; FAO, 2014; Towers, 2013

3.2. Trends/historical data

Aquaculture in Thailand has a long history, and has significantly developed since before the 1950s, firstly with freshwater aquaculture particularly with snakeskin gourami and carps, and much later with brackishwater aquaculture (Edwards, 2011; Falvey, 2000; FAO, 2009). Table 3.1 presents major milestones in the aquaculture industry related to the four species in this chapter.

Table 3.1 A summary of milestones in the aquaculture industry in Thailand relevant to the four target species

Years	Shrimp	Tilapia	FW Prawn	Striped catfish
< 1949		Introduction and importation of *Tilapia mossambicus* from Malaysia		
1950-1959	Extensive shrimp farming using wild seed (*Penaeus* spp.)	FAO earliest record of production -	Wild PLs for pond stocking for local & export markets	FAO earliest record of production
1960-1969		*Tilapia niloticus* introduction	On-going research Success in breeding in Thailand	Successful breeding in captivity by DOF
1970-1974	Shrimp farming with hatchery seed (*P. monodon*)	Started efforts with all-male fry production	Small-scale hatcheries started to appear	Private hatcheries learn from DOF and produce commercially
1975-1979			Government hatchery operational in East Started stocking ponds from hatcheries Exportation of wild prawns Wild catch started to decline Cooperation between DOF and FAO started	
1980-1984		Breakthrough in commercial all-male seed production	Importation started	
1985-1989	Rapid expansion of farms	All-male tilapia hatchery set-up in NET (AIT-NGO Udon) Red tilapia seed also became available through DOF-Ubon		Production recorded at >20,000 mt (190 M Baht)
1990-1994	Thailand became world's largest black tiger shrimp exporter Disease threatened industry (YHV)	Joint all-male tilapia hatchery set-up in central (AIT-Romsai), 3 private all-male tilapia hatcheries set-up in west, northeast, east CP started growing red tilapia commercially,		

Years	Shrimp	Tilapia	FW Prawn	Striped catfish
		initiating contract farming for tilapia		
1995-1999	Disease threatened industry (WSSV) Government ban on inland shrimp farming SPF *L. vannamei* broodstock imported from Taiwan Industry self-imposed standards on shrimp production	CP started commercial seed production after years of experimentation CP promoted cage farming		Production recorded at <7,700 mt (138 M Baht)
2000-2004	*P. monodon* slow growth syndrome began White shrimp became popular species Limited SPF broodstock imports tested Lobbied for more SPF broodstock imports DOF bans antibiotic use in shrimp EU zero tolerance of antibiotics Massive rejection of shrimp exports to Europe SPF white shrimp locally produced (F1) Domestic shrimp consumption promoted Taura virus syndrome	Grobest Frozen Foods Co. set-up tilapia processing plant in Nakhon Phanom		
2005-2009	White shrimp widely cultured (98% of production)	Tilapia pond production reached > 200,000 t Export of tilapia fillet began Around 20 all-male hatcheries operating	Wild capture <700 t Government efforts to export	Pilot project by govt & private company for production & export (NET) Exported 11 t fillet to US from pilot project, although not sustained due to supply issues
2010	Blue shrimp introduced by Sarasin hatchery			

Years	Shrimp	Tilapia	FW Prawn	Striped catfish
	(south)			
2012-2013	Early Mortality Syndrome (EMS) developed into Acute Hepatopancreatic Necrosis Disease (AHPND) resulted in lower production & decreased exports			Exports decreased while imports from Vietnam increased, 8 to 14 t

Sources: Belton and Little, 2008; Belton et al., 2009, 2006; Bhujel, 2011; Briggs et al., 2005; Edwards et al., 1983; GSJ-UBC, 2010; Kongkeo and Davy, 2010; McAndrew, 1981; New, 2010; Payooha et al., 2009; Potaros and Sitasit, 1976; Singholka et al., 1980; Szuster, 2006; TFFA, 2010a; Thai Customs Department, 2014; Wyban, 2007

Thailand's aquaculture areas are divided into the inland freshwater and brackishwater/ coastal areas, and the species produced and their production systems are defined by the location of the farms. However tilapia, a non-native freshwater species is also considered a euryhaline fish which makes it possible to culture in saline water, i.e. it can withstand higher salinities of up to 30-40 ppt with varying tolerance according to species, but with slower growth rates than in fresh water (Lambooij et al., 2008; Pongthana et al., 2010; Stickney, 1986; Suresh and Lin, 1992).

Meanwhile, white-legged shrimp was introduced and subsequently cultured in inland freshwater areas (Briggs et al., 2004, 2005; Flaherty and Vandergeest, 1998; Goss et al., 2000; Kongkeo and Davy, 2010) . In fact, the first trials of white shrimp in Thailand were performed in Nakhon Pathom province in the late 90s after black tiger shrimp farming in inland farming areas was banned by the Thai government in 1998 (Kongkeo and Davy, 2010). These farms were previously freshwater prawn farms which had converted to black tiger shrimp farms due to higher economic returns from selling shrimp. The culture of marine penaeids in freshwater inland areas had always been a contentious issue but the introduction of white-legged shrimp led a to a rapid increase in area cultured, from 70,400 ha in 2002 to 75,736 in 2003 (Tookwinas et al., 2005). DoF started to record production of white shrimp in 2002, which was 11% of total shrimp production, then in 2003, production was recorded at 52% of total shrimp production (Tookwinas et al., 2005). More recently the government has ceded responsibility to the provincial governors of affected inland provinces to decide on banning the culture of *L. vannamei* in their areas as they see fit (Sukpanich, 2011), which gave rise to a very complex situation.

Between the years 1950 and 1970, only production from tilapia and striped catfish was reported by FAO statistics for freshwater fish species, which ranged from 130 t in 1950 to almost 1,650 t in 1970 for tilapia, and 2,800 to 6,600 t for striped catfish for the same period (FAO, 2014). For freshwater prawn and black tiger shrimp, the earliest production statistics appeared in 1984, at 14,542 t and 1,189 t, respectively (FAO, 2014).

Oreochromis (=Tilapia) mossambicus was first introduced to Thailand for aquaculture purposes in 1949 from Malaysia (De Silva et al., 2004) whereas *Oreochromis (= Sarotherodon) niloticus* was introduced in the mid-1960s (McAndrew 1981; De Silva et al. 2004; Bhujel 2011). In early 1950s, FAO provided assistance to Thailand to construct ponds around 15,000 ponds for tilapia production, aiding the change in the Thai palate from carps to tilapia (Falvey, 2000).

Freshwater prawn farming started in the mid 1970s, stimulated by the growing demand in both domestic and export markets and after a breakthrough in hatchery and nursery technology by government researchers (Singholka et al. 1980; New & Kutty 2010).

Black tiger shrimp culture started in the late 1970s and took the lead in production and export from the mid 1980s, until its decline in the 2000s (Briggs et al., 2005; Kongkeo and Davy, 2010; Szuster, 2006). White shrimp started to dominate the aquaculture industry in both freshwater and brackishwater/marine pond systems in early 2000s and the rise in production was phenomenal (Figure 3.4). It is worth noting that the multiple waves of diseases which plagued the black tiger shrimp industry resulted in the replacement of black tiger shrimp with white shrimp in 2002 onwards (Lebel et al., 2010). However in 2012-2013, the Early Mortality Syndrome (EMS), later known as the Acute Hepatopancreatic Necrosis Disease (AHPND), affected shrimp operations and resulted in decreased production as well as lower export levels (CPF, 2012; FAO Globefish, 2014; Pratruangkrai, 2013; TFFA, 2012).

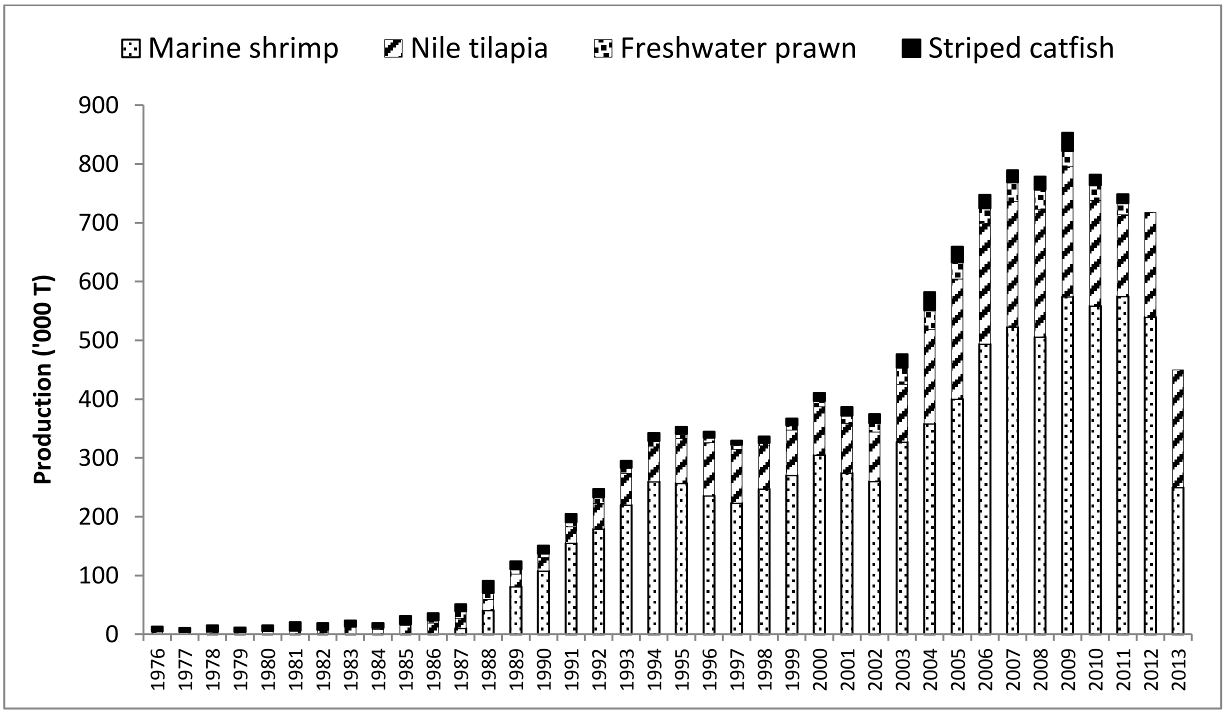

Figure 3.4 Annual production of important aquaculture species

Source: DOF, 2013a; FAO, 2014; Pratruangkrai, 2013; TFFA, 2012

3.2.1. Freshwater prawn

Farming of the giant freshwater prawn, *Macrobrachium rosenbergii* became symbolic of the rise and technical capacity of Thai aquaculture as it has been in existence for nearly half a century (Singholka et al. 1980; Chareontawee et al. 2007; Karaket et al. 2011), pre-dating that of other countries in the Region by several decades. Kongkeo and Davy (2010), New et al. (2010) and Singholka et al. (1980) gave detailed accounts on the history and development of freshwater prawn farming and its status as well as production levels, summarised in the following sentences.

Thai researchers had already been experimenting with larval rearing of the prawn in the 1950s, which were followed through by Malaysian researchers who then achieved success in hatchery rearing (Singholka et al., 1980). Furthermore, in the 1960s, supplies of freshwater prawn for both local and export markets came mainly from capture fisheries in the central region of Thailand. A decline in catches from the wild led to the importation from Burma to satisfy both local and export demand. Freshwater prawn farming in Thailand developed mainly to augment the lack of supply from the capture sector. It was the development of small private hatcheries in the Eastern region in the early 1970s through the prawn extension project of DoF and FAO, based on project demonstrations that laid the groundwork for the *Macrobrachium* industry and other species including black tiger shrimp that followed (Kongkeo and Davy, 2010; New et al., 2010; Singholka et al., 1980).

Production was less than 0.5 t in 1975 (New 2010), while FAO records on freshwater prawn production began in 1978, recording production at 100 t which peaked in 1987 at almost 12000 t, and 2004 at around 32500 t (FAO-FishStatJ, 2011). A government prawn hatchery in Chachoengsao province became fully operational in the late 1970s (Singholka et al., 1980), which operated later than the small private hatcheries set-up in the early 1970s. Production was small at the beginning but during 1979 to 1981 the cooperation between Thai DOF and FAO resulted in expansion of prawn farming, not only in Thailand but also in other countries through sharing of knowledge and expertise (New 2010). In addition, government personnel also set-up their own private operations, and this technical knowhow was then transferred to neighbours and farmers (Kongkeo and Davy, 2010).

Between 1992 and 2001, average global production of *M. rosenbergii* expanded rapidly due to increased production mainly in India and a resurgence in production in Thailand, with China still leading the production (New 2005). The growth during this period was also attributed to a certain extent to the failure of the black tiger shrimp industry (Chareontawee and Poompuang, 2007). However, as of 2005, the global production of freshwater prawn was still considered small compared to overall marine shrimp production (New 2005), which was a similar trend in Thailand, with marine shrimp production dominated by white shrimp (Figure 3.4). Even though it was predicted by New (2005) that the output of freshwater prawn in Thailand would expand significantly as the country realised the global demand for prawn and its more environmentally friendly culture system, it was only in 2007 that production grew to nearly 27% of the 2006 prawn production, then it dropped to 3% in 2008, and had negative growth in 2009 (Figure 3.5).

The perception was that the low levels and inconsistency in production were due to slow growth rate, size variation, poor pond environment and genetic deterioration of local broodstock (Chareontawee & Poompuang 2007). These reasons may not only apply to freshwater prawn but also to other cultured species. Another perspective on the reasons for inconsistency in prawn production referred to factors such as marketing, expansion of marine shrimp farming, inland culture of white shrimp and the effect of diseases on the income of marine shrimp farming (New & Kutty 2010). In 2001 Thailand was just fourth among the top fifteen producers of freshwater prawn, despite being considered as one of the pioneers along with Taiwan, when production was reported to be rising in Thailand then (New 2005). A decade later, it was reported that Thailand was the third largest producer of farmed freshwater prawn (following China and India), with the fisheries catch much lower than before (New 2010). The rate of growth in production could be seen in Figure 3.5, where during mid-1990s the negative growth was due to the farmers switching to culture black tiger shrimp in freshwater prawn ponds in inland areas, as well as problems with marketing and economic factors (New and Kutty, 2010). The renewed increase in production starting in the late 1990s has been related to increasing local demand for a traditional food item, the ban in inland shrimp farming, and government efforts to promote exports (New & Kutty 2010).

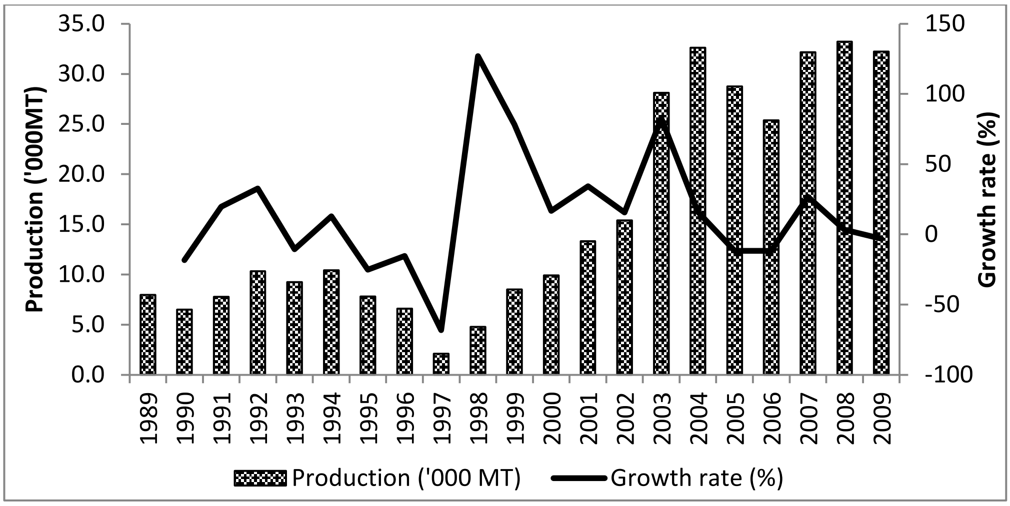

Figure 3.5 Production and growth rate of freshwater prawn in Thailand (1989-2009)
Source: FAO, 2014 (production data only)

Export data against production of freshwater prawn from 2002 to 2009 are shown in Figure 3.6. There has really been no development in terms of export activities during the last 10 years, and since 2007 the exports have not reached 10% of production. According to Na-Nakorn and Jintasataporn (2012) a limited export market and low yield are hindering the development of giant freshwater prawn business, and suggested the development of better genetic strains, and improved culture techniques including culture of all-male prawns.

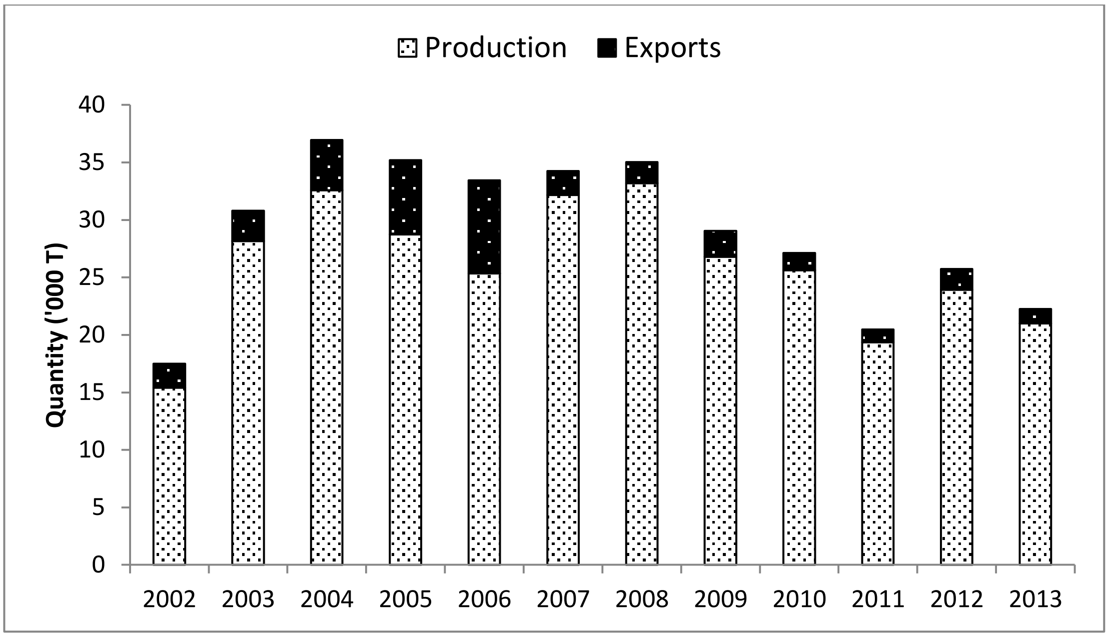

Figure 3.6 Production and export data of giant freshwater prawn from 2002 to 2013

Source: DOF-Economics, 2013; DOF-Thai Customs Bureau, 2009; FAO, 2014

According to prawn hatcheries in the Suphanburi area during our scoping surveys in 2010, the market for prawn PLs was still good, which means that grow-out production in the ponds was on-going. The decrease in the number of hatcheries (from around 75 to 10) during 2010 within less than 10 years in the main prawn hatchery area in Suphanburi province (Don Chedi sub-district) was because of bankruptcy of hatchery operators due to a disease outbreak, and for other unknown reasons resulting in no production.

There could be other reasons why the giant freshwater prawn has not been popular for export, i.e. not just poor genetic stock as mentioned by Na-Nakorn and Jintasataporn (2012). Some of these reasons were pointed out by Kongkeo and Davy (2010) regarding the physical characteristics of the giant freshwater prawn i.e. the unattractiveness of its thick shell and big carapace in export markets, deteriorating quality after defrosting, and small meat to body weight ratio which would be uneconomical when exported as peeled and frozen. In addition, the domestic market for freshwater prawn is stable i.e. good price and higher demand as it is a favoured food item in Thai cuisine (New, 2010; Schwantes et al., 2009).

In 2012, the problems faced by the freshwater prawn culture included the high cost of inputs such as feed and labour, fuel shortage, and seed quality, and lower market demand affecting the price of prawns (DOF-Economics, 2012).

3.2.2. Striped catfish

Thailand has been culturing striped catfish (*Pangasius* sp.), a native fish species, since the 19th century using wild seed and raised in ponds, and cages in rivers (Edwards et al., 1983), and traditionally it was considered an important fish for local consumption (Edwards et al., 1983; Payooha, 2002). A number of species such as *Pangasionodon hypophthalmus (a.k.a Pangasius sutchii)*, *P. lanaurdi, and P. bocourti* were cultured mainly in wooden cages along river canal systems, with the Mekong River and its tributaries considered the most suitable. *P. bocourti* has been considered an important species in the Mekong basin for cage culture in both Thailand and Vietnam (Jiwyam, 2010). Earliest production records by FAO started in the 1950s indicating that at that time it dominated freshwater fish production among the four species being reviewed until the 1980s (20,353 t worth 190.2 M Baht in 1988). It appears that a decline in production (13,000 to 6,800 t from 1989 to 1997) occurred as tilapia was introduced and became established (Figure 3.4) (DOF, 2013a; FAO, 2014; Payooha, 2002). Pangasius production from the late 1990s gradually increased again (from 11,339 t in 1999 to 30,922 t in 2009) reaching about 14% of tilapia production by 2009 in Thailand (DOF, 2010a; FAO-FishStatJ, 2011), and a mere 3.1% of the 993,000 t production in Vietnam in 2009 (Phan et al., 2011) (Figure 3.7). Latest data show that Pangasius production in Thailand in 2011 dropped to 15,252 t , equivalent to only 11% of tilapia production in Thailand and 1.3% of Vietnam production, in the same year (FAO, 2014; Vietnamese Fisheries Directorate, 2011). Figure 3.7 shows that Thai striped catfish production and industry are incomparable with Vietnam and continue to lose ground. While Vietnam's export orientated industry has rapidly innovated, in Thailand the basic culture systems continue to be used and the fish produced are not of export quality.

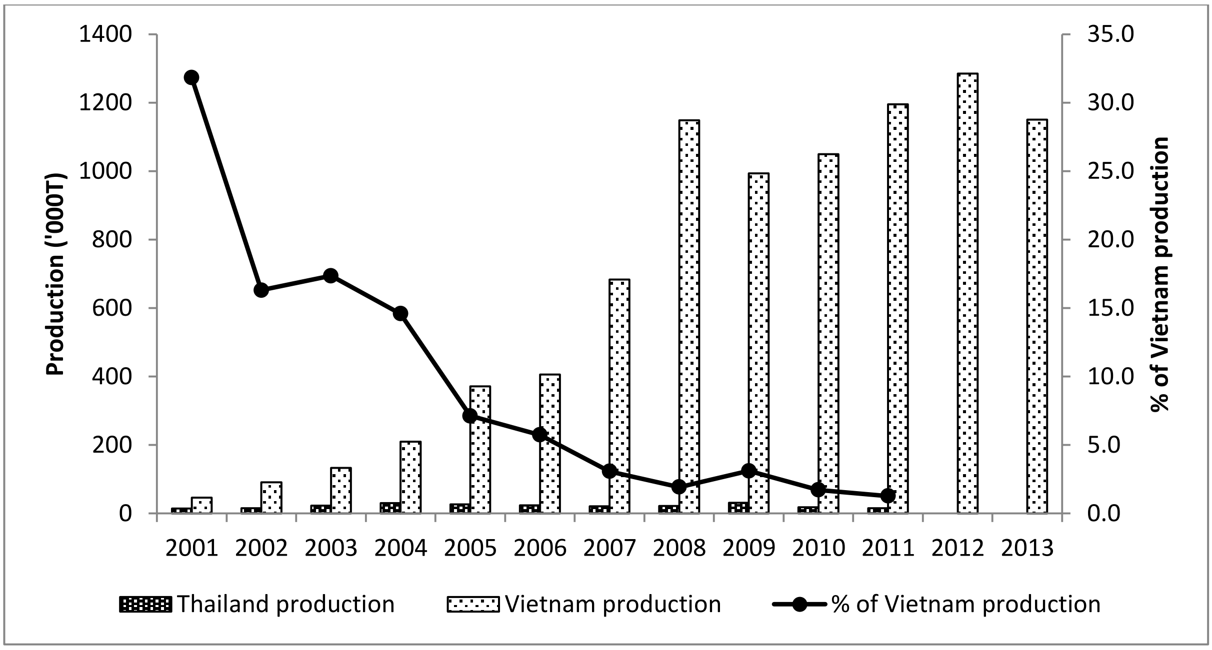

Figure 3.7 Production of striped catfish in Thailand and Vietnam

Source: FAO, 2014; Vietnamese Fisheries Directorate, 2013

Most striped catfish in Thailand (especially in the central region) have been grown in ponds on poor quality feeds, especially waste cafeteria feeds resulting in poor quality, off-flavoured fish with low value. Cages in rivers have been traditionally used for growing striped catfish (Edwards et al., 1983; Payooha et al., 2009; Phillips, 2002), but in the northeast region, previous catfish cage farmers have shifted to growing tilapia due to the latter's shorter culture period to reach marketable size (Payooha et al., 2009). The shift allowed for more income to be received by the farmers (at least 2-3x per year) compared with striped catfish which takes nearly a year or more to be harvested and sold (from scoping survey among cage farmers in Ubon Ratchathani province).

3.2.3. Tilapia

In the mid 1990s, CP company started to contract farmers in the central and the northeast regions to grow ruby (tabtim) or red tilapia in ponds and cages, offering seed and feed so they would have a supply for their processing plants for both local and domestic markets (Belton et al. 2006). Furthermore, ruby or tabtim tilapia became a cheaper and fresher substitute i.e. higher quality alternative, to marine fish which required long hours of transport especially to upcountry inland areas. The development of cage-based tilapia systems has been attributed mainly to CP company (Belton et al. 2006; 2009) resulting from its research, development and marketing activities, for both local and export markets. Through its innovative marketing strategies in which food services were targeted before retail markets, the production and consumption of cage-produced red tilapia has become popular in many areas of the country. Recently, other companies (for e.g. Grobest) with seed, feed, inputs and processing capacities have also contracted cage farmers to produce tilapia (both Nile and red), for both local and export markets. Although the supply is mainly for northeast provinces, they are sold into a premium live domestic market, where producers and traders could obtain higher prices, making it more expensive for the processors to offer to buy them. Most (81%) of tilapia produced still came from pond systems with 19% from cages in rivers (DOF, 2013a).

Although tilapia cage farming has become popular, sustainability of cages is in question considering the nature of public water bodies which limits expansion as well as lack of control over water quality and disease outbreaks (Belton et al. 2006). A number of cage farmers in Suphanburi had to reduce their cages while those in Ubon Ratchathani had to stop stocking tilapia because of disease occurrence and uncertain fry quality (from scoping survey data, 2010). Some key informants who were growing tilapia in cages, for example, in Ubon Ratchathani province also mentioned that the quality of their tilapia was not acceptable enough for export due mainly to off-flavour, presence of chemical residues and size.

Figure 3.8 shows the proportion of tilapia exports to production, as well as for the two export forms of tilapia, with very little change in the last few years. Less than 10% of production was exported, the highest in 2006 and 2008 (DOF, 2010b). This suggests that demand for domestic market has stabilised during that period, but due to some issues such as disease, water supply and quality, as well as environmental changes (flooding, drought, high temperature), production was affected especially during 2010 onwards. Thus it was not only the market constraints to export that the industry had to contend with, but also a continuing strong local demand.

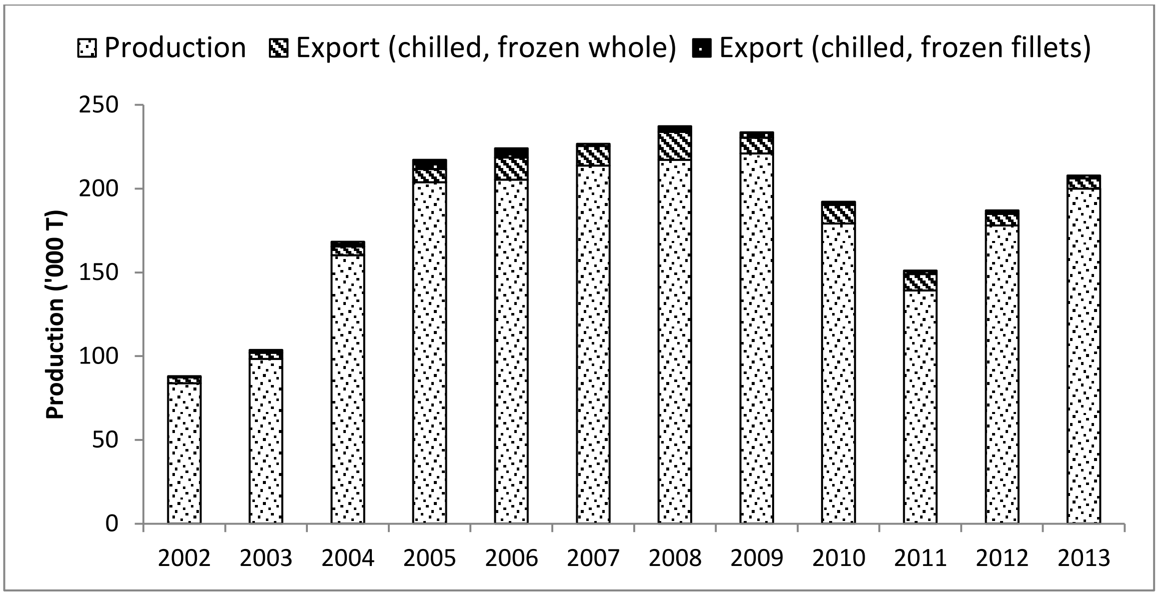

Figure 3.8 Tilapia production and volume of exports for Nile and red tilapia

Source: FAO, 2014; TFFA, 2014

3.2.4. Penaeid shrimp

Traditional penaeid shrimp farming had already been practiced in Thailand as early as the 1930s in extensive systems with *Penaeus merguensis* (banana shrimp) (Kongkeo, 2007), however, Thailand's black tiger shrimp industry started in the early 1970s following the development of hatcheries in Thailand and with promotion from DoF (Kongkeo and Davy, 2010; Tookwinas et al., 2005), and took off in the mid-1970s following the shrimp production crash in Taiwan and the high value of shrimp in international markets that was an outcome of increasing demand (Briggs et al., 2005; Kongkeo and Davy, 2010). This resulted in the proliferation of many small intensive farms in Thailand making it the production leader in the early 1990s until the end of the millennium (2000) with black tiger shrimp, and continued with white shrimp.

Thai shrimp grow-out management systems have evolved through the years, with the *P. monodon* industry peaking in the 1990s and then crashing towards the 2000s (Briggs et al., 2005). There was a shift in species of choice from black tiger to white shrimp in the early 2000s due to problems with growth and disease resulting in major losses, as white shrimp production was able to fill the niche vacated by black tiger shrimp thereby meeting the demand for more shrimp in the global market (Lebel et al. 2010). In addition, with *L. vannamei* being credited to be fast growing and less susceptible to disease as long as proper measures are followed to create a disease free environment, it has become popular among growers who wanted recovery from the economic and environmental crises faced with black tiger shrimp farming (Wyban, 2007). Figure 3.9 shows that white shrimp production was only 23% of total shrimp production in 2002 but by 2004, it had risen to 70% of total shrimp production. Currently more than 99% of total production is white shrimp (Figure 3.9) (FAO, 2014).

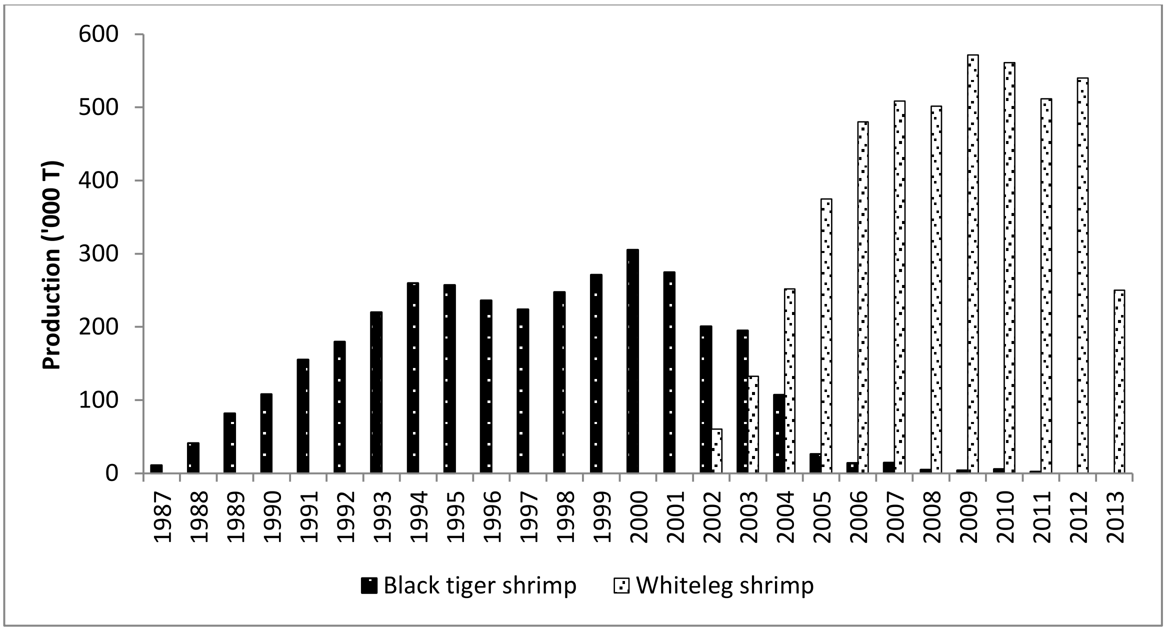

Figure 3.9 Black tiger and white shrimp production in Thailand, 1987 to 2013

Source: DOF, 2013a; FAO, 2014; Pratruangkrai, 2013; TFFA, 2012

Shrimp is the most important commodity in terms of production among the four species studied. However the *P. monodon* industry was plagued by disease outbreaks and slow growth syndrome which resulted in great losses among producers during the 1990s until the early 2000s (Chayaburakul et al. 2004; Briggs et al. 2005; Wyban 2007; Lebel et al. 2010; Kongkeo & Davy 2010). The disease outbreaks and the desire to increase production prompted farmers to use more treatment and conditioning methods with chemicals and antibiotics which eventually affected the quality of exported shrimp.

In the early 2000s there was a high number of incidences of contamination with antibiotic residues (e.g. nitrofurans) and pathogens such as vibrio in Thai shrimp exports, as reported by the EU Rapid Alerts System for Food and Feed (EU-RASFF), but such antibiotic use and related contaminants in the final product have significantly decreased (Figure 3.10) in recent years (RASFF, 2010). The use of substances such as nitrofurans for prophylaxis, and treatments during disease outbreaks in *P. monodon* led to the banning of Thai shrimp exports to the EU (Graslund et al. 2003; Holmstron et al. 2003; Lebel et al. 2008).

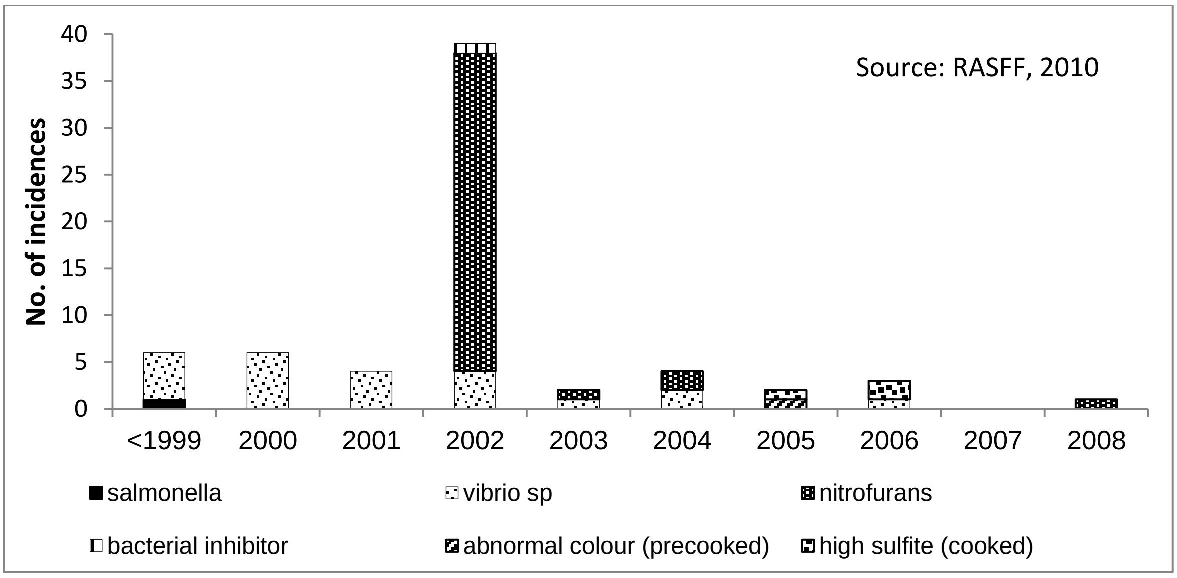

Figure 3.10 Food safety incidence reports on Thai shrimp exports to Europe

In the late 1990s to early 2000s, the private sector first introduced specific-pathogen free (SPF) *L. vannamei* from Hawaii for experimentation mainly in the freshwater areas of Thailand i.e. Nakhon Pathom province, where *P. monodon* farming was banned following a government regulation due to concerns for salt water intrusion into freshwater supply (Kongkeo and Davy, 2010; Wyban, 2007). White shrimp production then spread to other parts of the freshwater inland areas. In early 2000, white shrimp farming expanded to the coastal areas, resulting in a sharp increase in production (Kongkeo and Davy, 2010).

White shrimp production data began to appear in the FAO database in 2002. The shift in species was mainly driven by the problems of disease and slow growth faced by black tiger shrimp producers, and the opportunities provided by white shrimp culture in terms of faster growth, lower production costs, and better environmental and disease management (Lebel et al. 2010).

The shift to *L. vannamei* and the subsequent regulatory frameworks, advances in biosecure and green techniques and the cooperation among different stakeholders through farmers' clubs/groups have helped the industry to recover (Lebel et al., 2009 & 2010; McIntosh, 2008a; Wyban, 2007; Yamprayoon and Sukhumparnich, 2010). These efforts, including the government's regulation banning the use of antibiotics and other hazardous chemicals, have resulted in drastic reduction in the use of antibiotics and other hazardous chemicals in aquaculture initially with shrimp culture and recently expanding to other aquaculture systems (Lebel et al. 2008; Rico et al., 2012).

3.3. Importance of seed and hatchery development

It has been established that for aquaculture to fully develop, a reliable supply of quality seed is important (AIT Outreach 2000; Little et al. 2002). In the past when fish farming was still extensive and demand for farmed products was modest, reliance on wild seed was sufficient. However, due to the development of aquaculture to respond to increasing demand for food fish not only locally but also globally, a hatchery sector producing consistent quality juveniles has been critical.

Artificial fish seed propagation in Thailand developed at different periods of time depending on species and location (Belton, 2012; Belton et al., 2009). As aquaculture systems intensified, good quality seed, i.e. less size variation, sufficient quantities at the time required and stress-resistant, were required, and reliance on hatchery seed also increased (AIT Outreach 2000; Little et al. 2002; Kongkeo & Davy 2010). In Thailand, efforts of the Government, researchers and a network of private entrepreneurs/operators and traders contributed to a strong seed production industry making fish seed available which promoted aquaculture development in the country, especially among the species studied (Little & MacNiven 2001; Little et al. 2002; Belton &Little 2008; Kongkeo & Davy 2010; New & Kutty 2010).

Tilapia production in Thailand topped freshwater fish production after tilapia hatchery technology through mass seed production was developed by AIT and became established through private-public partnerships and training (Belton, 2012; Belton et al., 2009; Bhujel, 2011). One of the major reasons for the rise of tilapia as an important aquatic food commodity was the success in seed production technology, specifically the application of artificial egg incubation and all-male fry production (Bhujel 2009). The use of monosex fish is particularly critical for population control and final size management in the semi-intensive systems that still dominate in Thailand. More importantly are the informal interactions among enterprising individuals which were efficient in extending hatchery technical know-how from research institutions to the private sector (Belton, 2012).

The history and development of tilapia hatcheries in Thailand, especially for monosex tilapia fry production was described by Belton et al. (2009) and Bhujel (2011), attributing tilapia hatchery development to the close collaboration among academic research institutes such as the Asian Institute of Technology, the DoF and the private sector, including banks such as the Asian Development Bank and the Bank of Agriculture and Agricultural Cooperatives (BAAC). DoF was credited for its contribution to provision of high quality broodstock, in addition to its many other roles of fry production and extending seed production technology to the provinces. BAAC provides credit for agricultural activities to individual farmers, agricultural cooperatives, farmers' associations as well as government-secured loan projects (BAAC, 2009).

Hatchery development has been instrumental in the development of tilapia aquaculture which resulted in higher production and consumer acceptance. Disease occurrence in tilapia fry and fingerlings may be the major constraint of the industry and research on how to prevent disease infestation is on-going. Specific pathogen resistant (SPR) broodstock may be critical in the future (Warren Turner, personal communication, 2010), considering that a growing number of serious tilapia diseases reduce performance and growth. For example, in tilapia cages, there is a need to use chemical inputs, both as prophylactic for disease prevention, as well as for treatment when disease occurs (Rico et al., 2013).

The establishment of first, freshwater prawn and then, black tiger shrimp backyard hatcheries was a major factor in seed production and hatchery development in Thailand (Kongkeo and Davy, 2010). Furthermore, the success in shrimp was initially linked to the fact that the hatchery techniques based on prawn were already well established. These household owned and operated backyard hatcheries favoured their technical success over Government employee-based hatcheries as extended family members could provide round the clock labour and management, and it was useful to have the operations within distance from the owner's house.

The Thai DOF as well as local educational institutions (Department of Vocational Education's agricultural colleges, universities) played a major role in research, training and development of skilled labour, and most of the time DOF technical staff and workers themselves or their families were the entrepreneurs establishing backyard hatcheries (Belton et al., 2009; Little et al., 1987). This informal extension of knowledge and skills gained from formal employment into private enterprise is a characteristic of the Thai aquaculture hatchery sector in general and has also been described for Vietnam and elsewhere in Asia (Belton, 2012; Little et al., 2002).

The loan from the Asian Development Bank to Thailand during the mid 1980s until 1993 to promote black tiger shrimp aquaculture enabled the establishment and improvement of a number of government shrimp hatcheries, which resulted in increased production of up to 60 million PLs, the majority (70%) of which were used to restock the wild and for research at DOF, and the remaining 30% sold to farms (ADB, 1996). Based on the production levels of shrimp during ADB project implementation, i.e. 118,000 to 250,000 t from 1990 to 1994 (ADB, 1996), at a conservative 50% survival rate (from PL to marketable size of 30 shrimp/kg), around 7 to 15 Billion PLs were required for stocking. Private sector seed production thus quickly became the main source of supply to shrimp farmers.

In the late 1990s when the industry shifted from culturing black tiger shrimp to white shrimp, broodstock of *Litopenaeus vannamei* had to be imported as it was "an introduced species in Asia and the Pacific" (Briggs et al., 2005). Subsequently, the tiger shrimp hatcheries either stopped operation or shifted to producing white shrimp PLs. Hatcheries importing white shrimp broodstock had to register with the DoF, which was part of the regulatory and control measures especially related to disease prevention, with the broodstock required to be certified as specific pathogen free (SPF). However, non-SPF broodstock continued to be imported without permit from DOF into the late 1990s and early 2000s (Briggs et al., 2005; Tookwinas et al., 2005). Regulating imports of broodstock starting in early 2002 (Tookwinas et al., 2005) helped in achieving success in white shrimp production, as the control ensured that only SPF broodstock were used, with the suppliers (from Hawaii, USA) required to become certified SPF producers and obliged to meet DOF criteria (Tookwinas et al., 2005; Wyban, 2007).

Home-grown F1 broodstock soon became available but the quality of postlarvae was lower (slower growth, more variable sizes and more vulnerable to diseases) than those coming directly from imported SPF broodstock (Wyban, 2007). Mcintosh (2010) pointed out, though, that domesticated, disease-free shrimp was one of the key drivers in reviving the shrimp industry in Thailand, mentioning about selective breeding programmes of which the CP breeding programme in Thailand is the largest, supplying PLs to their farms and clients. The good quality broodstock and PLs mentioned by Mcintosh (2010) above obviously referred to subsequent generations and not specifically the F1 generation mentioned by Wyban (2007). These importing hatcheries would sell nauplii to the smaller scale hatcheries located in the eastern provinces of Chachoengsao and Chonburi, and Phuket province in the south, as well as sell PLs directly to growers and use in their own growout farms (Kongkeo and Davy, 2010). These hatcheries also had to develop their own selective breeding programmes so they would not be dependent on imported broodstock in the long run. With CP's purchase of the broodstock production facility in Hawaii, broodstock imports have been limited to their (CP) own hatcheries (source from a key informant during surveys).

Thus private sector development with all its informal relationships and networks has also been central to the expansion of seed production technology in Thailand (Belton, 2012). An example of private sector effort in development of seed production technologies is that by Charoen Pokphand Foods company, a large vertically integrated company which has been an industry leader in shrimp seed production through its development of efficient, biosecure techniques including selective breeding to ensure healthy broodstock and good quality PLs for their own operations as well as for their leased and contract farms (McIntosh, 2008b). The company believes that in order for a vertically integrated operation to survive they need to have a strong foundation in the production of reliable, high quality and healthy PLs. Currently they have 10 corporate hatcheries catering to their farms (owned and leased) and have the capacity of producing 80 to 900 million PLs/month.

Pangasius is one of the earliest species spawned in Thailand, at Nakhon Sawan Fisheries Station in 1958 (Boonbrahm, 1959). The Department of Fisheries still has the capacity to breed them, although commercial supply of juveniles has long been dominated by private sector hatcheries. Traditionally farmers would collect fingerlings from rivers and stock them in cages (Payooha et al., 2009). In Vietnam, they also used to collect fingerlings from the wild but would stock them in their “latrine” backyard farms (De Silva and Phuong, 2011).

In Nakhon Phanom, northeast Thailand, along the Mekong River, the government’s initiative in one of its pilot projects to promote striped catfish culture for export in 2005 resulted in a temporary high demand for fingerlings of *Pangasius bocourti* to be stocked in growout ponds and cages (Payooha et al., 2009). The Thai interest in this species was probably motivated by the success of the Vietnamese industry as well as a long period of decline in the domestic market of the pure striped catfish species (*P. hypophthalmus*), thus there was an attempt to re-launch it as an export item or boost its exportation (BAAC, 2009). However quality issues related to flesh and flavour might have constrained the success of the initiative (DOF-Economics, 2009).

To ensure enough seed supply, researchers at the Nakhon Phanom Department of Fisheries Station successfully cross-bred the female of *Pangasianodon hypophthalmus* and male *P. bocourti* which is more fecund and has a higher survival during nursing (Payooha et al., 2009). The flesh texture is similar to that of *P. bocourti*. This is marketed as Thai Panga and the local name is *Sawai Mong* (Payooha et al., 2009). There are major concerns on this in relation to biodiversity issues and certification as cross-breeding species is not supported by major certifiers. Even though Thailand has developed the technology of seed production and culture a long time ago, there is lack of comparative advantage in producing good quality Pangasius for export. For example, the Vietnamese can achieve good quality product through intensive water management (Phan et al., 2011), whereas Thailand has opted for technical short cuts such as hybridisation or genetic manipulation of the native species to solve the yellow flesh problem, for e.g. genetic techniques (Na-Nakorn and Moeikum, 2009).

Seed quality continues to be an issue especially with white shrimp and tilapia, in terms of achieving strains which are of good quality and resistant to diseases which ail the industry. When juvenile shrimp started dying *en masse* 30-45 days after stocking (symptoms of the Early Mortality Syndrome) during 2012-2013, the quality of post-larvae was thought to be the likely cause, resulting in majority of farmers changing their seed sources. The DOF and private sector also collaborated in having a consensus for guidelines which hatcheries should follow to produce better quality PLs (DOF, 2013b; TFFA, 2012).

For tilapia, despite being well-known as a species that is easy to breed and culture (Belton et al., 2009), and widely produced (Norman-López and Bjørndal, 2009), disease prevention is still one of the major concerns in order to strengthen tilapia industry (Towers, 2013). In addition to quality concerns for tilapia seed, Bhujel (2011) also emphasized the importance of producing enough quality seed. Over the last few decades considerable resources have been invested in training fish geneticists in the Thai DOF and Universities and 'improved strains' have been identified as a key requirement for increasing performance for all cultured species. Participation of Thailand in the regional GIFT project (Genetically Improved Farmed Tilapia) has been a major success with a high proportion of commercial Nile tilapia strains now being GIFT or GIFT hybrids (75% of fingerlings cultured by farmers) (Ponzoni et al., 2010). Trials across the region in the early 2000s showed that adoption of GIFT strains would increase production thereby lowering price and making tilapia more accessible to a large population (Ponzoni, 2008).

The relative importance of disease control, genetics and other factors in seed production remains contested however, such as what Na-Nakorn and Jintasataporn (2012) claimed that genetically improved strains of freshwater prawns would help expand the business. On the other hand, it is notable that Vietnam has built its huge Pangasius industry essentially based on wild, unimproved genetic stock.

3.4. Emergence of feed industry

Thongrod (2007) reported that there were about 60 feed mills in Thailand, with 32 producing shrimp feeds, 12 producing tilapia with the remaining produce both shrimp and fish, as well as specific ingredients such as additives and premixes. An analysis of advertisements in professional magazines in 2011 identified more than 20 aquaculture feed companies, producing feeds for shrimp (white and black tiger), prawn, tilapia and other fish and aquatic animals such as for catfish, sea bass, carp and other herbivorous fish, crab, lobster, soft-shelled terrapin turtle and frog. In addition there are more than 60 brands and or feed types/grade, with some companies producing as many as nine different feeds for various species and ages/sizes. Figure 3.11 shows the location of the feed mills by density (average number/ production area), according to species. Feed mills are strategically located based on the aquatic species which are commonly raised in that particularly area, with a concentration in the 'fish belt' around Bangkok where freshwater fish culture dominates. The feed mills are producing feeds for tilapia, catfish and other herbivorous fish species.

Feed mills have their own sales offices and shops with sales agents in strategic provinces close to concentrations of farms. In addition, agricultural and feed shops also exist in the provinces, sub-districts and villages to cater to medium and small scale farmers. These shops could either be direct distributors of feed companies or independent retailers. Farms which have a high number of ponds in operation requiring a large volume of feeds per time (i.e. medium and large scale farms based on SEAT project classification) typically buy directly from feed companies as they can purchase in bulk and have enough storage area to keep the feed. Cooperatives and farmer clubs/associations also helped to negotiate with feed companies directly for a cheaper price than buying from retail feed shops/dealers (Lebel et al., 2009).

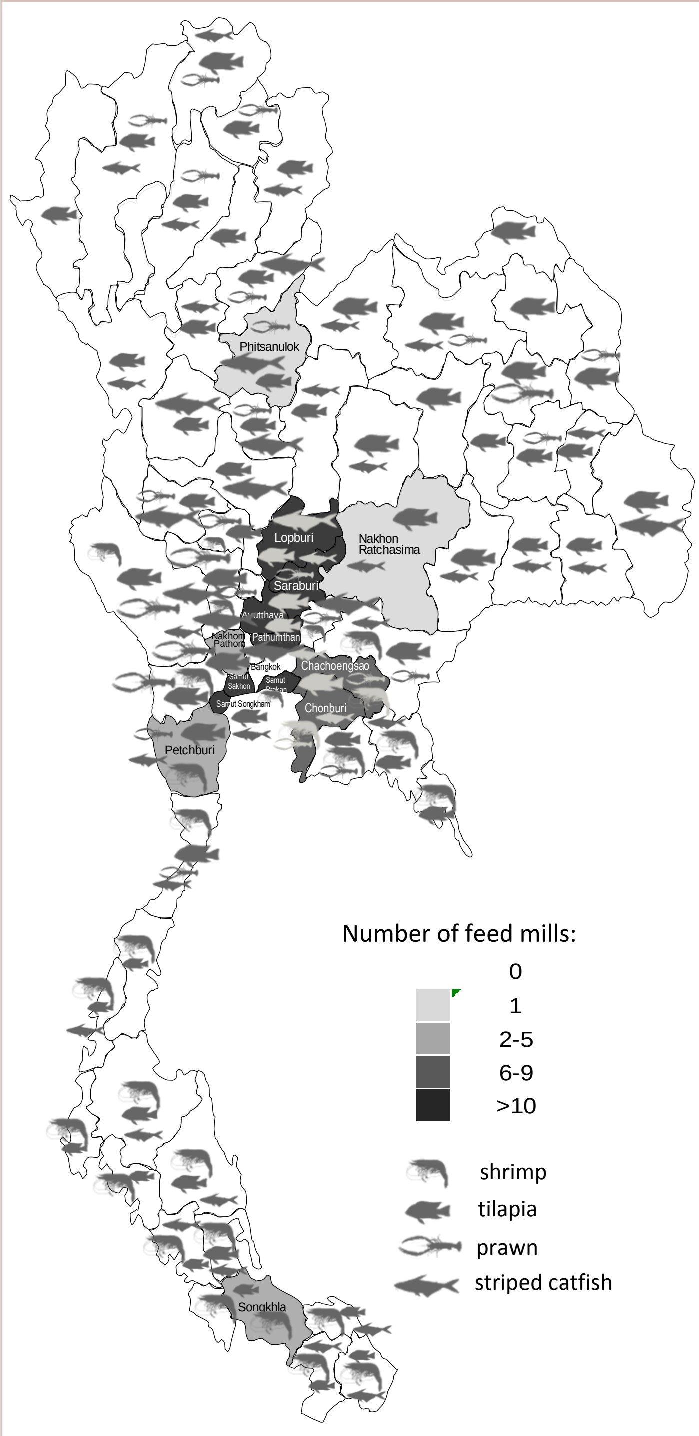

Figure 3.11 Location of feed mills and production areas by species

Table 3.2 shows that most of the feed mills did not start with fish and shrimp feed production but rather with livestock (chicken or swine) feed or production. The oldest feed mill company (Betagro) was established in 1967 as an animal feed manufacturer, which later established a fully vertical integrated system for poultry and swine. Their aquaculture feed business came much later, in the mid- 2000, producing mainly feeds for Nile and red tilapia (The Nation, 2007). In fact nearly all the feed mills started their feed manufacturing business as animal feed producers then evolved into vertically integrated operations for livestock production such as for poultry and swine before diversification into aquatic animal feeds. When they entered the aquaculture business, they followed this same pattern of vertical integration (from feed, seed, production, processing and marketing).

Table 3. 2 Number of aquatic feed mills and their original activities

Years established	Years started as animal feed producer	Years started with aquafeed	Started aquafeed production	Current products
>20 years	6	4	1988 - 2006	Livestock feed, fish and shrimp feed, livestock production, aquaculture, food processing, exports
<20 years	2	2	1999 - 2000	Shrimp and fish feed, livestock feed, processing, additives, equipment, exports

Source: Scoping survey, 2010

The decade following the establishment of Betagro company saw the establishment of other companies, such as Cargill Siam, Centaco, Grobest and Laemthong. As with Betagro, these companies did not start as aquatic feed manufacturers outright (except for Grobest), but as animal feed manufacturers, livestock producers, and agricultural food processors. In 1978, Charoen Pokphand company was established, manufacturing and distributing animal feeds initially in the south of Thailand. It later on expanded into agro-industry and the food production business, mainly in livestock and aquaculture, as fully integrated operations, from feed raw material procurement, feed manufacture and distribution, animal breeding, animal farming, meat processing, and manufacturing of food products from meat (CPF, 2008).

As part of general agricultural development and the intensification of livestock systems especially poultry, more feed mill companies were established in the 1980s through the 1990s until 2000, the last year reported for a feed mill becoming established, although some established companies continue to set-up new plants even in 2006-2007. Through the years these companies expanded into aquaculture feed manufacturing as opportunities and species diversity of the aquaculture sector grew , increasing availability and competitiveness of the sector with different brands competing on price and service, and contributing to the continued 'immanent' development of Thai aquaculture (Belton & Little 2011). In addition, the intensification of aquaculture systems further fuelled demand for commercial formulated feeds.

Feed mill operations could be a starting point of upgrading activities of companies which move up the value chain, or a result of upgrading from other agricultural and fishery operations. This is one example of upgrading where operations upgrade with the aim of obtaining more returns by producing items with added value or changing to more profitable activities (Bolwig et al., 2010). One of the feed mill companies belonging to the Apitoon Group of seafood companies (established in 1975), primarily producing and processing surimi and other marine food products from their fisheries operations, went into fish meal processing to utilise processing fish by-products and wastes (Apitoon Group, 2002). Being a producer of premium grade fish meal, they considered it natural to branch out into fish and shrimp feed manufacturing, including other livestock feeds, and shrimp and finfish aquaculture to ensure stable supply for their processing business (Apitoon Group, 2002). Similarly upgrading and more diversified operations occurred with the Thai Union Group, with their first manufacturing company for tuna established in 1973, then frozen seafood processing and export started in 1988, and feed mill in 2000. Thai Union Group is considered Thailand's largest canned and frozen seafood producer, with business interests in many parts of the world (Thai Union Group, 2012).

The development or evolution of animal feed manufacturers and livestock producers into aquatic feed manufacturers and aquaculture producers, processors and even exporters reflected the fact that the aquaculture industry was growing and becoming more important (McIntosh 2008b). In addition, higher margins from these operations compared to terrestrial livestock feeds were possible since aquafeeds tended to be of higher quality and required higher processing costs, for example to achieve water stability. Companies that ventured into this type of expansion also became vertically integrated to ensure full management control of operations and supplies in all phases of operations.

A few of the aquatic feed mill companies established in the latter part of the expansion era did not have a history of livestock feed production in Thailand but rather had specialized in aquatic feed production in other countries in the region. Stand-alone feed mill companies, i.e. those which did not have their own growout operations, would tend to enter into contract agreements with growout farms, to sell their feeds and provide after sales technical assistance.

The wide range of feeds in the market has led to intense competition with significant choice for farmers although the rising cost of raw materials and, inevitably that for formulated feeds are major constraints for the feed manufacturers and farmers, respectively (Sataponrnvanit et al., 2011).

3.5. Importance of seafood processing capacity

Thailand has been supplying processed food to the global market for more than 20 years and the success in the export of processed agricultural food products has been attributed to the growing confidence international consumers have in Thailand to produce quality food products, including frozen shrimp (Sukphisit, 2010).

Thailand has more than 200 seafood processing plants with about 160 of them exporting the target seafood species of this research (TFFA, 2010b). The combined capital of at least 128 factories is nearly 30,000 M Thai Baht, ranging from 1 to 8,000 M Thai Baht (TFFA, 2010b) (US$ 1 = 30 Thai Baht in 2010). Most processing plants are located in Samut Sakhon and Samut Prakarn provinces near Bangkok, and in Songkhla in the south (Figure 3.12). Songkhla province continues to be one of the main centres for capture fisheries, with the greatest, and increasing, number of registered fishing boats (up to 21% of national fleet in 2011) although in terms of tonnage in 2011, it only ranked 7th since most (88%) of the boats were of smaller size (<14 m) (DOF, 2013a). Songkhla port is also one of the major landing ports for fishing boats going outside Thailand’s EEZs (Lymer et al., 2008).

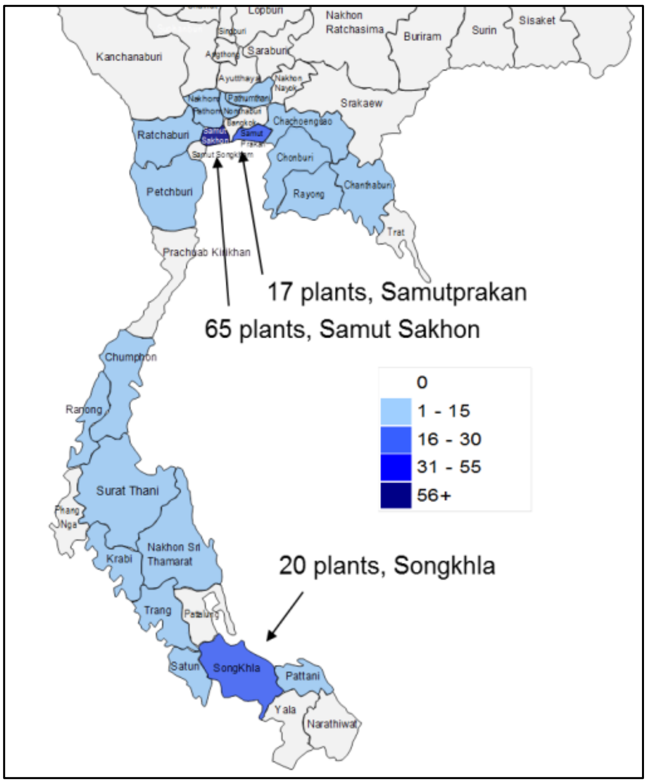

Figure 3.12 Data map showing the number of seafood processing plants

Source: TFFA, 2010b

Figure 3.13 shows the time period when processing plants were established from the information of 140 companies (out of the 200 processing plants mentioned above) in different locations. The establishment of these processing plants, most of which began as processing of products from capture fisheries and have diversified to processing and exporting shrimp from aquaculture, could also be related to the rise and fall of the shrimp industry during the 1980s and 2000s (rise) and the late 1990s (fall). In a broader sense, the trend could also be compared to the economic climate of Thailand during those periods as described in Rigg (2012) wherein GDP annual growth (The World Bank, 2013) and incidence of poverty were plotted over time from 1962 to 2011, and divided into periods of “slow growth (70s to 1986)”, “miracle growth (1987 to 1996)”,“crisis1 (1997 to

2002)" and "crisis2 (2008 to 2011)". The 6 plants established in 1996 were processing not only shrimp but also prawn and tilapia due to a rising demand for these species in the export markets at that time.

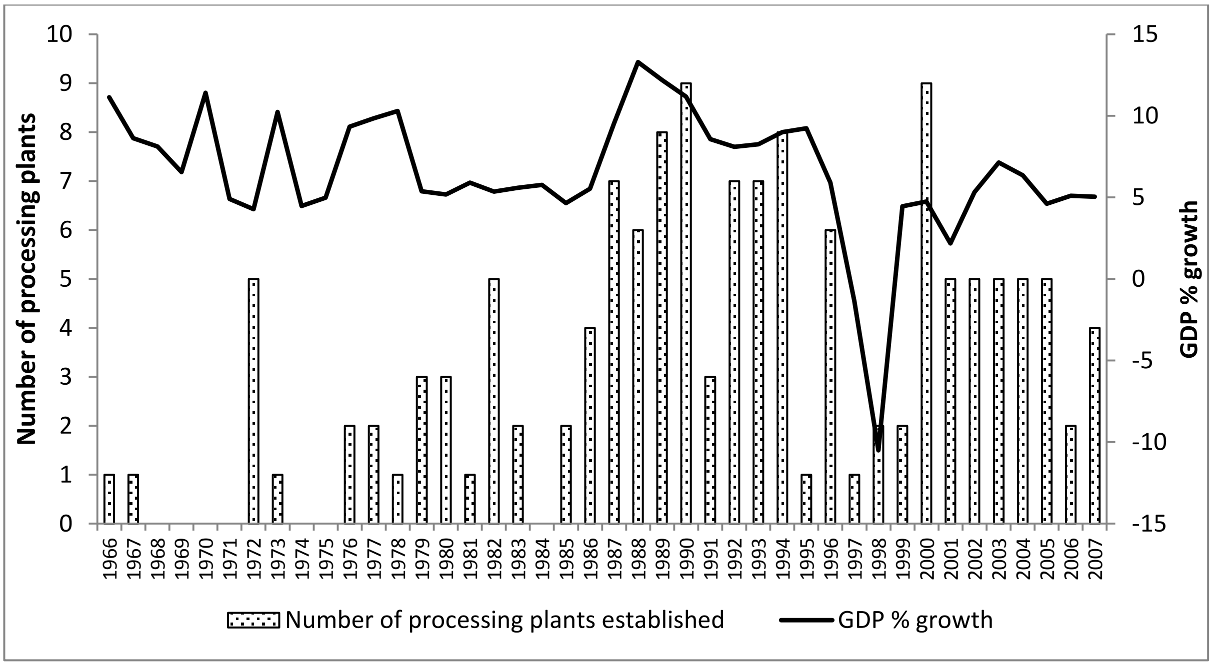

Figure 3.13 Establishment of processing plants and GDP % growth in Thailand

Source: TFFA, 2010b; The World Bank, 2013 (processing plants n=140)

Of the three provinces, a great majority of processing plants and other fishery industrial activities are located in the province of Samut Sakhon, at the mouth of the Tha Chin River, which is a tributary of the Chao Phraya River, emptying into the Gulf of Thailand. Along its coast are many fields being used for sea salt production, which played a role in the origins of shrimp farming in the country, whereby people would allow or stock shrimp PLs into the ponds (Hossain and Lin, 2001). The province's former name was Tha Chin, which means "Chinese port", because it was a commercial trading port between the Thais and the Chinese traders who came in their Chinese ships or junks; the port was established commercially in 1548 (TAT, 2008). Its proximity to Bangkok (distance, 30 km) and the sea (distance, 2 km) makes it an ideal location for businesses and industries related to fisheries and shipping. The urbanisation of Bangkok in the mid-1980s to early 1990s spilled over to the neighbouring provinces including Samut Sakhon, one of the five provinces around Bangkok considered as the Bangkok Metropolitan Region (BMR), although their governance is still under the jurisdiction of their respective provincial and local governments and not under the Bangkok Metropolitan Administration (BMA) (Davivongs et al., 2012; Kritsanaphan and Sajor, 2011; Rigg, 2012; Trethanya and Perera, 2009). The other four provinces in the BMR are Nakhon Pathom, Nonthaburi, Pathumthani and Samut Prakarn.

These conditions led to rapid urbanisation in this province which resulted in a good basic infrastructure such as better roads, communication and irrigation canal systems. In the past the canal river system was the main commercial transportation system connecting people especially traders to many areas. Previously, the sources of livelihood of the people there were salt making, charcoal production, fishery and boat making, and agriculture (Parks, 2012). Many industrial and food companies and factories were established in this province from the 1980s onwards due to its proximity to the seaport and city centre. More than 1,000 ships dock in this province for trading, loading and unloading of goods. This province is also the wholesale seafood center for landing, auction/selling, processing and exporting, even for production of feeds and farming of shrimp and fish. The Mahachai Talay Thai Market, an auction wholesale market for seafood coming from the nearby fish landing port as well as for shrimp and other finfish from many provinces in Thailand, is located here. It is considered one of the biggest seafood markets in the region. The province continues to be an important location for the seafood industry economic activities as it has the major port, and is the biggest producer of sea salt in the country (source: key informant interviews during Scoping Survey, 2010). The second major processing zone in Thailand is located in the south, in the province of Songkhla, where the industry caters mainly to off-shore marine catches such as tuna, squid and other finfish, as well as shrimp from aquaculture ponds in the surrounding provinces. Most often the processing plants in this province are sub-branches of those in the central Thailand areas.

Canned and processed seafood was 14th among the key 15 products exported from Thailand in 2010, which was about 2.1% of the total exports in that year (DEP, 2011). Thailand is also a secondary processor of several other seafood products which are imported from other countries specifically for processing and re-export (ILO, 2012; SEAFISH, 2008). The processing plants have to adhere to several global and local standards and certifications within and outside Thailand to be able to sell their products. Table 3.3 presents the major constraints these processors face in terms of types of seafood exported.

Table 3. 3 Constraints faced by processing plants in exporting their products

Constraints	Frozen fish/ seafood	Value Added product
Customers' claims/complaints	✓	n.a.
Tariff barriers	✓	n.a.
Exchange rate fluctuations	✓	n.a.
Unstable raw material price while selling price remains constant	✓	✓
Importing country economy	✓	✓
Food safety standards	✓	✓
Low supply of raw material	✓	✓
Lack of skilled labour	✓	✓
Diverse regulations in each country	✓	✓

Source: Scoping survey, 2010

Processing plants have varying capacities to produce products for export as well as for the domestic markets, depending on orders. Table 3.4 shows the standard classification of exports according to species, used for tilapia, shrimp and prawn, and catfish (not specified in terms of species of catfish) (FAO, 2014; TFFA, 2014; Thai Customs Department, 2014). However product differentiation may be more specific according to processors, classifying products as whole round, gutted (gilled)/head-on, gutted/shell-on/head-off, fillet/shell-head-off, value added/cooked (Thai Union Group, 2014).

Table 3. 4 Classification of forms of exports by species

Forms exported	Tilapia	Shrimp & prawn	Catfish
Fresh or chilled	✓	✓	✓
Frozen	✓	✓	✓
Fillets, fresh or chilled	✓	x	✓
Fillets, frozen	✓	x	✓
Steaks, frozen	x	x	✓
Dried, salted or in brine	x	✓	x
Live	x	✓	x
Not frozen	x	✓	x
Prepared or preserved, in airtight containers	x	✓	x
Prepared or preserved, not in airtight containers	x	✓	x

Source: FAO, 2014; TFFA, 2014; Thai Customs Department, 2014

The majority of processing plants deal with shrimp and prawn for export (Table 3.5), whereas there are also some processing plants for both shrimp and tilapia, as well as a combination of other species. There is some confusion in the literature especially because the terms “shrimp” and “prawn” are used interchangeably, as in Table 3.5 from the list of processing plants. Thus “prawn” could refer mostly to shrimp as used by the processing plants, since the term “Macrobrachium” was specifically mentioned to refer to the freshwater giant prawn.

Table 3. 5 The number of plants processing various species for export

Species processed	Number of processing plants
Shrimp & prawn*	109
Macrobrachium	1
Tilapia	6
Pangasius	1
Shrimp & macrobrachium	2
Shrimp, prawn & tilapia	33
Shrimp, prawn, tilapia & Pangasius	2
Tilapia & Pangasius	3
Shrimp, macrobrachium & tilapia	2
Shrimp, macrobrachium, tilapia & Pangasius	1
Macrobrachium, tilapia & Pangasius	1

*Shrimp & prawn are used interchangeably by processors to refer to penaeid shrimp.

Source: TFFA (2010b)

3.5.1. Shrimp

For shrimp, Figure 3.14 shows the export data in the last six years (2008 to 2013) according to the main product forms as reported by the Thai Frozen Foods Association (TFFA, 2014) (TFFA). The decline in the quantity of shrimp exports coincided with the decline in production in 2012 to 2013 due to the EMS problem (Figure 3.9), nevertheless the proportion of exports to domestic supply increased from 60% in 2012 to 77% in 2013 (Figure 3.15) probably due to the fact that processing plants had to fulfill orders from foreign buyers.

The term “chilled/frozen” refers to the shrimp product under HS code 0306, which covers fresh, chilled, frozen, cooked, steamed and boiled; whereas, the term “prepared/preserved” refers to the product under HS code 1605 which includes those put in air tight containers, including shrimp paste, and dried fish, including value-added products (Thai Customs Department, 2014). The value added market has been growing and the amount of value-added products being produced and exported has also increased (Panisuan Jamnarnwej, personal communication, 2010).

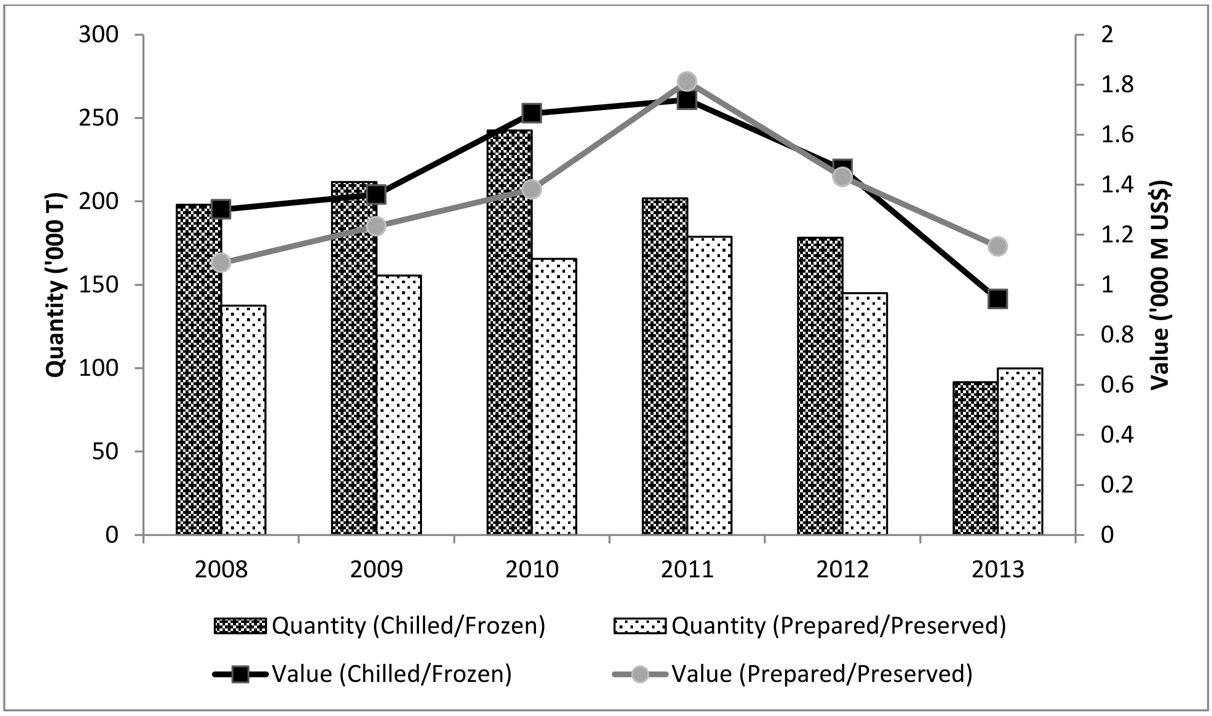

Figure 3.14 Quantity and value of shrimp exported, 2008 to 2013

Source: TFFA, 2014

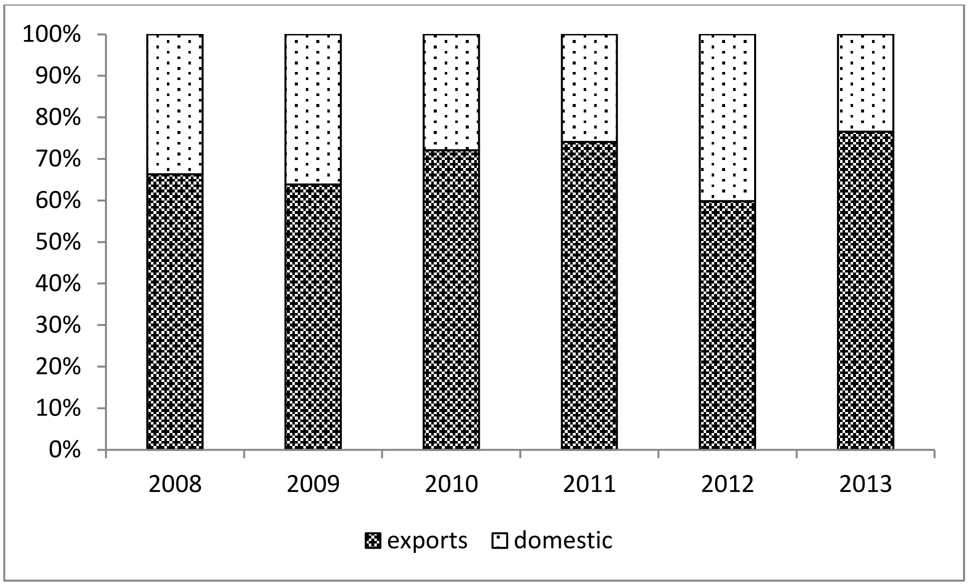

Figure 3.15 Proportion of shrimp production for domestic and export markets, 2008 to 2013

Source: FAO (2014); TFFA (2014)

3.5.2. Tilapia

Tilapia is exported from Thailand as both whole frozen fish and fillet. The important markets for tilapia fillets are USA, Europe and the Middle East; whereas for whole frozen tilapia, Europe (esp. France, United Kingdom and the Netherlands) and the Middle East are the main markets. The main competitor of Thailand in tilapia exports is China, considered the top global producer ($1x10^6$ tons in 2009) and exporter ($2x10^5$ t) of tilapia (Bamreurak, 2010), and recently exporting 21.5% of its 258,000 mt production (Towers, 2013). Thailand is also exporting tilapia to some Asian countries namely Japan, Taiwan and the Philippines (both fillet and frozen whole). The major constraints facing processors in relation to tilapia are the quality (muddy/off-flavour and chemical/antibiotic residues) and quantity (enough supply of raw material of the right size as per orders) (Fegan and Fitzsimmons, 2008; Yamprayoon and Noomhorn, 2003).

3.5.3. Pangasius

With excellent processing facilities, it would have been easier to integrate processing of striped catfish into frozen fillets if the processors could get enough raw material of a certain quality i.e. white flesh which the global market requires. However, in Thailand, the problem of yellow colouration of striped catfish flesh remains a constraint as this has a significantly lower value in export markets, thus Vietnam which could produce a better quality flesh has a comparative advantage (Belton et al., 2011). Striped catfish remains as a cheap fish in the local markets, partly due to the way they are cultured in ponds especially in terms of feeding management (Payooha, 2002).

CPF found that there is very low value of striped catfish produced in Thailand, thus they could not sell it as a value-added fish fillet. CPF has already achieved the level of quality the market so desires for striped catfish after intensive research, yet due to its low value in Thailand, CPF plans to set-up a farm and processing plant in Vietnam for processing to obtain a higher price for processed striped catfish (Wara Taparhaudee, personal communication, 2011). This company already has a presence in Vietnam in feed processing.

The result of this effort is that Pangasius fillet is now imported into Thailand and available in the local supermarkets as well as in CPF food markets. According to Pangasius Vietnam News (2013), Thailand exports of Pangasius fillets have been decreasing, pointing to the increasing value of the Thai baht against the US dollar and the lack of orders as reasons for Thai processors to reduce or stop production. On the other hand, imports of Pangasius fillets from Vietnam into Thailand have been increasing, with Thailand ranking 2nd among ASEAN importers of Vietnamese Pangasius (2.5% of Vietnamese exports) (Pangasius Vietnam News, 2013)

In Thailand the price of striped catfish with white meat is not different from that of the yellow meat striped catfish (Jesada Is-Haak, personal communication, 2011), i.e. it is not differentiated. The case of Pangasius in Thailand is a clear example of an early adopter ‘losing out’ to late entrants who have developed export markets strategically and in response to necessity, thus when the Vietnamese faced trade barriers in their main export market, the USA, they rapidly developed alternative markets in the EU (Belton et al., 2011).

A number of studies on Pangasius concentrated on genetic mapping and improvement for better breeding performance (Na-Nakorn & Moeikum 2009; Kanlapapuk 2010); however, research efforts should be made to increase competitiveness of Thai-produced striped catfish in both domestic and foreign markets to increase the value of good quality meat, encourage growers to invest more and for the industry to capitalize more on the growing demand for it. Likewise the perception of Pangasius as a cheap, low quality fish has to be changed to be able to demand a higher price in the market, and this will involve social marketing in addition to better culture management skills and financial strategy. However given the way Vietnam produces their Pangasius, and the volume being produced, Thailand might not be able to compete still.

3.5.4. Cold storage

Aside from processing plants, there are also cold storage companies which provide only warehousing facilities for fresh and frozen products, mainly to smaller processors who do not have their own facilities for storage. Figure 3.16 summarises the main roles which these independent cold storage companies play within the processing and export community (Bangkok Companies, 2011). These companies are good examples of upgrading having started as cold storage then later on expanding into other related businesses as opportunities opened up and contacts have been established, especially with foreign markets. Other examples of upgrading (Bolwig et al., 2010) in these seafood clusters supported through the integration with global markets is the manufacturing of cold storage and refrigeration equipment for the domestic and export markets. Most of the larger processing plants have their own cold storage facilities although may also use external cold storage depending on supply and orders.

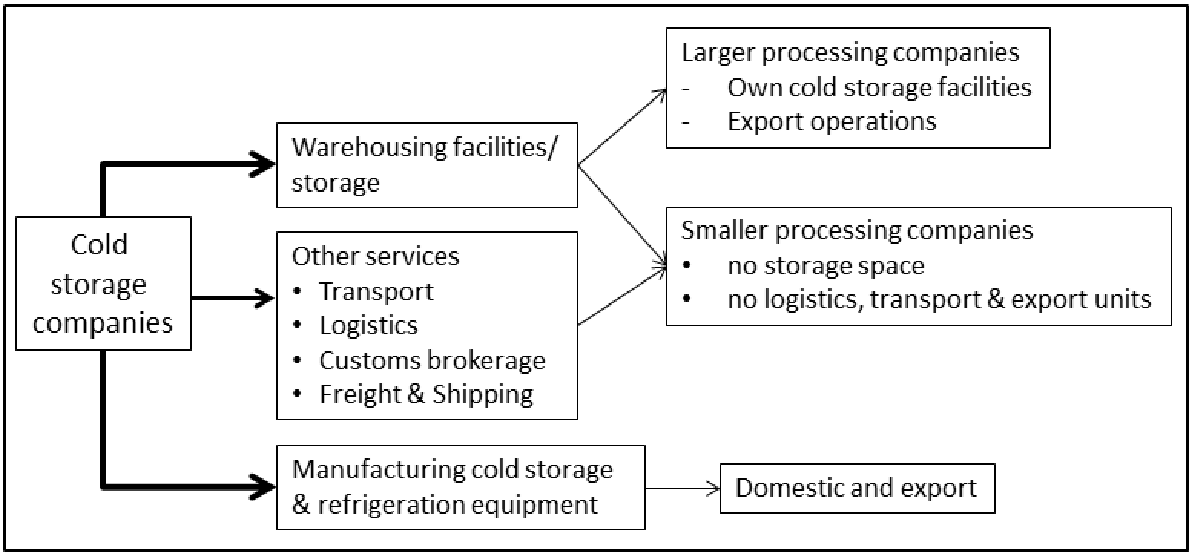

Figure 3.16 Roles of independent cold storage companies

Source: Bangkok Companies, 2011

Samut Sakhon is the main location of cold storage warehouses, where the majority of fish and other seafood products are landed, stored, processed, packaged and eventually distributed. There are nearly 50 cold storage companies with a varying range of activities as in Table 3.6.

Table 3. 6 Number of cold storage facilities and scope of activities

Type of activity	Number	Remarks
Cold storage (warehouse, storage)	23	One company has cold storage space of nearly 1200 m^2 at -5 to +10°C, humidity 70-90%; refrigerated space is 774 m^2 at -15 to -30°C
Cold storage, food processing	18	Food processed are shrimp, prawn, freshwater & marine fish & other aquatic species, agricultural products, semi-processed food One company has capacity of 4,000 t frozen seafood and 1,000 t shrimp; another company has capacity of 18,096 t frozen seafood
Cold storage, customs brokers/agents, freight & shipping, transportation, material handling, logistics	2	Includes warehousing, customs clearance, inland transportation, through transportation by sea/land, temperature controlled transport, packaging
Manufacturing equipment, building materials, insulation, container services	4	Insulated roofing and panel systems, expandable polystyrene foam, refrigerator spare parts, 20 and 40-footer refrigerated marine containers (also rental), metal products

Source: Bangkok Companies (2011)

3.6. Inter-sectoral learning

Sustainability in aquaculture does not only mean knowledge about the technical aspects of growing aquatic species and its impact to the environment, but also awareness of the human side such as social networking and cultural relationships that go with it (Lebel et al. 2009). The establishment of farmer associations and clubs by the producers themselves in the late 1990s created a “seminar culture” among the stakeholders, as regular events brought them together to share knowledge, give advice, promote innovative technologies and exchange information, as well as establish a level of trust among stakeholders (Lebel et al. 2009).

Other aquaculture associations such as for freshwater aquaculture or national level associations have also been set-up by producers and relevant stakeholders, and efforts have been made to bring stakeholders together in a similar format as that for shrimp. For example, the Thai Aquaculture Association organises meetings with farmers to discuss the potential for tilapia export, with cooperation from the government DOF, the Thai Frozen Foods Association, and input providers, who would share information on latest trends and other technical issues.

Costs of these meetings were borne by various sources, such as company sponsorships, registration fees of participants, and club membership fees. Participants who attended could be both members and non-members, and registration fees were charged to cover expenses for venue, meals, and materials.

Thus the development of the aquaculture industry in Thailand is not a stand-alone effort. Its development and intensification are linked with other developments in other sectors, such as in the animal feed production and vertical integration of companies, the growth in other sectors both in the community and national levels, as well as involvement in the global trade of other products and industry (Belton & Little 2008). Due to globalization Thai producers and entrepreneurs have become more aware of and exposed to what the market wants, and have adjusted their operations accordingly. Some companies such as Charoen Pokphand are industry leaders in technological innovation to improve efficiency and sustainability (McIntosh, 2008a). This has involved investment in infrastructure to improve biosecurity, and seed quality (through the introduction of SPF and PCR testing). In addition, producers are now eager to understand what happens to their products after reaching overseas markets, such as how their products are presented and marketed (Satapornvanit et al. 2011).

Internally, the industry has learned from its experience with the boom and bust of the black tiger prawn period that was linked to factors such as disease outbreaks, indiscriminate use of chemicals especially antibiotics for treating disease rather than prevention, and complete disregard of the environment and other issues for economic gain especially foreign exchange earnings (Lebel et al., 2010; Lebel et al., 2009). Thus, efforts within and outside Thailand for a better and more sustainable aquaculture practice have prompted the industry (led by the DoF and the private sector) to a rethink of the whole system for shrimp initially, and for other species eventually.

The Food Safety Year in 2004 declared by the Thai Government strengthened the food safety control programmes for food and agricultural commodities (Yamprayoon and Sukhumparnich, 2010). Furthermore, the policy for food safety and good traceability system is linked with the "Kitchen of the World" initiative of Thailand supported by government and private entities (CPF, 2012; Thai Union Group, 2014). The Thai Government through the relevant ministries adopted this as a policy, recognising their responsibility and mandate to take the lead in establishing and implementing regulatory mechanisms for the industry to thrive under international pressure (Yamprayoon and Sukhumparnich, 2010). As a result, for the shrimp industry initially, registrations, movement documents and checking as part of the traceability systems have been put in place, with the private sector cooperating and even going beyond regulatory requirements by engaging with foreign buyers and consumers as well as 3rd party certifiers (Yamprayoon and Sukhumparnich, 2010).

Even though it has been reported that local communities and local governments can be effective regulators of aquaculture activities such as shrimp farming, and that external certification mechanisms are detached due to its non-participatory approach in its formulation (Vandergeest, 2007), there is still a lack of awareness and trust among buyers and consumers in importing countries of local regulating mechanisms which are not endorsed by global or 3rd party institutions and companies (Satapornvanit et al., 2011).

A key element of experience of the Thai aquaculture industry has been the success of domesticated broodstock, in the case *of L. vannamei*, where disease management was found to be easier (Lebel et al. 2010) than obtaining broodstock from the wild. So in the case of *M. rosenbergii* broodstock, the industry is being cautious in bringing in broodstock from other countries such as Bangladesh (Wara Taparhudee, personal communication, 2011). It is ironic that since in the early 1990s, Thailand had given a number of broodstock to Bangladesh where freshwater prawn is also a native species there (New 2010).

The value of interactions among different stakeholders, through the benefits gained by exchange of ideas and networking was confirmed in a stakeholder meeting held to triangulate early research findings about the sector (Satapornvanit et al. 2011). Vertical and horizontal business relations between the producers and different levels of sellers and buyers of their products, i.e. input providers, processors, exporters and overseas buyers are crucial for business negotiations and building trust (Lebel et al. 2009).

The Thai aquaculture industry led by actors within the shrimp industry has sought to regain the trust of buyers in its product quality through the efforts of the Government, producers, processors and other stakeholders in compliance of food safety regulations and standards. However, many are still of the opinion that local food safety standards are unknown to outside buyers and consumers, thus the producers have to comply with global albeit more expensive certification standards. Small-scale producers could be at a disadvantage in terms of compliance to these standards due to their insufficient economic and technical capability (Wilkings, 2012). The Thai DoF has set-up a unit called the Aquaculture Development and Certification Center (ADCC), which will provide certification according to international standards ISO/IEC Guide 65 accreditation, giving an alternative certification to farmers which is less complex (DOF, 2013c).

3.7. Seafood intrinsic qualities and issues for domestic and export

According to the Economics Division Report (Economics-DOF, 2011), the culture of striped catfish in Thailand is big business but the whitish-yellow flesh is not acceptable for the export market. In the domestic market, it is sold in both wet markets and supermarkets, as whole fish or cut into steaks, as well as being processed into fish balls. Interestingly there are frozen Pangasius fillets and steaks from Vietnam which are sold in the supermarkets as well. The same Economics Division Report (Economics-DOF, 2011) suggested that DOF should research more on how to achieve white flesh and come up with a feed formulation to produce white fish flesh. Considering that it is already known how to achieve white fish flesh through feeds and intensive water exchange (Vietnam) (Phan et al., 2009), it may be more beneficial to conduct a research on how to achieve white flesh under conditions of limited water exchange since this is more likely the issue in Thailand or to enhance ways to add value through post-harvest processing to the current quality of farmed catfish. From the same report (Economics-DOF, 2011) it was stated that smoked Pangasius is an indigenous product in Thailand that has not been promoted and that strategies to add value in this and other ways require development.

The key question about Pangasius in Thailand is why there is a lack of interest or progress toward an export industry, given that historically it was considered a high value commodity from the wild and produced in cages, then became a low value farmed species in ponds. Pond culture of Pangasius in peri-urban areas utilised agro-industrial by products and waste food from eating establishments, which led to lower quality flesh which fetched lower prices than other fish species in the market (Payooha, 2002). Reasons for its slow uptake for global market production include a limited area for intensification due to cost as ponds have to be dug deeper, and more resources required for feeding and water usage. In the Vietnamese experience, water is important in Pangasius farming, in terms of the quantity and efficiency of use (Phan et al., 2011). Thailand has a large number of water bodies but there are other competing activities to utilise available water resources (Falvey, 2000), and factor in the changes in weather patterns leading to droughts and floods, water has become a much more valuable resource. So this will be a challenge especially for Pangasius production systems, as well as for the whole aquaculture industry, to use water efficiently to produce better quality seafood.

Creating a niche market such as organic Pangasius may have potential but alternative strategies include further development of value-added products through Thailand's innovative and well developed seafood processing industry.

Macrobrachium rosenbergii was traditionally known as king prawn in Thailand, especially because of their larger size (500 g) compared with other river prawns (Sukphisit 2011). Freshwater prawns were considered superior to marine shrimp for many Thai dishes and their popularity keeps local market demand strong. The head which has a high fat content is sought after for its creamy taste when cooked in a soup. Thus the whole prawn is eaten, and with the head nearly 50% of the whole body size it is not economically viable as an export product where heads are usually removed prior to processing.

> *"The qualities that give river prawns their reputation as the best of the best are their firm meat and delicate flavour with no fishy odour. The head is filled with the orange prawn fat that is highly esteemed in Thai cuisine for its delectable flavour. Its aroma is said to have a stimulating effect on the appetite." – Suthon Sukphisit, Simply Irresistible: Jumbo Prawns & Shrimps, http://www.TATnews.org* (Sukphisit, 2011).

The high overall product value domestically, compared to its processed value for export, is a key reason for the lack of export development despite having been cultured in

Thailand for more than 30 years. Prices for prawn compared to shrimp remain highly differentiated locally. In 2012, wholesale market price of live freshwater giant prawn ranged from 235 Baht/kg (>20pcs/kg) to 418 Baht/kg (13-14 pcs/kg), whereas for chilled product, the wholesale market price ranged from 135 Baht/kg (25-40 pcs/kg) to 304 Baht/kg (13-14 pcs/kg) (DOF-Economics, 2013). In terms of unit area, however the value of shrimp is almost three times higher than prawn (US$ 4,407.20/rai versus US$1,511.50/rai, 2008 data, 1 rai=1600 m^2) reflecting the much higher intensity of production in the former and explaining its popularity among farmers. These figures are based on the total value of production of each species and the total production area (DOF, 2010c).

With more than 80% of production of freshwater giant prawn sold in the domestic market and the potential for exports, the production is not enough to meet the demand for both domestic and export markets. The stagnation in growth could be due to the production sector facing problems such as genetic deterioration leading to slow growth and disease, as well as factors related to techniques and economics (Chareontawee and Poompuang, 2007; New, 2005; Schwantes et al., 2009; Whangchai et al., 2007). The cannibalistic nature of prawns is certainly a limitation to intensification with a higher stocking density so it will be more likely to be in lower density monoculture and/or polyculture systems.

There have been reports on freshwater prawn exports, such as those by Singholka et al. (1980) and (FAO, 2014). Exports were increasing from 2002 (2,099 t valued at 514 M Baht) to 2006 (8,087 t valued at 1,712 M baht) then it decreased in 2007 (2,099 t valued at 486 M Baht) and 2008 (1,837 t valued at 392 M Baht) and increased slightly in 2009

(2,262 t valued at 519 M Baht) (Figure 3.13). The major importing countries are USA, South Korea and China, although it is exported to nearly 30 countries (Figure 3.17).

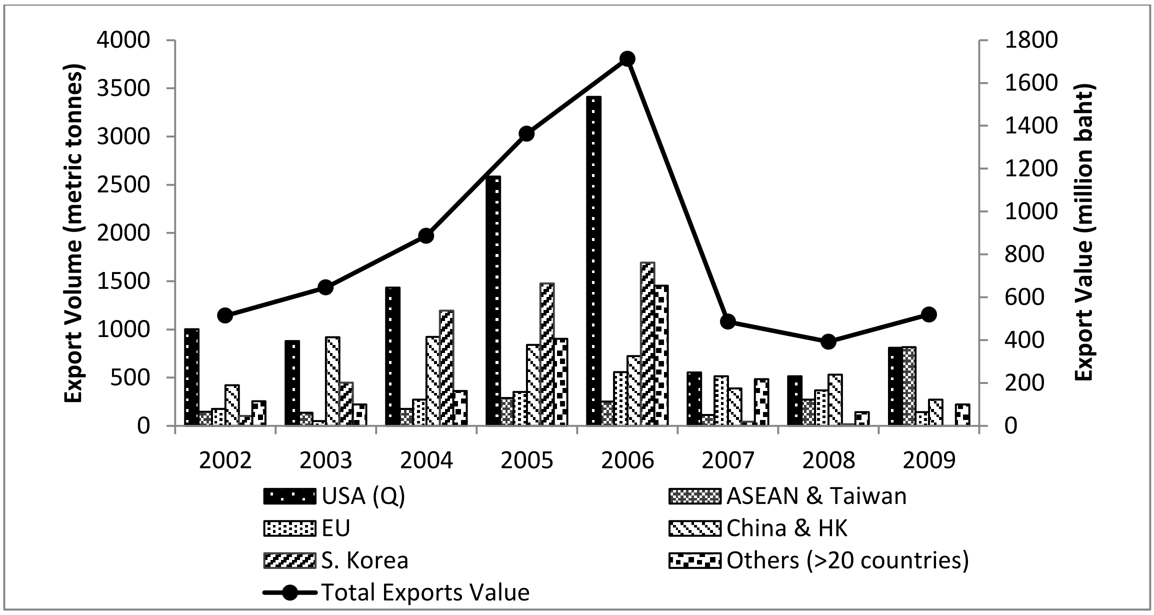

Figure 3.17 Freshwater prawn exported to several countries and value

Source: DOF (2010b)

Thailand produced large quantities of black tiger shrimp (*Penaeus monodon*) in 1998, when the area for shrimp production increased by 21% from the previous year, and production increased by 90%, although the industry was well established long before this. Based on DOF statistics (DOF, 2009), 99.2% (nearly 30,000 farms) of shrimp produced in Thailand are grown in intensive operations, and the remaining 0.78% in semi-intensive operations (Table 3.7). Extensive shrimp production ceased to be practiced after 2004. Super-intensive systems have recently been added by the industry to denote those highly intensive systems mainly in concrete tanks which utilize bacterial floc for feed and water quality maintenance (Shrimp News International, 2010), as well as automation of feeding and water quality monitoring.

Table 3. 7 Definition of shrimp farming systems

System	Definition
Extensive	Traditional allowing shrimp to come from natural flow into the pond, bigger pond sizes, more than 25 rai/pond, no inputs added, no management
Semi-intensive	Similar to extensive but with added inputs, ponds sizes 10-25 rai/pond, PLs may come from hatcheries stocked at < 40,000 PL/rai, with feeding, with or without aeration
Intensive	Use new/modern techniques/technologies, with management of water, temperature and disease prevention, well-managed systems, pond sized from 1-10 rai/pond, all PLs from hatcheries, stocking > 40,000 PLs/rai, feeding 3-5x/day, day to day or intense management, with aerator at 1 unit/1-2 rai of water area
Super intensive	Similar to intensive in terms of management but in concrete tanks located indoor using bacterial floc, and more culture cycles

Source: DOF (2009); Shrimp News International (2010)

Shrimp farming has high capital and operation costs especially those related to innovation and compliance to export certification standards. Farmers mentioned about the significant recurrent costs for auditing and testing required to maintain certification status. FAO (2007) also reported that producers had to shoulder higher costs for some certification schemes, although there were no significant benefits in terms of premium prices especially for small-scale producers. Input costs such as for seed, feed, substances, labour and energy are also increasing which challenges the farmers to complete production to get returns on their investments (information from scoping survey). Despite all these, shrimp farming and related businesses i.e. seed, feed, processing mainly, remain lucrative although the benefits received by each actor could vary. Thailand continues to produce, even to exceed what it could possibly export (based on what EU can import), prompting the Thai Shrimp Association to inform producers to reduce production for certain years (Ekapoj Yodpinij, Surat Thani Shrimp Club, personal communication, 2010). However, farmers were aware of the demand situation especially the growing demand from China for more shrimp, and farmers would continue to produce to meet the requirements from the processing and export companies (Banjong Nissapavanich, Eastern Thai Farmers' Association, personal communication, 2010). Furthermore, the capacity of Thailand to produce shrimp was 500,00 T which was already achieved, but farmers would continue to produce despite this as they thought they could earn more. Thus it was suggested that DoF should legislate a law regarding production ceilings and regulate the implementation (B. Nissapavanich, personal communication, 2010).

Tilapia has been regarded as promising to become the second most important aquaculture species in Thailand next to shrimp (Bhujel & Woollard 2011). Although it is now the top producing freshwater species with nearly 300,000 t annual production, a mere 10 % is exported (DOF, 2010a; FAO-FishStatJ, 2011). The expansion of tilapia culture (in terms of area coverage and increased production) could be hindered by several issues facing the producers. These issues include high production costs, low market price, off-flavour, problems with communal water bodies, expensive formulated feeds, low quality supplementary feeds, seed quality, genetic quality of broodstock, and production of drug residue-free fish for export (Bhujel & Woollard 2011).

The Thai government together with other organisations has been promoting exports of tilapia by giving information to farmers on market trends, demands, requirements and what Thailand has to do to compete globally. The main markets for Thai tilapia depend on the product form. For frozen fillet, the USA and Asia are the main markets, whereas for frozen whole fish, the main markets are the EU and the Middle East (Bamreurak, 2010). USA remains the most important export market for frozen fillet with 20% of tilapia exports (50% of total exports value of tilapia) going there in 2009. In 2011, Grobest, the biggest tilapia producer, processor and exporter, exported 1,400 MT tilapia fillet, which was 65% of the total fillet exports (2,140.65 MT, TFFA, 2014) from Thailand. Even with this amount, Grobest was not able to meet the orders from their customers, mainly from the USA, as demand was higher than supply.

EU states (mainly France, Netherlands and UK) prefer whole frozen fish, with 40% of total exports (31% of total value). The other important markets are the Middle East (Saudi Arabia and UAE for whole frozen fish) and Asia (Japan, Taiwan and Philippines for frozen fillet). In EU, the trend is to import more tilapia because it is popular with consumers. Due to the global economic crisis, tilapia's cheaper price can provide them with protein from a white flesh fish and good taste, although growth was slow possibly because of the rapid takeover of the same market by Pangasius.

Table 3.8 summarises the strengths and weaknesses of tilapia industry in Thailand which could be considered as potential or hindrances, respectively, in promoting exportation, based on the perspective of Bamreurak (2010), owner of a processing plant for tilapia, freshwater prawns and fruit.

Table 3. 8 Strengths and weaknesses of Thailand tilapia for export

Strengths	Weaknesses
Global recognition of good quality standards of Thai tilapia.	• Broodstock has problems with health and quality. • Stock growth is slow, with disease outbreaks. • Research development is limited.
Government support for production (technical know-how) and export promotion (marketing).	Higher production costs esp. price of feed but low selling price
Global consumption and demand are increasing.	Most producers are small scale farmers, so they might not be commercially stable

Source: Bamreurak, 2010

Despite the weaknesses pointed out in Table 3.8 that are hindrances to exports, these are the perceptions from the processing and exporter side. Farmers continue to produce tilapia for the local markets, mainly due to market price, which they can sell higher than selling to the processing plants. Disease, water quality, low price and high input costs are the common problems faced by the producers which need to be addressed first.

3.8. Stakeholder analysis and roles of intermediaries

In order to understand the existing situation in the aquaculture industry and to know the people or actors who are involved in every process, a stakeholder analysis is a critical initial step. Stakeholder analysis aims to recognize people or groups who can have impact on a certain issue or phenomenon (Reed et al., 2009) and be affected by whatever is done on this, explain aspects of an issue coming out of an act or a resolution, and arranges the order of influences of those involved on any decision made related to the issue (Reed et al., 2009). This also includes the social networks among stakeholders (Prell et al., 2008), which could influence perceptions and decision-making, especially relevant to sustainability of their operations and interactions with other actors in the value chain.

Stakeholder analyses take different forms and are being used by different groups (Reed et al. 2009), having origins in the business sector, but now being used in other disciplines such as natural resources management, and development fields.

Stakeholders in the aquaculture value chain were classified according to their role or stake in the aquaculture industry, from materials and service provision, production, collecting, processing, trading, and regulatory. There are many levels of role overlaps, either simple for individuals but more complex for corporations especially with vertical integration. Stakeholders may be both primary and secondary in some of these cases (Table 3.9).

Table 3. 9 Stakeholder analysis matrix (aquaculture global value chain in Thailand)

Stakeholder	Stake/role in the industry	Stakeholder classification	
		Primary	Secondary
Inputs/service provider	Produces and/or sells inputs and provide services as required, such as feed, health & feed supplements, water and soil conditioners, probiotics, equipment, technical and professional services. Some companies have contract agreements with producers to provide inputs then buy back the production at an agreed price.	✓	
Broodstock provider	Provides broodstock to seed producer Conducts breeding programme to improve stock	✓	
Seed producer	Provides seed for growout producer	✓	
Grow-out producer	Provides products for local market and/or raw materials to processors for export Produces according to requirements of buyers, such as standards/certifications There are >25,000 shrimp and >255,000 tilapia farming operations, mainly individual farms but there are also family and corporate operations.	✓	
Farm worker/ staff/	Employed by the farmer/operator/farm	✓	

Stakeholder	Stake/role in the industry	Stakeholder classification	
		Primary	Secondary
employee	owner/company. Roles are according to the scale of operation of the farm, for e.g. large/medium-scale farms will hire managers who oversee the whole farm operations, technicians for laboratories/ heads of zones/machineries, administrative staff and pond workers per pond; small-scale farms will have a married couple as workers for the whole farm		
Collector/harvester	Specialised group of people who provide their services to the producers at harvest time, bringing their own harvesting equipment. Compensation depends on negotiation with farmers.	✓	
Trader/ middlemen/ women/local buyer/broker/ distributor	Buys directly from farmer at farm-gate Negotiates for the selling price of product Purchases products from producers Sells products to local wholesalers or retailers or processors Finds producers who can supply as per market demands	✓	
Trader/buyer/ seller	Buys from a collector, trader, wholesaler or retailer, or an auctioneer in an auction market		✓
	Purchases products directly from producers or from brokers/auction markets	✓	
Processor/ exporter	May have contract agreements with producers Processes products according to customer/ importer requirements Knows market information, demand, requirements and communicates information to producers and brokers Facilitates or funds 3rd party certifications for producers		
Importer	Provides information to processors/ exporters regarding consumer/market requirements and preferences	✓	
Provincial Fisheries Officer	Provides information on government policies and technical training of producers Conducts registration of farms Issues movement documents to seed and growout producers		✓

Stakeholder	Stake/role in the industry	Stakeholder classification	
		Primary	Secondary
	Checks farms and provides this information to Department of Fisheries		
Department of Fisheries Officers	Check farms and conduct sampling of fish, shrimp, feed Issue GAP and CoC certifications		✓
Department of Fisheries Export Inspector/ quality checker	Analyses samples of feed and products to check for presence of banned substances Provides health certificates prior to export Approves products to be exported		✓
Other related government organisations	For pollution control, labour issues, security and safety, water supply, business, local administration, etc.		✓
Producers'/ Processors' Organisations	Provide information to members/ community on technical and market requirements, prices and trends Monitor supply and demand and inform producer community as to level of production for each year Negotiate with input suppliers especially feed providers Negotiate with buyers/ brokers regarding farm gate prices		✓
Ice producer	Provides ice to harvesters, buyers, and processors for transporting of products		✓
Technical consultant	Provides technical support and advices Conducts research		✓
Certifier/ auditor	Conducts assessment and audits of farms and processing plants as per local or international guidelines and standards		✓
Retailers/ Sellers	Domestic and foreign, communicates market requirements to importers, processors and sometimes may communicate directly with the producers May even create a market for a product they want to sell	✓	
Consumer	Domestic and foreign	✓	

Primary stakeholders are those directly involved in the production, processing and trade (export) of seafood products. In an industry such as aquaculture in Thailand, there are situations when a certain stakeholder has more than one role, such as in vertically integrated operations, when the stakeholder (a company as the legal entity) operates a hatchery to produce seed for their own farm, and also sells the seed to others, then produces own feed, and markets the feed as well. Another instance will be a technical person who is employed by a formal institution or has other business concerns, and then also has a hatchery or a grow-out farm or a shop which sells aquaculture inputs. There are many levels of role overlaps, either simple for individuals but more complex or complete for corporations; stakeholders may be both primary or secondary in some of these cases. The primary stakeholders in the production sector especially in the farming aspect include not only the owners or operators but equally important are the farm staff/employees and workers.

Traders or middlemen/women are important stakeholders as they link the producers with the markets for the products. A review on agricultural middlemen in Thailand by Rigg (1986) described the important role played by middlemen, especially Chinese traders since the middle of the 17th century in Thailand, in marketing and providing opportunities for farm producers to sell their products. To the present time, traders/middlemen/ women albeit in various forms continue to play an important role, as primary and secondary stakeholders in the aquaculture business.

Retailers and consumers (domestic and foreign) are classified as primary stakeholders, as their requirements drive market demand for the seafood products, which in turn inform the other stakeholders on what and how much to produce at what level of quality. In this case they are stakeholders who are important even though they are not directly involved in the actions of production and processing and trading but their preferences on the type of products are important information to both the primary and secondary producers.

Secondary stakeholders are those not directly involved in the production and processing of aquatic products, but their involvement is more on providing services as well as regulatory, advisory and monitoring, to ensure processes adhere to good, legal and safe practices. Due to the need for transparent processes for the sustainability of international trade in seafood to be possible, there are governance mechanisms put in place to achieve these.

Whilst there are a number of institutional agents impacting the aquaculture trade industry especially in seafood exports, the Thai Department of Fisheries obviously plays a major role, and all seafood exports have to pass through their checking and certification system. This was also mentioned by Belton & Little (2008) in that amidst all the institutional interventions for aquaculture development, the prominence of DOF as one of the main government executing agencies was obvious, as it spearheaded the dissemination and adoption of several techniques to improve culture systems as well as in capacity building. In addition, DOF also handled or spearheaded all the government initiatives on national standards setting and negotiating with international standards fora. Other institutions such as the Asian Development Bank (ADB, 1996) and the BAAC or Bank of Agriculture and Agricultural Cooperatives (BAAC, 2009; Chaitrong, 2008; Klungboonkrong, 1991) helped to promote aquaculture by providing funding and loans to government fisheries institutions, farmers and cooperatives. The other point of relevance was that the rapid expansion of shrimp although initially short-lived supported development of an 'infrastructure' which supported other species to develop subsequently (Belton & Little 2008).

With the responsibilities of DOF from policy formulation, enforcement, implementation and actual involvement in the industry until exportation, stakeholders from farmers, processors and exporters expect DOF to give more support to them in order for their business to become more stable (information based on key informant interviews during Scoping survey, 2010).

Subsidies by the government through the financial institutions such as BAAC have helped in aquaculture development, by providing loans to farmers, who needed financial help not only to their fish system but they could also have other farming systems such as rice and other crops. However, more is required as farmers demand assistance with selling price of their products and the increasing costs of inputs. The government also provides financial packages to those affected by natural calamities such as flooding but farmers have to register with the DOF to have the right to claim for damages. For e.g., after the 2011 flood, the government provided monetary compensation to farmers who lost their crops, with fish farmers receiving 4,225 Baht/rai, and shrimp/crab farmers receiving 10,920 Baht/rai but they could claim up to 5 rai; while fish cage farmers could claim 315 Baht/m^2 of cage up to 8 m^2 (The World Bank, 2012).

In 2009, the Food and Agriculture Organization of the UN and the DOF organized a Workshop on the Options for a Potential Insurance Scheme for Aquaculture in Thailand (FAO, 2010). The consensus in the workshop was that the need for aquaculture insurance was recognized and the stakeholders supported the setting up of a mutual fund for the Thai shrimp farming industry, which should include small and medium-scale shrimp farmers including local feed distributors and hatchery operators. The insurance will cover the following risks: natural perils damaging the stock, diseases, other perils such as theft and mechanical failure, and price fluctuations. However there was no legal framework yet at the time (year 2009) and it was suggested that government assistance should be given to address this matter.

A number of local, regional and international organisations and institutions have also contributed to the development of aquaculture especially in providing venues for information and knowledge exchange among stakeholders. Specifically the Network of Aquaculture Centers in Asia and the Pacific (NACA) whose headquarters are in Bangkok has been visible in this role, as well as in promoting sustainable aquaculture, and providing academic, research and institutional support to various stakeholders not only in Thailand but in the region and beyond.

3.9. Conclusions

Looking at the four farmed aquatic species, not all of them have export potential. The main issue for the viability as an export product is the capacity to meet international standards and consumer requirements. This will be a challenge for Pangasius as to the way it is cultured in Thailand, whereas the physical characteristics of freshwater prawn will be a constraint for frozen product forms. Both these species are meeting domestic needs but might not be able to meet export requirements.

Penaeid shrimp culture has a comparative advantage over the other three species in terms of export trade due to its high global demand, translating itself to a premium price for producers. The recent developments in consumer requirements have changed the way shrimp is grown in Thailand in recent years, and stakeholders (producers, processors, traders, exporters) now have become more aware of sustainable and ethical principles in their operations. Adherence to local and foreign standards and certification is now considered a must for those who desire to continue meeting the demand for the export market.

Thailand may not have a comparative advantage with Pangasius in terms of developing an export trade as production cost will be high and there is no assurance that the product can be sold at a premium price so there is wariness to invest in upgrading Pangasius production systems. In addition, Thailand will not be able to compete with Vietnam, since the Vietnamese Pangasius production systems require high quantities of water for water exchange (Phan, 2014). However market creation can be initiated capitalising on the historical significance of Pangasius to appeal to Thai consumers, for the domestic markets, in order to compete with the growing Pangasius imports into Thailand.

Producing Pangasius for a niche market, such as organic Pangasius, may have potential for export but only through a vertically integrated operation, and if sourcing out from other producers, it should be through contract growing (seed, feed and processing by the organic company) so there is close monitoring of production to ensure adherence to organic standards.

As freshwater prawn is so much a part of the Thai cuisine, domestic demand will remain high. Although, the potential for export remains high especially for live exports to neighbouring countries but volume production of processed prawn seems to be limited by vulnerability to diseases and cannibalism at higher densities and higher costs of production than competitors.

Polyculture systems in freshwater areas, such as tilapia with finfish, tilapia with white shrimp, or freshwater prawn with white shrimp, may be limited to smallholder systems. Production from these systems may be acceptable for export if farms are registered into the traceability system of the Government and be certified locally. Tilapia industry should look more into developing high quality, SPF broodstock to strengthen the stock for grow-out, that is fast growing and disease resistant. In addition, development of low cost, high quality feed for improved feed efficiency is necessary resulting in increased production per unit area.

With China facing constraints in terms of labour shortage in the processing sector, and its strict control of migrant labour, China's capacity to process and export tilapia at the current rate would eventually be affected (Zhang, 2014). Thailand could then use this as an opportunity for Thailand to expand quality tilapia production to meet export demands but there is a need to enforce good labour practices along the value chain.

Producers and other value chain actors could benefit from training to develop their entrepreneurial skills as fish farming or other related activities is a business enterprise, at the same time strengthen campaigns for environmental stability and social responsibility, which will eventually give an edge to production and marketing. This role could be taken up by the producer clubs/associations as well as the media which are effective in disseminating information to the public.

With the importance of shrimp in seafood export trade, and the strong potential to increase exports of tilapia, it is then necessary to look into more detail at the production practices of these two species. As global standards and certification schemes are important entry points for products to be traded in the export markets, the following chapters will focus on how shrimp and tilapia production systems operated to fulfill market demands. The following chapters, 4 and 5, will focus on the technical and environmental aspects of shrimp and tilapia production practices, and the human resources aspects of shrimp production, respectively.

4. CHAPTER 4 Shrimp and tilapia farming in Thailand: fulfilling domestic and global market needs

4.1. Introduction

Shrimp and tilapia were described as the two aquaculture species which have developed, or have potential to develop, respectively, significant to global trade. The dynamism of the shrimp and tilapia sectors are worth understanding in greater depth, in relation to what types of farms are they being produced and the diverse production systems which farmers are employing to be able to meet market demand, both locally and globally. This chapter then focuses on the current practices and status of farming these species vis-à-vis the criteria regarding farm management in the globally accepted certifications and standards.

Certification and standards in global trade of food products, of which seafood is a major commodity, has grown in importance, evidenced by the multiple certifications and standards emerging, both location-specific and global (Washington and Ababouch, 2011). Some examples of these standards and certification schemes which Thai seafood producers and exporters have to follow if they wanted to export food products to various countries include GlobalGAP (Europe), Naturland (Europe), ThaiGAP (Europe, USA), Global Aquaculture Alliance/Best Aquaculture Practices (USA), Safe Quality Food (global), and the British Retail Consortium (global) (Washington and Ababouch, 2011). Little is known about the number of shrimp and tilapia farms in Thailand operating according to different global standards and certifications, although some such as GAA/BAP regularly announces the names of farms they certify.

The Thai DoF has the local registration and certification mechanisms for the traceability system of products for export, such as mainly for shrimp, followed by tilapia, and planning to implement with other species (Yamprayoon and Sukhumparnich, 2010). Globally, only 4.6% of aquaculture production is certified (Bush et al. 2013). The majority of shrimp farms exporting their products operate to comply with these standards in order to compete in the export market, but there are farms which operate to produce for any market (local or global if certifications are not required). In addition, farms change their mode of operation due to market demands and standards requirements, or there are other reasons driving these changes.

The global standards and certifications covered in this chapter refer only to the ones issues by the Global Aquaculture Alliance/Best Aquaculture Practices (GAA-BAP, 2013), GlobalGAP for shrimp and tilapia (GlobalGAP, 2012), and the Aquaculture Stewardship Council (ASC) for tilapia (ASC, 2012). Although these standards and certifications are accepted by the industry and are being used as a way to achieve sustainability, they may still have limitations in terms of measuring the impacts of the external environment on the farms (Han and Immink, 2013).

4.2. Research hypothesis/questions

The research hypothesis is that the larger and more corporately managed farms are more capable of operating according to global standards and certifications, enabling them to participate more and compete in the export trade of seafood products. Conversely, smaller scale farms are likely to be excluded from global trade activities leading to discontinuance of their business because of an inability to comply with 3rd party standards. If the small scale farmers can continue in operation, their production will be geared towards competing only in domestic or international markets which do not require strict standards. However, as mentioned earlier, certification and standards are growing in importance as well as in geographical distribution which means that there is a possibility that those countries not requiring certified products now will require them in the future (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification, 2012).

Thailand currently exports seafood especially shrimp not only to countries that require 3rd party certification (for e.g. USA, Europe, Canada, Australia and Japan), but also to other countries such as those within Asia and the Middle East which do not really require 3rd party certification. Likewise, some requirements for export products might be easier to comply with than others, depending on the resource base, technical capacity of farmers, and scale of the farm operations. In addition, changes occurring in farm operations in recent years may be influenced by other factors that may be of local importance.

The research work presented in this chapter was guided by the following research questions:

1. How do the farms measure against the major global standards and certifications on environmental and farm management aspects to meet market needs?
2. How did the farms vary in the changes in their operations in recent years?
    a. How different were the reasons for changes among farms of different scales?

b. Which farm scale was most likely to change or stop farming?

4.3. Scope

The data presented here came from the responses of shrimp and tilapia farm owners/operators and/or managers of the sampled farms during the Integrated Farm Surveys (IFS) conducted in Thailand from December 2010 to March 2011. Farm owners are individuals who have legal ownership of the farm, can be an individual or a company (if registered as a Thai business), can be co-owners in the case of husband and wife, or he/she can be the legal lessor of the farm in the case of the farm being leased from a legal owner. These owners may or may not be the managers/operators of their farms, especially for small and medium scale farms. Large/corporate farms will always have a manager employed.

Farm managers are those who are hired or employed by an individual farm owner or a corporate farm. He or she may or may not be a shareholder in the company.

Data on trends and changes came from both the IFS (based on respondents' recall) and the phone transition survey conducted in March to May 2013.

4.4. Materials and Methods

4.4.1. Integrated Farm Survey (2010-2011)

This study involved a survey of 206 shrimp and 199 tilapia farmers from the major production areas in Thailand identified during a scoping stage (Table 4.1). The sampling methods including selection of study areas and farmers are described in Chapter 2. The

IFS was conducted according to the methodology described in Chapter 2 during the period December 2010 to March 2011. The integrated farm survey (IFS) used a structured questionnaire (Appendix 4) to obtain information on demographics, as well as the technical, social and economic aspects of farm operations. Preparation for the survey occurred from July to November 2010, which involved survey instrument preparation, deliberation and revision, piloting of surveys, contacting and procuring permissions from respondents, and training of enumerators. A project t-shirt was provided to each respondent as a token of appreciation for their willingness to participate in the survey.

The information from the IFS provided the data for the current practices of shrimp and tilapia farming during 2010-2011, which formed the basis to address the research questions on level of compliance to certification standards as well as trends and changes.

Table 4. 1 Study sites with corresponding number of farms by scale

Region	Province	Species	Small	Medium	Large	Total
East	Chachoengsao	Shrimp	56	13	-	69
		Tilapia (pond)	26	22	-	48
	Chanthaburi	Shrimp	32	11	4	47
Central	Nakhon Pathom	Tilapia (pond)	54	9	1	64
	Petchburi	Tilapia (pond)	39	10	-	49
	Suphanburi	Tilapia (cage)	38[1]	-	-	38
South	Surat Thani	Shrimp	42	36	4	82
	Nakhon Si Thammarat	Shrimp	-	-	1	1
	Satun	Shrimp	-	-	2	2
	Songkhla	Shrimp	-	-	5	5
	Total	Shrimp	130	60	16	206
		Tilapia	157	41	1	199

[1] Tilapia cage farms were not subjected to the same scale criteria as pond farms.

In the IFS questionnaire, a number of questions related to changes over the last 5 years covering from 2005/2006 to 2010/2011 were also asked, which gave the opportunity for the respondents to share by recall the trends they have experienced and observed on certain topics/issues such as land holding and use patterns, farm infrastructure, aquaculture production patterns, labour patterns, feed management, water management and chemical and substance use and management.

The team of survey enumerators was composed of 9 females and 2 males, with 3 of the females and 1 male involved since the start of the survey until it was completed (Appendix 1). All the interviews were conducted in the Thai language.

4.4.2. Transition survey (2013)

Recent changes in shrimp farming operations and respondents' situation were assessed using a telephone survey between 7 and 15 March 2013. Respondents from the 2010-2011 survey who signified their willingness to participate in further research activities were contacted by phone in February 2013 to inform them of the transition survey, and to explain the reasons for conducting such survey.

Out of the 206 shrimp farm respondents during IFS in 2010-2011, 160 (78%) indicated that they were willing to participate in future research activities of the project (Table 4.2). From this 160, only 158 could be contacted by phone. An additional 7 respondents were contacted, composed of 6 who did not respond during IFS if they were willing or not to participate in future research, and 1 who responded No but was contacted by mistake. Thus a total of 165 persons were contacted for the telephone survey.

Table 4. 2 Transition survey sample design

Species	Total IFS respondents (2010-2011)	Willing to participate in further research	Contacted for transition survey (2013)	Responded to phone survey (2013)
Shrimp	206	160	165	117
Tilapia	199	166	131*	81*

*Burana-osod et al. (2013)

Out of these 165 potential respondents, only 117 (71%) responded to the phone survey. Whereas 8% did not answer the phone, 5% had no telephone number recorded in the database, and the remaining 16% had various reasons for not responding to the phone survey (Figure 4.1).

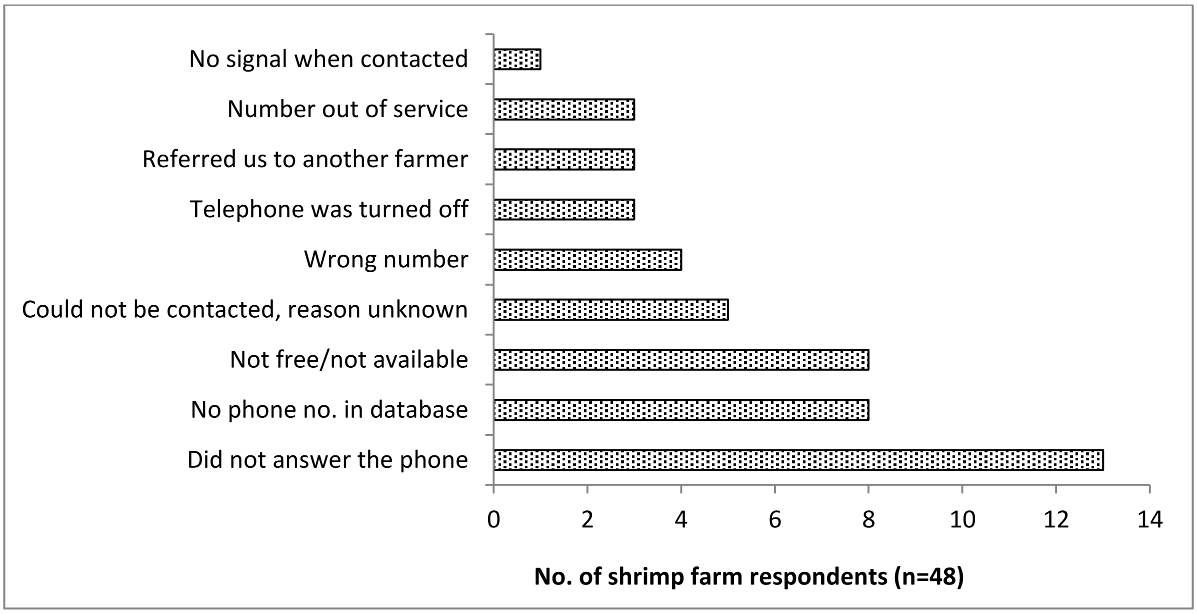

Figure 4.1 Reasons for not responding to shrimp phone transition survey

The transition survey questionnaires (for both shrimp and tilapia) were piloted during February 2013 with farmers in Surat Thani (10 shrimp) and Prachinburi (2 tilapia). I was responsible for shrimp survey while another student was responsible to implement the tilapia survey.

The shrimp telephone survey took about 30 to 45 minutes per person, depending on how long the respondent responded to the questions, as well as the clarification needed by enumerators, if any. For most, the interviews took place during the 2nd or 3rd calls, since the first call was to inform about the interview, and to make an appointment. There were five female enumerators who conducted the interviews. These enumerators were trained on the survey instruments prior to the interviews to explain and familiarize themselves with the questions (Appendix 5).

For tilapia farming changes, some secondary data obtained from the transition survey conducted by Burana-osod et al. (2013) is used for comparison purposes.

4.4.3. Data analysis

Data from the IFS were inputted into pre-designed database in MS Access (Murray et al., 2011). The independent variables were species and farm scale. Dependent variables are those that correspond to the three major certification standards, which have been categorized for presentation in this chapter, were legal aspects, environmental management and farm management. It has to be noted that the data from the IFS did not respond to all the criteria in the standards thus this is not a comprehensive review of the status of farms re: overall compliance but only looking at how farms comply with the selected aspects mentioned above.

The human resources, worker safety and welfare aspects will be discussed in Chapter 5.

As the sample design was unbalanced (e.g. far fewer large than small or medium farms), it was necessary to present proportions rather than 'raw' frequencies or percentages i.e. using total numbers of respondents in any particular combination of independent factors in cross-tabulation or pivot chart as the denominators Thus weighting of survey data was applied when necessary in order to reduce misrepresentations and biases caused by unbalanced sample sizes. Each farm scale sample size was assigned weights to be used as denominators, using the following formula: 1/n x 100 or 100/n, where n is the number of respondents for each scale, for a particular response. It has to be noted that n values varied because not everybody in the sample responded to all the questions, i.e. there were some questions wherein a number of respondents did not provide information, either because it was not applicable, or they were not willing to disclose the information, or the data was not collected.

In addition, as the survey was mainly focused on the farm system, no data outside the farm was collected. Thus for standards relating to external environmental or social impacts of farm activities, there were no external validation regarding conservation, biodiversity, measurements of water quality and eutrophication of the outside water body, and wildlife protection. However there were a few anecdotal references based on individual comments of the respondents.

Data from the shrimp transition phone surveys were inputted into excel sheets. The key independent variable was farm scale. Data analysis had both quantitative and qualitative elements, the latter which were coded prior to entry to allow for descriptive statistics and comparison.

Statistical analysis to determine differences among farm scales whenever necessary was conducted using SPSS version 21 and Minitab.

4.5. Results

4.5.1. Existing aquaculture certification and standards

There are three major 3rd party certification standards which are being followed by the aquaculture global trade market, summarised in Table 4.3.

Table 4.3 General information on the global aquaculture standards used in this study

Certification/standard	Certifying body	Species	Remarks
Best Aquaculture Practices Certification (BAP)	Global Aquaculture Alliance (GAA)	Shrimp, tilapia	Shrimp started in 2002 Tilapia started in 2008
GLOBALG.A.P. (Good Aquaculture Practices)	Global GAP	Shrimp, tilapia	Started in 2007
ASC Tilapia Standard	Aquaculture Stewardship Council (ASC) [1]	Tilapia	Started in 2012

[1]The ASC released the Shrimp Standard in March 2014 so it was not included here.

The various standards have similarities and differences. For the purposes of this chapter to present the data from field surveys, Table 4.4 presents the various criteria, under which the dependent variables were based, to be compared against the independent variables. The data in this chapter will be presented according to the points in Table 4.4

i.e. not all standards criteria were covered by this research as this was not to evaluate the standards *per se* but to assess the performance of farms in relation to the standards.

In Thailand, the Department of Fisheries (DoF) has implemented a number of local standards for farms to follow. Table 4.5 gives a brief description of these local standards. Among the shrimp farms surveyed during IFS, only 1 large and 2 medium shrimp farms had been certified by BAP/GAA (Table 4.6), i.e. as of 2011. A large majority (93%) of shrimp farms surveyed were certified under ThaiGAP offered by the Thai Department of Fisheries.

For tilapia farms surveyed, only 20% or 38 farms, comprising of 5 cage and 33 pond farms had ThaiGAP certification.

Table 4. 4 Summary of standards for shrimp and tilapia farms based on global certifiers for aquaculture that have relevance to this study.

STANDARDS FOR REQUIRED COMPLIANCE	GLOBAL STANDARDS/ CERTIFICATIONS			SPECIES	
	GAA/BAP	GlobalGAP	ASC	Shrimp	Tilapia
Legal aspects:					
Community: Property rights and regulatory compliance	/			/	/
Site management: Legislative framework & documentation		/		/	/
Obey the law & comply with all national & local regulations: Evidence of legal compliance			/	x	/
Environmental Management:					
Effluent Management	/			/	Ponds
Water usage and disposal		/		/	/
Water quality control	/				Cages
Pond sludge management	/			/	Ponds
Stocking sources, control of escapes	/			/	/
Predator control		/		/	/
Farm Management:					
Feed management, records, storage		/		/	/
Preference for better feed manufacturers			/	x	/
Fish welfare, management and husbandry: treatments, records, mortality		/		/	/
Fish health management			/	x	/
Drug and chemical management, storage	/	/	/	/	/
Biosecurity: Disease control	/			/	/
Traceability: Record-keeping requirement	/	/		/	/
Use resources responsibly: Energy use			/	x	/
Food safety: Harvest, packing and transport	/	/		/	x

Legend: / (covered); x (not covered). Source: ASC, 2012; GAA-BAP, 2013; GlobalGAP, 2012

Table 4. 5 Aquaculture standards by DoF, Thailand

Name	Details	Remarks
Safety level	Farms under this scheme should be registered and not use prohibited substances, have less detection of residues of antibiotic and hazardous substances, and have fry and fish movement documents.	Legal requirement for registered farms, produce usually sold to domestic markets only. Also applies to hatcheries.
Thailand Good Aquaculture Practices (ThaiGAP)	A more detailed guideline in addition to the safety level standard, covering issues related to location, management, inputs, fish health management, farm hygiene, harvesting and transportation, and data collection. Fishery Movement Documents from hatchery and growout are required for those exporting.	Required for all farms producing for export market. Certified for 2 years and renewable after acceptable audits. Also applies to hatcheries.
Code of Conduct (CoC)	Criteria to be followed includes: site selection, general farm management, stocking density, feed, shrimp health management, therapeutic agents and chemicals, effluent and sediments, harvest and transportation, social responsibility, farm grouping and training, data collection Also specific guidelines for hatcheries, nurseries, distributor, processors/ exporters. Fishery Movement Documents from hatchery and growout are required for those exporting.	Shrimp hatchery, growout, processing, input providers, marketing
GAP Plus	This is a certification given to those complying with the GAP plus additional other practices that are beneficial to product safety and quality such as the Sustainable Shrimp Programme (SSP) or recently ASEAN GAP.	Initially with shrimp farms

Source: NACA et al., 2007

Table 4. 6 Certified status of shrimp farms surveyed

Farm Scale	GAA/BAP	Thai Code of Conduct (CoC)	Thai GAP + SSP	ThaiGAP
Small	0	1	0	121
Medium	2	0	1	58
Large	1	8	2	12
Total	3	9	3	191

Source: Integrated farm survey, 2010-2011

4.5.2. Study sites

A total of 206 shrimp farms (130 small, 60 medium, 16 large) were surveyed, with 56% from the eastern region (Chanthaburi and Chacheongsao provinces), and the remaining 44% from the southern region, mainly from Surat Thani province, and a few large farms were sampled from further south in the provinces of Nakhon si Thammarat, Satun and Songkhla to ensure that the number of large farms in the survey was adequate (Figure 4.2). These two coastal regions (east and south) are the main shrimp producing areas in Thailand.

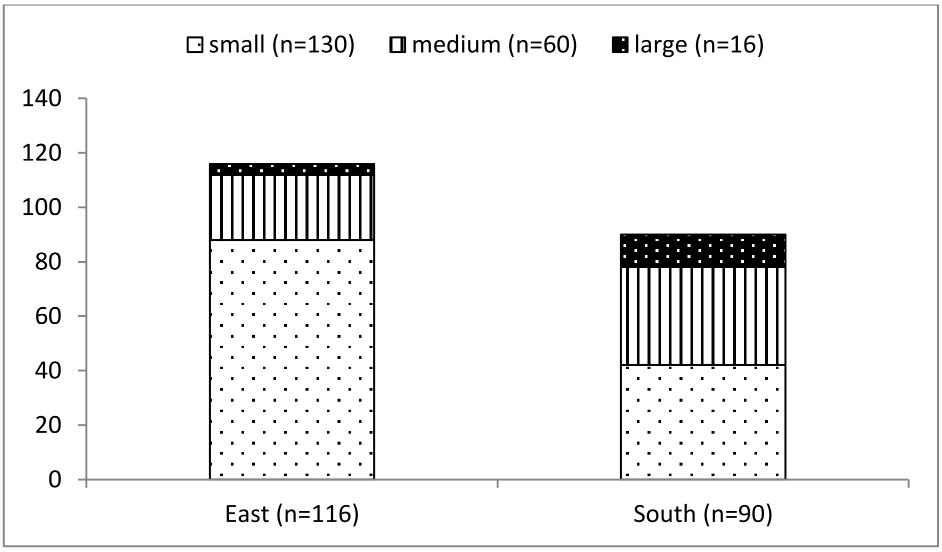

Figure 4.2 Location, scale and number of shrimp farms surveyed, 2010-2011

For tilapia, 199 farms (157 small, 41 medium, 1 large) in the provinces of Chachoengsao, Nakhon Pathom and Petchburi were surveyed for pond farms, while Suphanburi province was surveyed for cage farms (Figure 4.3). Regarding large tilapia farms i.e. corporately owned and registered as a business, there are very few in Thailand, and only one agreed to participate in the survey.

Cage farms in Suphanburi were all categorised as small-scale as no definite criteria could be set during farm sampling regarding scale of operation; farmers' perceptions were that cage farms were scale neutral with respect to labour as one person (usually the owner or household) could manage even up to 100 cages, and would just hire part-time workers for specific tasks such as harvesting.

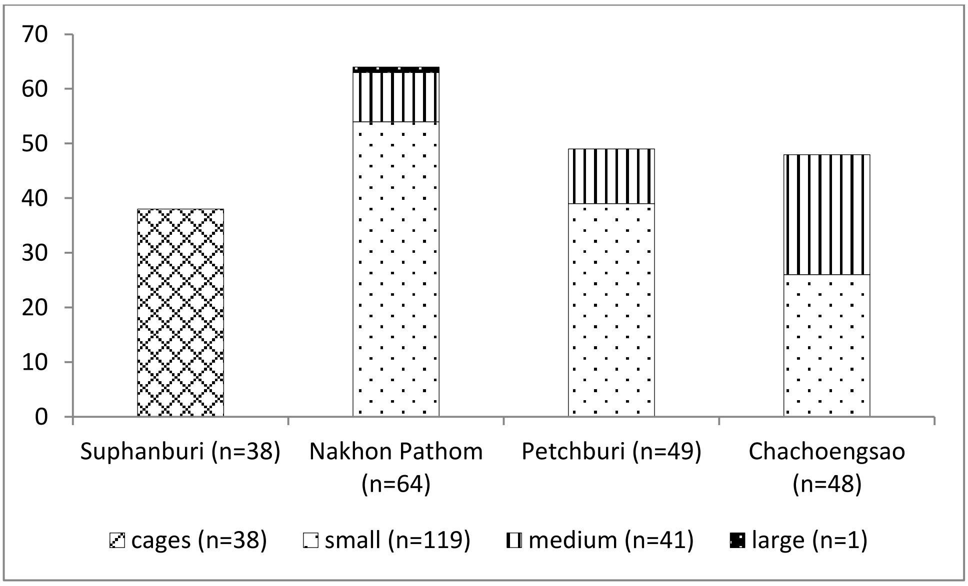

Figure 4.3 Location, scale and number of tilapia farms surveyed, 2010-2011

4.5.3. Farming systems

4.5.3.1. Shrimp

All the shrimp farms surveyed followed intensive management as monocultures, based on the definitions stipulated in Murray et al. (2011). Table 4.7 shows the production characteristics of the shrimp farms surveyed.

Table 4. 7 Production characteristics of shrimp farms by farm scale

Farm scale	Mean Grow-out days*	Mean Crops/ year	Days between stocking**	Stocking density (PL/m^2)	Stocking size or stage
Small	50-130	1-4	0-180	5-250	PL3-20***
Medium	84-150	1-4	3-110	31-120	PL2-15
Large	80-160	1.5-3	7-30	50-125	PL8-13

*The number of days it will take for the shrimp to reach marketable size from the day of stocking

**The number of days between harvest and stocking the ponds again with a new batch of shrimp post-larvae

***PL – post larva. It takes about 10 days from hatching of eggs to reach the post-larval (PL) stage. At the PL stage, as each day passes, the days are numbered PL1, PL2 and so on.

Shrimp stocking size is based mainly on the stage of the post-larvae. Stocking size or stages range between PL2 and PL20 for all farms, with majority stocking between PL10 and PL12. Small and medium scale farms in the east stocked a wider range of PL sizes (PL3 to 20 and PL2 to 15, respectively), whereas in the south, small and medium scale farms stocked the sizes of PL8 to 14 and PL2 to 15, respectively. For large farms, those in the east stocked from PL9 to 12, while those in the south stock from PL8 to 13. With only 1 large farm and 2 medium scale farms having dedicated nursery ponds (Figure 4.10), the majority of farms stocked PLs directly into grow-out ponds.

Initial shrimp stocking densities were not significantly different between enterprise scale and location (Eastern and Southern regions).

4.5.3.2. Tilapia

Tilapia culture systems can be categorized into two major types (1) monoculture (all cages/ some ponds), and (2) polyculture[1], deliberately stocked with one other species only for e.g. white shrimp, or two or more other aquatic species of economic value (finfish, shrimp, prawn and frogs). In addition, in both pond cage systems, non-stocked species were also harvested. All polyculture systems are in ponds. In each case there are various production characteristics.

Figure 4.4 shows the tilapia farming systems by farm scale followed by the respondents in this survey (based on weighted data). The majority of farms surveyed for all scales were polyculture systems, in ponds. Of the small scale intensive monoculture farms (24% based on weighted data), all except 1 were cage farms.

Tilapia cage farming systems are considered intensive systems based on inputs used as described in Murray et al. (2011). Regarding farm scaling for tilapia cages, since our criteria for large scale is corporate ownership i.e. registered as a company, there are only

[1] Non-stocked species also enter the ponds and cages and so nearly all systems are 'polycultures', similar to the farmer managed aquatic systems described in Amilhat et al. (2009).

very few companies which operate tilapia cages, such as CP and Grobest. Even these companies have contract agreements with farmers (small scale based on criteria of ownership and labour) who grow tilapia on cages, buy seed and feed from these companies, and after 3 to 4 months of grow-out, sell the fish back to these companies. Tilapia produced from contract farms should still meet the quality standards set by these companies i.e. size, flavour, no chemical residues.

Thus the cage farms in this research were considered small scale according to the SEAT Project definition. Scaling for cages may need to be further explored considering other factors that are different from pond systems, such as intensity of production per unit area.

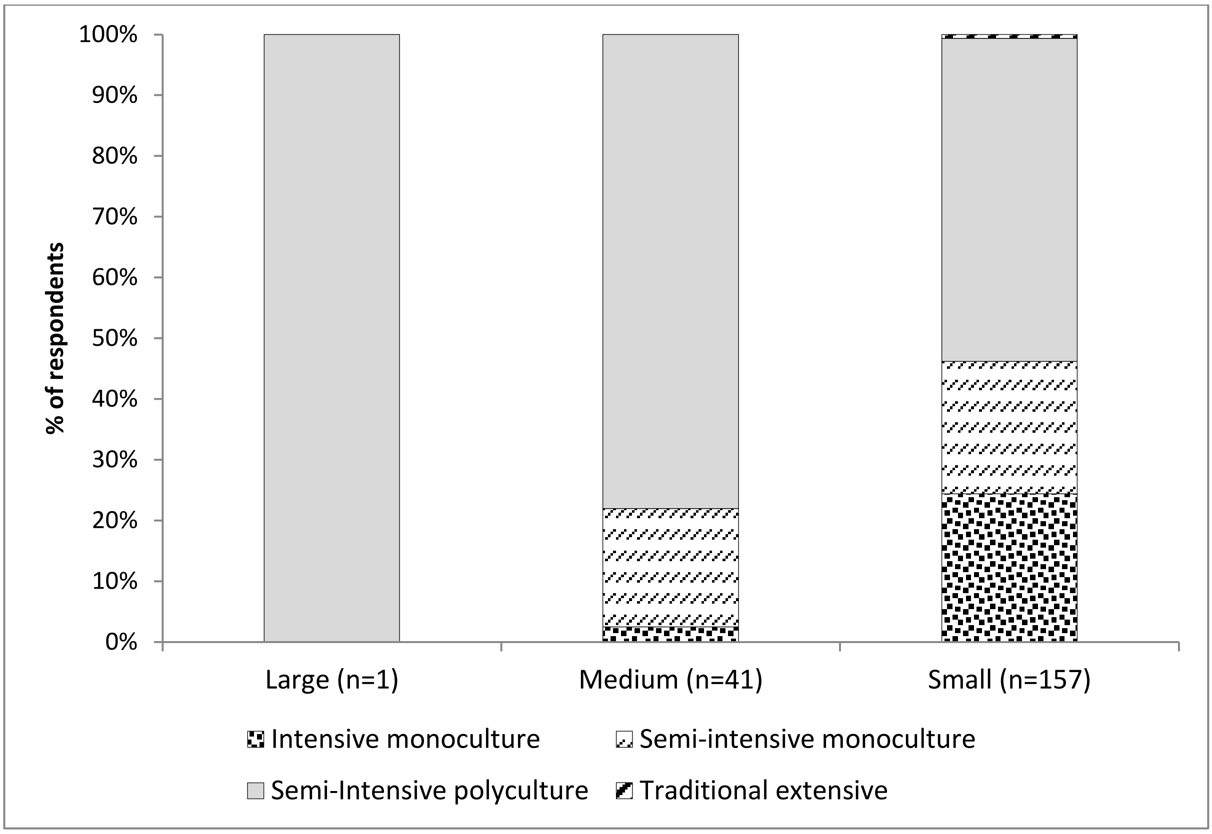

Figure 4.4 Tilapia farming systems according to farm scale

One tilapia pond farm in Petchburi was classified as traditional extensive (Figure 4.4), the main reason was that the farmer was not using any feed and fertiliser to grow tilapia (Murray et al., 2011). The farm (1.6 ha) was formerly a snakehead farm and is now stocked with mixed sex tilapia fry from a hatchery and only has one cropping period for 180 days.

The majority of the small and medium sized pond farms follow a semi-intensive polyculture farming system, with tilapia as the primary species (Tables 4.8 and 4.9), although there were farms that changed the primary species to other species depending on the season and market prices. Other species stocked with tilapia included Chinese carps (*Hypophthalmichthys molitrix* or silver carp and *Aristichthys nobilis* or bighead carp), Indian major carps (*Cirrhinus mrigala* or Mrigal and *Labeo rohita* or rohu) and common carp (*Cyprinus carpio*), Thai silver barb (*Barbonymus gonionotus*), white shrimp, freshwater prawn, catfish (*Clarias sp.*), snakehead (*Channa striata*), climbing perch (*Anabas testudineus*), snakeskin gourami (*Trichopodus or Trichogaster pectoralis*), pacu (*Colossoma macropomum*) and frogs (*Rana ranina*) (Table 4.9). The only large pond farm surveyed also followed the semi-intensive polyculture system, stocking with Chinese carps, Indian carps and Pangasius.

Tables 4.8 and 4.9 show the details of these tilapia production systems mentioned above. A distinction is made between tilapia in polyculture with just white shrimp, and tilapia in polyculture with 2 or more other species (white shrimp and others) due to the much higher stocking density of white shrimp (up to 125 PL/m^2) in the first system, while in the second system, density ranged 7.5 to 31.3 PL/m^2. In addition, the number of crops per year (maximum 6) for white shrimp in the first system (tilapia and white shrimp only) was more than in the multi-species system (maximum 2 crops/year), indicating that stocking shrimp only with the tilapia (first system) was a more important economic activity for the farmer respondents during the period of the survey.

Table 4. 8 Production characteristics of tilapia pond and cage farms surveyed

Farm scale	Species	Mean Grow-out days	Mean Crops/ year	Days between stocking	Stocking density (fry/m^2)*	Stocking size	Stocking size unit
Monoculture in pond, n=37:							
Small	Tilapia	70-365	1-2	15-56	0.6-9.4	0.3-5	cm
Medium	Tilapia	150-365	1-2	0-90	0.3-10.6	0.5-3	cm
Monoculture in cage, n=35							
Small	Nile tilapia	84-180	1-3	15-56	61-500	22.5-40.0	g
	Red tilapia	112-210	1-3	0-90	22-500	22.5-66.7	g
Polyculture (tilapia and white shrimp), n=10:							
Small	Tilapia	120-240	1-2.5	30	0.6-3.1		
	White shrimp	60-120	1-3	60	6.25-62.5		
Medium	Tilapia	210-280	1-3	60	1-2		
	White shrimp	84-90	2-6	30-60	5-125		

*Based on one-way ANOVA by Minitab, the stocking density used in tilapia cage culture is significantly different from the densities used in pond culture at 95% CI.

Table 4. 9 Production characteristics of tilapia pond polyculture with ≥ 3 species

Farm scale	Species	Mean grow-out days	Mean crops/year	Days between stocking	Stocking density (fry/m^2)
Small	Nile tilapia	84-392	1-2	1-135	0.03-62.5
	Catfish	120-365	1-2		0.003-12.5
	Chinese carp	150-365	1-2	30-135	0.02-3.1
	Climbing perch	180	1		0.5
	Common carp	280-365	1	30	0.2-3.1
	Mrigal	180-365	1-2		0.1-3.1
	Pacu	240-300	1		0.01-0.9
	Rohu	150-392	1-2	30-135	0.03-3.1
	Silver barb	150-392	1-2		0.03-3.1
	Snakeskin gourami	240-730	0.5-1	7-60	1.6-62
	Snakehead	270	1	90	12.5
	White shrimp	105-120	1-2		7.5-7.8
Medium	Nile tilapia	96-365	0.67-2	30-60	0.2-31.3
	Catfish	150-300	1		1.3-12.5
	Chinese carp	182-365	1	30-60	0.1-4.4
	Common carp	240-270	1	30	0.1-0.3
	Giant freshwater prawn	120	2		0.6
	Mrigal	182-365	1	30-60	0.1-1.9
	Rohu	182-365	1	30-60	0.1-4.4
	White shrimp	120-270	1-2		1.3-31.3
	Silver barb	182-365	1	30-60	0.2-3.1
	Snakeskin gurami	180-365	1	56	1.7-31.3
	Snakehead	240-300	1	56-60	0.2-1.1
Large	Nile tilapia	270	1	15	2.5
	Chinese carp	270	1	15	0.1
	Mrigal	270	1	15	0.03
	Rohu	270	1		0.3
	Pangasius	270	1	15	0.1

4.5.4. Seed source

Shrimp seed come from various sources, but mainly from commercial hatcheries (Figure 4.5). The majority of the shrimp farmers, especially small and medium scale farms did not know the source of the broodstock the hatcheries were using. It could be that they did not request for this information from the hatcheries. Whereas the majority of the large scale farms knew that the broodstock used by the hatcheries were domesticated. Only one of the large farms surveyed knew the broodstock was domesticated because the farm was using its own postlarvae as the hatchery is part of their vertically integrated operations.

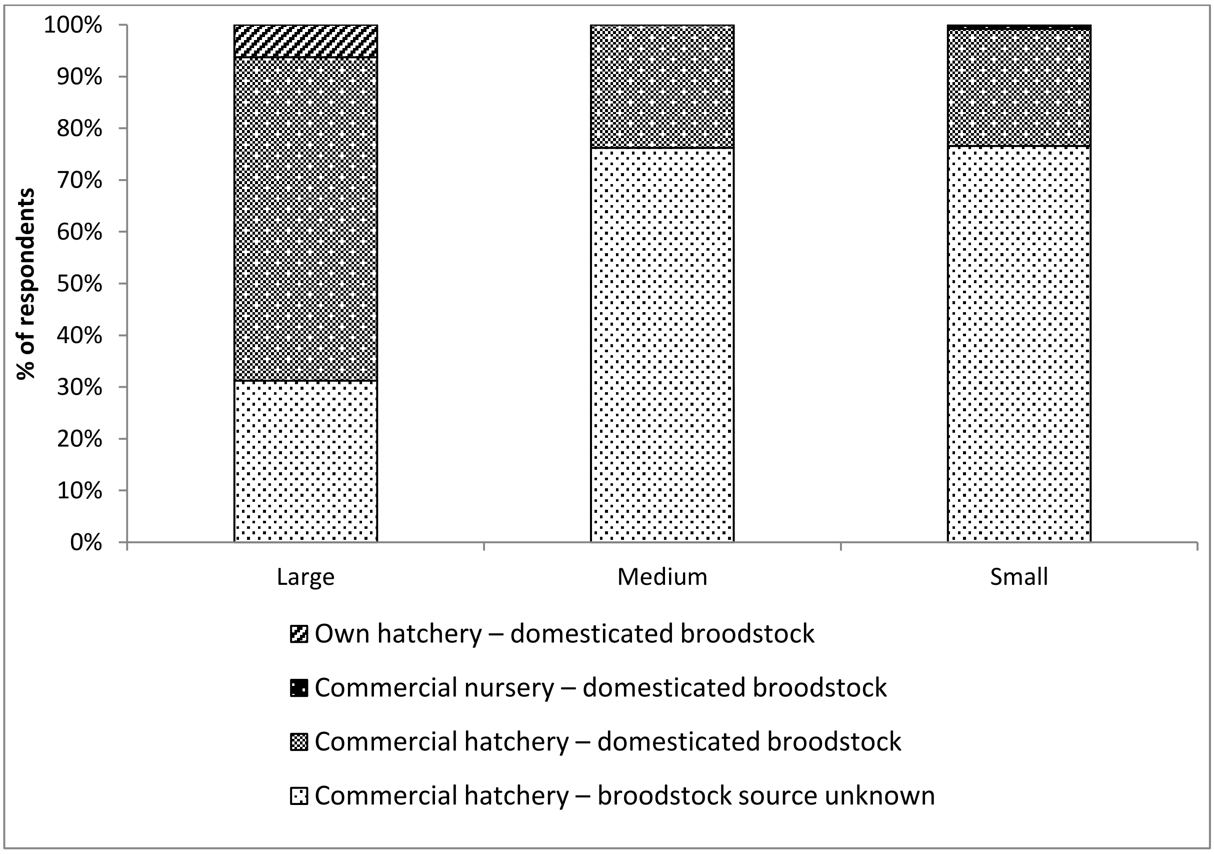

Figure 4.5 Source of shrimp seed by farm scale

N: large=16, medium=59, small=124

Tilapia seed stocked in cages and in large farms are all sourced from tilapia hatcheries, and were all sex-reversed fry. However, tilapia seed stocked in small and medium scale farm ponds come from various sources. Although > 50% of small and medium scale farms used sex-reversed fry from tilapia hatcheries, some proportion i.e. 27% of small and 24% of medium farms still stocked mixed sex fry into their ponds. Figure 4.7 shows all the sources of tilapia seed by farmers surveyed.

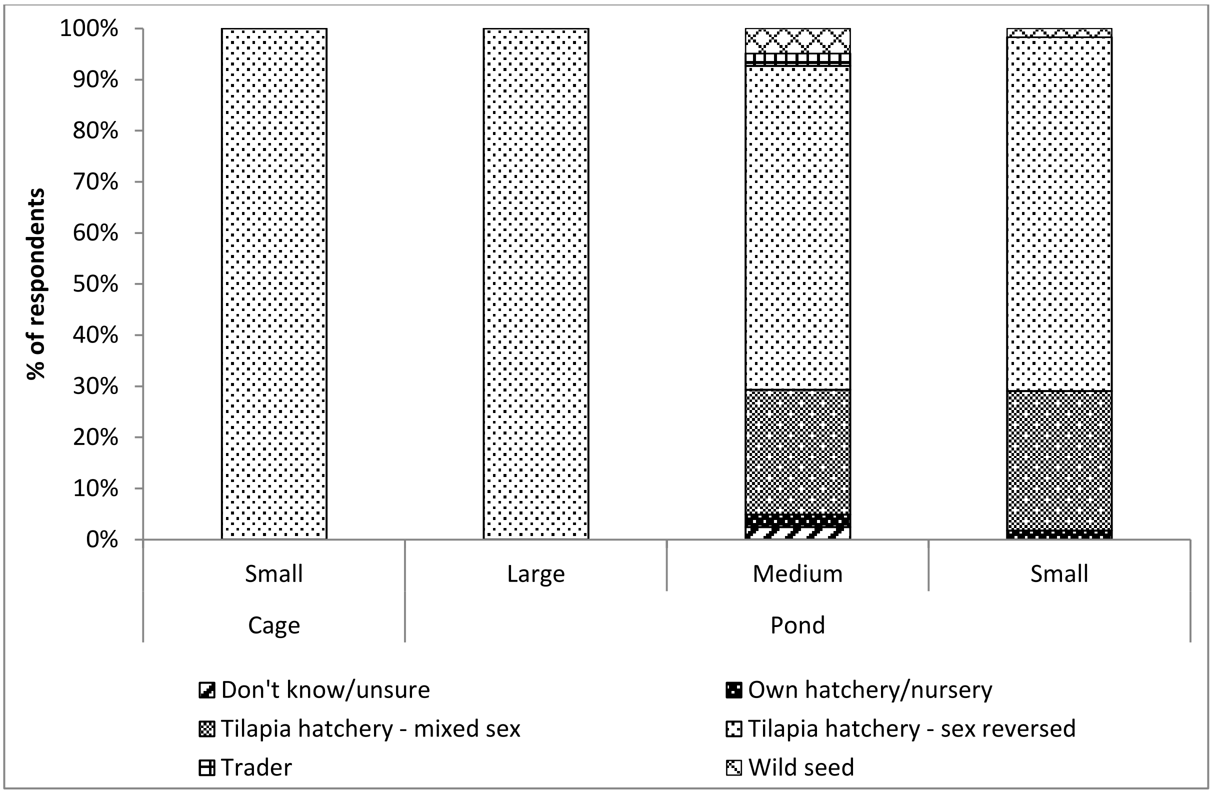

Figure 4.6 Source of tilapia seed by farm scale

N: large=1, medium=41, small=117, cage=36

4.5.5. Stocking size

The terminology and ways used by tilapia farmers regarding stocking sizes of tilapia fry and fingerlings vary. Farmers stocking in ponds buy fry according to length per fish, usually between 1 and 3 cm (equivalent to 1” or less, or 0.2 g or less/fish) (Tables 4.8 and

4.9). Farmers would refer to this size as the leaf of the tamarind (*bai makham*). Cage farmers mainly stock according to number of fish/kg, weight/fish, and length per fish.

There are at least three stocking sizes for tilapia, i.e. small (1-3 cm or 0.2 g), large (3.5” to 5” or 20-40 g or 25-30 fish/kg), and very large (>60 g). The majority of pond-stocked fry are small fish, which are cheaper and easier to transport, whereas larger fish are stocked in cages. Only a few farms (both cages and ponds) stock very large size (>60g/fish) as they are more expensive and more difficult to transport live, although culture period will be shorter.

4.5.6. Containment systems

4.5.6.1. Number of ponds and cages

There is a wide variation among the farm scales in terms of the number of containment units, i.e. ponds and cages, per farm. For small-scale shrimp farms, the number of ponds per farm ranged from 1 to 20, with an average of 4 ponds, and a mode (majority) of 2 ponds. Whereas for medium scale, there is a range of 1 to 34 ponds per farm with average of 9 ponds, and a mode (majority) of 5 ponds. For large farms owned by companies, the number of ponds range from 10 to 146 ponds, with average of 57, and a mode (majority) of 88 ponds (Figure 4.7).

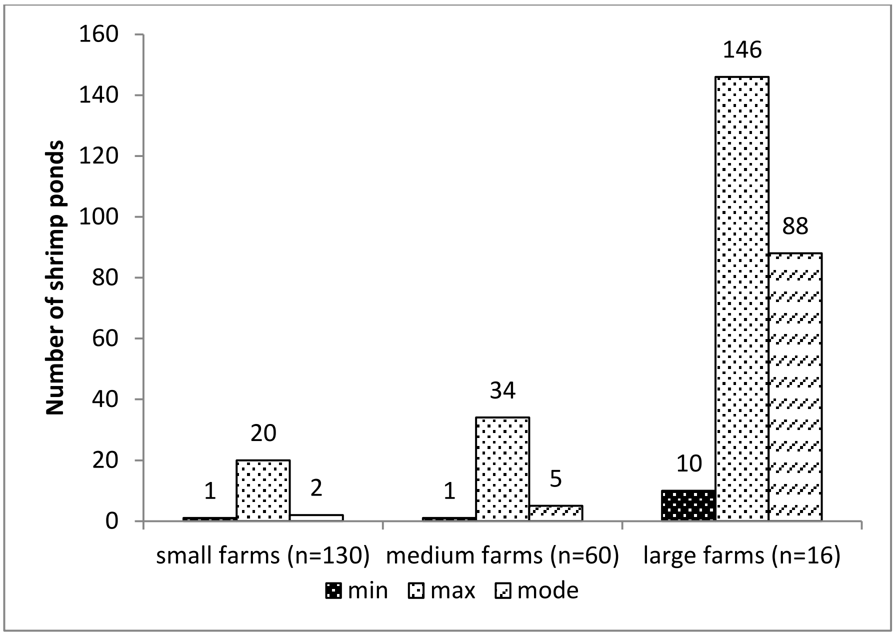

Figure 4.7 The number of shrimp ponds according to farm scales

The average water area per pond for large shrimp farms ranged from 0.5 to 2.2 ha, for medium scale farms, 0.1 to 1.2 ha/pond, and small scale farms from 0.1 to 1.9 ha/pond.

For tilapia pond farms, both small- and medium scale farms had a nearly similar range in the number of ponds, with a minimum of 1 pond and a maximum of 11 to 14, average of 3 to 4, and a mode (majority) of 1 to 2 ponds (Figure 4.8). In terms of area per pond, medium scale farms range from 0.11 to 4.8 ha/pond while small scale farms range from 0.01 to 3.2 ha/pond. Thus small scale farms have generally smaller pond sizes than medium scale. The maximum water depth for medium scale farms range from 1 to 4 m, while small scale farms range from 0.5 to 3.5 m.

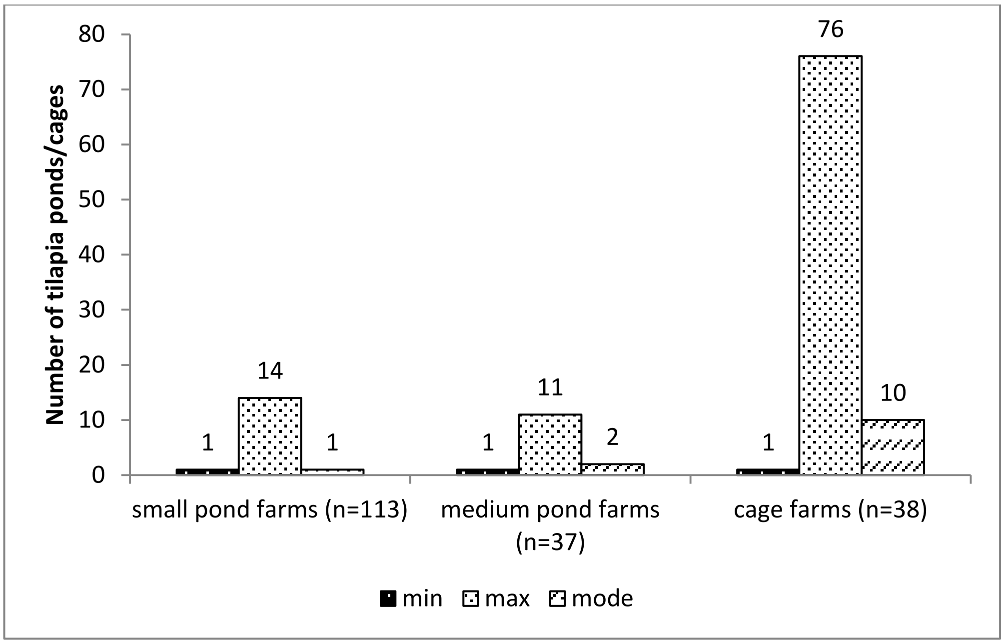

Figure 4.8 Number of ponds and cages in tilapia farms surveyed

For tilapia cage farms, the number of cages ranged from 1 to 76 with the average at 17, with majority of farms having 10 cages (Figure 4.8). The average size dimension of cages is 3 m x 3 m. Maximum water depth of the cages ranges from 1.5 to 2.8 m, mode of 1.5 and SD of 0.4. Water volume per cage ranged from 13.5 to 259.2 m^3, with a mode of 13.5 and SD of 41.0. A wide range of number of cages and water volume could mean varied production levels per unit area. These should be considered in assigning scales for cages.

4.5.6.2. Uses of shrimp and tilapia ponds and cages

For both shrimp and tilapia farms, the ponds and cages are used in various ways, either solely for one purpose i.e. dedicated for nursery, growout, storage only of clean water, or alternated with other purposes, or concurrently used for 2 purposes. Figure 4.9 shows the uses of these containment systems.

For shrimp farms, referring to Figure 4.9 in detail, among large farms (n=16), 94% have dedicated growout ponds, 87.5% have dedicated clean water storage ponds, 81% have dedicated effluent storage/sediment ponds. For medium scale shrimp farms (n=60), 98% have dedicated growout ponds, 90% have dedicated clean water storage ponds, and only 38% have dedicated effluent storage/ sediment ponds. For small scale shrimp farms (n=130), 93% have dedicated growout ponds, 69% had dedicated clean water storage ponds, and only 26% having a dedicated effluent storage/ sediment pond.

The pond uses, whether dedicated or alternate with other uses, have implication for biosecurity issues especially in relation to water quality, water management and contamination.

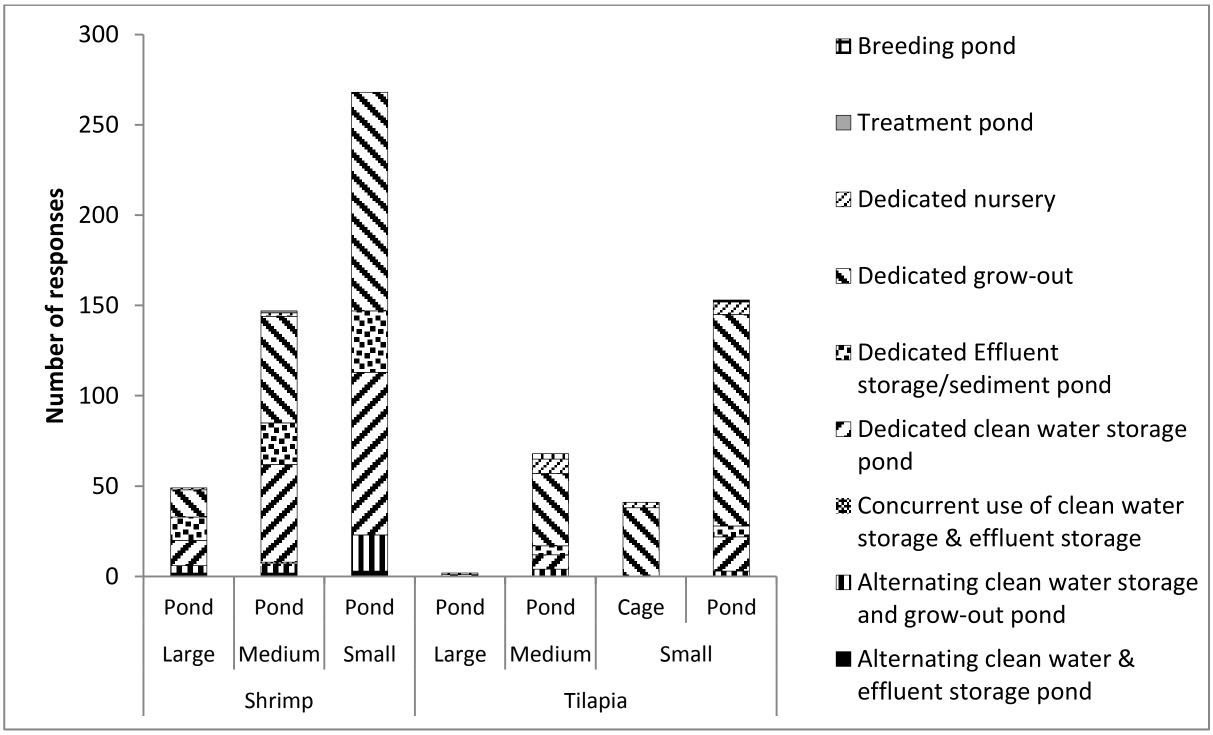

Figure 4.9 Uses of ponds and cages in shrimp and tilapia farms by farm scale

N: shrimp=206 (small=130, medium=60, large=16); N: tilapia=199 (cages=38, small ponds=119, medium=41, large=1) (Multiple responses)

For all the tilapia pond farms, the majority of their ponds are dedicated for growout production. Almost 20% of the medium (n=41) and 16% of the small scale (n=119) pond farms attempt to have dedicated ponds for clean water storage, to ensure availability of supply when needed. A few of the pond farms (10% medium and 2% small) use their growout ponds as alternative units to store clean water. However the majority would have no stored clean water which could be critical if pond water quality deteriorates and these farms do not have clean water to exchange.

4.5.7. Status of farm operations according to selected standards and certifications criteria

4.5.7.1. Legal aspects: Obey the law and comply with all national and local regulations.

Figure 4.10 shows the status of the shrimp and tilapia farms surveyed in terms of their compliance with the Department of Fisheries regulation for registration of farms for ThaiGAP (ACFS, 2009) as well as for the Fisheries Movement Document (FMD). These documents are more important and relevant for shrimp farmers because these are requirements for trading with processing plants for export of shrimp, as part of the traceability system. Whereas for tilapia, as most of the production (about 90%) are for the domestic market, such documents are less important, although the Department of Fisheries does try to encourage farms to register for other purposes such as for data collection and statistics. Access rights (mainly fisheries and aquaculture in public waters) are governed under the Fisheries Act regulated by DoF, while ownership, development and other land use are governed by other government agencies such as Land Development, Ministry of Natural Resources and Environment, and Pollution Control

Department. Land owners are provided with Freehold Title Deeds which land owners could use as proof of land ownership during auditing for legal compliance (USAID-MARKET, 2013).

This documentation especially the movement documents are also related to traceability, thus the data in Figure 4.10 also inform the status of farms for the following standards criteria:

- Fish welfare, management and husbandry: Traceability at farm
- Harvesting: Labelling/traceability of harvested fish or shrimp

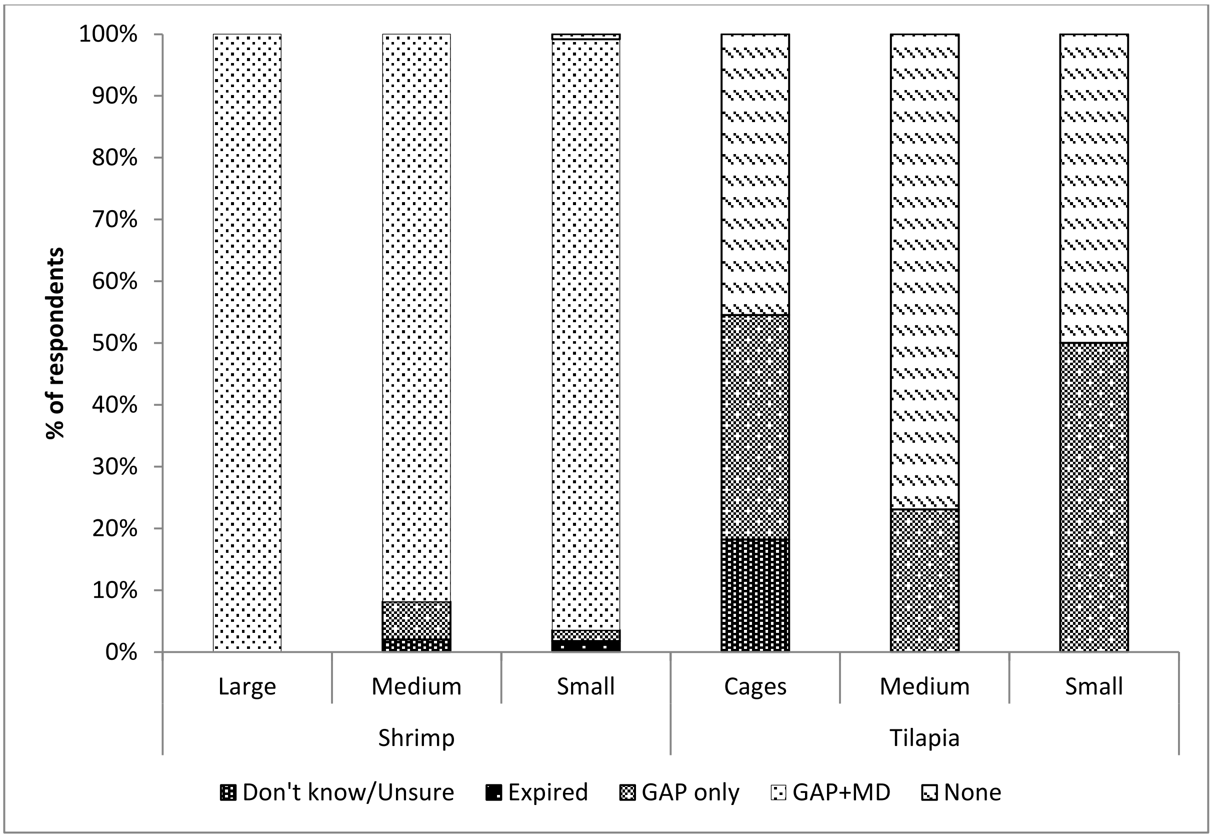

Figure 4.10 Status of surveyed farms regarding registration with DoF according to species and farm scale

N, shrimp: large=13, medium=49, small=114; N, tilapia: medium=13, small=24, cages=11

Among the tilapia farms surveyed, none were using FMDs, with <10% responding that they were registered with the DoF. This is mainly due to the fact that most of the tilapia harvested is sold in the local retail and wholesale markets, usually live for the best price. So they did not see any need to have the MDs. However, key informants in one wholesale market in the outskirts of Bangkok mentioned that when a processor buys tilapia from the auction market and requires an MD, this document can be provided at the market itself.

4.5.7.2. Environmental Management: Effluent management

Effluents are the water discharged from farms after use or culture. They can either be released within the farm and treated, recirculated, and reused, or discharged to the external environment, with or without treatment. Treatment involves removing substances from the wastewater which could pollute or contaminate the receiving environment. Farms have various ways to treat the wastewater or effluents discharged from their ponds. Figures 4.11 and 4.12 show how shrimp and tilapia (pond) farmers, respectively, handle their effluents.

Effluent from shrimp farms may or may not be treated. In this survey, 159 (77.2%) out of 206 shrimp farm respondents provided their responses. Out of those who responded, a large majority, 114 (71.7% of 159) i.e. 72 small, 38 medium, and 4 large scale farms, did not treat their shrimp farm effluents, although they would drain them into a canal or empty pond within the farm, for reuse. The remaining 45 farms (28.3% of 159) treat their effluents in various ways. In shrimp farms, the large scale farms are more likely to treat their effluents, whereas a majority of the small and medium scale farms did not have any treatment at all.

There are different ways of treatment by the various farm scales (Figure 4.11). Based on majority of responses, large scale shrimp farms treated their pond effluents mainly by settling them in a settlement reservoir/pond (50%), whereas medium scale shrimp farms treated effluents chemically (8%) and small scale farms treat effluents biologically using probiotics or effective microorganisms (12%).

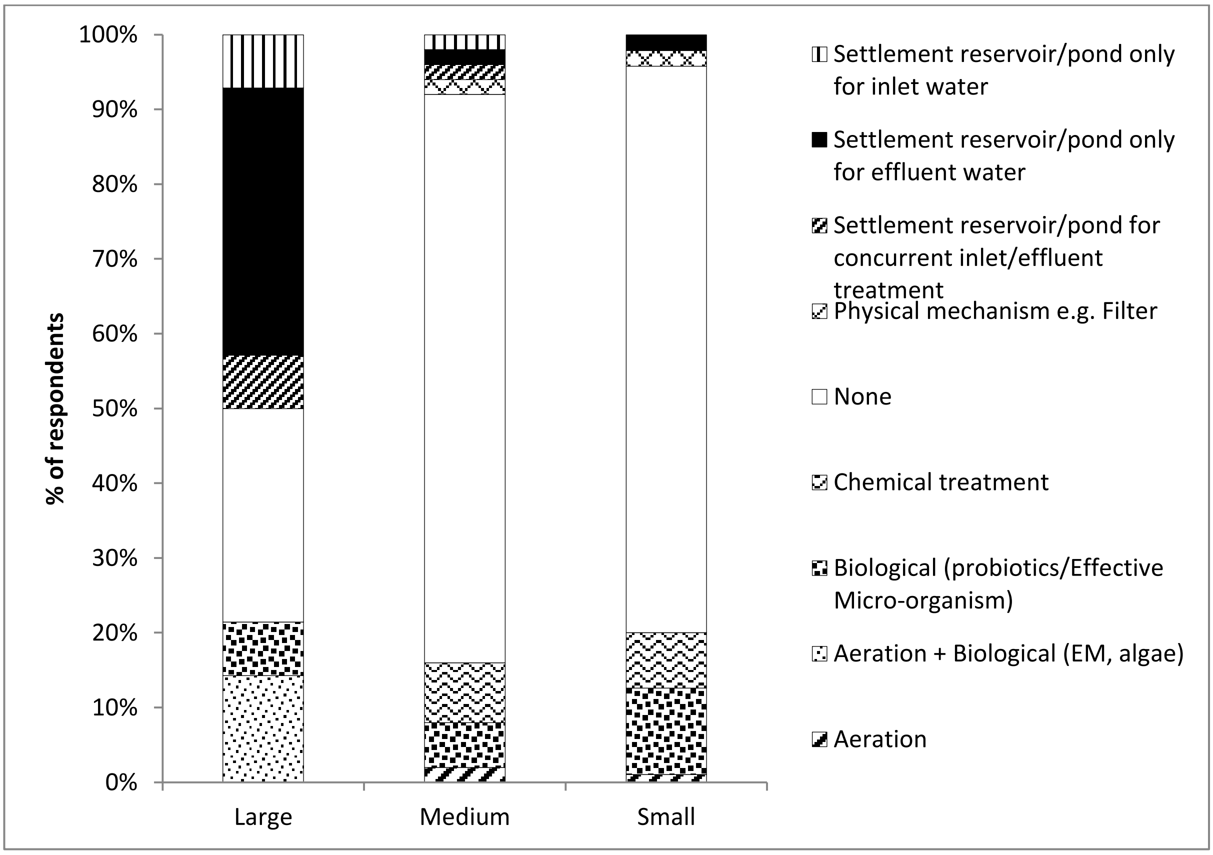

Figure 4.11 Ways to treat the effluents from shrimp farms

N: large=14, medium=50, small=95

Treatment of effluents from tilapia pond farms is not so common. A large majority (87.5%, n=112) said that they did not treat their tilapia pond farm effluents. For the very few (12.5%, n=112) treating their effluents, methods used included physical (aeration), biological (probiotics), chemical methods and settlement in a pond (Figure 4.12). For both medium and small scale pond farms, biological treatment using probiotics and effective microorganism (EM) was most common.

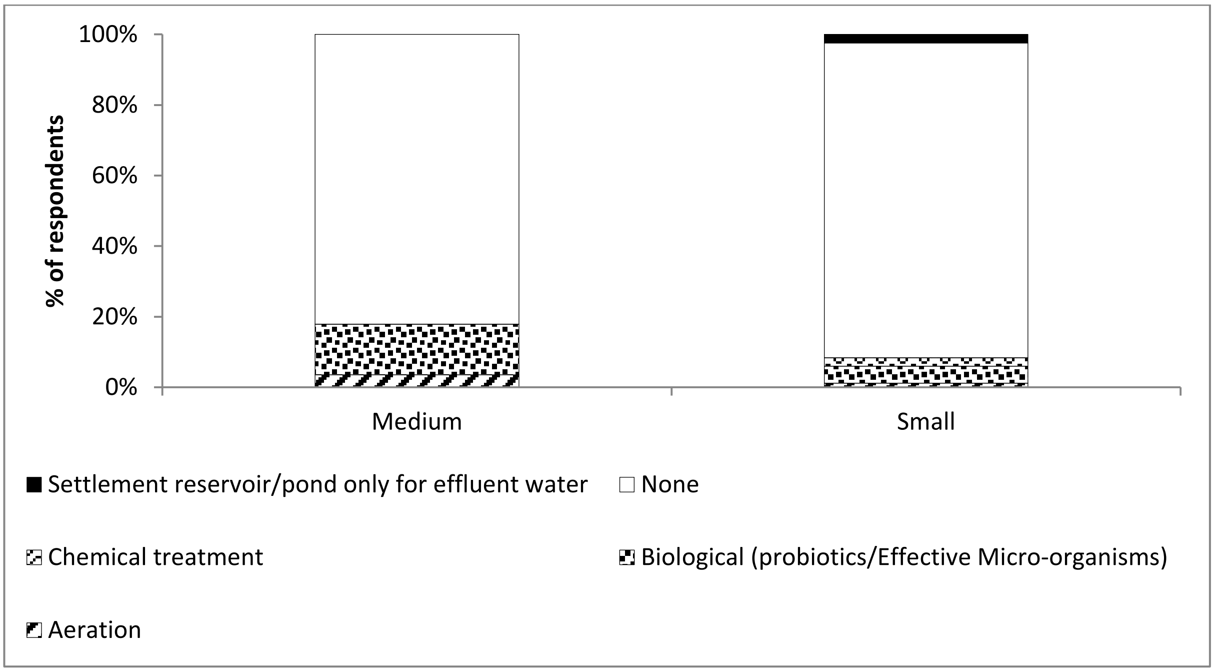

Figure 4.12 Status of effluent treatment among tilapia pond farms
N: medium=28; small=84

4.5.7.2.1. Discharge methods and routes

Farms discharge the waste water or effluent from their culture ponds into another location inside the farm, mainly into the drainage canal which is part of their farm system. The certification standards do not specify how farms should remove the wastewater from the pond to another area but are more concerned on whether the effluents are released into the external environment, and that they should be treated prior to discharge.

Figure 4.13 shows that the majority of the farms have their own drainage system within the farm. Thus this would likely minimise impacts external to the farm. It has to be noted that especially for shrimp farms, closed and recirculating systems are commonly used which means that the water discharged from the culture ponds is not allowed to leave the farm but kept in another pond for the next culture period. This is likely to be similar for tilapia farms as water is scarce. Tilapia pond farms pumping into its own drainage system is the majority choice for both small (73%) and medium (50%) scale farms.

Gravity, by pumping and a combination of both were the modes of discharge used by shrimp farms. For large scale farms, the majority (>50% of large scale farms, n=14) used gravity draining, whereas pumping out was more common among almost half of the medium (n=47) and small scale (n=96) farmers.

Section 4.4.10 on energy use describes the source of energy for pumping water was affected by farm scale; a large majority of farms used diesel pumps, i.e. > 70% of small and medium scale shrimp farmers, and > 80% of tilapia small and medium scale. Large scale shrimp farms were more likely to use a combination of grid electricity (> 60%) and diesel (50%). However the information was not specific whether the pumping was for inlet or effluent discharge.

With nearly all the ponds having their own drainage system, this means that whether the effluent is pumped out and/or allowed to flow out by gravity, effluents would remain within drainage canals within the farm for settlement and reuse.

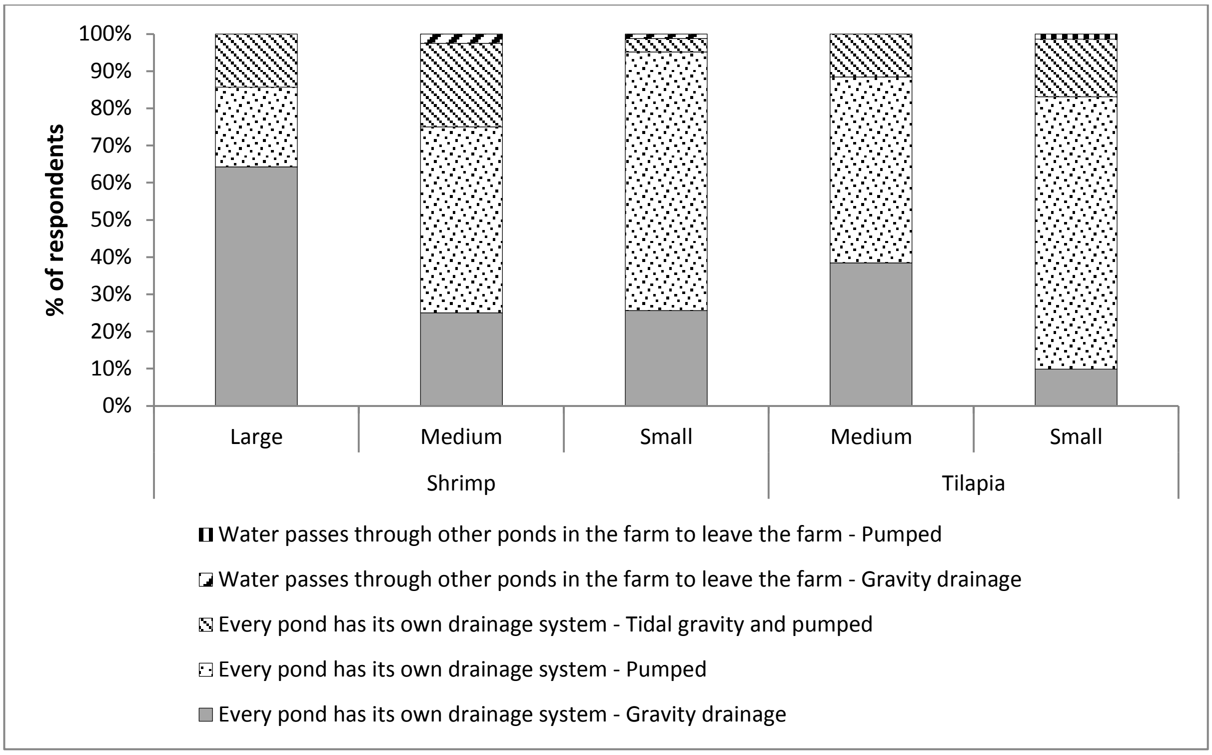

Figure 4.13 Methods and routes of discharge of effluents from shrimp and tilapia ponds by farm scale

N: shrimp: large=14, medium=40, small=82; tilapia: medium=26, small=71

4.5.7.2.2. Effluent agreement

As part of effluent management, respondents were also asked about co-operation with other land-users regarding effluent discharge. This was to explore co-ordination with respect to disease (primarily) and environmental management. Table 4.10 shows the responses of 264 farmers, who mostly (92%) did not have any agreement with their neighbours. A few (7.6% of 264) agreed to synchronise discharge/intake with their aquaculture neighbours.

Table 4. 10 Whether there was agreement or not regarding discharge of effluent with neighbours

Farm scale	Species	Collective agreement on treatment processes	Collective processing	Synchronise discharge/ intake with aquaculture neighbours	No agreement
Small	Shrimp			4.2	28.8
	Tilapia	0.4	0.4	1.5	29.5
Medium	Shrimp			1.1	17.4
	Tilapia				11.0
Large	Shrimp			0.8	4.9
Total		0.4%	0.4%	7.6%	91.6%

Note: Data shown as percentage (%) of responses (n=264).

The most probable reason for lack of agreement with neighbouring farms is the fact that based on Section 4.5.7.2.1, effluent discharge to the external environment was not common, with the majority of pond effluents being retained within drainage systems on-farm, majority of the farms discharge their effluents into the drainage system within the farms.

4.5.7.3. Water quality monitoring

Farms surveyed also monitored water quality in their ponds and cages. All shrimp farms regularly monitored water quality in their ponds, investing in water quality equipment and kits, whereas for tilapia, water quality monitoring was important to only 16% of cage and 7.5% of pond farms (Figure 4.14).

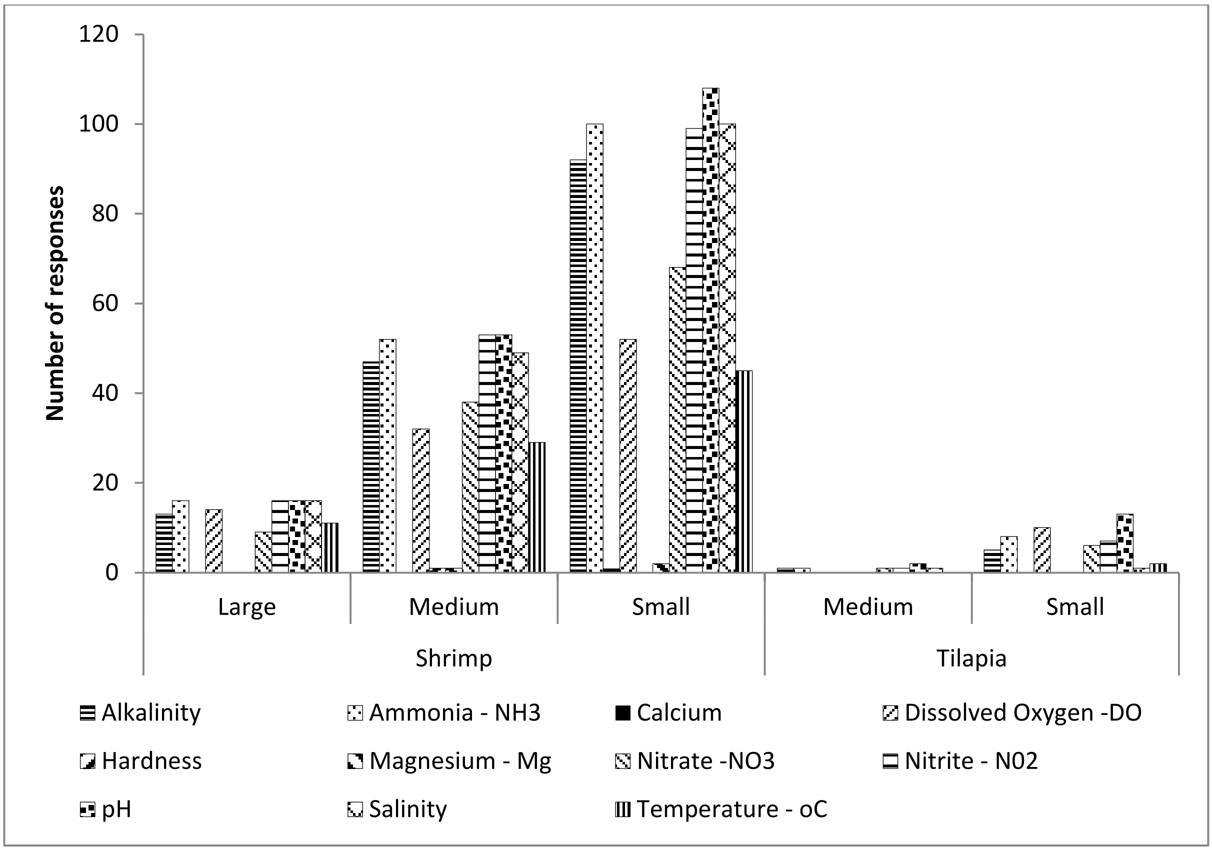

Figure 4.14 Water quality monitoring in shrimp and tilapia farms by farm scale

(multiple responses) N: shrimp large=16, medium=53, small=108; tilapia: medium=2, small=15 (6 cages, 11 ponds)

4.5.7.4. Pond sludge management

Shrimp farms need to manage the pond bottom by taking out the sediments regularly. Pond sludge mainly contains organic wastes from cultured stock such as their faeces and uneaten feed, as well as some inorganic matter like soil particles, mainly in unlined ponds, as well as from the source water, especially if it is not settled prior to use in the culture pond.

Large scale shrimp farms mainly pumped pond sludge into sediment ponds (69% of all large scale, n=16) with the remaining 31% adding them to pond dikes (Figure 4.15). On the other hand, 61% of medium (n=54) and 63% of small scale (n=114) farms added them to the pond dikes, with >30% each of medium and small scale farms pumping into their sediment ponds. At least 1 medium scale farm and 4 small scale farms pumped the sediments into their own fields nearby. The fields were used to produce rice, garden crops, oil palm or others.

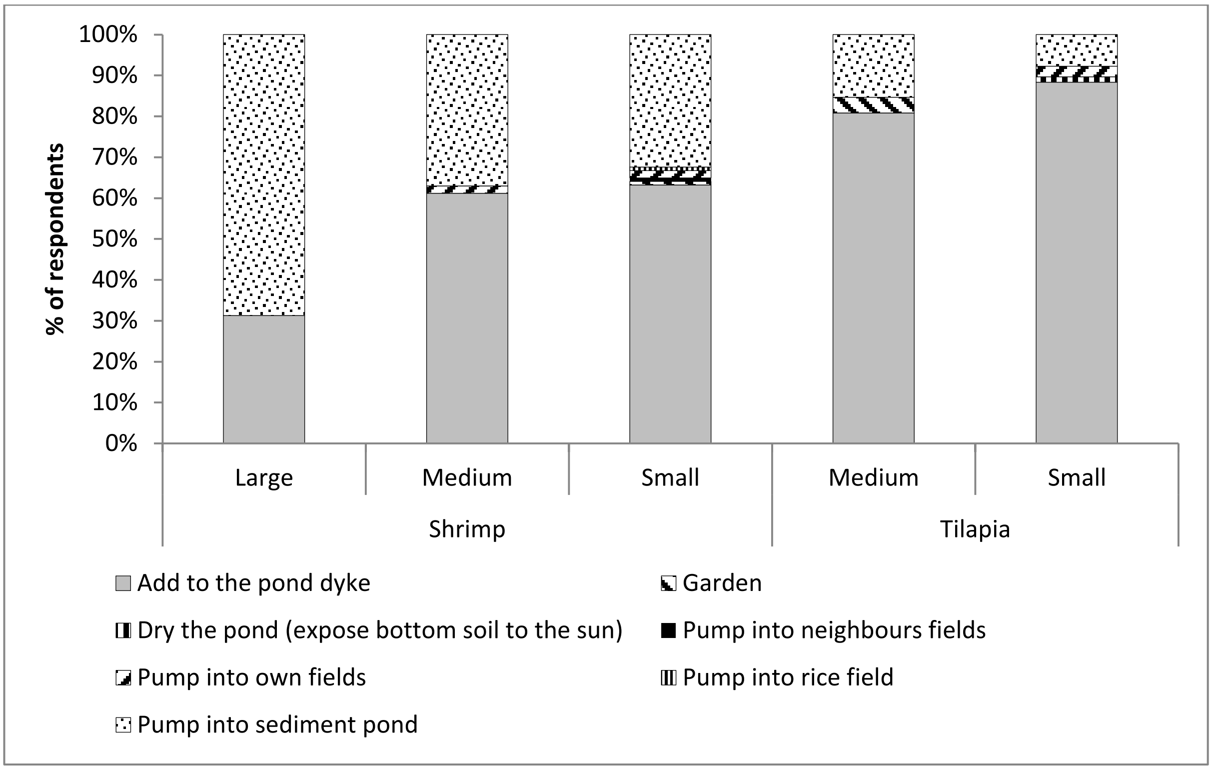

Figure 4.15 Fate of sediments from shrimp and tilapia pond farms

N: shrimp large=16, medium=54, small=114; tilapia medium=26, small=77

For tilapia pond farms, more than 80% of both medium and small scale farms disposed of sludge by adding it to pond dikes, while 15% of medium and 8% of small had sediment ponds to pump the sediments into (Figure 4.15). Sediments were also pumped into their own fields and/or garden of one medium and 2 small scale farms. At least one small scale farm disposed of sediments by prolonged sun-drying after drainage.

The majority (73%) of shrimp farms (n=184) removed sediments after more than one cycle (Figure 4.16). This trend is reflected by farm scale as follows: 69% of large scale (n=16), 70% of medium scale (n=53) and 77% of small scale (n=115) farms. The culture cycle for shrimp is from 1-4 cycles per year (Table 4.7). Large shrimp farms had a longer interval between removing sediments, i.e. every 3-4 and up to 8 years (Figure 4.17). The majority of medium and small scale shrimp farms removed sediments more frequently (every 1-2 years). The sediment build-up in the pond is related to nutrient loading based on feed, which in turn is related to stocking density. In addition, other farm management features such as water exchange, aeration, pond design and lining status could play a role in the build-up of sediments.

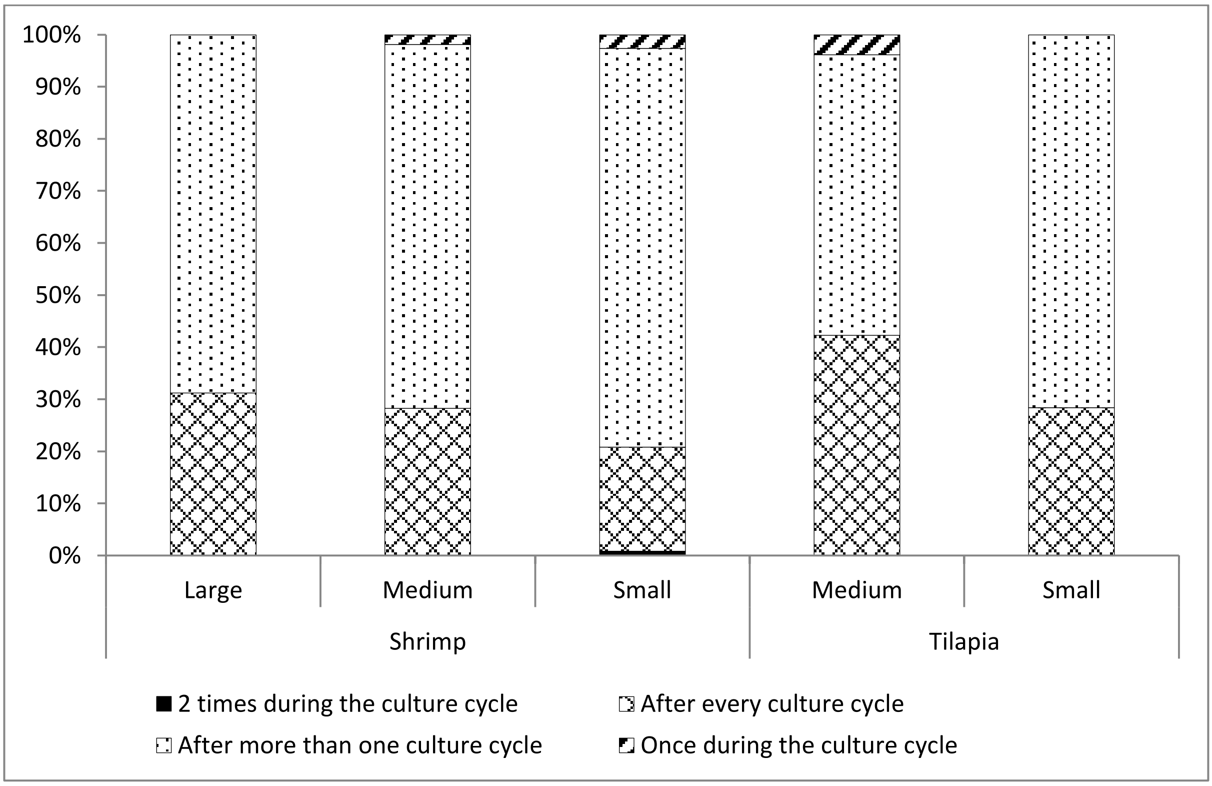

Figure 4.16 Frequency of sediment removal in shrimp and tilapia pond farms according to farm scale

N, shrimp: large=16, medium=53, small=115; N, tilapia: medium=26, small=74

Tilapia pond farms also followed similar trends i.e. 54% of medium (n=26) and 72% of small scale (n=74) farms removed sediments after more than one cycle. The culture cycle for tilapia in ponds is from 1-2 cycles per year (Tables 4.8 and 4.9), thus removal was from every year up to every 5 years (Figure 4.17).

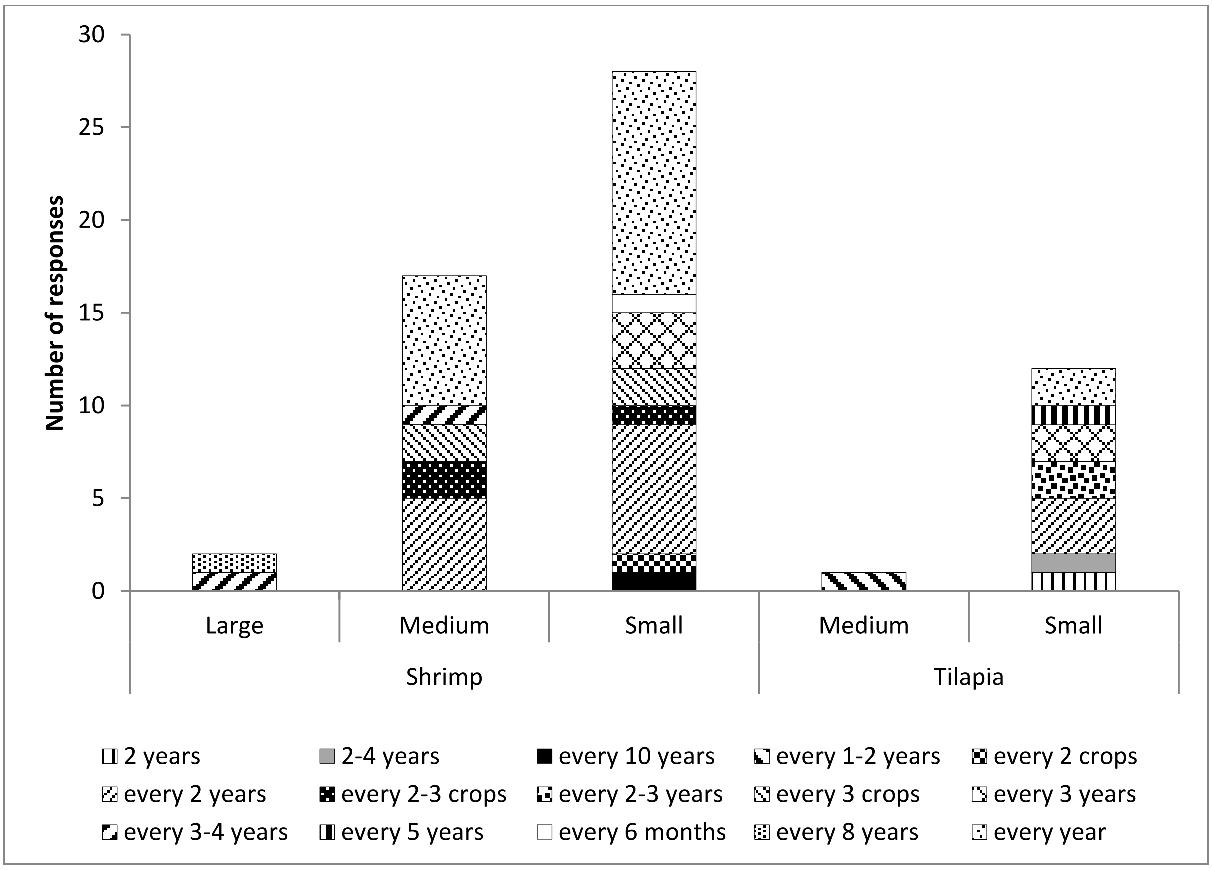

Figure 4.17 Detailed frequency of removing sediments for more than one culture cycle

N, shrimp: large=2, medium=17, small=28; N, tilapia: medium=1, small=12

4.5.7.5. Feed Management

4.5.7.5.1. Feed manufacturers

Figure 4.18 shows the various feed types used for shrimp and tilapia culture. The use of commercial industrial sinking pellets among shrimp farms was universal in this survey.

For tilapia cage systems, commercial industrial feed pellets (whether floating or sinking) are the main sources of nutrition (Figure 4.18).

In tilapia pond systems, there is a wide range of feed strategies used (Figure 4.18). The majority of the small scale farms (63%, n=96) used commercial industrial feed pellets, either sinking or floating, or in combination with other inputs, whereas only 38% of the medium scale farms (n=39) used them. A few of the medium (8%) and small (5%) scale pond farmers did not use any feed at all, whether produced by farmer on-farm from ingredients bought or collected, or industrial formulated feed pellets (produced by a feed mill). For those who indicated that they were not using industrial feed pellets alone, a variety of agro-industrial by-products, with or without rice bran, are commonly used including fish waste purchased from fish sauce factories, cattle skins, waste food from cafeteria, palm oil, broken rice and grass (55% of medium and 33% small) (Figure 4.18).

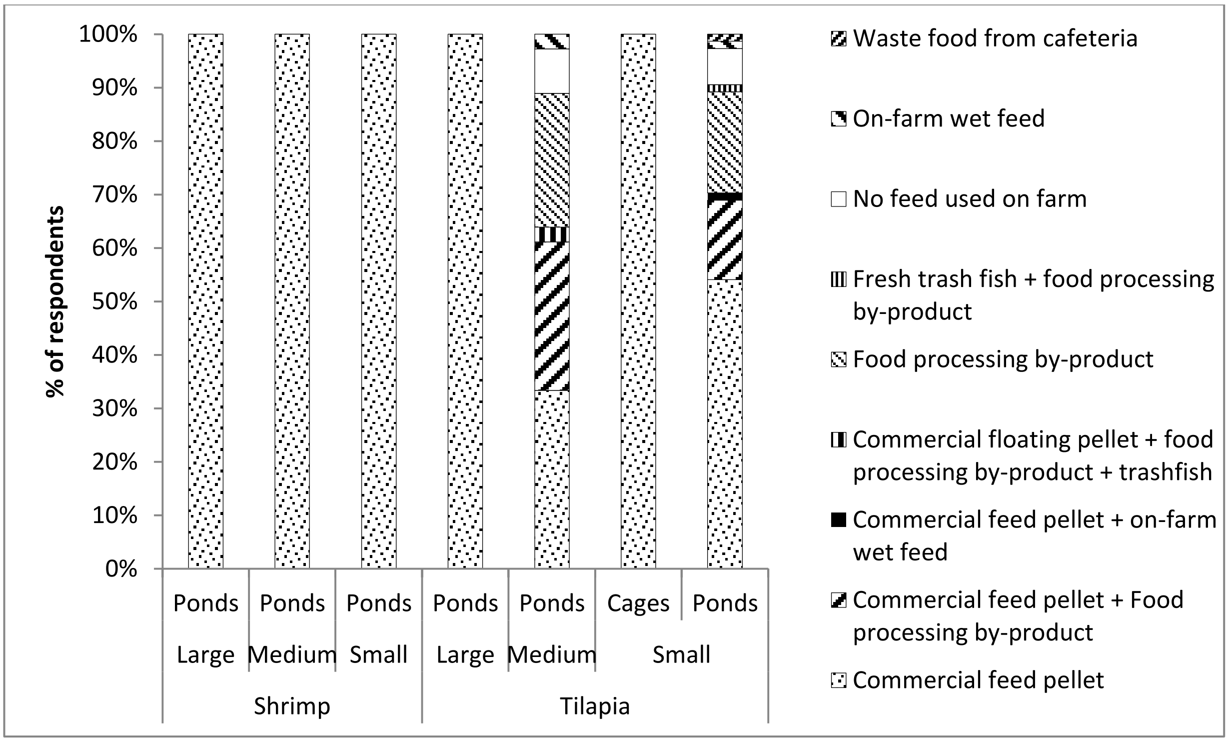

Figure 4.18 Types of feeds used in shrimp and tilapia culture by farm scales

N, shrimp: large=16, medium=58, small=124; tilapia: medium=39, small ponds=96, small cage=37

Figure 4.19 shows that there are three shrimp feed manufacturers preferred by shrimp farms. A major feed company (named here as Company A to protect identity) is preferred by nearly 65% of the surveyed farms (75% large, 64% medium, 64% small). Small scale farms tended to use a greater variety of feed manufacturers than the large and medium scale farms.

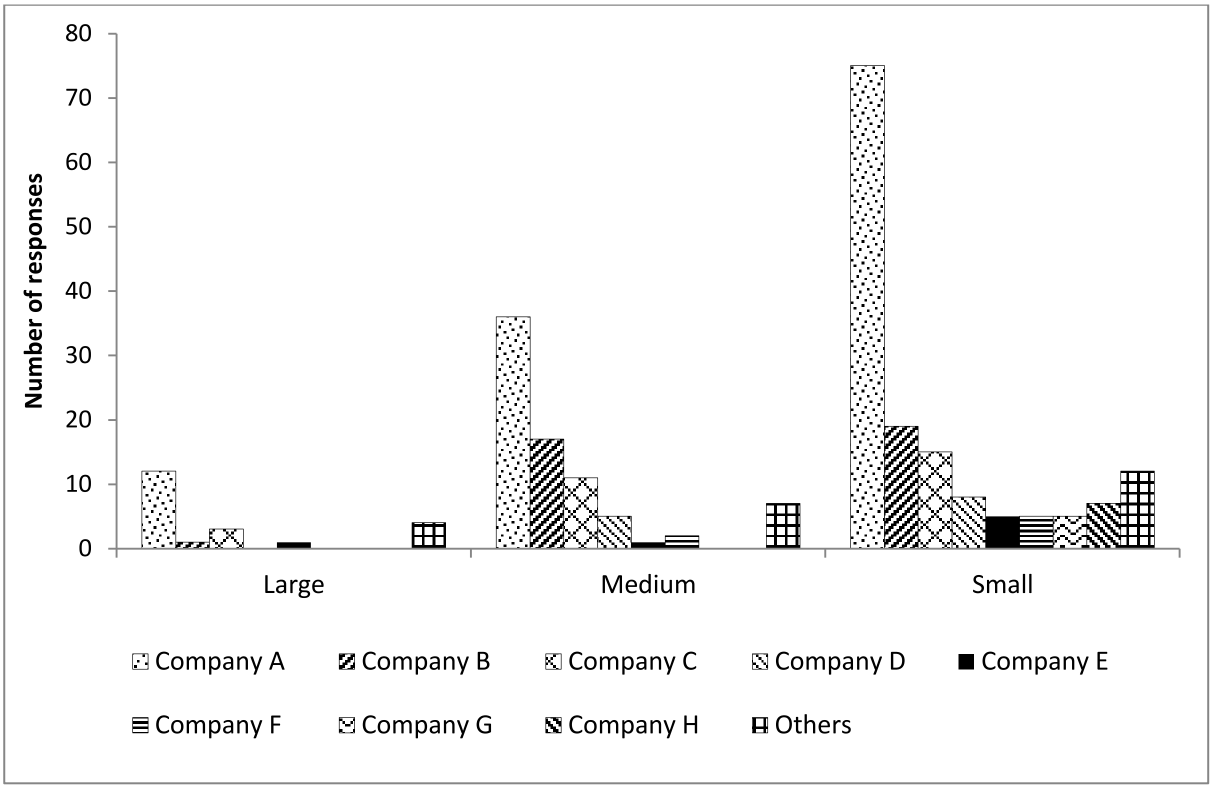

Figure 4.19 Shrimp feed manufacturer preference

n, large=16, medium=56, small=118 (multiple responses)

The lone large tilapia farm had its own feed mill to produce feed pellets for use in the farm. Medium and small scale tilapia farms sourced feed from a number of different manufacturers. The same feed company (Company A) most preferred by shrimp farmers was also preferred by 71% of the tilapia pond farms, but by only 18% of the cage farms (Figure 4.20).

The preferred companies are considered the best among the feed companies in Thailand, having received a number of certifications and recognitions. The development of the feed industry in Thailand is described and explained in more detail in Chapter 3.

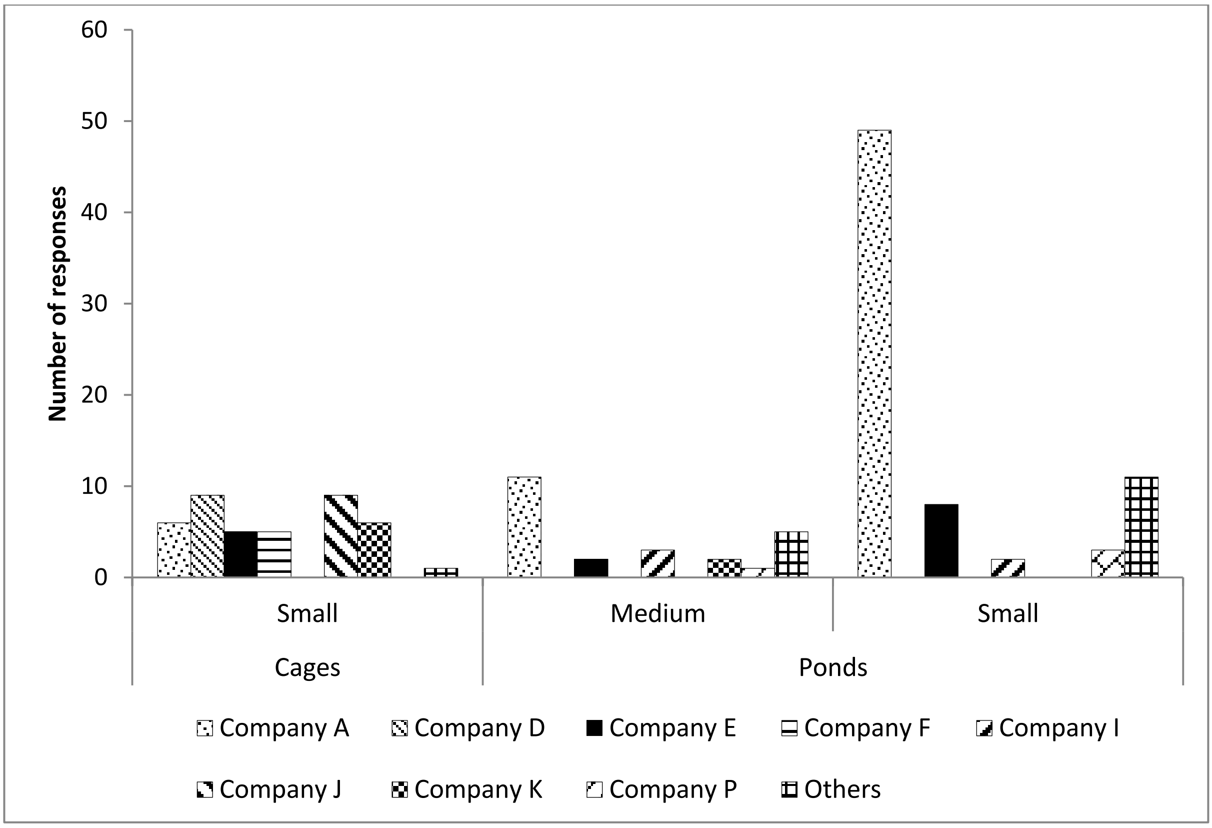

Figure 4.20 Tilapia feed manufacturer preference

n, cages=34 , ponds medium=20, small=64 (multiple responses)

In this study, the large scale shrimp farms used feeds from three major feed manufacturers in Thailand. Based on the accounts of the respondents, the large scale farms have more direct access to these feed companies. Whereas for smaller scale farms, their access could be limited to the local feed suppliers and would entail more costs to them. Probably due to the need to reduce costs, these small scale farmers would be more vulnerable to the marketing ploys of feed sales agents, making them change their choices accordingly. This has probably to do with the business aspects in terms of quantity and frequency of orders, agreements, accessibility, brand loyalty, delivery and technical services, and negotiations between feed companies/sellers and shrimp companies and farmers. However, farmers still needed to be vigilant in choosing which manufacturers had feed certifications (issued by the DoF from random checking) to ensure that the feeds used were not contaminated/ adulterated.

4.5.7.5.2. Feed records

Shrimp farms were more likely to keep records regarding feeds than tilapia producers, i.e. large scale shrimp farms (100%), medium (95%) and small (73%) (Figure 4.21). For tilapia farms, 66% of cage farms, 56% of small pond farms and 30% of medium pond farms kept records about feed use. These percentages are based only on the total number of farms keeping records. It has to be noted that among tilapia pond farms, more small scale farms used commercial feed pellets than medium scale, which could probably be the reason why more small scale farmers kept records. Feed companies usually provided free record keeping books to farmers with ready to fill tables.

4.5.7.6. Traceability: Record keeping

Information on traceability from hatchery to processing is contained in the Fisheries Movement Documents, especially for shrimp production destined for export. The hatcheries provided the document called Fry MD to the growout producers every time post-larvae were sold. Then when the harvest in growout ponds were ready, the producers would report the information on pond area, production and harvest size, to the local office of the Department of Fisheries, to obtain an MD of growout harvest or production. Then the producers would give these documents to the buyers (brokers or market wholesalers or processors), who in turn would pass them on to the exporters. According to exporters interviewed, they would keep these documents, and could provide them to foreign buyers/ exporters when requested.

Traceability of goods used and processes occurring (outside and within the farms) during production could be achieved through regular record keeping. For those from outside the farm, this would require issuing certain documents or certifications such as from manufacturers of feed and other substances.

Within the farm, Figure 4.21 shows the farm data recorded by farm respondents according to farm scale. Most of the data recorded were water quality parameters and feed usage as these were asked in the survey. However other data such as financial information are also recorded among others especially for medium and large scale farms.

For shrimp, large scale farms consider the parameters water quality, stocking, mortality, growth, feed and chemical use (Figure 4.21) as equally important to record, whereas for the medium and small scale farms, stocking, feed and water quality were the most important.

For tilapia cages, stocking, feeding and chemical use were important to record. For medium-scale tilapia pond farms, stocking information was the most recorded, while for small scale pond farms, stocking and feeding were most recorded.

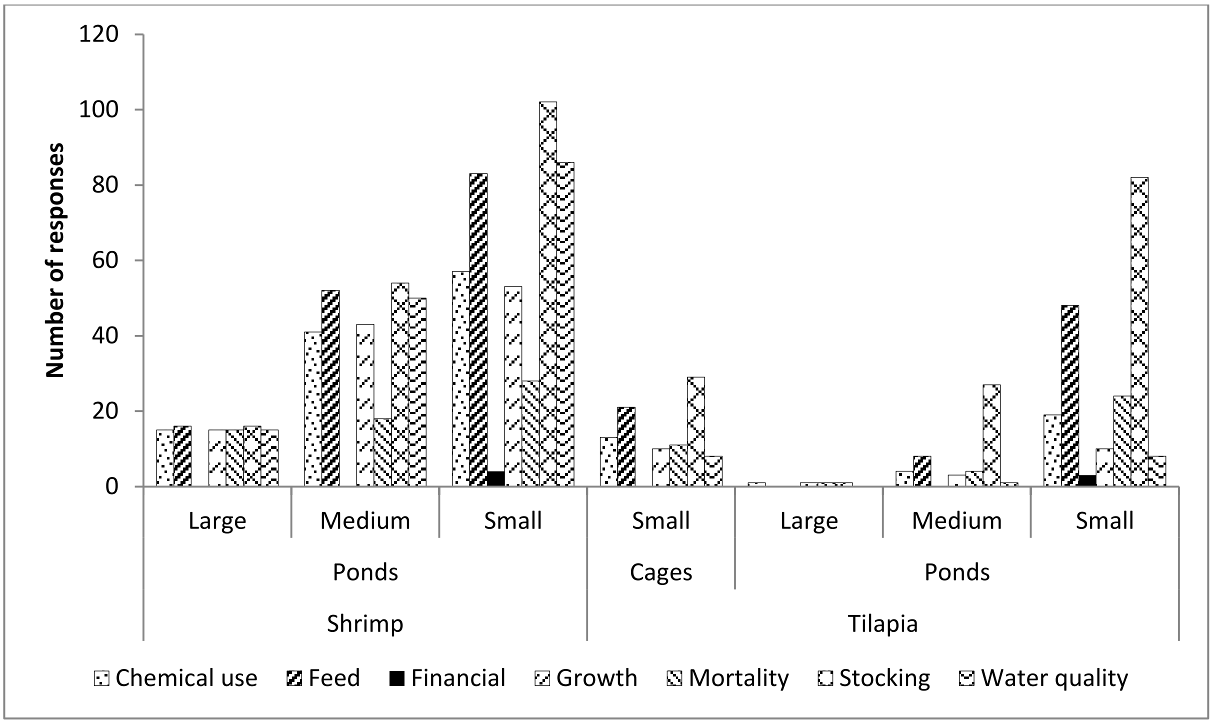

Figure 4.21 Record keeping by species and farm scales

N, shrimp: large=16, medium=60, small=130; N, tilapia: ponds-large=1, medium=27, small ponds=86, small cages=32 (multiple responses)

4.5.7.7. Energy use

The main sources of energy in shrimp farms were a combination of diesel and grid electricity, whereas for tilapia farms, diesel was the main source for pond farms and grid electricity for cage farms (Figure 4.22). In addition, shrimp farms also used other energy sources such as propane or liquefied petroleum gas (LPG) and gasoline. Small and medium scale farmers tried to reduce costs by combining energy sources rather than just depending on grid electricity alone. The majority of shrimp farms of all scales (76% small, 86% medium and 62.5% large) used a combination of energy sources to power farm activities.

All tilapia cage farms used grid electricity only (for lighting and air pump/stone aeration). Whereas the majority of small (61%) and medium (63%) scale tilapia pond farms used diesel only. The only large scale tilapia pond farm was using a combination of diesel and grid electricity (Figure 4.22).

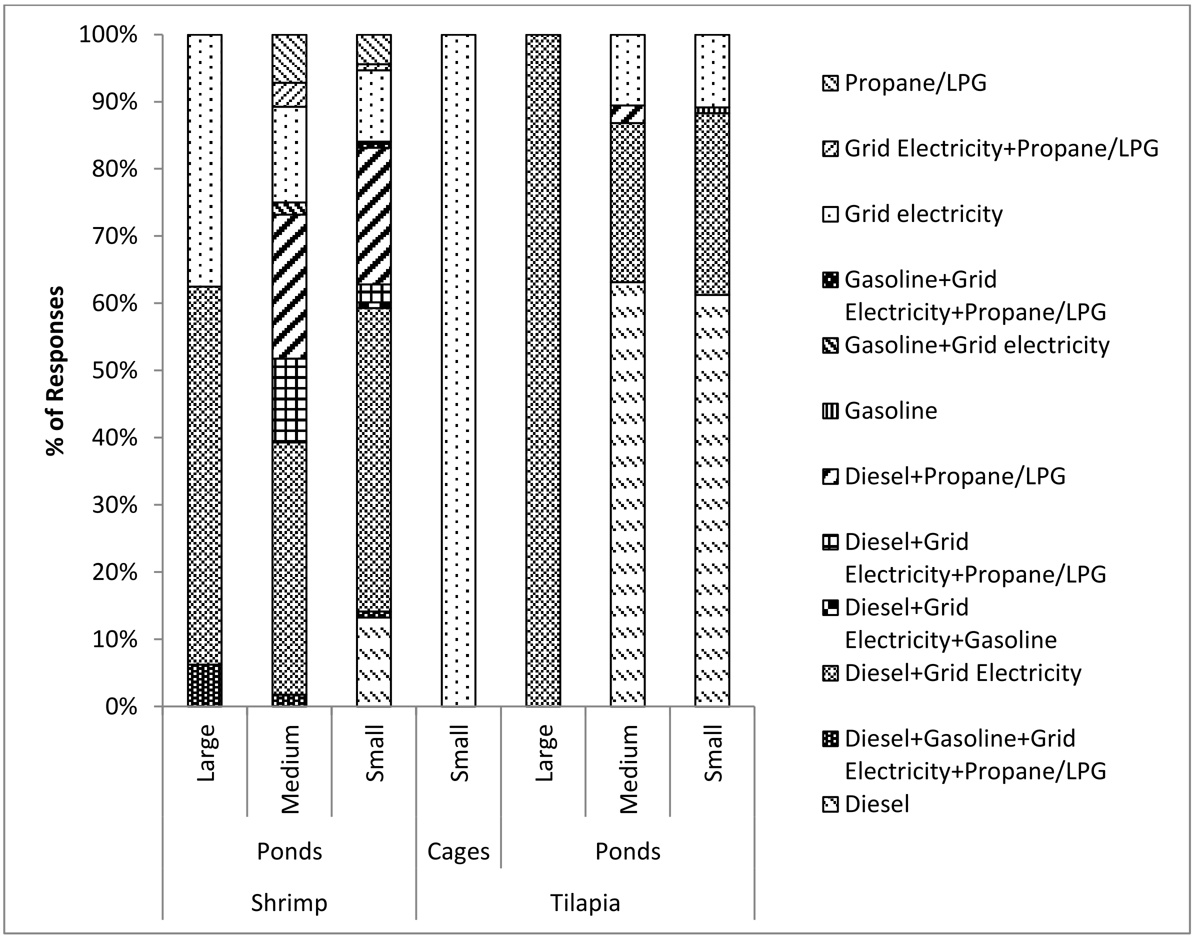

Figure 4.22 Sources of energy in shrimp and tilapia farms by farm scale

N, shrimp=185: large=16, medium=56, small=113; N, tilapia=186; ponds: large=1, medium=38, small=111; cages=36

Energy was used to conduct various farm activities; the main ones were aeration, feeding, generating power, lighting, operating farm vehicles, transportation and water pumping (Figure 4.23). The energy sources for each activity vary according to the primary species cultured and farm scale (Figure 4.23). Large shrimp farms mainly used grid electricity for aeration (100%) and lighting (62.5%), while they used both electricity (62.5%) and diesel

(50%) for water pumping. Medium shrimp farms used diesel mainly for water pumping (81%), whereas grid electricity and propane/LPG were used for aeration (54 and 44%, respectively). Small scale farms used diesel for water pumping (77%), a combination of diesel (35%), electricity (53%) and propane/LPG (30%) for aeration (35%), and grid electricity (30%) for lighting.

The lone large tilapia farm used grid electricity for aeration, feeding and lighting, and diesel for farm vehicles and water pumping. Diesel was mainly used for water pumping by 89.5% of medium scale pond farms and 92% of small scale pond farms (Figure 4.23).

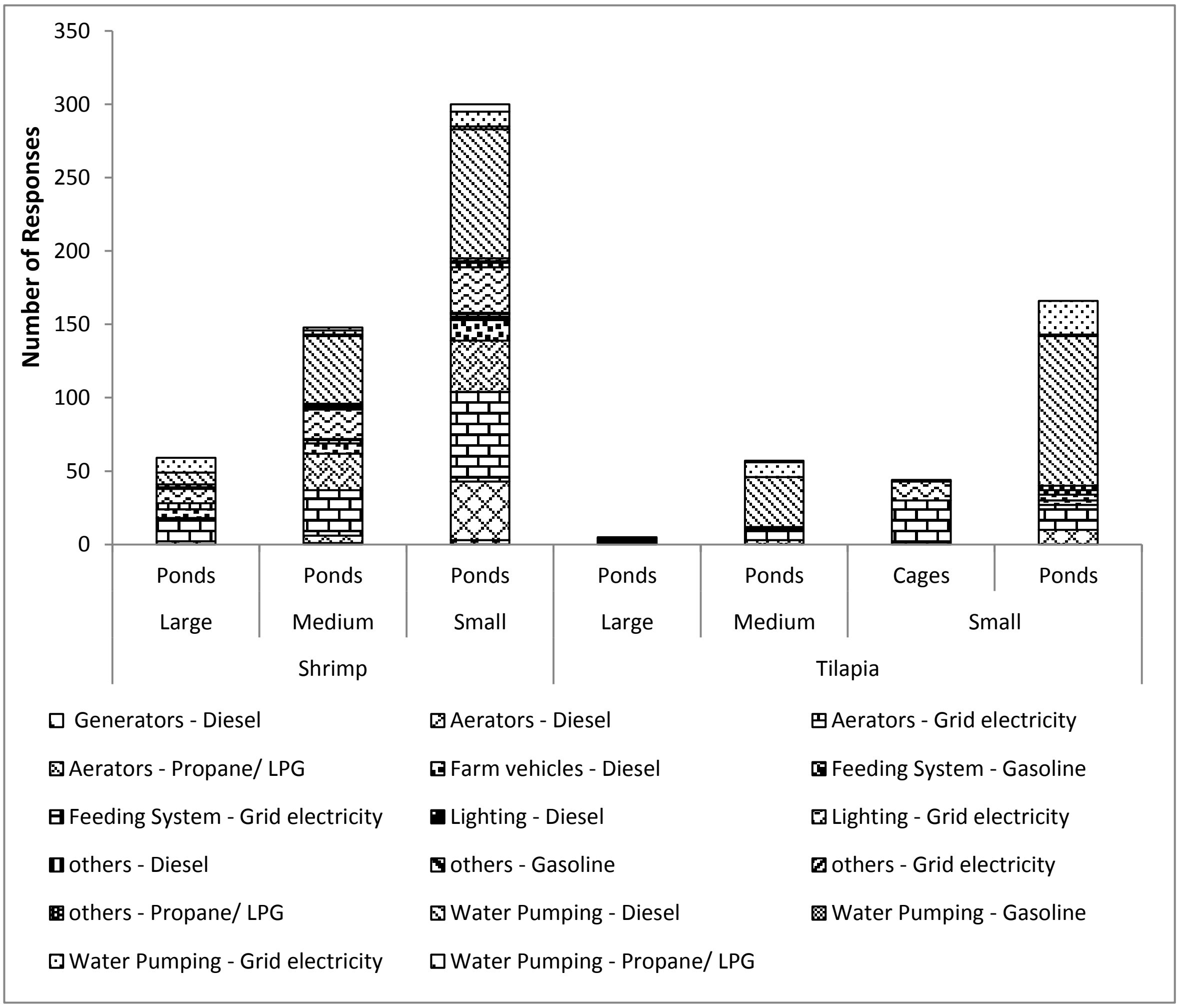

Figure 4.23 Uses of energy in shrimp and tilapia farms according to farm scales
N, shrimp: large=16, medium=57, small=115; N, tilapia: large=1, medium=38, small ponds=111, small cages=34 (multiple responses)

4.5.7.8. Predator control

Farmers and operators had to employ various ways to guard or protect their farms against animal predators and human poachers. These ways depend on species cultured and farm scales (Figure 4.24). Table 4.11 shows the number of precautionary measures employed according to farm scale. The measures taken by farms reflected the value of the species being farmed and the intensity of operations, i.e. there are more measures taken to protect shrimp farms and tilapia cages as there is more threat of theft and poaching due to the higher value of their stock.

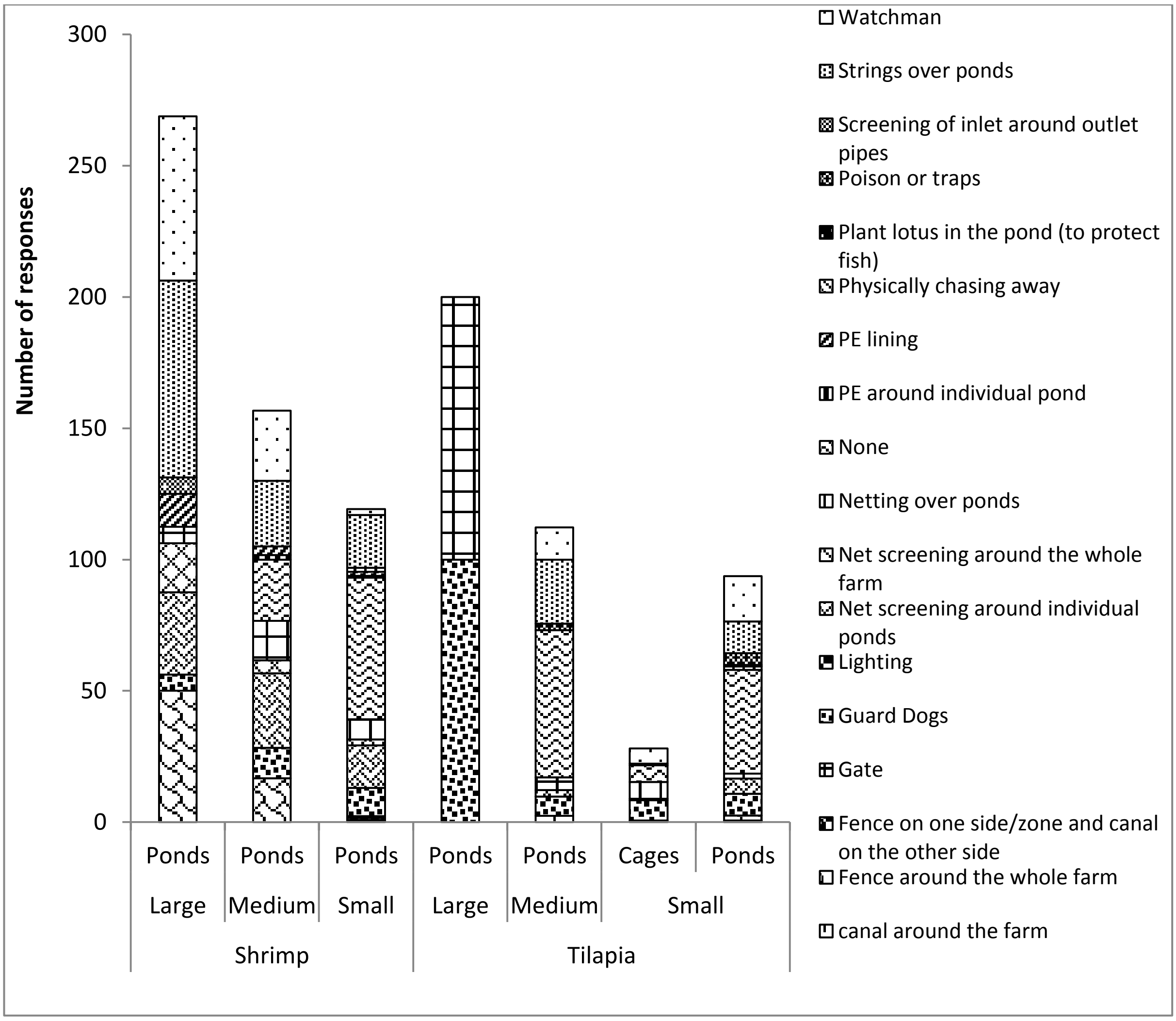

Figure 4.24 Precautions taken by farms against predation and poaching by farm scale

N, shrimp: large=16, medium=60, small=130; N, tilapia: large=1, medium=41, small ponds=119, cages=38 (multiple responses, weighted data)

Large scale shrimp farms were more concerned about predation and poaching, thus all the large scale shrimp farms had precautionary measures to prevent both. Whereas, only 77% of medium and 45% of small scale farms had such precautions.

Larger farms were more likely to use at least one form of predator precaution. The main precaution against predation used by shrimp farms (75% large shrimp ponds) was having strings over the ponds to prevent avian predation. For poaching, 63% of large shrimp farms had a watchman while 50% had fences around the whole farm. Among the medium scale farms, the main measure was screening around individual ponds (49%) and having a watchman (35%). For small scale, the main measure used was strings over pond (44%) and screens around individual ponds (36%).

For tilapia farms (Figure 4.24), the one large farm had guard dogs and netting over ponds. Cage farms were more cautious with 74% having measures while medium and small scale pond farms were less cautious, with only 44% and 48%, respectively, had precautionary measures. The most common measures among cages were having guard dogs (43%) and netting over cages (36%).

Table 4. 11 Number of precautionary measures used by farms to avoid predation and poaching

Species	Farm Scale (% of n)[1]	Predation	Poaching	Predation + Poaching
Shrimp	Small (45%)	3	3	4
	Medium (77%)	2	2	3
	Large (100%)	3	2	3
Tilapia	Small-pond (48%)	4	3	2
	Medium-pond (44%)	3	2	2
	Large-pond	1	1	-
	Cages (74%)	1	3	2

[1] n, shrimp: large=16, medium=60, small=130; n, tilapia: large=1, medium=41, small ponds=119, cages=38

4.5.7.9. Fish welfare issues: Fish health management and welfare

4.5.7.9.1. Certified free from disease

The Specific Pathogen Free (SPF) broodstock of Pacific white leg shrimp (*Litopenaeus vannamei*) imported by large hatcheries into Thailand was assumed to ensure that the shrimp broodstock were free from at least nine diseases (pathogens) that commonly plague shrimp stock. Polymerase chain reaction (PCR) checks of post-larvae prior to stocking into the growout ponds are also common to ensure that there are no pathogens of these common diseases present. Figure 4.25 shows that the majority of shrimp farms from all scales had their PLs checked by PCR method to detect any pathogen and to ensure that the PLs are disease-free before stocking into the ponds.

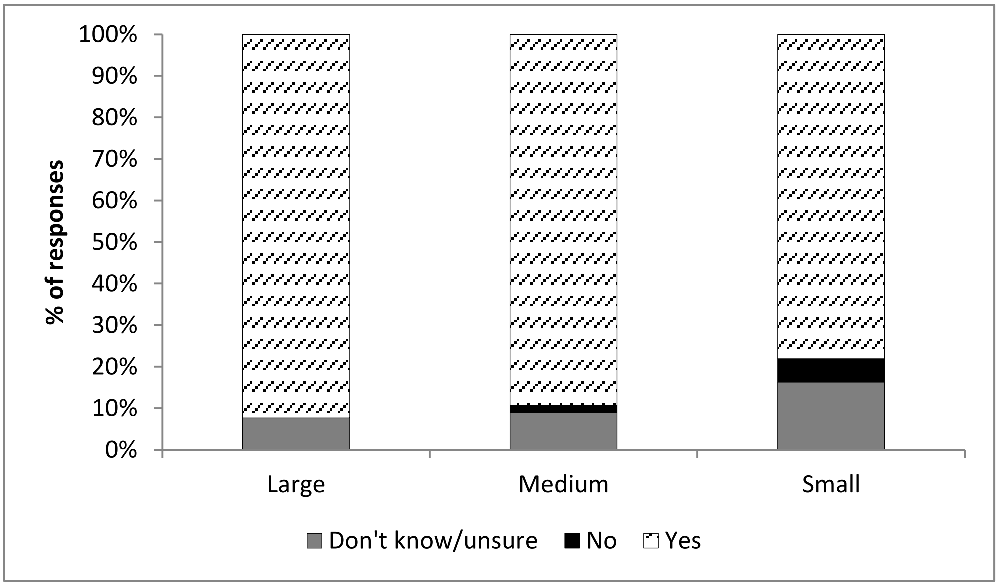

Figure 4.25 Shrimp farms checking PLs by PCR method

n: large=13; medium=56; small=123

4.5.7.9.2. Diagnostic services and capacity

In terms of diagnostic services, Figure 4.26 shows that various services are available to shrimp and tilapia farmers, although there were respondents from all farm scales who responded that using diagnostic services was not applicable to them, i.e. 42% from small, 35% from medium and 6% from large scale farms.

The most popular were those provided by professional services such as from companies, universities and other research facilities. This is especially true for large shrimp farms (62.5%). In addition, 25% of the large shrimp farms had their own trained health specialists, and nearly 20% obtained services from feed companies. For small and medium scale shrimp farms, diagnosis support from feed companies was the most common (38% from each scale), followed by services from professionals and universities (23% medium and 26% small).

For tilapia farms, obtaining services from professional organisations, universities and other research facilities was the most common (47% cage farms, 26% small scale pond farms and 22% medium scale farms). In addition, 49% of cage farms obtained diagnostic services from feed companies.

The importance placed by the farms on professional diagnostic services from universities and research institutes, especially among the shrimp farms, was observed. Whereas for tilapia, a large majority of the small and medium scale farms might not be aware of either doing proper diagnostics or where to obtain them.

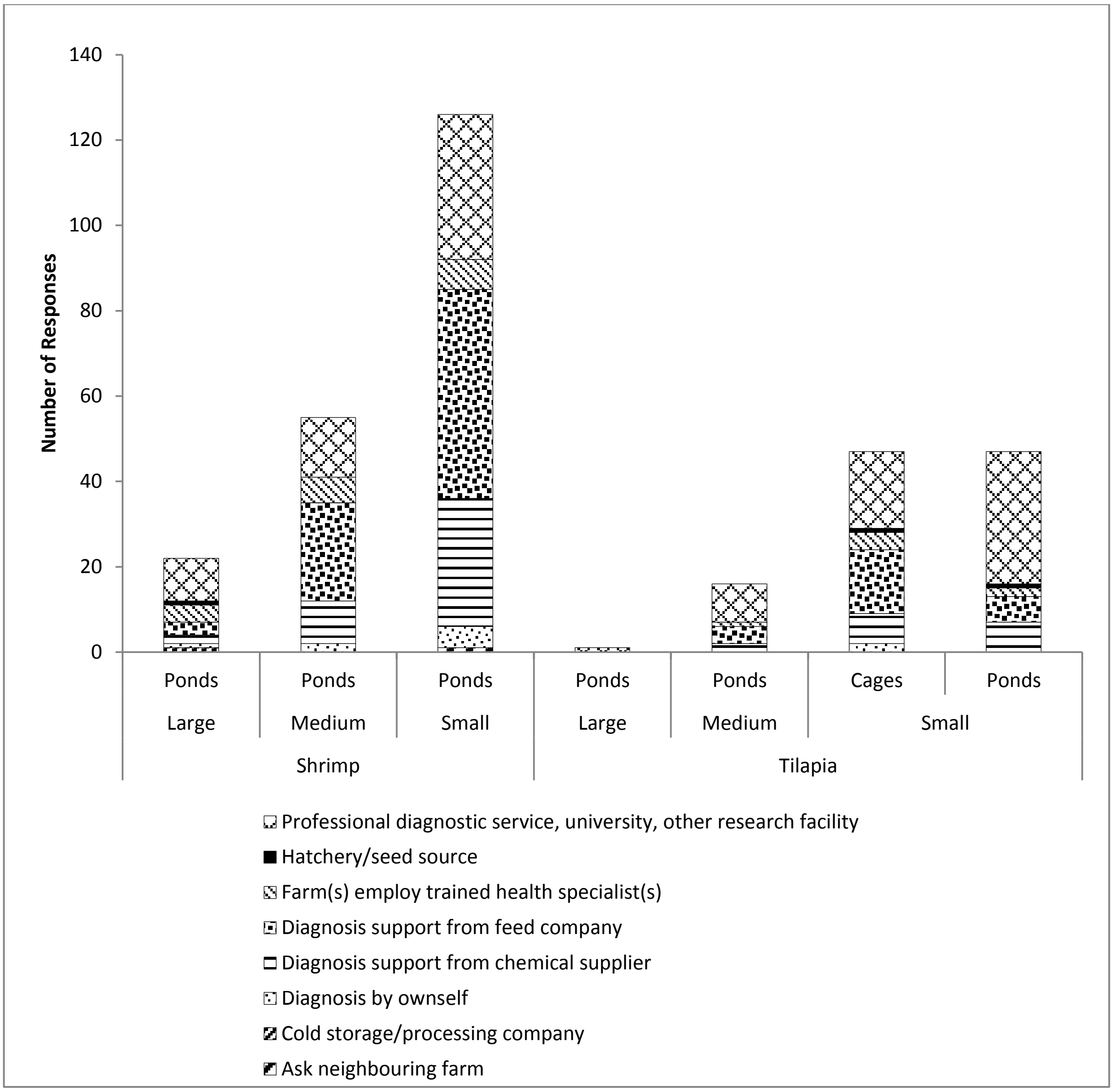

Figure 4.26 Services available to shrimp and tilapia farmers for diagnosing disease problems

n, shrimp: large=16, medium=60, small=130; N, tilapia: large=1, medium=41, small ponds=119, small cages=38 (multiple responses)

4.5.7.10. Biosecurity

4.5.7.10.1. Pond lining in shrimp farms

Pond lining is one feature of intensification and improved biosecurity in shrimp farms, to reduce exposure to disease pathogens especially coming from the soil. Among the shrimp farms surveyed, a large number of small scale farms still did not use pond liners in their grow-out ponds. Figure 4.27 shows the lining situation in grow-out ponds according to farm scale. Based on weighted data, a large majority of small-scale farms (90%) did not line their ponds, whereas for medium scale farms, 40% used lining. Use of polyethylene lining is even higher among large farms (69%).

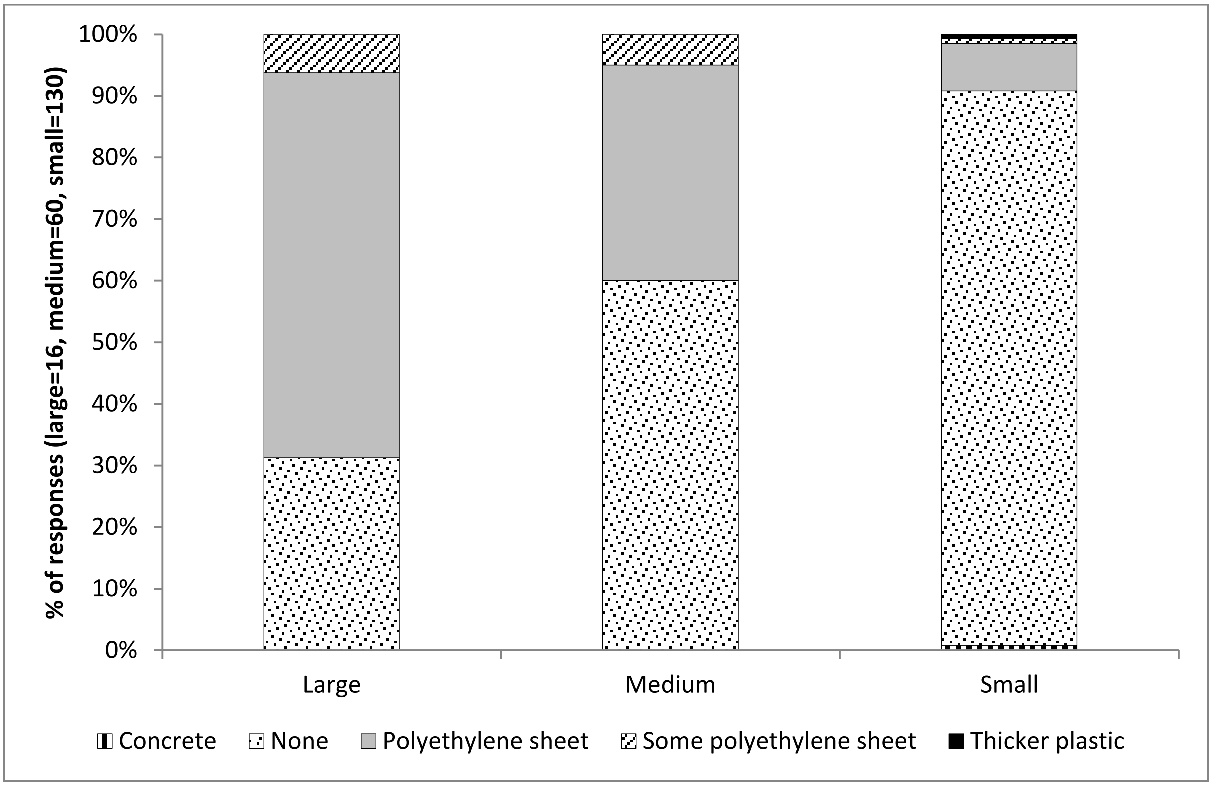

Figure 4.27 Pond lining in shrimp farms used for grow-out production according to farm scales

4.5.7.10.2. Other biosecurity measures

One of the distinguishing features of shrimp farms is the appearance of (red) strings over the ponds. The main purpose is to prevent birds flying into the ponds for direct predation and transfer of pathogens, as birds could be potential carriers of pathogens. As mentioned in Section 4.6.8 having strings over ponds is one of the most common precautionary measures against predation, and in this case, it is also one of the biosecurity features in farms. Even tilapia farms install strings over their ponds especially if doing a polyculture with shrimp. Although this is a popular feature, the effectivity of this method in preventing predation and disease was not measured during the survey.

A number of measures presented in Section 4.5.7.8 (Figure 4.24) could also be considered biosecurity measures as they help to prevent the entry of potential disease carriers (Figure 4.28).

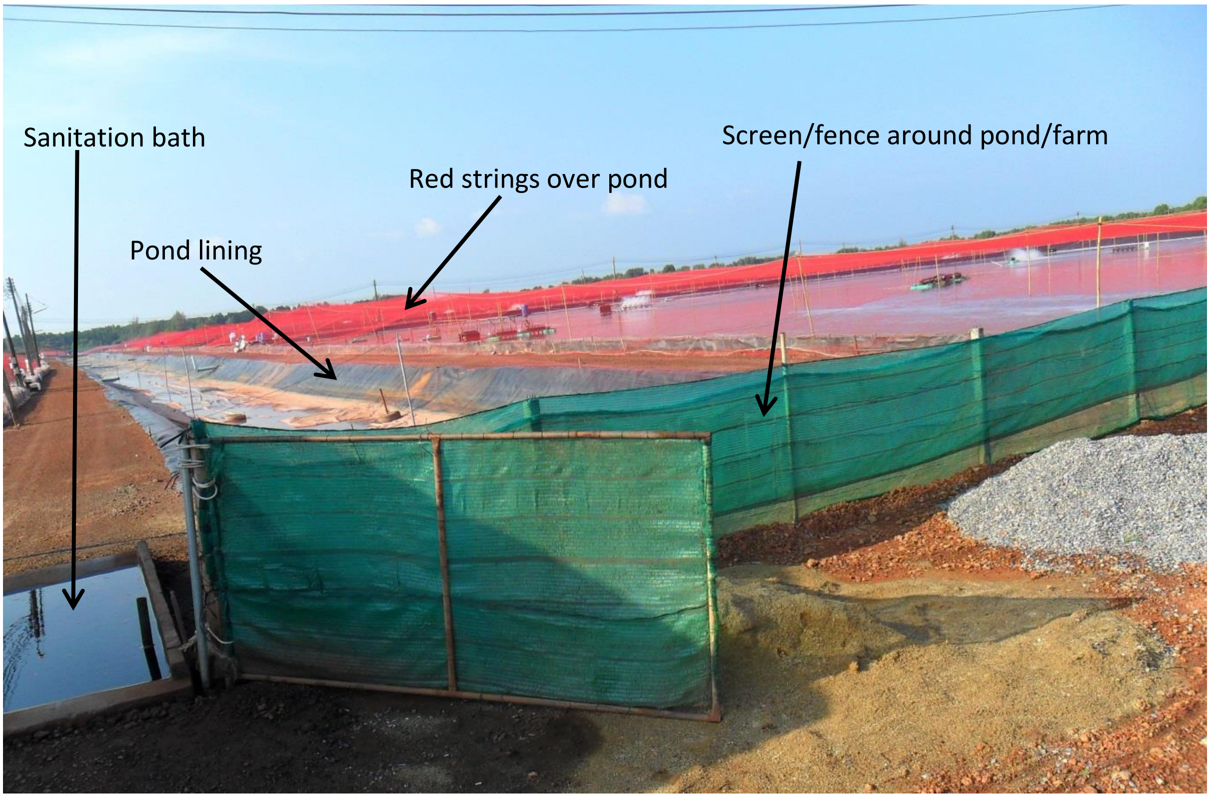

Figure 4.28 A large scale shrimp farm with biosecurity features

4.5.7.10.3. Mortalities

As for stock lost during the culture period, various ways are being used by the farms to handle them (Figure 4.29). Among shrimp farms, the most common approach to dealing with lost stock was to leave them in the pond and disinfect (46% large scale farms), or to sell to middlemen (39.5% medium and 30% small). Shrimp farms rarely re-used dead stock as on-farm fertiliser and never fed them back to cultured species or other species.

For tilapia farms, the lone large farm used them as on-farm fertiliser, while 40% of medium pond farms left them on the pond dyke, 25% of small pond farms burned or buried them, and 39.5% of cage farms used them as fertiliser on their crops.

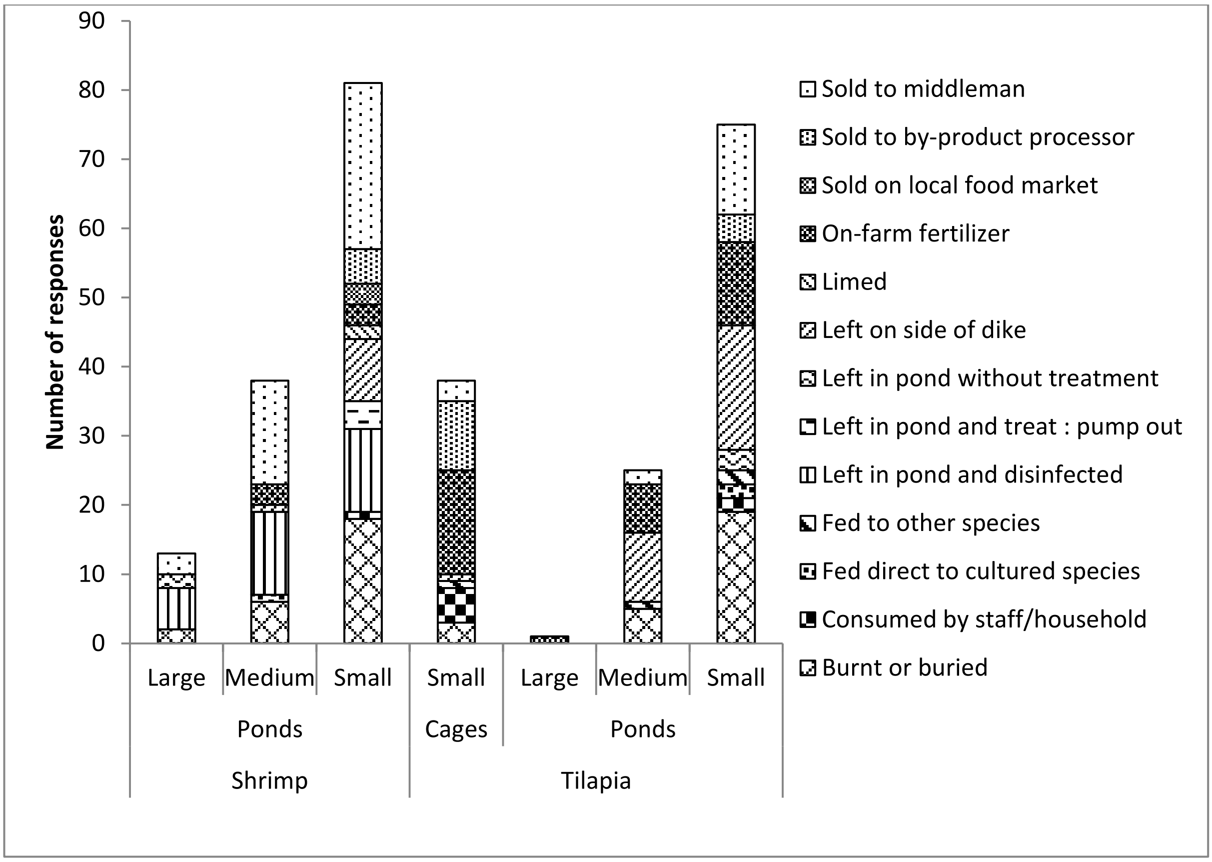

Figure 4.29 Fate of stock lost during culture period

N, shrimp: large=13, medium=38, small=81; N, tilapia: large=1, medium=25, small ponds=76, small cages=38 (multiple responses)

The information in Figure 4.29 shows that there is potential for recycling of resources not only within the aquaculture farm system, but also with other subsystems such as agriculture and/or livestock. Figures 4.30 and 4.31 show that tilapia and shrimp farms, respectively, which have agricultural activities, have potential to re-use lost stock as fertiliser but not all of them make use of this potential. The tilapia farms are more efficient in re-using the lost stock as on-farm fertiliser than shrimp farms.

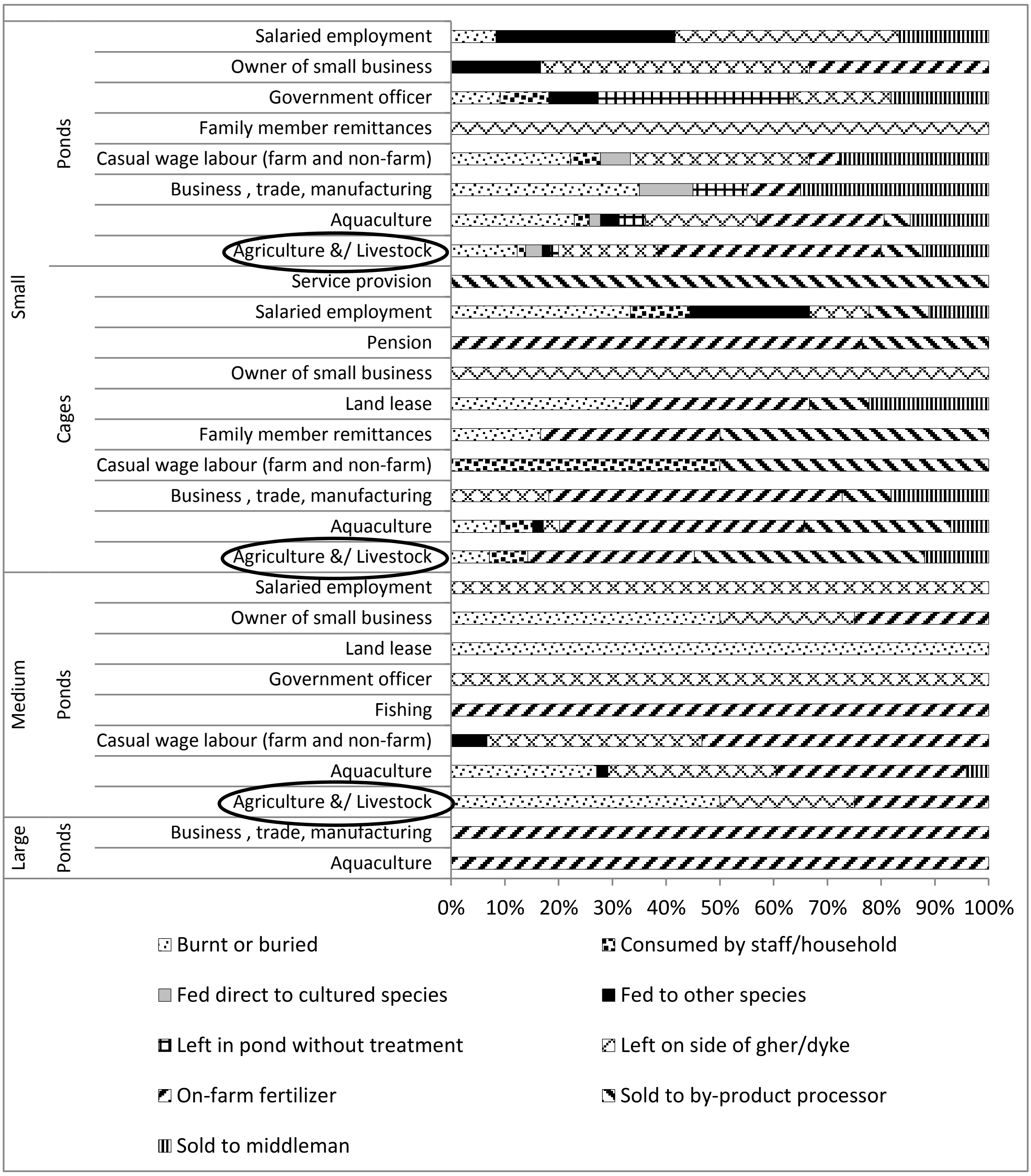

Figure 4.30 Livelihood activities of tilapia farmers

Note: % of responses, multiple responses (n=562)

Figure 4.31 shows the other livelihood activities of shrimp farmers, and the fact that the lost shrimp stock still has economic value, as they can still be sold by the majority of the farms.

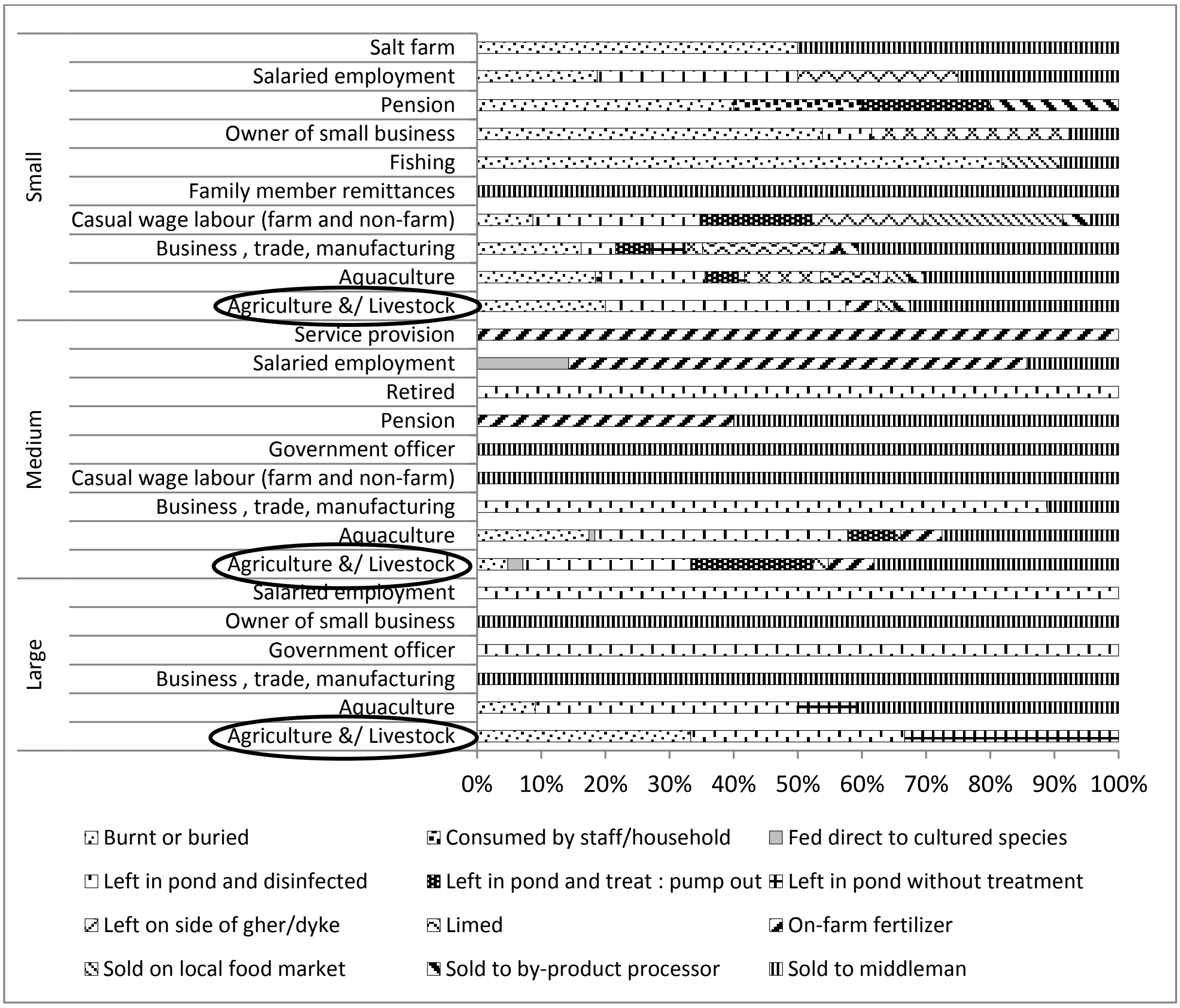

Figure 4.31 Livelihood activities of shrimp farmers
Note: % of responses, multiple responses (n=586)

Although not specifically asked during the surveys, there were also observations and anecdotal evidence regarding measures to ensure cleanliness and sanitation as well as protection from potential pathogens on farms, especially in shrimp farms. Outside equipment for example including sampling containers and DO and pH meters were not allowed to touch the culture water. Instead, each pond has its own bottle to be used to collect water samples. This was more common among large scale farms. Such measures were much less common on small and medium scale farms. Workers also revealed restrictions on mobility within farms if infections occurred to reduce the likelihood of cross-contamination of these areas. In larger farms, vehicle sanitation baths at farm entry points were common.

4.5.7.11. Status of surveyed farms according to selected certification standards in aquaculture

The summary of information on current farm practices presented in Section 4.5.7 is shown in Table 4.12. The information shows how the various shrimp and tilapia farms perform in terms of their compliance to some criteria in the global certification standards. It also addresses the main research hypothesis in this chapter, i.e. that the large scale farms are more likely to comply with global certification standards than the small scale farms.

The main areas where all the shrimp farms have ease in compliance were: effluent discharge within the farm only, water quality monitoring, and pond sludge management within the farm only. The main areas where large scale shrimp farms have the advantage over the medium and small scale farms, were in the legal aspects on registration and traceability, effluent treatment, record keeping, predator control, fish welfare issues, and biosecurity. For tilapia, the cage farms are more efficient in biosecurity regarding the disposal of mortalities, and they are much better than pond farms in record keeping, predator control, and availing of diagnostic services. However, biosecurity could not really be ensured during production as ponds and cages are open systems (exposed to natural elements). Areas that tilapia ponds are efficient include effluent discharge and pond sludge management, which are done within the farm and not released outside.

Table 4. 12 Summary of outcomes in relation to compliance criteria of certification standards

REQUIRED STANDARDS FOR COMPLIANCE	SHRIMP			TILAPIA		
	Small	**Medium**	**Large**	**Small (ponds)**	**Medium (ponds)**	**Cages**
Legal aspects	n=114	n=49	n=13	n=24	n=13	n=11
Registration with Department of Fisheries (GAP + MDs)	95.6 %	92.0%	100.0%	-	-	-
Registration with Department of Fisheries (GAP, no MDs)	1.7%	6.0%	-	50%	23%	36.4%
Environmental Management						
Effluent Management:						
- Treatment	24.2% (n=95)	24.0% (n=50)	71.4% (n=14)	10.7% (n=84)	17.9% (n=28)	n.a.
- Discharge – within farm drainage system	99% (n=81)	97% (n=39)	100% (n=15)	99% (n=70)	100% (n=26)	n.a.
- Agreement for synchronised discharge	12.6% (n=87)	6.1% (n=49)	13.3% (n=15)	7.1% (n=84)	0 (n=29)	n.a.
Water quality monitoring	100% (n=130)	100% (n=60)	100% (n=16)	7.6% (n=119)	4.9% (n=41)	15.8% (n=38)
Pond sludge management:	n=114	n=54	n=16	n=77	n=26	n.a
- Within farm	95%	98%	100%	97%	96%	
- To crop fields	5%	2%	-	3%	4%	-
Farm Management						
Feed Management:						
- Preference for better feed manufacturers	85% (n=130)	81% (n=72)	88% (n=18)	80% (n=71)	72% (n=21)	86% (n=41)
- Feed records	73% (n=114)	95% (n=55)	100% (n=16)	56% (n=86)	30% (n=27)	66% (n=32)
Record Keeping	88% (n=130)	92% (n=60)	100% (n=16)	72% (n=119)	66% (n=41)	84% (n=38)
Energy Use	n=113	n=56	n=16	n=111	n=38	n=36
- Single source (electricity)	11%	14%	37.5%	11%	11%	100%
- Single source (diesel)	13%	-	-	61%	63%	-
- Combination of sources	76%	86%	62.5%	28%	26%	-
Predator control	45% (n=130)	77% (n=60)	100% (n=16)	48% (n=119)	44% (n=41)	74% (n=38)
Fish welfare issues						
Certified free from pathogen (PCR testing – shrimp only)	78% (n=123)	89% (n=56)	92% (n=13)	n.a.	n.a	n.a.
Diagnostic services availability/ capacity	58% (n=130)	65% (n=60)	94% (n=16)	28% (n=119)	29% (n=41)	74% (n=38)
Biosecurity: *Disease control*						
- Pond lining-shrimp farms	10% (n=130)	40% (n=60)	69% (n=16)	n.a.	n.a.	n.a.
- Mortalities	62% (n=130)	63% (n=60)	81% (n=16)	64% (n=119)	61% (n=41)	100% (n=38)

4.5.8. Trends and transition survey: changes occurring among farms

4.5.8.1. Trends and changes 5 years before the IFS (2005-2010)

During the 2010-2011 IFS, respondents were asked regarding the changes that have occurred over the last 5 years in their farms and operations, namely: land holding and use patterns, farm infrastructure, aquaculture production patterns, labour patterns, feed management, water management and chemical and substance use and management.

Among shrimp farmers, the majority of them cited changes in feed management (52%), production patterns (49%) and labour patterns (41%) during the period 2005 to 2010 (Figure 4.32). These were followed by chemical use and management (31%), land holding and use pattern and farm infrastructure (21% each), and water management (13%).

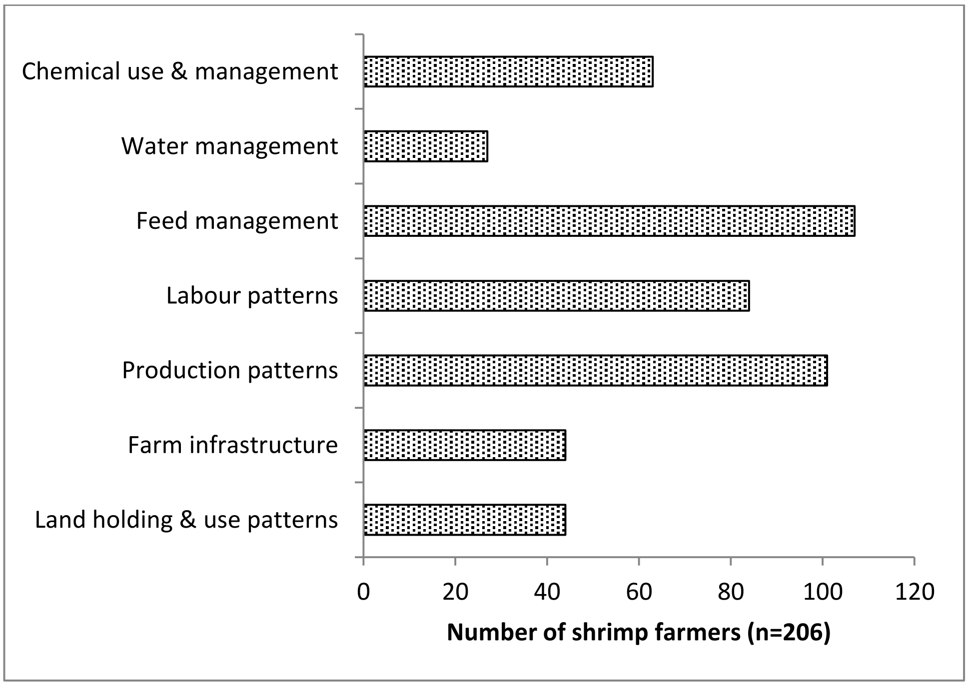

Figure 4.32 Changes in shrimp farms during 2005 to 2010

The changes which occurred in shrimp farms varied according to farm scales (Fig. 4.33). The top three changes for large farms were labour patterns (75%), production patterns (50%) and feed management (50%), whereas for medium farms, changes were mainly in production patterns (65%), feed management (55%) and labour patterns (53%). For small farms, most changes were in feed management (51%), production (42%) and labour patterns (31%).

For shrimp farms, the majority of changes in labour patterns included the following (n=117):

- Changed the labour/worker (18%)
- Increased the number due to increase in area, and more production (13%)
- Moved towards more hired labour from either no hired labour or use of exchanged labour as previously did by own self (8%)
- Reduced labour due to autofeeder, or managed by owners themselves (7%)
- Changes in the type of labour (from Thai to migrant worker) (2%)
- Changes due to cultural and working/life style differences
- Increased labour costs
- Increased difficulty in finding workers
- Increased seasonal hiring

Changes in chemical use and management were the most important among small (27%) and medium (42%) farms, whereas for large farms, the next most important change was in farm infrastructure (31%). The least changes occurred in water management in all farms (10% small, 20% medium and 13% large).

For chemical use changes, the main trends for shrimp farms were (n=109):

- Use of probiotics instead of other types of chemicals
- Changes in the brands of probiotics and other substances used
- Chemicals were used only when problems occurred
- Decreased use of any substances
- Use substances now but before did not use
- Increased use of substances or using more now than before

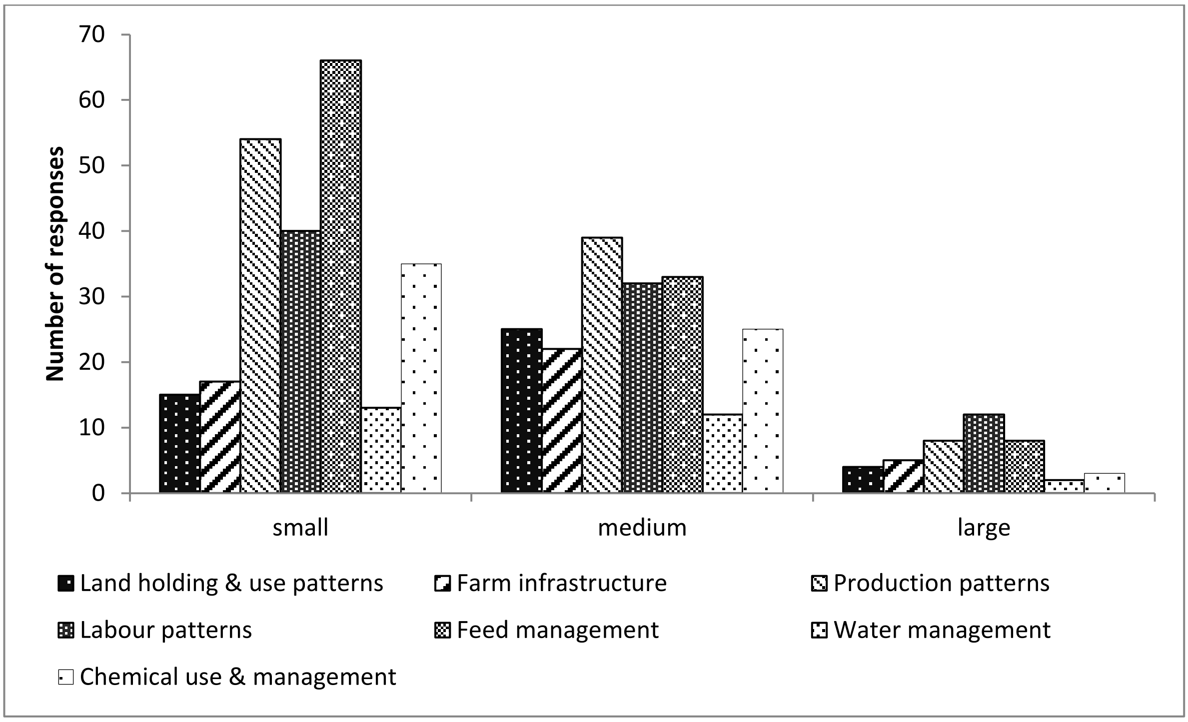

Figure 4.33 Changes in shrimp farms in various categories during 2005 to 2010

For tilapia farmers, the changes in various categories faced by cage and pond farmers are shown in Figure 4.34. Farmers responded most about changes in production patterns and feed management, followed by land holding and use patterns, chemical use and management.

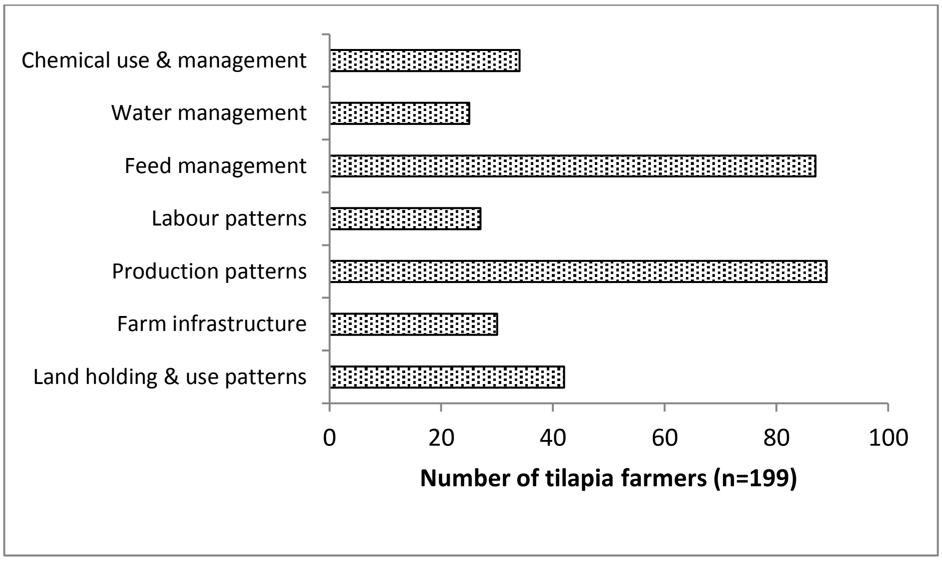

Figure 4.34 Changes in tilapia farms 2005 to 2010

Feed management changes were cited by the majority of cage farms (76%), but for pond farmers, changes in production patterns were most mentioned (39%) (Figure 4.35). The change occurring in feed management involved changing feed sources or brands, due to increased cost and lower quality of feed. For production patterns, the changes included lower production, increased production, change in seed sources and culture species, harvesting modes, and changed markets.

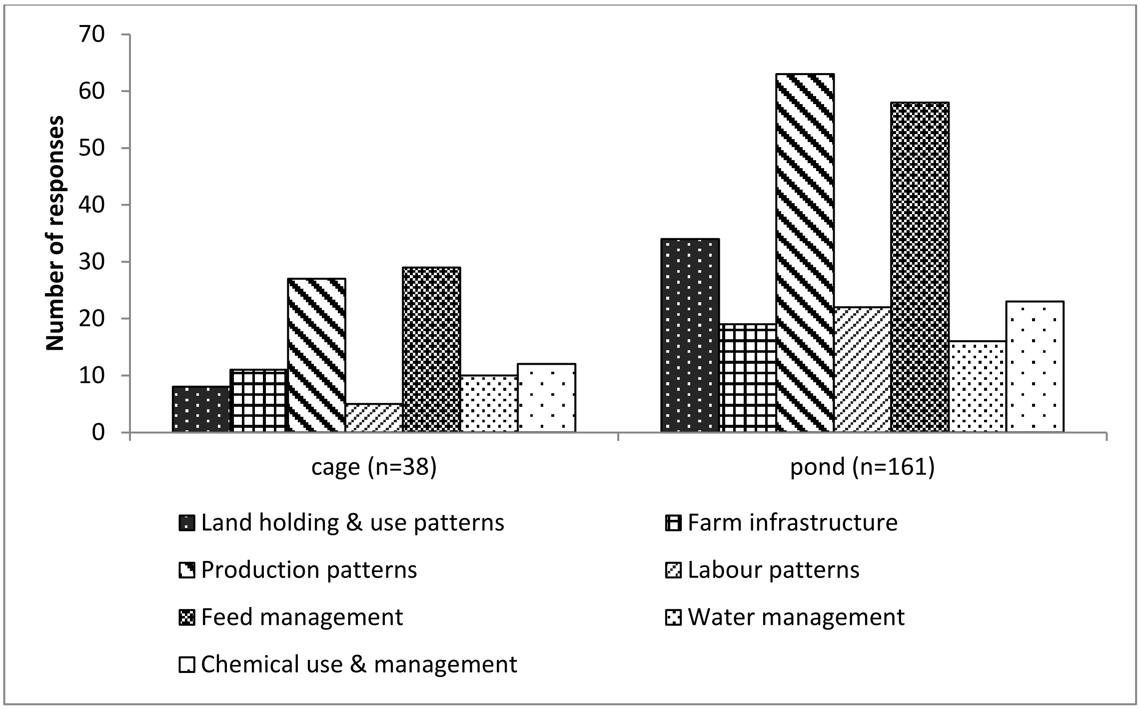

Figure 4.35 Changes in tilapia cage and pond farms during 2005 to 2010

4.5.8.2. Transition survey results of shrimp and tilapia farms (2013)

4.5.8.2.1. General changes

This section will report on the results of the transition survey which was described in Section 4.4.2.

Out of the 120 shrimp farm respondents interviewed by phone, the majority (82% large, 74% medium, 56% small) were farming as normal with some changes (Figure 4.36). There were also those who were farming as normal without any significant changes (18% large, 19% medium, 16% small). Ten farmers (7% medium, 10% small) stopped farming permanently. All farm scales had made changes but the small scale farms made more major changes than large and medium scale farms.

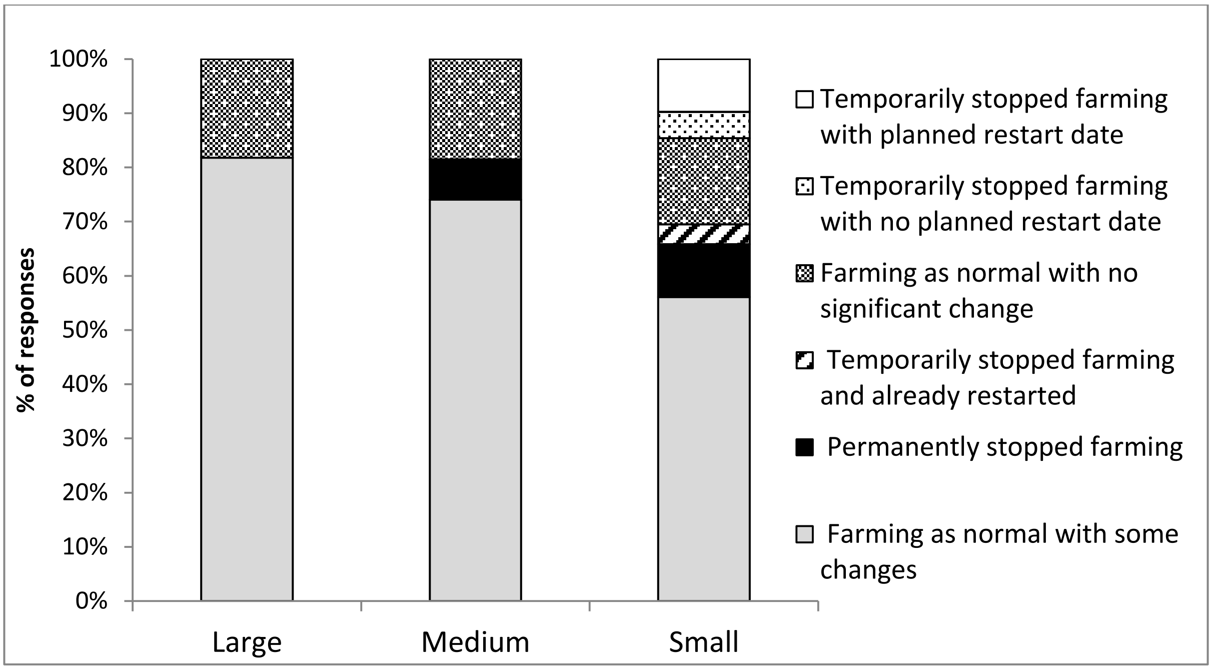

Figure 4.36 General status of shrimp farms two years after IFS

N: large=11, medium=27, small=82

For tilapia farms, based on data collected by Burana-osod et al. (2013), the majority (75% medium, 64% small, 55% cage) of tilapia farmers were farming as normal with no significant change. More cage farms had major changes than pond farms (Figure 4.37), ranging from some changes to permanently stopping farming. Whereas the majority of tilapia farms continued to farm as normal with no significant change or with some changes, 14% of cage farms had permanently stopped farming. The reasons for stopping were farm related (flooding, fish mortalities due to bad water quality), and personal (accident).

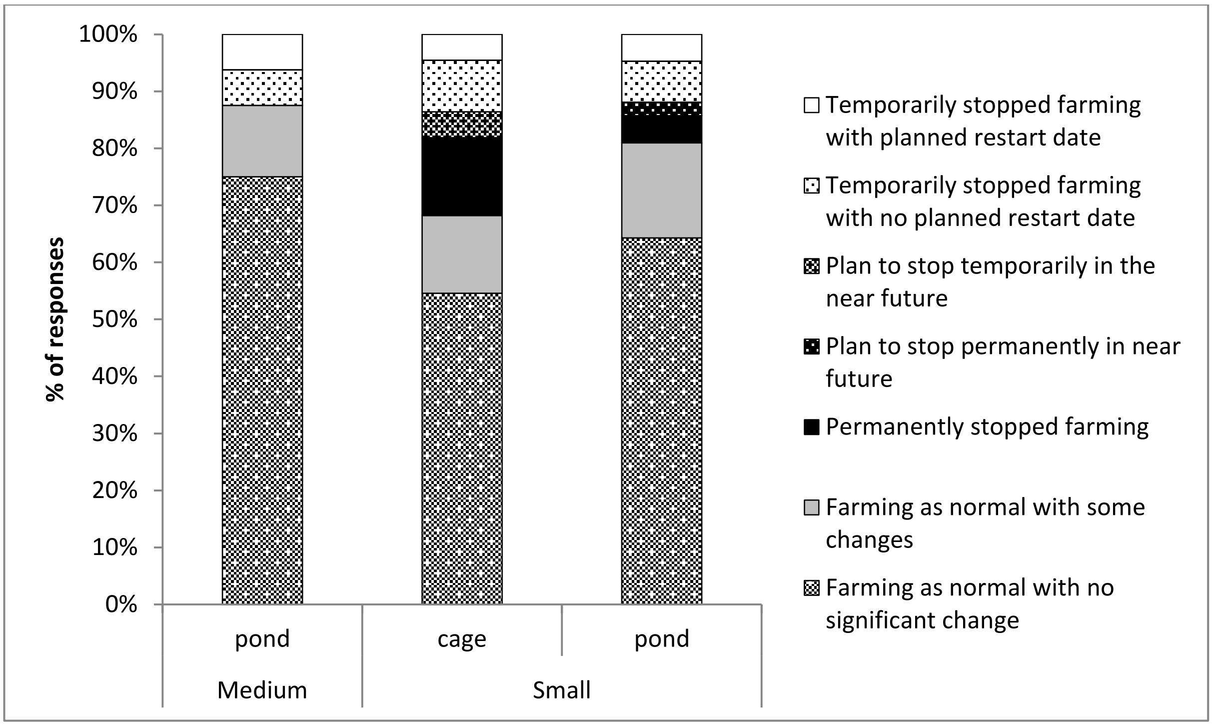

Figure 4.37 General status of tilapia farms two years after integrated farm survey

N: medium ponds=16, small ponds=42, cages=22

For tilapia farms which temporarily stopped farming, the main reasons are shown in Table 4.13. The water quality and supply issues were the main ones encountered by both the cage and pond farms, since the main water supply comes from the dam controlled by the Irrigation Department.

Table 4. 13 Reasons for stopping tilapia farming temporarily

Reasons	Details	System
Water supply & quality	• Water supply from dam was not available i.e. Irrigation Department did not open • Lack of water in canal from dam • Lack of supply water in canal because there is waste water instead • Adding water into pond caused fish mortality • Lack of oxygen in water led to fish mortality	Cages Ponds (small & medium)
Disease	• Caused mortality of tilapia • Bacterial infection	Cages
Weather	• Hot weather caused fish mortality	Ponds (medium)
Seed quality & supply	• Fry quality is not good • No fry to culture	Ponds (small)
Low price	• Price of tilapia is low so lost the investment	
Area	• Not enough farm area for culture	Ponds (small)

Source: Tilapia phone transition survey (Burana-osod et al., 2013)

4.5.8.2.2. Changes in farming practices

Regarding the changes shrimp farm respondents made in their farming practices over the past 2 years (2011-2012), Figure 4.38 shows that seed source (27.5%) and yield (27.5%) were the main changes, followed by FCR (22.5%), stocking density (21.7%), number of crops per year (20%) and feed related changes such as amount of feed input (17.5%), brand of feed (17%), feeding method (12%) and source of feed (9%).

Large-scale farms made the most changes (36.4%) including FCR (better for some, uncertain for some), seed source, predator exclusion over ponds, number of ponds and yield. For medium farms, seed source was the most common change (30%). Decrease in yield due to disease outbreak was the most common change experienced by small scale farms (27%).

Respondents (n=27) cited that the FCRs increased (i.e. feed conversion was less efficient) (30%) due to their stock were affected by diseases or feed quality was low, although 26% observed improved feed efficiencies (decreases in FCR e.g. from 1.8 to 1.5, or from 2.0 to 1.5.)

> "The FCR decreased because I changed my feeding method. I am now
> using an autofeeder and the amount of feed input has decreased."
> (Mr. W.S., a small-scale shrimp farmer)

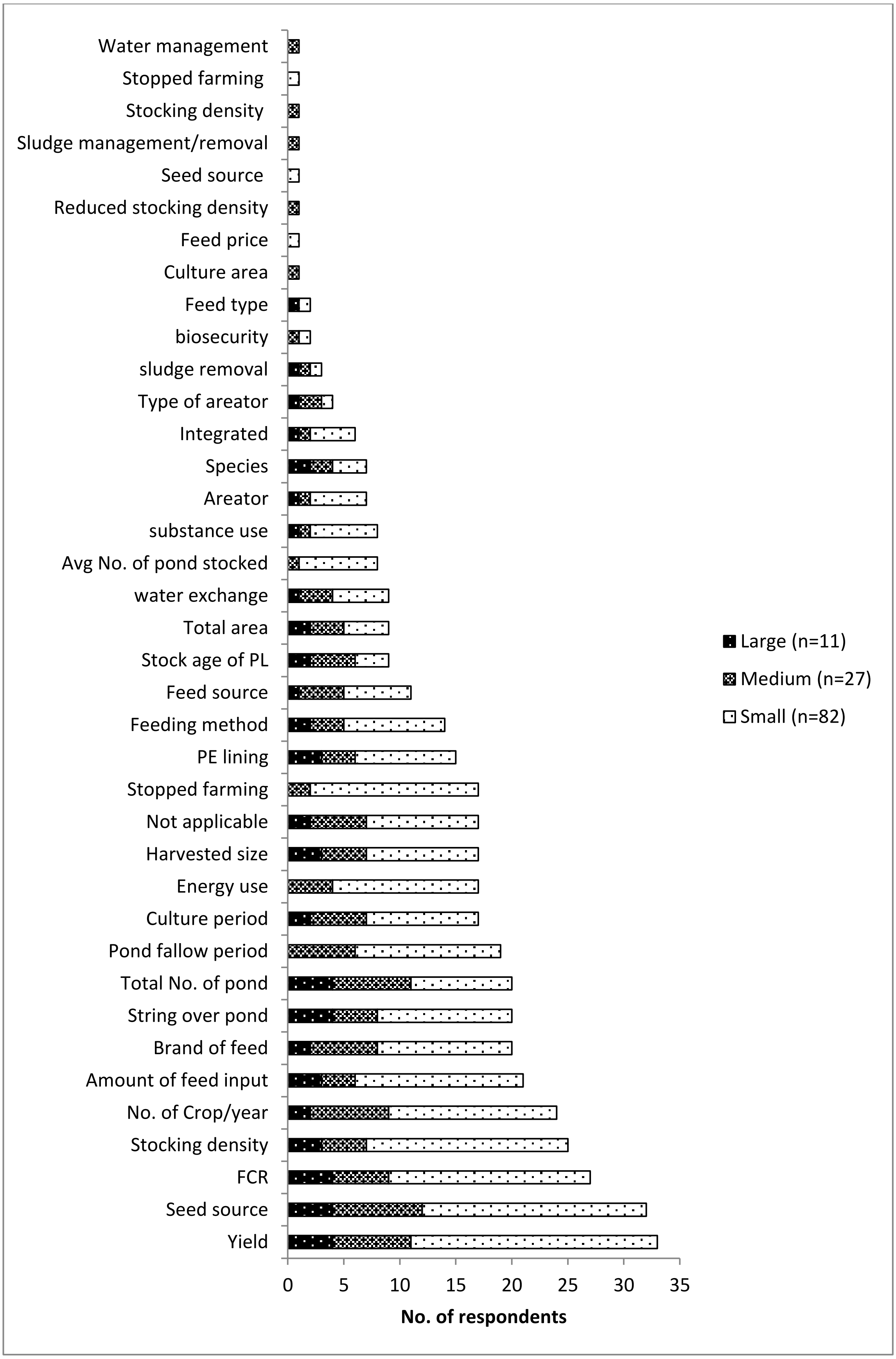

Figure 4.38 Changes that occurred in shrimp farms by farm scales

4.5.8.2.3. Marketing aspects

Regarding marketing aspects, 63 respondents mentioned changes occurring in this category, the majority of responses were related to product price, regardless of farm scale. This was also related to the responses regarding market fluctuation, as selling price was dependent on the market (Figure 4.39). Product quality was also mentioned, in relation to price as well as checking for residues depending on the buyer. Since the survey was conducted when the shrimp industry in Thailand was facing the EMS crisis, there has been the problem of supply in the market which had led to increased prices.

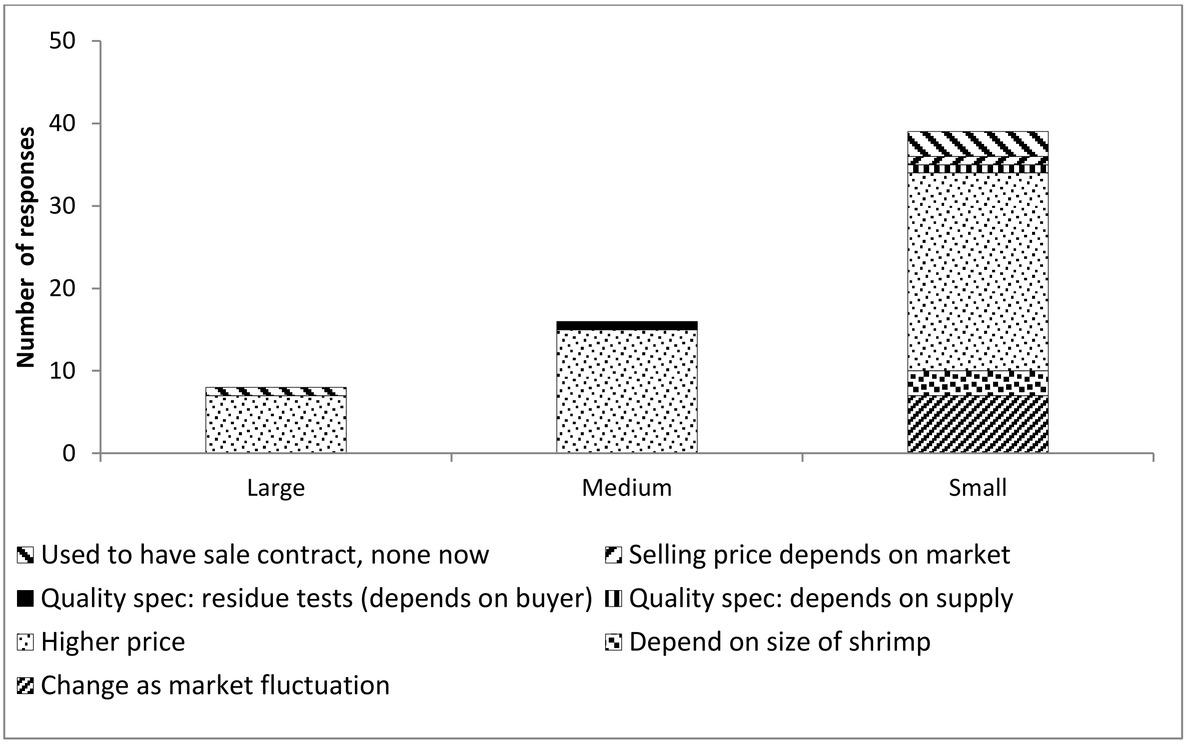

Figure 4.39 Changes in the marketing aspects of shrimp farming

n: large=8, medium=16, small=39 (multiple responses)

4.6. Discussion

4.6.1. Certification, standards and farming systems

Based on the summary of certifications and standards in Table 4.3, the focus species in this research are covered by global certifications and standards. All three standards, namely Best Aquaculture Practices (BAP), GlobalGAP and Aquaculture Stewardship Council (ASC) cover tilapia production, whereas only the first two cover shrimp production. This is evidence that these species can be regarded as key aquaculture species in the world. In the past, the main driver of development especially in shrimp aquaculture was to generate foreign exchange earnings for the producing countries as well as other financial benefits, but consumers in importing countries have been mainly ignored (Neiland et al., 2001). Nowadays, the rise of global certification and standards have been mainly driven by market and consumer demands and needs for a better quality food product which has been produced sustainably and ethically, although there are limitations to these certifications (Washington & Ababouch 2011; Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012; Bush et al. 2013). Looking at these standards and how they fit with shrimp and tilapia sustainable production, it could be seen that there is favour towards the environmental and management aspects, although the legal and social aspects (including human resources) were also covered. There are no specific guidelines or criteria related to the economic aspects such as costs and monetary benefits. Thus it could not be concluded that compliance to these standards equates to sustainable systems.

The Thai Government's response to market and consumer demands especially in the export market was to set-up various levels of aquaculture standards, from safety level to the local version of GAP (ThaiGAP), towards the Code of Conduct (CoC) and then on towards ThaiGAP Plus (any additional standards) (Yamprayoon and Sukhumparnich, 2010). On a regional level, there is the ASEAN-GAP and the ASEAN Shrimp Standards Project which are still being discussed in the region and yet to be implemented (Prompoj, 2013; USAID-MARKET, 2013). These are attempts to harmonise standards across the region, benchmarked with the FAO guidelines. The main producer-driven certification standard which has been recognised by the DoF is the Sustainable Shrimp Project (SSP) which is viewed as being complimentary to the ThaiGAP. This was developed by the Surat Thani Shrimp Farmers' Club based on their practice of promoting no chemical use in the shrimp production (Ekapoj Yodpinij, personal communication, 2010).

Whereas there are very few shrimp farms in this survey which have already received global certifications, there are more than 90% which have the ThaiGAP certifications given by the DoF. Of the shrimp farms surveyed during this research, the large scale farms were more likely to fit in the certification and standards guidelines into their operations. As Washington & Ababouch (2011) have stated that the costs of certification are paid by those upstream rather than those who demand certain product qualities, the cost of compliance is an issue for smaller scale producers. Therefore it is understandable that there is more compliance in shrimp farms compared with tilapia farms as shrimp has a higher market value compared to tilapia.

The stocking densities used by shrimp farmers in the survey (small scale 5 to 250 PLs/m^2, medium scale 31 to 120 PLs/m^2, large scale 50 to 125 PLs/ m^2 at stocking ages of PL2 to 20) are considered highly intensive stocking densities. Whereas densities in extensive systems are 1 PL/m^2, and intensive systems range from 22 to 31 PL/m^2 (Bosma et al., 2012). The ThaiGAP (ACFS, 2009) specifies that appropriate stocking age should be PL12 and density at this stage should be 50 to 94 PL/m^2, for a culture period of 120 days.

The mean grow-out days were over a wide range, i.e. 50 to 130 for small scale, 84 to 150 for medium, and 80 to 160 days for large scale, compared with the ponds reported by Thakur et al. (2010) which ranged from 76 to 126 days, although the ponds in their study were not classified according to farm scales.

Regarding the source of shrimp broodstock used by hatcheries, smaller shrimp farm operators were not aware of the source of broodstock, which could reflect on the farm operations competence or capacity, especially regarding traceability of stock. Domesticated broodstock programmes for white shrimp was one of the requirements by DoF to qualify for importing SPF white shrimp broodstock (Tookwinas et al., 2005). It is also important for biosecurity to know the source of broodstock and whether they are domesticated and SPF (Lightner, 2005), and should come from a credible source (Merican, 2007). It is possible that smaller scale farm operators obtain PLs from commercial hatcheries which buy broodstock through intermediaries.

4.6.2. Legal aspects

The Thai Government through the Department of Fisheries and other related agencies have implemented a policy on food safety from 'pond to plate', in order to achieve quality seafood products for consumers (Yamprayoon and Sukhumparnich, 2010). As per the criterion on legal aspects of the global standards and certifications, it was stipulated that farms should adhere to the laws of the land, i.e. in relation to environmental, documentation, land use, and farming related activities (ASC 2012; GlobalGAP 2012; GAA-BAP 2013). In this case, the local regulations refer to the Good Aquaculture Practices for Marine Shrimp by the Thai Agricultural Standards Bureau of the Ministry of Agriculture and Cooperatives, also known as TAS 7401-2009 (ACFS, 2009). The regulations in Thailand related to farm registrations regarding their food safety policy are linked with the traceability system initially implemented for shrimp production and processing, and later on expanded to other species, both food fish and ornamental species (Yamprayoon and Sukhumparnich, 2010). One notable aspect related to traceability is the issuance of Fisheries Movement Document (FMDs) at the hatchery and growout phases until the product is sold to the processing sector.

In this study, the majority (81%) of the shrimp farms regardless of scale responded that they had GAP registration with the DoF and used the FMD system. The farmers surely saw the importance of these documents as these are required by the buyers and processors to ensure traceability of the batch of shrimp bought. This compliance is mainly driven by the requirements for exporting the products, since the health certificate requested by the processor to export their products needs to be accompanied by the MD related to the products. In the ThaiGAP for shrimp farms, it is a major requirement for farms to be registered with the DoF (ACFS, 2009).

However the situation with tilapia is not as positive in relation to documentation, as < 50% are registered with GAP and there are no movement documents. This does not comply with the standards. This issue needs to be addressed as it defeats the purpose of the traceability system and only fulfils a small part of the requirement.

Other legal aspects in the global standards are concerned with land ownership or rights, and registration of business. In the ThaiGAP, it is a major requirement for farms to have legal land rights or permits, which could be ownership or lease (ACFS, 2009). During the survey there has been no report of conflicts regarding land ownership or lease. However regarding the registration of business, there had been some issues, mainly related to the criteria set by SEAT project on farm scales (Murray et al., 2011). One of the criteria is business ownership, whereby those owned corporately are distinguished by being registered as a company with the Department of Business Registration/Development (Ministry of Commerce), abiding by the Thai Civil and Commercial Code and other business regulations. With this categorisation of farm scales, most of the traditionally known 'large scale' farms were classified as 'medium scale' farms in this research study since they are not registered as companies as explained above. The main reason cited by medium scale farm operators for not registering was the tedious and time consuming documentation processes involved.

Washington and Ababouch (2011) suggested that farms follow the national/public regulations/standards as the foundation to achieve sustainable production, making it easier to meet the additional criteria from private standards and certifications. Thailand still has a long way to go to be able to achieve compliance to its local ThaiGAP and FMDs especially with tilapia production.

Recently in March 2014 the Aquaculture Stewardship Council has launched the global certification standards for shrimp (ASC, 2014). Also in the process of dialogues and discussions among stakeholders in the ASEAN region is the ASEAN GAqP, which is implemented under the ASEAN Economic Community (AEC) Blueprint.

4.6.3. Environmental Management: Effluents

Effluents from aquaculture operations, especially from shrimp, are a big and contentious environmental issue. Thus national governing bodies would need to consider this issue for regulation (Boyd, 2003). Farms, especially shrimp farms, are faced with the need to reduce nutrient loading to the outside environment (Thakur et al., 2010). The importance of this issue is also foremost in the standards and certifications, providing criteria on management of effluents, including regular monitoring and proper disposal.

The reduction of nutrients from effluents prior to release into the outside environment is one reason why the Thai government had a provision in the ThaiGAP for effluent management (ACFS, 2009). Major requirements in this aspect include the monitoring and testing of effluent quality to ensure it is not a pollutant, and prevention of release of saline water into freshwater areas (GAA-BAP, 2013). GAA/BAP has a proviso that this standard "does not apply to farms of < 50 ha" and which do not discharge regularly and < 1% of water is exchanged daily, referring to farms which reuse all the water or have limited water exchange.

Levels of effluent parameters are also given but in this research study, the effluents were not measured or monitored. It has been reported that in Thailand, a majority of shrimp farms practice the closed system, i.e. keeping the water within the farm system and recycling or reusing it, rather than releasing outside and getting new water. This is linked with biosecurity to ensure that efforts to keep and maintain good water is maximised. In the past it was believed that many shrimp and fish farms would be constrained by such requirements and suffer significant additional costs (Boyd, 2003), which could marginalise those operations which have a poor resource base.

Thakur et al. (2010) found that the most of the nutrients including suspended solids in effluents were concentrated at the bottom part of the water/effluent column, thus they recommended that the bottom portion (last 30 cm) of the effluent at harvest be retained in the pond during harvest, so it could reduce the nutrient loading discharged outside. In addition, it could serve as a stock for primary production for the next culture period.

The majority of the shrimp farms (73% out of 159) in this study did not treat their pond waste water or effluents However in the global standards, treatment was not specified, rather it was more important not to release effluents or waste water directly into the external environment. This is complied with by the farms in this study as nearly all discharge their effluents within the farm system, in order to recycle and reuse the eutrophic waste water for the next culture period.

The availability of sedimentation ponds for treatment of effluents is dependent on farm scale, as found in this research. Since the large scale farms have these facilities, their treatment method was mainly allowing effluents to settle in these ponds. Whereas for medium and small scale farms, most of their treatment is done by adding substances such as probiotics or effective microorganism, and inorganics such as lime. All farms also use combinations of settling, adding substances, aeration, and filtration. According to a regulation of DOF in the early 1990s (under the Fisheries Act of 1947), shrimp farms with more than 8 hectares area should allocate at least 10% of the farm area for wastewater treatment and/or sedimentation ponds (Tabthipwon, 2008). The majority of the small and medium scale farms in this research have less than 8 hectares farm area.

For tilapia pond farms in this study, effluent is not much of a major issue, owing to the fact that most are semi-intensive polyculture systems, which allow every niche in the water column to be occupied by various fish species. Thus nutrients present in the water will be consumed rather than be wasted into the water or pond bottom, although some other suspended solids/particles will still be present in the water column, such as from the bacterial floc and inorganic matter. Tabthipwon (2008) reported that total suspended solids level in tilapia effluents was 55 to 75% less than in snakehead and *Clarias* catfish systems, respectively, while 33% more than that in freshwater prawn systems. However he did not specify what systems they were but mentioned that effluent quality depended on culture species and feed used. In addition the levels of TSS increase at harvesting period for all systems, due to the organic matter including pond sludge mixing with the waste water. For tilapia, the TSS level increases by 5.5 times (Tabthipwon, 2008).

Polyculture systems are beneficial not only in environmental terms but also financially, as it can improve productivity and additional revenue, for e.g. salmon and mussel polyculture (Whitmarsh et al., 2006), or welfare-wise, preventing transfer of disease pathogens among stock (Washington & Ababouch 2011), or sustainability and ecological efficiencies, such as the traditional systems in China (Bostock, 2011).

A major aspect not covered in this research was the potential of the cage systems to add to eutrophication of the water systems they were placed in (Tabthipwon, 2008).

4.6.4. Environmental management: Water quality monitoring

ThaiGAP recommends that the shrimp farms be closely located to areas where water quality is suitable for shrimp culture, and that testing of water and recording of water analysis results be done (ACFS, 2009). These are the only references to water quality which is not a major requirement. In this study, majority of the farms, (all shrimp farms, 15% of tilapia cage farms and <10% of tilapia pond farms), were adept at monitoring water quality. The availability of instruments and water quality kits in the market also facilitates the farmers to be able to monitor water quality on farm on a daily basis. Tilapia farms are much less compliant in this aspect compared with the shrimp farms, regardless of farm scales.

The GAA/BAP standards have specific criteria for cages regarding water quality monitoring, in that cage farms are required to monitor water quality to ensure that key parameters remain within the acceptable ranges stipulated by BAP (GAA-BAP, 2013). In the case of the 38 tilapia cage farms, only 15% were monitoring the water quality, and the possible reasons for not doing so would be that the farmers did not deem it important to do so, and it involved investment in water quality equipment and kits. Tilapia was not as highly valued as shrimp, and farm gate price is cheaper than shrimp. Thus investing in water quality equipment such as dissolved oxygen and pH meters as well as water quality kits for every parameter would be an added cost to the farmers.

Although the ThaiGAP is not explicit about water quality management i.e. water exchange and water replacement, it is assumed that these are all part of the farm management manual which is a major requirement for all farms (ACFS, 2009).

4.6.5. Environmental management: Pond sludge

Sediments in ponds could be sinks for nutrients and toxic substances. Pond sludge is considered as a pollutant and an environmental concern when released directly into the open waterways outside the farms (Miranda, 2010; Tabthipwon, 2008), resulting in enrichment of the water body and eutrophication. Standards specify proper disposal of farm sediments or pond sludge, with GlobalGAP making it as a 'major must' (GlobalGAP, 2012). Even though it is a minor requirement in ThaiGAP for non-disposal of sediments into public or non-permitted areas, it is still suggested that the discharge should not cause environmental impact and if possible to reuse them. High sludge accumulation on the pond bottom could be reduced by having proper pond design, including placement of aerators in the pond, and erosion prevention by gravel or vegetation on bare areas (McIntosh 2010; GAA-BAP 2013).

According to Thakur et al. (2010), shrimp pond sediments samples taken at 10 cm depth contained 74% nitrogen and 78% phosphorus, higher than in the effluent water. Therefore they suggested to let the sediments remain in the pond together with the lower 30 cm of water to reduce nutrient loading if release outside the farm. Actually it is mainly the practice of both shrimp and tilapia farms surveyed in this study to remove sediments after more than 1 cycle, with larger shrimp farms removing sediments less frequently (every 3-4 years) than the small and medium farms (every 1-2 years).

For shrimp farms in this survey, the large scale farms would mainly pump the sludge in sedimentation ponds and the rest would put them on the pond dikes. It is the reverse for the medium and small scale farms. A few would reuse them for rice, garden, palm and the like if their fields are next to the farms. Thus they also realised that pond sludge has nutrient value for crops. This is similar to the aim of the Sustainable Shrimp Project (SSP) being implemented by the Surat Thani Shrimp Farmers' Club, which is to reuse the sludge from shrimp ponds for growing crops instead of just leaving them on the dikes (Ekapoj Yodpinij, personal communication, 2010). The "zero-discharge system" is being practiced widely by the shrimp farms in Thailand, keeping the sludge with in the farm parameters, to comply with the standards for international trade (Tabthipwon, 2008). Larger farms have a greater capacity to manage pond sludge, whereas smaller scale farms find it a challenge to do so (Sataपornvanit et al., 2014).

The Kung Krabaen Bay Royal Development Center in eastern Thailand is also using shrimp sludge as a component of compost fertiliser, which they are selling to the public. Shrimp sludge is rich in nutrients, and it has been reported from the KKBRDC experiment that growth of vegetables was better, less water was required, absorption of nutrients was more efficient than chemical fertiliser, less fertiliser or bulk needed, shelf-life is longer (Hoousiri and Pudtarn, 1992). The high labour requirement might constrain the sustainability of this approach (Satapornvanit et al., 2014) outside the government subsidised initiative.

There is also a concern about salinity levels from shrimp pond sludge. However in white shrimp culture, usually the salinity in the culture water would be less than 5ppt or even 0 ppt at the end of the culture cycle. Direct use with crops especially salt-tolerant species could be beneficial but capacity of farmers to manage and reuse sludge need to be strengthened (Satapornvanit et al., 2014).

There are also economic implications on the use of pond sludge. As in the experiment by Kaewjantawee (2007) on freshwater prawn pond sludge, farmers who used the pond bottom soil for their Chinese kale did not earn a profit as they incurred more costs. There might be other factors involved in this such as labour cost and product price. However, they experienced better growth of the vegetables, and improved soil quality. Therefore the ecological costs/gain could be factored in when calculating the benefits of using pond sludge. On the other hand, conversion of abandoned shrimp farms into other aquaculture (finfish) and agricultural activities (palm oil) proved to be profitable (Banchun, 2012).

A public-private sector partnership may be necessary to define ways and means to utilise the nutrient rich shrimp pond sludge, including strengthening capacities, and the good practices developed by the Thai shrimp industry need to be packaged into appropriate technologies for application not only within the shrimp farming community but more importantly into the wider agricultural community. With shrimp pond sludge as one of the most contentious issues, it will give advantage and credit to the shrimp farming industry if the nutrients obtained from shrimp culture and from other inputs are returned to the environment through recycling and reuse to grow a diverse range of crops to feed not only rural communities but also urban consumers.

4.6.6. Farm management: Feed management

Feed is one of the major costs in aquaculture as they are expensive (Thongrod, 2007), especially with shrimp farming and tilapia cage farming, which rely heavily on commercial industrially produced feeds. Even in tilapia pond farms, majority of the small scale farmers resort to using industrial feed, more so than the medium scale farmers who tended to use more on-farm formulated feeds (Burana-osod et al., 2013). High input costs especially feed costs were one of the main reasons for shrimp farm abandonment in the early 2000s (Banchun, 2012).

The various standards also had many criteria on feed management, among them the choice of feed manufacturers, storage, traceability, and record keeping. The standards guidelines are also geared towards the use of commercial feeds and may be construed as not favourable towards the use of on-farm formulated feeds, the raw materials of which would include agro-industrial by-products. However, in the ThaiGAP for shrimp farming, there is a provision regarding preparing feed on-farm, that proper documentation of all ingredients used should be done and not to use banned ingredients (ACFS, 2009). This will have implications regarding traceability especially with agro-industrial by-products which might not have their own documentations regarding origins and production.

Feed manufacturers should have a “sustainable sourcing policy for feed ingredients” (ASC, 2012). The major feed manufacturers chosen by farmers in this research all have visions of achieving sustainability in their operations, to provide the best quality feed to Thai farmers (CPF, 2012; McIntosh, 2008c).

The high inclusion of fishmeal in shrimp feed has been a controversial issue for the Thai shrimp farming industry, and efforts to change shrimp feed formulation to reduce the amount of fish meal are underway (Patrik Henriksson et al., 2014). Fishmeal is a highly nutritious feed ingredient, with a high crude protein content ranging from 50 to 60% (Thongrod, 2007), giving the feed a good flavour and odour to improve the appetite of organisms. Reduction in fish meal content in feeds will help the environment (Henriksson et al., 2014), both at the farm level (lower nutrient loading) and externally (less emissions from the factory), and could reduce cost (Xie et al., 2014). Already, the leading feed manufacturer in Thailand, Charoen Pokphand Foods, announced in 2013 that it is phasing out fishmeal from its shrimp feed, substituting it with protein from soybeans and grains, as tests have shown that shrimp still grew normally even if feeds do not have fishmeal (The Nation, 2013).

For the ThaiGAP guidelines, feed management is part of the pond manual that is required, but the details on the use of commercial and on-farm feeds, as well as on storage, are of a minor requirement. It is indeed important in the interest of food safety and animal welfare, to know the quality of raw materials used for feed (Washington & Ababouch 2011), whether manufactured industrially or made on-farm. Better feed management can result in better feed utilisation and less organic loading and sediment build-up (PJG Henriksson et al., 2014).

The standards set on feed management would be difficult to comply with by farmers who produce their own feeds (such as the tilapia pond farmers) using agro-industrial by-products or other wet feeds, since there is no provision for this in the standards. Thus farms especially tilapia producers and the majority of fish producers in the developing world who choose to produce their own feeds to reduce costs would not be able to comply with the feed standards and the opportunity to participate in the global trade will be lost (Belton et al., 2011, 2010; Wilkings, 2012).

The criterion set on preference for better feed manufacturers (ASC, 2012) require producers to be more informed on the sources of raw materials as ingredients for the feeds formulated by feed mills. Most often, producers rely on the marketing and promotional pitches of various feed companies to obtain their custom. As feed is oftentimes the most cost consuming in aquaculture farm operations, farmers had to carefully choose the best feed for their stock, in terms of cost as well as quality. The large feed companies operating in Thailand had to rely on good customer relations through providing information that will be beneficial to both sides (McIntosh, 2008c; The Nation, 2007).

4.6.7. Energy Use

The Aquaculture Stewardship Council (ASC) for tilapia has specified a standard for energy use, to identify energy sources and then calculate and verify total energy used in kj/mt/yr of tilapia produced. Similarly, ThaiGAP recommends for farms to have safe electricity systems as well as to save the use of energy and/or renewable sources.

Among the farms surveyed, none mentioned the use of renewable energy sources such as solar or wind, but rather the majority of the farms combine various sources mainly to reduce their costs. There is potential for solar energy in farms but installation and maintenance costs need to be within their means. Energy use on farms will be important especially in determining ecological and/or carbon footprints and in life cycle assessments of aquaculture production. Efficiency in the use of energy to produce fish and shrimp will be considered as an indicator to determine impacts of the contribution of aquaculture to the environment (Pullin et al., 2007). Boyd et al. (2007) mentioned that the range of efficiency of energy use in aquaculture is wide, citing that traditional/extensive systems (those relying on natural inputs) as the most efficient, and systems which are too dependent on inputs from industrial production such as feed are at the other end, i.e. requiring high energy use to produce.

High energy consumption and costs associated with electricity leads farmers to combine energy sources such as diesel and gasoline to power farm activities, such as pumping. The cost of setting up of a power grid or station within the farm could be uneconomical for small scale farmers but more cost-efficient for larger scale with various operations running to use it. Electricity could be cheaper (to use) than diesel if the government has a policy to reduce tariffs to shrimp farmers who follow standards, thereby affecting relative competitiveness of the Thai shrimp industry. In a multiple-country Life Cycle Assessment (LCA) studies conducted by Henriksson et al., (2014), results have shown that the Thai shrimp industry, along with Bangladesh, has generally lower emissions than China.

Paddlewheels in shrimp farms are usually the highest energy consumers and Henriksson et al. (2014) suggested better management of aeration systems, and providing more information to the farm operators so they are better informed to decide on fuel use, monitoring of oxygen, pond design, and schedule of aeration.

4.6.8. Fish welfare issues

A number of topics related to fish welfare have been covered in this study, among them fish and shrimp health management, diagnostics, predator control, and biosecurity. The ability of the farms to comply with the various related standards are dependent on their resources capacity and, to a certain extent, the farm scales. However there are matters for e.g. the strings over ponds, screening and the PCR checking of PLs which are similar across the shrimp farm scales. Although FAO (2000) had pointed out some limitations of PCR as a diagnostic tool, it has become widely accepted in Thailand especially among shrimp farmers. There are now locally manufactured PCR equipment or kits available at a cheaper cost. With shrimp as a more valuable product, more efforts and investments are placed to protect their stock, than with tilapia farms.

In terms of biosecurity, it has been referred to as one indicator of sustainable shrimp farming, together with genetic improvement (Moss et al., 2010), as it ensures the safety of stock from diseases. Measures such as pond lining, strings over ponds, screens around ponds, sanitation wash, use of SPF broodstock and PLs, and a closed culture system, among others, are being practiced. However, these measures were not able to prevent the outbreak of EMS which threatened the sustainability of the shrimp farm industry not only in Thailand but also the region and the world. Rather than just following a trend, i.e. everyone has black lining and strings over pond, etc., Lightner (2005) suggested identifying the risks in a system and then to design biosecurity measures to mitigate those risks.

Fish welfare aspects may still be at its infancy stage in Thailand, unlike in western aquaculture such as with salmon or tilapia, as elaborated by Young et al. (2010) and Olesen et al. (2011). However, several of these efforts have been emphasised through these standards and certifications, and it is expected that these will address the issue in Thailand. In addition, determining the mindset and perceptions of farmers regarding fish welfare aspects will help in understanding and in developing approaches in promoting concerns for fish welfare. Changes from harvesting and distribution on ice to live hauling of tilapia may need to be incorporated as well.

Compliance to various guidelines especially under this section such as biosecurity and predator control entails investment costs on the part of the farmers/operators. And yet in order for the farms to be qualified to sell their products to the processing plants, and to sustain their production, they will have to comply with them. As it is related to animal welfare, compliance will not only benefit their business but also ensure that the animals experience good rearing conditions.

Thailand aquaculture's efforts in promoting food safety has been commendable and leads the region in promoting good practices in control and regulation (Clausen et al., 2014).

4.6.9. Trends and changes

Changes that occurred and were faced by shrimp and tilapia farmers in Thailand were varied, ranging from environmental issues, technical advancements, to societal and economic forces, similar to those discussed by Lebel et al. (2008) and Bostock (2011). Production and operational changes are constantly occurring for both species. Changing farming practices especially among shrimp farmers was their way of coping with difficulties and shocks (Kruijssen et al., 2013). However, for shrimp farmers, labour pattern changes were more common, especially among large scale farms, during the period 2005 to 2010. In 2013, majority of the changes among shrimp farms were specifically seed sources and yield. This was during the period of the EMS epidemic, wherein there was an issue that the pathogen might come from postlarvae, before the most likely causes were identified by the scientific community. The DoF together with the private sectors and practitioners collaborated to come up with mitigation measures and risk reduction, detailing prioritized needs (DOF, 2013b). For tilapia farms they have not changed much since the same production and marketing strategies are being used (Burana-osod et al., 2013). Marketing of live tilapia will make it easier to develop a quality processing industry and export trade.

Some of the changes which farms (especially shrimp farms) had to make were in response to market and trade demands (Lebel et al., 2008), such as those from the standards and certifications, in order that their products will be acceptable to processors.

Shrimp farm operators are more dependent on their aquaculture operations for income, compared to tilapia farm operators, which have other sources of livelihood. This was shown by the livelihood indicators index (based on the contribution of aquaculture to household income) calculated by Kruijssen et al. (2013) on a subset of farmers in this research study, i.e. 0.82 for shrimp and 0.46 for tilapia. This has implications to the farms' capability to diversify or change to another income source if something drastic happens to their respective industries. Despite the exposure to financial shocks and damages (shrimp farmers face more than tilapia farmers), Thai farmers have a higher capability to survive, based on their varied coping mechanisms, shorter recovery time and level of damage (Kruijssen et al., 2013).

4.7. Conclusion

Shrimp and tilapia are two important aquaculture species in Thailand for trade. Proof of the fact is that the globally accepted standards and certifications cover these two species. However, for Thailand, the majority of the tilapia farms are not yet ready to be audited against these standards. Aside from the fact that tilapia production is still mainly for the local market and enjoys a larger market share of 90%, the standards themselves are geared towards industrial level of monoculture. As most of the tilapia farms are semi-intensive polyculture systems, with 1 to 4 other species stocked with tilapia in the pond, the standards are quite complicated to be applied to these types of farms. Likewise, for the tilapia cages, the absence of local governance on how they are managed in public water areas may also limit the compliance to standards.

The large scale shrimp farms are more able to comply with the various criteria set by the global standards and certifications (as discussed here), because these standards were designed with the “industrial” and “intensive” nature of production in mind. Considering the importance placed by the standards on the environmental aspects of shrimp farming, the farms across all scales can be said to comply, especially in not releasing effluents and sludge to the outside environment.

The global standards often refer to the local regulations for the specifics of their standards. In this case the ThaiGAP should be more specific and clearer and informed to the farmers/producers so they can easily understand how to comply with the standards. For general aquaculture, unless the standards provide alternative aquaculture production systems which cover the other spectrum, i.e. semi-intensive, less-industrial, polyculture and integrated systems, the medium and small scale farmers/producers may be left out from selling their products for exports. Compliance to certification standards is more a gateway for entry to the export trade rather than as an indicator of sustainability.

Changes in farm operations and management occurred due to the changing scenarios such as environment and weather, disease, and markets (consumer demands, price fluctuations). It is more difficult for farm operations with high investment costs (for e.g. shrimp farming) to permanently stop or to diversify to another activity, as they have already invested heavily on infrastructure in the farms, compared with less capital intensive operations (for e.g. semi-intensive polyculture tilapia pond farming) wherein other species can still be farmed in the same unit. The dependence on other livelihood income sources among tilapia farmers could be one of the reasons.

5. CHAPTER 5 Assessment of the quality of life of shrimp farm workers in Thailand

5.1. Introduction

The export of seafood from producing countries including Thailand has increased considerably over the last two decades, for selected species. The intensity of labour use along the value chain varies among the countries, and in Thailand, there has been an increase in the use of migrant labour from the three neighbouring countries, namely Cambodia, Lao PDR and Myanmar. Issues in labour practices particularly in the shrimp sector in Thailand have been brought out in recent years, particularly related to migrant labour, child labour and human trafficking (US Department of State, 2013). A number of studies and reports have been published highlighting the critical issues mainly in the processing sector (Diallo et al., 2010; EJF, 2013b; Sakaew, 2011; UNIAP, 2011; Vartiala et al., 2013), and in general, the Thailand situation through the Asian Decent Work Decade (2006-2015) initiative under the International Labour Organization (ILO) and Human Rights Watch (2010). Agriculture including fishing has the largest proportion (58.9%) of informal employment in Thailand, and further defined informal employment as a category for those workers who do not have social security coverage (ILO, 2013b).

Thailand attracts migrant labour from neighbouring countries due to its shortage of labour in some sectors (ILO, 2013b), including the aquaculture industry (UNIAP, 2011). This shortage could be termed as “relative labour shortages” wherein the local workforce are not willing to do the work, for reasons of low wage, remoteness of area, unsuitable employers, and unattractive work (Böhning, 1996). Fisheries and aquaculture work are some of the jobs considered by Thais as 3D (dangerous, difficult and dirty).

The shrimp value chain in Thailand (Figure 5.1) is composed of various sectors, and employs a number of workers, both Thais and non-Thais, men and women, depending on the type of work.

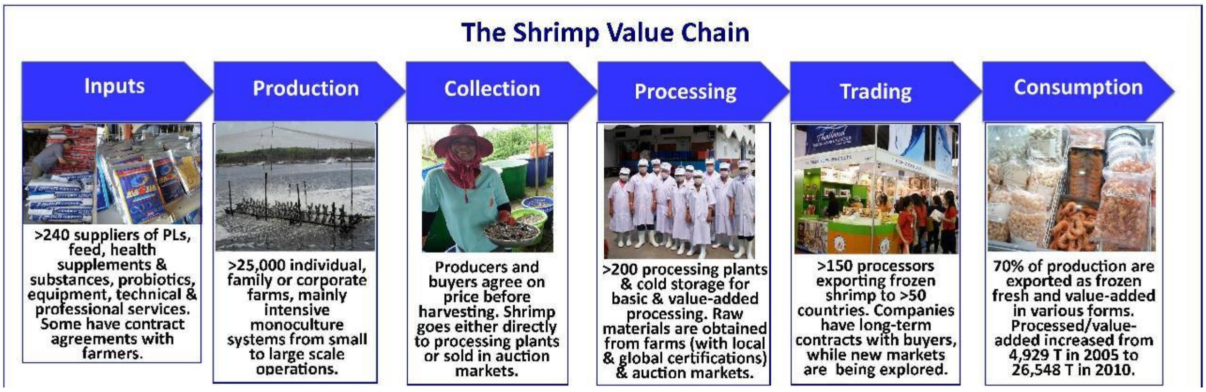

Figure 5.1 The shrimp value chain in Thailand

Source: SEAT-KU (2012)

Most of the negative issues published in the international press which resulted in bad publicity for the Thai shrimp industry, come from the so-called exploitative practices in the shrimp pre-processing sector or shrimp peeling sheds, where a large number of migrant workers are employed by small to large companies. This sector supplies pre-processed shrimp (i.e. peeled, headless) to a number of large processing factories and cold storage plants. These operate as single and separate entities sub-contracted by these large processing factories.

The ILO and other international organisations have placed an Amber alert on the Thai shrimp industry due to reasons that workers are being exploited and abused, and that the industry is not following global standards related to worker welfare. These are based mainly on their in-depth studies and observations in specific nodes of the value chains, i.e. pre-processing and peeling sheds, including the fisheries sector (fishing vessels and fishing port areas) (Derks, 2010; EJF, 2013b; Human Rights Watch, 2010; ILO, 2012; UNIAP, 2011; US Department of State, 2013). In the media debate around employment abuses in the sector little differentiation is made regarding the location of the key problems leading to the impression that abuses and exploitation occur throughout the shrimp value chain.

Going upstream towards the production sector, i.e. the shrimp farms, labour is also an important part of farm operations. However, few in-depth studies have been carried out on the working and living conditions on farms, including the quality of life of workers, and this data deficiency has driven this research to focus on this sector. There are both Thais and non-Thais employed on shrimp farms. The ILO has considered this sector as low-risk at the moment in relation to the other sectors being checked, on the assumption that worker exploitation is less likely but that a watching brief especially on smaller farms with migrant families as workers is required. ILO also wants to do more field work in shrimp farms so there is more understanding of the labour issues in that sector (T. Poutiainen, personal communication, 2013).

The SEAT Project has used labour as one of the criteria to set the scale of farms, as described in Chapter 2 General Methodology, and in Murray et al. (2011). A range of farm scales still exists even though consolidation has occurred. In addition, the lack of Thai workers willing to work in shrimp farms has led to opportunities for workers from neighbouring countries to obtain jobs in the farms. A large number of nationals from Cambodia, Lao PDR and Myanmar, have been coming into Thailand to find jobs in various sectors as the Thai work force has become scarce for jobs considered the 3 Ds (dangerous, difficult, dirty). As shrimp farm operations are located in various regions generally away from metropolitan areas mainly in the eastern and southern regions, there could be a preference for certain ethnicity as well as migrant status. However, informal networks consisting of familial and business relationships could also influence choice and contracting of workers.

The ILO reported that in 2010 registered migrant workers in the informal sector generally received less than half the remuneration the Thai nationals received i.e. average monthly wages of 5,730 Baht and 12,554 Baht, respectively, with women migrants receiving much less than male migrants and Thais, at 5,264 Baht/month (ILO, 2013b).

Quality of life (QOL) has many aspects, and, according to Petrosillo et al. (2013), it “can be seen as a multidimensional concept”. The global standards on human resources in aquaculture ensure that workers are treated and provided with enough compensation and good living and working conditions as befits a human being. However, do these labour standards capture the essence of working in Thai shrimp farms of various scales? There could be other aspects of shrimp farm work such as the issues mentioned by Resurreccion & Sajor (2010), wherein the tasks are completed not by the hired person alone, but shared between two persons, i.e. husband and wife, and yet the wife’s effort in fulfilling the task is not considered “work” therefore not to be compensated.

Third party certification (TPC) standards cover worker welfare in farms, which shows that the emerging consensus of this market-led governance is that the labour conditions and employee welfare on farms are being considered at the same level as environmental management, animal welfare and food safety for sustainable and ethical production of seafood.

This research therefore has the following research hypotheses (RH) based on the above labour situation, focusing on compliance to labour standards, exploitation potential, and sustainability and economic impacts.

- RH1: Working conditions in large scale farms are much more compliant with labour standards set by 3rd party certifications than small scale farms.
- RH2: Ethnicity and migrant status affect working and living conditions in shrimp farms.
- RH3: Migrant workers in shrimp farming in Thailand are important to correct a labour shortage and contribute to the economies of the neighbouring, poorer states.

Based on these hypotheses, this study aimed to answer the following research questions (RQ), looking at the various farm scales, origins and gender of the workers.

1. How do workers perceive their quality of life in the farms?
    a. Are the workers better or worse off than before working in shrimp farms?
    b. Are the workers in large farms more likely to be treated according to the standards for worker welfare (according to 3rd party standards) than in small scale farms?
    c. Is the quality of life of workers in large scale farms better than those in small scale farms?

2. How do employers treat workers from different ethnic backgrounds and migrant status?
    a. Does a certain ethnic group of workers have more access to assets and opportunities?
    b. Are the registered or documented migrant workers treated better?
3. Why has migrant labour become more common in the shrimp farming industry in Thailand?
    a. Why do migrant workers choose to work in shrimp farms?
    b. What is the value of shrimp farming to the economies of the neighbouring countries where the workers come from?
    c. How is Thai labour affected by the influx of migrant labour?

A gender dimension was also attempted to follow and incorporate the gender dimensions framework in the analysis, especially within the certification standards to make them more gender-sensitive. Value chain actors are in constant interaction with each other, to transact business, for business networking, and for family and social activities. Even within the shrimp farm setting, there are also varying roles by different genders, interacting with each other. Gender refers to the social differences between men and women, boys and girls, which are determined by society and may be learned and changed, and could vary between and within cultures (Arenas and Lentisco, 2011). As noted by Laven & Verhart (2011), most tools and interventions lean toward non-gender sensitiveness in working with value chains and rural livelihoods, thus they have attempted to create a trajectory on gender in value chains by combining gender and women empowerment with value chain/pro-poor development. Looking at differences among actors in the farm environment based on genders can add a human dimension to the analysis.

In this research we have attempted to integrate gender aspects into the methodology in order to bring out some gender related results, which could lead to an understanding of how gender relations affect decision making among shrimp farm workers and their families, as well as their opportunities for advancement and access to information and meeting their needs.

As in Chapter 4, the global certification standards to be used as benchmarks will be the Best Aquaculture Practices or BAP (GAA-BAP, 2013) and the GlobalGAP (GlobalGAP, 2012), which have standards for shrimp farms. The main areas covered by these certification standards in relation to farm workers include workers' safety and occupation health, worker welfare and living conditions, legal aspects and documentation including labour laws, as well as knowledge and training. The aspects of quality of life and workers' perceptions with a gender perspective are not covered in these standards, and it is the aim of this chapter to add value to the review of workers' conditions in shrimp farms by trying to include them.

Two types of employment need to be considered according to the Department of Labour Protection and Welfare. First is "industrial" which is within the system and covered by the labour law or code, and the second is "agricultural/domestic/home-based" which is outside the system and therefore not covered by the labour law or code, as provided by Ministerial Regulation No. 9 BE 2541 (Ministry of Labour, 1998).

The main difference between these two types of employment is the 300 baht/day minimum wage, which is required if employed under the industrial system. For employment outside the system, wages could be less or more than this but should have an agreement between Employer and Employee. Related occupations in aquaculture under industrial employment i.e. within the system, include work in seafood cold storage and processing plants, where in this case the employers are registered as companies or business enterprises. Workers in shrimp farms are considered working outside the system (unless large scale corporate farms attached to another company affiliate), and to have a similar status to those working in general agriculture, domestic work, as well as home-based business for e.g. jewelry making and sales. There are no specific labour laws for shrimp farm work, in contrast to sea fisheries which has a specific stipulation under the Ministerial Regulation No. 10 B.E. 2541 (1998) issued under the Labour Protection Act B.E. 2541 (1998) (Ministry of Labour, 1998), which defines wages as “the share which an Employer agrees to pay an Employee according to the value of the aquatic animals being caught”. Aquaculture falls outside such a ‘crews share’ system but is also generally not covered by minimum wage norms (currently set at 300 Baht/day), works involving both fisheries and aquaculture were excluded (Ministry of Labour, 2012).

5.2. Methodology

A sequential mixed methods approach was applied, wherein systemic survey work and pattern analysis was followed by an in-depth explanatory qualitative work. The sample frame of this phase of research was an outcome of the earlier multi-phase sample design. This approach improves the generalisability of the findings of the study.

As mentioned in Chapters 2 and 4, an integrated survey among shrimp and tilapia farmers was conducted in 2010 to 2011 which included information on gender disaggregated data on labour aspects to confirm farm scales. In 2013, an in-depth or face to face survey was conducted among a sub-set of these farms to determine specific changes in labour patterns, as labour is one of the main determinants in the farm scaling which the SEAT project has created to categorise the farms.

5.2.1. Survey respondents

The respondents for the face to face surveys on shrimp farm labour consisted of the following:

- Shrimp farm owners or farm managers only
- Shrimp farm workers
- Key informants from government and non-government groups related to community and labour issues

Shrimp farm owners and farm managers who were the respondents of the integrated farm survey conducted in 2010-2011, were the first point of contact for this survey. Respondents were selected based on a telephone survey regarding changes in shrimp farming operations. As mentioned in the Methods section in Chapter 4, the transition survey was conducted during 7 to 15 March 2013. Out of the 165 respondents contacted by phone, 117 responded to the survey over the phone. The face to face survey on labour patterns reported in this chapter was conducted from April to May 2013.

From the March phone survey, 23 respondents gave direct responses regarding labour changes. An additional 10 respondents were selected from those whose operations changed based on the reasons given for labour changes but did not respond directly on labour changes. They are considered the priority group for the face to face survey. A second group of respondents was selected as reserve based on the reasons given for labour changes but did not respond directly on labour changes (Table 5.1).

The respondents were categorized according to farm scales (small, medium, large) and regions (east, south), aiming to have a total of 30 respondents. The priority group as explained above was first contacted and the purpose of the face to face survey was explained, and then appointments were made for interviews with the farm owners or managers. In addition, it was also requested to grant permission to interview their farm workers. The intention to interview migrant workers drew an unfavourable reaction with at least one prospective respondent (farm owner), and she declined even an interview with herself, saying that migrant labour was a sensitive topic.

The New Year holiday (Thai, Lao, Cambodia and Myanmar) delayed interviews in April and complicated access to migrant workers who often returned home during this period. Thus the surveys were extended into May especially in the south. In a few farms where the schedule to interview fell in April especially in the east and workers were largely absent only farm owners could be interviewed. In addition to the timing of Thai New Year, the Early Mortality Syndrome (EMS) outbreak also affected the number of workers on farms available for interview because shrimp farming operations had slowed down or been suspended. If the operations stopped, there were no shrimp in the ponds, so farms had tended to lay-off workers temporarily.

Table 5.1 Responses in relation to labour changes in the shrimp farms

Responses	No. of responses according to farm scale			Remarks
	Small (n=97)	Medium (n=15)	Large (n=8)	
Changes in labour situation in the farms	12	6	5	• Increase in number of workers due to increase in farm area or number of ponds • Increase in wages • Decrease in number of workers due to lack of profit, difficulty in getting labour, cease in operation due to disease or changed occupation, not operating at full capacity, using technology to replace workers
Changes in number of ponds and farm area	14	10	4	• Decrease in no. of ponds stocked • Physically increase no. of ponds (add more) • Increase storage area
Changes in various farm operations due to disease	14	2		
Changes in farming methods	8	4	2	From manual feeding to use of autofeeders (changed to either 50% or 100%)
Shrimp farming not the main income source	24	7		
Stopped farming	16	2		Either temporarily or permanently

Source: Telephone transition survey, March 2013

Shrimp farm owners are those who have the legal ownership of the farms, can be an individual or a company (if registered as a Thai business), can be co-owners in the case of husband and wife, or he/she can be the legal lessor of the farm in the case of the farm being leased from another. These owners may or may not be the managers of the farms, especially for individual owners. Corporate owners will always have a manager employed.

Farm managers are those who are hired or employed by an individual farm owner or a corporate farm to manage the shrimp farm enterprise. He or she may or may not hold ownership or share in the company.

Depending on the scale of operations, shrimp farms have various types and levels of hired persons to undertake various tasks in the farms. In the Thai language, the term 'worker' refers to one who is doing the manual/pond work in the farm, domestic work, driving vehicles, and guarding the farm. The term 'employee' or 'staff' refers to one who works in the office or laboratories or machinery or oversees the workers. This could include the managers, technicians, and those involved in accounting and administration.

The basic unit of the shrimp farm is the pond. A worker (usually male) is assigned to take care of one pond. A pond worker can also be a female, but oftentimes, the tasks given to female workers are 'female' or light tasks. If a married couple or a husband and wife team is hired or contracted to work in the farm, they are assigned at least 2 ponds, or the whole farm, depending on the size and scale.

If farms have a large area and many ponds, the ponds are grouped into zones. Usually one zone consists of 3-10 ponds. Each zone is usually headed by a technician, who therefore is in-charge of all the ponds and workers within the zone, as well as additional work assigned by the owner or manager. Workers may also be given additional assignment depending on their expertise, such as for machine maintenance or repair, electrical troubleshooting, and feed measurement, which will cover the whole farm needs.

5.2.2. Face to face interviews

The face to face interviews took about an hour or so with farm employers and key informants, but about half hour with workers, depending on how long the respondent provided the answers to the questions. For example when we interviewed a farm manager and his two female workers, we started the interview with the farm manager at 1500 hrs and finished at 1600 hrs, then the first worker interview at 1600 until 1630 hrs, then the second one at 1630 to 1700 hrs. Time included translation of questions from English to Thai, noting down by the translator of some responses in Thai, then translation of responses from Thai to English, and writing down the responses in English.

As the interviews were semi-structured, follow-up questions were also asked based on the responses to the questions, as well as clarifications. Thus translation of the responses back to the main researcher was necessary in order to frame the follow-up question when necessary. I could follow the conversation and was taking down notes while the Thai interviewer was talking to the respondents. However, translating back the conversation helped to confirm the notes taken.

Photographs of the respondents were also taken for documentation. A few times the workers would show their documents they kept with them and photographs were also taken of them. Tables 5.2 and 5.3 show the information regarding the respondents surveyed for this chapter.

Table 5.2 Information on farm owners and managers interviewed

Farm Scale	Designation	Gender	Number	Remarks
Small	Owner & Manager	Male	8	
	Lessee & Manager	Male	2	
	Owner	Female	2	Husbands as co-owners & managers
	Owner	Female	1	Hires an external manager
	Owner	Male	1	Hires an external manager
Medium	Owner & Manager	Male	7	
	Manager	Male	1	
	Manager	Female	1	
Large	Owner & Manager	Female	1	
	Owner & Manager	Male	1	
	Manager & Shareholder	Male	1	
	Manager	Male	3	
		Total	29	

For this face to face survey, permission was requested from the farm owners and/or managers to interview their workers regarding their working conditions, migration information, well-being and aspirations. Not all the farms in Table 5.1 above allowed their workers to be interviewed, for various reasons such as being unavailable due to harvesting and other farm work at the time of farm visit, or the workers went to work in another farm for the day due to less work in the current farm, or the workers have gone or left the farm due to the operations have stopped (during the EMS outbreak). It was attempted to interview both men and women workers, as well as workers coming from the three neighbouring countries. However, as the availability of workers to be interviewed was oftentimes dependent on their employers as well as the situation when we visited the farms, the choice for the worker respondents was not always ideal. No Cambodian workers were interviewed as the farm respondents who had Cambodian workers had released them to work in other farms or they have gone back to their countries for the New Year holiday. Cambodian workers were mostly found in the eastern region which is near the Cambodian-Thai border.

Table 5.3 Information on shrimp farm workers who were interviewed

Farm Scale	Designation	Gender	Nationality	Tasks	Remarks
Small	Farm worker	Female	Myanmar	Take care of ponds (liming, cleaning, feeding, checking) keeping record	Husband is also working in the farm. Both of them take care of the whole farm.
	Farm worker	Male	Lao	Take care of ponds (cleaning, feeding, check water)	Wife (Thai) and children stay with him in the farm but only he works in the farm.
	Farm worker	Male	Thai	Take care of ponds (cleaning, feeding, check water)	Wife and children stay with him in the farm but only he works in the farm.
Medium	Pond worker and equipment maintenance	Male	Lao	Take care of 2 ponds, maintenance & repair of all farm equipment	Wife and child stay with him in the farm but only he works in the farm.
	Farm worker	Male	Lao	Take care of 3 ponds, put feed in autofeeder, cleaning, check feed, shrimp & water, record keeping	Still single

Farm Scale	Designation	Gender	Nationality	Tasks	Remarks
	Farm worker	Male	Myanmar	Take care of 2 ponds, put feed in autofeeder, check feeding, liming	Still single. Now the only worker in the farm with 5 ponds as the other workers (Thais) have left.
	Farm worker	Male	Myanmar	Take care of ponds	Wife stays with him in the farm and helps in some pond work.
	Farm technician/ zone manager	Male	Thai	Take care of 1 zone, water quality monitoring, check autofeeder & feed, check nets, manage workers	Still single
	Farm technician/ zone manager	Male	Thai	Take care of 1 zone, water quality monitoring, check autofeeder & feed, check nets, manage workers	Still single
Large	Farm worker	Male	Myanmar	Take care of 2 ponds, feeding, machine maintenance, check screens, nets, cleaning area	Wife is staying with him and also working in the farm in the inventory/inputs section. Children in home country.
	Farm worker	Male	Myanmar	Take care of 1 pond, from preparation, watching, aeration, feeding, autofeeder, check feeding	Still single
	Farm worker & farm equipment repair	Male	Thai	Take care of 1 pond, and fixing autofeeder and paddlewheels of all ponds in his zone,	Wife is staying with him in the farm, also used to work in the farm. But she is now pregnant so stopped

Farm Scale	Designation	Gender	Nationality	Tasks	Remarks
				maintain area together with workers in zone	working.
	Farm worker & farm equipment repair	Male	Thai	Take care of 1 pond, and fixing autofeeder and paddlewheels of all ponds in his zone, maintain area together with workers in zone	Wife and 2 children staying with him in the farm. Wife is not working as she is looking after the children.
	Farm domestic worker	Female	Lao	Recently hired as domestic worker in farm manager's house. Before that did not do any pond work, only housework for her and husband.	Wife of pond worker. Their children are not staying with them in the farm.
	Farm worker	Female	Thai	'Female' tasks (her term): measure pH, check water, give feed, turn off aerators, clean area	Newly hired. Husband is also working in the farm. She gets her own salary. Their children are not staying with them.
	Farm worker	Female	Thai	'Female' tasks (her term): measure pH, check water, give feed, turn off aerators, clean area	Newly hired. Husband is also working in the farm. She gets her own salary. They do not have children yet.
	Head worker	Female	Thai	Take care of all the workers (11 persons) in the farm as well as take care of 1 pond. Check water quality, prepare/ measure/distribute	Her husband is also working in the farm, taking care of only 1 pond. Their children are studying in their home province and live in a dorm.

Farm Scale	Designation	Gender	Nationality	Tasks	Remarks
				feed to workers. Take care of emergency.	
	Office and farm worker	Female	Thai	Assists farm manager in accounting and reports, to send to head office in Bangkok. Assists head farm worker in checking feeding, put feed in autofeeder, feeding tray, switch on autofeeder, data input in computer	Married with a son, her husband is not working in this farm but also related to shrimp farming. They live nearby the farm (outside) as they are local people.

5.2.3. Key informants

A number of key informants were also approached to be interviewed regarding the general situation of shrimp farm workers in their respective area of assignment, especially in relation to labour protection, institutional and legal aspects, as well as migrant labour. Therefore, representatives from the Thai government's Department of Employment, Department of Labour Protection and Welfare and the Sub-district Administrative Organization in the provinces were interviewed. In addition, respondents from NGOs working closely with migrant workers were also visited, as well as researchers who have worked with migrant workers. Table 5.4 shows the key informants interviewed.

Table 5.4 Key informants interviewed for worker issues, at their place of work

Sector	Organization	Level	Gender	Number
Government	Department of Employment	Provincial	Female	1
			Male	1
	Department of Labour Protection and Welfare	Provincial	Female	2
			Male	2
	Sub-district Administrative Organization	Sub-district	Male	3
Non-government	Labour Protection Network	National	Male	1
	Raks Thai Foundation	National	Female	1
	Asian Institute of Technology/Stockholm Environment Institute	Regional	Female	1
	World Vision	International	Male	1
International	International Labour Organisation	International	Male	1

5.2.4. Survey instruments

A semi-structured questionnaire (Appendix 6) was designed and piloted with a number of shrimp farm owners and workers in February 2013, after which some of the questions were revised accordingly. As well, during the interview itself, additional follow-up questions were asked depending on the answers of the respondents to the questions. The main topics in the interviews with workers included the following:

- Recruitment and migration pathways
- Working and living conditions
- Worker tasks and benefits

- Gender dimension on access to assets and opportunities, decision-making
- Workers' family matters
- Worker well-being

5.2.5. Analysis

Interview transcripts were coded according to the research questions using NVivo for data management and coding framework. Analysis was through descriptive statistics for quantitative data as well as by narrative addressing the research questions.

The QOL framework based on needs suggested by Costanza et al. (2007) was used as a guide but modified to fit the workers' perceptions responses.

5.3. Results

5.3.1. Background of workers

A total of 18 shrimp farm workers were interviewed i.e. 9 from large scale, 6 from medium and 3 from small scale farms. There was an equal number of Thai (9) and migrant workers (9) interviewed. Figure 5.2 gives details on country of origin and the gender of respondents.

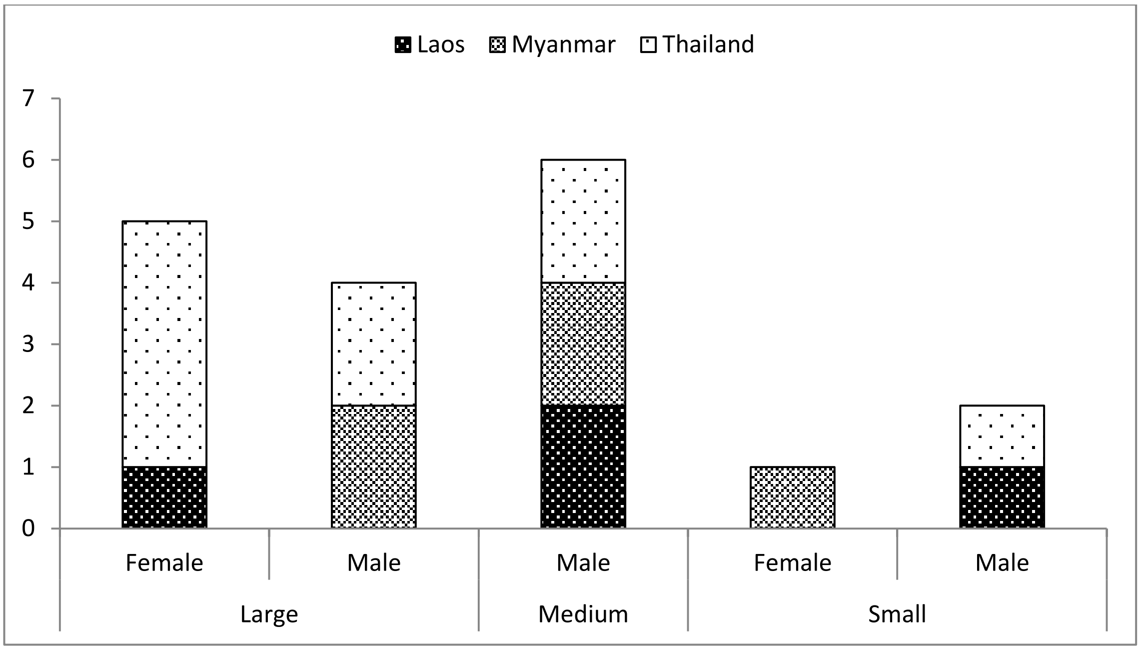

Figure 5.2 Country of origin and gender of shrimp farm workers surveyed

The total number of shrimp farm workers in Thailand is not known. Estimates of the total number of workers for shrimp farms may be calculated based on the number of ponds if this information is reported. Shrimp farms usually hire one worker to take care of a single pond. However, the DoF annual statistics only report the number of farms and the total area of farms.

5.3.2. Quality of life of workers in shrimp farms

5.3.2.1. Occupation prior to working in shrimp farms

The majority (78%, n=18) of the shrimp farm workers interviewed, both Thai and migrants, have worked in various occupations before working in shrimp farms. Figure 5.3 is a tag cloud showing that the main occupations of shrimp farm workers previously were rice farming (22.2%) and construction work (16.7%). Those in rice farming were doing it in their home countries, whereas those in construction work were already in Thailand, and moved to the shrimp farming areas to find work in the shrimp farms.

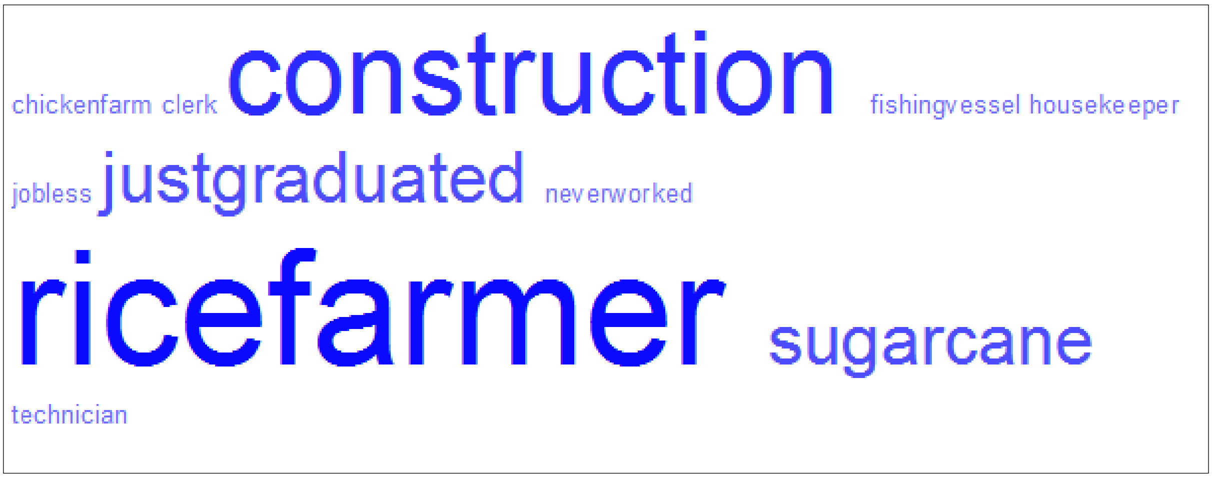

Figure 5.3 Previous occupation of shrimp farm workers

Figure 5.4 shows the details of previous occupations or situation of workers by country of origin and gender distribution. Both men and women in all three countries were in rice farming in their own rice fields. Only males from Lao and Myanmar were in construction in Thailand.

Those who did not have any previous occupation included two Thai male technicians in one medium scale farm, who started work right after graduation from a fisheries university in Bangkok; a newly married, 19 year old Thai female worker who came to a large scale shrimp farm with her husband (who is also working in the same farm), and a male worker from Myanmar who was jobless in his country before coming to Thailand 7 years ago to work in a large scale shrimp farm.

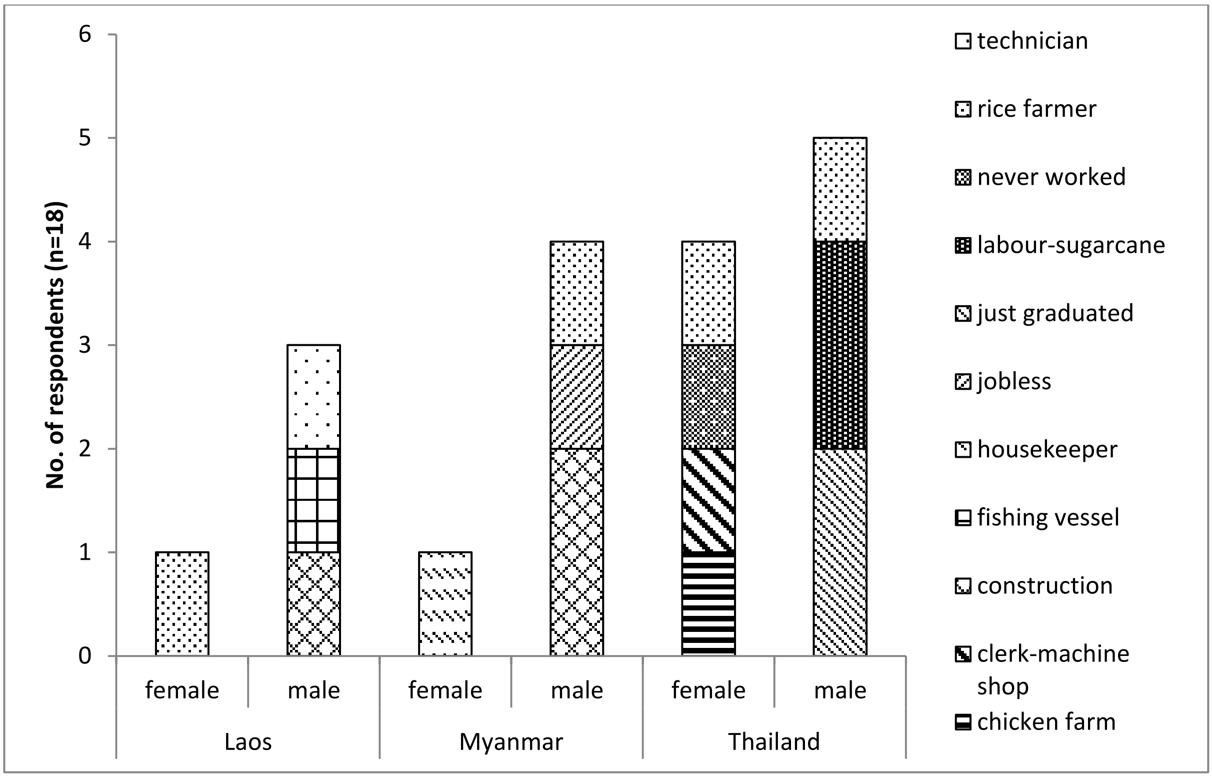

Figure 5.4 Country and gender distribution of workers' occupation prior to shrimp farm work

5.3.2.2. Workers' perceptions on their quality of life

Workers had a positive assessment of the quality of their lives working and living on shrimp farms, compared with their lives before their employment in the sector. Out of these 16 responses, 5 said they were much better-off and 10 said they were better-off, while 1 said that it was all right but did not specify whether it was better or much better off. The latter was a Thai male worker in a small scale shrimp farm (Table 5.5).

Table 5.5 Perceptions of shrimp farm workers on their quality of life

Farm Scale	Country of origin	Gender	Much better-off	Better-off	OK
Small	Thai	Male			1
	Lao	Male		1	
	Myanmar	Female	1		
Medium	Thai	Male		2	
	Lao	Male	1	1	
	Myanmar	Male		2	
Large	Thai	Female	2	2	
	Lao	Female		1	
	Myanmar	Male	1	1	
Total			5	10	1

n = 16

Reasons for shrimp farm workers considering they were much better-off now than before included economic and financial, as well as emotional, social and physical reasons (Table 5.6). Reasons referring to emotional well-being in Table 5.6 were more frequently mentioned (12 times), followed by economic and physical (7 times each), then social (4 times). These are based on multiple responses, wherein one worker could cite more than one reason.

Table 5.6 Reasons for workers' perceptions of a better quality of life

Emotional (12x)	Economic (7x)	Social (7x)	Physical (4x)
• No pressure, less stressful, happiness factor • Can live together with spouse • More freedom, independence • More comfortable life • Makes a person more mature and responsible • No problems faced • Peaceful	• Spend less money, more to save & send back home • Additional income such as bonus, benefits • Non-monetary benefits such as housing, water, electricity, meals • Fully paid for effort made	• Owners are kind • Enjoyable working with employers & other workers • Respect among each other in the farm • Familial atmosphere living in the farm	• Mechanisation reduced workload • Work is easier • On-going production • Better living conditions • Closer to nature

Note: Needs categorisation modified from Costanza et al. (2007)

Emotionally, workers experienced that working in shrimp farms was less pressurised and stressful for them, than in their previous occupations. The work on shrimp farms was routine and had a schedule that was generally considered favourable; most workers found it fun, enjoyable, comfortable, and easier than construction or fisheries, except when disease outbreaks occur. Both male and female workers cited the above reasons, in addition to the fact that having their spouses and, for some, their children, living with them in the farms helped in giving them peace of mind. For the employers, one of the reasons for allowing families to stay together in the farm was that this tended to increase contentment and productivity of the workforce. In addition, most employers also preferred to hire married workers as they were less likely to seek off farm entertainment than single employees.

Working on a shrimp farm also gave freedom and independence to the workers, compared to working under more rigid conditions in other occupations such as construction, fisheries, factories or domestic work. The assignment of specific ponds to individual workers gave clear responsibilities and allowed some autonomy of decision-making.

> "*We used to work in Bangkok. I worked as a housekeeper in*
> *Bangkok while my husband worked in a market in Rangsit.*
> *We were not staying together, so we only met on weekends.*
> *We wanted to work together and stay together. Working*
> *in a shrimp farm allows us to be together. We have more*
> *freedom here and can make decisions independently.*
> *We have less expenses here.*" (Myanmar female shrimp farm worker)

> *"Working on a shrimp farm makes me feel more free than on a fishing boat…*
> *I can move around and the workload is lighter because of the machinery*
> *we use".* (Lao male shrimp farm worker).

Economic and financial reasons for being better-off included being paid both a basic monthly salary as well as a bonus which is based on the amount of production. In addition, non-monetary benefits which workers received from employers reduce the living expenses of workers. Workers claimed that this directly increased remittances they could send home. Migrant workers usually support their children who are left behind in their hometowns or countries, for basic living and educational expenses. Single employees send money back to support their parents and siblings. Workers felt well compensated overall compared to other types of comparable employment where higher living costs tended to erode any differences in salary.

Physical aspects of living on the shrimp farm also improved workers' lives compared to alternative employment; including the application of technology that resulted in reduced workload. This, together with the free housing, freedom from commuting to work and a work environment located in natural surroundings made for emotional well-being.

Socially, people in the farms work together, treat each other as family and friends, and help each other when their workload was light. There was also respect from the new worker for the older or existing workers. A migrant male worker mentioned that life on the shrimp farm was like staying at home. One lead female worker responsible for a group of other workers mentioned that conflicts among workers tended to be sparked by minor issue and were generally easy to resolve. One migrant worker who had been on the same shrimp farm for 10 years, and was the first migrant worker this farm had ever hired, mentioned that he had not faced any problems in the farm, and that if he had, he would not have stayed that long in the farm.

5.3.2.3. Key informants' perceptions on workers' quality of life

The KI from the one subdistrict administrative organization who is also a shrimp farmer observed that the living situation of migrant workers is better now compared to 4 to 5 years ago. When the migrant workers first came to Thailand at that time, almost all came and worked illegally, so they were afraid to move around and go out. These problems were linked to the shrimp sector at that time having no requirement for registration. But nowadays, most of the migrant workers were registered and had legal IDs so life is much easier for them.

5.3.3. Status of compliance to labour standards

Third party certification standards for finfish and crustacean aquaculture, namely the Global Aquaculture Alliance/Best Aquaculture Practices Certification (GAA/BAP) and the GlobalGAP Risk Assessment in Social Practice (GRASP), emphasise standards and guidelines promoting worker safety, occupational health and safety, as well as employee relations, in shrimp farms (GAA-BAP, 2013; GlobalGAP, 2011). This section will look at the work situation and living conditions of the workers interviewed vis-à-vis the two standards mentioned above. The standards emphasise that farms should comply with local and national labour laws in order that workers are adequately safe in the working environment, not exposed to health issues, compensated properly, and provided with good on-site living conditions including enough training to perform their specific tasks related to chemical handling and hygiene standards (GAA-BAP, 2013; GlobalGAP, 2012).

5.3.3.1. Salaries & wages

Salary information obtained from farm owners, managers and workers is shown in Table 5.7. Information from farm owners and managers revealed that salaries of workers are paid monthly and are based on the number of ponds assigned to them, usually one worker is assigned one pond only. For wages based on a daily wage, workers are still paid monthly based on the number of days worked that month i.e. less the number of days for breaks or holidays.

Table 5. 7 Salaries and bonuses of shrimp farm workers according to farm scale

Farm Scale	Salary range[1] (Baht)	Bonus (Baht/kg produced)	About the Workers	Remarks
Small	3,000 to 9,000/ month	1 to 2	Female, Myanmar: 5,000 Bt/mo	Based on no. of ponds and no. of years worked
Medium	5,000 to 8,000/ month	1 to 3	Male, Myanmar: 4,000 Bt/mo, 1 pond; 2 Bt/kg bonus Male, Laos: 6,000 Bt/mo, 1 pond; 2 Bt/kg bonus	Based on no. of ponds; couples are assigned 2-3 ponds
Large	6,000 to 10,000/ month	1 to 3	Female, Laos: 6,000 Bt/mo (domestic work)	
	9,000 to 20,000/ month	3 to 4 months' salary		Longer term workers
	300/day, paid monthly	0.75	2 males, Myanmar	1-2 ponds/ worker depending on performance

[1] £1 = 50 Baht, approx

Since responses from workers regarding salaries were incomplete (56% response rate), it was difficult to cross check the data with the workers for the following reasons: a) salaries are confidential especially they are mentioned in contracts (for large scale farms), and, b) the interviews were conducted together with another worker so the respondent might not want the other to know or did not feel comfortable to disclose it.

For workers in large scale shrimp farms paid based on the 300 Baht/day minimum, if they take one day off per week, the number of days they can work in a month will range from 25 to 27 days. Thus the salary they receive per month will range from 7,500 to 8,100 Baht. Large scale farms are registered as companies so they are considered under the industrial system (Thai Labour Code) which means that they have to abide by the requirement of the 300 Baht/day minimum wage.

In general, employers expect workers to stay for a minimum of one cropping period. This is because the complete payment will be paid at the end of the cycle. Usually workers get paid every 1st and 15th of each month, or once a month, based on the salary rate per pond. Then at the end of the culture period, the remaining salary (for those taking care of 2 ponds) and bonus (based on production) will be paid.

In most small scale farms, it is often the case that the couple is hired by the farm owner/ manager to manage the whole farm by themselves, regardless of the number of ponds (usually not more than 5). They are paid as a couple, wherein the payment is given on a monthly basis. Either they are paid for the whole farm or per pond. For example there are farms which pay 5,000 Baht/month/pond. If a pond is managed by just the husband or by a couple, they only receive 5,000 Baht/month salary. But if a person or couple manages 2 ponds, he or they can receive a payment of between 9,000 to 10,000 Baht/month for the 2 ponds. In addition to this, they also receive the bonus commission.

5.3.3.2. Benefits

Employers provide the basic benefits to all their staff and workers, regardless of farm scale and nationality (Table 5.8). These benefits are housing inside the farm or a housing allowance for those living outside, water (for drinking and domestic use), and electricity. Basic furnishings and beddings are also included, and especially mentioned by workers in large scale farms. At least one large scale farm provides their workers access to internet as well.

Workers may or may not have social security membership, which includes health insurance. Thai workers without social security could avail of the 30 Baht medical scheme for Thais by presenting their Thai ID in any medical establishment. A Myanmar male worker had the 30 Baht medical card which he could use in the district hospital. The farm manager or head of their zone would bring the workers there when it was necessary to go to the hospital.

Table 5. 8 Benefits provided to shrimp farm workers

Item	Small scale farm	Medium scale farm	Large scale farm
Housing	✓	✓	✓
Water	✓	✓	✓
Electricity	✓	✓	✓
Social security with health insurance		✓	
Meals 3x/day on farm			✓
30 Baht medical card			✓
Plain or sticky rice		✓	
Gas		✓	

Regarding the issue of benefits, the Department of Labour Protection and Welfare (DLPW) makes sure that employers in Thailand provide their employees the following:

- Working hours: 8 hours/day
- Holiday: 13 days/year
- Treat women and men workers equally
- Safety at work

For shrimp farms, which are not considered an industrial work place, the DLPW office also tries to ensure that employers provide at least the following: safety in the work place, drinking water, and salary payment of at least once a month. Safety in the work place refers to ensuring that the workers do not face risk of injury and sickness from equipment, substances, infrastructure, and human forces. Shrimp farms have the same basic guidelines in terms of labour as in the law, for e.g. workers need to work within the time frame, spend some time for meals, work and rest in accommodation. Housing and bonus are not specified by law for aquaculture farms, but shrimp farmers/operators provide these to their workers anyway, by their own initiative. The key informants mentioned that most shrimp farms hire legal workers. However, if they find illegal workers in any farm, the DLPW will inform the owner or recruitment company to register the workers at the local Labour Employment office.

5.3.3.3. Child labour (ages of workers)

The ages of the workers interviewed ranged from 18 to 50, with 50% of them aged from 26 to 35 (Fig 5.5). Thirteen of the fourteen married workers live with their spouses and small children in the farm. According to the KI at the Department of Employment, they do not usually look at the ages of migrant workers registered with them, but they are usually

18 to 40 years old, with majority between 18 and 30. There are also those who are up to 50 years old, and, even if they do not work, they also register so they can be with their children and family in Thailand.

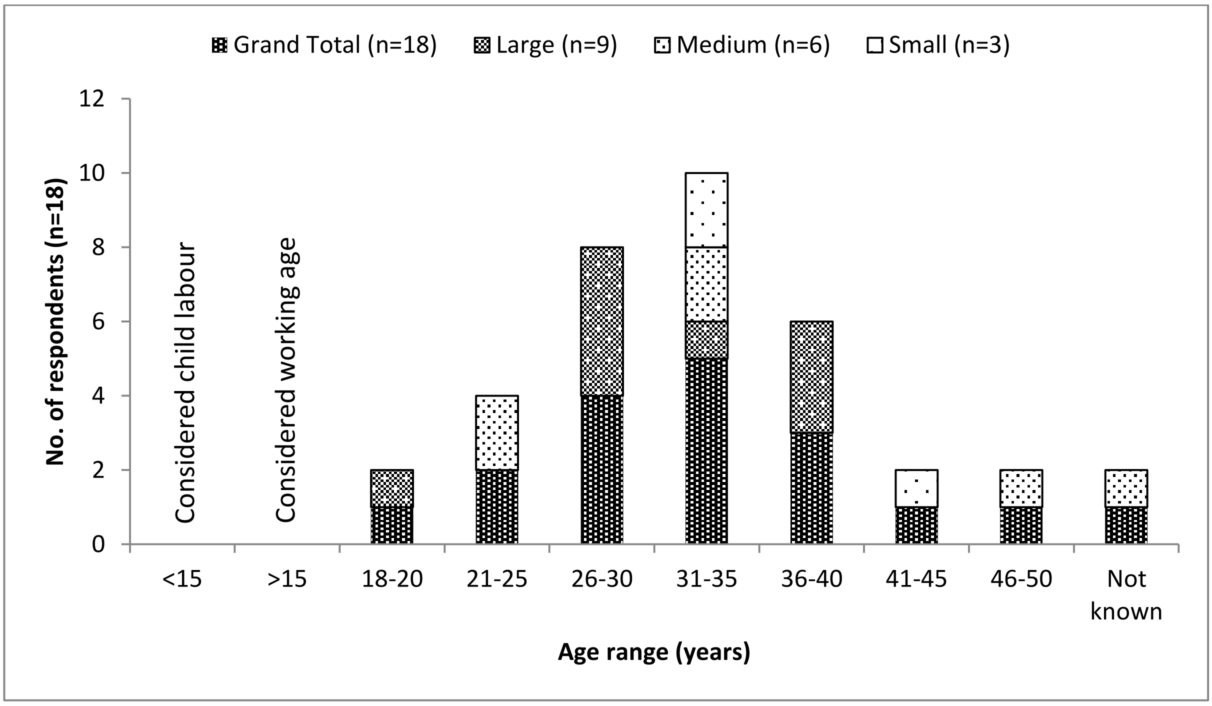

Figure 5.5 The ages of workers in shrimp farms interviewed for the survey.

As a general rule, female partners of shrimp farm workers did not work if they had dependent infants and small children. The husband is the main person employed by the farm, and the wife would accompany the husband. Sometimes they already have children before coming to the farm, or they will have children while living in the farm. The wives would usually assist the husband in the economic tasks, in addition to taking care of the reproductive tasks. Shrimp farm employers do not allow the children to be left alone with no one to take care of them for safety reasons, thus avoid employing the women for farm work when the children are still small. However, once the children can go to school, female partners are typically encouraged to work with the husband assisting in pond work, or are hired separately for other tasks inside the farm, or find work outside. The shrimp farms set the production areas with ponds and machinery as off-limits to those who are not involved in pond production, especially to ensure the safety and protection of children.

5.3.3.4. Working time

Regarding the workers' working hours in the farm, thirteen of them responded specifically on the times they had to work in the ponds.

For the female migrant workers on small scale farms who are employed with their partner, work starts at 6 am, then at 10 am, 2 pm and 6 pm. Feeding the shrimp takes 10-15 minutes to do. Her tasks include cutting grass around the ponds, feeding the shrimp, liming, checking feeding activity of shrimp, and adding supplements to mix with the feed. She would also record the amount of feed. Checking of feeding trays to monitor feeding activity is done every 2 hours. Liming of pond is done weekly to increase the pH.

For medium scale farms, the two male Thai workers mentioned that their work is usually from 6 am to 6 pm, but the last round of checking the nets is at 5 pm. So if the work was done before 6 pm, they could already rest. They also had time to rest in between when there was no need for them to be in the ponds. They also had a lunch break for 1 hour.

One migrant worker mentioned that the shrimp takes 5 months to culture, during which time he needed to be present during the whole period. For the another migrant worker, auto feeders were filled in the morning, then after 1 hour, feeding trays require checking to monitor feed response. At night, at around 10 pm to midnight, he would apply lime as the lime would breakdown easier when the water pH is lower. During the day he could also rest or sleep if he did not have to be in the ponds. Thus the working time and activity depended on the management system of the farms.

For large scale farms, the workers responded that their working hours are either from 6 am to 6pm or 8 am to 5 pm, but they are not continuously working during this period, as they could rest for an hour after 2 hours of work during this period. There is usually a one hour lunch break, and they can also rest in between the other times if there was no need to be in their ponds, although they are on call all day. Their houses are near their ponds so it is easy for them to go to rest and back to the ponds when necessary. One of them said that at night, it is not necessary to stay and watch the ponds; only if there is something wrong with the machines. One female worker supervisor (Thai) mentioned the she could not estimate the number of working hours especially during an emergency when she would have to work longer. But during normal days she would also work during usual time as the others, although she is on call all the time.

5.3.3.5. Breaks and holidays

Workers are also given longer breaks such as during holidays or for vacation. Workers regardless of farm scale, usually have a break in between cropping periods when the ponds are empty. The break can be from 1 week up to a month. During their breaks, workers would tend to either stay on farm or return to their home town (Thais) or country (migrants). One of the workers said that during the break of 1 week in between crops, he would stay at the farm, try to prepare the pond but there are no specific tasks of what to do compared when the pond is stocked. For another, he and his family would visit his home country for 2 weeks. A third worker said he could take leave at any time, especially if related to a need for official documentation.

After stocking, leaving the farm is much more constrained although one day break per week is common for both Thais and foreign workers, when the Thai technicians/zone leaders would cover duties.

On days off, usually Saturday or Sunday, employers may offer transportation to the local town, especially for migrant workers. Public or Thai holidays are only taken by farm office workers. For pond workers, even Thai holidays such as Thai New Year (Songkran holiday) are not observed if ponds are stocked, as one Thai female worker said, “One could not stop work in shrimp farming except when in between crops.”

Workers could also take sick leave, and they should inform their employers if they are not feeling well.

5.3.3.6. Documentation and registration

The documents required of legal migrant workers include a passport with the visa status stamped into it, worker’s ID and work permit. Passports are either regular or temporary, depending on their origin; migrant workers usually enter Thailand with valid passports from their own countries, or without passports, which makes their entry and stay in Thailand illegal. The Thai government offers a certain period of time for illegal migrants to register. To obtain a valid passport is a process that requires citizenship verification, and registration of workers. These two steps, often problematic for applicants to complete, are now offered as a One Stop Service by the Ministry of Labour. Opportunities to register for illegal migrant workers are only offered for certain periods.

The work permit, issued after the worker has registered, specifies the name of the employer and the place of work. If the worker changes employer, he/she needs to apply again but they can keep or continue to use the medical insurance until it expires. According to a key informant at the DoE, if the worker changes the farm where he/she works another work permit fee needs to be paid, normally by the new employer. Failure to re-register with a new employer risks arrest.

The Thai government has set up a Memorandum of Understanding (MOU) with the three neighbouring countries (Cambodia, Lao PDR and Myanmar) to manage the recruitment and hiring of migrant workers. Employers in Thailand can find workers through this MOU to bring workers in legally. Those who are registered in the offices handling the MOU have legally come to work in Thailand. Government records through the National Economic and Social Development Board (NESDB) statistics started to show the number of migrants under the MOU in 2007, at 86,248 migrants (NESDB, 2014). The number has been increasing every year and by 2012, had increased by almost ten-fold (826,868). However the records did not specify the nature of employment in which migrants were engaged. But the MOU limits employment to two types: manual labour and domestic work. Official data (NESDB, 2014) suggest significant year-on-year variation in application for registration by illegal migrants.

Table 5.9 summarises the various types of migrant workers based on their status when they come to work in shrimp farms. Basically, there are three major types of migrant workers, i.e. legal and registered to work, legal (with passport) but not yet registered to work, and illegal and not registered. Legal means the workers have passports and they came into Thailand with proper documentation, i.e. with a visa to enter.

There are several steps that employers have to follow to obtain permission to employ migrant workers. The Department of Employment undertakes the registration process and issuance of work permits while the Department of Labour Protection and Welfare ensures that the Labour Code is followed. The Social Security Office processes the medical insurance and hospital card for the registered workers. Figure 5.6 outlines the basic steps taken for registration of migrant workers.

Hiring and registering migrant workers involve costs. Table 5.10 summarises these costs but the list is not exhaustive. The information was obtained from interviews with employers/managers, key informants and the workers.

An issue of importance to international standards is that all labour is not coerced and entered into on a voluntary basis. The retention of original identity papers of migrant workers, namely the passports and work documents is therefore a potential issue. This research found a mixed situation, some employers kept workers' papers, but others did not. Table 5.11 summarises the various opinions related to the retention of workers' documents by employers.

Table 5. 9 Types of migrant workers hired in shrimp farms

Type of migrant worker	Action from farms	Remarks / examples
Migrant worker recruited through MOU (government initiative)	Farm contacts recruitment company in neighbouring country	Recruitment company processes all documentations and farm pays fee to recruitment company
Migrant worker has legal papers already i.e. work permit, passports, registration ID	• Farm accepts worker immediately • Farm manager brings registered worker to local employment office to re-register with the new farm name to put in work permit	Most preferred by farms
	Broker handles all registration process, workers pay the broker a fee, and assigns them to farms	• Workers responsible to keep their own documents • Employers might pay broker fee also
Migrant workers have passports only	Hired and will register once Department of Employment approves quota request	• Process with Department of Employment • Workers keep their passports with them
Migrant workers with no legal papers (came in illegally, not yet registered)	Accept if really needed but human resources department of company will process registration of papers	Large scale farm
	Accept and employer will register them once hired	Medium scale farm keeps original documents (for 90-day reporting) and gives copies to workers to show to authorities
	Hired but workers have to pay their own registration after hiring, employer can provide cash advance and pay back by salary deduction	Employer keeps documents until worker has fully paid the cash advance
	Hired and employer will process registration and pay for the fees	Employer does not need to deduct fees as long as the workers are diligent in doing their jobs
Documents not required by employer	Hired but employer assumes either illegal or registered	Small scale farm

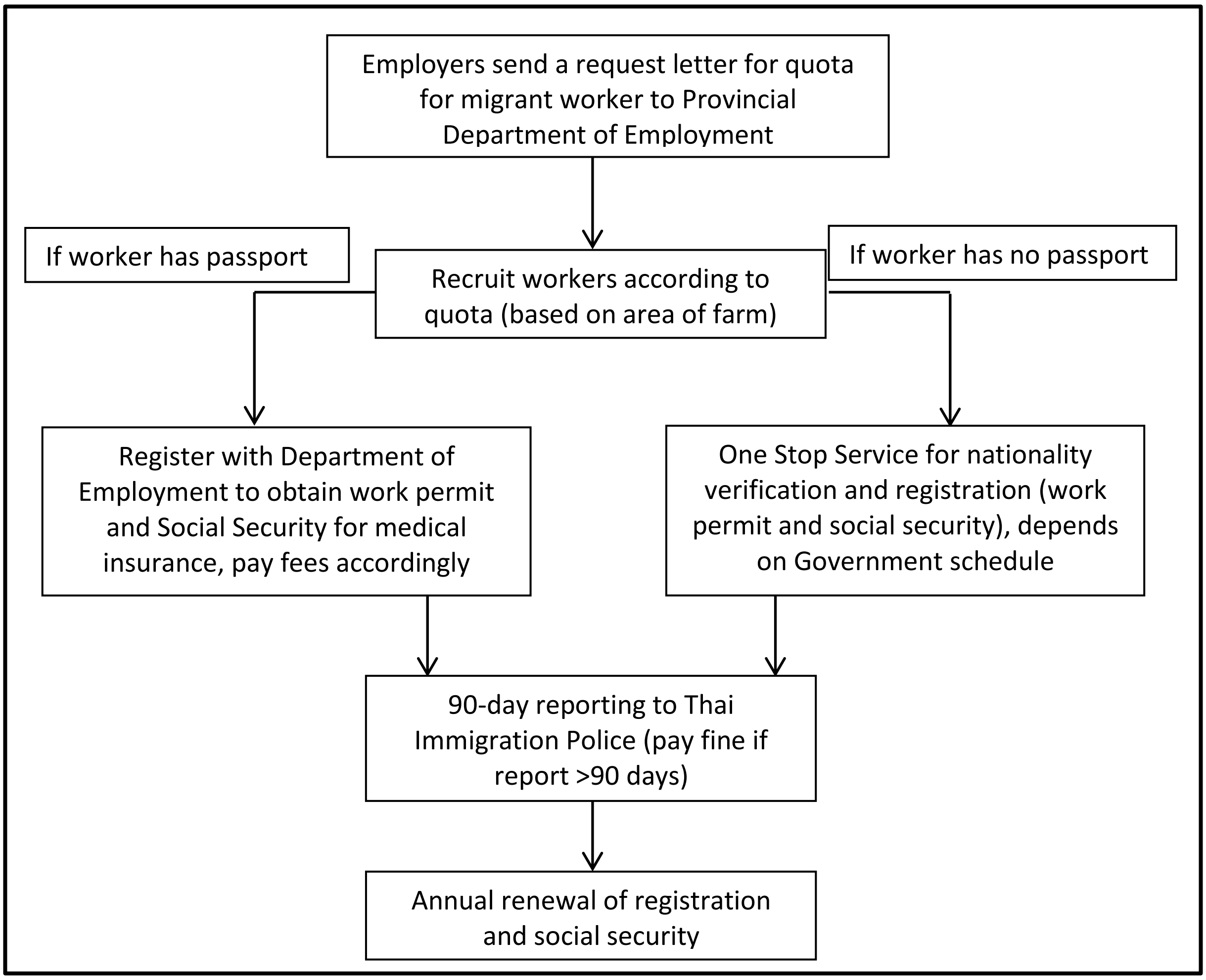

Figure 5.6 Basic steps for registering migrant workers

Regarding retention of documents and its impact on employment tenure and worker mobility by keeping the documents of the workers, there are various scenarios if the documents are still with the employer and the worker wants to leave the farm (in the case that employer advanced the registration fees on behalf of workers). These are as follows:

- If fee payment has been completed, they can ask for the document from the owner and owner will return the documents.
- If fee payment is not complete yet, worker can pay by cash to the owner, and the owner will return the documents.

- If the worker leaves without telling the owner, the owner will inform the Department of Employment/Labour office that the worker is not working in his farm anymore.

Table 5. 10 Costs in the recruitment and registration of migrant workers

Item	Costs[1]	Remarks
Transporting a worker from Laos	5,000 Baht (~£100)	Paid by employer, transferred directly to the worker, already known from recommendations of existing workers
Passport cost	6,000 Baht (~£120)	2 years, can be extended in-country
Worker's registration	3,800 Baht (~£76) i.e. 1,900 Baht for registration with Dept of Employment + 1,900 Baht for Social security with hospital card (600 Baht for check-up and 1,300 Baht for medical insurance)	Annually, work permit and social security with medical insurance Who pays depends on each farm
Passport and registration (work permit, social security with medical)	15,000 to 17,000 Baht (~£300 to 340)	At the border
Broker fee	3,000 to 4,000 Baht (£60 to 80) per worker	Employer pays to broker, if illegal worker; workers could leave any time
	10,000 Baht	Employer pays to broker or recruiter, will process registration for legal documentation
Payment to police	?	If employer is hiring illegal workers
Recruitment and registration processing fee (under MOU)	18,000 Baht/person (one-time payment)	Employer pays the recruitment agency directly
Fine when caught with illegal workers	?	Employers had to pay so now they choose to register their workers
Fine for not reporting 90-days stay (after 14-day window)	2,000 to 4,000 Baht, and passport holder has to appear in person and sign apology letter to be approved by immigration officer	Employers can report in lieu of workers, reason why they have to keep passports in case they forget

[1] £1 = 50 Baht approx.

Table 5. 11 Opinions on keeping the original documents by employers

Opinions	Details/rationale	Remarks
Employers keeps documents for the 90-day reporting to Thai Immigration	To be able to monitor the time in order not to forget or else they will be fined	There are farms which do not keep passports but only ask when needed at the time of reporting. Risk of workers to forget, workers will report in person and pay overdue fine.
Company keeps original documents	Company provides a copy to workers. Will return original if workers inform that they will leave the farm.	There is no assurance that workers will stay on but this farm had workers staying for 7-8 years already.
Employers do not keep documents	Letting the workers to keep their own passports and other documents give them freedom.	No assurance that workers will stay anyway
Company does not keep documents	It is good for workers to hold their own documents, so they can present it to authorities when asked.	

Understanding by migrant workers about the requirement for changing documentation if they change employer can be poor resulting in them leaving without requesting them from their old employer.

The importance of registration to migrant workers is that it offers protection from arrest and allows free movement in Thailand, and back to their own country. Lack of a current registration card requires them to deal with a broker to leave, which is more expensive, as well as illegal. There are times when workers currently working in farms do not have an active registration card as it has already expired and it is now past the registration period given by the Thai Government. This necessitates both employers and workers to wait for the new round of registration and legal mobility is constrained at this time. The practice of intermittent registration opportunities encourages local corruption by police and other officials.

Farm owners/operators all supported the employment of legal or registered migrants, because of or despite the difficulties faced in both situations (legal and illegal, registered and unregistered).

5.3.3.7. Contracts

Contracts, written or verbal, are agreements between two parties, in this case, between the employer (farm owner/employer/company) and the worker. Written contracts are the norm for companies, thus workers in large scale shrimp farms had written contracts issued to them by the human resources department of the companies. It may also be in the form of an application form where the salaries and benefits, together with the job description are explained. In both cases the worker affixes his or her signature on the document.

The written contract, in Thai, has to be explained to the migrant worker before signing, as explained by a male Myanmar worker, where his direct supervisor, the head of the zone, explained the contents to him. He received what the contract mentioned in terms of salary and benefits.

However most commonly contracts are verbal and based on trust on small and medium scale farms. The general expectation is that although workers knew they could stay as long as they wanted, they were expected to stay for at least one culture period. This is advantageous for both sides, as the farm owner has assured labour and the employee can receive their bonus based on the production, in addition to the monthly salary and the non-monetary benefits. The workers interviewed felt secure in the work even without a written contract, presumably because of this clear mutual benefit. The terms of work and benefits were clear to them and they were satisfied with that, referring to their responses in the quality of life and the salary and benefits sections.

Both parties perceived that it was not necessary to have a written or signed contract as the agreement comes with trust between the two parties (employer and workers). From the employers' side, along with this agreement is treating the workers (Thai and migrant) as human beings, such as allowing them to have a break or a rest. The employers do not set specific rules on taking breaks or rest times-allowing workers to set their own specific routines given the prevailing conditions. Terms of employment were explained by employers to new workers at the start of their employment, although generally these would have been explained to them already by those who recruited them and introduced them to the farm. The employer would also assess the workers according to diligence in the initial stages and increase benefits if they were performing well. However they could not specify the time and duration because if the worker wanted to leave the farm they were free to go.

Written contracts and agreements are meant to protect the interests of both parties. As a written contract is a requirement for global certifications and standards, the companies are more likely to comply with it. Table 5.12 summarises the various types of agreements between employers and workers in shrimp farms

Table 5. 12 Types of contract agreements with workers

Type of agreement/ contract	Worker	Farm scale	Terms	Remarks
Written, in Thai	Migrant worker	Large	• Duration 1 year, renewable • Monthly salary • Bonus • Benefits • Tasks	• Worker signs, with farm manager as witness • Required for certification
Written, in Thai	Migrant worker under MOU	Large	• Duration 4 years • Monthly salary • Bonus • Benefits • Tasks • Conditions about staying in farm	Required for certification
Written, in Thai	Thai workers	Large	• Monthly salary • Bonus • Benefits • Tasks	• Duration not mentioned • Required for Thai Social Security
Terms of reference, in Thai	Thai workers/staff	Large	• Duration 1 year, renewable • Monthly salary • Bonus • Benefits • Tasks	Worker signs, with farm manager as witness
Application form, in Thai	Thai workers	Large	• Monthly salary • Bonus • Benefits • Tasks	Worker and farm owner sign
Verbal	Migrant and Thai workers/ staff	Large, Medium, Small	• Monthly salary • Bonus • Benefits • Tasks	Based on trust, expect to work for at least one culture period

5.3.3.8. Recruitment

The main method to recruit workers is through the informal networks of farms managers and existing workers have (Table 5.13). Thus nearly all the workers end up in their work places through introductions by existing farm workers, or those working in nearby farms, who can be family members or relatives, town mates or friends. This is one of the reasons why workers in one area of shrimp farms would know one another. It is well known among shrimp farm communities where a particular nationality or group of migrant workers is working. Employers trust this network approach as it is likely to ensure greater harmony with less conflicts between different groups. Usually workers will share food and cooking equipment and other facilities thus it is important for employers to hire the same group or clan of migrant workers.

Table 5. 13 Various ways to recruit shrimp farm workers

Recruitment method	Farm scale	Remarks	Costs
Recruitment company, if hiring under MOU	Large	• Recruitment company is based in the origin of workers • Saves employer time and cost of traveling, searching, processing papers	18,000 Baht/person to recruitment company, will process everyting
Vacancy announcement	All scales	Posted outside farm	
Informal networks	All scales	• Employers would request their workers to recommend somebody they know and contact employer if direct hiring, or go to recruitment company in their country if hiring through MOU • Employers' friends could recommend • Employers could directly recruit	Employers may pay for transportation cost from home country if recruited through recommendation
Walk-in	All scales	Usually hear from another if there is a vacancy, or find the announcement outside farm	
Broker	Small, medium	Employers could request migrant workers from brokers, could be legal or illegal workers	Broker's fee approx. 10,000 Baht/person

Using the informal network of an existing and neighbouring nationality group in the area facilitates recruiting new workers for owners and managers. There are various ways that exist for migrant workers to come to work in Thailand. Figure 5.7 shows the major routes, but there could be others. The informal network of family, relatives and friends is an important recruitment and migration pathway. Among these family, relatives and friends, there are also those who act as brokers, and may or may not charge a fee. Some even go to the extent of charging monthly for commissions.

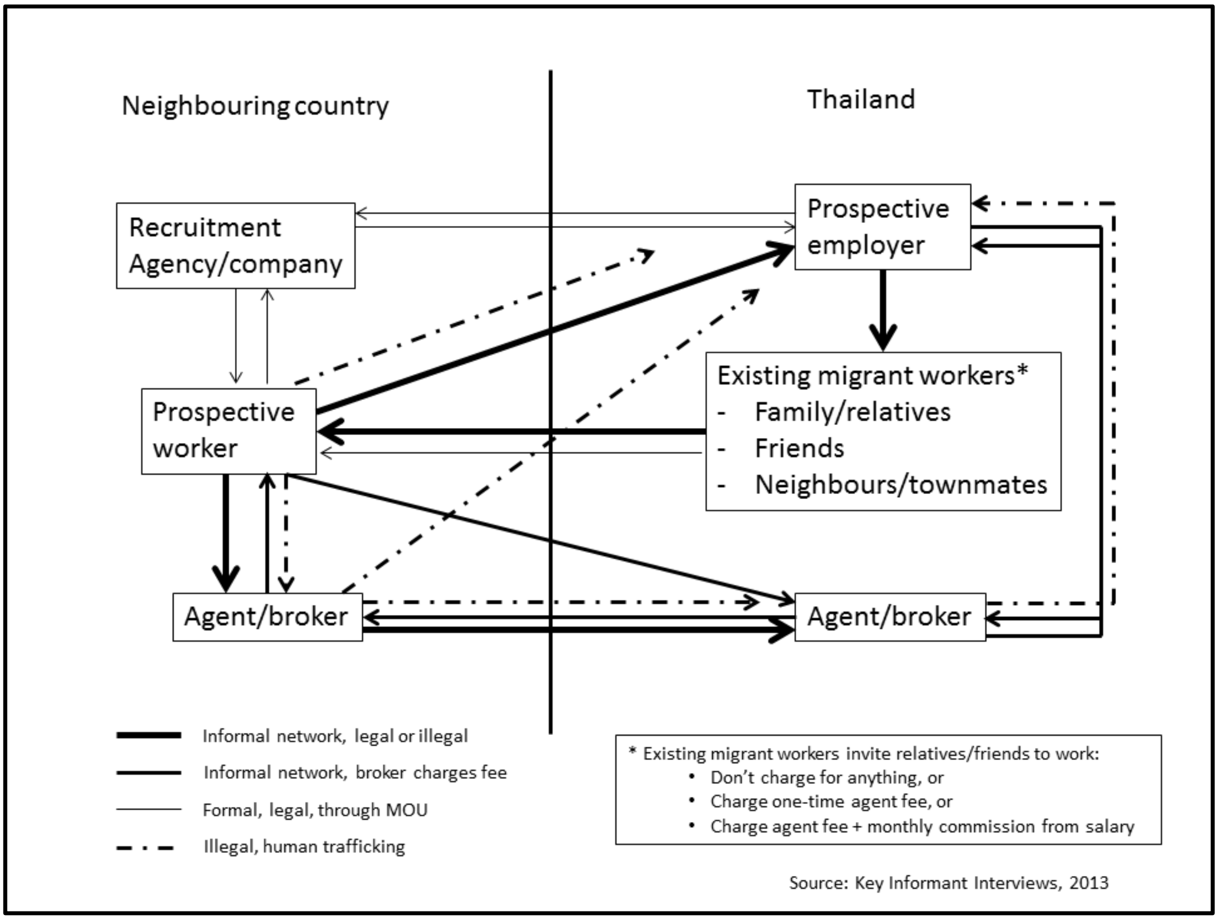

Figure 5.7 Recruitment pathways for migrant workers

The negative aspect of the dependence on the informal network especially among small, closely knit groups is that if conflicts or dissatisfaction do develop, a farm could lose most of its workforce at one time.

Although farmers prefer to employ workers that are introduced for the reasons explained, 'walk-in applications' are sometimes used. This is perceived as a greater risk and requires evaluating personality as well as nationality, and judgement as to the likelihood that they would fit with the existing group of workers. For example a 'walk-in' applicant from Laos and married to a Thai, and who had been living in northeast Thailand, was recruited by a medium scale farm in Chanthaburi. This farm already had a few Thai workers so the judgement was made that it was acceptable to them.

One of the issues pointed out by a key informant was the social protection for migrant workers, which should be in place and that they can be regular workers, so that there is less vulnerability for exploitation and abuse. What employers try to do is to comply with the requirement of the Departments of Labour Protection and Welfare, and Employment to register their workers for work permit issuance if they do not have legal status to work. The burden for payment of fees lies on both the employers and the workers, and there are various arrangements on who pays. The dilemma of the employers would be that they sometimes do not have the assurance that having spent for the registration and documentation, the workers would stay long in the farm. In some experience, most of the workers would leave and move to another farm which has a better offer for them, and the former employer, if he/she spent for worker registration, would experience a loss in their investment. This is the reason why for some, the responsibility for fee payment is put on the workers.

5.3.3.9. Collective bargaining/representative to management

On large scale farms hiring mainly workers from Myanmar, communication is often an issue. In general one person in the group who knows Thai language well, takes unpaid responsibility to help explain the tasks to other workers in their language, as well as to communicate with the zone leaders and manager any problems or issues faced.

The director of the Provincial Department of Labour Protection and Welfare mentioned that for migrant workers, there are not so many complaints received related to language problems. His office had hired translators to communicate with migrant workers, through volunteer workers but the number of complaints was few largely because shrimp farm workers received higher benefits and payments due to prevailing labour shortages. According to him, the Thai government was aware of the requirement for ILO members to permit and facilitate the setting up labour unions for migrant workers (Freedom of Association). Although discussions were underway as to if such unions should be workplace–based or at provincial level, in theory migrant workers can already initiate groups, select representative and negotiate for salary, benefits and the like. Although yet to be implemented for smaller enterprise, companies with more than 50 workers, where they have a committee, can already allow a migrant worker to be part of that committee.

This Department also has responsibility for disseminating information regarding rights of workers and other issues to employers and workers. Information dissemination is done through many ways such as brochures and posters in various languages, TV and mobile phone. For some Thai workers, they are not interested about this if there are no issues to bother them. This Department also invites employers and migrant workers to attend meetings so they can provide information on laws and regulations, and available benefits. For example, regarding work permit registration, the office prepares materials in many languages to inform the workers and employers about their rights and the regulations. They can also communicate through the volunteer groups to tell others in their area.

This Department also looks at drug problems in the work place and has promoted a drug-free workplace through its "white factory program".

In terms of communication with volunteers, this office in cooperation with the Police would invite famous Burmese monks every year, provided they did not talk about politics and other controversial issues, but provided information about how to work and live with Thais. They should try to encourage positive thinking among workers, as well as the spiritual aspect. Since it is a religious activity, they also work with the temple as the base for meeting/ training, and information dissemination. The workers will go to the temple, usually their employers will take them there. Workers consider this as good because they can also go to make merit.

5.3.3.10. Status of surveyed farms according to selected certification standards in aquaculture (Labour aspects)

The status of compliance to some labour certification standards, as presented and discussed in the chapter, is presented in Table 5.14. The major issues that need to be focused on more are as follows:

- salary payments to couples if the wife also helps, however the issue with the employers would be that the employment agreement is with the husband, and they also provided non-monetary benefits for the family
- legal employment status of workers in small scale farms
- complaint procedures set by the standards need to be revised to ensure they are applicable to shrimp farming
- written contracts for farm of all scales

Table 5. 14 Status of compliance to labour standards in shrimp farms

Required standards for compliance	Small	Medium	Large
Salaries and wages	***	***	***
- Individual payments if both couple are hired	***	***	***
- Couple salaries if only husband is hired but wife helps	**	-	-
Welfare and benefits			
- Accommodation	***	***	***
- Water, electricity, gas	***	***	***
- Meals, rice	X	X	**
- Bonus payment	***	***	***
- Medical care	***	***	***
Legal employment (migrant workers)			
- Registration with work permit	**	***	***
- Social security with medical	**	***	***
Child labour	X	X	X
Contracts/agreements:			
- Written	X	X	**
- Verbal	***	***	**
Workers' children on farm			
- Access to education	***	***	***
- Safety	***	***	***
Workers' time (as per shrimp farm times)			
- Working hours	***	***	***
- Breaks/rests	***	***	***
- Holidays	***	***	***
Family friendliness	***	***	***
Complaint procedures	**	**	**

*** Fully comply ** Comply with some X Not comply/None

5.3.4. Treatment of workers , especially migrant workers in shrimp farms

5.3.4.1. Nationality preference

Employers and key informants have varied perceptions regarding the characteristics of migrant workers, which shape their preference or lack of preference for certain nationalities. Even though Thai workers are preferred by some, most farms could not find Thai workers. Respondents did not specify which region of Thailand they preferred Thai workers to originate from.

Knowledge of the Thai language is one of the main considerations in hiring migrant workers, especially for workers from Myanmar. Lao workers can communicate in Thai language and many farms do not differentiate between Thais (especially northeastern Thai) and Laotians.

Differences mainly relate to personality rather than nationality. Important personality traits are keenness to understand instructions regarding work, inputs and safety, as well as diligence, responsibility and trustworthiness. Sometimes close cultural or kinship ties are not considered positively.

> *"I do not really have a preference for nationality but I do not like Thai workers especially my relatives because it is difficult to reprimand or tell them off." – A small scale farmer whose current workers, who he has employed for ten years, are a couple from Myanmar*

Another reason for choosing a certain group is based on location. The same group of workers would find jobs together in the same area due to the informal network of introductions. An employer in Surat Thani has hired workers from Myanmar on a continual basis because they are the group that is most available.

Other considerations identified by one large scale farm manager to explain why Myanmar workers are in particular demand and very few Thais are hired, include the unresolved political issues between Cambodia and Thailand, and the long duration of Laotians' seasonal break.

Table 5.15 summarises some of the opinions and perceptions of shrimp farm employers in working with various groups of people, both Thai and migrant workers. These are based on their experiences in working with these groups of people. There are varying and contrasting opinions, and there could be other factors that affect the behaviour of the workers, not only their ethnicity.

On the other hand, there are farms which have never hired migrant workers, mostly large farms. Their reasons include:

- They could still find Thais who are willing to work in shrimp farms.
- They do not want to encounter communication problems, especially related to reading and writing due to the technical aspect of shrimp farming.
- They do not have courage to hire them.

Large farms are more successful in getting Thai workers, again using their informal network such as their previous workers to help contact and recruit their relatives, neighbours and friends.

Table 5. 15 Shrimp farm employers' opinions on working with different nationalities

Ethnicity	Positive	Negative
Thais	Easy to communicate Gentle	Difficult to reprimand Goes out often Inefficient Irresponsible Proud
Northeast Thais	Easy to communicate	Leave during festivals and do not return Not satisfied to work in shrimp farms Do not want to work hard Want more freedom to leave when they want
Laotians	Easy to communicate Not hard-headed More gentle personality Diligent Easy to follow instructions Honest Kind	Leave during festivals and not come back Choosy in the work to do No skills in doing the work
Myanmar	Diligent Stable Honest Trustworthy not to steal shrimp Strong spiritual belief Low maintenance Hard working Tidy Willing to listen Good in following assigned tasks	Hard-headed Strong personality Difficulty in communication Difficult to convince to do something Harsh Could not be trusted Want to stay together as a group
Khmer		Untidy Harsh Could not be trusted Want to stay together as a group

5.3.4.2. Access to opportunities for self-development

The majority of workers (Thai and migrant) do not have prior knowledge or experience in shrimp farming. They learn aquaculture skills ‘on the job’ once on farm mostly from their employers and co-workers. Technical publications and magazines are not accessible to migrant workers who could not read and write Thai or English. Thus the following are the main sources of knowledge for them which provide them with opportunities to better themselves in their work and in their future occupations:

- Hands-on training from employers, managers, experienced co-workers
- Technical meetings and discussions with the team on-farm
- Company technicians and salespersons who come to the farms
- Technical seminars given by companies outside the farm
- Consultation and discussions with other shrimp farm workers, face to face or by phone
- Watching television (technical as well as Thai language)

For medium scale farms, the two Thai male workers who graduated from university are assigned as zone leaders, overseeing the workers in each zone. They are the ones handling the technical matters including calculations and analysis of parameters such as for water quality and shrimp behavour. They learned skills from university studies, as well as from other sources such as magazines, books, CD, internet, etc. They would also talk with workers who have been in the farm for a long time and have experience, as well as with other technical staff in other farms when they attended technical seminars.

What is beneficial to the workers is the fact that most of the employers or managers would be on the farm every day to interact with them and train them. For example, a female employer encourages workers to observe, check and tell her directly about the situation in their ponds. This makes them eager to learn more about shrimp farming and working in the farm has given them many opportunities to learn.

Working in the farm and learning from employers/managers, technician and co-workers help in improving worker skills. One of the male Myanmar workers in a large scale farm is now assigned by his zone manager to train new workers, after learning the skills. Better skills can result in them being assigned two ponds rather than one, directly equating to a bigger bonus if they can make good production.

5.3.4.3. Communication and interaction with employers

Communication with employers, managers, technicians/zone heads and co-workers is important, together with interaction to share information and present problems and solutions. The majority do not face problems in communication with employers. Myanmar workers may not be able to speak clearly in Thai but they can understand what the employer or manager was saying.

Non-Thai speakers can at least communicate orally and listen to Thai, although reading and writing are not possible. Thus record keeping task is limited, and the zone managers/ technicians (mainly Thai or long term migrant worker) are the ones doing the record keeping and technical analysis but the workers assigned in their individual ponds provide the manual work.

The topics of communication have been categorised into the following:

- Technical – which includes teaching and training workers with skills and assigning them tasks
- Support – able to communicate directly, easily, and well with employers/managers, and encouraged to do so
- Family – being treated as part of a family or being in a friendly atmosphere
- Health – communication related to health matters
- Social – positive feeling in communication with employers
- Legal – matters related to documents and registration

Workers are all able to communicate directly especially regarding problems such as diseases in their ponds. These problems could create stress to them but they had to directly tell their zone leader/technician or manager or employers so a solution could be made. In addition to problems related to production, they could also communicate to their managers or employers regarding taking leave and medical matters. Usually the employers take the migrant workers to the hospital when they are sick.

For all farm scales, the opinion and observation of workers is that living together as an extended family on the farm with employers, other workers, and their families, is highly valued.

Communication between employers/managers and workers related to both technical and non-technical issues, the latter including personal issues. Figure 5.8 shows the main areas of communications between employer and workers by farm scale.

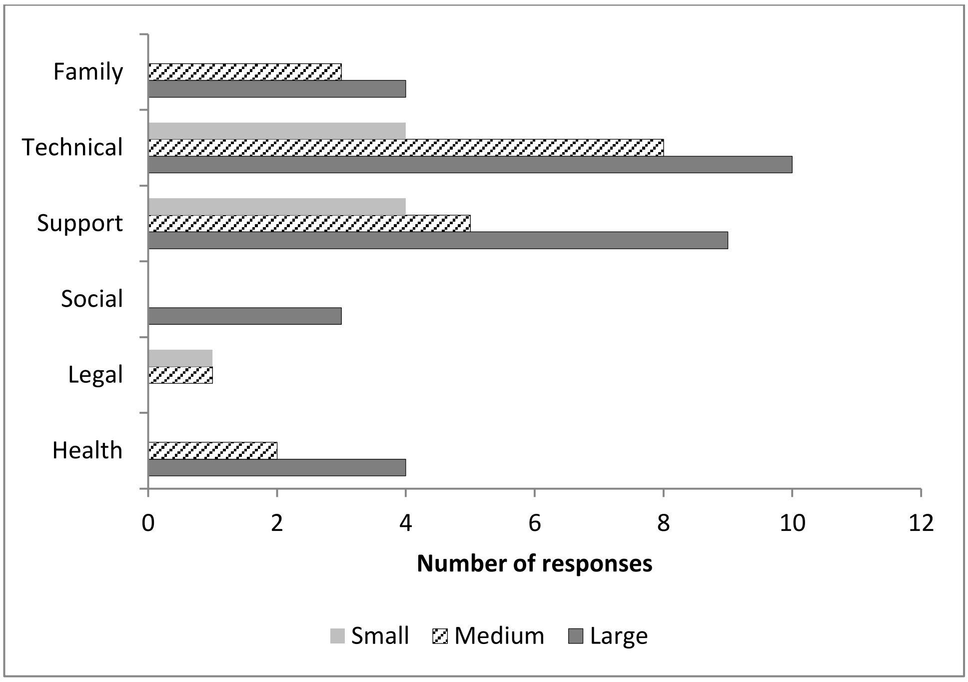

Figure 5.8 Main areas of communication and interaction by farm scales

N: Large=7; Medium=6; Small=3 (multiple responses)

Based on country of origin, Thai and Myanmar workers talked with employers more about technical than non-technical issues, while the Laotians cited more communications focused more on the non-technical (Figure 5.9). Legal matters were also mentioned by the migrant workers.

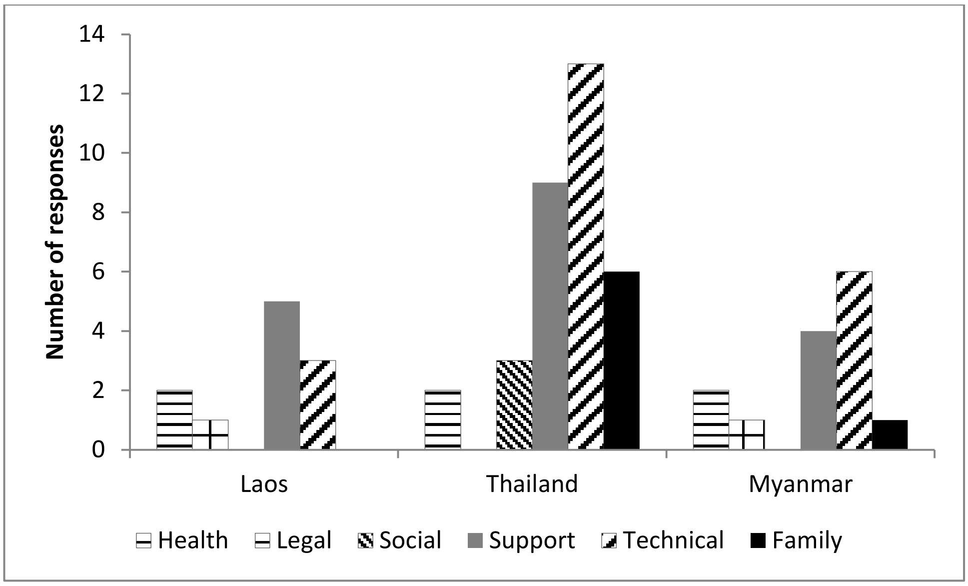

Figure 5.9 Main areas of communication and interaction by origin

N: Laos=4, Myanmar=5, Thailand=7 (multiple responses)

5.3.5. Importance of migrant labour in shrimp farms in Thailand

5.3.5.1. Migrant worker profile

According to the local Department of Labour Protection and Welfare which looks after all workers including Thai and other nationalities, shrimp farm workers get more than the basic for labour wage (300 baht/person/day). Because shrimp farm workers also get free housing, rice, electricity and water supply, minimum. There are more foreign workers in the manual labour category as Thais will not do this kind of work anymore because they prefer to work in other sectors. So Thailand has to depend on foreign workers for manual work.

Aquaculture is usually treated as the same sector with fisheries, like in Surat Thani. The sector still faces labour shortage problem so employers tend to provide benefits which are better than standard regulations to convince workers/employees to stay with them -

give housing, food etc. – not provided by other sectors. The law for migrant workers is linked with the ILO agreement. Thailand is a member of ILO so it has to abide to treat everybody equally, whether legal or illegal, and treat them the same as Thai workers. With the benefits given to migrant workers, it seems that they are even treated better than Thai workers in other sectors.

Due to labour shortages, employers compete for workers to work for them, so they provide more and better benefits. When workers know these, they will move to the farm which gives better benefits. This also poses as a problem to current employers.

Migrant workers also stick together in groups, have strong leadership providing communication with potential employers and often have high levels of intelligence about employment options. In contrast, shrimp farmers usually have limited choices regarding whom they can employ. This imbalance explains the emphasis employers place on treating their workers well and striving to create a family and fun working and living environment with maximum flexibility and learning opportunities for them.

5.3.5.2. Reasons for migrant workers to work in shrimp farms in Thailand

Working in a shrimp farm is perceived to earn more monetary benefits than in other work places.

> *"It is better to work in a shrimp farm than in construction, especially as the pay and benefits are better. In construction, I received 150 Baht/day including housing, but there were no benefits such as bonus, rice, water, electricity, etc. In addition,the work in the shrimp farm is not too busy, so I can work without any pressure."* – Lao male worker, medium scale farm

Likewise, a worker from Myanmar said that he saw his friend who worked in a shrimp farm that he earned a lot of money when this friend went back to his hometown. His friend invited him to work in a shrimp farm so he came to Thailand, by himself and not through a broker. He knew that there was more income in shrimp farming as long as the shrimp do not die. He considers that working in shrimp farms is different from another job, and it is better because he can save money, as there is enough income and there is no need to spend much. The living conditions are also better in the farm, and life is more relaxed, as well as he has everything he needed. He never had living conditions like this in his country and hometown. In the shrimp farm, there is also no need to work all day, whereas in Bangkok where he had to carry heavy things, the workload was too much. This view is also shared by other migrant workers from Myanmar as well as Laos.

5.3.5.3. Value of shrimp farming to economies of neighbouring countries where workers come from

The economic benefits of working in shrimp farms in Thailand have been mentioned every time by the migrant workers, it being one of the main reasons for coming to Thailand in the first place. Table 5.16 provides a summary of the plans of migrant workers after working in Thailand for a number of years.

The couple from Myanmar who are working in a small scale shrimp farm shared that they have already bought a piece of land (5 rai or 0.8 ha) in their country and have planted it with rubber trees. They have already started to get a production out of these trees. They have been working in the shrimp farm in Thailand for 10 years. Each of them earns 5,000 Baht/month/person, so as a family they earn 10,000 Baht/month. Her husband will give her his salary and she is the one who keeps the money and sends some money back to Myanmar for their son's education and living expenses. The son lives with his grandparents. In addition they also receive a bonus of 2 Baht/kg production/cycle. From the farmer's reported production of 42 T/year for the whole farm managed by this couple, they earned a bonus of 84,000 Baht. Thus their total earnings in one year could be more than 200,000 Baht (joint with her husband).

Table 5. 16 Future plans of migrant workers after working in shrimp farms in Thailand

Plan to do	Country/gender	No. of years working in shrimp farms in Thailand (scale)	Remarks
Rubber plantation	Myanmar (married couple)	10 (small)	Already bought land and planted rubber trees
Shrimp farming / Business	Myanmar (male)	> 1 (medium)	Will work 2 more years; can save 40,000 to 50,000 Baht/cycle
Rubber plantation	Lao (Couple)	4 (large)	Have already bought land; Will work 2 more years
No plans yet	Myanmar (couple)	7 (large)	Will continue to work in farm and send back to children
Rice field	Lao (male)	1 (medium)	Will go home to work on rice field then come back to shrimp farm again
No plans yet	Lao (male)	>10 (medium)	Will keep working in the farm, his wife and child are with him

When farms produced 20 T/crop and with 3 crops/year, workers could earn about 100,000 Baht as commission. They could send this money home including their monthly salary. Workers do not spend much while living in the farm because the employers provide almost everything for housing and living in the farm. In shrimp farms, if there is work, they work. The rest of the time is for resting and family. If they go out, usually the employers would provide transportation for them to go to the town or to the temple especially during festivals.

5.3.5.4. How Thai labour is affected by influx of migrant labour in shrimp farming

The main reason for hiring migrant workers in the majority of shrimp farms is the lack of Thais who are willing to do farm level work i.e. manual labour, especially in small and medium scale farms. Large scale farms can still find Thai workers through their own informal networks, however only a few have 100% Thais in the workforce.

During the interviews, managers and key informants mentioned that Thais nowadays prefer to work in factories and industries, since Thailand has changed from being mainly agricultural to a more industrial economy. The 20-30 age bracket work inside the factories, while the 30-40 age bracket would sell food and other items in front of the factories. According to a key informant at the sub-district office, in the upcoming implementation of ASEAN Economic Community in 2015, migrant workers are foreseen to go back to their own countries when other industries move to their countries. This could create a problem to Thailand because there will be a lack of migrant workers/labourers.

Although in large scale farms, with other units such as laboratories, administration, marketing, technical (middle management level) i.e. not manual labour, there are also Thais employed in the farm. The men are usually farm technicians and heads of zones while the women work as lab technicians, administrative and accounting staff, and cooks.

Now the perception is that no more Thai workers can be found who will work in shrimp farms, not because the migrant workers are getting their jobs, but because there are no available Thai workers.

5.3.6. Gender aspects of shrimp farm labour

A male manager of a large shrimp farm mentioned that a single woman could not work in the shrimp farm setting, as it is a male-dominated workplace. The company has a policy not to hire single women to work in the farm as it is quite a remote place. Likewise single women or women who are alone will also not want to come as the farm is far from the town and they do not feel safe. At the moment there are only two women hired in the farm for domestic work and cooking assistant. They are wives of the workers and they stay together in the farm. As the position for women worker is now full, the wives of the other married workers have to find jobs outside the farm and may or may not stay with their husbands in the farm, depending on their workplace.

Regarding the issue about payments for couples, there are farms which pay salaries separately to husband and wife whenever it is clear that they are employed individually and they have specific tasks. However, in most cases, especially in medium and large-scale farms, it was the husband that was hired and the wife accompanied the husband to stay in the farm. The wife is not prohibited to assist the husband, which is their own decision to do, especially if there are no small children to take care. The wife can help by cleaning the area around the pond and homestead, and growing vegetables in the farm which the farm manager or owner provides capital for. The vegetables can be consumed by the farm residents, or the wife can then sell them in the wet market outside the farm for additional income for the worker's family.

In terms of decision making and control of assets, women are still entrusted with the salaries that their husbands earn. In addition, the workers also said that they consult their spouses when it comes to purchasing large items, although the wives are oftentimes responsible for marketing, as well as conducting transactions to remit cash back to their own countries for their children and family. Most of the financial decisions are made by the wives as they are entrusted with the money to keep and save.

In Thailand, there are specific laws related to women and youth labour. Normally, women can take leave from work to deliver their babies. Presently there are more children of migrant workers who are born in Thailand. So this issue is a concern regarding the welfare of these children. The Thai government supports child education until Grade 6 so there is no need to pay for tuition fees. The children of migrant workers can study in local schools up to Grade 6 for free. In some local schools, the migrant children even outnumber the Thai children. As one key informant from the local administration office puts it, it is good to have the migrant children to study in the local schools in order to maintain the number of students needed to keep the school open. Otherwise, according to the Thai Ministry of Education law, the local school has to be closed if there is not enough number of students, and the children will have to travel far to get to the nearest school.

There is an issue regarding the increasing number of migrant children who either came with their parents or who were born in Thailand. Thus the Surat Thani Department of

Labour Protection and Welfare had started a project with Raks Thai (a Thai NGO) and ILO-Surat Thani, to study the living conditions and education situation of migrant children, and try to come up with a solution for this. They are still studying possible ways to handle the problem. The two major options are as follows:

- let the pregnant migrant worker to go back to her country to give birth there, with pay, and not bring the baby to Thailand, or,
- let the pregnant migrant worker to deliver the baby in Thailand, allow them to stay and learn the Thai culture

5.4. Discussion

5.4.1. Quality of Life of shrimp farm workers

Improving the quality of life (QOL) is the goal of every individual and organization (Costanza et al., 2007), which is the reason for working to generate income and to make lives better. The main concern for looking at working and living conditions of workers in aquaculture, especially migrant workers, is to determine whether their lives are better off or worse off now than before, i.e. have the lives of people improved which would make them valuable members of society. A number of researchers have tried to come up with ways to measure the quality of life of people, including looking at various factors and indicators. Even the aquaculture standards and certification guidelines for workers have these objectives in mind, i.e. protection of workers and assurance that they are provided a good quality of life while working on farms. Van Egmond & de Vries (2011) mentioned that quality of life can be viewed according to economic or financial value at one end, and the human value at the other end. For migrant workers in shrimp farms, when asked about the quality of their lives as shrimp farm workers, all of them mentioned that they are better off or much better off than before. The 'before' part could mean their lives in their own countries doing agricultural or other jobs or not working at all, or as migrant workers in Thailand in other occupations such as in construction, agriculture, fisheries (at sea), manual jobs in markets and service sectors, and domestic work. Their reasons for perceiving a much better life include both financial and human values, meeting their basic physical, emotional, spiritual and social needs. Again, Van Egmond & de Vries (2011) mentioned that the meeting of human needs and their satisfaction depends on people's value orientation. However, other views such as that of (Sen, 1993) point out that a person's well-being or quality of life depends on a person's capability, or on what he/she can achieve. Although terms of employment are not standardized by regulation the prevailing norm in shrimp farms of all sizes was that responsibilities were given to workers dependent on their capabilities, which were then linked to monetary benefits. The standard responsibility for a single pond, on which the monthly salary is based is incentivized by up to 100% (responsibility for up to 2 ponds) if a workers' performance was high, and through bonus payments linked to the yields produced. Shrimp farm workers vocalized the benefits of this transparent system allowing them to earn more income.

Costanza et al. (2007) pointed out that defining quality of life and measuring its progress may be difficult due to varying opinions and disciplines involved, thus they have suggested an integrative definition of QOL, combining both the objective (or quantitative) and subjective (perceptions or qualitative) indicators. In reflection, the factors mentioned by shrimp farm workers as contributing to a better quality of life in the farms can be considered fitting to the definition and diagram created by Costanza et al. (2007). It can be said that working in shrimp farms is contributing to improving the quality of life of workers by meeting their needs now and in the future through the opportunities provided by the shrimp farm working and living environment and because their income and savings result in remittances back to their home countries, there is a direct effect on the lives of their families back home, and indirectly the community there benefits as well.

For Lao migrant workers, they remit finances to their homes to support their families, about two to three times a year (Phouxay, 2008), with 76.6% of families claiming better circumstances due to the financial support. These remittances were used for house repair or construction, purchase of farming materials or motorbikes, buy land, family saving, children’s education, pay outstanding debt, and purchase other items resulting in improved family relationships and better living conditions.

It could not be denied (based on their accounts) that workers (Thai or migrant) in shrimp farms in Thailand are able to save more cash than in other comparable occupations due to their lower spending when living on farm. Other migrant workers like the ones described by Vungsiriphisal et al. (2010) complained about expenses deducted from their salaries including accommodation fee and social medical expenses. All of the workers interviewed shared their plans to save enough to remit back to their families, as well as for the future, to purchase land in their home towns for agriculture or aquaculture, or to start a small business. However, there is not enough quantified information in this study regarding the economics of remittances but suffice to say that during the peak of shrimp farming in Thailand, workers could earn up to 100,000 baht/year (approx. £1,800-2,000) from their bonuses alone. A discussion by Imai et al. (2014) on their study of migrant remittances in Asian and Pacific countries concluded that remittances had a direct effect on reducing poverty, although it is also vulnerable to shocks during an economic crisis when unemployment in host countries increases, and other economic factors such as currency depreciation.

Happiness in life is not obtained by economic improvement alone, according to a study by Bartram (2013) among eastern Europeans who migrated to western Europe. Although worlds apart, the basic human needs of people are similar, and this was shown by the way the workers responded in this study, citing not just economic gains as the main reason for a better-off life. Migrant workers in Thai aquaculture farms were happy as they did not have the same opportunities in their home countries (Kruijssen et al., 2013).

5.4.2. On compliance to global standards and certifications

Regarding contracts, under the specific standards and certifications, contracts should be written (GAA-BAP, 2013; GlobalGAP, 2012). However under the Thai labour law (Ministry of Labour, 1998), contracts may be “written or oral, expressed or implied”, with the employee agreeing to work for an employer, and the employer agreeing to pay wages for the work done. Thus in almost all cases especially among small and medium shrimp farms, there was only oral agreement between shrimp farm owner/manager and the worker, based on trust on both sides. Trust that the employer will pay the monthly salaries and the after-production bonuses, as well as provide the benefits for living in the farms such as housing, and utilities. Large scale farms are differentiated by having written and signed contract agreements, as they are required for the certification of farms to comply with the requirements of 3rd party certifiers.

As mentioned in the introduction, shrimp farm work does not fit under industry type of work therefore are considered outside the system governed by the national labour law. However, key informants from the Department of Labour Protection and Welfare mentioned that shrimp farm employers/owners try to follow the guidelines set forth under the Thai labour law, and even provided their workers more than the minimum required by law. According to the employers themselves, they have to treat their workers as partners in their shrimp farm operations, because if they get good production, both sides also benefit. Farm employers know that workers' attitudes to their work are critical to high performance especially the need for presence at the side of the pond, attention to detail, and observation skills, among others. This is a major reason why they allow workers, who are mainly men, to bring their wives and children with them, so they can have peace of mind and be happy working on farm, rather than worrying about their families if they are away from them.

All the farms comply in terms of salaries and benefits, as per the national labour law and standards, that farms should pay the workers for the work rendered. In addition, workers received benefits such as housing, water, electricity and sometimes rice or meals, including bonus or commission from production. According to the officer from the local Department of Labour Protection and Welfare, housing and bonus are not specified by law but shrimp farmers/operators provide these to workers anyway, by their own initiative. Also according to the law, employers should pay salary once a month but the majority of the shrimp farms pay their workers more than once a month. Large and medium scale farms are more likely to comply with most of the guidelines in the standards and certifications.

Other aspects in the standards which do not quite fit with the nature of work in the shrimp farms include working time, breaks, over time, etc.

Resurreccion & Sajor (2010) brought out the issue regarding payments to couples that is prevalent among shrimp farms. They argued that as the wives are also contributing to the work, their work effort should also be recognised, therefore wives should also be paid a salary separately from their husbands. To them, ‘couple payments’ imply that the wives’ contribution in shrimp production is not counted as work. From the shrimp farms visited in this study, the majority pay individual salaries to men and women workers accordingly, although indeed there are farms especially the small scale farms that employ the couple and pay per couple. For the former type of employment, husbands and wives working in the farms together get their own individual payments, especially when it is clear that the farms hired them to work and assigned them their own tasks such as taking care of a pond, cooking the meals of workers, and doing the inventory, among others.

In instances when payment is given to the couple and not individuals, the salary is often based on the number of ponds assigned. Usually, the farms hire the husband only to work and take care of a pond. Or two ponds will be assigned to each couple, and if the monthly salary is based on per pond, this will also mean that each person gets paid the same salary per month. Male workers are free to bring their wives and children with them to the farms. Sometimes wives will assist their husbands even though the farms do not ‘employ’ them officially. As noted in Table 5.7, the salary ranges and bonuses are varied according to farm scales and duration of work in the farm.

In a report by ILO (ILO, 2013b), the registered migrant workers who are part of the informal sector (legally working) receive less than half of what a Thai would receive in terms of salary. In contrast, this research found that salary levels on the farm depended on the length of service and the task, and not on nationality.

5.4.3. On treatment of migrant workers by employers

Equal treatment of workers, be they Thais or migrants, male or female, is a provision in both the national labour law of Thailand (Ministry of Labour, 1998) as well as international labour law under the ILO. In fact there are specific chapters devoted to employment of women and young workers in the Thai national labour law, to ensure they are protected and treated equally. The key informants from the provincial offices of the Department of Labour Protection and Welfare all have mentioned that they have a mandate to treat all workers, both Thai and migrant workers, in Thailand equally under the Thai labour law as well as the ILO regulations. Derks (2013) mentioned that although the Thai government is accountable for the protection of human rights of migrant workers, there are still conditions which exclude migrants from being protected. In her study of Khmer migrant workers in the eastern seaboard, she argued that the issue is not based on migrant legal status but more on how they are controlled and immobilized, and that the legal frameworks give employers and local authorities control over the workers. It seems that the Thai government is contradictory in its stand on protecting migrant worker rights and yet through the legalisation of undocumented migrant workers, Thailand is in fact controlling migration through “aggressive means to suppress, arrest, prosecute and deport” the illegals (Derks, 2013; LPN, 2011).

A study on the Thai ethical landscape among various value chain actors and non-aquaculture actors revealed that the majority considered “respect for minorities” and “equal working conditions” as undesirable, reflecting on the historical relationship between Thailand and its neighbours (Bremer et al., 2013). Furthermore, this could explain that the labour issues among migrant workers especially their poor working conditions in many sectors in Thailand may be cultural and social in nature.

Shrimp farm workers interviewed all mentioned that they are being treated as family members in the farms, and that their employers show their care for them through providing them with the benefits while living in the farm. Employers have also mentioned the importance of treating their workers well in order to have good production, that it is a win-win situation for both sides. If the production is good, both of them will benefit from the revenues. Key informants at the subdistrict and provincial levels expressed that they are mandated to treat all workers equal according to the law. These experiences shared by both employers and workers in this study are in contrast to what is being described in the paper by Derks (2013) related to Cambodian migrant workers’ experiences in fisheries and construction. Working and living conditions between these jobs and shrimp farms are vastly different.

She further pointed out that the Thai government has curtailed migrant workers’ rights of freedom to move around with the issuance of a decree to control migrant workers’ unruly behavior. This is in contrast with the report of Vungsiriphisal et al. (2010) wherein they found that there is freedom to travel during free time. For workers living in a shrimp farm with the responsibility to take care of one pond wherein a bonus is attached at the end of the cropping period, going outside the farm regularly for entertainment (for e.g. gambling, drinking) is not encouraged but not prevented. In fact migrant workers' experiences in shrimp farms are in contrast with the accounts of migrant workers in Derks' (2013) study as the terms of reference are quite different.

Other issues that need to be resolved are in the area of migrant worker registration and documentation. The period for registration of migrant workers given by the Thai government is not all throughout the year. This poses a problem to both employers and workers who could not immediately register themselves and have to wait for the period to open. Furthermore, the registration period itself is just for a few months.

People perceived that keeping the original documents of the migrant workers might be the employers' way of ensuring that the workers will not leave the farm. GAA-BAP (2013) considered holding of identity papers such as passports as one kind of force or bonded labour. Under this category also is the prohibition to leave the premises or forcing them to work.

In their study about recruitment of Cambodian and Lao workers to work in Thailand through recruitment companies, Vungsiriphisal et al. (2010) concluded that the complex recruitment process, cost of processing, confusion even among government officials, and recruitment companies taking advantage of loopholes leading to potential exploitation, are some of the challenges that need to be overcome.

5.4.4. On importance of migrant labour in shrimp farms in Thailand

In the past, majority of the workers in shrimp farms in the east and south were from the northeast of Thailand (Resurreccion and Sajor, 2011). The migration from rural northeast to rural east and south came about due to poor or lack of income from arid rice fields (Ekachai, 1990; ILO, 2013b; Rigg and Salamanca, 2009). However, due to the lack of local Thai labour force for shrimp farms, and the lack of employment opportunities in neighbouring countries, namely Cambodia, Laos and Myanmar, there has been an influx of migrant labour, not only in shrimp farming sector but in many sectors in Thailand in recent years (ILO, 2013b; Resurreccion, 2010; Vungsiriphisal et al., 2010). This has led to many issues including human trafficking, child labour, and exploitation, which the international community and the media have linked with Thailand's seafood trade e.g. Derks (2010 and 2013). Since Thailand is the global leader especially in shrimp production and exports, consumer groups and markets in the west have been vocal about the need for Thailand to focus and resolve these issues (Bangkok Post 2012; US Department of State 2013;). The Thai government through the facilitation of the International Labour Organisation has collaborated with the private sector in abiding by the international labour laws.

Thailand currently has about a million registered migrant workers and a similar number of undocumented workers (Boonchalaksi et al., 2012), but the number working in shrimp farms is not known. Furthermore, they added that the government expectation and assumption that these are temporary migrant workers may not be in place and there is concern that a number could be staying indefinitely for settlement and integration into Thai society. It could be true for some, as in this research, half will continue to work in shrimp farms while the other half mentioned that they planned to go back in a couple of years to work on the land they have invested from their income in Thai shrimp farms (Table 5.16).

The use of informal networks for recruitment of migrant workers into Thailand (not only in shrimp farms) is considered safer than using external brokers, however they could also be risky depending on the work the migrant workers will be doing, as the case of sex industry in the Thai-Lao border described by Molland (2012). He further added that legalisation of migration flows by the Thai and Lao governments is attempted in order to eliminate brokers and reduce human trafficking. Thus viewing informal networks as "safer" could be an advantage for shrimp farm worker recruitment as employers rely heavily on this informal migration flow to find workers.

5.4.5. Gender issues

Shrimp farms especially those located in remote areas are still limited as work places for women. Concerning the reasons of one company for not hiring women workers who are single or living alone due to concerns for their safety and security, as well as the remote farm location, these are similar to the findings of Sritha (2007) in her study about the constraints for having more women shrimp farm managers, which mentioned about safety and security issues due to the nature of work in the shrimp farms. This could be due also to stereotyping such as the one pointed out by the Mekong River Commission (2006) as to why there was less focus on gender and specifically women's contribution to fisheries and aquaculture. Thus during this study, it was not possible to set an equal number of men and women respondents for the surveys.

In terms of decision making and control of assets, women are still entrusted with the salaries that their husbands earn, similar as reported by Kruijssen et al. (2013). Even then for those employed in shrimp farms and paid couple salaries instead of individual salaries, as also raised by Resurreccion & Sajor (2010), it might be necessary to consider the contribution of the wives to the work effort in relation to production of shrimp from the ponds assigned to their husbands, i.e. need for ecological and social accounting. Employers would argue that in addition to the cash salaries and bonuses provided, the non-monetary benefits such as free housing, rice, water, electricity and the freedom to live together as a couple or family can also be costed and would correspond to amounts paid to individual workers. Couple salaries are more common in small and medium scale shrimp farms, when the farm operators hire couple to manage the whole farm or, hire only the husbands but the wives also live with them on farm (Resurreccion and Sajor, 2010).

Weeratunge et al. (2010) defined employment as any kind of activity that generates economic or social gains, in cash or in kind, under an agreement that is either oral or written, and in any time frame. This concurs with the findings of Resurreccion and Sajor (2010) in terms of 'employment' of partner arrangements for couples living together on responsibilities for women in financial management of resources and in decision making in the household, were demonstrated in this research. Weeratunge et al. (2010) suggested that providing opportunities to improve themselves will greatly enhance the capability of households and the community and society in general. These improvements could be in the form of "improving their income, educational levels, and access to information."

Provision of child care facilities either on-farm or in the local community might be helpful in providing women more opportunities to perform production or economic roles rather than just stopping work altogether and concentrate on their reproductive roles. In a study by Kusakabe and Pearson (2013) of Burmese women migrant workers in Thailand they documented that these women faced difficulty in finding good child care so that they can continue to work, adding to the stress of being undocumented and working in "exploitative conditions." The wives of shrimp farm workers in this study might not have a similar experience as the women in Kusakabe and Pearson (2013)'s study as they live on farm with their husbands and did not have to travel.

5.5. Conclusion

In addressing the research questions for this chapter, the following conclusions have been formed:

Shrimp farm workers from all farm scales perceive that the quality of their lives is better or much better than before working in the shrimp farms. Using the QOL integrative definition, it can be said that working in shrimp farms can meet the various needs of workers leading to dignified lives in the farms and when they go back to their own countries. The monetary as well as non-monetary benefits they receive are more than what is stipulated in the global labour standards as well as the local labour law.

Employers have varied opinions regarding nationality preferences. However, independent of nationality, workers experienced that they are being treated well by their employers, managers and co-workers, and that there is a family and friendly atmosphere in the shrimp farm environment. Workers are hired in certain areas because they are more available due to the informal network among workers of the same ethnic backgrounds which would introduce their own kind to the farms in the same area.

The methodology in this chapter of interviewing workers in the farms, sometimes with the presence of their employers/managers in some interviews, could lead to a bit of skepticism in the responses. The presence of farm employers during interviews could present a potential bias of responses of the shrimp workers interviewed. The conclusions reached in this chapter i.e. more positive responses related to farm working and living conditions, are in contrast with what the secondary literature have been describing, although most of the latter were referring to a different node in the shrimp value chain. Nevertheless, it is acknowledged that a more balanced approach would have been to also conduct interviews with shrimp farm workers without the presence of their employers, preferably outside the farm setting. Other factors to be considered which could have an effect on responses include the legal status of workers (registration) as well as recruitment conditions (bonded with brokers or independent). Thus the conclusion can be taken only as a case study of the specific farms interviewed in this study.

Migrant labour in shrimp farms will continue to be important as most Thais do not want to work in shrimp farms, as Thais consider the work as difficult for them to do. The benefits from working in Thai shrimp farms will continue to attract migrant workers, as they see that working in shrimp farms could help them to achieve their dreams of saving money, sending their children to school, owning land or establishing a business in their home country when they go back.

Various gender issues still need to be addressed, explicitly in the 3rd party standards and in the Thai labour law, especially in the area of couple payments, access to opportunities and skills development, social protection and freedom of association.

Having looked at the detailed farm practices in relation to technical/environmental and social aspects, and have determined how the farms operate to fulfill market demands, the following chapter will report on the sustainability concerns of shrimp and tilapia farm operators and other actors in the value chain that interact with them.

6. CHAPTER 6 Shrimp and tilapia value chain actors in Thailand: their perceptions on sustainability

6.1. Introduction

Thai aquaculture has developed rapidly over the last half century. Its market-driven characteristics have implications for a wide range of stakeholders rather than being the domain of the producers or household farmers only. The sector is characterized by a complex value chain of input production, service provision, marketing, processing and trade. As it entered into foreign trade through exports of valuable species such as shrimp and tilapia, more actors have become involved, not only locally but also in many parts of the world. Thailand has come a long way since over a century ago when it started with "artisanal aquaculture " with carps, as influenced by the Chinese traders (Edwards et al., 1997). Processed snakeskin gourami (*Trichogaster pectoralis*), the first species to be produced on a large scale in Thailand, had a long standing trade in Southeast Asia, and this has given Thailand a good experience in trading with its neighbours as well as beyond (Yoonpudh and Little, 1997).

Despite the perceived strength of Thailand in shrimp production and exports as well as industry expansion, shrimp producers have experienced challenges to the sustainability of their operations, such as disease, price fluctuations and rising input costs. In the midst of global competitiveness, the "small rural farmers face most of the risks and burdens of the shrimp production business" (Lebel et al., 2008).

For tilapia, the decline in prices and returns relative to off-farm employment opportunities could pose a challenge to sustaining tilapia farming operations. In 2004, tilapia farm-gate prices ranged from US$ 0.92 to 1.15/kg, giving gross margins of US$ 0.06 to 0.50/kg (Mariojouls et al., 2004). Whereas in 2010, the prices ranged from US$0.87 to 2.0, depending on the province (DOF, 2013a). Tilapia farm households also have more diverse sources of income, i.e. aquaculture is not only the main source (Kruijssen et al., 2013).

Sustainability in aquaculture is complex in that it could not only be addressed by technical improvement within the farm, but there may be a need to also look at factors outside the farm, such as governance, defined as “how society organises to use power to manage natural resources, including the environmental and social impacts of their use” (Lebel et al., 2008).

Thailand has been leading in the production and exports of shrimp, reaching 540,000 MT in production in 2012 and exports of >323,102 MT (FAO, 2014). However due to the Early Mortality Syndrome (EMS) which started to affect shrimp farms in 2012, the production and export quantity in 2013 dropped to 250,000 MT and 191,446 MT, respectively (FAO, 2014). Whereas for tilapia, Thailand’s domestic market continue to trade 90% of production from ponds and cages with only 10% exported as frozen whole fish and fillet.

In Chapter 3, the various stakeholders involved in aquaculture were identified, in order to understand the existing situation in the aquaculture industry and to know the people or actors who are involved in every process. Through stakeholder analysis, it is aimed that the people or groups who can have an impact on a certain issue can be identified, including how they can be affected by what is going on around them (Reed et al., 2009), especially in view of the sustainability of their operations.

Who is then responsible to achieve sustainable aquaculture? Robertson (2014) stated that in order for people to change they need to be driven by economic rewards, i.e. to improve their quality of life, which links with both environmental balance and social equity. Do actors involved in aquaculture value-chains have an understanding of sustainability? Individual stakeholders might not necessarily share the same perspectives, even those coming from the same value chain node. There could be many factors within and outside their own systems which could affect their perceptions leading to different efforts in responding to these factors to make their operations sustainable. Therefore an improved or shared understanding of sustainability would enhance and/or accelerate a drive to more sustainable practices.

6.1.1. Sustainability definitions/theories

Through the years a number of definitions of sustainability have been formulated, mainly based on the Brundtland Report's basic definition of "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Figure 6.1 shows what the elements are to be considered when considering about sustainable seafood production and trade, as oftentimes sustainability is equated with just environmental aspects, which is just one part of the whole picture of sustainability.

Figure 6.1 The main elements in sustainable seafood production and trade

Source: Diagram by me with information derived from SEAT (2009).

It was also important to define farm systems and scales in order to categorise the farms and to identify if differences in perceptions of sustainability occur based on them. Different types of stakeholders are likely to be involved with different sized/types of production enterprises. In Thailand, shrimp production systems are mainly intensive, thus likely to be high risk and capital intensive (Belton and Little, 2008; Thongrak et al., 1997), since there is total dependence on formulated diets which are nutritionally complete, mainly in the form of pellets although practiced at different scales (defined in the methodology section).

6.1.2. Global value chains

Kaplinsky and Morris (2000) define a value chain as a "range of activities required to bring a product or service from conception through different phases of production, processing, marketing, distribution, delivery, until disposal." In addition, the chain also involves inputs that go into each process. Value chain analysis may look at individual enterprises or a whole industry including linkages with other actors that contribute to the processes

(Nang'ole et al., 2011). A number of global value chain (GVC) analysis approaches have been developed to study commodities such as agricultural and forest products (Nang'ole et al., 2011), coffee (Ponte, 2004), fish and fishery products (Silva, 2011), and seafood species such as shrimp, tilapia, striped catfish and freshwater prawn (Jespersen et al., 2014; Ponte et al., 2014). There are also specific studies integrating and looking at gender aspects of the value chains (Laven and Verhart, 2011; Laven et al., 2009; Mayoux and Mackie, 2008; Pryck, 2013).

Value chain analysis is important in order to know how to survive or sustain business or operations in the global market, and with increasing competition there is a need to be more efficient with operation and use of resources such as labour and other inputs, and to understand the various forces and the dynamics that are going on (Kaplinsky and Morris, 2000).

The components looked at in the GVC in coffee by Ponte (2004) included input-output structure, geographical coverage, form of governance and institutional framework. Further, the analysis also looks at power of various firms and how their interactions with each other affect the structure of trade. Bolwig et al. (2010) suggested the integration of poverty and environmental concerns in the value chains analysis framework in order to determine and document the impact of enterprises producing for the global markets on the communities specifically on poverty and gender, and the environment.

In the GVC analysis of seafood products relevant to this study in Thailand, i.e. shrimp and tilapia, Ponte et al. (2014) found that upgrading has been successful in both farm and processing levels for shrimp, but for tilapia, there could be little room for upgrade as fillets are already the most popular export form to Europe. Furthermore, public sector and regulations continue to support product upgrading in terms of value addition and certification (Ponte et al., 2014).

6.1.3. Research questions

This research was guided by the following research questions:

- What does sustainability mean to various stakeholders (in terms of what people think of their future?)
- How diverse are the stakeholders' perceptions regarding sustainability according to their roles in the value chain, and among different farm scales, systems and demographics, including gender differences?
- How much importance does each stakeholder place on the factors they perceived to affect their operations?

6.2. Methodology

This study involved three major activities in connecting with stakeholders. The first two activities were described in Chapter 2. The methods here will only describe the specific data collection for sustainability perceptions and analysis.

The first activity was a scoping exercise wherein a number of key informant (KI) interviews were conducted to obtain perceptions on sustainability of different types of aquaculture stakeholders in the shrimp and tilapia value chains. These KIs (Table 6.1) represented the various nodes of the value chain for shrimp and tilapia, from both the government and the private sectors.

A checklist of questions was used to obtain information from the KIs (Appendix 2) covering various aspects of the SEAT Project. However the question asked related to sustainability was: What factors (environmental, economic, social, institutional) do you foresee could affect your aquaculture operations in the future?

The second activity was an integrated farm survey focusing on individual producers (farmers/operators/managers) of shrimp and tilapia from major production areas in Thailand. More detailed questions on sustainability and generational factors were asked, along with other demographic and technical questions. Technical details are reported mainly in Chapter 4.

The third activity was a state of the system workshop which was conducted to present the findings from the earlier activities, to triangulate and confirm the findings, and to come up with a consensus within and between groups regarding factors affecting sustainability for each group. Representatives from different stakeholder groups participated in the workshop.

The sections below briefly describe the steps taken during these three activities.

6.2.1. Activity 1. Scoping/exploratory research

The scoping/exploratory research activity was conducted from late January 2010 to mid-July 2010. Primary data on various stakeholders involved in shrimp and tilapia value chains were collected through the following methods: direct observation and site visits, semi-structured interviews of value-chain actors and key informants using a question checklist, and participation in producer organisation (PO) and other stakeholder meetings.

Secondary data were collected using district and national level government statistic reports, trade organization statistics and reports, peer-reviewed journal articles, research and workshop reports, newspaper and technical magazine articles, technical, export and trade related websites, fisheries movement document and export databases, and thesis manuscripts. Based on secondary data, provinces were identified for field visits according to production and trade importance for the target species. The first points of contact were the provincial fisheries offices and the producers' associations. As no timely disaggregateddata could be sourced at the enterprise level, 'a snow-ball approach' was taken to site selection commencing with key informant interviews at association meetings and exhibitions. A number of farm visits were also made based on published information (magazines) and recommendations by the local fisheries offices and the producers' associations.

A number of stakeholders/actors (Table 6.1) in the value chain were visited and/or interviewed to obtain information on their roles and general information on the physical and financial aspects of their enterprises, and their perceptions on factors affecting the sustainability of their systems in the future.

Table 6. 1 Number of value chain actors interviewed/visited/met during the scoping research

Value Chain Actor	Number interviewed		Province[1]
	Shrimp	Tilapia	
Hatchery operator	3	3	22, 24, 25, 72, 73, 76, 82
Grow-out producer	18	12	10, 11, 21, 22, 24, 34, 46, 72, 73, 75, 76, 82, 83, 84
Processor/exporter[2]	40		10, 46, 74
Market/trading[3]	2	1	46, 72, 74, 84
Company sales agent	2		46, 73
Government agencies[4]	14		10, 11, 21, 22, 34, 53, 72, 73, 74, 82, 83, 84
Producers/processors' organizations	3		10, 73, 83, 84
Feed retailer[5]	3	1	25, 83, 84
Fish meal producer	1		83

[1]Codes for provinces: 10-Bangkok, 11-Samut Prakan, 21-Rayong, 22-Chanthaburi, 24-Chachoengsao, 25-Prachinburi, 34-Ubon Ratchathani, 46-Kalasin, 53-Uttaradit, 72-Suphanburi, 73-Nakhon Pathom, 74-Samut Sakhon, 75-Samut Songkram, 76-Petchburi, 82-Phang Nga, 83-Phuket, 84-Surat Thani

[2]1 processor was visited in the factory, 1 in the farm, the rest were interviewed or contacted for information during events such as training course, meetings and trade exhibition in Bangkok

[3]shrimp buyer, shrimp wholesale/auction market; tilapia buyer for wholesale market

[4]Department of Fisheries, Provincial Fisheries Office, Thai Frozen Foods Association, Thai Chamber of Commerce, Department of Internal Trade, National Food Institute

[5]1 retailer was selling products for both shrimp and tilapia

6.2.2. Activity 2. Integrated Farm Survey (IFS)

The main methodology in this activity is described in Chapter 2. Briefly, shrimp farm samples were based on production scales, i.e. small, medium and large, whereas for tilapia, sampling was based on containment system (cages in river, ponds) at the first instance. Then for tilapia pond farms, they were further divided into farm scales (small, medium, large).

The questions asked relating to sustainability factors were as follows:

- Would you like your children to farm shrimp/tilapia in the future? Why or why not?
- What factors do you perceive could negatively/positively affect your farm operations in the next two years?
- Can you rank these factors according to their order of importance? (1 – most important)
- What do you plan to do about these factors?

These questions were semi-open in that the further questions asked were mainly for clarification of answers, although enumerators were also instructed to ask “Why?” or to elaborate more when the responses were not on the list of expected responses. Due to the survey methodology that this question was one of the more than 30 or so questions, it was not possible to ask real open questions due to time constraints.

6.2.3. Activity 3. State of the System Workshop

A one-day state of the system (SOS) workshop was conducted (May 2011) among various stakeholders to review and summarise outcomes of systems analyses conducted during the first phase of the project. The majority of the participants came from the shrimp and tilapia value chains in the eastern part of Thailand, and representatives of nationally based value chain actors. As representatives of their respective nodes in the value chains, the participants were encouraged to discuss the outcomes of the workshop with their families, friends and associates who were not present. The SOS workshop was attended by 47 value chain actors representing the following: hatchery/nursery operators, shrimp and tilapia producers, input and service providers, post-harvest (processors/exporters) and institutions (local government, academe, non-government organisation). A set of pre-prepared questions asked during the survey was asked of the stakeholders to clarify and obtain needed information. An individual exercise on sustainable factors affecting the value chains in the next 1-2 years was conducted by asking the question: "What factors do you foresee that could POSITIVELY or NEGATIVELY affect the performance of your business or service over the next 1-2 years?" They were asked to rank the results in terms of overall importance.

6.2.4. Analysis

Preliminary information on stakeholder perceptions regarding sustainability from Activity 1 (exploratory/scoping research) were put in a matrix to show similarities and differences, as well as citation frequencies.

Data gathered from the integrated farm survey on generational information and sustainability perceptions were entered in ACCESS database, together with demographic and technical information for each farm. Data on sustainability factors were placed in a matrix according to their effects (negative, positive, uncertain) and ranks as perceived by the producers, and the frequency based on their ranks was noted. Descriptive statistics were used to determine trends, and statistical analysis of non-parametric data was used to analyse significant differences and correlations among variables.

Responses of different stakeholder groups during the SOS workshop were immediately entered into a pre-prepared relational ACCESS database to obtain combined citation frequency and rank of factors.

For the farmer groups, the citation frequency of responses to the same question asked in the integrated farm survey were cross-referenced with the results of this exercise. All respondents were asked to clarify which of the two project species (shrimp or tilapia) were of relevance to their operation and/or expertise; this could be one or in some instances both species. Descriptive statistics was used to determine trends, and statistical analysis of non-parametric data was used to analyse significant differences and correlations among variables.

Statistical analyses to determine significant differences of relevant data were conducted using SPSS ver. 19. Independent variables used were primary species, farm scales, gender of respondents and children, geographical location of farms and stakeholder groups. Whereas dependent variables were preference for children to farm shrimp or tilapia in the future, the sustainability factors, and importance of sustainability factors according to ranking. As data gathered were non-parametric, χ^2 test was used for dichotomous data on generational differences, Friedman's analysis was used for ranked data of sustainability factors, both significant differences at $P < .05$, and the Wilcoxon Signed Ranked Test with Bonferroni correction to determine differences between two sustainability factor variables with $P = .000758$ for shrimp and $P = .001389$ for tilapia.

6.3. Results

6.3.1. Generational information

Both shrimp and tilapia producers were asked whether they would like their children to farm shrimp and tilapia, respectively, in the future. In general, the majority of farmers interviewed (67% of 206 shrimp farmers and 71% of 199 tilapia farmers) did not want their children to farm shrimp and tilapia, respectively, in the future, and the difference with those that agree is statistically significant ($\chi^2 = 49.675$, $P < .01$).

The difference in the responses according to farm scales of all respondents (not by species) is not significantly different ($\chi^2 = 4.062$, $P = .131$).

Among shrimp farmers, there is a statistically significant difference in the responses based on farm scales ($\chi^2 = 8.515$, $P = .014$) where 75% of small farmers replied that they would not like their children to continue with the farming business, followed by 67% of large farmers and 52% of medium farmers. This means that small farmers think more strongly against their children farming shrimp than that of the medium and the large farmers.

For tilapia, 75% of medium scale and 70% of small scale farmers would not like their children to farm tilapia in the future which is not different in terms of statistical significance (χ^2 = 0.275, P = .60). The manager of the only large scale tilapia farm surveyed replied positively.

There are different responses among farmers based on their level of education. Tilapia farmers with higher education (Bachelor degree and above) and shrimp farmers with intermediate and secondary education (mostly from small and medium scales) are more likely to not want their children to continue farming tilapia and shrimp, respectively (Figure 6.2). Although statistically, education level among shrimp and tilapia farmers did not significantly affect their responses (χ^2 = 7.834, P = .05 and χ^2 = 3.623, P = .305, respectively).

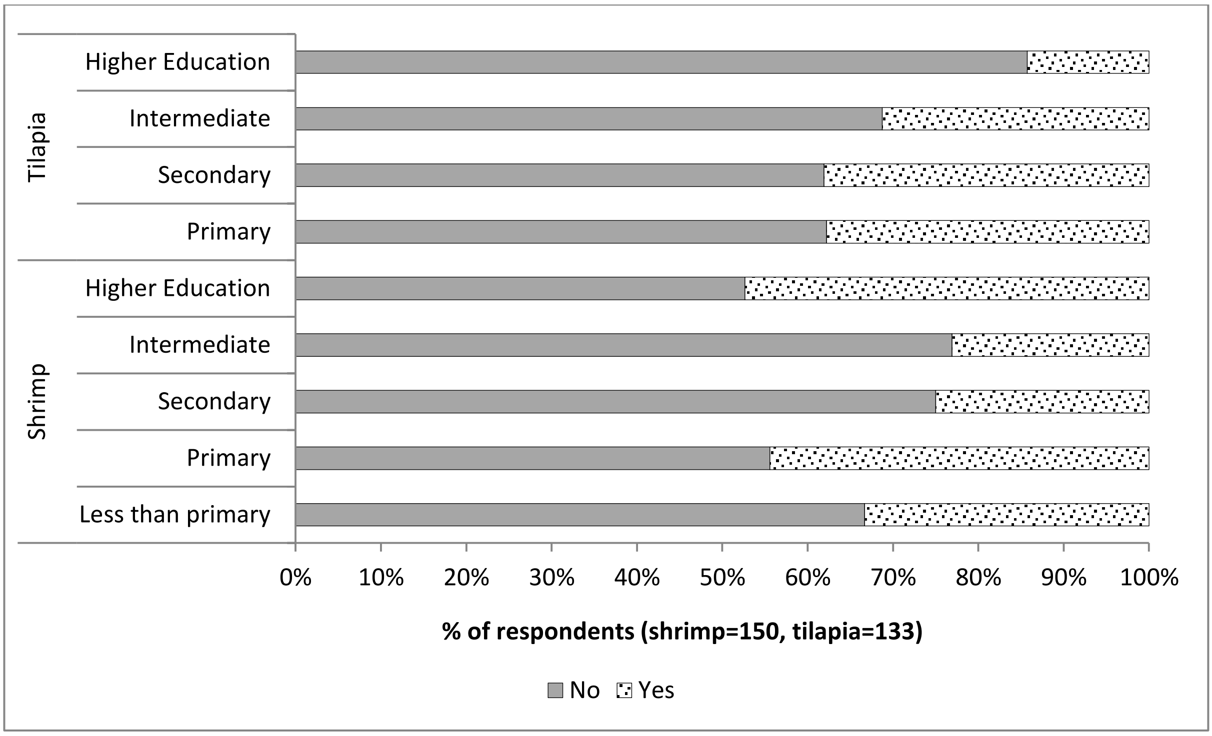

Figure 6.2 Responses of farmers according to their educational level on the future involvement of their children

The responses based on gender of respondents did not show any statistically significant difference on whether they like their children to continue farming shrimp and tilapia in the future (χ^2 = .140, *P* = .708 and χ^2 = 3.640, *P* = .056, respectively).

The respondents were asked regarding their reasons for their preferences on the future of their children's involvement with aquaculture and gave various responses. For those who would like their children to farm shrimp or tilapia, the main reason was that they wanted them to continue with the family business. They considered it a family heritage and to give the business as an inheritance to their children, as they have been in the business for nearly 20 years. In addition running the farm as their own business would mean the children have their own career and they would not have to depend on employers for their salaries. They also wanted to keep the family physically together. For some respondents, their adult children are already helping them either on a full time or part time basis. Shrimp farmers (mainly medium scale) also said that shrimp farming business is a good and stable operation, and can give them good income.

For those who responded that they would not like their children to continue farming shrimp or tilapia, 57% said that they wanted their children to do another job aside from aquaculture, while 41% said that it would depend on their children to decide to do it, with some of the respondents adding that they did not expect their children to go into fish or shrimp farming, as they might not want to do it anyway. In addition, almost a quarter (23%) pointed out that aquaculture is not a stable or sustainable occupation, it involves high risk, and it is not considered as a profession probably perceived as low social status especially the small scale farms; furthermore, 19% said that aquaculture is hard work, with lack of government support as well as resources. In addition, 20% said that their children were either already employed with non-aquaculture jobs (as government employee, factory worker or crop farmer), or had their own business (not specified). Other reasons mentioned were: they wanted their children to study (15%), their children did not like aquaculture (10%), and, they (5%) have daughters who might want to get a higher education, they want them to have an easier job, or they might get married.

The previous occupations of the majority of respondents, especially tilapia farmers and medium and small scale shrimp farmers were in agriculture i.e. rice farming, crops and livestock (Figure 6.3). For the large scale shrimp farm managers, the majority were students, at a college or university.

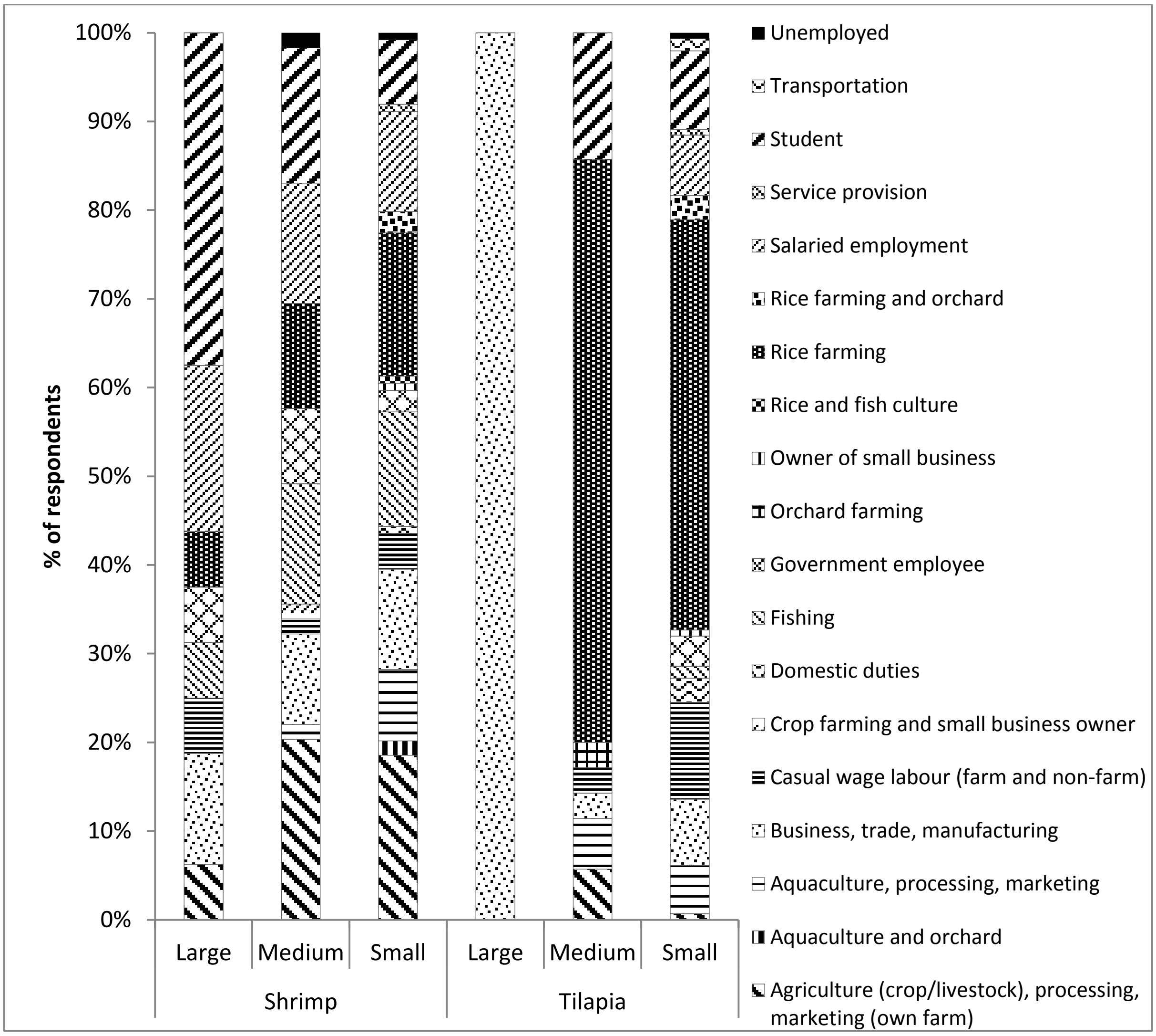

Figure 6.3 Previous occupations of survey respondents

N: shrimp, large=16, medium=49, small=124; tilapia, large=1, medium=35, small=147

6.3.2. Stakeholders perceptions on sustainability of their operations in the next 1-2 years

6.3.2.1. Shrimp Farmers

There was a statistically significant difference in the perceived importance of sustainability factors by shrimp farmers (Friedman's analysis, X^2 = 422.701, P < 0.05). Disease was by large margin the most important, followed by price (Figure 6.4). The mean ranks of the factors based on their importance (with 1 as most important) including the median scores are shown in Table 6.2. There was a statistically significant difference between disease and all the other factors. The results are shown in Table 6.2 showing the differences in perceiving the importance of the different factors.

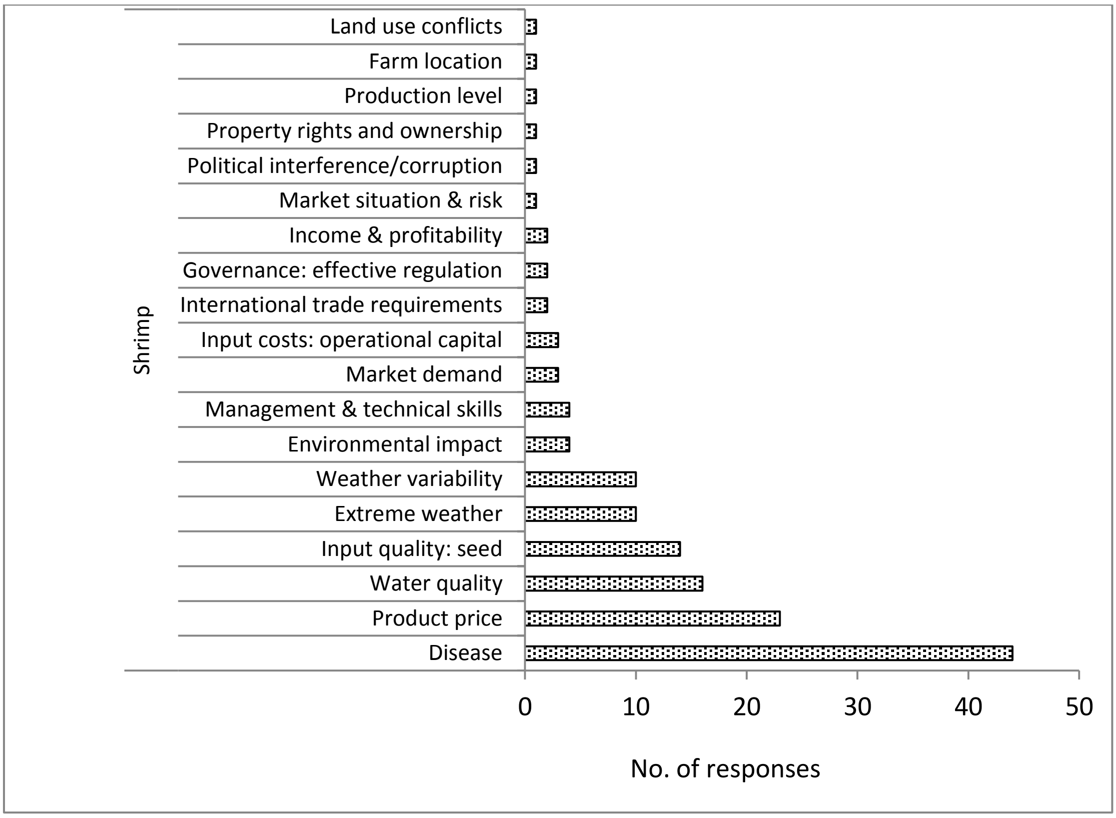

Figure 6.4 Sustainability factors ranked no. 1 by shrimp producers

Table 6. 2 Important sustainability factors according to ranking by shrimp farmers

Sustainability factor	Mean Ranks	Median
Disease	3.86	2.00
Product price	5.23[ab]	7.00
Water quality	5.88[acde]	7.50
Input quality: seed	5.99[befgh]	7.50
Extreme weather	6.54[cfijkl]	7.50
Weather variability	6.65[dgjmno]	7.50
Input costs: operating capital	6.79[hknpqr]	7.50
Management & technical skills	7.12[lorstuv]	7.50
Environmental impact of farming	7.23[impswxy]	7.50
International trade requirements	7.49[qvyz1]	7.50
Market demand: local & foreign	7.55[ux12]	7.50
Extreme weather: drought & flooding	7.65[twz2]	7.50

Notes: Factors with the same superscripts are not significantly different from each other. N = 190. Mean ranks with 1 as the most important.

6.3.2.2. Tilapia Farmers

Water quality was ranked as the most important (no. 1 rank) by 35% of tilapia farmers, whereas extreme weather came close with 34% ranking it as no.1 (Figure 6.5). Extreme weather is a combined measure of responses related to flooding and drought.

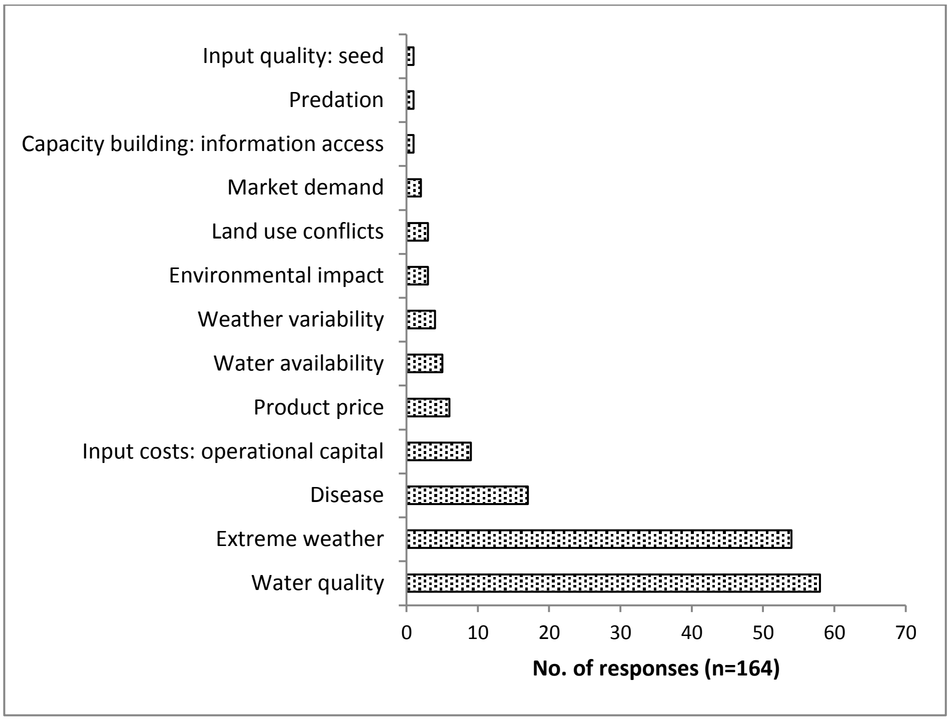

Figure 6.5 Sustainability factors ranked no. 1 by tilapia producers

There was a statistically significant difference in the perceived importance of sustainability factors by tilapia farmers (Friedman's analysis, X^2 = 180.548, P < 0.05). The mean ranks of the factors based on their importance (with 1 as most) including the median scores are show in Table 6.3. There was a statistically significant difference between water quality and all the other factors. The differences between each factor are based in terms of their perceived importance.

Table 6. 3 Important sustainability factors according to ranking by tilapia farmers

Sustainability factor	Mean Ranks	Median
Water quality	3.47	3.00
Disease	4.56[abcd]	5.50
Extreme weather: drought	4.94[aefgh]	6.00
Input cost: operating capital	4.96[beijk]	5.50
Extreme weather	5.00[cfilmn]	5.50
Product price	5.23[dgjlop]	5.50
Weather variability	5.45[hkmoqr]	5.50
Input quality: seed	5.59[npqs]	6.00
Predation	5.79[rs]	6.00

Note: Factors with the same superscripts are not significantly different from each other.
N=177. Mean ranks with 1 as the most important.

6.3.2.3. Other stakeholder groups

Other stakeholder groups were also interviewed regarding their perceptions on factors which could affect the sustainability of their operations (hatcheries, input providers and processors/exporters) in the next 2 years. Likewise representatives from academia and local institutions were also asked about their perceptions on factors which will affect the sustainability of aquaculture operations in the next 2 years. This interview was conducted during the state of the system workshop when a number of stakeholders across the value chains for both shrimp and tilapia participated.

Input providers and processors consider the costs of raw materials as the main factors for their specific operations, also related to the supply. The type of raw materials for each group is different, as they belong to different streams, i.e. upstream (production) and downstream (processing and delivery), respectively. Raw materials for input providers are mainly feed ingredients for feed mills, and substances to formulate pond inputs. Whereas for processors, the main raw material is the raw fish or shrimp needed for processing, which will be a constraint if they could not fulfill orders from their buyers.

The main issue related to raw materials for processors, especially for tilapia, is quality. Off-flavour in tilapia is one of the constraints to the expansion of Thai tilapia export trade. Processing plants and exporters cited that the quality of raw material i.e. the supply of good quality tilapia (without off-flavour) is one of the factors affecting the sustainability of their export operations. Even in the domestic market there is a growing awareness of and demand for good quality tilapia, and consumers are willing to pay for it. That is probably the reason why live tilapia in the market is popular and demands a higher price due to perceptions of consumers that it is better in quality and taste.

Little is known whether producers and traders are aware of this off-flavour situation affecting exports but as the results show, tilapia producers had not mentioned off-flavour as one of the factors affecting their operations. They were more concerned with the production factors such as water supply and quality, weather and disease, which could adversely affect their production.

The main issues for hatcheries are technical in nature, i.e disease, extreme weather and seed quality they produce.

Input costs: raw materials, management and technical skills and environmental impact were factors cited by all groups, in that order (Figure 6.6). Only processors/exporters cited government market intervention as the factor, which involves raw material taxation, floor prices, and subsidies such as for energy. These are related to the exportation and regulations that exporters have to follow.

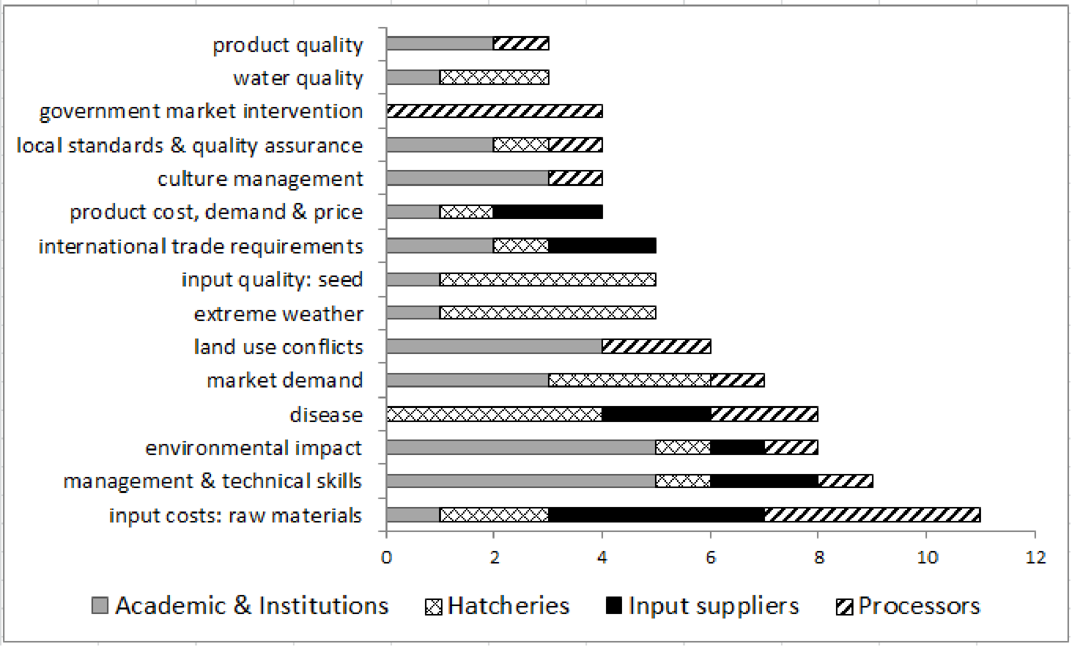

Figure 6.6 Sustainability factors cited most frequently by other stakeholder groups (N=20 i.e. academics and institutions (6), hatcheries (6), input suppliers (5), processors (3)).

6.3.2.4. Comparing responses between producers and other stakeholder groups

Table 6.4 shows the factors according to a percentage cut-off for shrimp and tilapia farmers, and by frequency citation for all other stakeholders (due to smaller sample size in a workshop). These factors have been generally categorized into technical, economic, social and institutional and environmental aspects, although they are not exclusive i.e. some may fall under more than one category.

Product price is the concern of the majority of stakeholders, except for processors/ exporters, which is understandable considering the fact that they are, most of the time, responsible for setting the price with farmers or traders. However for upstream actors especially in the production sector, they have to contend with the cost of inputs as well as the selling price of their products, and in order to make a bigger margin, they have to reduce costs.

The second most cited constraint which affected production was disease. Among shrimp producers, disease has been ranked the most important as well. With shrimp as a valuable commodity, shrimp farmers had the most concerns for sustainability, due to their investment cost and the less flexibility to change to another occupation compared with fish production.

It is interesting to note that the academics did not think disease was a factor, while they cited farm management/sanitation. It is possible that they considered farm management as the fundamental problem with disease as a result of poor management. Another possible reason could be the background of members of this group i.e. local government official, university lecturer, and food safety trainers (NGO staff), who might not have exposure to the shrimp and fish production sector.

Table 6. 4 Sustainability factors most cited by respondents from different stakeholder groups

Factor	Input/ service providers	Hatcheries	Tilapia farmers	Shrimp farmers	Processors/ exporters	Academics/ institutions
ENVIRONMENT						
Disease	✓	✓	✓	✓		
Water quality		✓	✓	✓		
Input quality: seed		✓	✓	✓		
Farm mgt, sanitation						✓
Predation			✓			
Environmental impact of farming				✓		✓
Extreme weather		✓	✓	✓		
Extreme weather: drought			✓			
Extreme weather: drought & flooding				✓		
ECONOMIC						
Input costs: raw material	✓	✓			✓	
Product price, market demand	✓	✓	✓	✓		✓
Input costs: operating capital, production cost			✓	✓	✓	
International trade requirements				✓		✓
Product quality						✓
SOCIAL/EQUITY						
Government intervention					✓	
Land use conflicts					✓	✓
Management & technical skills	✓			✓		✓

Source: Survey during State of System Workshop, May 2011

6.4. Discussion

6.4.1. Generational information

A significant ($p<.01$) majority of the farmers (i.e. small shrimp, small & medium tilapia) did not want their children to farm fish or shrimp in the future, as they regard aquaculture as hard work, risky and unstable. Medium-scale shrimp farmers are more likely to want their children to continue with the family business, probably because their operations are more stable, have a greater degree of autonomy in decision-making and management as well as enjoying economies of scale to produce and earn an income. In addition, the passing on of a profitable enterprise as inheritance to the next generation was considered important.

In Rigg et al. (2008) the industrialisation of areas such as Ayutthaya province in Central Thailand has led to labour migration, with 70% from the poorest region of Thailand in the northeast going there to find employment. The farthest province in the northeast (Ubon Ratchathani) would be about 550 km away from Ayutthaya province. In this research one of parents' reasons why they would like their children to continue farming shrimp was they wanted to keep the family physically together, rather than let their children go too far to earn an income. Thus it might be important to create an economic activity or entrepreneurial spirit within the village in order to keep people from migrating to places that are too far and dangerous. In a later research by Rigg et al. (2014) they found that local migrants return to their home village with some having skills that could be applied in the village while some could not apply their skills in the village context.

There have been stories told by Ekachai (1990) related to working in far areas and the dangers which could lead to destroyed lives. Two generations of economic migrants from Northeast Thailand experienced failure in their search to upgrade their status economically, in the areas of education, skill and human capacity development (Rigg et al., 2014).

With Thailand's efficient infrastructure re: transport, and people having their own cars, mobility and farm accessibility might not be an issue especially for those whose adult children are helping their parents on the farm part-time, as they could travel to their farms to help out. In Northeast Thailand, more people are now working in non-agricultural jobs, either they have fully stopped or they still work part-time with agriculture, emigrating outside the northeast region, with incomes earned helping their families greatly (Grandstaff et al., 2008). They further pointed out that for those who stayed within the farming occupation, they are also better-off due to the breakthroughs in the adoption of glutinous rice, with the plain rice providing complementary incomes.

The lack of desire of many smaller and medium–scale shrimp and tilapia farmers to pass on their fish farming occupations to their children, may also be due to the perceptions that farm work is menial or manual work, thus they could just hire workers to do the job. A way to encourage the younger generation to be attracted to farm work could be through changes in the Thai educational system. UNICEF has raised concerns in terms of the quality of education in Thailand and are working to mainstream the "Child-Friendly School" concept, wherein teaching should put the best interests of the child as first priority (UNICEF, 2014).

Most of the respondents said that they would not force their children to go to shrimp or fish farming, allowing their children to make that decision whether to work in their farms or not. Education, as pointed out by Rigg (2006), is one of the factors which could influence the way rural people look at work and farming, including the future of their children. The emphasis of the Thai government on industrialisation (Rigg and Nattapoolwat, 2001) including the promotion of technology education as the basis for developing other sectors including agriculture (Shinatrakool, 2000) could be one of the reasons why there is less interest in farming or agricultural work as a profession.

Efforts to improve the profile of agriculture and its attractiveness to younger generations have been made in several countries. For example, the new K to 12 curriculum in the Philippines, wherein aquaculture is taught since Grade 7 (13 years old) under the Technical-vocational electives especially in areas where there are existing fisheries and aquaculture activities (SEAMEO-INNOTECH, 2012). This new curriculum started implementation only in 2012 under the Education for All Plan, and is part of the comprehensive education reform to address changing needs in the workplace, to provide basic competencies at an early age, preparing them for practicalities in the workplace including entrepreneurship (SEAMEO-INNOTECH, 2012). It might be too early to evaluate impacts.

In Thailand, fisheries vocational education starts at Year 4 (16 years old), and at university (18-19 years old). At Kasetsart University, the Faculty of Fisheries provides opportunities for children of those involved in fisheries and aquaculture activities to apply separately from the general applications, giving them a higher chance of getting into university to pursue fisheries-related studies, although this may be far too late to garner interest among the young generation.

Education has been seen as a gateway to be able to achieve occupations which are not farming related (Rigg et al., 2008), as farming has been perceived as low in status therefore “to be avoided” (Rigg, 2006). In a study by Garbero and Muttarak (2013) wherein they investigated the role of education in protecting a community in rural Thailand from “livelihood and climate shocks”, they found that “education may have a role in reducing economic vulnerability” as those with higher educational attainment have more access to government support. This is probably the reason why a large majority of farmers wanted their children to have more education, so they can have more professional jobs, and could have more access to economic opportunities and even a higher status in the community. And yet, several countries, including Thailand, have been caught in a “middle-income trap” despite their education and involvement in highly skilled and highly paying employment (Rigg et al., 2014). What will be important to study is how many of the shrimp and tilapia farmers/operators have advanced from low income to middle income, and if any have reached the high income category. This is beyond the scope of this study.

There is a possibility that parents did not foresee themselves working permanently in fish or shrimp farming. What parents expect their children to be in the future could influence children’s future career choices (Irwin and Elley, 2013), which has a positive and negative connotation. Positive if the children are given the freedom to choose, and negative if they will be forced to do what parents want for them. In studies about parents, youth and employment conducted by McLoyd et al. (2011) and Purtell & McLoyd (2013) in the United States, they found parents' involvement in their children's future career was important to the subsequent focus and orientation. McLoyd et al. (2011) also mentioned that children from lower income families have lower expectations about what to do in the future especially regarding occupations. However, in this present study with Thai parents having higher and/or different aspirations (more stable income, more comfort, higher status) for their children to choose a different profession from fish or shrimp farming due to hard work and unstable income, it could have a positive influence on children's decision making regarding their future careers. Their parents' influence will likely to lead them away from farming towards urban-industrial livelihoods.

Despite the parents' seeming detachment regarding their children's future choices, in saying that they would leave it to the children to make a choice when it is time, it could be beneficial to expose their children to their farm, giving them a choice in the future whether to choose a farm-related occupation, for example aquaculture related careers, especially in inheriting farm management work, or another profession.

Early positive influences may encourage a return to farming after a period spent in higher education/industry. One of the respondents to our survey who graduated with a Bachelor Degree in computer programming four years ago and before returning to, and now managing, their family's medium scale shrimp farm in Chanthaburi said:

“What influenced me to go back to our shrimp farm was my exposure to the farm since I was a little boy. I used to tag along with my father and I learned how my father would manage and handle the day to day operations in the farm. Now I am working on my computer programming skills to improve our farm system to make it more efficient.” – Mr. STH, medium scale farm owner/manager

In a study among Thai students in an international programme of a Thai school/university, the factors they considered important in future choice of occupations included their expertise in the subjects, the appeal of the tasks, the assurance that they can obtain the job and the sufficiency of income from it (McDevitt et al., 2013). Due to the more international background of students in the study, it was stated that there was more focus on globalization and technology in their career choices with and more confidence, compared with those from less privileged background. The authors recommended that career guidance counselors should consider children’s cultural, family, academic and socio-economic backgrounds. However this study probably cannot translate to less advantaged groups.

The general view of the Thai farming population that there is more economic opportunities in non-farming occupations could be reflected in the changes in the agricultural landscape in the rural areas, with some spaces now converted into other land uses (Rigg et al., 2008). With Thailand’s main industry now focused on manufacturing and trade, there is higher demand for factory workers and skilled technicians in these sectors. The Thai workforce would prefer working in factories to farms, in an office with air condition and a desk (Nopporn Kitrattana, Department of Labour Protection and Welfare, personal communication, 2013). This had led to a shortage in both agricultural and non-agricultural labour that has been filled by migrants. It is worthy to note that in 2010, skilled agricultural and fishery workers still had the largest share of employment by occupation, at 38% (ILO, 2013b), with men more than women, followed by the service sector (23%), with more women than men. This could mean that agricultural and fishery sector is still an important source of skilled employment.

6.4.2. Sustainability perceptions

The perceptions of stakeholders on what makes their operations sustainable reflect what they understand about sustainability. The factors cited by the stakeholders have been categorized into the major pillars of sustainability, namely environment, economics and social (equity), to fit with the 3 E's (Robertson, 2014) (Table 6.4).

Stakeholders cited environmental (technical), economic, social and institutional (equity) aspects of their operations as factors which will affect the sustainability of their operations. Some studies equate sustainability as an environmental concern, thus environmental impacts of human activities (such as aquaculture for example) needs to be quantified into economic terms to measure its benefits to society and human welfare (Ekins, 2011). This also makes sense but efforts should not limit on the environment only. Miranda (2010) reported on the destruction of mangroves due to shrimp farm construction and considered them unsustainable. She further noted efforts for mangrove replanting but urged the need to monitor the health of the mangroves, and considered systems which reduce the release of waste water into the environment as more sustainable.

Shrimp farmers put importance on disease as a major factor affecting the continuity of their operations to survive in the business, and this relates to the state of the environment in surrounding areas as well as in other areas where the inputs are produced. The recent events on the Early Mortality Syndrome (EMS) had taken a toll on the shrimp farming industry in Thailand (Prachachart, 2013), with those able to continue operations stocking only at 50% capacity, and with a high number of farms stopping operations for e.g. around 80% in one province alone (Shrimp News International, 2013), affecting many other factors such as labour, income and general well-being. The shrimp industry has long been plagued by various shrimp diseases especially with the black tiger shrimp culture until early 2000 (Briggs et al., 2005). When the industry started to culture the exotic species Pacific white shrimp (*Litopenaeus vannamei*) in the early 2000s, the Department of Fisheries had to formulate regulations to regulate the import of SPF broodstock to ensure that the industry would not face the same situation as before (Belton and Little, 2008; Briggs et al., 2005; Mcintosh, 2010; Walker and Mohan, 2009) from the perspective of introducing diseases, whereas now the situation might be different.

Differences in sustainability perceptions are also common even in other sectors outside aquaculture. For example in the exercise to set-up sustainability indicators in the health services sector between two groups of stakeholders from two different countries, Cambodia and Somaliland, the responses were based on the respondents' background situations in their respective countries (Blanchet and Girois, 2013). Cambodia pointed out ministerial responsibilities including budget allocation, whereas Somaliland suggested equity and coverage of services, as key components of sustainability, in their context. The challenge is how to integrate them together to come up with indicators that are relevant to the whole sector.

Operations leaning towards industrialisation, as premised by Woodhouse (2010) but referring to agricultural activities, might be unsustainable in the long run, and suggested smaller scale and more labour-intensive operations as more sustainable. If we look at the various shrimp farm operations in this study, we might conclude that they fit in the description in the above-mentioned study, re: "industrial aquaculture". As an example, the majority of the farms have switched to autofeeding, which is mainly powered by electricity, and this is one of the reasons for reduction of labour in the farms. In tilapia farms, generally managed as semi-intensive and producing a lower value product than shrimp, operations may not be considered as being industrial in scale, yet most are already dependent on industrially produced feed, machinery such as pumps and and increasingly, drugs and other chemical inputs .

Social sustainability is not as well-discussed and studied compared with environmental and economic, and as Psarikidou & Szerszynski (2012) suggested, "sustainability's social dimension has been relatively neglected in studies of sustainable food initiatives". They suggested that social aspects should be treated not as a separate entity but part of the whole process of people in constant interaction with their environment and the economy. This is where the ethical aspect comes in when we think about food production and trade, including the moral issue. This includes not only the welfare of the animals being cultured but also the welfare of actors involved in the value chain. Olesen et al. (2011) talked about ethical perspectives but focused mainly on the welfare of salmon. Whereas, sustainable aquaculture should lead not only to aquaculture development which will benefit owners and companies, but also to ensure that those who lose out in the process do not experience deficiencies in meeting their basic needs (Rivera-Ferre, 2009). This will be a concern for example for farms not achieving certifications as they lose out on opportunities to participate in trade, therefore alternative markets will be needed to market their products.

Ethical issues in Thai aquaculture should also be considered and included in the whole concept of sustainability, not just focusing on one or two aspects i.e. certification, environment (Bush et al., 2013). In this way, issues and practices related to human rights and labour abuses in the workplace as well as environmental degradation and market manipulation could be addressed, and a balance between environmental protection, economic development and social equity can be achieved. This will lead to an improvement in the image of Thai aquaculture among consumers and media, resulting in the strengthening of an industry on which millions of people, including migrants, are dependent on for their livelihood (Songsangjinda and Smithrithee, 2008; UNIAP, 2011).

The Thai ethical landscape based on the respondents in this research, studied by Bremer et al. (2013) showed that Thais considered family and household as most important to a good life, whereas for a good society, they value health, safety and income security. In general, their study concluded that Thai ethical landscape is “collectivistic” which focuses on family and social harmony. Species wise, shrimp farmers put more value on “animal and nature” while tilapia farmers put more value on “personal prosperity” and “religion’.

Understanding the ethical terrain of each value chain actor in relation to sustainability will enable us to recognise which factors these actors find important to them.

The principles of “solidarity” and “polluter pays” were desirable principles among Thai respondents (aquaculture and non-aquaculture) conducted by Bremer et al. (2013). This knowledge could be exploited to be used in campaigns for better management practices in the farms in achieving sustainability. Social marketing campaigns by some companies in Thailand make use of this concept by appealing to the Thainess of the audience (Chevron, 2014; PTT, 2014).

Sustainable development of aquaculture may follow the suggestion by Lorek et al. (2012) to not only focus on economic growth and sustainable consumption and production, but also to be guided by enabling fair share of resources with everyone, fulfilling basic needs and ensuring well-being, less materialism and wealth accumulation, social equity and ecological balance, and community level resilience. The global aquaculture certifications including the Thai standards covered in this research have components on social and community impacts. However these need to be a concerted effort and the question is who will be responsible to lead these initiatives: companies with their corporate social responsibility programmes, local or national governments, civic and social organisations, media or private citizens? The migrant workers may be excluded unless they form into groups and be represented. Bush et al. (2013) suggested that certification schemes should be integrated with other governance mechanisms and public rulings, including local standards that are already in place, making use of the existing local expertise.

6.5. Conclusion

Each stakeholder group strives to work towards achieving sustainability so they can remain in operation in the next few years, to survive in the business individually and corporately, and at the national level, to be the best provider of sustainably and ethically produced seafood for the world. Farms may need to innovate and evolve their systems to be more efficient, and to be more responsive to changing buyer requirements. Information and communication among various value chain actors are important to hear and learn from each other. The "seminar culture" prevalent in the Thai aquaculture sector and more widely described by Lebel et al. (2009) has had a good influence in bringing together actors and encouraging social learning. The differences in perceptions which exist among these stakeholders should be understood by every sector and efforts should be made to address them so that there is cohesiveness in efforts and in giving support to achieve sustainable seafood production and trade.

There should be educational campaigns to encourage young people from aquaculture families to pursue a career in aquaculture to ensure that individual or family owned farming business operations can continue to thrive either through upgrading or outgrading of production systems. The training on sustainability and not just on a particular discipline will provide a holistic view of aquaculture in relation to all other factors that give input to and benefit from aquaculture.

Through the upgrading or outgrading of operations, shrimp and tilapia aquaculture industry in Thailand will remain diverse i.e. operating at various farm scales and production systems according to resource base and markets, sustaining the livelihoods of various stakeholders along the value chain networks. A strong institutional framework supporting the shrimp value chain in Thailand has been beneficial in enabling the Thai shrimp industry to develop capabilities and produce high quality products for the export market (Jespersen et al., 2014).

The export-focused shrimp industry has a simpler value chain, but this does not mean less people are involved than the more local tilapia industry. The simpler chain than that of tilapia could mean better traceability of the product's life cycle, especially when a good traceability system is implemented and enforced.

The scale of farm operations is just one of the factors which could affect sustainability, i.e. larger operations are more likely to stay in business, if sustainability is based just on compliance to standards. Farm operations regardless of scale should focus on the whole aspects of sustainability, with moral ethics at the core in order to make decisions that are beneficial to all (ideally) but in reality, there should be mitigation measures or compensations for those that will eventually lose out.

The importance of factors affecting sustainability of export orientated aquaculture value chains varies among stakeholders. Controlling disease and water quality were more important for farmers, while market and price related factors were cited by almost all stakeholders. The factors obtained in this study have to be considered when developing indicators of sustainability from the stakeholders themselves. By considering their varied perceptions, such sustainability indicators could be more targeted to the real situation of the industry and of the particular stakeholder group.

7. CHAPTER 7 Overall Discussion and Conclusion

7.1. Overall Discussion

This research looked at sustainability issues faced by the various actors in the shrimp and tilapia value chains in Thailand. The focus was on the perceptions of producers or farmers, and on their efforts to enhance the positive factors and reduce or mitigate the negative factors affecting them.

A systems review on the four species being studied under SEAT project, namely penaeid shrimp, tilapia, freshwater prawn and striped catfish, of which this research was based on, was conducted. Out of these four species, shrimp and tilapia emerged as the most important in Thailand, in relation to trade and sustainability aspects.

Thailand aquaculture has both depth and breadth, as it can serve both the important domestic markets with species which it could not export, such as tilapia, freshwater giant prawn, and striped catfish, as well as the global market, as evidenced by its leadership in shrimp production and exports. Seafood produced in Thailand, such as shrimp and tilapia, are well-known to be of good or better quality than the other competing exporting countries such as China. Although Zhang (2014) cited that one of the success factors of Chinese tilapia in export market is its good texture and flavour. The traceability system being implemented for shrimp production, processing and trade in Thailand should be properly enforced, especially as it is being expanded to cover tilapia and other aquatic species to be exported. This will ensure that quality of the products will be maintained, however, if sustainability aspects will be considered, this is not enough.

Thailand has dominated the global shrimp industry for a number of years, starting with black tiger shrimp since the early 80s, and then followed by the white shrimp in the mid 2000s. In Chapter 3, several factors were brought out pointing to reasons why Thailand has become the global leader in shrimp production and exports. The long history of Thailand in fish and shrimp farming provided a strong heritage of fish and shrimp culture expanding to other related activities (Edwards, 2011; Falvey, 2000; FAO, 2009). The development of seed production techniques and backyard hatcheries provided sufficient supply to the growout sector supporting its development (Belton and Little, 2008; Kongkeo and Davy, 2010; Little and MacNiven, 2001; Little et al., 2002; New and Kutty, 2010). The strong institutional support from both public and private entities, especially in the technical, financial, trade, marketing and traceability aspects further spurred the development of the shrimp industry. In addition, private sector initiatives to form farmer clubs and associations, with support from government such as the Department of Fisheries encouraged learning and sharing of know-how (Lebel et al., 2009). The expansion and upgrading of other related sectors supported growout production and processing activities, such as agricultural feed companies to produce quality aquaculture feeds, cold storage facilities from capture fisheries processing aquaculture products (basic and value-added). A well-developed infrastructure, for transport, communications and logistics, enabled efficient delivery of inputs and products throughout the nodes of the value chain. Likewise the proactivity of the various sectors, such as technological innovations in growout production for more efficiency in feeding, water management, and energy, and responding to global requirements led by the Thai Government (Yamprayoon and Sukhumparnich, 2010) provided quality products for exports.

Regarding the potential of tilapia for exports, the existing demand could not be met, according to processors, unless tilapia production is intensified in the existing areas. Water quality and availability continue to be issues that farmers face, and in cage systems in rivers, this will require coordination among various government departments such as the Royal Irrigation Department and Pollution Control Department, the sub-district administration organization and local farmers' groups (aquaculture and non-aquaculture), with the Department of Fisheries. With the main competitor, China facing labour shortage problems in the near future (Zhang, 2014), Thailand could exploit this situation to its advantage as long as it complies to the certification standards. The issue of off-flavour in tilapia will remain a constraint for the processors if farmers could not produce on-flavour tilapia, especially if they do not see the importance of investing capital and management to improve their systems. Research being undertaken by the private sector in developing lined and shaded production systems to produce on-flavour fish will be useful but requires high capital investments.

Narrowing down to the production part, the study looked at the current systems being followed by the producers in their farms, and the framework of presentation was according to the guidelines of the global standards and certifications for shrimp and tilapia farms as described in Chapters 4 and 5. In addition to describing the operations, following this framework allowed us to see the level of compliance of these farms to these guidelines, including their motivation to comply and the constraints for low or lack of compliance.

With disease as the most important factor pointed out by shrimp stakeholders, the Early Mortality Syndrome (EMS) that has affected Thailand since 2012 seemed to threaten the sustainability of the shrimp farming industry, at all nodes of the shrimp value chain. The low supply of raw materials to processing plants, due to low production as a high number of farms were not producing, or the production was too small in volume and individual shrimp size for the export market, have affected many actors in the value chain, especially labour and price. And yet a number of farmers continue to produce, while imports of shrimp have increased to provide raw materials for the processing sector so they could meet orders for exports. Thai farmers are more resilient to shocks (Kruijssen et al., 2013) and the concerted efforts of both public and private sectors in working together to overcome the negative effects of EMS could help them to sustain until the EMS issue is resolved.

The issues faced by producers, such as costs involved in complying with standards, need to be considered, especially if they require a large farm area and high capital investments in order to comply. Other issues could be related to technical capacity, such as analysis of water quality parameters which are complicated and require investment in on-farm equipment, and efficient record keeping. These can be rectified by providing training and mentoring to ensure understanding of the methodologies or the reasons for doing them. A more difficult issue is on labour aspects especially the employment of migrant labour who do not have the proper documentation, and the other legalities required such as registration period set by the government.

Those downstream of the value chain, especially certifiers, standard setters including consumers and the media need to understand the situation of producers in order to avoid misinterpretation and giving negative publicity or judgment on aquaculture products which are being exported. One illustration is regarding the working conditions in shrimp farms, wherein all the shrimp farm workers (Thais and migrants) considered themselves better-off. The positive outcomes and benefits received as per the QOL framework are currently not considered by standards setters, as well as the efforts of the employers to provide the best for their workers.

Standards and certifications have also been criticized in that the companies that run them have leaned towards their own business interests such as gaining market share rather than the interests of both the producers and consumers (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification, 2012). Global certifications will need to expand their knowledge base and in order to succeed in the Southeast Asia, it is necessary to recognise the small-scale producers and their capacity and efforts to comply with the standards (Wilkings, 2012). Vandergeest (2007), for example, found that local communities and governments are effective in regulating shrimp farming in South Thailand, thus it is necessary to obtain their inputs or (give them a voice) on these standards that they have to comply with.

In order for a certification standard to be considered as a tool for “holistic sustainability”, all the actors in the value chain need to be considered, and not just a few, since standards and certifications ideally should benefit all of the actors. The perceived dominance of voices from the North to gain control over producers in the South, could lead to exclusion of the smaller producers in trade participation (Belton et al., 2011).

Labour in shrimp farms is also considered critical and important, although this is one factor that producers can still manage i.e. to find workers, compared with disease and market factors which are beyond their control. Farm operators go to great lengths to identify and manage workers who will stay and do the best job possible, as described in Chapter 5. Shrimp farms need well-motivated and trained people at the pond side most of the time to take care of the stock due to the high investment cost and high value of shrimp. Both farm operators and farm workers have a stake in each pond and they risk losing money if it is not well-managed, therefore it is not economically sustainable. The technical complexity of shrimp farming as described in Chapter 4 requires a high level of management and dedication on the part of workers assigned to each pond.

The issue that the international community, especially the importers, consumers and the media have been clamoring about re: exploitative working conditions of workers in "shrimp farming industry" is focused on one very small part of a very long value chain i.e. peeling sheds, and ignored moves to better practices elsewhere (such as in the farms as this research has revealed). Most of the reports are based on the downstream sector of shrimp pre-processing and processing. Reports like these are like wake-up calls to the local authorities and regulators, to right what is wrong as part of the issues related to ethical supply chain management and its many challenges. One example is the Rana Plaza disaster in Bangladesh in April 2013, where it exposed the superficiality of standards designed to protect the vulnerable. Now ILO is facilitating the Government of Bangladesh together with employers, trade unions and the international community to ensure that the incident will not be repeated in the future (ILO, 2014). They should also include the garment factory workers in these discussions in order to know their concerns so they can be addressed.

There was a need to also look at the shrimp farm workers in order to fill the information gaps regarding workers conditions, including migrant labour. Thus this research investigated the quality of life of shrimp farm workers, based on their perceptions as well as the QOL assessment mentioned by Costanza et al. (2007) and Petrosillo et al. (2013). Other issues which are oriented towards the welfare of the shrimp farm workers in particular and which have been used by the negative publicity include the low wages and the bad living and working conditions in the shrimp farms (Resurreccion and Sajor, 2011). However, the findings in this study as reported in Chapter 5 through the perceptions of the workers interviewed have shown that they considered themselves better-off or much better-off than in previous employments or situation in their own countries. The description of their working and living conditions followed the framework of the global standards and certifications for human resources, which farms employing legal migrant workers are compliant to. Kruijssen et al. (2013) also confirms with the farm migrant workers interviewed expressing their happiness to work in aquaculture farms in Thailand. However a cautionary approach has to be taken in taking the responses as a general indication of shrimp farm worker status as some of the worker interviews were conducted with the employers present.

Thailand's long term exposure and integration with global markets which began with processing wild caught stocks (capture fisheries) led to diversification with processing aquaculture species for export. The openness of Thailand to outside investments and the transfer and then development of indigenous expertise, for example shrimp hatchery technology from Japanese/Taiwanese experts, including the investments from Thai agribusiness companies, all contributed to make Thai aquaculture industry attractive for business as well as for employment. Migrant workers from poorer neighbouring countries of Cambodia, Lao PDR and Myanmar consider Thailand as a land of opportunity, creating a mass migration of both legal and illegal workers (Panam et al., 2008; Phouxay, 2008; Vungsiriphisal et al., 2010). These countries are also within Thailand's economic 'orbit' as part of an integrating market for goods and services, traditionally through informal border trade but now developing based around the ASEAN free trade zone. Thailand is supporting development in those countries through remittances of cash and expertise, thus any balanced analysis of the sustainability of Thai shrimp farming must take these impacts into consideration.

Rural based employment has strengths over urban (processing) especially in a market where skilled labour is at a premium, and workers can move to a better deal just nearby or down the road. The vertically integrated tilapia production complex set-up by Grobest company in Nakhon Phanom, Northeast Thailand is one example. The complex is in a remote area, with an aqua feed mill, processing plant, offices, and production ponds and cages along the Mekong River, with the nearest residential village about 1 km away. Their workers come from northeast, the farthest is from a town 40 km away, and the company campaigns for people to come back to their hometown to work, citing benefits such as staying near their family and spending time with them more, eating together and better quality of life. This is appealing to their ethical values map (Bremer et al., 2013) . This is a better alternative than traveling down to an urban workplace more than 500 km away. In looking for workers, Grobest choose those who are not into rice farming so they do not take them away from farming livelihoods. They require labour but the workers still prefer to go to Bangkok and nearby industrial areas. This is a similar trend with the findings of Rigg (2013) wherein migration from farming communities to non-farm areas such as Ayutthaya occurs for employment purposes.

Aspects of the global standards need to be encompassing the nature of Thai aquaculture or in general Asian aquaculture. The emphasis in the standards is towards industrial aquaculture, which might not be suitable for sustainable development, as it does not consider a number of social and ethical issues. However, with the complexity of the standards as they are now, it will need a simpler framework if more criteria will be added.

All throughout the study the main issues focused on the sustainability of shrimp and tilapia production, as well as the perceptions of stakeholders on issues affecting their operations. Certification standards do not cover actual Life Cycle Assessment (LCA) of products therefore important environmental impact indicators such as greenhouse gas (GHG) emissions, acidification, and eutrophication could not be determined. LCAs of shrimp and tilapia farming industry showed that GHG emissions were higher in Thailand than those in other countries (China, Vietnam) studied due to the fact that feeds used in Thailand have a higher percentage of fishmeal included (Henriksson et al., 2014). This is linked to the upstream capture fisheries to collect trash fish as raw materials for fishmeal, which has high GHG emissions. If tilapia polyculture systems with carps and other aquatic organisms were taken into consideration, there could be a possibility that the calculation for GHG emissions will be lower, similar to China which yielded lower emissions from tilapia-carp polyculture systems. Tilapia cage systems were also high in eutrophication potential due to the excess nutrients from cages are released directly into the water body environment.

With fishmeal production identified as a major hotspot, the certification standards have also set a criteria regarding the use of feed, i.e. the use of protein feed ingredients from terrestrial sources, fish processing and fisheries by-products and from responsibly managed fisheries (ASC, 2012; GAA-BAP, 2013). It will be worth to benchmark whether compliance to the standards would result in lower emissions to the environment.

Another aspect of environmental impact from shrimp farming is mangrove destruction. Often times, when it comes to aquaculture, most people think only about the negative impacts on the environment. This was due mainly to previous reports that shrimp culture caused the destruction of mangroves and the coastal ecosystem (Lebel et al., 2002; Miranda, 2010). Land Use and Land Use change (LULUC) are components of the LCA as well, and mangrove destruction to accommodate shrimp farms implies higher carbon emissions (PJG Henriksson et al., 2014). The Thai shrimp standards (ACFS, 2009), GAA-BAP (2013) and GlobalGAP (2012) all have provisions related to mangrove areas and wetland conservation, thus acknowledging the importance of these areas for marine ecosystems. Shrimp farm operators are also aware of the importance, thus one of the large scale farms even bought the land surrounding her shrimp farm so she could plant mangroves and release crabs and other organisms.

Lately, other issues have come up due to the increasing awareness about food safety and ethical production and consumption. Aside from animal welfare issues, there has been a focus as well on the social aspects of aquaculture, such as workers' rights and their living and working conditions, social equity and power. The demand for safe and traceable seafood products has resulted in the setting up of various standards, certifications, and eco-labels to satisfy the consumers (Bush et al., 2013; Konefal and Hatanaka, 2011; Roheim et al., 2012). Producers have to contend not only with the challenges on-farm and marketing within the country, but also with foreign market demands, if their purpose is to export their products. In addition, producers should not only concern about the production and technical aspects but also the social dynamics with in the farm, especially with regards to working and living conditions of workers and their families.

The demand for tilapia in the local market remains high, which could be one of the limiting factors why, despite the Thai government's efforts to promote the export of tilapia, only about 10% of production is exported. Processors reported that their main constraint is finding good quality tilapia, i.e. fish without off-flavour. However, many farmers were not really aware about this issue as they were more concerned with water quality and availability, disease and price. As the demand for tilapia increases, the price in the local market also increases, thus producers would rather sell to local traders and/or wholesalers rather than to processors. In addition, producers did not have to follow the standards and certifications demanded by processors if they would just sell locally. For producers the effort and cost in following the standards and certifications are not comparable to the market price of their products. However if there is a premium price to compensate for following the strict guidelines, the producers would surely follow them. Thai tilapia producers change their production systems to respond to changing conditions (Belton et al., 2009). Thai tilapia industry has strong sustainability attributes such as resource use efficiency and appropriation of ecosystem space and services but these were not considered in the development of a globally accepted tilapia certification standard (Belton et al., 2010).

The demand for domestic consumption of shrimp has also grown as purchasing power has grown. Tilapia could follow the same trend if a strong base in terms of domestic demand could support export market development. However, the market for tilapia is already quite differentiated, with cage products selling live fish, at a price higher than what processors could offer, whereas manure fed pond fish have a lower price. China could successfully export their tilapia due to its lower production cost, competitive prices, large quantities of production resulting in a stable supply, among the reasons pointed by Zhang (2014). Probably the main advantages of Chinese tilapia over Thai tilapia production systems are the lower cost of production, availability of government subsidies to improve farm system, and larger areas with enough water to support production.

7.2. Reflections on sustainability perceptions of shrimp and tilapia VC actors

The importance that stakeholders placed on various issues relating to sustainability of their operations is different for each species, as described in Chapter 6. For shrimp, the most important issue affecting production is disease, whereas for tilapia, it is water quality. For trade, product price is most important for shrimp while cost of inputs is most important for tilapia. Other factors mentioned are similar between the two species groups, with varying importance, except for international trade requirements pointed out by shrimp farmers (Table 7.1).

Reflecting on impacts of farm scales and species in terms of sustainability, disease is the most important factor among small and medium scale shrimp farmers, as well as with the lone large scale tilapia farm. For the large scale shrimp farm, the most important factor was weather variability, with disease and international trade requirements having the same importance. Small and medium scale shrimp farms consider product price as second most important, with medium scale farms considering next water quality and small scale farms consider seed quality.

Table 7.1 Summary of sustainability issues for shrimp and tilapia

Category	Shrimp	Tilapia
Production	Disease Water quality Seed quality Weather conditions	Water quality Weather conditions Disease Water availability
Trade	Product Price Market demand Cost of inputs International trade requirements	Cost of inputs Product price Market demand

The EMS disease threatened the sustainability of the shrimp farms, across the scales and farmers had to respond by changing their production patterns, i.e. reducing intensity, or stopping culture, either temporarily or permanently. The importance of Thai shrimp in global trade was affected, as production dropped, so did exports, and this resulted in higher prices for those who could produce. The processing plants responded by importing white shrimp from countries such as India, Malaysia, Myanmar and Bangladesh, for around 13,600 T in 2013 (64% from Asian countries), which was 2.4% less than what was imported in 2012 (TFFA, 2014).

For tilapia all farms scales considered water quality as the most important, with extreme weather conditions and disease as the next most important for both small and medium scale tilapia farms. Water supply and quality issues were also reported by Burana-osod et al. (2013) as reasons affecting tilapia farmers' operations.

The polyculture of tilapia with white shrimp has been reported to reduce or prevent EMS occurrence in ponds in Vietnam (Tran et al., 2014). This production system is not new, as several studies have been done to look at its potential (Yi and Fitzsimmons, 2004; Yi et al., 2002), and in Thailand, farmers have been practicing it to augment the lower income they obtain from tilapia and other species. This production system is also beneficial ecologically as long as algal growth will be managed, and could be considered a more sustainable choice (diversification) than highly intensive shrimp monoculture. The carrying capacity of the system has to be taken into consideration to maintain ecological balance, thereby making this system sustainable. However, certification and standards do not cover this production system as yet so there is a question whether the shrimp and tilapia from these systems will be acceptable for export.

In terms of technical efficiency and sustainability, Kruijssen et al. (2013) showed that the sustainability concerns were similar for low, medium and highly efficient farms, wherein environmental factors are the most important. Other important factors included market supply and demand, input quality and production costs.

Environment and economic factors are considered important in the sustainability of operations. However there is a need to also focus on the social aspects especially ethical issues in production and trade, and how to shape guidelines for best practices and certification standards based on values that the Thais consider are important (Bremer et al., 2013). With the migrant workers as important members of the value chain, their ethical values may need to also be determined to shape human resources guidelines as well. This requires awareness among all actors of the sustainability concept in order that they can assess their operations completely. The release of ILO of a manual on employing foreign workers (Böhning, 1996) shows that migration for work is important. Migrant workers have a role to play in the economy of their host countries, as they fill in the gap brought about by labour shortages, as already seen in the case of Thailand. This is a common phenomenon in labour intensive food production globally, such as the Eastern Europeans in the United Kingdom (Parutis, 2011; Shubin and Dickey, 2013), Mexicans in the United States (Sanderson, 2014), or in other parts of the world (Cobble, 2013).

Even the generational aspect of future continuity of the farming business by the children of farmers and operators need to be considered.

7.3. Future perspectives and policy implications

The ASEAN Economic Community which will be implemented in 2015 in all the 10 countries in the ASEAN region will definitely have an impact on sustainable development of the aquaculture industry in Thailand. Issues that need to be focused on include the importance of migrant labour in Thailand, as well as the free trade of products including those from aquaculture, which have food safety issues. Governance issues related to AEC are discussed at the level of the intergovernmental agency such as the Association of Southeast Asian Nations (ASEAN), and the readiness of each country to implement policies at all levels might not be the same. Specifically, it will be beneficial to consider how the implementation of the AEC in Thailand will affect migration in and out of Thailand, and how this will impact the shrimp farm industry that is heavily dependent on migrant labour. It is also worth to study the sustainability impact on the families and communities of migrant workers, to quantify the perceived benefits reported by the workers themselves.

The influx of migrant labour not only for shrimp farms but for all other jobs in Thailand for migrant workers is a big challenge to the immigration policy of the Thai Government, especially the presence of undocumented workers. As the importance of migrant workers in Thailand continues to grow, the Thai Government really needs to consider all avenues to curb illegal migration in order to reduce the opportunities for exploitation and violation of migrant workers' rights. This is a serious issue which involves many sectors of the Thai Government, the neighbouring countries' Governments, as well as international organisations involved with labour issues, human rights, security, and trade, among others.

The situation with EMS already has Thailand importing more raw materials to process to meet orders from importing countries. The free trade area under the AEC will increase the flow of food products including raw materials for processing into the country. There needs to be a traceability system in place that is implemented in various countries in the region. This has been the concern of the DoF as well as other relevant organisations, because Thailand's reputation for good quality food is at stake if there is no assurance of food safety in other ASEAN countries which export raw material products to Thailand. As a rule in processing and manufacturing, the raw materials may be mentioned in the package labels, but the label indicating the manufacturer of the finished product should be the country where the final processing takes place, in this case, Thailand. There should be a clearer policy on traceability systems which will cover the upstream processes of raw materials coming into Thailand for processing and re-export. This will require strong cooperation and collaboration with supplying countries in complying with the traceability system that adheres to international standards so the products will be acceptable.

Looking more specifically on the compliance to various standards and certifications, it will be a bit difficult and more complicated for smaller scale farms to comply with them. Complete compliance to these standards requires changes in current farming practices. It will be easier to do if it does not entail costs such as capital investments, otherwise, the producers will still be limited in their participation in trading their products for export. The Government policy of farm registration for traceability and compliance to local standards is basic for all farms, but are faithfully adhered to mainly by shrimp farmers as they are considered requirements for exporting the products. This policy then is not entirely followed by all farms as the majority of the farms do not participate in the export trade anyway. A changed perception is therefore necessary, such that adherence to the policy of traceability and standards should be more for improvement of production systems to benefit farm, the environment and the community.

7.4. Critique of the methodology

Due to the broadness of the topic on sustainable development, this study was not able to tackle all aspects. In addition, finding one specific framework for the whole thesis was not possible thus several approaches were employed to suit the type of information and analysis required.

The study attempted to give voice to other stakeholders who are otherwise not heard in the scientific world, such as the shrimp farm workers, because in most literature, majority of labour related issues concentrate on the labour in the processing or fisheries sector, considering that there are major issues there that also need to be addressed. Securing interviews with shrimp farm workers required permissions from employers, which is common courtesy and ethics as the interviews occurred in the work place and using workers' time. Oftentimes, the employers and managers were also present in some of the interviews, and it might or might not have affected the quality or depth of responses. Ideally, interviews should have been conducted outside the workplace or without the presence of employers or managers. However, interviewing farm workers without the knowledge of the employers may not be considered ethical if interviews are conducted in the work place. If the researcher has the luxury of time then it would have been useful to live in the farms with the workers to observe and interact with them. This would still require permissions from the employers.

Quantitative methods such as factor analysis and economic modeling especially in relation to benefits were not employed in this research but technical production efficiencies and livelihood indicators were analysed elsewhere (Kruijssen et al., 2013) on the same survey respondents in this research i.e. farm operators only.

Although it was planned to apply the gender dimensions framework at the beginning for all survey methods, this was still limited in the actual implementation of the research, as it was a challenge to bring together various disciplines, for example in creating a harmonised survey instrument that was balanced and not tedious to use, for both enumerators and respondents. More efforts need to be placed to make sustainability studies gender sensitive. Equipping aquaculture researchers with gender research tools should be a priority.

The low response rate for some of the questions in the integrated farm surveys (IFS) was quite noticeable. At the start of the interviews, as part of the ethical methodology, the respondents were informed that their responses would be treated as confidential, and that they were free to respond or not to the questions. The interviewers had to respect respondents' decisions if they decided not to respond. During the training of enumerators, there were some suggestions on how to rephrase the questions in case respondents did not respond at first, to try to coax them into giving responses. Another reason based on observations was that the respondents during the integrated farm surveys (IFS) got bored during the interviews due to the length of the questionnaire, thus they did not respond to them and would keep asking how long until we finished the interviews. As mentioned in Chapter 2, the IFS was not just for this research, but informed all the other components of the SEAT project, which covered various topics.

7.5. Recommendations for future study

From this research, a number of emerging issues came up which are recommended to be further studied, as follows:

The impact of aquaculture activities on the communities where farms and other value chain activities are located need to be studied, specifically to determine the impacts on the lives of the people living in the area as well as on their surrounding environment. In addition, due to the major role of migrant/transnational workers, the impact of working in Thailand on their lives, the lives of their families left behind, and the conditions in their communities in their home countries may also need to be studied.

An alternative approach to interview shrimp farm workers outside their working area may be necessary in order to complement their responses regarding their working conditions and quality of life perceptions which were obtained within the farms and oftentimes in the presence of their employers.

It is also recommended to focus on specific aspects from this research, for example converting perceptions of well-being into quantitative terms as well as indices such as the happiness index. For migrant workers, determining how much benefit their home countries and their families obtain from migrant work in Thailand will be useful in adding knowledge to the contribution of aquaculture in poverty alleviation and improving the quality of life of the family of migrant workers in their home countries.

As already recognised, standards and certification schemes could not totally provide a complete assessment of the sustainability of aquaculture systems. It is recommended that aspects related to the environment be benchmarked with tools which measure environmental impacts, for example Life Cycle Assessment (LCA), and footprinting (i.e. ecological, carbon, water, other materials). The social aspects may need to include gender aspects such as relational issues re: couples as workers, spouses as supporters and children's well-being. In terms of economics, the assumption is that farms are economically viable for them to operate.

A comprehensive critical assessment of the various standards and certification schemes affecting the Thai seafood industry is also recommended.

It is also proposed that sustainability factors obtained from this research be integrated with the on-going work on formulating aquaculture sustainability indicators to measure the sustainability of shrimp and tilapia aquaculture systems.

7.6. Conclusion

As a conclusion, the sustainability issues facing shrimp and tilapia aquaculture in Thailand are varied, and oftentimes relative to the current situation they are facing now. Nevertheless, these issues still fall under the various dimensions of sustainability, and are to be considered for aquaculture systems to continue over the long term, at all farm scales.

Environmentally, the efforts of farms to contain their wastes (effluent and sludge) and not releasing them into the external environment, as well as using less chemicals, for example, are beneficial and all fall under good and responsible aquaculture practices. However, the practice of stocking at very high densities, for example in shrimp farms, might challenge the carrying capacities of their systems. Production systems which are disease-free, pathogen-resistant or controllable, with good quality water are ideal. Various policies, guidelines and standards related to proper farm and environmental management as well as animal welfare are in place and beneficial to the systems only if they are adhered to. However environmental stability alone is not enough to warrant sustainable operations.

The desire for higher economic gain drive farmers to go beyond what is required of the systems in terms of inputs and resources to be used in the farms, and this could adversely affect their operations. Upstream related to costs of inputs, and downstream in relation to selling prices of products are all factors affecting decisions regarding farm management. A balance in the use of resources will be beneficial to both the farm environment and the people running the farm.

Socially, maintaining good family and social relationships extends to the way farmers interact with their family members, employees, fellow farmers and other actors in the aquaculture value chain. It also means providing people with equal access to things which are needed to sustain their lives and enabling the quality of their lives to improve. In the context of shrimp and tilapia aquaculture, this means that benefits from aquaculture operations are shared with everyone involved i.e. employers and their workers. These benefits also extend beyond them, to their families and communities, even beyond the Thai borders, for the present and future.

Future generations of aquaculture farmers may not come solely from the original owners of the farms, considering the present situation. However this trend could change if the younger generation could see that aquaculture is a sustainable occupation.

Strong support from various institutions (government, non-government, civic organisations, producer clubs, private sector) also contributes to strengthening aquaculture activities, providing information and good guidelines to promote sustainability.

Sustainable Thai aquaculture then could mean that the actors in the various nodes in the value chain could continue to operate because the environment is ideal for their operations and is not being exploited, resources are used within reasonable levels to produce to meet market demand, economic benefits from operations are fairly shared among those involved, social and family relationships maintained and harmonious, and institutional and regulatory frameworks provide support to every node in the value chain.

All stakeholders have to consider themselves agents for change (Robertson, 2014) and that each one has a role to play to achieve sustainability within their farm system, and in the external environment as well.

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9. APPENDICES

Appendix 1. Contributions to research design, data collection, data analysis and writing

	Research design	Data collection	Data analysis	Writing (Commenting)
Chapter 1				**ANS,** DCL
Chapter 2				**ANS,** DCL (FJM)
Chapter 3	**ANS,** DCL, FJM, KS	**ANS**, KS, KK, PS, TK, FT1	**ANS**, KS	**ANS,** DCL
Chapter 4	**ANS**, **FJM**, **DCL**, KS, TK	**ANS**, FT2, FT3, KS	**ANS**, FJM, KS	**ANS,** DCL
Chapter 5	**ANS**, **DCL**, **FJM,** KS, TK	**ANS**, FT4, KS	**ANS**, DCL	**ANS,** DCL
Chapter 6	**ANS, FJM, DCL**	**ANS**, FT2, KS, KK, PS	**ANS**	**ANS,** DCL
Chapter 7				**ANS,** DCL

Notes: Initials in bold: Main responsibility and/or contribution
ANS – Arlene N Satapornvanit
DCL – Prof David C Little
FJM – Dr Francis J Murray
KS – Dr Kriengkrai Satapornvanit
KK – Dr Kulapa Kuldilok
PS – Dr Prapansak Srisapoome
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FT1: Field Team 1 (Scoping) – Ms Kaewta Limhang, Ms Pariyada Jarukhom, Ms Atidtaya Yaophruckchai, Ms Pichsuporn Visutdhi

FT2: Field Team 2 (Integrated Farm Survey) – Ms Atidtaya Yaophruckchai, Ms Pichsuporn Visutdhi, Ms Wanwichanee Sritha, Ms Naphat Dungputtangkoel, Ms Apinyaruk Wankeo, Ms Jidapa Khatikarn, Ms Laksiri Chomcheun, Ms Supawinee Thasanasuwan, Ms Wiparat Taweewattana, Mr Phongsakorn Hongjun, Mr Wattana Krajangyuth

FT3: Field Team 3 (Phone Transition Survey) – Ms Wanwichanee Sritha, Ms Jintana Jaithiang, Ms Chutipat Duangmala, Ms Monthira Tongman, Ms Wanna Yaprajan

FT4: Field Team 4 (Face to Face Labour Survey) – Ms Wanwichanee Sritha, Ms Jintana Jaithiang

Appendix 2. Checklist on Scoping and Overview of Production Systems

General Questions:
- Size
- Scale
- Ownership
- Market Share
- Species
- System
- Specialisation
- Final market
- Importance of business to the immediate local community
- How did they got involved in this business
- Labour profiles (gender, roles)
- Constraints to sustainability of system (environmental, economic, social, institutional)

WP3: Life Cycle Assessment (LCA)
- What are the different components of the system?
- Who are the people involved in this system (on-farm and off-farm)?
- What are the interrelationships of these components, activities and people involved?
- How intense are these interactions and relationships between and among them?
- What are external factors (i.e. other activities outside) affecting the system?

WP5: Social and Economic Dynamics
Global Value Chains (aka Value Chain, Marketing Chain, Supply Chain)
- What is your role in the business? Why did you start? How has it changed?
- What are your inputs and who are they from? (e.g. hatchery, feed)
- To whom do you send your product? (e.g. farmers, traders)
- Who tells you what to do? (e.g. retailers, governments, processers)
- What do they require? (e.g. quality, price, standards, quantity, safety, timing)
- What happens if you do not meet these requirements?
- Who do you think has the most power in the value chain?
- What benefits and training do you provide to staff?
- What are the risks/problems/challenges you face?
- What do you see happening in the future?
- Are you concerned about environmental or social certification?

Sustainable Livelihoods:
- Is this activity the main source of income for you and your family?
- Why did you start? What did you do before?
- What are the benefits of this employment?
- What alternatives do you have?
- What are the risks/problems/conflicts you face?
- Do you have any help to improve your activity? From who? How?
- How has the aquaculture business changed since you started?
- How does it need to change to increase the benefits to you in the future?

Gender specific info:
- Labour profiles (gender, roles)
- How different are the wages between female and male labour? Why is there a difference, if any?
- What are the hierarchies/stereotypes in the work place (farm, processing plant, office, etc.) that exist between women and men?

- Who gets more benefit from the aquaculture business between women and men in the local community?

WP6: Food Safety and Public Health
WP7: Assessment of Contamination Risks
Farms

- What chemicals are used at your farm and for what purpose and volume? (Type: E.g. Pesticides, disinfectants, antimicrobials, feed additives and volume of each listed chemical)
- How do you obtain knowledge of how to use the chemical (E.g. label, training, retail shop etc.)
- Have you had any problems with chemical use at your farm on:
- Inspection authorities
- Contamination of water source
- Health issues for farmers/workers at the farm
- Have you received any kind of certifications for your farm (National, International, GAPs, BMP, etc)
- Farmers/workers: Which types of health problems do you see associated with different working tasks on the farm (Skin rash and/ wound infections or from handling of disinfections/other chemicals etc.)

Processors

- What are your perceived main chemical and microbiological food safety issues/problems and their origin in the exported commodities?(E.g. salmonella, disinfections, other chemicals?)
- Have you received any kind of certifications for your processing unit (National, International, GAPs, BMP, etc)?
- What preventive measure do you have in place to address food safety issues?
- Processing managers/workers: |What are the main health problems associated with working on a processing plant (Skin rash, wound infections, Back pain, head ache etc)

Government institutions

- What are the national regulations on aquaculture food safety in your country for each of the selected species?
- What are the main chemical biological and chemical contaminants you find in feed, aquatic produce, water quality from intensive aquaculture areas?
- What certification systems do you have in place for ensuring food safety of aquaculture products (including farm level and processing level measures)?
- What chemicals and drugs are banned from being used in aquaculture?
- What are the main future challenges/problems you see for the sector in relation to use of chemicals and related environ mental and food safety issues?

WP8: Framing Key Values Within Ethical Framework

- What are the consultation processes for standards and licensing? Who is consulted?
- Do you have any data on socio-economic impacts of aquaculture?
- How do you judge the available capacity for oversight?
- What is your perception regarding the requirements for exporting aquatic foods to Europe?

WP10: Transparency and utility of trade-related information

- How do you access information about regulations in different markets?
- How would you like to have such information made available for you/staff?

WP11: Policy development and implementation

- What is the cost of meeting the current requirements (testings, etc.)
- What are the practical difficulties faced (i.e. unexpected inspector visits?)
- What are some of the policies you would want to be implemented to ensure sustainability of your production and marketability?

January – July 2010

Tilapia farmers – Samut Prakan – phone interview **August 2010**

1. General
    a. When did you start tilapia farming?
    b. What is the size of the farm and how many ponds?
    c. Freshwater or brackishwater? Seasons?
2. Stocking
    a. What is the stocking size
    b. How much per rai do you stock?
    c. Where do the tilapia fry come from?
3. Culture
    a. What inputs are used? (fertilizer, feed, lime, antibiotic, others)
    b. When do you use them?
    c. How much is applied for each input?
4. Production
    a. When do you harvest the fish?
    b. At what size are they harvested?
    c. How many times in a year do you grow tilapia?
    d. How much is your production?
5. Market
    a. Who buys the tilapia?
    b. Is it live or dead?
    c. Where are they sold?
    d. How much do you sell them?
6. Others
    a. How many men and women are working in the farm?

What are the factors that affect the sustainability of your tilapia business?

Appendix 3. Details on key informant interviews for sample framing

Key informants (Nov 2010)

Note: Information leading to identities were removed as per agreement with persons involved

Location	Name	Contact	Action
Tambon Bangkachai Amphur Laemsingh Chanthaburi	JK Shrimp Club		Key informant interview Ask contact info of kamnan
Tambon Nongchim Amphur Laemsingh Chanthaburi	SN Shrimp club		Key informant interview Ask contact info of kamnan
Tambon Huasai Amphur Bangkhla Chachoengsao	PJ Kamnan		Ask contact info of kamnans and/or puyai ban of the following: Tambom Thathongluang, Amphur Bangkhla Tambon Konkaew, King Amphur Klongkuean Tambon Bangkaew, Amphur Muang
Tambon Bangkabao Amphur Bansang Prachinburi	W&TD Aqua shop/tilapia farmer		Key informant interview Ask contact info of kamnan and head of tilapia farmers' association
Amphur Phunphin Surat Thani	JC		Key informant interview Ask contact info of kamnan and/or puyai ban of the following: Tambon Lilet, Amphur Phunphin Tambon Plaiwat, Amphur Kanchanadit Tambon Thathong, Amphur Kanchanadit

Guidelines:

1. Introduction – research project at KU under Dr. KS (SEAT in Thai)
2. Purpose of Key Informant Interviews – part of the sampling framework to know general aquaculture situation/profile of the tambon which was randomly chosen for survey
3. Conduct the interview according to the KII form
4. Do we need to visit them for more detailed interview especially when we have randomly identified farmers?
5. Closing – thanks, ask if we can contact him again once we have randomly identified farmers

Shrimp Key Informant 1

A. Key Informant/ Site Details			
Date วันที่	19/11/10	Collected by สำรวจโดย	
Key Informant ผู้ให้ข้อมูล	Mr. PY	Role/position ตำแหน่ง	Kamnan
Mobile No โทรศัพท์เคลื่อนที่		District อำเภอ	Kanchanadit
SubDistrict (Tambon) ตำบล	Plaiwat	Province จังหวัด	Suratthani
Village Name หมู่บ้าน	total 9 villages	GPS Co-ordinates ตำแหน่ง GPS	-
B. Scale factors and correlation with size			
Scale ขนาด	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) การเป็นเจ้าของธุรกิจ	Household or extended family ครอบครัว หรือเครือญาติ	Household or extended family ครอบครัว หรือเครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษั
Indicator2: Full-time (non-family labour) พนักงานประจำ / พนักงานเต็มเวลา	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management การจัดการ	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วยประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds จำนวนบ่อเลี้ยง	maximum 2	3 +	
Main activities of full time labour ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา	2	3-10	>30
Number of farms (range) จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)	3 farms	4-5 farms	3-5 farm

Avg Number of Ponds Per Farm ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม	1-2 ponds	3-5 ponds	>100 ponds
Min Farm Culture Area (ha) จำนวนพท.เลี้ยงต่ำสุด	-	30 rai	>100 rai
Max Farm Culture Area (ha) จำนวนพท.เลี้ยงสูงสุด	-	40 rai	1,000 rai
Avg Farm Culture Area (ha) ค่าเฉลี่ยพท.เลี้ยง	>10 rai	-	-
Number farming on own land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)	70%	60%	50%
Number on private lease land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)	30%	40%	50%
Number on own and private lease land (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)	-	-	-
Number of farms leasing government land จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ	-	-	-
Number business owned/operated by local จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่	100%	50%	50%
Number businesses owned by outsiders จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่	-	50%	50%
Note: Give range of numbers if precise numbers not know e.g. 30-25 farmers			
Additional notes รายละเอียดอื่นๆ:			
- Most farmers changed to palm plantation.			
- Some shrimp farms are affected by flooding.			

Shrimp Key Informant 2

A. Key Informant/ Site Details			
Date วันที่	19/11/10	Collected by สำรวจโดย	
Key Informant ผู้ให้ข้อมูล	Mr. CK	Role/position ตำแหน่ง	นายก อบต.
Mobile No โทรศัพท์เคลื่อนที่		District อำเภอ	Kanchanadit
SubDistrict (Tambon) ตำบล	Plaiwat	Province จังหวัด	Suratthani
Village Name หมู่บ้าน	total 9 villages	GPS Co-ordinates ตำแหน่ง GPS	-
B. Scale factors and correlation with size			
Scale ขนาด	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) การเป็นเจ้าของธุรกิจ	Household or extended family ครอบครัว หรือเครือญาติ	Household or extended family ครอบครัว หรือเครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษั
Indicator2: Full-time (non-family labour) พนักงานประจำ / พนักงานเต็มเวลา	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management การจัดการ	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วยประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds จำนวนบ่อเลี้ยง	maximum 2	3 +	
Main activities of full time labour ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา	1 labour per pond	-	1 labour per pond
Number of farms (range) จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)	<20 farms	-	12-15 farms

Avg Number of Ponds Per Farm ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม	1-2 ponds	-	-
Min Farm Culture Area (ha) จำนวนพท.เลี้ยงต่ำสุด	3 rai	-	-
Max Farm Culture Area (ha) จำนวนพท.เลี้ยงสูงสุด	5 rai	-	-
Avg Farm Culture Area (ha) ค่าเฉลี่ยพท.เลี้ยง	-	-	>100 rai
Number farming on own land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)	80%	-	80%
Number on private lease land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)	20%	-	20%
Number on own and private lease land (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)	-	-	-
Number of farms leasing government land จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ	-	-	some farms are in preservative land.
Number business owned/operated by local จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่	100%	-	-
Number businesses owned by outsiders จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่	-	-	100%
- should have meeting with large farm scale.			
- large scale such as CP, seahorse, Mod Deang, Kung Nang, Coorperative of Suthep Therksuwan, CV, Pasert farm, Likit, Poonim, Num Surat.			
- There are shrimp culture in Moo 1, 2, 3, 5, 6, and 8; Shrimp farms are not affected by flooding.			

Shrimp Key Informant 3

A. Key Informant/ Site Details			
Date วันที่	19/11/10	Collected by สำรวจโดย	
Key Informant ผู้ให้ข้อมูล	Mr. PC	Role/position ตำแหน่ง	Kamnan of Lilet
Mobile No โทรศัพท์เคลื่อนที่		District อำเภอ	Phunphin
SubDistrict (Tambon) ตำบล	Lilet	Province จังหวัด	Suratthani
Village Name หมู่บ้าน	total 8 villages	GPS Co-ordinates ตำแหน่ง GPS	-
B. Scale factors and correlation with size			
Scale ขนาด	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) การเป็นเจ้าของธุรกิจ	Household or extended family ครอบครัว หรือเครือญาติ	Household or extended family ครอบครัว หรือเครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) พนักงานประจำ / พนักงานเต็มเวลา	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management การจัดการ	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วยประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds จำนวนบ่อเลี้ยง	maximum 2	3 +	
Main activities of full time labour ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา	-	-	-
Number of farms (range) จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)	<50 farms	<40 farms	1 farm

Avg Number of Ponds Per Farm ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม	1-2 ponds	>5-30 ponds	30-40 ponds
Min Farm Culture Area (ha) จำนวนพท.เลี้ยงต่ำสุด	-	20 rai	-
Max Farm Culture Area (ha) จำนวนพท.เลี้ยงสูงสุด	-	150 rai	-
Avg Farm Culture Area (ha) ค่าเฉลี่ยพท.เลี้ยง	<7 rai	-	1,000 rai
Number farming on own land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)	80%	60%	100%
Number on private lease land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)	20%	40%	-
Number on own and private lease land (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)	-	-	-
Number of farms leasing government land จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ	-	-	-
Number business owned/operated by local จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่	90%	80%	-
Number businesses owned by outsiders จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่	10%	20%	100%
Note: Give range of numbers if precise numbers not know e.g. 30-25 farmers			
Additional notes รายละเอียดอื่นๆ:			
- Total land title of Lilet 17,000 rai which are shrimp farm area 8,000-9,000 rai. Each farm has storage pond area 30-40% of total area and 60-70% is culture pond area.			

- 1997 as economic crisis and Thai government decreased exchange value then shrimp farmers gained more income. Thus, shrimp farmers responded to expand culture area and shift to intensive system which affect to disease, production cost, and water pollution. Consequently, farmers loss and environmental degradation.
- 2002 found the shrimp club and develop the discharge system and prohibit to pump sediment into river.
- 2004 found many environmental clubs.
- 2006-07 either environment or farms financial are better.

A. Key Informant/ Site Details

Key Informant Shrimp 4

Date **วันที่**	16 November 2010	Collected by **สำรวจโดย**	
Key Informant **ผู้ให้ข้อมูล**	Kamnan CI	Role/position **ตำแหน่ง**	Kamnan
Mobile No **โทรศัพท์เคลื่อนที่**		District **อำเภอ**	Bangkhla
SubDistrict (Tambon) **ตำบล**	Thathongluang	Province **จังหวัด**	Chachoengsao
Village Name **หมู่บ้าน**	Baanklongsopa	GPS Co-ordinates **ตำแหน่ง** GPS	

B. Scale factors and correlation with size

Scale **ขนาด**	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) **การเป็นเจ้าของธุรกิจ**	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) **พนักงานประจำ / พนักงานเต็มเวลา**	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management **การจัดการ**	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds **จำนวนบ่อเลี้ยง**	maximum 2	3 +	
Main activities of full time labour **ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา**	เลี้ยงตามเวลา ส่วนมากทำกันเองในครอบครัว ฟาร์มขนาดเล็ก ไม่ได้จ้าง Mostly do by family, regular feeding time,	เลี้ยงตามเวลา มีตารางการให้อาหาร หว่านอาหารให้ปลากุ้ง ถางหญ้า ทำเป็นเวลา ไม่ได้ทำทุกเวลา แต่ต้องทำทุกวัน Regular feeding time, There is time table to feed shrimp, fish	ไม่มี (None)

		And remove glass Work every day because it needs to feed every day but not all time	
Number of farms (range) **จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)**	30 ฟาร์ม (farm)	15 ฟาร์ม (farm)	-
Avg Number of Ponds Per Farm **ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม**	1-3 ponds	มากกว่า 4 (5-30) ponds More than 4 (5-30) ponds	-
Min Farm Culture Area (ha) **จำนวนพท.เลี้ยงต่ำสุด**	1 ไร่ (rai)	20 ไร่ (rai)	-
Max Farm Culture Area (ha) **จำนวนพท.เลี้ยงสูงสุด**	3 ไร่ (rai)	100 ไร่ (rai)	-
Avg Farm Culture Area (ha) **ค่าเฉลี่ยพท.เลี้ยง**	-	40-50 ไร่ (rai)	-
Number farming on own land only (range)	18 ponds	6 ponds	-
Number on private lease land only (range)	12 ponds	7 ponds	-
Number on own and private lease land (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)**	-	2 ponds	-
Number of farms leasing government land **จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ**	-	-	-
Number business owned/operated by local	30 ponds	10 ponds	-
Number businesses owned by outsiders	-	5 ponds	-

Additional notes **รายละเอียดอื่นๆ:**

คุณ พว สมาชิกอบต.ท่าทองหลาง
เลี้ยงกุ้งมา10 กว่าปี ฟาร์มขนาดกลางเป็นผู้ให้ข้อมูลเพิ่มเติม เนื่องจากกำนันไม่ได้เลี้ยงสัตว์น้ำ

For additional information are given by Khun PW TAOs thathongluang member. He is feeding shrimp since 2000. His farm is middle size. Asking for more information because Kamnan do not feed aquatic.

Key Informant Shrimp 5

Date **วันที่**	16 Nov, 2010	Collected by **สำรวจโดย**	
Key Informant **ผู้ให้ข้อมูล**	Kamnan RT	Role/position **ตำแหน่ง**	กำนัน (Kamnan)
Mobile No **โทรศัพท์เคลื่อนที่**		District **อำเภอ**	คลองเขื่อน (Klongkuean)
SubDistrict (Tambon) **ตำบล**	ก้อนแก้ว (Konkeaw)	Province **จังหวัด**	ฉะเชิงเทรา (Chachoengs ao)
Village Name **หมู่บ้าน**	ดอนสนาม (Donsanam)	GPS Co-ordinates **ตำแหน่ง** GPS	

B. Scale factors and correlation with size

Scale **ขนาด**	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) **การเป็นเจ้าของธุรกิจ**	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) **พนักงานประจำ / พนักงานเต็มเวลา**	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management **การจัดการ**	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds **จำนวนบ่อเลี้ยง**	maximum 2	3 +	
Main activities of full time labour **ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา**	เป็นลักษณะครอบครัว ทำกันเองให้อาหารกุ้ง ปลา ทำนา	เลี้ยงกุ้ง ปลา ให้อาหาร ให้ปูน Feeding shrimp fish, put lime The activities are the same as	ไม่มี

	Do by family Feeding shrimp, fish and rice farming	small size. It just adds more worker	
Number of farms (range) **จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)**	30	20	-
Avg Number of Ponds Per Farm **ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม**	3-4 บ่อ	กำหนดไม่ได้ แล้วแต่ฟาร์ม Can not answer, depends on farm	-
Min Farm Culture Area (ha) **จำนวนพท.เลี้ยงต่ำสุด**	3	50	-
Max Farm Culture Area (ha) **จำนวนพท.เลี้ยงสูงสุด**	20	100	-
Avg Farm Culture Area (ha) **ค่าเฉลี่ยพท.เลี้ยง**			-
Number farming on own land only (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)**	21	-	-
Number on private lease land only (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)**	-	10	-
Number on own and private lease land (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)**	9	10	-
Number of farms leasing government land **จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ**	-	-	-
Number business owned/operated by local **จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่**	24	14	-
Number businesses owned by outsiders **จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่**	8	6	-

Note: Give range of numbers if precise numbers not know e.g. 30-25 farmers

Key Informant Shrimp 6

A. Key Informant/ Site Details

Date **วันที่**	16 Nov, 2010	Collected by **สำรวจโดย**	
Key Informant **ผู้ให้ข้อมูล**	Kamnan HS	Role/position **ตำแหน่ง**	กำนัน Kamnan
Mobile No **โทรศัพท์เคลื่อนที่**		District **อำเภอ**	เมือง Muang
SubDistrict (Tambon) **ตำบล**	บางแก้ว Bangkaew	Province **จังหวัด**	ฉะเชิงเทรา Chachoengsao
Village Name **หมู่บ้าน**	ไผ่เสวก Paisawek	GPS Co-ordinates **ตำแหน่ง** GPS	

B. Scale factors and correlation with size

Scale **ขนาด**	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) **การเป็นเจ้าของธุรกิจ**	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) **พนักงานประจำ / พนักงานเต็มเวลา**	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management **การจัดการ**	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds **จำนวนบ่อเลี้ยง**	maximum 2	3 +	

Main activities of full time labour **ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา**	เลี้ยงกันในครอบครัว ให้อาหาร ใส่ปูน ติดเครื่อง ติดไฟฟ้า เช็คไฟ	ให้อาหาร ใส่ปูน ติดเครื่อง ติดไฟฟ้า เช็คไฟ	ไม่มี None

	Do in family, feeding ,putting lime, checking electricity, pump	feeding ,putting lime, checking electricity, pump	
Number of farms (range) **จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)**	40	100	-
Avg Number of Ponds Per Farm **ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม**	2-3	4-20	-
Min Farm Culture Area (ha) **จำนวนพท.เลี้ยงต่ำสุด**	3	12	-
Max Farm Culture Area (ha) **จำนวนพท.เลี้ยงสูงสุด**	4	70	-
Avg Farm Culture Area (ha) **ค่าเฉลี่ยพท.เลี้ยง**	-	40	-
Number farming on own land only (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)**	40	30	-
Number on private lease land only (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)**	-	35	-
Number on own and private lease land (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)**	-	35	-
Number of farms leasing government land **จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ**	-	-	-
Number business owned/operated by local **จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่**	40	90	-
Number businesses owned by outsiders **จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่**	-	10	-

Note: Give range of numbers if precise numbers not know e.g. 30-25 farmers

Additional notes **รายละเอียดอื่นๆ:**

The answers are from estimation (not exactly number)

KEY INFORMANT INTERVIEWS: TILAPIA

Province	Key informants	Teams	Dates	Remarks
Nakhon Pathom	1. Provincial Fisheries Office 2. Muang: District Fisheries Officer, TAO, Kamnan, Village chiefs, group leader 3. Banglen: District Fisheries Officer, TAO, Kamnan, Village chiefs, group leader 4. CP technical person (give info to Oom)	A-PFO, CP , DFO-muang B-Muang C-Banglen	7 Dec	Teams stay o/n in Petchburi (Team B) and Suphanburi (Teams A & C)
Petchburi	Provincial Fisheries Office Banlaem: District Fisheries Officer, TAO, village chiefs, group leader	1-PFO, DFO, TAO 2-village chiefs, group leader	8 Dec	Team B
Suphanburi	1. Provincial Fisheries Office 2. Duembangnangbuach: District Fisheries Officer, TAO, Kamnan, Village chiefs, group leader 3. Samchuk: District Fisheries Officer, TAO, Kamnan, Village chiefs, group leader	1-PFO 2- เดิมบางนางบวช Duembangnangbuach 3-Samchuk	8 Dec	Teams A & C: re-group
Chachoengsao	1. Department of Fisheries Research and Development Center 2. District Fisheries Officer-Bangpakong 3. TAO, Kamnan 4. Village chiefs, group leader	1-DOF, DFO 2-TAO, Kamnan 3-Villages, group leader	13-17 Dec	during shrimp survey in Chachoengsao

KEY INFORMANT INTERVIEWS: TILAPIA (contact persons)

Province	Key informants	Office	Contact info	Remarks
Nakhon Pathom	PD	District Fisheries Office, Banglen	Tel:	
	PR	Provincial Fisheries Office, A. Muang	Tel: Email	Head
	SL	PFO, Provincial Govt Office	Tel:	Staff
	KP	CP Technical Officer	Tel:	
	TAO, kamnan	Banglen		
	Village heads			
Petchburi	AL	Farm	Tel:	Tilapia farmer, group leader
		Provincial Fisheries Office		
	Pramong Amphur	Banglaem		
	TAO, kamnan	Banglaem		
	Village heads			
Suphanburi	AN	Provincial Fisheries Office	Email tel:	Can ask for contact of pramong amphurs
	CM	Nongbuach	Tel:	Group leader, tilapia cages
	Pramong Amphurs	เดิมบางนางบวช Duembangnangbuach Samchuk		
	TAOs	เดิมบางนางบวช Duembangnangbuach Samchuk		
Chachoengsao	DOF Research and Dev Center	Bangpakong	Check DOF directory	
	Pramong Amphur	District Fisheries Office, Bangpakong	Check with PFO, Chachoengsao	
	TAO, kamnan	Bangpakong		
	Village heads			

Key Informant Tilapia 1

A. Key Informant/ Site Details

Date **วันที่**	16-11-10	**Collected by สำรวจโดย**	
Key Informant **ผู้ให้ข้อมูล**	TP	**Role/position ตำแหน่ง**	Owner
Mobile No **โทรศัพท์เคลื่อนที่**		**District อำเภอ**	Bansang
SubDistrict (Tambon) **ตำบล**	BangKabao	**Province จังหวัด**	PrachinBuri
Village Name **หมู่บ้าน**	-	**GPS Co-ordinates ตำแหน่ง GPS**	

B. Scale factors and correlation with size

Scale **ขนาด**	Small	**Medium**	**Large**
Indicator1: Business ownership (i.e. regardless of land ownership) **การเป็นเจ้าของธุรกิจ**	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) **พนักงานประจำ / พนักงานเต็มเวลา**	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management **การจัดการ**	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds **จำนวนบ่อเลี้ยง**	maximum 2	3 +	
Main activities of full time labour **ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา**	-	All Work	-

Number of farms (range) **จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)**	-	50 Farms Up	1 Farm (Of CP)
Avg Number of Ponds Per Farm **ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม**	-	4 - 10	-
Min Farm Culture Area (ha) **จำนวนพท.เลี้ยงต่ำสุด**	-	20 Rai	-
Max Farm Culture Area (ha) **จำนวนพท.เลี้ยงสูงสุด**	-	50 Rai	-
Avg Farm Culture Area (ha) **ค่าเฉลี่ยพท.เลี้ยง**	-	35 Rai	-
Number farming on own land only (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)**	-	10	-
Number on private lease land only (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)**	-	20	-
Number on own and private lease land (range) **จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)**	-	20	-
Number of farms leasing government land **จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ**	-	-	-
Number business owned/operated by local **จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่**	-	20 %	-
Number businesses owned by outsiders **จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่**	-	80 %	-

Additional notes **รายละเอียดอื่นๆ:**
Need to know about another farm or more information contract with “NamSai Farm”
เกษตรอำเภอ บ้านสร้าง tel. #
อบต.บ้านสร้าง tel.

A. Key Informant/ Site Details	Key Informant Tilapia 2		
Date วันที่	7/12/10	Collected by สำรวจโดย	
Key Informant ผู้ให้ข้อมูล	ST	Role/position ตำแหน่ง	Fisheries volunteer
Mobile No โทรศัพท์เคลื่อนที่		District อำเภอ	Banglean
SubDistrict (Tambon) ตำบล	Banglean	Province จังหวัด	Nakornpathom
Village Name หมู่บ้าน	3	GPS Co-ordinates ตำแหน่ง GPS	
B. Scale factors and correlation with size			
Scale ขนาด	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) การเป็นเจ้าของธุรกิจ	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) พนักงานประจำ / พนักงานเต็มเวลา	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี

Indicator3: Management การจัดการ	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds จำนวนบ่อเลี้ยง	maximum 2	3 +	
Main activities of full time labour ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา	-	-	-
Number of farms (range) จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)	-	-	-
Avg Number of Ponds Per Farm ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม	1-8	-	-
Min Farm Culture Area (ha) จำนวนพท.เลี้ยงต่ำสุด	4 Rai	-	-
Max Farm Culture Area (ha) จำนวนพท.เลี้ยงสูงสุด	~ 20 Rai	-	-
Avg Farm Culture Area (ha) ค่าเฉลี่ยพท.เลี้ยง	10	-	-

Number farming on own land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)	-	-	-
Number on private lease land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)	-	-	-
Number on own and private lease land (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)	most	-	-
Number of farms leasing government land จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ	-	-	-
Number business owned/operated by local จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่	100%	-	-
Number businesses owned by outsiders จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่	-	-	-
		-	-
Note: Give range of numbers if precise numbers not know e.g. 30-25 farmers			
Additional notes รายละเอียดอื่นๆ:			

- 50% is Tilapia monoculture and 50% polyculture.
- Farmers buy Tilapia fry from Manit Farm, Namsai Farm, and CP.
- Most farmers have pond near their house.
- Most farmers have nursery pond.

Key Informant Tilapia 3

A. Key Informant/ Site Details			
Date วันที่	7/12/10	Collected by สำรวจโดย	
Key Informant ผู้ให้ข้อมูล	MC	Role/position ตำแหน่ง	Fisheries volunteer, Assistant Village Headman
Mobile No โทรศัพท์เคลื่อนที่		District อำเภอ	Banglean
SubDistrict (Tambon) ตำบล	Dontum	Province จังหวัด	Nakornpathom
Village Name หมู่บ้าน	8	GPS Co-ordinates ตำแหน่ง GPS	
B. Scale factors and correlation with size			
Scale ขนาด	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) การเป็นเจ้าของธุรกิจ	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) พนักงานประจำ / พนักงานเต็มเวลา	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี

Indicator3: Management การจัดการ	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds จำนวนบ่อเลี้ยง	maximum 2	3 +	
	Household Scale	Small Scale	Medium Scale
Main activities of full time labour ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา	-	-	2-3
Number of farms (range) จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)	~ 20 farms	25 farms	5 farm
Avg Number of Ponds Per Farm ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม	-	-	-
Min Farm Culture Area (ha) จำนวนพท.เลี้ยงต่ำสุด	3 Rai	10 Rai	50 Rai
Max Farm Culture Area (ha) จำนวนพท.เลี้ยงสูงสุด	5 Rai	30 Rai	100 Rai
Avg Farm Culture Area (ha) ค่าเฉลี่ยพท.เลี้ยง	-	-	-

Number farming on own land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองเท่านั้น (จัดลำดับ/ประมาณช่วง)	-	70%	20%
Number on private lease land only (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ที่เช่าเท่านั้น (จัดลำดับ/ประมาณช่วง)	-	-	80%
Number on own and private lease land (range) จำนวนฟาร์มที่ตั้งอยู่บนพื้นที่ของตัวเองและพื้นที่เช่า (จัดลำดับ/ประมาณช่วง)	100%	30%	-
Number of farms leasing government land จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ	-	-	-
Number business owned/operated by local จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่	98%	98%	98%
Number businesses owned by outsiders จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่	2%	2%	2%
Additional notes รายละเอียดอื่นๆ:			
- Number of pond per farm can not specify due to some farmer have pond area 3-4 Rai/pond but another have 40 Rai/pond.			
- The farmers of Banlen district are not monoculture yet, shifted to polyculture.			
- This village (Moo8) does not have large scale and are separated into 3 scale; household, small, and medium scale.			

Key Informant Tilapia 4

A. Key Informant/ Site Details			
Date วันที่	8/12/10	Collected by สำรวจโดย	
Key Informant ผู้ให้ข้อมูล	TM	Role/position ตำแหน่ง	Owner's son (manage farm)
Mobile No โทรศัพท์เคลื่อนที่		District อำเภอ	Derm Bang Nang Buod
SubDistrict (Tambon) ตำบล	Nang Buod	Province จังหวัด	Suphanburi
Village Name หมู่บ้าน	6	GPS Co-ordinates ตำแหน่ง GPS	
B. Scale factors and correlation with size			
Scale ขนาด	Small	Medium	Large
Indicator1: Business ownership (i.e. regardless of land ownership) การเป็นเจ้าของธุรกิจ	Household or extended family ครอบครัว หรือ เครือญาติ	Household or extended family ครอบครัว หรือ เครือญาติ	Private company เป็นเจ้าของในรูปแบบบริษัท
Indicator2: Full-time (non-family labour) พนักงานประจำ / พนักงานเต็มเวลา	maximum 2 ไม่เกิน 2 คน	3 +	Yes มี
Indicator3: Management การจัดการ	Household or extended family เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย	Household/extended family or external เป็นเจ้าของประกอบกิจการเอง / คนในครอบครัวช่วย ประจำหรือไม่ประจำที่ฟาร์ม มีการจ้างแรงงานอื่น	External มีการจ้างแรงงานอื่น
Indicator4: No. of culture ponds จำนวนบ่อเลี้ยง	maximum 2	3 +	
Main activities of full time labour ลักษณะงานที่ทำของพนักงานประจำที่ทำงานเต็มเวลา	-	-	-

Number of farms (range) จำนวนฟาร์ม (จัดลำดับ/ประมาณช่วง)	-	-	-
Avg Number of Ponds Per Farm ค่าเฉลี่ยจำนวนบ่อต่อฟาร์ม	40 cages	-	-
Min Farm Culture Area (ha) จำนวนพท.เลี้ยงต่ำสุด	36 m^2	-	-
Max Farm Culture Area (ha) จำนวนพท.เลี้ยงสูงสุด	450 m^2	-	-
Avg Farm Culture Area (ha) ค่าเฉลี่ยพท.เลี้ยง	360 m^2	-	-
Number farming on own land only (range)	-	-	-
Number on private lease land only (range)	-	-	-
Number on own and private lease land (range)	100%	-	-
Number of farms leasing government land จำนวนฟาร์มที่ตั้งอยู่บนที่เช่าของรัฐ	-	-	-
Number business owned/operated by local จำนวนธุรกิจที่ดำเนินการโดยคนในท้องที่	100%	-	-
Number businesses owned by outsiders จำนวนธุรกิจที่ดำเนินการโดยคนนอกพื้นที่	-	-	-
Additional notes รายละเอียดอื่นๆ:			
- There are 2 districts of Suphanburi that farmers are cage culture of Tilapia; Samchok and Derm Bang Nang Boud.			
- For Derm Bang Nang Boud district, there are around 40 farmers, 20 persons are member of K.K’s group. Only one farmer member is in Samchok district.			
- K.K’s household has 96 cages which are separated into 3 owners; K.K (father), TM (son), and NM (son). They registered with PFO 3 names but only one GAP registered as K.K.			

Appendix 4. Questionnaire for Integrated Farm Survey

Surveyed before Y[ ] N [ ] _____________________ Follow-on survey? Y[ ] N[ ]

All questions refer to visited site & last culture cycle unless otherwise stated

Section 1. Survey and Interview details (*classify after survey)

Table 1.1 Survey details.

SurveyCD	*PrimarySpeciesCD	*FarmSystemCD	*FarmScaleCD
- - - - -			

Table 1.2 Interview details

Survey Forms			ACCESS Database		
Date collected	Collected by CD	Survey CheckByCD	Date entered	Entered by CD	Checked by CD

Table 1.3 Farm Location Re start 'Farm Number' from 01 in each village/ commune

CountryCD	ProvinceCD	DistrictCD	SubDistrictCD	SubSubDistCD	SupraVillage CD	VillageCD	SubVillageCD	Farm Number	GPSLocCD					
									GPS Coordinates					
									East			North		
											.			.

- Bangla: Country, District (Zila), SubSubDistrict (Upazila), SubSubDistrict (Union), Village, SubVillage (Para), Farm No
- Thailand: Country, Province, District (Amphoe), SubDistrict (Tambon), Village (Mu), Farm No
- Vietnam: Country, Province, District, SubDitrict (Commune), (SubSubDistrict) Hamlet, Farm No
- China: District, SubDistrict (county), (SubSubDistrict),Township, Village

Table 1.4 Respondent, manager and owner details.

Enter respondent details in the first column (i.e. always code RespondentCD = 1). Talk to manager or owner where possible. Enter details of both the farm manager and the owner (even if not interviewed).

RespondentCD	1 (Respondent)	2	3
Farm RoleCD			
Full Name			
GenderCD			
Age			
NationalityCD			
EthnicityCD			
ReligionCD			
CasteCD (Bangladesh)			
Owner RelationCD			
EducationCD			
Home Km From Farm			
Tel. Number			
YearBeganAquaculture			
PreviousOccupationCD			

Section 2 Respondent household details

Table 2.1 Household details (ask only of interview respondent's household)

Normally resident Number			**Absentee Residents Number**		**HH Birth-place**	**If No:**	
						Origin CD	
Male	**Female**	**Kids**	**Male**	**Female**	**LocalCD** Y[ ] N[ ]	**Years HH current location**	**Move ReasonCD**

Q2a Would you like your children to be involved in farming of fish/shrimp/prawns (as relevant) in the future? Yes [ ] No [ ]

Q2b Give reasons for your answer?

2.2 Household Income
Rank the same households main income sources over the five years and contribution to total annual income over the last year. (Consider absentee HH members if sending/ receiving regular remittances)

	IncomeSourceCD	**% Last Yrs Net Income**	**% Last 5 Yrs Net Income**
Last Year			
Last 5yrs			

Table 2.3 What was the (tick box) net profit [ ] or total income [ ]
(-) or loss (+) from aquaculture last year
(tick appropriate box above – use profit where possible)

To Respondents Household	**Owner (if not respondent & known)**

Section 3. Sustainability Perceptions

Table 3.1 What factors do you foresee that could positively or negatively affect your farms performance over the next 1-2 years?
Note: factors that could be either +ve or –ve (e.g. product price) should be entered in the 'uncertain' section.

	SustainabilityFactorCD	OverallRank	ResponseCD
Negative			
Positive			
Uncertain			

Section 4. Farm details

Table 4.1 Additional Farm Details (for visited site)

Farm Trading Name	
Traceability RegistrationCD	
RegistrationNumber (if accessible)	
LastTraceabilityRegDate	
Farm Address	
Year Farm Established	
PriorLandUseCD	
Did You Establish Aqua Farm Y/N	

Table 4.2 Additional Farm Details – Continued Answer only if the current operator did not originally establish the visited farm.

Previous Aqua Farm Owner/User CD	
TransferYear	
Transfer Reason CD	
NumberOfTransfersSinceEstablished	

Section 5. Other income-generating aquaculture land holdings

Table 5.1 For enterprises with 5 or less separate land-use groups
List all aquaculture holdings generating income for the owner(s) of this farm. Site 1 = the visited aquaculture farm visible at visit. Use a separate column for different combinations of geographically separate plots and usage (grey-shaded).

Otherwise use the Table after this to summarize holdings for larger/ more diversified enterprises i.e. > 5 land-use groups

Site No	**1**	**2**	**3**	**4**	**5**
Km from site 1	0				

CurrentUseCD					
OwnershipCD					
ContractLengthYrs					
MangementCD					
Full-time staff					
Land Area					
***TotalWaterArea**					
AreaUnitsCD					
No. of Ponds					
CurrentUseFromYr					

*Including both storage and culture ponds

Table 5.2 For enterprises with more than 5 groups of income-generating aquaculture land holdings
Summarize number/ ranges under different economic-use & ownership categories

GroupNo	**1**	**2**	**3**	**4**	**5**
CurrentUseCD					
OwnershipCD					
AvgContractLeaseYrs					
No.Sites/Farms					
TotalLand Area					
***TotalWaterArea**					
AreaUnitsCD					
Full-time Staff					

* Including both storage and culture ponds

Q5a Main Changes in land-holding & use patterns over the last 5 years?

Section 6 – Infrastructure & Production for the visited farm

Table 6.1 Farm Infrastructure

Containment Use CD	**Containment System CD**	**No units**	**Total Water Area**	**Area Units CD**	**Max water Depth (m)**	**PondLining material CD**

Q6a Main change in visited farm infrastructure over last 5 years?

Table 6.2 What written records do you regularly keep Tick only those kept over the last year, otherwise leave blank – add additional categories as necessary

RecordCD	**Yes (tick)**
Feed	
Mortality	
Growth	
Water quality	
Chemical use	

Table 6.3 Production outcomes Complete for all stocked and traded species over the last complete culture cycle of visited farm.

Species CD						
Scheduling		**Production Scheduling CD:**				
		MeanCropGrowOutTime (stocking to harvest) (Days)				
		Mean crops per pond per year				
		Number of Ponds Stocked Simultaneously				
		Interval between stocking (Days)				
		Winter fallow (Days)				
		Start Date (week,month,year)				
		LastHarvestDate (week,month,year)				
		Number cycles last 5 yrs (inc. this one)				
Stocking		**SeedSource CD**				
		TilapiaBreedingObservedYN				
	Select one	**SeedAvgWeight (g)**				
		Seed Avg Length(cm)				
		Seed Avg Depth (cm)				
		Juvenile Stage (Days)				
		MeanSeedCost				
		CostUnits				
		StockingDensity No/m^2[ ] m^3[ ]				
Harvesting	**Select one**	**Avg Weight at Harvest (kg)**				
		Avg Pieces/kg (shrimp/prawn)				
		Avg Sale Size - Minimum				
		Avg Sale Size - Maximum				
		Total marketed harvest (t)				
		Survival to harvest %				
		Removed losses to harvest kg				
		Delayed Harvest Reason CD				
		Advanced Harvest Reason CD				
Marketing		**SalesTypeCD**				
		Avg Price/kg				
		Min Price/kg				
		Max Price/kg				
		Distance to market (km)*				
		Time to market (hrs)*				

*Only if not sold at farmgate

Q6b Main change in aquaculture production patterns over the last 5 yrs

Table 6.4 Other non-stocked catches present in ponds? **Yes [ ] No [ ]**
Answer following questions only if the answer is yes

Non-stockedSpeciesCD					
Total Production					
ProductionUnitsCD					
MainUseCD					
TotalValue					

Table 6.5 Integrated agricultural production during last cycle (e.g. pond dyke production, rice, orchard etc)

AgriSpecies CD	FarmSub System CD	Area Cultivated	Area Units	ProductionUseCD

Table 6.6 Animals on farm

	AnimalCD	Count of Animals	Production useCD
Integrated (count)			
Not-integrated (count)			
Wild animals (YesNo		Yes/ No	
	Rats/ rodents		
	Birds		

Section 7 Farm Labour

Table 7.1 During the last complete culture cycle for the visited farm

		Household members	Relatives/ Friends	Full-time hired staff	Part-time HiredWorker			
Men	MainTasksCD							
	WorkerNumbers							
	Mean hrs/day							
	TotalDays							
	PayBasisCD							
	Pay							
	Other benefit CD							
Women	MainTasksCD							
	WorkerNumbers							
	Mean hrs/day							
	TotalDays							
	PayBasisCD							
	Pay							
	Other benefit CD							
Children <15yr	**MainTasksCD**							
	WorkerNumbers							
	Mean hrs/day							
	TotalDays							
	PayBasisCD							
	Pay							
	Other benefit CD							

Table 7.2 If any couples are jointly paid for work enter here & not Table7.1

		Household members	Relatives/ Friends	Full-time hired staff	Part-time HiredWorker			
Couples	MainTasksCD							
	Worker numbers							
	Mean hrs/day							
	TotalDays							
	PayBasisCD							
	Pay							
	Other benefit CD							

Table 7.3 Full-time staff with permanent on-farm accommodation

Total persons				
No of families/couples				
OriginCD				
MonthsOnFarm	**Max**		**Avg**	

Q7a China/Vietnam: What% of full-time staff return after NewYear?

Q7b Main changes in labour patterns over the last 5yrs

Section 8 Feed Inputs

Table 8.1 Total feed applied during last culture cycle

Feed CategoryCD	Weight (t)	eFCR	Meal CalcCD	Feed methodCD
Total commercial pellet feed (t)				
Total on-farm pellet/ wet feed (t)				
Totals (t)				

Table 8.2 Commercial feed suppliers (list in order of volume used during last production cycle for the visited farm)

No.	FeedProducerCD	Trade name (if known)
1		
2		
3		

Table 8.3 Feed details – ranges for processed grow-out feed and unprocessed feedstuffs

FeedTypeCD				
InputSourceCD				
TotalFed(t)				
Max Protein %				
Min Protein %				
MaxStorageDays				
FeedCost Min				
FeedCost Max				
FeedCostUnitCD				

Table 8.4. Payment Terms - for your main source of commercial feed

PaymentTermsCD	
CreditTermsCD	
CreditInterest %	
CreditPeriodCD	

Q8a Main changes in feed management over the last 5 years?

Section 9. Stock Losses and Disease

Table 9.1 Stock losses (and catfish flesh-colour)
Over the last culture cycle for the visited farm, rank what you consider to be the main cause(s) of loss for your primary species, and, for VIETNAM ONLY causes of catfish flesh discolouration?

LossCauseCD	Primary Species Loss			Catfish flesh discolor cause rank	
	LossRank lastcycle	Loss FateCD	Price/kg (+ or -)	Pink/red[1]	Yellow[1]
Stress					
Feed Quality					
Water Quality					
Stocking density					
Parasite					

Disease					
ExtremeWeather					
Escape					
Cull					
Unsold Harvest					
Poor quality PL					
Predation					

Table9.2 Catfish Flesh Discolouration

OwnFirstAssessment(g)						
OwnCheckFreqCD						
WeightFirstAffected(g)						
%OfHarvest	White		Red/Pink		Yellow	
[1]SourceOfDataCD						
*AsscocWithHealthProblems?	Y [ ] N [ ]					

For the rest of section 9 consider the LAST FIVE YEARS for the visited site.

Table 9.3 Disease symptoms pictures Enter codes for any of the pictured symptoms you have seen on your farm over the last five years?
Repeat for any named secondary SEAT species if this is a polyculture system.
Do you associate any identified catfish symptoms with flesh discolouration (**Y/N**)

	SpeciesCD	**SymptomCD**					
PrimarySpecies							
PrimarySpecies							
***Symptoms assoc. with flesh discolouration Y/N**	Catfish						

*Answer only if response to last question in Table 9.2 was yes

Table 9.4 Named diseases
DiseaseCD Enter codes for any named diseases you think you have experienced on your farm over the last five years? (ask independently of previous question)

	SpeciesCD	**SymptomCD**					
PrimarySpecies							
SecondarySpecies							

Table 9.5 Have you used any of the following diagnostic services (tick only those used over the specified period – add additional categories if necessary)

DiagnosticCD	**Yes (tick)**
Professional diagnostic service, university, other research facility	
Diagnosis support from chemical supplier	
Diagnosis support from feed company	
Farm(s) employ trained health specialist(s)	

Q9a Shrimp/prawn PLs tested by PCR method? **Y [ ] N [ ]**

Section 10 Water Management

Table 10.1 Source and Storage

Source& Storage	**Main water source CD**	
	DistanceToMainSourceIfPumped(km)	
	Secondary water source CD	
	WaterStorageMethodCD	
	MinStorageBeforeUse (days)	
	Recirculate&ReuseWaterCD	No [ ] Partially [ ] Fully [ ]

Table 10.2 Ignore the next questions on replacement and discharge if response to the last question was '<u>Fully</u>' re-circulated (i.e. water top-up but no discharge)

Discharge	**Max water replacement (@max density)**	**% [ ]** **Depth [ ] cm**			
	Water replacement freq (@max density)				
	DischargeMethodCD				
	DischageRouteCD				
	Main water discharge to CD				
	Effluent treatment method CD				
	EffluentAgreementCD				

Table 10.3 Sediment removal and water quality

Sediment	**Sediment removal frequency CD**	
	Fate of sedimentCD	
	Regular (min monthly) water monitoring	Salinity[ ] **min:_______max:_________** pH[ ] NH3[ ] NO3[ ] NO2 [ ] Alk [ ] oC[ ] DO[ ]

Q10a Changes in water management over the last 5 years

Section 11 Other Inputs

Table 11.1 Fertilizers

FertTypeCD	TotalUse	UseUnitsCD	Total Cost	*Fert WhenCD	*Fert WhereCD

** Only if human or other animal excreta is used for fertilisation*

Table 11.2 Soil/water treatment Inc. **probiotics** (effective micro-organisms), antibiotics, disinfectants, pesticides and alkalines

SubstanceType CD	TotalUse	UseUnitsCD	**Protective measures CD	TotalCost
*$CuSO_4$				
Niclosamide				
Limestone				
Quicklime				

* Used to control snails – ask specifically about snail control

** Leave blank if no protective measures taken

Table 11.3 Therapeutics and feed supplements **–** bath or feed treatment

ManufacturerCD	Substance TypeCD	UseModeCD	Amount Per application	Amount UnitsCD	Application Frequency	Total Cost	Cost Units CD

Q11a Main change in chemical & substance use/ management over last 5 years?

Section 12 Energy use Over the last complete culture cycle.

Table 12.1 Energy Sources

Energy SourceCD	Rank	Total	Units	Total Cost
Grid electricity				
Propane/LPG				
Gasoline				
Diesel				
Coal				
Wood				

Table 12.2 Energy Consumption

Main energy use by cost, rank

ConsumptionCD	Electricity	Propane/LPG	Petrol/Diesel	
Generators				
Aerators				
Pumping				
Farm vehicles				

Section 13 Aquaculture Market value chain networks

Table 13.1 Membership of marketing and production formal and informal value chain networks (producer organization, certification, traceability,)

	NetworkPurposeCD	Scheme NameCD	Date Joined	Date Left	Joining ReasonCD	Rank importance
Current						
Past						

Section 14 Financial assets, public transfers, insurance

Ask about technical and subsidy categories for the entire tenure of the farm;
Financial assets for the respondent's household

Table 14.1

AssetCatCD	AssetTypeCD	AssetY/N	AssetDetails
Technical	Technical assistance Govt		
	Technical assistance NGO		
	Tech assist by Uni's/Res Inst's		
	Supply companies (feed etc)		
Subsidy	Public subsides/ grants		
Financial (respondent household)	Bank savings		
	Informal savings e.g. ROSCA		
	Loans taken		
	Loans to others		
	Livelihood insurance		
	Welfare benefit		
	Aquaculture insurance		

Section 15 Personal values

Table 15.1 Value systems

Separately for values listed under 'Values 1' and 'Values 2' the question to the farmer is: **Ask yourself what is most important to you in your life?**

After presenting the value picture cards for the farmer, then list the farmer's ranking, where 1 is most important (allow split ranks where necessary). Use the ID letters - A to J - on each card for easy to identify the different values.

Values 1 ***- society "units"***			**Values 2** ***- society and livelihood issues***		
This is about respect and care for			***These are issues about***		

the different "units"	**ID**	**Rank**	*attitudes and focus areas for having a good society and livelihood*	**ID**	**Rank**
Personal prosperity, hapiness and well-being	**A**		Health, safety and income security	**A**	
Family and household	**B**		Equal personal opportunities for such as gender, age, class	**B**	
Friends and relatives	**C**		Individual freedom to such as speech, vote, religion	**C**	
Local community	**D**		Respect between humans	**D**	
Country	**E**		Collaboration and cooperation in community	**E**	
Animals and nature	**F**		Social harmony	**F**	
Future generations of community and country	**G**		Environmental concerns	**G**	
Religion and God	**H**		Strong political leadership	**H**	
Other values			Other values		
Other Values			Other values		

Q15a Would you like to make any further comments based on your understanding of the purpose of this survey

Q15b Would you be willing to participate in a follow-up survey at a later date

Y[ ] N[ ]

Section 16 Visual Observation

Try to answer all the remaining questions using visual observation (ask the farmer only where visibility is limited e.g. for a very large farm)

Q16a Was the farmer willing/happy to participate? Y[ ] N[ ]
Q16b Comments on farmer behavior & attitude

Q16c Did the named respondent answer all of the questions? Y[ ] N[ ] Q16d If not why and whom answered which questions?

Q16e Which language(s) did the farmer speak?

English		Mandarin		Leizhou		Bangla	
Cantonese		Thai		Burmese			
Lao		Khmer		Vietnamese			

Q16f What precautions are taken against predators and poaching

Predator/PoachingPrecautionCD				

Q16g Height of dyke above maximum operational water level ____ (m)

Q16h Hygiene: sealed latrine visible on visited site? Y[ ] N[ ]

Section 17 Photographs, Land Use & Additional GPS Coordinates

A Respondent(s) & farm buildings	B Farm view	C Effluent discharge Point	D Receiving water body

Upstream Land useCD	Downstream Land useCD
E Upstream Land useCD	F Downstream Land useCD

Any other pictures (labels of chemicals/ feeds etc) – continue labeling sequence

G Major machinery	H	I	J

Additional GPS measurements (effluent outflow, water source etc.)

GPSLocCD	GPS Coordinates	East		GPS Coordinates	North	
			.			.
			.			.

Source: Murray, F., Zhang, W., Nietes-Satapornvanit, A., Phan, L.T., Haque, M.M., Henriksson, P., Little, D.C., 2011. Report on Boundary Issues. Sustaining Ethical Aquaculture Trade Project. 83pp.

Appendix 5. Questionnaire for Shrimp Transition Survey

PART 1. Telephone Survey

1. Survey Details

1.1. SurveyCD			**Date***	
1.2. Interview Date				
1.3. Enumerator				
1.4. Respondent Full Name				
1.5. Farm RoleCD (manager, owner etc)				
**1.6. Same Respondent? Yes/No ** **	**Survey 1**		**Survey 2**	
1.7. Telephone number(s)				
1.8. Gender	M:		F:	

* Date of integrated survey (remind the respondent of this date)

** Survey 1 = Integrated survey   Survey 2 = WP5 livelihoods

2.1 Farming transition status

Are you farming as normal or have there been some changes?

	Change Status	**Tick**	**Month & Year**	
1	Farming as normal i.e. no significant change			
2	Farming as normal with some changes			
3	Temporarily stopped farming and already restarted			
4	Temporarily stopped farming with planned restart date			
5	Temporarily stopped with no planned restart date			
6	Permanently stopped farming			
7	Plan to stop temporarily in near future			
8	Plan to stop permanently in near future			

2.2 <u>(only ask if farmer has made the decision to stop farming permanently or temporarily from Q2 items 3-8)</u>

Why did you (or do you plan to) permanently or temporarily stop farming?

Stop cause	**Give details**
Stock loss disease	
Stock loss other	
Seed quality	
Low sales price	
Lack operational finance	
Lack capital finance	
Have new business	
Land access	
Water access	
Regulatory burden	

2.3. If you have stopped farming, or plan to stop farming temporarily, and plan to restart later:

i) why?

____

ii) when do you plan to restart?

____

2.4. If you have stopped farming, what are you doing now? Or if you plan to stop farming, what do you plan to do?
Why?

____
____

For those who respond Permanently stopped farming (6) or Plan to stop permanently in near future(8) **Please go directly to answer Q6, 7.1, 7.2 and 7.3**

3. What changes have you made to your farming practices? Comparing present and the past 2 year? (refer to the farm-site visited for previous survey only)

Category	**Production change**	**First survey**	**Now Y/N**	**Details & reason(s) for change**
Species	Species			
Farm info	Total culture area (ha)			
	Total number of ponds			
	No. of crops/year			
	Pond fallow period (wks)			

Stocking	Avg No ponds stocked/ cycle			
	Avg pond area stocked/ cycle			
	Source of post-larvae (PL)			
	Average stocking density			
	Stocking age of PL			
Feeding management	Supplier of feed inputs			
	Type of feed inputs			
	Brand of feed			
	Level of feed inputs (amount of feed)			
	Feeding method			Manual from side or boat / autofeeder / mixed
	FCR			
Sludge management	Sludge removal freq/cycle			
Biosecurity	Pond lining			Specify side only or side and bottom
	Strings above pond			
Aeration	Type of aeration			
	Energy source for aeration			
Water Management	Water exchange			
	Chemical/probiotics used?			
Harvesting	Culture period (days)			
	Average Harvest size			
	Yield			
Environmental	Integration			Specify if farmer has mangrove planted around, or bivalves in canal, other forms of integration

4. Post harvest: What is the present situation for each marketing category? Is it different from the last 2-3 years? If yes, what is the difference? Why have they changed? (refer to the farm-site visited for previous surveys only)

<table>
<tr><th colspan="2">Marketing change</th><th>FirstSurvey</th><th>Now</th><th>Details & reason(s) for change</th></tr>
<tr><td colspan="2">SalesTypeCD</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Sales to which buyers
(list in order of volume;
1 = highest)</td><td>1</td><td></td><td></td><td rowspan="3">If sales typeCD is more than 1</td></tr>
<tr><td>2</td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td></tr>
<tr><td rowspan="3">Sales contracting
(use contract code)
(list in order of volume;
1 = highest)</td><td>1</td><td></td><td></td><td rowspan="3"></td></tr>
<tr><td>2</td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td></tr>
<tr><td colspan="2">Advanced Sales Contract
(How far in advance the farmers know to whom they will sell their shrimp? – response is specific time in weeks or months, before stock or harvest)</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Farm-gate price</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Quality specifications by buyers such as: size/wt</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Quality specifications by buyers such as: residue tests</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Quality specifications by buyers such as: others, specify</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">% Domestic sales</td><td></td><td></td><td></td></tr>
</table>

5. Investment What other changes have or will you make to your business practices? Comparing present and the past 2 year? (all but first (grayed) item refer to visited farm-site)

Production change	**Previous Survey**	**Now(or planned)**	**Mnth&Yr**	**Details & reason(s) for change**
Number farms owned				
Business ownership				
Land ownership				
Land area				
Labour No. full-time				
Labour No. part-time / daily wage				
Other investment Farm buildings Storage (feed, equipment) Fences, gate Vehicles Boats Laboratory Others, specify				
Certification				

5.1 How do you finance your operational costs? (rank: where 1 = most important)

If farmer has no response, enumerator should prompt him with the list
1. Use own savings/profits
2. Sell something, what?
3. Borrow, where? From whom?
4. Gift from whome?
5. Credit from ?

Income Category	Rank (now)

6. Rank current income generating activities for your own household <u>(Include income of everyone in the Household)</u>

If farmer has no response, enumerator should prompt him with the list
1. Aquaculture farming
2. Crop farming, livestock
3. Wage labor (on-farm)
4. Wage labor (non-farm) Source?
5. Business , trade, manufacturing
6. Land lease, Asset Lease
7. Other, specify

Income Category	Rank (now)

7.1 Has there been a change in your role/responsibility in the business/farm since the first survey (or over the last 2 years)? Y / N

Details: ____

____

7.2 <u>(Ask only if respond yes in 7.1)</u> How has this affected you personally – both positive and negative impacts?

Details: ____

____

7.3 Considering your previous responses, are you better or worse-off now than 2yrs ago?(tick one box). Ask respondent to explain answer. This should refer to respondent not the farm.

Much worse-off [ ]
Worse-off [ ]
No-different [ ]
Better-off [ ]
Much better-off [ ]

8. Future Plans: Do you plan to make any changes to the following? If yes, when?

		Yes/No	**When? Month & Year, if known**	**Details on changes to be made**
Production	Species			
	Farm area			
	Post-larvae (Stocking density, PL size, PL source)			
	Feeding (Supplier, feed type, brand, level, method, FCR)			
	Biosecurity (Pond lining, strings, others)			
	Aeration & Energy			
	Water Management (Water exchange, substances, probiotics, others)			
	Sludge management (Removal frequency, use)			
	Harvesting (Culture period, average harvest size, yield)			
	Environmental (Integration with bivalves, mangroves, palm oil, others)			
Marketing	Type of Buyer			
	Sales Contracting			
Investment	Number of farms to own			
	Business ownership			
	Land ownership			
	Farm infrastructure (Storage, fences, laboratory, others)			
	Vehicle			
	Others, specify			
Labour	No. of full-time workers			
	No. of part-time/ daily wage workers			
Certification				

END OF PHONE SURVEY

Appendix 6. Questionnaire for Face to Face Survey

Part 1. In-depth survey on-farm (Farmer/Manager)

Section 1. Survey Details

1.1. SurveyCD		
1.2. Interview Date	Phone:	Now:
1.3. Enumerator		
1.4. Respondent Full Name		
1.5. Farm RoleCD (manager, owner etc)		

Section 2. Labour information

2.1 During the culture period being referenced (2012)

		Household members	Relatives/ Friends	Full-time hired staff	Part-time HiredWorker
Men	MainTasksCD				
	WorkerNumbers				
	Mean hrs/day				
	TotalDays				
	PayBasisCD				
	Pay				
	Other benefit CD				
Women	MainTasksCD				
	WorkerNumbers				
	Mean hrs/day				
	TotalDays				
	PayBasisCD				
	Pay				
	Other benefit CD				
Children <15yr	**MainTasksCD**				
	WorkerNumbers				
	Mean hrs/day				
	TotalDays				
	PayBasisCD				
	Pay				
	Other benefit CD				

2.2 If any couples are jointly paid for work enter here & not in 1.1

		Household members	Relatives/ Friends	Full-time hired staff	Part-time HiredWorker
Couples	MainTasksCD				
	Worker numbers				
	Mean hrs/day				
	TotalDays				
	PayBasisCD				
	Pay				
	Other benefit CD				

2.3 Full-time staff with permanent on-farm accommodation

Total persons				
No of families/couples				
OriginCD				
MonthsOnFarm	**Max**		**Avg**	

2.4. What is the process of hiring your staff/workers? (Thai and migrant) Based on tasks, gender, age, qualification?

2.5 Which nationality do you prefer and why?

2.6 What are your specific migrant labour requirements? Why?

2.7 How important is the status of migrant worker registration vis-à-vis their opportunities to be hired, level of salaries & benefits, tenure, mobility, etc?

2.8 What are the contract arrangements (signed, tenure, other conditions) with:

2.8.1. Thai staff

2.8.2. Non-Thai staff

2.9 How do you secure that the migrant workers stay in your farm? (keep passport, more benefits, etc)

2.10 What do you think about individual payments for husband and wife rather than couple salaries?

2.11 What are the challenges you face in working with different types/levels of workers? Give examples - ***What are the challenges you face in working with different types of workers (nationality, gender, shrimp culture experience)***

2.12 What happens to your workers after leaving your farm?
(work in another shrimp farm in the same province or another province / work in factory / return to hometown or country / study / others specify)

Section 3. Children involvement in aquaculture

3.1 Farmer's children (<15 years of age)

Children SN	Gender	Child StatusCD (student, working)	Living with responden t? (Y/N)	Reasons for living arrangements & what respondent thinks about the living arrangement.	Would you like your children to be involved in farming of fish/ shrimp/ prawns (as relevant) in the future? Why?

3.2 Regarding families of workers: separately for Thai and migrant

a. Do the families (spouse, children) of workers come with them initially or do the families come later after they get the jobs?

b. What are the living arrangements with the families?

c. For migrant workers: What happens to their children born in Thailand? Welfare issues (education, health, etc)?

Section 4. Sustainability perceptions

4.1 What factors do you foresee that could positively or negatively affect your farms performance over the next 1-2 years?

Note: If the respondent is not the owner or the manager - the question should address the employee's perceptions of factor likely to influence his future with the enterprise.

*F*actors that could be either +ve or –ve (e.g. product price) should be entered in the 'uncertain' section.

4.2 Rank the specified factors in order of importance for the enterprise

4.3 What do you plan to do about the specified sustainability factors (leave blank if nothing).

4.4 Why are the factors different now from the first survey in 2010-2011?

	First Survey SusFactorCD	4.1 Sustainability FactorCD	4.2 OverallRank	4.3 ResponseCD	4.4 Reasons for different responses
Negative					
Positive					
Uncertain					

Ask respondent if we can interview one of their workers. If yes, go to Section 5 to ask the worker (next page) …

Part 2. FACE TO FACE SURVEY - SHRIMP FARM WORKER

Section 5. Worker's views

5.1. Background Information

Name			
Age			**M/F**
Origin			
Previous occupation		**Where?**	
How long working in this farm			

5.2 How did you come to work in this farm?

5.3 Why did you choose to work here?

5.4 What are your specific tasks in the farm? Working hours?

5.5 What are your terms of employment?
- **5.4.1 salary**
- **5.4.2 benefits – in kind, health, etc**
- **5.4.3 contract (verbal or written)**
- **5.4.4 worker's registration (if migrant) ID**
- **5.4.5 documents/passports**
- **5.4.6 leaves/holidays**
- **5.4.7 how is your interaction with your employer/supervisor?**

5.6 How did you learn the skills about aquaculture/shrimp farming? What are your opportunities to learn more?

5.7 Family
- **5.7.1 Is your family (spouse, children) with you since you started working in this farm or did they come later?**
- **5.7.2 What are the living arrangements with your family?**
- **5.7.3 Does your spouse also work in the farm? What tasks? If not, where?**
- **5.7.4 Household roles – What**
- **5.7.5 Education of children**
- **5.7.6 Children's future and would you like your children to be involved in farming fish or shrimp in the future?**

Gender of Child	**Number of children**	**Yes/No**	**Reasons for response**
Boy			
Girl			

5.8 What are the positive things you experience in your work here?
5.9 What are the constraints you face in your work here? What do you suggest to overcome them?
5.10 What are your plans for the future? Regarding work, family?
5.11 Are you better or worse-off now than 2 yrs ago? (tick one box). Why?

Much worse-off [ ]
Worse-off [ ]
No-different [ ]
Better-off [ ]
Much better-off [ ]
Reasons:

END OF FACE TO FACE SURVEY

Appendix 7. Checklist for Key Informant Interview on Migrant Labour in Shrimp Farms

FOR KEY INFORMANT INTERVIEWS: MIGRANT LABOUR IN AQUACULTURE IN THAILAND

In addition to the in-depth face to face interviews among selected farmers from the phone surveys, key informant interviews will be conducted among those working with migrant labour from the government, non-government and private sectors. The main objective is to obtain information on migrant labour issues related to mobility, security, networking and access. It is also aimed to obtain qualitative and quantitative information on the importance of migrant labour in the aquaculture industry in Thailand specifically for shrimp production, processing and export.

Face to face and KIIs will be conducted during the same period, as most of the local offices are located in the same provinces where the shrimp farms are located. Aside from the KIIs, secondary literature will also be a major source of information related to statistics, status, legal aspects and activities of various organisations working on migrant labour issues.

Potential KIs:

1. Department of Labour Protection and Welfare
   http://www.labour.go.th/en/index.php/home
   a. Surat, Chanthaburi, Chacheongsao
   b. Nakhon Pathom, Suphanburi
   c. Samut Sakhon
2. Department of Fisheries – eg Dr Siri E?
3. National Council for Child and Youth Development (NCYD)
4. NGOs in the ground:
   a. Raks Thai
   b. Labour Protection Network (LPN) –Samut Sakhon
5. Thai Frozen Foods Association (TFFA)
6. Thai Food Processors’ Association (TFPA)
7. Employers’ Confederation of Thailand (ECOT)
8. Local shrimp clubs
9. Local KIs – tambon and village level
10. Experts in migration, gender issues (Dr Babette, Dr Kyoko, Mahidol Migration Center, etc)

SUSTAINING ETHICAL AQUACULTURE TRADE

KEY INFORMANT INTERVIEW ON MIGRANT LABOUR FOR AQUACULTURE IN THAILAND

KII-CD:	Date:
Name:	
Designation:	
Organisation:	
Address:	
Tel.	Email address:
KII conducted by:	Venue:

Guide questions to key informant interviews (refer always to male, female, boy, girl):

A. General information

1. How many migrant workers (male, female) from each country are working in this area (specify the district)? Rank based on number if more than 1.
2. What are the ages of migrant workers?
3. What are the characteristics (+/-) of a particular migrant group?

B. Movement/accessibility

1. Why do the migrant workers come to this area rather than another area?
2. How do the migrant workers come to this area from their countries? (pathway in terms of movement)

C. Recruitment

1. How do the migrant workers find jobs in aquaculture? (pathway in terms of access to jobs)
2. What is the process of hiring migrant workers for aquaculture?
3. What are the roles of formal and informal networks (links between existing workers and original communities) in recruitment from source and within country?
4. How do the migrant workers decide on which job to take and where?
5. Why do farmers in this area (specify district) hire this migrant group rather than another group?
6. What are the specific migrant labour requirements of the farms according to their scale of operation?

D. At work/farm

1. What salaries & benefits do migrant workers receive from their jobs? Living conditions?
2. Are there specific tasks and living conditions allotted to certain types (origin, skills level, marital status, gender, language) of workers?
3. What are the contract arrangements and agreements between employers and migrant workers?
4. What are cultural/ethnicity/attitudinal factors which both employers and migrant workers face? Or have to overcome to work efficiently?

5. How does ethnicity affect Thai employers/workers' attitudes in interacting / relating with migrant workers? Vice versa?
6. What are the constraints faced by Thai employers, Thai workers and migrant workers in working together in the farms?
7. Examples on how they positively & negatively work together

E. Social/legal

2. How important is the status of migrant workers' registration vis-à-vis their opportunities to be hired, salaries, benefits, tenure, mobility…?
3. Regarding families of migrant workers:
    a. Do the families (spouse, children) of migrant workers come with them initially or do the families come later after they get the jobs?
    b. What are the living arrangements with the families?
    c. What happens to their children born in Thailand? Welfare issues?
    d. Do their sons and/or daughters eventually work in aquaculture and related occupations? Why?
4. How does ethnicity affect people's attitudes in interacting / relating with migrant workers? Vice versa?
5. Is criminalization in the aquaculture migrant labour community common? Why?
6. Why are migrant workers vulnerable to criminalization?
7. What type of protection (legal, social, economic etc) is provided to migrant workers?
8. Who provides protection (specify type) to migrant workers?

F. Access to skills development and other opportunities:

1. How varied are the skill levels of the migrant workers, specific to aquaculture?
2. What opportunities do they have to develop and/or improve their skills in aquaculture? In other fields?
3. What access do they have to avail of these opportunities?
4. What are their attitudes towards developing and/or improving their skills?

G. Additional information: