The Current Situation and Issues with the Shrimp Farming Industry in Vietnam: Management Improvement of the Shrimp Farming in the Mekong Delta

（ベトナムにおけるエビ養殖産業の経営改善に関する研究）

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Sincerely yours,

Author:

NGUYEN THI KIM QUYEN

DECLARATION

This dissertation is the result of my own works and research with the collaboration of advisor, vice-advisors and staff at Kagoshima University, as well as interviews performed at points of data gathering throughout Vietnam between 2017 and 2020. This dissertation has not been previously submitted, in part or whole, to any university of institution for any degree, diploma, or other qualification.

This paper is of 43,442 words, 31 Tables and 49 Figures

Signed:_____

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SUMMARY/ABSTRACT

Title: The current Situation and Issues with the Shrimp Farming Industry in Vietnam: Management Improvement for the Mekong Delta

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Vietnamese shrimp farming contributes great export value for the country. When international demand on shrimp products has increased continuously, farmers expanded intensive system of White Leg Shrimp that has leaded to disease outbreak and port rejections due to quality violation. Many farmers are applying VietGAP certification; the remaining farmers still cultivate shrimp without GAP. The dissertation was conducted aims to objectives: (1) to clarify the current situations of VietGAP in disease control; (2) to clarify the situation of VietGAP in quality and food safety management; and (3) to propose solutions for better management of small-scale shrimp industry for the Mekong Delta.

Regarding (1), a study was conducted by taking a mass survey to 50 shrimp farmers in VietGAP system and 50 farmers in non-GAP system. The result shows that farmers in VietGAP system practiced rather well some control points of disease management, exception for sludge deposal and less disease reporting to the managers. By the way, fewer farmers reported diseases with lower profit damage than farmers in non-GAP system.

The study aims to accomplish with (2) was carried out via interview with 100 key shrimp farmers in VietGAP and non-GAP applied systems. Talking briefly to the result, farmers

in VietGAP system have good controls quality than farmers in non-GAP system. Several control points need to be improved such as quality of seeds, frequency of sludge removal and pond design. Shrimps produced according to VietGAP had little quality rejection. But no

price premium and little certification awarded are still challenges of VietGAP.

Regarding (3), a case study was conducted at Hoa Nghia cooperative – the first ASC certified shrimp cooperative in the MD. The cooperative has pursued VietGAP in 2014 and ASC in 2017. The auditing process was supported by World Wide Fund for Nature - Vietnam (WWF-VN) with the participation of processing company, international buyer, local authorities, and independent certifier. The certified process costed $0.22US/kg, and auditing cost paid by processing company. Farmers can get a premium price of $0.17US/kg regulated in farm contract and but farmers can break the contracts easily.

In conclusion, VietGAP has shown its meaning in disease control and quality improvement but low economic benefit. Therefore, ASC was proposed for substituting. A three-step roadmap was given by authors to improve the management of the shrimp farming in the MD, i.e re-structuring small-scale shrimp farming by cooperative/cluster (step 1); training and applying VietGAP (step 2); and upgrading ASC (step 3). This route needs actions from all related stakeholders and organizations, especially horizontal collaboration among farmers and vertical collaboration among various stakeholders and support organizations.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

$: Dollar (currency)

ASC: Aquaculture Stewardship Council

BAP: Best Aquaculture Practice

BMP: Best Manufacture Practice

CAB: Conformity Assessment Body

CMB: Cooperative Management Board

CoC: Chain of Custody

CRSD: Project of Coastal Resources & Sustainable Development

DARD: Department of Agriculture and Rural Development

DoF: Department of Fisheries

EIA: Environmental Impact Assessment

EMS: Early Mortality Syndrome

EU: European Union

FAO: Food and Agriculture Organization

FCR: Feed Conversion Ratio

GAP: Good Aquaculture Practice

GMO: Genetically Modified Organism

Ha: hectare(s)

HACCP: Hazard Analysis and Critical Control Points

HNC: Hoa Nghia (Hòa Nghĩa) Cooperative

ICAFIS: International Collaborating Centre for Aquaculture and Fisheries Sustainability

KIP: Key Informant Panel

MARD: Ministry of Agriculture and Rural Development

MD: Mekong Delta

MSC: Marine Stewardship Council

MT: Metric Ton

NAFIQACEN*:* National Fisheries Inspection and Quality Centre

NAFIQAD: National Agro-Forestry-Fisheries Quality Assurance Department

NGOs: Non-government Organizations

PAD: Pangasius Aquaculture Dialogue

PCR: Polymerase Chain Reaction

PLs: Post Larvae

SIA: Social Impact Assessment

TSV: Taura Syndrome Virus

US: The United States

USA: The United State of America

VASEP: Vietnam Association of Seafood Exports and Processors

VND: Vietnam Dong (currency)

WSSV: White Spot Syndrome Virus

WWF: World Wild Fund for Nature

YHV: Yellow Head Virus

Chapter I

INTRODUCTION

Summary

This chapter gives the information on introduction of the dissertation, including background, research rationale, research questions, objectives and limitation. The chapter is come firstly with background information which explains in detail the importance of aquaculture and capture sector in scales of globe, nation and region. More detail information on shrimp farming was illustrated in the section. It is followed by problem statement, which accentuate current situation of shrimp industry in Vietnam and Mekong Delta (MD). These are divided into two problems to the shrimp farming that need to be managed better; these are disease outbreaks and quality control. Next subtitle is research questions in accompany to objectives which set the pace to explains what goals are. Limitation of the study also gives the focus of the research and explains why several contents of the thesis could not be included. Finally, the part "outline of the thesis" points out a comprehensive structure of the dissertation, hence, readers can follow more easily.

1. Background

Vietnam has over one million hectare (ha) of water surface with 3,200 km of coastline and more than 4 thousand different sizes of island. This characteristic has created great potential for aquaculture and fisheries production. Since capture fisheries has

declined from 2000s, aquaculture is considered as a multi-billion-dollar industry that brings a major source of foreign currency of the country (Bosma & Verdegem, 2011; Huysveld, et al., 2013). An increasing production of aquaculture in the recent years is a clear evidence for the dominant role of the sector. In 2010, the figure got 148.50 million metric tons (MT), accounting for 38% of total fisheries production (including capture amount) traded internationally. In 2018, total aquaculture production covered 4.15 million MT with an area of 1.30 million ha, brought total exported value of nearly 6.7 billion United State (US) Dollar ($) (VASEP, 2019).

In considering structure of aquaculture industry, shrimp product is a main aquaculture species of aquaculture industry in both volume and value terms apart from *Pangasius* catfish. The shrimp production has increased continuously since white leg shrimp was introduced to Vietnam in 2000s (General Statistic Organization, 2015). The production of shrimp was 47.12 thousand MT in 1995, increasing to 449.7 thousand MT in 2010 and to 762 thousand MT in 2018 (VASEP, 2019). Vietnamese shrimp product has been exported to more than 95 countries and continents in the world. More than seven billion people worldwide are consuming Vietnamese shrimp products. Of which, the United States of America (USA), Japan, European Union (EU) and China are main markets for such a product (General Statistic Organization, 2015).

The shrimp farming systems and exportable species are diversified according to national geographical and climate conditions. Therefore, Vietnam has promoted aquaculture to comply with export markets (Nhuong, et al., 2013). The MD is in the southern area of Vietnam with area covering 12% of the total area of the country. The Delta

possesses more than 93% of the total shrimp farming area and shares over 82% of the total shrimp production of the country (Anh, et al., 2010). Shrimp farming in the MD started at the end of the 1990s and diversifies in terms of farming levels. Of which, intensive shrimp farming occupied 5.6%; semi-intensive and advanced extensive farming model shared 35.9% of the total production; the corresponding numbers for organic extensive farming and alternative rice-shrimp farming model were 30.5% and 28% respectively (Vietnam Institute of Fishery Economics & Planing, 2015).

With the remarkable economic achievement, large number of farmers who engaged in shrimp industry has increased significantly. The circumstance has leaded to an accomplishment through mobilization of hundreds of thousands of small-scale producers. There has been no satisfactory definition for small-scale aquaculture. A workshop in Nha Trang, Vietnam organized by Food Agricultural Organization (FAO) in 2010, agreed the definition of small-scale aquaculture with characteristics as followed: (1) Including limited investment in assets with several small investment in operational cost; largely family labor use and of aquaculture is just one of economic activities; (2) Systems in which aquaculture is the principal source of livelihood, in which the operator has invested substantial livelihood assets in terms of time, labor, infrastructure and capital; (3) Ownership, or access, an aquatic resource by family or community with relatively small size of landholding (Edwards, 2010). Regarding shrimp aquaculture farmers in Vietnam, in 2006, approximate 330,000 households operated shrimp farming, in which, 79,600 households practiced intensive/semi – intensive system (General Statistics Organization, 2007). An average production area of such model per household was only 0.7 ha. Thus, shrimp production in

Vietnam is dominated by small-scale holders with sector contributed more than 80% of total production (Nhuong, et al., 2013; Suzuki & Vu, 2017).

2. Exploration of the Problems

The rapid development of shrimp industry that has mentioned above accompanied with several challenges. Several previous major studies have shown these challenges as following (Chanratchakool & Phillips, 2002; Loc, 2006; Suzuki & Vu, 2017):

① Due to the high participation of farmers in shrimp industry, the supply does not meet the demand requirements at the certain place and time. In another words, unbalancing markets, including **uncertain market price** is a big challenge for shrimp farmer to deal with.

② Dramatic decrease in productivity in some traditional farming systems, especially extensive farming region due to low and fogy technology. The problem also was presented by high production cost that made of lack **of credit for investment of the poor**.

③ The boom of intensive farming, especially white leg shrimp has led to **disease outbreaks** as well as water environment.

④ **Technical and trading barriers in import countries.**

⑤ Lack of effective method to comply with **international standard requirement for food safe and quality requirement.**

Among problems mentioned above, disease outbreaks and quality control to comply with international customers` need have been vital and urgent problems as they are correlative (Suzuki & Vu, 2017). Black tiger shrimp *(Penaeus monodon)* was dominant in

the earlier decade of 2000s before promoting of white leg shrimp *(Littopenaeus vannamei)*. Unfortunately, the rapid growth of shrimp farming led to the bloom of disease outbreak (Li, et al., 2016), which has increased debt or economic risks and slowed down the incomes and harvest failure. During the past years between 1994 and 1999, the number of unsuccessful shrimp farms increased more than 200%, but World Bank reported that disease resulted in loss of 28 - $50 US million for the MD in 1994. As an unexpected result of shrimp culture, farmers tend to abandon their farm (Chanratchakool & Phillips, 2002; Thuy & Ford, 2010; Loc, 2006). Key diseases resulted economic failure include Red body disease (caused by Taura syndrome virus, TSV); white spot disease (caused by white spot syndrome virus, WSSV); Early Mortality Syndrome disease (EMS), the latter possibly caused by a phage-encoded toxin produced by Vibrio parahaemolyticus; and yellow head virus (YHV) (Li, et al., 2016). Farmers, therefore, are seeking new disease control for farming practices when they have considered that farming practices contributed to disease outbreaks, including inappropriate stocking management, overfeeding, environmental/water conditions, use of variety of chemicals including antibiotic that may subsequently accumulate in the cultured shrimp and negatively affecting the aquatic environment (Sapkota, et al., 2008). However, there are little information on current farmers' practices and education on disease management control measures. In another word, the appropriate farming practices to disease management for shrimp farming have not been fully identified and understood (Bryand, et al., 2006).

Additionally, to treat disease in shrimp farming, the overuse and misuse of chemicals/drugs, especially banned antibiotic, allowed problems of quality raise (Suzuki & Vu, 2017). Whereas Vietnamese shrimp commodities are mainly consumed worldwide

since production supply is overwhelming domestic demand. Vietnam has ranked as the sixth largest providers of seafood globally (Nhuong, et al., 2013). International seafood customers, due to the globalization together with the increasing of awareness on the nutritional advantages of consumption, their rights and expectation have been expanded in imported seafood commodities. The shrimp industry is, therefore vulnerable to increasing stringency of technical barriers and standards internationally because production practices and establishing a chain of custody for shrimp is very difficult due to the large number of small-scale producers and traders involved (Sebastian, 2009). This driven has affected on Vietnamese fishery products clearly. As can be seen from the Figure 1.1, the Vietnamese aquatic products had high ratio of port rejection due to problem of quality (Suzuki & Vu, 2017; UNIDO & IDE, 2013).

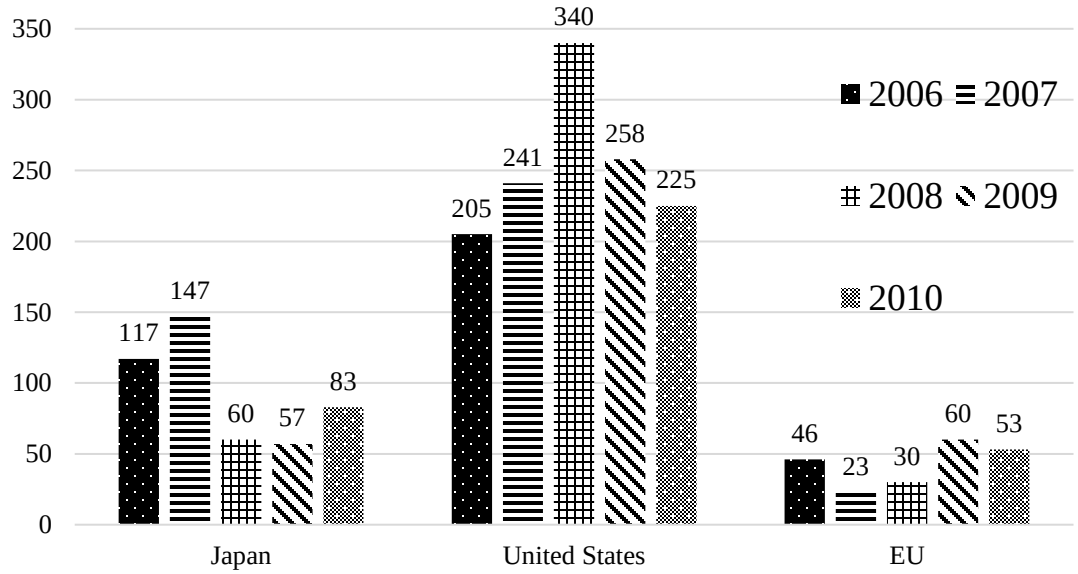


Figure 1.1 – Number of Rejections for Vietnamese Fishery Products

(Source: UNIDO IDE, 2013)

Table 1.1 – Reason for Rejection of Vietnamese Fishery Products in Selected Markets

Reasons	US	EU	Japan
Bacterial contamination	**961**	**127**	**145**
Other contaminants	209	24	1
Additives	120	33	32
Pesticide residues	**0**	**4**	**50**
Adulteration/missing document	103	7	0
Hygienic condition/controls	**981**	**20**	**23**
Mycotoxins	-	0	7
Packaging	0	2	2
Veterinary drugs residues	**170**	**172**	**297**
Labelling	349	2	0
Heavy metals	0	61	0
Others	21	32	6
Total	**2,914**	**484**	**563**

(Source: UNIDO IDE, 2013)

A detailed look at reasons for rejections across these markets reveals that bacterial contamination, pesticide residues, hygienic condition/controls, and veterinary drugs residues are the most common reasons (Table 1.1). Of which, three out of four reasons arise at the production stage. It shows that the detected veterinary drugs and pesticide

residues, especially antibiotics, might be not well controlled in production. That makes the residues be found in the shrimp's body parts such as tail and hepatopancreas (UNIDO & IDE, 2013). Contamination from various types of bacterial or other contaminants may be present throughout production stage and after harvesting. It seems that the feasible solution is to change actual practices at the farm site.

Actually, the shrimp farmers in the MD has awarded of this situation, since they have received continuously warnings from importers about the quality violations. A part of farmers therefore has sought new ways that not only deal with disease outbreaks, but also reduce usage of chemicals/drugs to improve the quality of shrimp products. While the others still practice intensive farming due to high economic returns (Suzuki & Vu, 2017). It seems to be that solution for problems of diseases and quality is investigation and changes the farming practices in shrimp production stage. In other words, the appropriate farming practices for disease management have not fully identified or understood by farmers (Bryand, et al., 2006).

Thus, certification schemes specific to aquaculture have developed and emerged over the last decade (Belton, et al., 2011). Certification standards are mostly a set of criteria developed by private organizations and non-government organizations (NGOs) (De Silva & Phuong, 2011). Certification is a market driven tool that provides guarantees related to quality, safety, environmental impacts, social responsibility, traceability and transparency of production processes. Mohan (2013) indicated that the popular aquaculture certification standards promoted by NGOs and industrial organizations such as Aquaculture Stewardship Council (ASC), Global Good Aquaculture Practice (GlobalGAP) and Best

Aquaculture Practice (BAP) are designed to improve social and environmental performance of global aquaculture production (Mohan, 2013).

In Vietnam, particularly, some researches in relation to fisheries quality chains were conducted. They focused on a growing customer demand for stable and high-quality products. Manufacturers and traders have no choice but to make good products and to control product quality. But hazards are still not free from fisheries products because there are many quality problems occurred in the entire fisheries supply chains. These problems affect product quality and value chain added of each stage of the supply value chain system that needs to be solved. To meet the growing sustainability expectations of these export markets, Vietnam has made several steps towards certification; firstly with the Vietnamese Good Aquaculture Practice (VietGAP) standards that were developed, promoted and considered a stepping stone towards compliance to internationally recognized standards such as the ASC, GlobalGAP and BAP (Khoi, 2011). Actually, a number of shrimp farmers have cultured shrimp according to VietGAP, while others still practice intensive farming without any certification (Quyen, et al., 2019). Actually, the number of shrimp farmers who have given up VietGAP is increasing notwithstanding efforts of functional branches to maintain the certification. There are many reasons behind that issue. One of these is the high cost without high return. It means that the meanings of certifications in terms of disease control and quality improvement were ignored. In other words, the appropriate farming practices for disease control and quality management in the VietGAP system have become worrisome or not fully understood by farmers (Bryand, et al., 2006). There is a need to conduct further studies aiming to find out the solutions for fisheries sustainable development, economic growth, and food security.

3. Research Questions and Objectives

This study focused on small-scale aquaculture, the largest group of aquaculture farmers and major contributors to the production. To understand reasons why Vietnamese shrimp commodities have faced with many challenges in farming practices as well as effort to improve management of the industry through improvement of disease control and quality management by applying aquaculture certifications such as VietGAP and ASC latterly, a general research question has offered as follow:

How do farmers manage their small-scale shrimp farming systems in the MD?

Particularly, sub-questions involve three-folds:

① *What are current situations of disease control of shrimp reported by farmers in VietGAP and non-GAP applied systems?*

② *How do they control quality of shrimp in different farming applied systems in the MD?*

③ *How to improve the management of small-scale shrimp farming in the MD?*

With the goal to answer these questions, a general objective was:

The study aims to give the solutions for better management of small-scale shrimp farming systems in the MD.

Corresponding specific objectives involve:

① *To clarify the current situations of disease outbreak of shrimp products reported by shrimp farmers.*

② *To investigate the situation of quality management of shrimp products during farming.*

③ *To propose solutions for better management of small-scale shrimp industry in the MD.*

4. Limitations of the Study

There are some limitations in the study due to short period of survey in the host country. The first survey was conducted in April 2018 and second field survey in March 2019, and the case study was done shortly in August, 2019. Two field surveys and the case study were short time for the field work. The study is limited to several provinces, some farming models in the MD as well as small-scale shrimp farming holders. The study was limited by special location characteristics at study site.

The geographical scope of the study site was some prefectures in the aquaculture zone along the MD. The stakeholder groups had high level of dispersion over the region and intricate system of rivers also prevented to access stakeholders hence inability to gather enough eligible individuals to be involved in the interviews. To what extent, respondents were not very high representative for the whole region and whole sector. Most of shrimp farmers do not have a written track record for their daily production. The socio-economic studies are usually obtained by drawing and sharing on the local perceptions of respondents. Thus their answers based on memories and estimates that might make high deviation.

The study focused on primary production at farm level and does not deal with other actors of the shrimp industry. Although quality problem could be come mainly from production stage, other nodes such as feed and chemical providers, seed traders, middlemen and processing companies could intercede to the process by contaminating products. Further study could focus on whole chain management for the enhancement and successful shrimp industry.

5. Outline of the Thesis

The thesis is organized scientifically and logically as academic reports and researches usually show them. There are four kinds of contents that will be displayed in the dissertation: introductory and explanation section, main section and appendix.

① Part 1: Introductory and Explanation Section

Additional section includes supplement parts that display author's attitude and make it easy for the audiences to follow the manuscript. Cover page appears the first which shows title of the thesis, author's name and affiliation as well as the information on parent education school. Next pages illustrate the additional parts. These are listed as Acknowledgement; Declaration; Summary; Table of content; List of Table; List of Figures; List of Abbreviations. These parts are organized in order with the purpose to make the thesis being more observable.

② Part 2: Main Content

This section is organized by chapters which essential components constitute to main body of the thesis (Figure 1.2). Each chapter represents for one major section and study. Chapter I provides introductory statement, which is followed by Chapter II of Aquaculture and Shrimp Farming Study Context. Chapter III looks at the Literature Review from secondary data, including related publications on current situations and management shrimp industry. The Chapter IV shows the key finding of a study on disease control by making comparison between VietGAP and non-GAP shrimp farming systems. Chapter V was conducted at the similar maner but focusing on quality management. Afterthat, a evaluation on achievements and problems of VietGAP to shrimp farming will be shown in Chapter VI. In order to deal with problem of VG, a case study on ASC scheme will be presented in Chapter VII as an alternative option. And Chapter VIII is the final conclusion and recommendations of the dissertation.

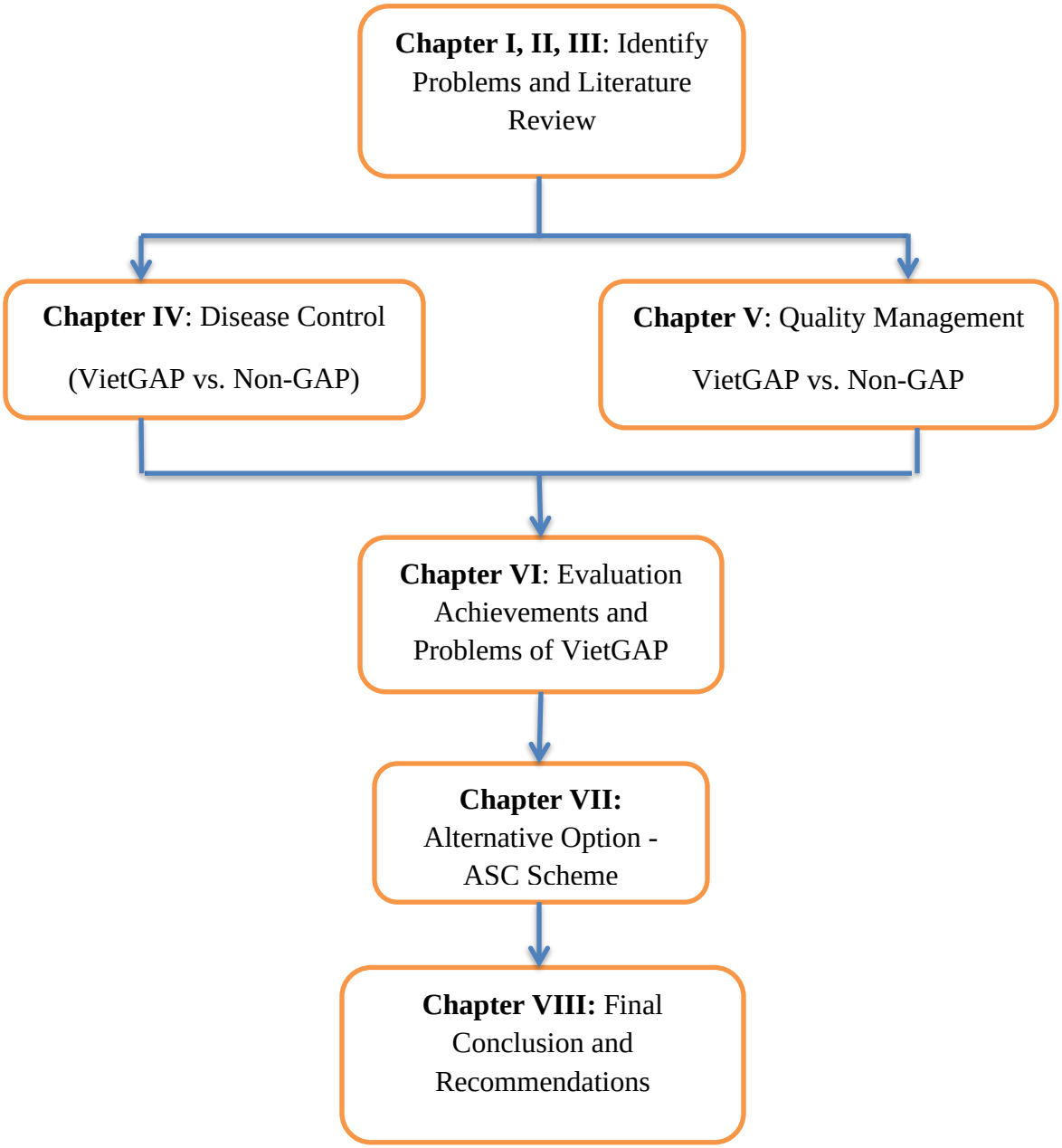


Figure 1.2 – Research Framework Presents for Dissertation Structure by Chapters

(Source: Author, 2020)

③ Part 3: Additional and Extra Documents

The thesis is generally finished in part two, immediately ending Chapter VIII. Part three involves references of the thesis, which gives all detail explanation of the citations. The final section is Appendices, which are findings of data processing ultimate in the thesis but being too long for showing in the body text; or secondary data and other documents that serve for the study but do not appear in any section, i.e. questionnaires, checklists, official legislations, governmental decisions, etc.

Chapter II

AQUACULTURE AND SHRIMP FARMING CONTEXT

Summary

The chapter aimed to provide general picture of Vietnamese aquaculture development in general, shrimp aquaculture in detail. The similar information on aquaculture and shrimp industry in the MD, main region of the industry, also would be provided. Issues related to shrimp industry such as socio-economic conditions, exports and markets, labor use in aquaculture, characteristics of small-scale farming, administrative mechanism, etc. would be explained to present the development as well as the vital role of Vietnamese shrimp products in the world fish market. Generally, aquaculture and shrimp industry plays a vital role to Vietnamese economy either volume or value. It brings a major export value thanks to exporting over 90 countries worldwide. The shrimp industry has developed continuously since 1980s. Diversification in species and farming systems provides livelihood for hundred thousand people, especially for the MD.

1. Aquaculture and Fisheries Industry in Vietnam

1.1 Aquaculture Production and Area

Vietnam is a tropical country where agriculture (rice cultivation) and fisheries plays a vital role for the economy. With the special location of longline of coastal and hundreds islands being different sizes, great potentials for aquaculture and fisheries are provided for residents and economy. The total aquatic output grew by over 2.2 times during the 1985-1999 periods, of which, production of aquaculture increased by over 2.6 times during this

period. In the years of 2000s, seafood output increased significantly whereas marine catch production still dominated aquaculture (Figure 2.1). Specifically, both marine catch and aquaculture strongly developed in recent years – from 2,003 MT in 2000 up to 5,126 thousand MT in 2010 and 7,743 thousand MT in 201, respectively (General Statistics Organization, 2017; VASEP, 2019). Aquaculture output accounted for nearly 50% in average of the marine catch output in the period of 1985-1999. From 2000, the growth rate of aquaculture output was over 65% of caught output between the years 2001-2002. According to the 5-year plan 2001-2005, the indicator of aquaculture volume was equal to marine catch.

Vietnam has a long coastline of over 3,200 km and more than 3,000 islands together with wide and wealth of wetland water bodies, especially dense network of lakes, canals, rivers and seasonal flooded water base. Water surface area was approximately 1.7 million ha and expected to increase by government experts. The devoted area to breeding and rearing of aquatic products rose from 385 thousand ha (1986) to 642 thousand ha (2000), 1,053 thousand ha in 2010 and 1,300 thousand ha in 2018 (General Statistics Organization, 2017; VASEP, 2019). The figure although has lightly cropped in ratio of growth but still has kept increase. The reasons for these expansions are (1) promoted policies related to fisheries development in terms of production and export of the Vietnamese government, (2) increase of seafood demand in the world, and (3) natural potential exploration thoroughly, especially natural grow areas in the MD.

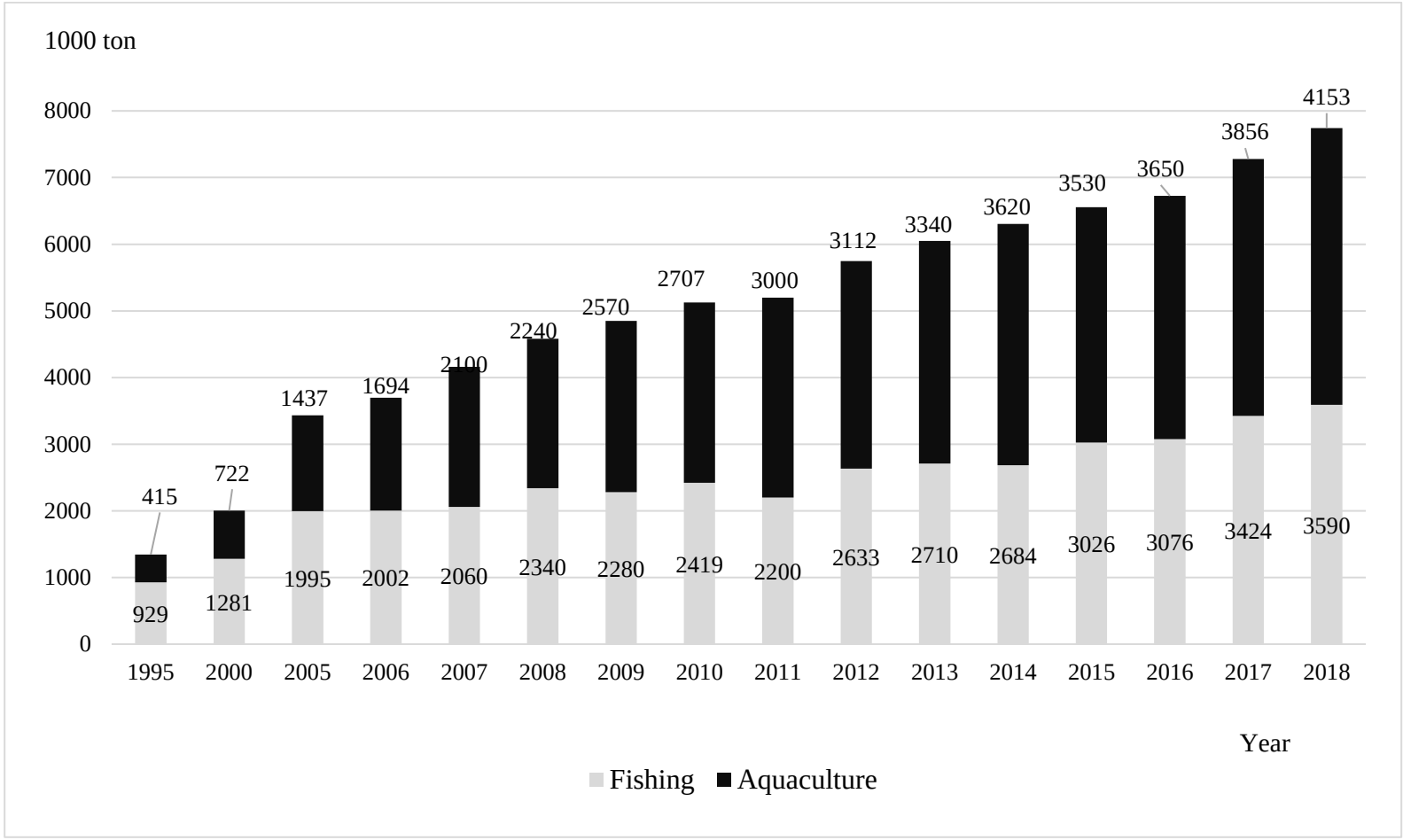


Figure 2.1 – Vietnamese Aquaculture and Capture Production from 2000- 2018

(Source: General Statistic Organization, 2018; VASEP, 2019)

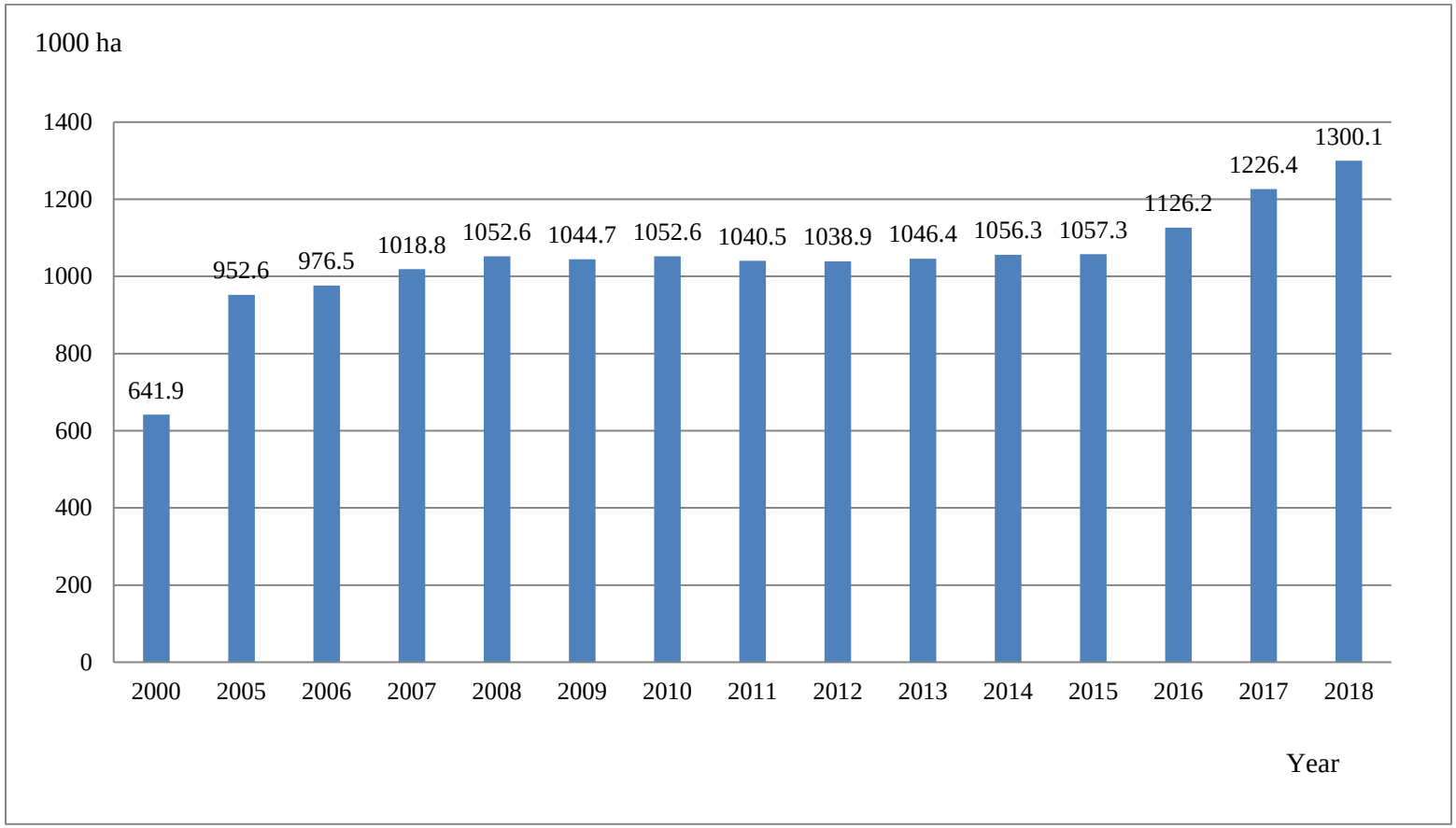


Figure 2.2 – Aquaculture Area from 2000 – 2018 (1,000 ha)

(Source: General Statistic Organization, 2017; VASEP, 2019)

1.2 Export Value and International Markets

Vietnamese seafood export has remarkable developed within the past 20 years. Vietnam is one of three key countries providing seafood products for global customers, apart from China and India (Khoi, 2011). In the list of top ten aquaculture producers in terms of volume ranked by FAO from 2004 to 2016, Vietnam always ranks from the first place to the fourth place during the period. Remarkably, from the years of 2005, the export value increased steadily from 2,739 million to $7,922 million US in 2014 thanks to the significant increase of aquaculture. The figure after that decreased slightly in 2015, but recovering at the following years and reaching a pick at 8,316 million USD in 2017. Although there was a strong fluctuation in growth rate of export value, the average figure is 15.6%/year and is expected to increase the future (Figure 2.3).

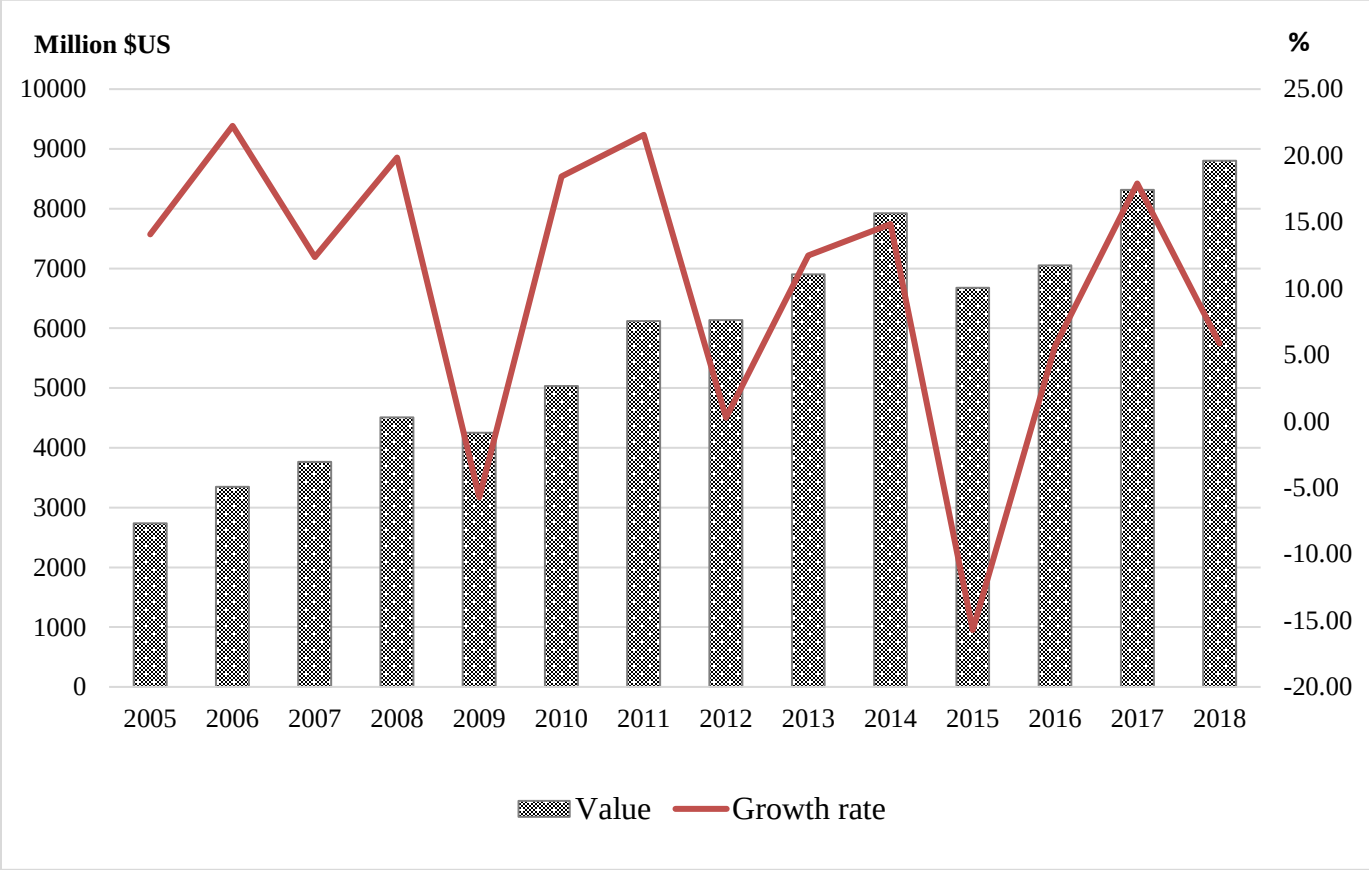


Figure 2.3 – Seafood Export Value (Million $US) and Growth Rate (%) (2005 – 2018)

(Source: General Statistic Organization, 2017, VASEP, 2019)

In 2005, Vietnamese aquaculture and fisheries products were exported to 86 countries and continents worldwide. Until 2017, 167 countries and continents imported Vietnamese fish food (VASEP, 2019). This industry brought foreign currency of 6 to $7 billion US per year. Considering to processing capacity, until June 2017, more than 600 companies and enterprises reached the conditions in terms of food hygiene and safety for export (NAFIQAD, 2017). Shrimp and catfish are key exported products which constituted more than 70% of production (Figure 2.4). Specifically, shrimp sector contributes roughly 40 to 45% of the total export value, equivalent to $3.5 to 4 billion US per year. In 2017, the export value was $3.13 billion US, 7% higher than that figure in 2015. Vietnamese seafood products rank third in terms of international producers (after China and India). With the non-stop effort, shrimp products have been exported to 100 countries and continents worldwide. Vietnam is also the largest shrimp supplier for Japan, the third for America and the fourth for EU. Globally, Vietnamese shrimp products is the top second suppliers in the world shrimp markets, equivalent to 13 – 14% in the total value of the world (VASEP, 2019).

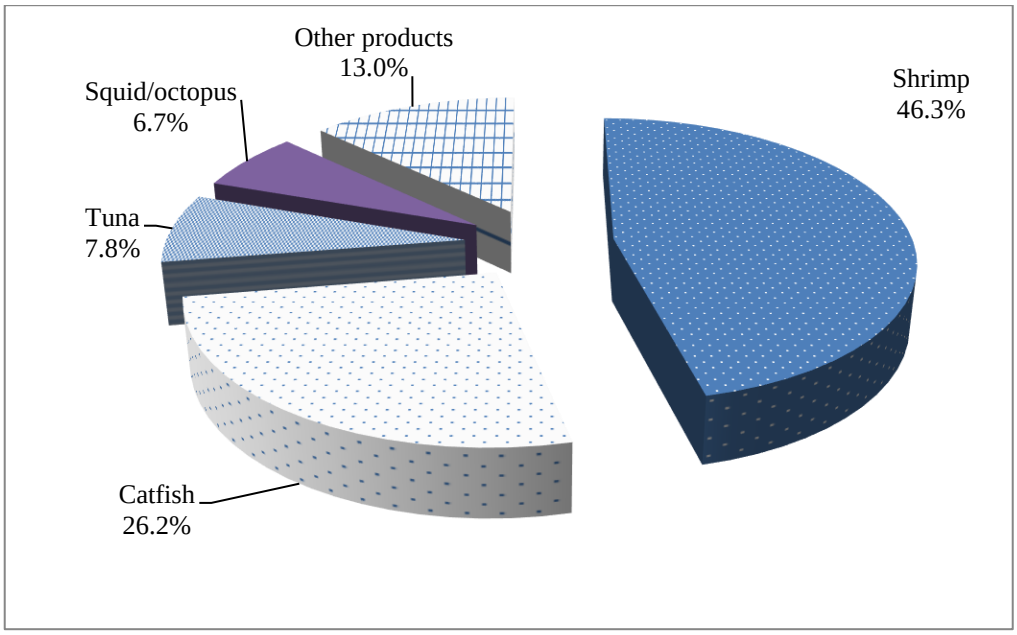


Figure 2.4 – Export Structure by Fisheries Products in 2016

(Source: General Statistic Organization, 2017)

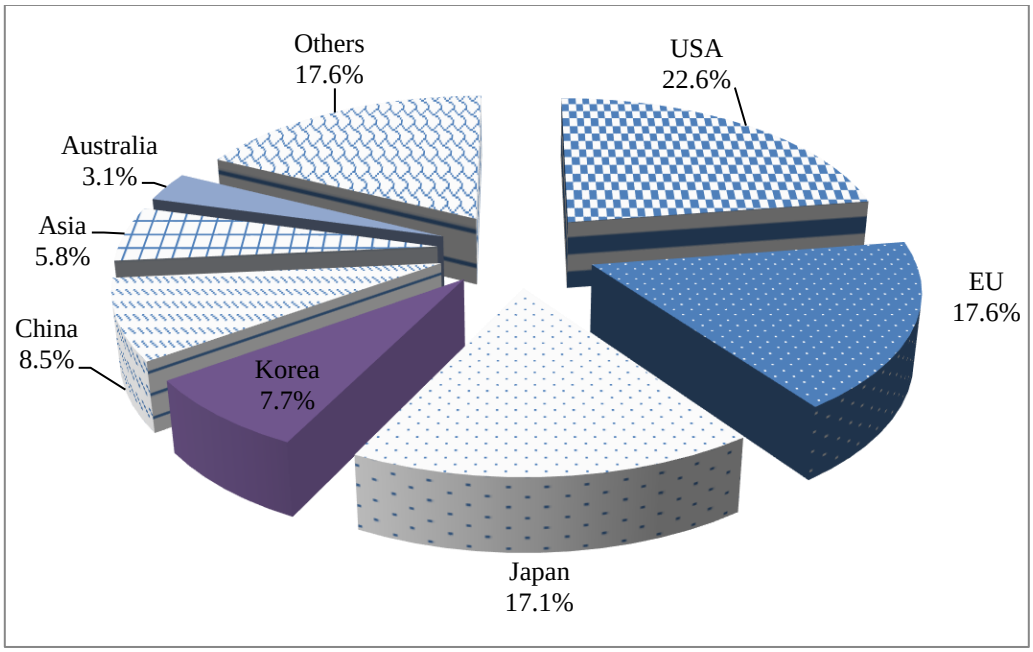


Figure 2.5 – Export Markets of Vietnamese Fisheries Products by Value in 2012

(Source: General Statistic Organization, 2015)

2. Shrimp Sector in Vietnam

2.1 History of Shrimp Farming

Shrimp farming activity in Vietnam has a stretch and long history with over 100 years ago in the MD, a significant area for aquaculture of the country. Commercial shrimp farming was beginning with the collection of natural shrimp seed for rearing into paddy fields with in the decade of 1970s in the North of Vietnam. As high economic return that shrimp culture brought to the farmers, people tended to commercial farming tiger shrimp in the central with in the period of 1980s. There were two traditional shrimp farming systems dominated in the MD at that time including mangrove – shrimp farming and improved extensive farming (Wilder & Phuong, 2002). From 1990s, shrimp culture developed significantly in the coastal area of the MD with mainly improved extensive system. The industry after that developed rapidly that pushed development of seed production of native shrimp in the MD. After 2000, the MD has contributed more than 80% in terms of area and production of the country, and remaining its importance until present time (AMDI & DAI, 2016).

Table 2.1 – History of Shrimp Farming – Shrimp Species

Time lines	Events	Places
1970s	The first trials in marine shrimp seed production	The North
1984 - 1985	*P. Monodon*: successful production; rapid development; high production export	The Central
1988	Seed production of native shrimp species	The MD
1997	Conversion to *P. Monodon*	The MD
2000	*P. vannamei* was introduced to Vietnam	The Central
2007	*P. vannamei* has been popular	The MD
Present	Balancing between *P. Monodon* and *P. vannamei* Super intensive farming model International quality certification	The MD

(Source: Developed by Author, 2019)

2.2 Shrimp Farming Area and Production

Vietnamese shrimp farming covers more than 600 thousand ha of surface water with two key species of Black Tiger Shrimp and White Leg Shrimp. The shrimp farming area increases steadily over the past 12 years, from 528.3 thousand ha in 2005 to 736.2 thousand ha in 2018, and increased by 3.8% compared to 2017 (VASEP, 2019).

Accompanied to the expansion of farming area, shrimp yield increased dramatically from the year of 2000, with the growth rate of yield witnessed an outstanding, double showing within the same period (Figure 2.6).

Black Tiger Shrimp in Vietnam is leading producer in the world, with a stable area ranging 600 thousand ha, and 300,000 MT per year (Figure 2.7 & Figure 2.8). In 2017, the farming area of this species was 622,400 ha, 3.7% higher than that figure in 2016. This is the conventional species in many past years. Regarding White Leg Shrimp, this species has been cultured in different provinces since 2008. However, the yield of White Leg Shrimp has increased remarkably within almost 10 years, with the figure up to 427,000 MT in 2017, increasing 8.5% in comparison to 2016. The notable growth of White Leg Shrimp yield comes from special models of the species. White Leg Shrimp is almost cultivated in intensive or super intensive models that Post Larvae (PL) could be stocked at very high density. That is a reason why high yield of shrimp could be generated over a small farming area. As the remarkable economic returns of intensive farming of White Leg Shrimp, number of farmers engaged in such model has increased significantly, that made up the conspicuous growth in shrimp yield at recent years (Quyen, et al., 2019).

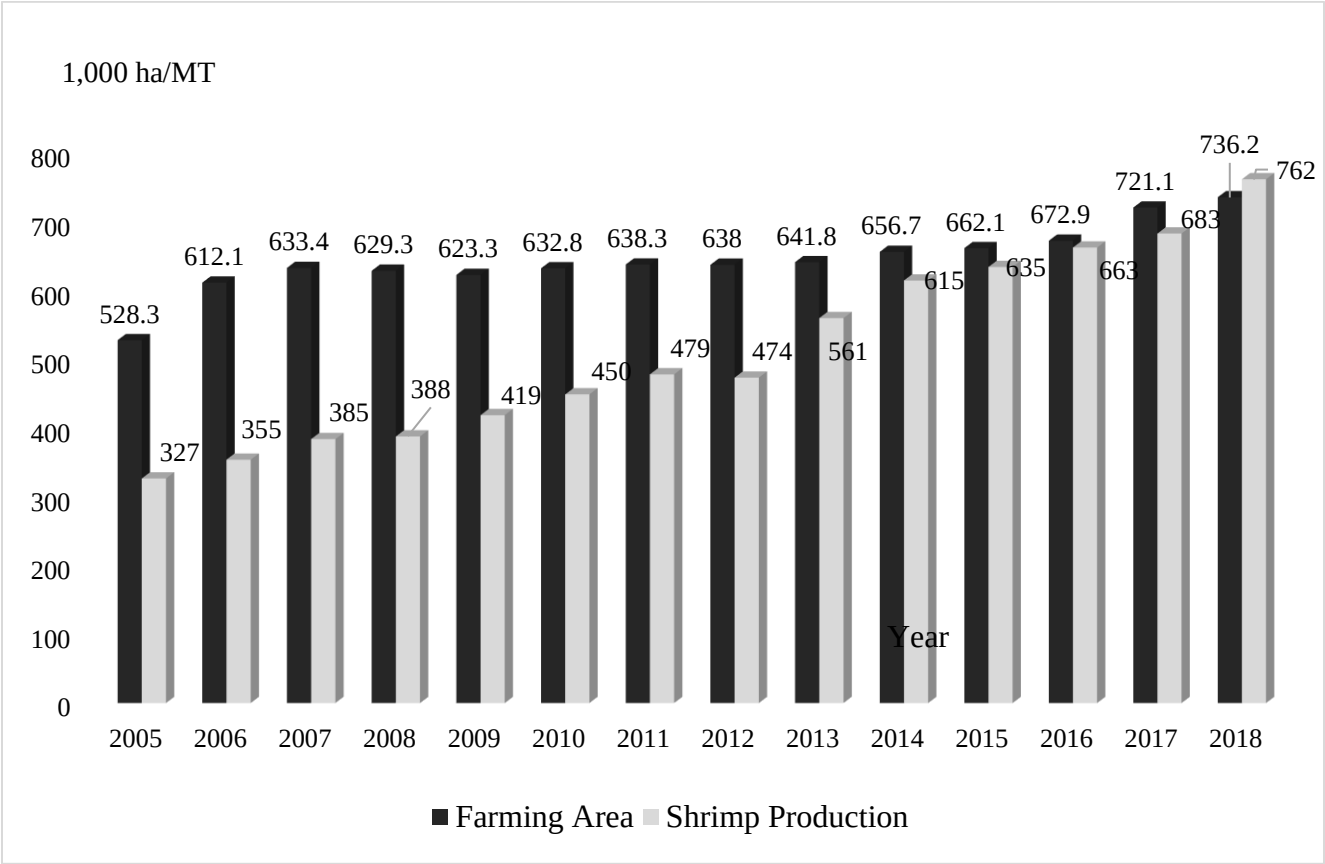


Figure 2.6 – Shrimp Area (1,000 ha) and Yield (1,000 MT) from 2005 – 2018

(Source: VASEP, 2019)

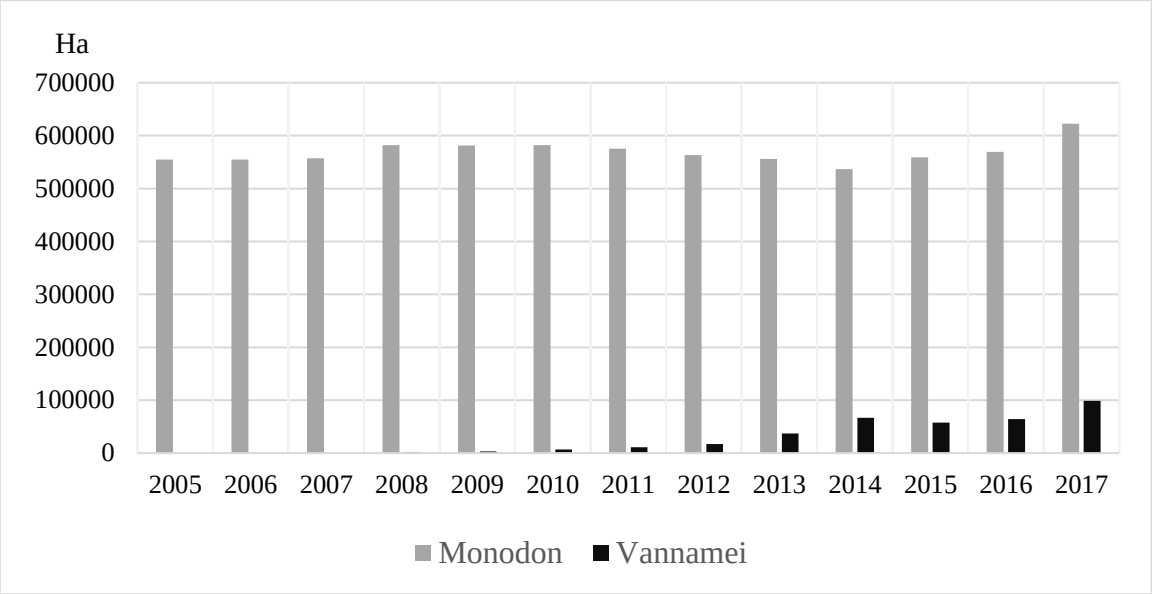


Figure 2.7 – Shrimp Farming Area (ha) by Species from 2005 – 2017

(Source: Institute of Fisheries Economics, 2015; VASEP, 2017)

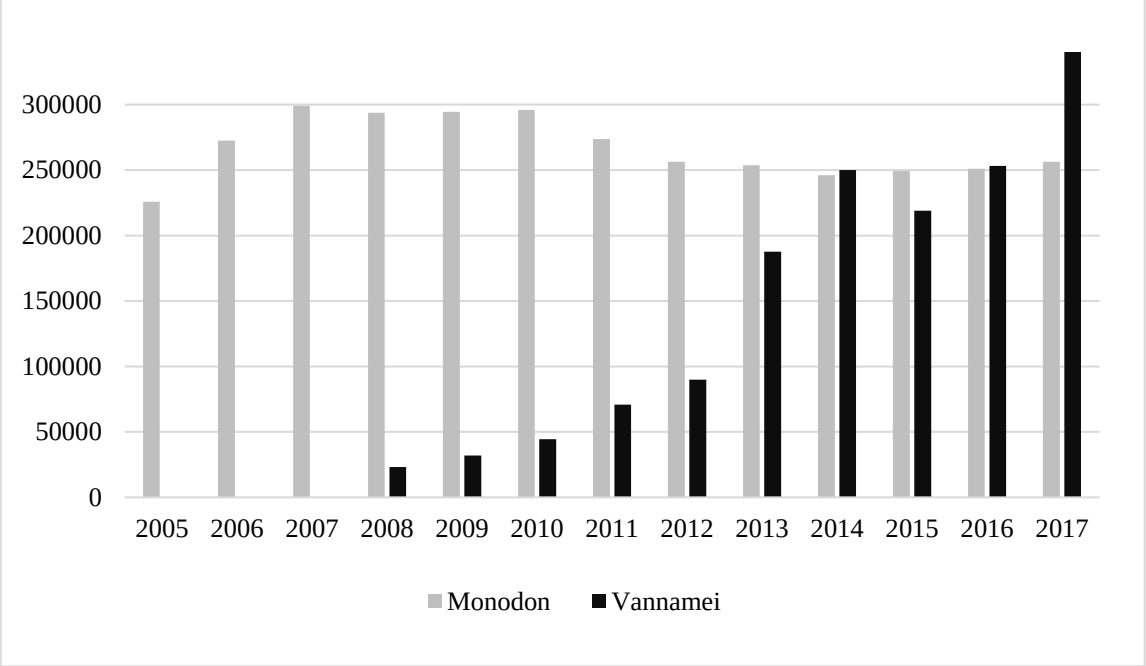


Figure 2.8 – Shrimp Production (MT) by Species with in Period of 2005 to 2017

(Source: Institute of Fisheries Economics, 2015; VASEP, 2017)

2.3 Shrimp Farming Systems

Brackish shrimp cultivation varies greatly in degree of cultivation, i.e. intensive, semi-intensive, advanced extensive, extensive, and diverse in surface farming systems, including earthen ponds, mangroves, and rice fields. Of which, improved extensive farming system and integrated farming system constituted the most. According to the Institute for Fisheries Economics and Planning (2015), in the MD, intensive shrimp farming occupied 5.04% of the area, extensive farming (including organic, integrated mangrove-shrimp farming) accounted for 32.01%, Rice – Shrimp was 27.91%, traditional extensive shared 27.91%, and improve extensive together with semi-intensive was 35.04% of the total area (Vietnam Institute of Fishery Economics & Planing, 2015).

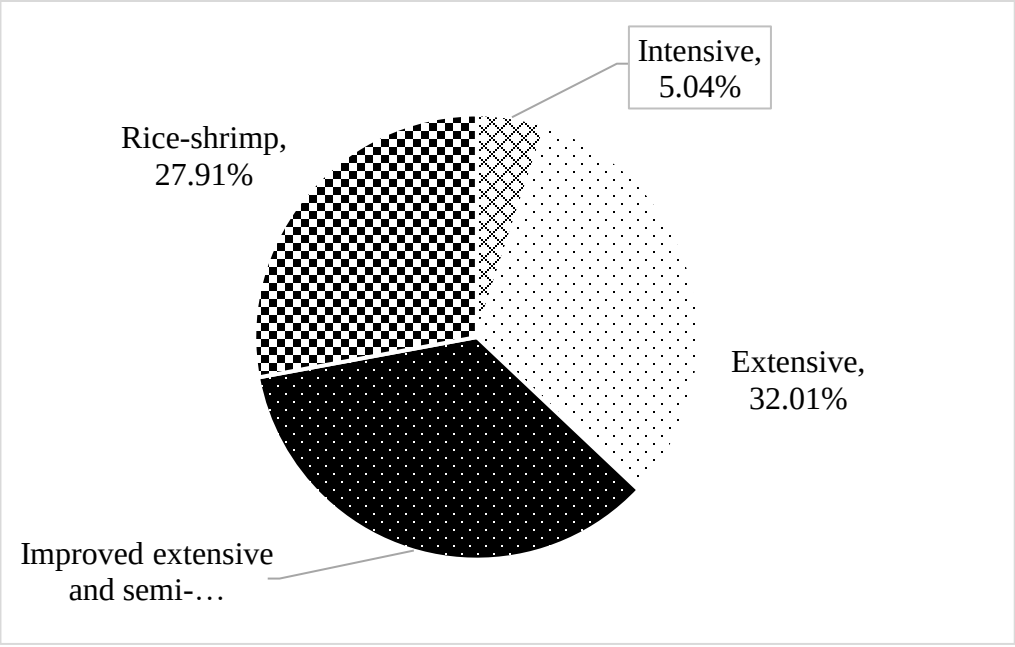


Figure 2.9 – Distribution of Shrimp Area by Farming Systems in the MD

(Source: Vietnam Institute of Fishery Economics & Planning, 2015)

Improved extensive farming and semi-intensive farming are the most common cultivation systems in Vietnam. The average productivity based on extensive farming system is around 300 kg per ha. The productivity based on semi-intensive farming ranges from 1,500 to 2,000 kg per ha. The differences in productivity are mainly come from stocking density and level of intensification (Table 2.2). According to Vietnam Institute of Fisheries Economics and Planning (2015), the area of intensive and semi-intensive farming accounts for 10% of the aquaculture area of the country. In some provinces, the productivity of intensive shrimp farming has reached five to seven MT/ha/crop; the highest can be nine MT. In a recent year, the farming technique has been improved significantly. That allows farmers to upgrade intensive farming system to super-intensive system. The system needs very high level of intensification, including advanced technique and modern equipment. It can bring very high productivity, ranging from 30 to 60 MT for White Leg Shrimp, and 10 to 20 MT for Black Tiger Shrimp.

In the Northern of Vietnam, there is usually only one crop per year that can be harvested, while shrimp farming in the South can be operated generally two or three crops per year. The enormous increase of the brackish-water aquaculture has some negative impacts, such as the silting of the inland areas reaching up to 10 km inland. In addition to this, there is an important reduction of the mangrove area. Although integrated mangrove – shrimp and rotation rice-shrimp farming system are considered as sustainable farming systems but very low productivity, ranging from 100 kg to 400 kg/ha/year for Black Tiger Shrimp.

Table 2.2 – Average Productivity/ha/crop of different Shrimp Farming Systems

Production Systems	**Species**	**Stocking Density (PLs/m^2)**	**Productivity (MT)**
Super Intensive	White Leg Shrimp	100-300	30 – 60
	Black Tiger Shrimp	40-100	10 – 20
Intensive/semi	White Leg Shrimp	70-150	10 – 15
	Black Tiger Shrimp	25-32	5 – 10
Rice-shrimp	Black Tiger Shrimp	4-6	0.33 – 0.5
Improved extensive	Black Tiger Shrimp	4-8	0.2-0.35
Extensive	Black Tiger Shrimp	1 – 2	0.1 – 0.15
Mangrove-shrimp	Black Tiger Shrimp: without stocking	1 – 2	0.1 – 0.29
	With supplement stocking	2 – 5	0.35 – 0.4

(Source: Adapted from Vietnam Institute of Fishery Economics and Planning, 2015; VASEP, 2016)

2.4 Labor in Shrimp Farming

Currently, the number of aquaculture and fisheries units is 713,087 units, with involving of enterprises and business, cooperatives, and households. In which, 54.4% of

them locates in the MD. The MD has around 1.35 million labors who are working in shrimp farming, in which, the majority of them works for Black Tiger Shrimp farming (1.13 million) and 0.21 million for White Leg Shrimp farming. Generally, over one million Vietnamese people earn a living from shrimp production, and 80% of them are small-scale farmers (Loc, 2006; Nhuong, et al., 2013). It is evidence that shrimp farming plays a vital role in the household economy (Table 23).

Labor requirement for shrimp farming depends on farming systems. Extensive farming system mainly uses family labors with average labors being two people/ha. Whereas intensive and semi intensive systems need an average amount of three to five people/ha. The intensive farming system occasionally needs more labors depending on indicators of intensive level, i.e. stocking density, feeding amount, etc. (Directing Board - MARD, 2017).

The profession of labor has much improved over five year period. In 2011, the majority of agricultural aquaculture and forestry labor was non-training in farming activity, at 97.12%. Some of them took the short trainings as experience sharing. Therefore, training certificates were not allocated to farmers. Professional education was very little at around 1.2%. Five years later, professional education of labor is much enhanced, with figure being 1.4%. Activity of technical transfer from agriculture and aquaculture extension unit is much promoted in collaboration to supply enterprises. Therefore, number of training with certificate was also increased from 0.57 in 2011 to 1.15% in 2016, respectively (Table 2.4) (Directing Board - MARD, 2017).

Table 23 – Labor in marine shrimp farming in 2014 (people)

Shrimp species	2005	2010	2011	2012	2013	2014
Black tiger shrimp	1,083,964	1,164,368	1,150,870	1,126,238	1,124,328	1,132,590
White leg shrimp	0	21,594	36,090	54,477	112,455	213,348
Total	**1,083,964**	**1,185,962**	**1,186,960**	**1,180,715**	**1,236,783**	**1,345,938**

(Source: Vietnam Institute of Fishery Economics and Planning, 2015)

Table 2.4 – Education and Training of Labors in Agriculture, Aquaculture and Forestry Sector in the MD (People)

Education and trainings	2011	2016	Structure in 2011	Structure in 2011
No training	5,051,724	3,720,439	97.12	95.38
Training without certificates	60,831	80,528	1.17	2.06
Training with certificate	29,825	44,929	0.57	1.15
Intermediate level	36,669	23,740	0.69	0.61
Vocational level	10,773	12,894	0.21	0.33
Undergraduate level	12,490	14,887	0.24	0.38
Other level		3,453		0.09

(Source: Directing Board of General Survey of Rural, Agriculture and Fisheries, 2017)

3. Introduction of the Mekong Delta

3.1 Natural, Economic and Social Conditions

The MD locates in the South of Vietnam where the Mekong River flows through. The region is named beautiful and prosperous land, where a large delta covers 39,734 km^2 over one city (directly under the central government) together with 12 provinces formed the region: An Giang, Dong Thap (Đồng Tháp), Hau Giang (Hậu Giang), Vinh Long (Vĩnh Long), Long An, Tien Giang (Tiền Giang), Ben Tre (Bến Tre), Tra Vinh (Trà Vinh), Soc Trang (Sóc Trăng), Bac Lieu (Bạc Liêu), Ca Mau (Cà Mau), and Kien Giang (Kiên Giang)

(Figure 2.10). The territory stretches over many islands and archipelagos with a coastline of 732 km. The MD is a part of the Mekong River Basin with a tangled network of rivers and canals. So it has abundant water sources beneficial for agricultural and aquaculture activities. The region is typical for monsoon climate with two distinct seasons of rainy season (From May to October) and dry season (December to April of the following year) (Center for Ocean and Island Studies - COIS, 2016).

The climate zone of the equator's characteristics is hot and humid year round, with high rainfall. The annual average temperature is 24 – 27 Celsius, ranging from 2 – 3 Celsius per year. The difference of temperature between day and night is low. Regarding natural conditions, the region often suffers from natural disasters and storms and floods from nature. The MD has been damaged greatly from drought and saline intrusion in a recent year. Hence, the residents often face with many difficulties, not only farming activities but also daily life activities (Dinhnghia, 2018; Center for Ocean and Island Studies - COIS, 2016).

The total population of the region is 17.45 million people in 2013, accounted for 43% of the total population of the country. Of which, more than 10.3 million people in labor age group (from 16 to 60 years old), sharing 59% of the entry population. Moreover, 73% of them settle in rural area which makes favorable conditions for agriculture, including aquaculture and fishery industry (Ministry of Agriculture and Rural Development, 2012; Dinhnghia, 2018). In summary, the MD converges fully favorable conditions of geographical location; nature and society facilitate to develop agricultural cultivation, aquaculture and fishery for the region.

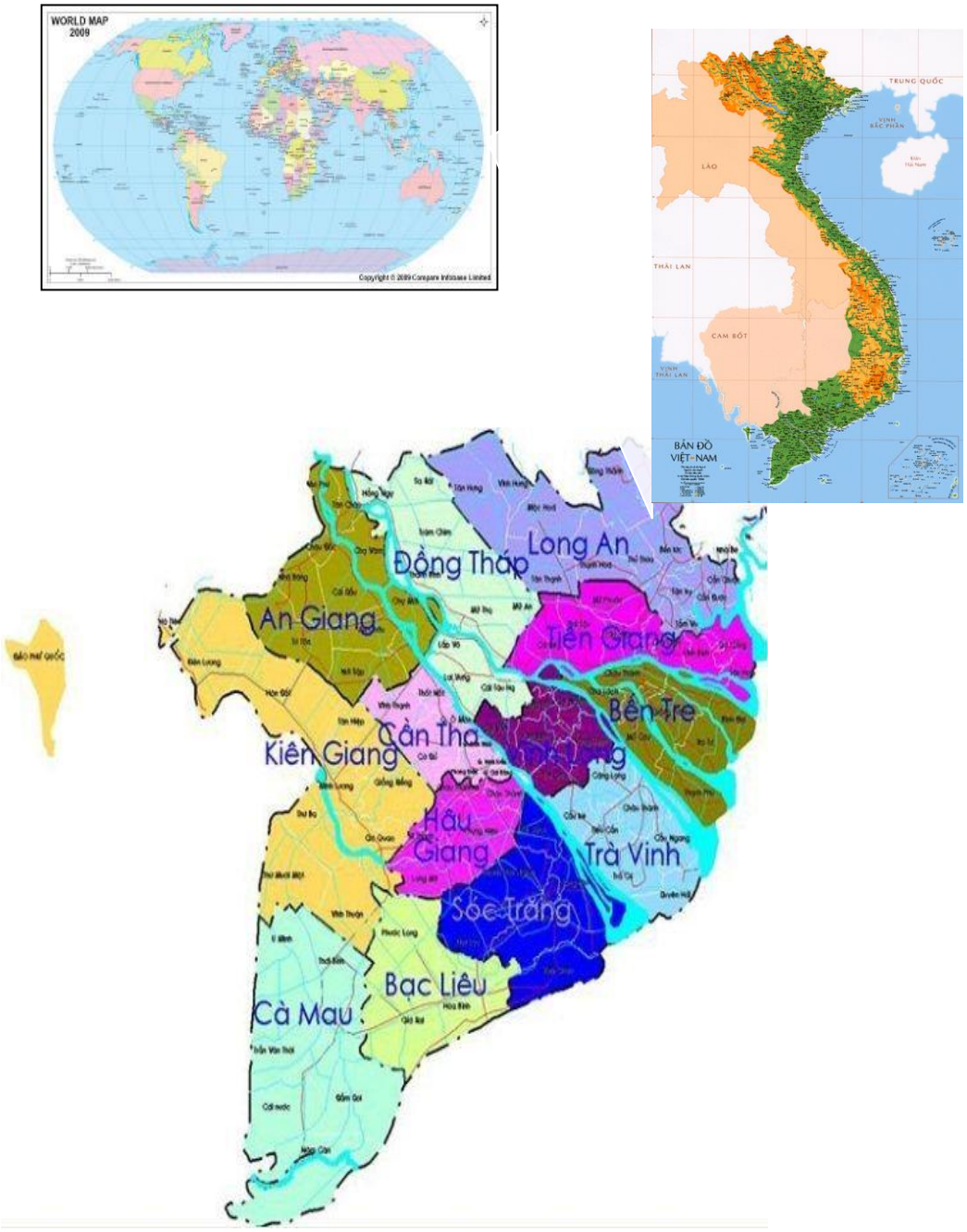


Figure 2.10 – Map of Viet Nam and the Mekong Delta

(Source: Dinhnghia, 2018)

3.2 Aquaculture and Shrimp farming in the Mekong Delta

Because of favorable natural conditions, the MD is considered the most productive area for aquaculture, including marine, brackish and freshwater aquaculture (Wilder & Phuong, 2002). These conditions have made the Southern provinces being main contributors of commercial aquaculture, which more than 70% of coastal aquaculture being produced in that area. Eight out of thirteen provinces in the MD are contiguous to the sea. Therefore, the MD is a target area for brackish aquaculture where key species such as shrimp and mud crab are produced.

In the year of 2010, total area and yield increased significantly in comparison to the past few years, reaching 742.7 thousand ha and 1,987 thousand MT, respectively (Appendix 1) (General Statistic Organization, 2015). These figures grew continuously making the region comprises more than 60% of the whole country, being 772 thousand ha and 2,536 thousand MT in 2016. Shrimp products responses to 683.4 thousand MT, equivalent to 68 – 71.4% of the whole country. Of which, provinces in Ca Mau Peninsula, namely Ca Mau, Soc Trang, and Bac Lieu, contribute almost shrimp production of the region, at 145 thousand MT; 111 thousand MT; and 108 thousand MT, respectively (Table 2.5) equivalent to 67% of the total production of the region.

There are four commercial shrimp species being cultured in the MD, including *Litopenaeus vannamei, Penaeus monodon, P. merguiensis and P. indicus* (Wilder & Phuong, 2002). *Penaeus monodon* was major species in the previous time, but being replaced by *Litopenaeus Vannamei* from the years of 2010. Since then, the production systems of intensive/semi-intensive and super intensive have been under rapid

development. The target of the region is to become a key region to provide major shrimp production for export. However, the problems of environment and degradation have arrived. Further aquaculture development, therefore, has turned vision to sustainability, widely application, raising income among impoverished farmers via developed program of combined farming systems such as rotation rice-shrimp, mangrove forest – shrimp farming systems (AMDI & DAI, 2016; Wilder & Phuong, 2002).

Table 2.5 – Shrimp Production distribution by Provinces in the Mekong Delta with in Remarkable Year Time (MT)

Provinces	2000	2010	2011	2012	2013	2014	2015	2016
Long An	595	6,660	8,912	10,179	11,809	12,717	12,061	10,513
Tien Giang	1,174	12,833	14,479	15,595	17,295	19,600	20,599	22,862
Ben Tre	5,827	29,208	38,251	35,796	53,589	55,946	47,180	46,519
Tra Vinh	2,310	20,944	24,678	11,256	20,592	35,465	35,430	37,304
Vinh Long	64	16	12	13	11	10	10	9
Dong Thap	316	1,727	1,889	1,900	1,541	1,822	1,399	1,430
An Giang	5	916	774	697	333	266	333	193
Kien Giang	1,764	34,765	39,668	40,292	41,978	51,430	52,210	56,825
Can Tho	17	22	25	22	20	19	19	25

Hau Giang	..	9	3	3	4	5	5	33
Soc Trang	11,143	60,830	47,753	40,529	68,514	82,197	90,664	111,240
Bac Lieu	10,403	70,462	72,400	77,107	84,957	93,825	104,532	108,343
Ca Mau	35,377	108,847	117,352	124,433	140,614	139,967	146,541	145,181
The MD	**68,995**	**347,239**	**366,196**	**357,822**	**441,257**	**493,269**	**510,983**	**540,477**

(Source: General Statistics Organization, 2017)

4. Institutional Mechanism for Management of Aquaculture and Fisheries

4.1 Organizational System of the Fisheries Sector

Brackish shrimp farming in Vietnam is managed directly under Ministry of Agriculture and Rural Development (MARD) (Figure 2.11) via numerous relevant Departments and Institute, such as Department of Agriculture and Rural Development (DARD) of each province and city, Department of Fisheries (DoF), Agricultural and Fishery Extension Centers, Substance Management Department Agro-forestry and Fishery products. Almost organizations and Institutes manage related issues as the following (Vietnam Institute of Fishery Economics & Planing, 2015):

① Shrimp fry and quality: they are responsible for quarantine shrimp fry, provision of seeds, and veterinary hygiene issues.

② Commercial culture: farming region management; farming crop; collaboration to related organizations in management of environmental sanitation and disease prevention.

③ Management activities of agents who are working in aquatic and aquaculture veterinary service supply: control of the quality of drugs, chemicals, feed in aquaculture and fishery.

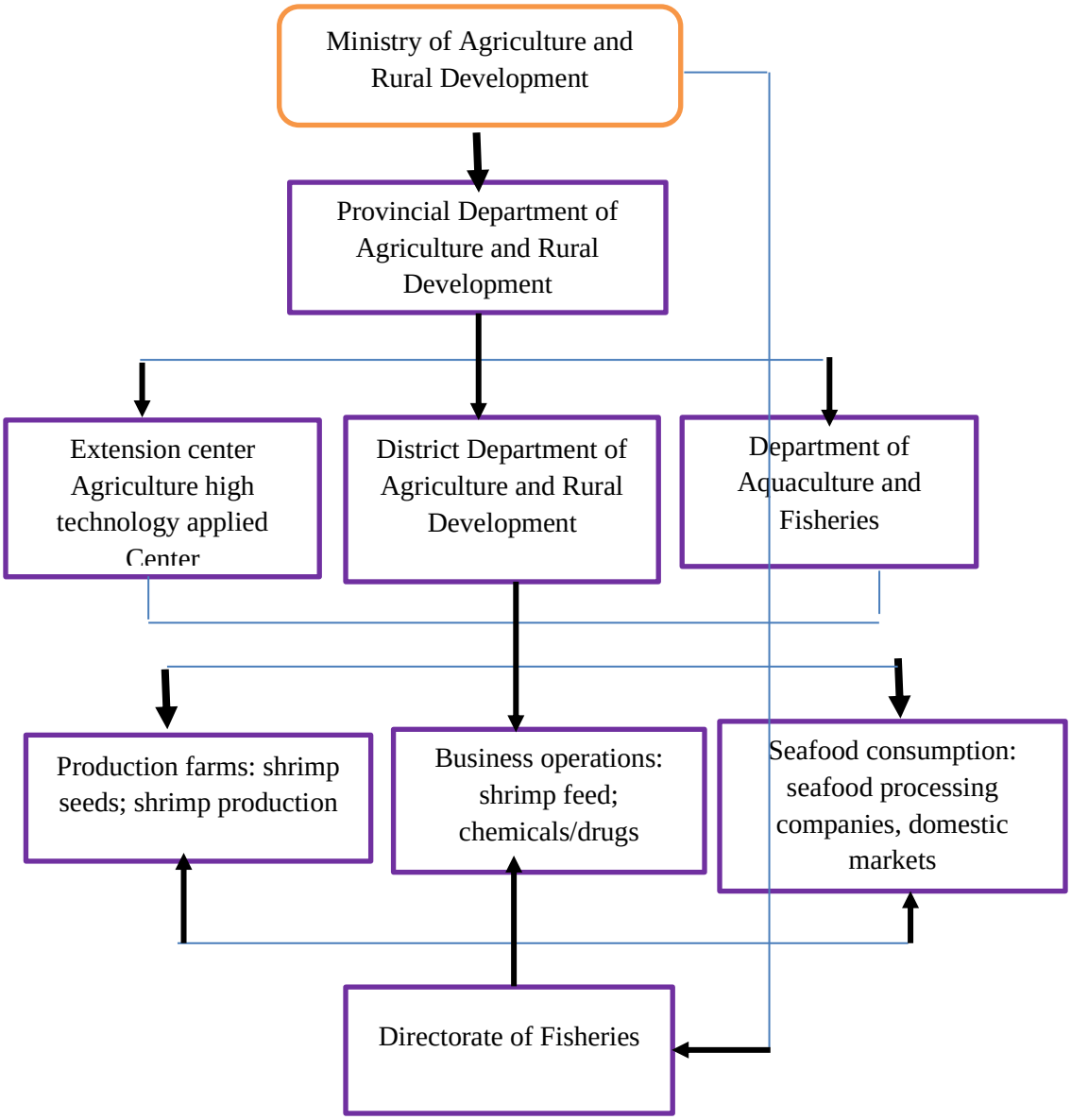


Figure 2.11 – Organizational Structure Chart of Fisheries and Aquaculture Industry

(Source: Adapted from Vietnam Institute of Fishery Economics & Planing, 2015 and created by Author, 2018)

4.2 Outline of major Fishery Institutes and Organizations

Relevant Fishery Institutes and Organizations generally are divided into three groups (Ministry of Agriculture and Rural Development, 2012; Vietnam Institute of Fishery Economics & Planing, 2015):

① *The support divisions assist the Ministry*: the divisions of aquaculture, collective and individual economic sectors, planning and finance, science and technology, international relations, legislation, personnel organization, bureau of capture fisheries and aquatic resources management, bureau of quality management, hygiene safety and fisheries veterinary services, ministerial inspectors and ministerial offices.

② *Specialized institutions support the Ministry*: working on research and development such as the Research Institute for Marine Fisheries, the Institute for Fisheries Economics and Planning; the Research Institute for Aquaculture No. 1 (Ha Noi); No. 2 (Ho Chi Minh City); No. 3 (Khanh Hoa province, in central Viet Nam), the National Fisheries Extension Center and Information Center. Many sectors in the University, organizations and institutes work in studying and researching aquaculture and fisheries.

③ *Unions and associations which support the development of the fisheries sector*: the Labor Union of Viet Nam's Fisheries Sector, Viet Nam's Fisheries Association and the Viet Nam Association of Seafood Exporters and Producers (VASEP), Especially, and Non-government organizations (NGOs).

4.2.1 Ministry of Agriculture and Rural Development – MARD

The organization was established in 1955 under the name of Ministry of Agriculture and Forestry. The organization after that was divided into four sub-offices, including Ministry of Agriculture; Ministry of Agricultural farms; Directorate of Fisheries; and Directorate of Forestry in 1960. Sixteen years later, Ministry of Seafood was established based on Directorate of Fisheries. In July of 1981, Ministry of Fisheries was established based on Ministry of Seafood. Such Ministry is governmental organization with three administrative levels, i. e. the central (national), provincial and district levels; including divisions and specialized institutions and associations. From 2007 onward, Ministry of Fisheries was emerged into MARD (Ministry of Agriculture and Rural Development, 2012).

4.2.2 Extension Center

The Aquaculture Extension Center was established in 2000, after that, it was renamed to the National Aquaculture Extension Center in 2003. The organization was formed aims to operate and manage activities as follow:

① Expand and transfer relevant documents and related regulations of the Vietnamese government;

② Training and transferring technology to the farmers.

The operation of Extension center focuses to six extension training programs:

① Reproducing seed of aquatic products;

② Development of shrimp culture;

③ Support for freshwater aquaculture *(Pangasius)*;

④ Brackish-water and marine-water aquaculture;

⑤ Off-shore fishing and protection of aquatic resource, preservation;

⑥ Processing and improvement of product quality for export.

4.2.3 Directorate of Fisheries

Directorate of Fisheries belongs to MARD, and was established in 1960. The Directory has responsibilities in aquaculture as follow (Khoi, 2011; Loc, 2006):

① To submit MARD planning of aquaculture area; aquatic seed categories; list of banned chemicals; certificate of feeds and seeds based on regulations.

② Guidelines, quality test, issue certificates for import and export of seed, feed, and raw materials for producing aquaculture feeds, bio-products, microorganism, treatment and improvement of the environment in aquaculture.

③ To direct, guide and inspect the implementation of the above regulations

④ Guiding production operation in aquaculture

⑤ Evaluating and designate a certification for aquaculture, organizing, inspection, assessment, designation and withdrawal of designation laboratories in aquaculture according to regulations.

⑥ To guide, to inspecting of environmental monitoring, warnings and management in aquaculture activities, experiment and expertise in aquaculture, avoid natural calamities in aquaculture.

4.2.4 National Agro-Forestry-Fisheries Quality Assurance Department (NAFIQAD)

NAFIQAD was formed in 1994 with the initial name of National Fisheries Inspection and Quality Centre (NAFIQACEN) – the national competent authority for fishery food safety assurance and quality control. In 2003, NAFIQACEN expanded its scope to veterinary (including fish and shrimp disease control). After that, it was renamed to NAFIQAD. NAFIQAD is an institution assisting the Minister to carry out the state governing of quality and safety of agricultural, forestry, fishery products and salt nation-wide. For the aquaculture and fisheries sector, the NAFIQAD not only governance the quality of products, but also manage quality of input and output product for aquaculture such as aquatic species breeding, agro-chemical compounds, feed, small collector and trader network. For the work of quality assurance in aquaculture product export, the NAFIQAD is responsible for taking samples to test quality and safety before exporting, ensuring at least 5% of the total shipments (NAFIQAD, 2017; Khoi, 2011).

4.2.5 The Vietnam Association of Seafood Exporters and Producers (VASEP)

VASEP was established in 1998, a NGO and representative for seafood processing and export companies (VASEP, 2019). VASEP is operated with the roles to support seafood processing and export activities. In detail, it shows functions as follow:

① Promote the growth of seafood industry and to facilitate the smooth export of seafood products internationally;

② Connect and create relationship between Vietnamese seafood producers and customers domestically as well as globally;

③ Gather, synthesis and provide market information, trends and develops national strategies for industry;

④ Organize and implement trade-promotion activities; to provide trainings and supports the business expansion of member enterprises;

⑤ Seeking financial and technical assistance to upgrade quality standards and added value to products;

⑥ To represents and protects its members' legitimate rights and interests with regard to governmental authorities and third-party bodies. Especially in several international lawsuits such as anti-dumping, technical and economic barriers.

4.2.6 Farmer's Union

In agriculture and aquaculture sectors, the farmers are managed by Farmer's Union. This is a representative organization which was established earlier in 1930 in many local provinces. Main activities of Farmer's Union are sharing production knowledge; support government in management of farmers, especially in rural area. The organization has witnessed several periods of changing name and administration and finally, the organization works under the name of Vietnam Farmer`s Union onward (Vietnamese Farmer's Union, 2012).

Table 2.6 – Historical Development of Farmer's Union

Time lines	Events	Notes
10/1930	Resolution on the establishment of the Indochina General Agricultural Association	The ex-name of Farmer's Union
06/8/1949	Resolution No. 02-NQ / TW on the establishment of the Central Committee for Agriculture	Issued by The Party Central Committee
12/1949	Establishment of Central Farmers Union	At The First Nationwide Farmer's Conference
21/4/1961	Association of Liberation Farmers of South Vietnam	A member of the National Front for the Liberation of South Vietnam
27/9/1979	*Vietnam Union of Collective Farmers*	Organized from central to local
01/3/1988	*Vietnam farmer's Union*	Be renamed and keeping until now

(Source: Vietnamese Farmer's Union, 2017)

4.3 Political Mechanism Systems

Since 1995, hundreds of political documents related to development of aquaculture and fisheries have been issued. These documents could be divided into nine groups (Vietnam Institute of Fishery Economics & Planing, 2015):

① Policies of economic restructuring

② Policies of encouraging aquatic breed development

③ Policies of marine aquaculture and island development

④ Policies of investment and financial support

⑤ Policies of land use

⑥ Policies of tax

⑦ Policies of aquaculture extension

⑧ Policies of product consumption

⑨ Policies of cooperative development

Some of noticed policies and laws are considered as follow:

① Viet Nam's governing law for fisheries: issued on Jan 1st , 2004 by the President of the Socialist Republic of Viet Nam, adjusting in 2016; consists of 10 chapters and 62 Articles in general regulations; protection and development of aquatic resources; capture fisheries; aquaculture regulations; regulations for fishing boat and fisheries services; regulations on processing, trading, export and import of aquatic products; regulations on international cooperation for fisheries operations; regulations on governmental administration of fisheries; regulations on rewards and sanctions as well as regulations on clauses for implementation.

② National technical regulation on brackish water shrimp culture farm - Conditions for veterinary hygiene, environmental protection and food safety (2014): apply for

intensive and semi intensive farming models, including regulations of 5 technical factors: Farm location; Infrastructure; Shrimp farming activities; Wastewater/waste; Technical labors.

③ There are also a number of decrees, decisions, etc. issued at government and ministerial levels on specific tasks to support the management of the fisheries sector. The results from political analysis allow extracting that these policies effect directly or indirectly to the development of aquaculture. In the terms of collective economy and linkages of shrimp commodities, a report of World Wild Funds – WWF Vietnam named ``Assess Institutional Value Chain Arrangements linking Small-scale Shrimp Farmers with Private Sector Companies in the Shrimp Supply Chain to Promote Responsible Shrimp Production in Vietnam``, the role of government was mentioned in detail by policies, laws, decisions and decrees in the box below:

Table 2. 7 – Box of Government Policies, Laws, Decisions and Decrees related to Aquaculture Management

The Civil Code No. 33/2005/QH11 dated on 14/06/2005, Trade Code No. 36/2005/QH11 and Decision No. 62/2013/QĐ-TTg dated on 25/10/2013 by Prime Minister – about "The policy to promote cooperative, linkages in agricultural production and trade and large scale; Code of law No.23/2012/QH13; Cooperative group. This law regulates the establishment and operation of cooperatives and collective groups. Besides that, to operate the value chain of ASC/BMP shrimp, the financial capital is the most important factor because the members of cooperative are small scale with limited capacity. Therefore, the lending of money to the value chains of shrimps is considered as a potential mean of expending the market share of banks in the short and medium term even if this activity can be highly risky. Regarding financial support, the government released a decree No. 55/2015/NĐ-CP which encouraged credit policy for value chain that allow credit institutions providing unsecured loans of up to 70% of the project value for organizations and individuals and up to 80% for enterprises, co-operatives and unions linkage in value chain. Decision No. 1050/QĐ-NHNN created a special credit mechanism lending up to 90% of project value and based on cash flow control of the project without asset mortgage but enterprises must participate in the pilot program of a linked value chain. And Agricultural Bank has announced a minimum credit package of 50.000 billion VND for clean agricultural development (effective from 01/11/2016) for borrowers participating in safe and large scale agricultural production. National Bank released Decision No. 2210/QD-NHNN-HSX dated 31/12/2015 on guidelines for lending to cooperative groups. Finally, commercial banks are considering loans for agriculture and fisheries value chains based on the Decree No. 55/2015/ NĐ-CP.

(Source: Tinh et al., 2017; Synthesized by author, 2019)

Chapter III

LITERATURE REVIEWS

Summary

This chapter focuses to review the secondary data as well as the available studies, published reports or articles aiming to create basis and background for the dissertation. The part includes the statement that why the research was conducted and direction of the research. Specifically, the most serious problems in shrimp industry management needs to be improved are disease outbreaks and the quality of exported shrimp. Also presented here are the related definitions to the study as well as several approached methods. In additionally, the author also shows the available conceptual viewpoints internationally throughout the table – based paper work. This chapter contributes significantly to the part of research methodology of Chapter IV, V and VII by building the concept and framework for the thesis.

1. Port Rejections of Vietnamese Aquatic Products

1.1 Motivation for Fishery and Shrimp Export

Aquatic products can be consumed domestically as well as globally. In the circumstance of Vietnam, the majority of seafood products are exported because the products of aquaculture and capture overwhelmed domestic consumption. The average fish consumption per capital of Vietnamese people was 33.2kg/capital (HelgiLibrary, 2011). With the total population of 87 million people (General Statistics Organization, 2017), a

calculated number of fish consumption for the whole country is 2.89 million MT. However, aquaculture and fisheries industry generate more than seven million MT per year. More than four MT extra fish products makes Vietnam be strong motivation for export. Additionally, fishery products involve aquatic animals and aquatic plants, i.e. marine fish, freshwater fish, crustaceans, etc. As regard Vietnamese aquaculture, *Pangasius* catfish and shrimp constitutes more than 90% of the total production. The circumstance makes extra crustacean products for export. The vital role of export in terms of export volume and value was explained in detail in section of Chapter II "Context of Aquaculture and Shrimp Farming". That Chapter explains why aquaculture and shrimp industry should remain its position to the country and livelihood of farmers.

1.2 Number of Rejections

Since market liberalization happened in 1990, Vietnam has expanded fishery export volumes, value and has ranked in the top fifth largest exporter in the world (FAO, 2011). Despite the remarkable growths over recent years, the Vietnamese shrimp sector has witnessed a major problem since implementing rapid growth of intensive system i.e. the high port rejection rate from importers due to violation of food safety. Among the ten countries with the most frequent agri-food import rejections within the following four main markets, Vietnam's rejection ratio was high, ranking third in Japan, sixth in US, and eighth in EU (UNIDO & IDE, 2013). This problem is proved by data on port rejection from major market as shown in the Table 3.1and Table 3.2 following below:

Table 3.1 – List of ten Countries with the most Agricultural Products Rejection from Key Imported Markets

Rank	**Japan**	**Australia**	**EU**	**US**
1	China	China	Iran	Mexico
2	US	Japan	China	India
3	**Viet Nam**	India	India	China
4	Thailand	US	US	UK
5	Ghana	Thailand	Thailand	Canada
6	Ecuador	Italy	Brazil	**Vietnam**
7	Indonesia	Philippines	Argentina	Dominican Republic
8	Italy	Republic of Korea	**Vietnam**	Thailand
9	Republic of Korea	Malaysia	Indonesia	Japan
10	Canada	**Vietnam**	Egypt	Indonesia

(Source: UNIDO & IDE, 2013)

Table 3.2 – Rejections of Vietnamese Agri-food and Fishery Product Imports from Major Markets

Market	Viet Nam's Rank	Total cases	Ratio of fishery products (per $US million imports)	Period
Japan	1	563	0.13	2006-2010
United States	6	3,443	0.37	2002-2010
EU	9	613	0.15	2002-2010
Australia	10	418	0.20	2003-2010

(Source: UNIDO-IDE, 2013)

The data from the Table 3.2 points out incident of rejections for Vietnamese agricultural food products from Japan, the US, the EU and Australia. Of the four markets, the highest rejected case comes from the US, at 3,443 cases. For other markets, Viet Nam's figures were prominently among countries with large numbers of rejections during the period concerned (UNIDO & IDE, 2013). Among various agri-food commodities, seafood products were facing rather high rejection rates when looking at the overall number of rejections. The numbers were up to around 500 cases in three major markets within the period of 2006 – 2010 (Table 3.2). Considering to average scale by $US million imports of aquaculture and fishery products, Viet Nam ranks top in the US market, and 9th in

Japanese market. It can be inferred that although Vietnamese fishery industry has shown a remarkable increase in recent years, the high rate of port rejections for Viet Nam fishery products has been high.

1.3 Reasons for Rejection

Turning to examination the reasons reported for these rejections, a closer look at the Table 1.1 in the Chapter I reveals that there are various reasons for rejection of Vietnamese fish and fishery products. Vietnamese fishery products are rejected for various reasons depending on the market. The numbers in Table 1.1 illustrate that there are various weak links in the supply chain of Vietnamese fishery products. Bacterial and other contaminations, pesticide residue, hygienic conditions/controls, and veterinary drug residue are not well controlled or tested throughout the supply chain (UNIDO & IDE, 2013). The rejections due to veterinary drugs residues rank first in the EU and Japan markets. The detected veterinary drug residues have correlated tightly in the production stage, as the residues are found in the bodies of fish and fishery products. It is followed by bacterial contamination in the US market. Bacterial contamination can happen even in and after the production stage, whenever products touch the hazard points (Suzuki & Vu, 2017). Several important reasons include hygienic condition/controls, additives, other contaminants, and pesticide residues. At the production stage, usage of antibiotics and other chemicals are not well controlled. This leads to overuse which again leads to the detection of these chemicals in the final product in the shrimp's body parts such as the tail and hepatopancreas (Shrimp Culture, 2019). It suggests that most contamination that is detected in the product is possibly present throughout the production stage. Depending on specific markets, the

problems of quality faced by Vietnamese exports differ slightly. The table is a simple summary that generalize the major reasons behind the high rejection rate of Vietnamese exports. We can infer that most of quality problems for product occur at the producers' level. It is very important finding that suggests investigation in farming practices need to change for better quality control.

2. Related Definitions of in Aquaculture Management

2.1 Small-scale Aquaculture

Agricultural industry is derived from traditional dichotomy into rural and urban zone (Edwards & Demaine, 1997). Since then, the term "rural aquaculture" is formed and still widely applied. However, this term is still ambiguous that created premise for term ''small-scale aquaculture'' come into vogue more recently. In recently, this term comes generally with several characteristics as followed:

① Small-scale aquaculture farms are family-owned, managed and operated. It is considered as small livelihood of residents in rural area, and home-business (De Silva & Davy, 2009). Unfortunately, understanding on the ownership in aquaculture operations is usually not available (NACA, 2006) which hinders usage of the term. Small-scale aquaculture is commonly referred in recognition diversity of systems and scales.

② Small-scale aquaculture is a continuum of system that involves limited investment in asset, small amount invests in operational costs, largely family labor, and aquaculture is one of several economic activity.

③ Small-scale aquaculture is the principal source of livelihood, of which the operator

has invested substantial livelihood properties, for instance, time, labor, infrastructure and capital.

④ Key characteristics of small-scale aquaculture: ownership or access to an aquatic resources; ownership by family or community; relatively small size of landholding; mostly based on family labors; informal management system; vulnerability in a certain; limited access to physical, technical resources, technical expertise; limited access to information (market); limited investment and value of sales; low household income; little contribute proportion of household income; and contribute to family food supply (Bondad-Reantaso & Subasinghe, 2013).

However, there are weaknesses in this definition (Edwards, 2010):

① Firstly, it does not have a boundary between small and large-scale aquaculture is addressed in this term. Small-scale aquaculture is to be useful; it is necessary to separate small-scale from medium to large-scale aquaculture.

② Secondly, the term ‘’operator’’ did not also distinguish between an ‘’owner-operator’’ and a ‘hired-operator’ clearly. The owner operates farm themselves which is a clear characteristic of a small-scale farms whereas hiring an operator is characterized by an off-farm or urban investor or entrepreneur, and may also characterize a medium or even large-scale farm.

③ These typical characteristics accompanied the definition of small-scale aquaculture, i.e. limited investment, usually limited value of sales, and low household income all do not necessarily apply to small-scale aquaculture but these also do not apply to medium and large-scale aquaculture farms or enterprises.

In the context of shrimp farming in Vietnam, a shrimp farm is considered to be small-scale farming when it meets the definition of small-scale farming established by the government according to Decree No. 56/2009/ND-CP (2009). A small-scale shrimp farm usually operates less than two ha, and ultimate limited inputs, or less than one ha but using inputs more intensively. Most farmers in Vietnam use limited inputs in the form of stocking materials, feed, and drug/chemical compounds. These practices are commonly found in extensive or improved extensive production systems, whereas farmers of intensive or semi-intensive production practice higher stocking density, and thus higher feed usage. In another words, there are two dimensions in definition of small-scale farming, including area devoted to production, and intensively level of input use. These criteria, i.e. stocking and feeding rates represent great investments of financial capital, equally importance to distinguish production system and scale of production in what extent.

From the above definition, it is found that shrimp production in Vietnam is dominated by small-scale producers. Shrimp is almost grown in small earthen ponds and run by family. Therefore, family labors are also key resource of the cultivation. Especially, the essential features of small-scale in shrimp farming are rely on farming practices such as additional seed stocking, feeding, and management inputs. Small-scale shrimp farming uses small amounts of feed and rarely use of antibiotics and other drugs. Intensive systems require more technically sophisticated management of water quality and disease control. However, considering to the sale of production, the farmers in intensive farm usually take advantage of house-land with small area to culture shrimp. They are mainly use family labor in order to save capital (Nhuong, et al., 2013).

2.2 Quality Control

The definition of quality control was synthesized in the Table 3.3 below:

Table 3.3 – An overview of Quality Control Definition

Definitions	Authors
Includes determining what to control, establishing units of measurement for gathering data, establishing standards of performance, measuring actual performance, interpreting the difference between actual performance and the standard, and taking action on the difference in order to prevent quality problems in the next batch/production. Improvement is a form of control in the control process where attention is paid to structural causes and solutions.	(Luning & Marcelis, 2006)
An aspect of the quality assurance process that consists of activities employed in detection and measurement of the variability in the characteristics of output attributable to the production system, and includes corrective responses.	(Businessdictionary, 2019)
A product focused concept, where checking of the actual results are done to ensure that things are as expected. If the correct controls are in place you can know for certain that the actual results have been achieved because the actual results have been checked.	(Glen, 2013)

A combination of technological and managerial quality functions. In an established food supply chain, the quality control should be implemented in the process and product of each member. To guarantee quality, these control activities must be directed to critical control points (CCPs). Important critical control points in quality control at aquaculture farm level are site selection, water management, the use of feeds, the use of antibiotics for fish disease treatment, and harvest.	(Luning & Marcelis, 2006; Khoi, 2011; Reilly & Kaferstein, 1997)
Quality control is observation techniques and activities implemented to fulfill requirements for quality.	American Society Quality (ASQ) (Russel, 2012)

(Source: synthesized by the author, 2020)

2.3 Quality Assurance

There are many perspectives on quality assurance for products. However, most of the perspectives could be concluded as follow (Khoi, 2011; Loc, 2006):

① Quality assurance is defined as a procedure or set of procedures which intended to ensure products or services under development process, which means that they are still being produced, as opposed to afterwards, still on process, meets required indicators which were set by specific individual or group of people.

② Quality assurance is a process about ensuring product being produced in the right way in some extent and somehow. It is concerned proactively about the processes or producing activities during the products development.

③ The planned activities and systematic actions implemented in a quality control system so that quality requirements for products or services will be fulfilled. Quality assurance and quality management consists of a common part focused on providing belief that requirements of quality will be fulfilled. The confidence that is provided by quality assurance is twofold: internal management and external customers, regulators, government agencies, certifiers, and third parties.

④ Consideration to relationship between quality assurance and quality control, quality assurance is occasionally expressed together with quality control as a single expression. In other words, quality control is embedded in quality assurance.

2.4 Quality Management

Quality management includes the total activities and decisions performed in an organization to produce and maintain a product with a desired quality level at minimal cost (Khoi, 2007).

Quality has been defined as fitness for use, conformance to requirements, and the pursuit of excellence. Even though the concept of quality has existed from early times, the study and definition of quality have been given prominence only in the last century.

Management activities and functions involved in determination of quality policy and its implementation through means such as quality planning and quality assurance (including quality control (Businessdictionary, 2019).

If divided according to level of expertise, quality management appears as the highest of academic, it is followed by quality assurance and quality control is the final activities and process.

2.5 Which is Aquaculture Management?

Management in Cambridge Dictionary means the control and organization of something; or the group of people responsible for controlling and organizing a company.

Management is the act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively (Lumenlearning, 2019).

Therefore, aquaculture management is a term that includes a set of actions to control people, activities, and operations in aquaculture and fisheries section. In another word, it is a practice of theory of management in a specific aspect, here means aquaculture and fisheries.

3. Collective Economy in Small-scale Aquaculture

With the purposes to encourage development of collaboration, production linkage accompanied with agri-product consumption, and large field construction, the Government issued a Decree No. 62/2013/QĐ-TTg dated 25th October 2013 and Cooperative Law No. 23/2012/QH13 dated 20th November, 2012. After five years of implementing these Decree and Law, the collective economy with the core of cooperatives *(Hợp tác xã)* and farming clusters *(Tổ hợp tác*) has made positive changes either quality or quantity, demonstrating

the primary role of this area in socio-economic development in general and rural area in particularly. Cooperatives are collective economic organizations formed from seven or more individuals, households, and/or legal entities. The founders have mutual needs and receive the same benefits. They voluntarily contribute capital and labor to carry out certain work to increase production efficiency and improve the livelihoods of members. Clusters are defined as economic organizations based on a cooperation contract under authentication of a communal People Committee, which is formed by three or more individuals who jointly contribute capital and labor to carry out certain work for mutual benefit and responsibility (Ha, et al., 2013). By the year 2018, it is estimated that there were 13,712 agricultural cooperatives nationwide, accounted for 61% of the total number of cooperatives. Revenue of cooperatives and income of workers was improved, positively impacting on household economy (Vietnam Cooperative Alliance, 2019). These cooperatives and clusters operate in the fields of credit, fishing, aquaculture, agriculture, services, construction, etc. Although the majority of them are formed spontaneously, under the forms of small-scale and fragmentation, the cooperatives and clusters are profitable thanks to the compact and flexible organizing governance mechanism. The farmers are supported financial capital, production technique, seeking for consumed markets and contributing income increase for farmers (Vietnamese Farmer's Union, 2012).

According to Circulars No. 09/2017/TT-BNNPTNT singed on 17th April 2017, Fisheries and aquaculture cooperatives are clusters engaged in aquaculture activity (marine and freshwater aquaculture, aquatic species breeding production); fishing (marine and inland fisheries, including preserving seafood on fishing boats). From the household economy, the small-scale farmers have converted to collective economy since the

establishment of Cooperative Law and achieved remarkable achievements by increasing production scale, enhancing productivity, collaborating multi-production agencies, accessing supported capital, in-put supplier collaboration, from then, increasing income for farmers.

4. Introduction of Standards and Certification in Aquaculture and Shrimp Farming Industry

4.1 International Trends toward Aquaculture Products

Aquaculture provides nearly 50% of the world's supply of seafood, with a value of $125 billion US. Moreover, this sector contributes 13% of the world's population's intake in term of animal protein, and employs about 24 million people. Aquaculture is one of the greatest growing global food production systems. Since wild capture is stagnating, aquaculture has expected to close the forecasted global deficit in fish protein by 2020 (FAO, 2012). The rapid expansion of this sector exposes to a wide range of concerns about its social and environmental impacts, including water pollution and degradation of the surrounding environment (Bush, et al., 2013). There is a pressing demand in the global seafood market for sustainable aquaculture. This understanding reviews the key trends in the international market that drive the development of sustainability requirements and the emergence of certification as a prominent strategy to meet such requirements (UNEP, 2016).

4.2 Certifications for Aquaculture and Shrimp Business

To get these remarkable achievements, since the founding in the early 1990s, the shrimp industry in Vietnam has grown in both scale and technical management. The industry has competence in quality, traceability, management of environment impacts throughout the entire supply chain starting with hatcheries, feed mills, shrimp farms and processing plants. The improvement has leaded to export through modern cold – storage facilities. To most reliable evidence that shrimp farming is both safe and sustainable can be found by the existence of the increasing number of certifications schemes put forth by international standards bodies for Good aquaculture practices including BAP, GlobalGAP and ASC. In order to achieve these certifications, farms must be built and operated based on these criteria:

① Compliance with law (legal compliance, legal right there).

② Conservation of natural environment and biodiversity.

③ Conservation of water resources.

④ Preserve diversity of wild species and populations

⑤ Responsible use of feed and other resources.

⑥ Animal health (no use of antibiotics and unnecessary chemicals).

⑦ Social responsibility (e.g. Non-use child labor, worker health and safety, freedom of assembly, community relations).

In Vietnam, to support international standards in responsible shrimp farming, VietGAP standards were promoted in the years of 2010s. As available considerations in

many studies, a rapidly growing shrimp sector has resulted in major challenges. Many efforts from private sector and governments have developed and implemented better practices as a key to responsible shrimp farming and health management. Under the higher conditions to apply international certifications, VietGAP was launched firstly to encourage small-scale aquaculture farming in Vietnam.

4.3 An Introduction to VietGAP Standard

VietGAP is abbreviation for Good Aquaculture Practice in Vietnam – a standard applied in aquaculture to provide insurance for the farming of safe and hygienic products, while reducing disease and pollution in the environment and promoting animal health and social responsibilities, as well as the traceability of products (Ministry of Agriculture and Rural Development, 2011). The standard was promoted first in 2011, with set standards and guidelines aiming to build capacity for accreditation organizations. The standard is based on the FAO's Technical Guideline for Aquaculture Certification and the ASEAN shrimp GAP (UNEP, 2016). This is a National Standard which was issued by the MARD and being regulated in the Decrees No. 379/QĐ-BNN-KHCN, No. 1503/QĐ-BNN-TCTS, No. 1617/QĐ-BNN-TCTS and No. 4835/QĐ-BNN-TCTS. There are 4 modules under ASEAN GAP, i.e. quality products and food safety, disease reduction, environmental safety, and social safety and welfare. Each country in ASEAN GAP is required to meet the food safety module at the first step and to be benchmarked with each other, therefore making 10 GAPs compatible with each other. Actually, the purpose of the VietGAP is not to increase the inequality or providing financial secure, but to improve production practices of farmers for safer and more sustainable agriculture (Ministry of Agriculture and Rural

Development, 2015). VietGAP standard sets requirements and guidelines of five principles and 45 criteria with whole principle 3 responding for shrimp health management and Principle 2 regulating food safety. Shrimp farms rely on GAP to manage diseases have to consider 11 criteria related to disease prevention and treatment such as pond preparation, management of seed, feed, water monitoring, chemical usage, disease reporting to authority, sanitation, etc. The VietGAP certification could be obtained either group or individual. However, the shrimp industry in the MD is predominately of small-scale and fragmented as well. Therefore, most shrimp farms are unable to follow the standard by themselves. Being a member of a cooperative gives them opportunities to follow GAP by participating in training activities, applying for certificates, receiving subsidy, and support. Each farm can be acquired VietGAP but small-scale farming being prohibitive because the level of requirements for infrastructure is too high. Only large farms or companies are awarded VietGAP separately. Eventually, the government gave supports to farmers in application of VietGAP as a group certification throughout the assist of shrimp cooperatives or farmer groups. By the year of 2019, there were 135 shrimp farms belong to processing companies and cooperatives being certified in the MD. Several provinces where shrimp industries were operated by community management such as Soc Trang and Bac Lieu served as pioneer provinces in the program. The cooperatives are functional in encouraging farmers to follow and acquire GAP through training activities, transferring subsidy and support (input providing contract, toolkit transferring, partly financial support), on behalf of holding VietGAP group certification and monitoring farmers to comply with VietGAP system.

4.4 In terms of Quality and Food Safety Assurance in Certifications

Because shrimp enterprises that are VASEP's members contributing around 90% of shrimp exports from Vietnam, VASEP through its Shrimp Committee has collaborated with the MARD, the NAFIQAD which belongs to MARD to solve the industry obstacles and problems including quality assurance, safety hygiene and the compliance with rules, regulations of Vietnam law and foreign markets.

Thanks to the collaboration between MARD, the NAFIQAD and VASEP in assurance of quality, safety hygiene, the compliance with rules and regulations of Vietnam law and foreign markets, the advanced certifications and compliance of Law of Labor, Law of Food Safety and the regulations of MARD, shrimp companies are implementing good practices in both farms and processing plants including shrimp products. Besides, every year, the companies must be inspected by the independent audit agencies, international certification bodies and Vietnam authorities.

To maintain 100 importing markets and develop the new market places, Vietnam shrimp companies must keep their reputation by the control the whole system to meet the higher and higher requirements and regulations from the world market. Some examples include:

① For labor issue: working hours for employees in Vietnam shrimp companies have been applied in accordance with Labor Code 2012, Decree 45/2013/NĐ-CP dated 10/05/2013 by the Government.

② Labor Union at shrimp enterprises: The Law regulates that every shrimp companies must declare and register Working Regulations with the local Labor Department, Invalids and Social Affairs in order to protect interest of workers including working hours and working conditions…

③ Getting ASC, Global GAP and other international standards shows that Vietnam shrimp farmers and processors are not allowed to use antibiotics and unnecessary chemicals in their production chain. Most importantly, Vietnamese authorities now have regulations and programs that strictly control the use of chemicals and antibiotics in aquaculture and seafood processing. Directorate of Fisheries and local fisheries authorities regularly guide and inspect the use of antibiotics and develop the shrimp industry in the direction of chain linkage (with strict contractual, controlled production, not using or restricting the use of antibiotics, stable consumption of products ...), certified shrimp farming.

④ Vietnam has been implementing the National Residue monitoring Program (according to Circular No. 31/2015/TT-BNNPTNT dated October 06th, 2015), implemented by NAFIQAD and every year send annual report on results of previous year and plan for the next year to the EU.

⑤ For seafood processors and exporters: they have been carrying out the program of internal monitoring and prevention of antibiotic residues in products (mandated according to Circular No. 48/ /2013/TT-BNNPTNT): Collect samples to test antibiotic residues and toxic substances at the farm before harvest; Take samples to test antibiotic residue to control when receiving raw materials before processing.

⑥ Before exporting, the competent authorities of Vietnam (NAFIQAD) take the sample from the consignment to test antibiotic residue before issuing the health certificates which is legally required by all European border inspection authorities for all imports of shrimp and all food coming from Vietnam to EU markets. Shrimp exports in 2017 reported the breakthrough with the growth of 22.3% to reach over $3.8US billion. In 2017, in the total of shrimp export products, White Leg Shrimp occupied the dominant position with the proportion of 65.6%; Black Tiger Shrimp accounted for 22.8%, the remaining was marine shrimp with 11.6%.

Table 3.4 - List of Relevant Certifications in Aquaculture

Oder Number	Certification	Main contents	Level applied	Coverage
1	SQF2000	Food safety assessment program covering processors, distributors and warehousing	Factory	Global
2	SQF1000	Food safety assessment program for primary producers	Farms, Hatchery	Global
3	HACCP	Hazard Analysis and Critical Control Points: Management system for the prevention of contamination by physical, chemical, and biological hazards	Factory	Global
4	GlobalGAP	Initiated by the members of the Euro-retailer produce association, main focus is on food safety and traceability, and concerns with social and environmental issues	Factory, Farms	Global
5	BRC	Food safety and quality criteria required for supplying to United Kingdom retailers and designed to standardize food criteria and monitoring procedure	Factory	
6	GMP	Developed by the US FDA for verifying the safety and purity of drug and food products	Drug and chemica suppliers	

	ISO22000	International food safety management system involving interactive communication between chain actors, and a system management approach based on HACCP principles	Factory	Global
7	ISO 9001-2000	Quality management system for providing consistent products and services to meet customer expectations, focusing on quantitative measurement of performance	Feed suppliers	Global
8	BAP	Address environmental and social responsibility, animal welfare, food safety and traceability in voluntary certification program for aquaculture facilities	Farms	Global
9	OHSAS	British standard for occupational health and safety management system	Factory	
10	PAD	PAD is *Pangasius* Aquaculture Dialogue, initiated by WWF, is a set of standards based on multi-stakeholder consultation	Farms	Global
11	BMP	Best Manufacture Practices: Be targeted to improve farmers' management practices, delivering increased profitability and environmental performance by making more efficient use of resource	Farms	Global

12	ASC	Provide a means to measurably improve the environmental and social performance of aquaculture operations.	Supply or value-added chain	Global
13	VietGAP	Provide insurance for the farming of safe and hygienic products, while reducing disease and pollution in the environment and promoting animal health and social responsibilities, as well as the traceability of products	Farms	National

(Source: Adapted from Khiem et al., 2010; UNIDO-IDE, 2013)

Chapter IV

CURRENT SITUATION OF VietGAP SYSTEM IN SHRIMP FARMING: FOCUS ON DISEASE CONTROL OF WHITE LEG SHRIMP *(Litopenaeus vannamei)* INTENSIVE FARMING

Summary

The increase in White Leg Shrimp farming throughout Vietnam in recent years has led to disease outbreak and economic loss for farmers. This Chapter aims to handle two objectives: (1) to clarify the status of disease reported by farmers; and (2) to investigate disease control in farming practices. The survey was carried from March to April 2018 in Soc Trang province and Ben Tre province. A total of 100 farmers were interviewed: 50 farmers in VietGAP standard compliance in Soc Trang province, and 50 farmers from non-GAP application in Ben Tre province. The research results showed that 50% of farmers in VietGAP applied system reported disease, with a profit loss of $6,364US/ha/crop. Some good practice areas were investigated such as keeping water in reservoirs, low stocking density, using toolkits for water quality monitoring, etc. However, sludge treatment and disease reporting to managers were not complied fully. Farmers in non-GAP applied system experienced disease at 62%, which caused economic failure of $17,144US/ha/crop. Good disease control practices observed were the well design of ponds, and better disposal of bottom sludge. However, some poor practice areas included high stocking density, overfeeding, and high usage of chemicals. In conclusion, disease was less serious in GAP cases. Application of VietGAP standard allows farmers to control diseases better. Shrimp

farmers should learn lesson from the Soc Trang province by promoting VietGAP, and participating in cooperatives.

1. Introduction

As available considerations in many studies, a rapidly growing shrimp sector has resulted in major challenges. Many efforts have developed and implemented better practices as a key to responsible shrimp farming and health management by applying aquaculture certifications such as VietGAP. Although application of VietGAP is growing, a large number of farmers do not apply this standard, and even though VietGAP applied farms, the control points for disease management have not been fully complied and number of farms being awarded certification officially was too small. Therefore, to understand what are differences of control points focus on disease management between VietGAP and non-GAP applied systems and what are control points actually being implemented at the farms? The study offers two research questions:

① What is the present situation of diseases during previous production cycle self-reported by shrimp farmers?

② How are shrimp diseases managed in different critical control points in farming practices?

Knowledge and capacity of shrimp farmers are vital when decisions are taken on the farming practices to attempt to disease prevention and treatment, in particular in small-scale shrimp farming where their knowledge are often poor or lacking. There is little

information about farmers' knowledge and practices on disease management control measures, including their capacity. The objective of this study was twofold:

① To clarify the status of disease reported by farmers of GAP and non-GAP applied system.

② To investigate the practices of disease control points between GAP and non-GAP applied system.

These objectives above were accomplished after applying a number of research methods as describing in following category.

2. Methodology

2.1 Study Sites' Context

Soc Trang and Ben Tre provinces were chosen for study because they are typical areas of shrimp farming. Shrimp farming in two provinces dominates in terms of farming area and production and presents for two sites of the Delta (Figure 4.1).

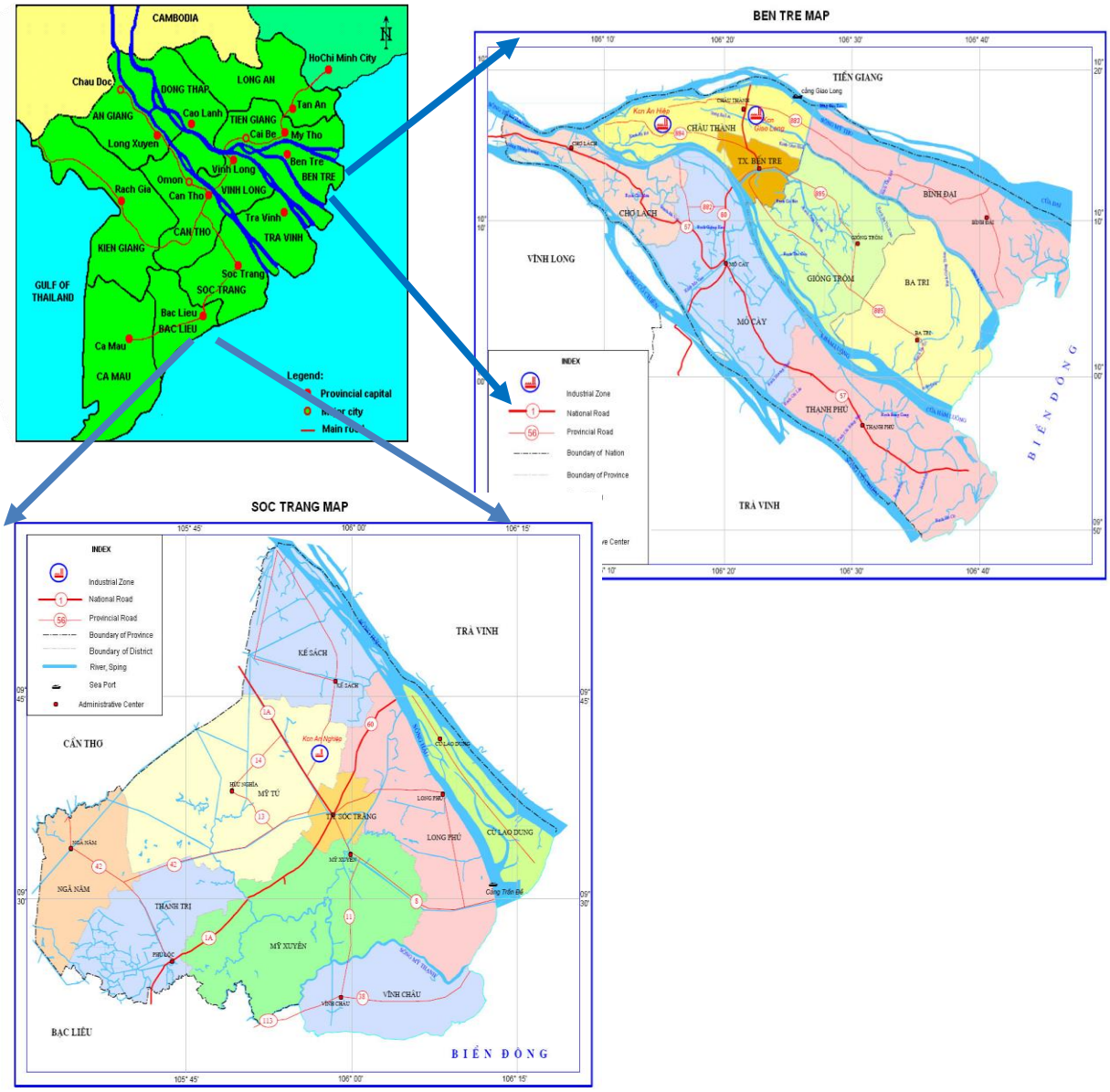


Figure 4.1 – Map of the Mekong Delta and Showing Location of Two Provinces

(Source: Soc Trang People Committee, 2018; Ben Tre Department of Agriculture & Rural Development, 2017)

2.1.1 Soc Trang's Study Context

Soc Trang is one of coastal provinces in the MD which locates in the lower basin of the Hau River, with the total area and population rank sixth in the MD. The province is divided into 10 administrative divisions with the total area and population of 76.15 km^2 and 173,922 people, respectively. Kinh people dominated, noticed ethnic groups are significant, including Chinese and Khmer people. The economy of the province is typical for agriculture, aquaculture and salt industry. The total shrimp farming area in Soc Trang is 54,098 ha in 2017. In which, area of white leg shrimp shared 63%. The province ranks third in shrimp production of the MD at 134,184 MT with sharing of white leg shrimp production at 110,000 MT. One of key tasks of re-structuring agriculture and fisheries is re-organizing aquaculture region focus on creation of collective economic. The province currently has established 27 cooperatives with 1,160 members over 2,658 ha (include 20 cooperatives of fishing). Additionally, to encourage implication of good aquaculture practices, MARD issued several Decisions and support policies to propagation and recommendation of application of VietGAP standard. Regarding to aquaculture, VietGAP is referred to Good Practices for Aquaculture in Vietnam. Shrimp farms practice GAP have to start from internal farm management with appropriate area, construction, water quality, feed quantity, etc. Soc Trang province is one of pioneer provinces in implication VietGAP for shrimp farming and achieve very effective first step (People Committee of Soc Trang, 2018).

2.1.2 Ben Tre's Study Context

Ben Tre province is typical case for disease outbreak due to significant development of intensive white leg shrimp farming. It is located at the end of the Mekong River Basin (Figure 4.1) with favorable natural conditions for aquaculture and fisheries (Khang, 2008). Regarding aquaculture, the total area of shrimp stocking has been rapidly extended, from 30,800 ha in 2010 and up to 35,000 in 2017. In the same period, the corresponding production was 29,208 MT and 55,000 MT, respectively, in which, white leg shrimp production covered over 86.3% of the total shrimp production (Ben Tre DARD, 2017). The white leg shrimp farming of the province is characterized by small scale farming, especially for intensive model with the most of farmers had a farm area less than half a hectare (Khang, 2008). Normally, small operators tend to look for short term economic benefit without consideration on environment degradation. Hence, rapid increase in small holders of shrimp farms has correlated to disease outbreak of the province. In 2017, the disease outbreak had spread to more than 1,200m ha and mainly occurs over white leg shrimp intensive farms.

2.2 Research Framework

The study was conducted over four steps framework (Figure 4.2) which was proposed by author as follow:

① The first step is an analysis of current data to get the general information and exploit the problems. Available published data such as scientific articles, journals, books, reports, statistical agency, etc. relate to current situation of shrimp industry were gathered first and table analyzing later.

② The second step is creation checklist and questionnaire, after that, they were translated into local language. The checklist was prepared to interview local fisheries officials of Soc Trang and Ben Tre DoF. The data was supplemented by secondary data. A semi-structured questionnaire was also composed to face – to – face interview to the shrimp farmers. Base on research questions and objectives, the questionnaire was designed with appropriate parts. The draft version was piloted to 5 shrimp farmers to detect inappropriate questions. The last version includes 5 parts: (1) Personal characteristics and production organization; (2) Disease occurrences experienced; (3) Economic effect of shrimp diseases; (4) Current disease control practices; (5) Problems and solutions.

③ The third step is field trip to interview fisheries managers of DoF from each province and shrimp farmers from March to April 2018. The total 100 key small-scale shrimp farmers were interviewed, in which, half in Soc Trang province and half in another one. Shrimp farms for surveyed were chosen from the list of shrimp farmer provided by local managers using a random sampling method. Farmers would answer questioned based on their own memory. Thus, the information on the last crop were asked aim to take the most exactly answers.

④ The last step is analysis the collected data. The data after that was coded and entered to the computer. The Microsoft Excel was used to analyze and process the data.

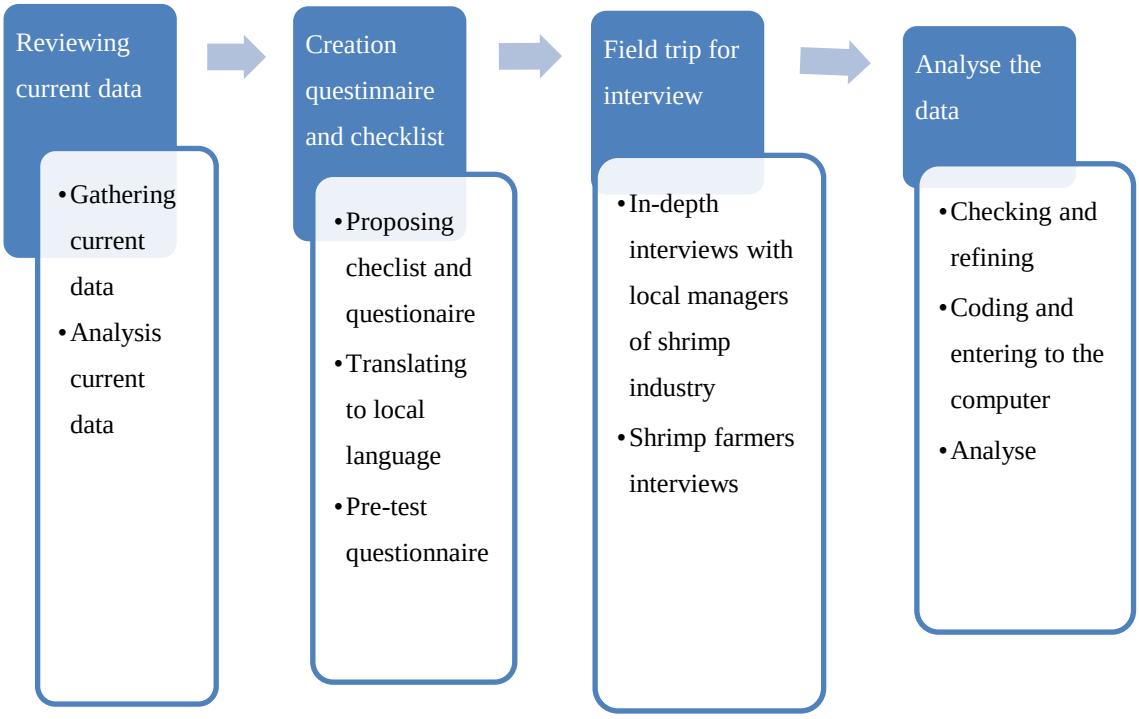


Figure 4.2 – Steps in Disease Control Research

(Source: Develop by author, 2018)

2.3 Research Method

Interviews were conducted from March to April, 2018 using semi-structured questionnaire. Local officers from DoF of Soc Trang and Ben Tre play their role in introduction potential respondents who are willing to engage in the research through the Key Informant Panel (KIP) interview. The annual reports and their perspective on shrimp industry were consulted as well. The respondents were chosen initially from a list provided by authorities, and they will be asked for introduced next interviewers, it is so-called "snow-ball" sampling method. Farmers would answer questions based on their own

experience, and information on the latest harvest (mainly from the end of 2017 or early of 2018) was asked to diminish possibility of error as most farmers relayed on memory recording.

2.4 Categories of Critical Control Point Practices Regarding to Disease Control

Shrimp farming has a variety of styles, and involves many steps from initial seeding to harvest. No matter what farm production and technology used, shrimp farmers must address the following variables: location of farm, infrastructure, pond preparation, shrimp species, feed, chemical usage, water environment, shrimp health, and farming waste (Bryand, et al., 2006; Ministry of Agriculture and Rural Development, 2015). Furthermore, the control points related to disease management involve many criteria from initial breeding to harvest as mentioned in the Principle 3 of VietGAP certification guideline.

After initial research, we divided practices associated to disease outbreak management. These are:

① Farm and pond construction and pond design

② Pond preparation and renovation

③ Seed stocking management

④ Feeding management

⑤ Water management

⑥ Waste and disease treatment

3. Results for VietGAP System: Soc Trang Province

3.1 Respondent's Profile

The characteristics of interviewed farmers are summarized in Table 4.1 and Figure 4.3. Average age of farmers was 50 years old and almost shrimp farmers had basic school education of secondary school (50%). There were 4% of them having a bachelor's degree. Each household includes nearly four members with around two to three people being engaging in shrimp farming. Farmers participated in the study had an average experience of more than 17 years in aquaculture with traditional farming model of black tiger shrimp. Therefore, farmer had long experience of shrimp farming between 10 and 20 years and a shift of white leg shrimp at around 8 years ago.

Shrimp industry in Soc Trang has been organized under collaborative production organizing mechanism (People Committee of Soc Trang, 2018), which resulted in 100% of interviewed farmers being member of shrimp cooperative. As the encourage of application VietGAP norms of aquaculture practices, there has been 63% of farmers applying VietGAP standard farming process within 3 years and 27% of them successfully receiving certificate but 14% has expired.

Table 4.1 – Famers' Profile

Indicators	Unit	Mean (N=50)	Standard deviation
Age	Years	50.04	11.56
Number of people of the family	People	3.96	1.21
Number of people engaged in shrimp farming	People	2.28	0.81
Aquaculture experience	Years	17.22	5.99
Shrimp farming experience	Years	15.88	6.92
Intensive white leg shrimp culture experience	Years	8.00	6.79

(Source: Author's survey, 2018)

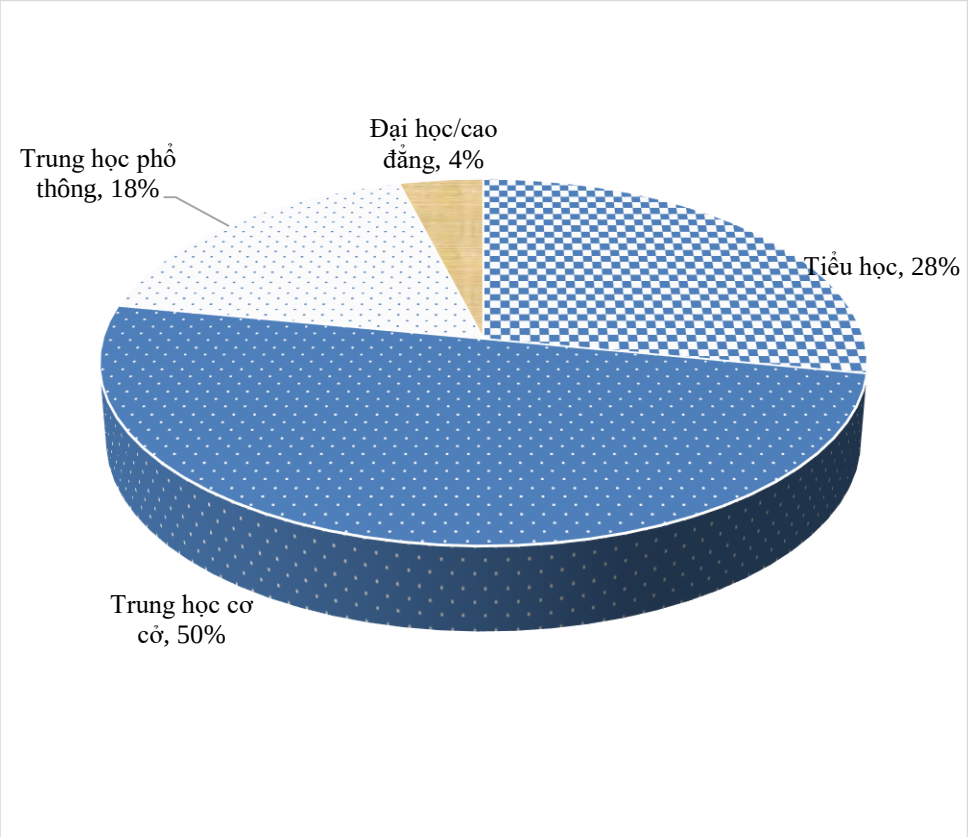


Figure 4.3 – Farmers' Education Level

(Source: Author's survey, 2018)

3.2 Diseases Reported by Farmers and Economic Losses

Half of shrimp farmers have experienced disease outbreaks with the highest report of red body disease at 20% of interviewed farmers which occurred over 12% of surveyed area. Red body disease was mainly caused by TSV and WSSV (Li, et al., 2016). Such disease usually occurs from 30 to 40 post-stocking days with clinical manifestations of red or pink body, diseased shrimps swim along the shore or floating to surface. The second common reported disease was hepatic diseases (18% of farmers) but farmers revealed that

disease caused by unknown-pathogen over the infected area of 7%. Main external expression of diseased shrimps was small, black or yellow liver. The diseases of slow growth syndrome, intestinal disease, early monitory syndrome and white feces diseases were reported by fewer farmers (between 2 and 8% of samples).

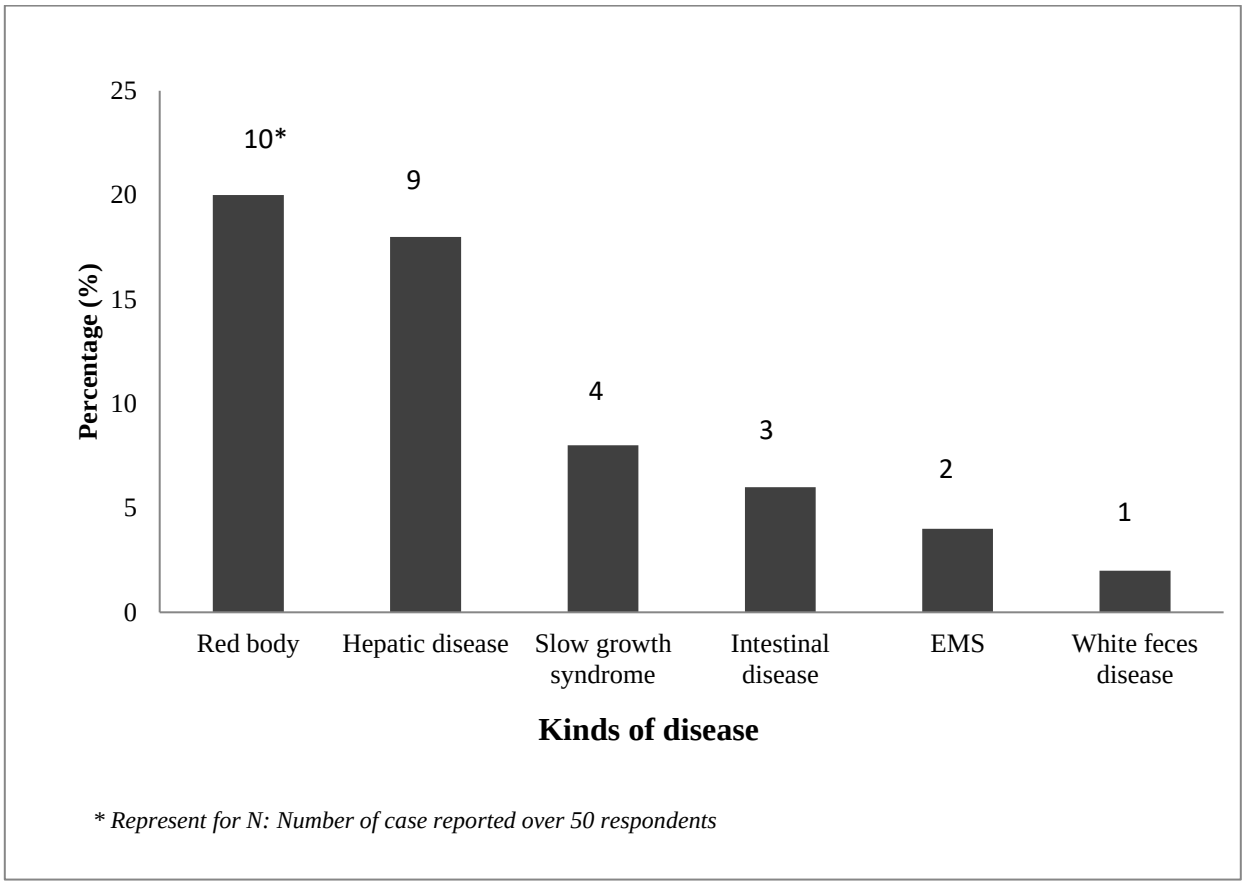


Figure 4.4 – Diseases Reported by VietGAP Applied Farmers

(Source: Author's survey, 2018)

Almost farmers reported that diseases resulted in financial losses for farmers due to significant decrease in production. A successful crop could reach a high production at 5.12 MT/ha, 1.38 MT higher than diseased crop (Table 4.2). The outbreak of diseases has

increased the economic risks, slow down industry development and clearly had a major effect on farm profitability (Chanratchakool & Phillips, 2002). The surveyed results show that income in no diseased crop was double of diseases crop ($13,024US/ha/crop in comparison to $6,660US/ha/crop). Some farms received no harvested production when serious diseases outbreak early (around one-month post-stocking) and cause mass monitory within some days of having clinical magnification. Such situation leads to 20% of farmers fell in debt by losing investment cost of $2,370US/ha/crop. Among various kinds of diseases, virus-caused diseased were considered as the most significant loses in economic terms (Gunalan, et al., 2014). In Soc Trang province, nearly 73% of farmers reported that red body, white spots and EMS caused main economic lost in shrimp farming.

Table 4.2 – Production and Economic Losses by Diseases

Indicators	Units	Mean	Standard deviation
Yield per no disease reported crop/ha	MT	5.12	2.57
Yield per disease reported crop/ha	MT	3.74	1.18
Net profit per no disease reported crop/ha	$US	13,024	5,423
Net profit per disease reported crop/ha	$US	6,660	1,055

(Source: Author's survey, 2018)

3.3 Practices of Critical Control Points in VietGAP System

3.3.1 Farm Construction and Pond Design

Almost farmers here operate farms over their private land to build the ponds with a total area of about 1.5 ha/household. Around 60% of the area used for shrimp farm construction. The stocking area in last crop was nearly 6,436 m^2. The rest of the area was used for constructing other facilities for shrimp farming such as warehouses, pumps, reservoirs, and treatment ponds. Each farm normally operates two to three ponds, with the average size of 2,650 m^2/pond. Each farm normally operated two to three grow-out ponds, with 46% of them operating large-scale (≥5,000 m^2). The survey shows that 94% of farms constructed reservoirs which are necessary in areas where high turbid water is located and overcrowded farms for better water monitoring. The area of reservoirs has to occupy at least 15% of farm size as the criteria of VietGAP standards. The Figure 4.5 illustrates that the allocation of reservoir area was accompanied with farm size and complied with VietGAP, with 34% of farmers using from 3,000 m^2, 32% having 1 to less than 2,000 m^2 of reservoirs.

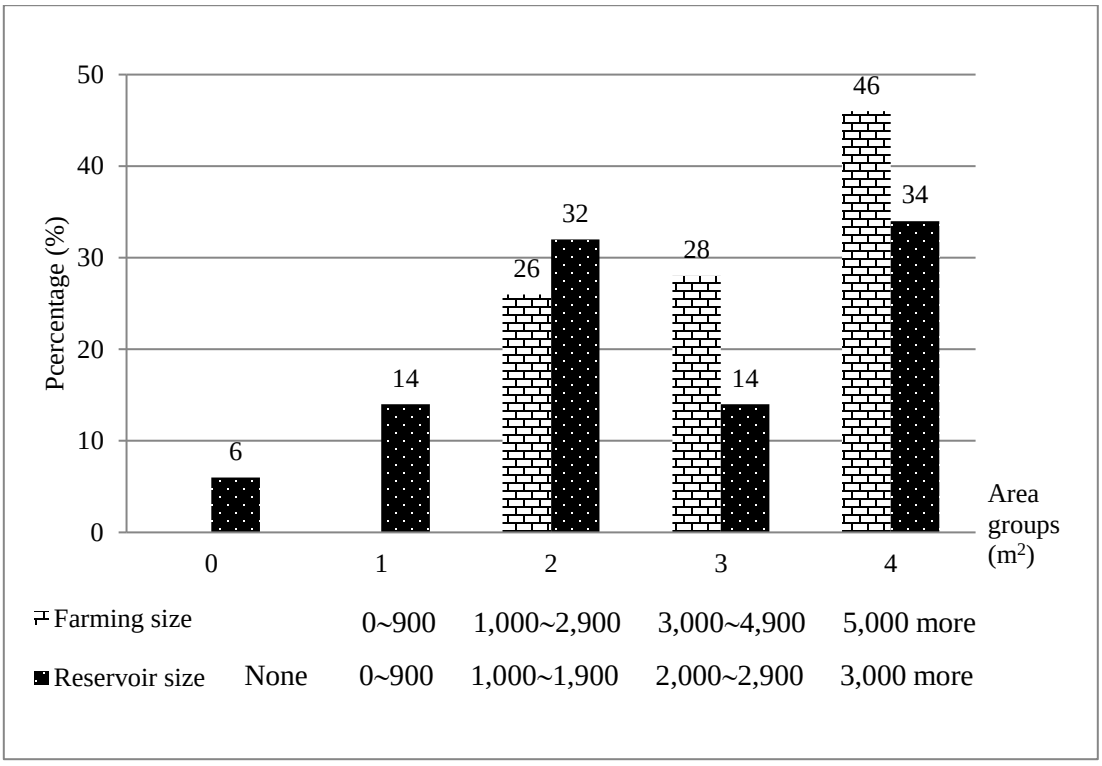
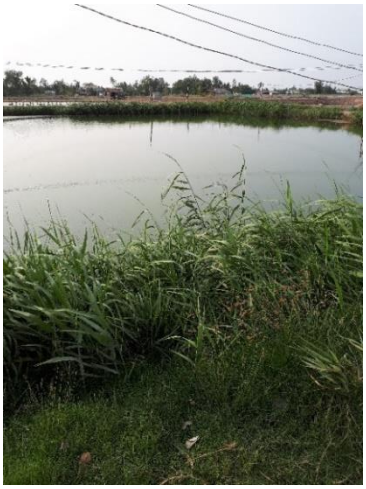


Figure 4.5 – Distribution of Farming Size combined with Allocation of Reservoirs in VietGAP Applied System

(Source: Author's survey, 2018)

The national technical regulation (issued in 2014 by MARD) specifies that minimum depth of pond is 1.1m and area of reservoirs occupy at least 15% area of culture ponds (Ministry of Agriculture and Rural Development, 2014). The survey shows that pond's depth is 1.2m and almost farms have reservoirs at 84% of farmers with the sharing area of 30% of stocking area. This meets the requirement of VietGAP's standards (depth: 1.1m, reservoirs occupying at least 15% area) (Ministry of Agriculture and Rural Development, 2015). Reservoir ponds are necessary in areas where high turbid water is located as well as overcrowded farms where intake and outfall are from the same source (Figure 4.6-a) (AA1,

2002). The requirement of VietGAP standard states that farms must construct separate, solid warehouse, and restrooms (Figure 4.6-b).



(a) **(b)**

Figure 4.6 – Images of Reservoir (a) and VietGAP Warehouse (b)

(Source: Author's survey, 2018)

3.2.2 Pond Preparation and Renovation

Actions in pond preparation and renovation such as cleaning pond bottom, ploughing on wet soil, use of lime are very important for reduce risk of disease outbreaks (Sebastian, 2009). Farmers usually remove bottom sludge every two crops (once a year) at 58% of respondents. After that, ponds are limed, and water will be filled around 15 days before stocking. In charge water is kept in reservoirs that help to improve water quality before pumping to grow-out ponds (90% of farmers). Before pumping in charge water to culture pond, a toolkit is used to measure some water quality indicators such as pH (>7), dissolved oxygen, salinity, temperature etc. This toolkit was supported by the project

aiming to encourage VietGAP standard apply for shrimp production cooperatives in Soc Trang. This practice was satisfactory the requirement of VietGAP standard, and was recognized by farmers.

3.2.3 Seeds and Stocking Management

The importance of seed quality in disease management was opined by most shrimp farmers (Sebastian, 2009). When 88% of farmers took into consideration the guaranty and good appearance of seed while purchasing, 94% of farmers chose virus-free seeds from local hatcheries through contracts signed by cooperatives. Farmers reported that WSSV and slow growth syndrome are should be tested before purchasing. Shrimp fries were stocked at low density of 37 PLs/m^2 at the size of PL12 (equal to length of 9 - 11 mm/PL (Ministry of Agriculture and Rural Development, 2014)). Most farmers were aware of ideal stocking density of shrimp production in VietGAP standard and adherence strictly. All farmers reported stocking density lower ideal stocking density in VietGAP standard and adherence strictly (70 – 120 PLs/m^2).

3.2.4 Feeding Management

Feed management was considered as an important part of shrimp farming in feed sources, quality of feed, time and way of feed being used (Bryand, et al., 2006; Khoi, 2007). Good feeding practice is essential to control water quality and ponds' environment. Pellet feed was purchased mainly from local traders with the priority of common branch at the average price of $1.36US/kg. Feed trays were applied after one month of stocking to calculate feeding dosage. Farmers put some feed into the tray and waiting until running out feed. Depending on how long that feed was finished, farmers would decide appropriate

feed dose (Figure 4.7-a). Farmers manage feed efficiently with manual feeding and low feed conversion ratio (FCR) at 1.11 (Figure 4.7-b). All of farmers did not add any hormone or banned-stimulant to the diet. The feeding dose and time were complied fully to guidance as shown on the package. However, farmers prefer high ratio of protein feed (39.36%) to accelerate growth rate, but such feed is usually expensive according to them. The total feed cost shared 57% of the total investment cost at $7,205US/ha/crop. High ratio of protein feed (39.36%) to accelerate growth rate. However, increasing protein intake by increasing the daily ration does not lead to better growth, but raises feed conversion ratio as well as the pollution loading of the system (Quintero & Roy, 2009).

(a) **(b)**

Figure 4.7 – Images of Feeding Tray Using (a) and Manual Feeding Regime (b)

(Source: Author's survey, 2018)

3.2.5 Water Management

Of the interviewed farmers, 80% filled water from main rivers whereas the rest used water from small canals. The quality was evaluated at relative good (3.48 scores over the scale of 5 from bad to good). Most of farms regularly monitored water quality indicators using a toolkit together with senses. Aeration systems were applied to maintain optimum dissolved oxygen. Up to 74% of farms only supplied water instead of exchanging with the frequency of 13 days/time. Around 14% of water is added more into pond per time (Table 4.3). In another words, 4% exceeded to ideal water exchange of water in the pond (10%).

Table 4.3 - Water Management Practices

Indicators	Unit	Value	Standard deviation
Frequency of water supply	Days/time	12.54	11.22
% of water exchange/time	%	13.54	13.28
% of farms of supply water only	%	74	-
Quality of water	1-5	3.48	0.65

(Source: Author's survey, 2018)

Water for exchange and supplying was kept in the reservoirs with proper chemical treatment and disinfection reduces the problems of turbidity, algal bloom, and bacterial contamination and ensures uniform quality water throughout the cropping period (Sebastian, 2009). Farmers reported that no water supply when disease occurred at the surrounding area. However, very little declaration on disease outbreak from farmers to

managers was reported. For that reason, the regional disease control information network is not working well. Moreover, when the farmers were asked to score the quality of water for shrimp farming from the scale of 1 to 5 (the lowest quality to the highest quality), the average score of quality was 3.48, ranking relative good quality. It means water environment is still potential for shrimp farming in that area but consideration on water quality is necessary.

3.2.6 Waste Treatment

Waste treatment practice is very important for following cultivation a well as sustainable aquaculture. Within farming period, much waste are released into the environment that need to handle, including waste water, bottom sludge, solid waste and diseased/dead shrimps.

After harvesting, most of farmers used chemical for disinfecting water before discharging into the rivers (at 47% of respondents). However, 21% of farmers had no treatment toward after-culture water. Some cases have preferred probiotic products rather than chemical compounds since the trainings of VietGAP standard application. There were 8% of farmers still keeping water in the pond and stocked tilapia into the water. This practice not only takes advantage of natural water purifying function of tilapia but also increase income by harvesting tilapia. There was 10% of samples discharging water into another ponds and keeping within 15 days to a month for natural filtering before releasing. Within farming period, using of feeds and drugs/chemicals released huge amount of solid wastes. Chemical containers and plastic bags and perishable items were collected and destructed by 80% of farmers. The rest preferred collecting and purchasing as recycling.

Regarding bottom sludge, the majority of farmers took advantages of available lands surrounding house such as house's yard, rice field, orchard, etc. for disposing. It is better for farmers to dispose sludge away from the farm site but it is very difficult as farms were clustered. Half of them dispose on the pond's shore leaving a chance for the sludge to seep back to the farm during rains.

Table 4.4 – Waste treatment reported by farmers in Soc Trang

1. Discharge water	**% of samples**
Disinfection using chemicals	47
Stocking tilapia into the pond	8
Pumping water to another ponds	10
Release directly to river/canals	21
Using probiotic	13
2. Solid waste	**% of samples**
Collection and destruction	80
Sale as scrap/recycling wastes	20
3. Waste bottom mud	**% of samples**
Digging storage ponds	25
Covering to pond's shore	50
Pumping mud into the house yard	14
Delivering to rice/fruit cropping area	11

4. Diseased/dead shrimps	% of samples
Urgent harvest	35
Destruction/stop cropping	35
Using medicine for treatment	30

(Source: Author's survey, 2018)

Turning to diseased/dead shrimp treatment, in case of appearing dead shrimps, they are removed and buried away from the pond. Together with clinical manifestations, if mortality further increases rapidly, an urgent harvest was conducted by 35% of farmers. This case usually falls into serious diseases that were believed no efficient treatment and occur at least one-month post-stocking. Some diseases occurred early (less than one-month post – stocking) such as EMS, white spot disease, 35% of farmers left such crop within some months and waiting for further crop. Only 30% of farmers tried to treat diseases using medical feeding and drugs/chemicals but most of them informed inefficient treatment method.

Figure 4.8 – Evidence of Direct Discharge of Bottom Sludge into Natural Canals

(Source: Author's survey, 2018)

4. Results for Non-GAP System: Ben Tre Province

4.1 Respondent's Profile

The average value of age (47.7 years old), aquaculture experience (8.84 years), shrimp farming experience (6.94 years) and intensive white leg shrimp culture experience (5.3 years) show that such farming model has developed for 5 to 10 years when shrimp culture was lucrative and rice cultivation faced many problems (Khang, 2008). There were 4 to 5 people in shrimp farming family and 1 to 2 members engaged to shrimp activities due to small scale farming (Table 4.5).

Figure 4.9 reveals that most shrimp farmers are young and compass secondary school at 56%. Two percent of farmers had collegiate level of education but the same

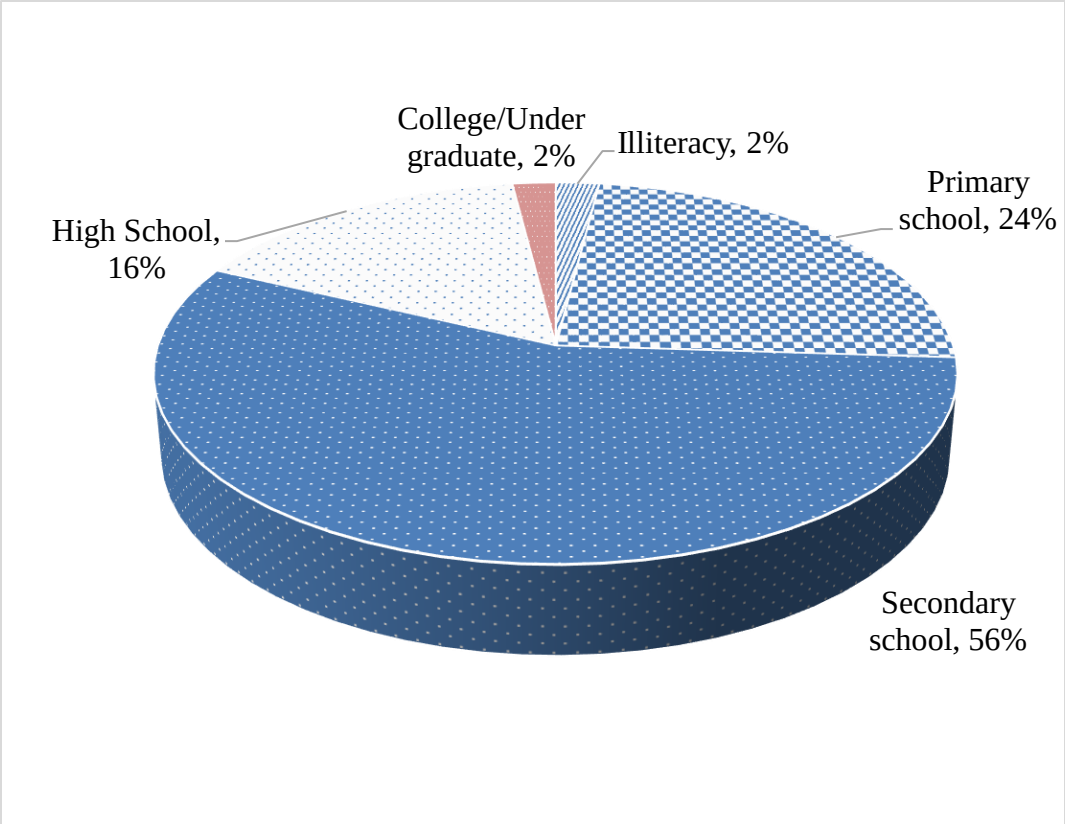
proportion of them was illiteracy. Almost farmers operated shrimp farming individually with normal process.

Table 4.5 - Farmers' Profile in Ben Tre Province

Indicators	**Unit**	**Average**	**Standard deviation.**
Age	Years	47.7	9.22
Number of people of the family	People	4.4	1.46
Number of people engaged in shrimp farming	People	1.58	0.57
Aquaculture experience	Years	8.84	6.18
Shrimp farming experience	Years	6.94	4.38
Intensive white leg shrimp culture experience	Years	5.3	3.04

(Source: Author's survey, 2018)

Figure 4.9 – Education Level of Farmers in Ben Tre Province



(Source: Author's survey, 2018)

4.2 Diseases Reported by Farmers and Economic Losses

There was 62% of farmers reported different diseases during last farming over 64% of the surveyed area. Three the most common diseases in Ben Tre province included intestinal disease (24% of farmers), white spot disease (18% of farmers) and hepatic disease (14%). White spot disease caused by WSSV which had occurred on nine farms with typical diagnosis of white spots appearance over the cephalothorax and abdominal exoskeleton, swimming along the shore and floating to surface, mass death within a few days (Li, et al., 2016). Red body, EMS, white feces disease and slow growth syndrome were reported by the rest 24% of farmers. Such diseases were stated rely on clinical

magnifications with unknown means of infection. Previous studies indicated that farmers were unable to identify certain causes of diseases, as they had little experience and limitation in diagnose and distingue between different diseases (Chanratchakool & Phillips, 2002)

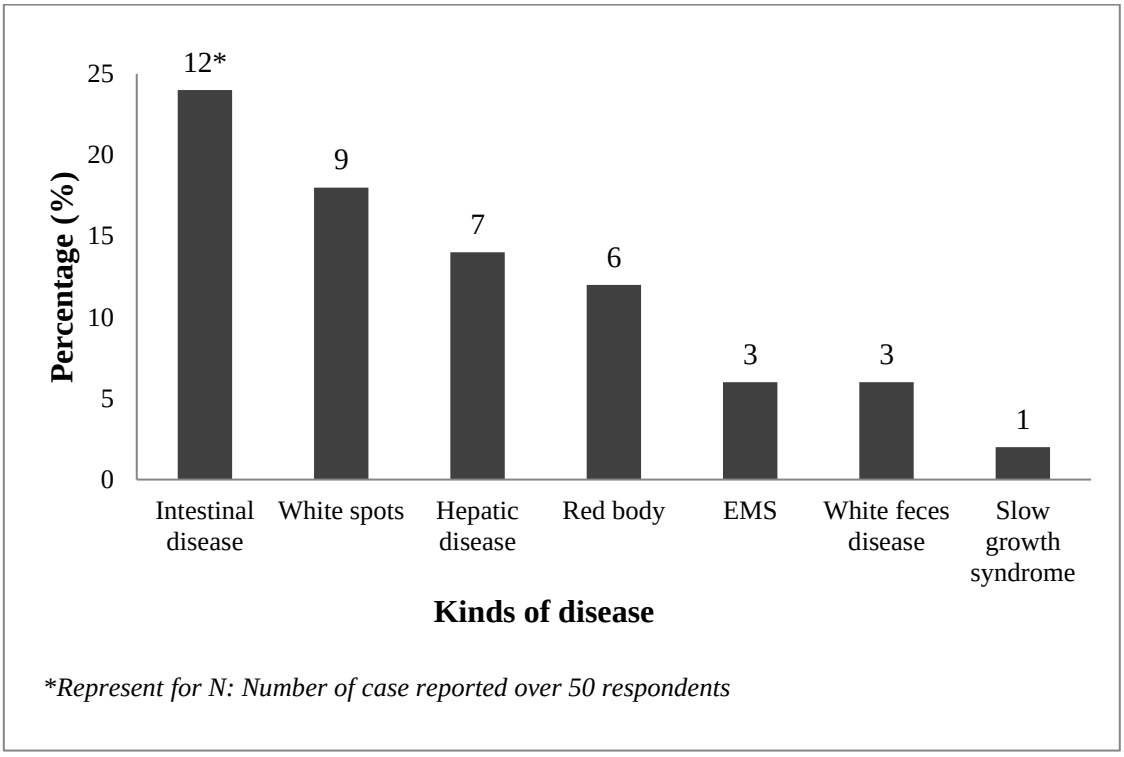


Figure 4.10 – Diseases within Last Crop Reported by non-GAP Applied Farmers

(Source: Author's survey, 2018)

As shown in Table 4.6, recent losses caused by diseases was significant with the decrease nearly half in production per ha (12.3 MT in successful crop, falling to 7.1 MT/ha in diseased crop). The diseases obviously had a severe effect on farm income with the losing amount being estimated at around $10,000 US/ha/crop. Apart from no or less harvest yield recorded, diseased crop also caused higher spend on chemical/drug cost at around

$5,468 US/ha/crop in comparison to $3,860 US/ha/crop. In cases of disease outbreak, 32% of farmers had negative profit. Such cases fall in to virus caused diseases or occurring early after stocking such as white spots, red body, EMS and several cases of hepatic diseases.

In Vietnam, attempts to eradicate the diseases have failed so far. White Spot Disease was responsible for the major shrimp farming disasters in Ben Tre and all shrimp areas in Vietnam, of which diseases caused by virus resulted in substantial economic losses.

Table 4.6 – Production and Profit Loses Caused by Diseases

Indicators	Units	Mean	Standard deviation
Yield per no disease reported crop/ha	MT	12.3	4.26
Yield per disease reported crop/ha	MT	7.10	2.01
Net profit per no disease reported crop/ha	$US	27,126	11,120
Net profit per disease reported crop/ha	$US	9,982	2,685

(Source: Author's survey, 2018)

4.3 Farming Practices in Non-GAP System

4.3.1 Farm Construction and Pond Design

Shrimp farming in Ben Tre is characterize by small-scale with almost households had a farm area less than 0.5 ha. Since the permission to convert low productivity agricultural area to aquaculture in the Resolution 09/ND-CP, the area of intensive/semi intensive shrimp farming has increased rapidly. The poorer farmers based on available and

restricted land to form shrimp ponds that resulted small grow out ponds. Normally, small holders tend to consider to short and economic term survival at the expense even understanding serious problems facing (Khang, 2008).

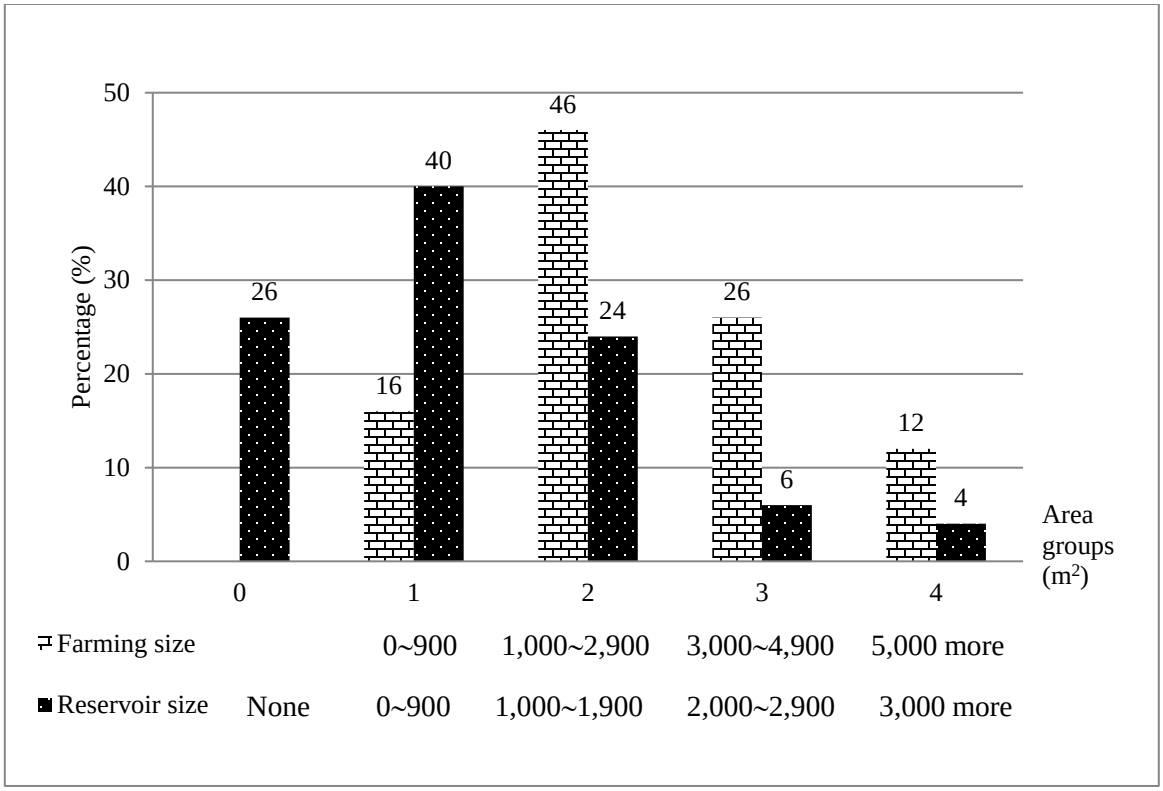


Figure 4.11 – Distribution of Farming Size combined with Allocation of Reservoir in non-GAP Applied System

(Source: Author's survey, 2018)

The surveyed result shows that total area of household was 8,600 m^2 with half of this area used for shrimp farming. However, stocking area in last crop was very small, at only 3.000 m^2. Almost farms did not have reservoirs for intake water. Normally, unstocking ponds were exerted as reservoirs. Nearly 46% of samples operated shrimp farm size from

1 – 3,000 m^2. The percentage of farmers who cultured 0.5 ha onward was insignificant (12%). The farm size was accompanied with the allocation of reservoir construction. Because of small land area, 26% of samples had no reservoirs, and 40% of farms constructed very small reservoirs (less than 1,000 m^2) that resulted in in-charge water being occasionally kept for disinfection. Only 4% of farmers had an area of reservoirs over 3,000 m^2. Grow – out ponds were small at just 1.810 m^2 but deep water at 1.75m. The ponds are designed with si-phon pit and using net surrounded to prevent pathogen carriers access shrimp ponds.

(a) **(b)**

Figure 4.12 - Images of Siphon Pits (a) and Surrounding Nets (b)

(Source: Author's survey, 2018)

4.3.2 Pond Preparation and Innovation

AA1 (2002) reported that pond preparation should be done through drying, tilling and ploughing (AA1, 2002). However, up to 60% of farmers did not care to remove bottom sludge unless there was a disease outbreak during last crop. There were even 8% of farmers still keeping previous post-farming water for further crop due to the belief of good water without pathogen and contamination in previous crop being advantage for current crop. Some cases try to dry bottom before pumping in charged water but very short time (2 – 4 days). The majority of farmers were unaware of keeping water in reservoirs at 80% before flowing to grow-out ponds. Application of disinfectants, lime and fertilization was good practice to enhance nutrient levels and maintain optimum phytoplankton.

4.3.3 Seeds and Stocking Management

More than 70% of farmers were aware of good PLs appear to be active swimming, well appearance and uniform size. Although most farmers had knowledge on optimum stocking density, they practiced at very high density at around 96 PL/m^2. In which, 16% of farmers stocked above standard (more than 120PLs/m^2), and 10% of farmers stocked below standard (<70 PLs/m^2). It is very important point for reduce disease risk as disease outbreak often increases with high density and culture intensity (Kautsky, et al., 2000). Seeds were stocked at size of PL11, smaller than national technical regulation on brackish water shrimp culture farm issued by (Ministry of Agriculture and Rural Development, 2014). Small size PLs are less resistant to environmental agents and high prone to loss during shipping and stocking. Almost farmers choose shrimp seeds from the central region of the country due

to traditional farming operation. And up to 96% of farmers rely on test document to choose virus free larvae.

4.3.4 Feed management

Feeding white leg shrimp in intensive farming model by pellet feed from the beginning is needed for faster and healthy growth (Fig. 4.13). Everyone understood that feeding is one of the most important factors determining growth rate of commercial shrimp (Sebastian, 2009). Most of farmers reported that they were full compliance to the guidance table shown in the package. It is believed that the dosage of feed should be administered by biologist working at feed processing companies who smoothly and give recommendations on diseases and feed (Bryand, et al., 2006). Due to selection of lower protein ratio at 36.29%, actual farming practice show that the FCR was 1.21 with average feeding times of 3 to 4 times/day. There were not specific criteria for FCR in VietGAP standard, however, the higher FCR, the lower feeding efficiency as high amount of feed being use. Therefore, 14% of farmers reported overfeeding with very high FCR (>1.4). Un-eaten feed could contaminate water, pathogenesis and harm shrimp as well as the habitat where the water is discharged. The fact that applying an appropriate feeding dosage not only saves money on feed by making sure it only supplies the shrimp with the amount of feed it needs but also reduces risk of disease outbreak by maintaining in-pond water quality (Khang, 2008). Farmers in Ben Tre chose various feed types rely on their experience and neighbors' and relatives' recommendations but quality of most of kinds were evaluated at good quality due to standardization of commercial feed industry.

Figure 4.13 – An example of pellet fed for white leg shrimp in Ben Tre province

(Source: Author's survey, 2018)

4.3.5 Water exchange/supply management

Water in shrimp farming includes initial in-pond and supplemental water together with rainfall (Anh, et al., 2010). Almost farmers only supply water instead of exchanging water to make up water to compensate for evaporation and seepage to very high rates of exchange from various sources such as tap water, ground water. Water use in shrimp farming is extremely variable, ranging from little to more than fresh water is normally used to mix with seawater in order to make up for evaporation in ponds and produce the optimum salinity, especially in the dry season (Khang, 2008). The picture shows how groundwater is compensated to the grow-out pond via a small tube. From one-month post-stocking onward, each supply time, nearly 16% of water is added into pond every 12.57 days. Farmers evaluated water at low quality and almost base on sensory monitoring of water

management without using any toolkit. Stocking water in reservoirs were not practical in some cases and even where it was possible people were found to use the reservoirs also as grow-out ponds and vice versa.

Table 4.7 – Water management practice in shrimp farming in Ben Tre province

Indicators	Unit	Mean	Standard deviation
Frequency of water supply	Days/time	12.57	12.26
Percentage of water exchange/time	%	15.65	15.93
Percentage of farms of supply water only	%	86	-
Quality of water	1-5	2.94	0.89

(Source: Author's survey, 2018)

Figure 4.14 – Compensation of Water via Tube Connecting to Ground Water

(Source: Author's survey, 2018)

4.3.6 Waste treatment management

Water removal was done after ending of production crop which is rich in nutrients and organic matter due to be derived mainly from waste food, metabolic products and over-use of feed. Thus, it is very important to have efficiency in waste water treatment (Khang, 2008). There were 48% of farmers stocking post-farming water to another pond before releasing for depositing contaminants and organic matters. More than 30% of respondents usually used chemical of probiotic compounds for treatment while the rest still released directly into the natural rivers or canals notwithstanding disease situation at previous crop. Farmers were poor aware of solid waste treatment when more than half of them expressed their disregard to such problem. Some cases still reported no treatment for solid waste, i.e. chemical containers, bottles, cans, paper, and plastic bags. Hence, there were much solid wastes floating in natural canals (Figure 4.15-a). In terms of bottom sludge treatment, for households owning extra available land, small ponds or trenches were dug to dispose (64%). The farmers tried their best in reducing direct discharge of sludge by utilizing available land such as pond's bunk, house yard (Figure 4.15-b) or cultivation land as storage space. With the aim of prophylaxis and against shrimp diseases, many types of chemicals compounds/drugs were used.

(a) **(b)**

Figure 4.15 – Examples for Floating Chemical Containers (a) and Disposing Sludge into House Yard

(Source: Author's survey, 2018)

Farms with higher stocking densities as reported were found to use more chemicals, both in terms of number and the quantity applied (Sebastian, 2009). In occasion of disease outbreak and high stocking density in Ben Tre province, 55% of farmers still believed in chemical usage for treatment disease. Even 26% of them confirmed that they still used banned antibiotic in shrimp farming. Most of cases of diseases occurring less than one-month post-stocking days, farmers had no reaction on treatment, just destructing crop and waiting for new crop as no shrimp yield harvested (37%).

Table 4.8 – Waste treatment reported by farmers in non-GAP Applied System

1. Discharge water	**% of samples**
Disinfection using chemicals	27
Pumping water to another ponds	48
Release directly to river/canals	21
Using probiotic	4
2. Solid waste	**% of samples**
Collection and destruction	4
Sale as scrap/recycling wastes	93
No treatment	3
3. Waste bottom mud	**% of samples**
Digging storage ponds	64
Covering to pond's shore	21
Pumping mud into the house yard	2
Delivering to rice/fruit cropping area	13
4. Disease/dead shrimps	**% of samples**
Urgent harvest	8
Destruction/stop cropping	37
Using medicine for treatment	55

(Source: Author's survey, 2018)

5. Major Constraints in Disease Management Faced by Shrimp Managers and Farmers

The shrimp farmers and managers who were interviewed for the study were asked to list the problems by them according to governmental and farming reasoning.

It is evident from Table 4.9 that, there were several major problems in governmental reasoning. Unfollow recommended cropping calendar from authority was listed firstly by managers. Shrimp diseases tend to show up during rainy season due to sudden drop in temperature, pH, salinity and other favorite indicators (Siriwardena, 1997). Thus, unfavorable months for shrimp culture are proposed by managers but not fully compliance as the continuing crop whole year for the financial objective. Additionally, it is difficult to manage quality of shrimp seeds across the province. Seed testing is one major step before being stocked. Seed will be tested when local hatcheries sell seed or seed import from other provinces. Test results are normally lower than planned, for example in 2005 only 70 % of the seed was tested even though the plan called for 100% of seeds to be tested. Total shrimp fry sources include local hatchery operators and imported from other provinces or central region (Khang, 2008). Migration and shipping shrimp PL across the province make it difficult to monitor the seed product. Moreover, small-scale and fragmented shrimp farming, little declaration of disease, un-strict punishment of illegal activities such as releasing sludge directly and poor awareness were mentioned.

In the farmers reasoning, problems in climate change, spreading of pathogens quickly, poor technique and awareness, high cost of disease treatment, little information on disease outbreak and uncontrolled seeds quality are considered.

Table 4.9 – Box of Problems in Disease Management Regarding Governmental and Farmers' Reasoning

Governmental reasoning	Farmers' reasoning
• Not followed cropping calendar • Manage seed quality • Small scale and fragmented farming • Less declarations when disease outbreak • Penalizing illegal activities is not strictly. • Limitation in people's awareness.	• Weather changes abruptly • Disease pathogen spread quickly • Limitation of technique and awareness • High capital for disease treatment • Lack of information on disease outbreak • Uncontrolled quality of seed

(Source: Author's survey, 2018)

As a result, water that is either not up to specifications for shrimp farming or contaminated with diseases from wild shrimp populations could be accidentally used. This may be one of the means of transport of infections such as vibriosis, NHP, or WSSV into ponds. Therefore, careful monitoring of the water as it enters the farm system could help prevent infections in the cultured shrimp.

6. Key Takeaways from the Study of Disease Control

After analyzing the differences between Gap and non-GAP from two provinces, it is concluded that:

① The situation of disease outbreak in VietGAP system was less serious and lower economic failure than farmers in non-GAP applied system.

② Generally, farmers in VietGAP system control disease better than farmers in non-GAP system throughout multiple of control points. Sometimes and somehow farmers in VietGAP system did not comply fully with the regulations of sludge treatment and disease reporting with managers. Therefore, VietGAP role is not to generate high profit but to provide insurance for losses due to disease outbreaks. The next study will focus on the role of VietGAP in quality and food safety management.

Chapter V

CURRENT SITUATION OF VietGAP SYSTEM IN SHRIMP FARMING: FOCUS ON QUALITY MANAGEMENT OF WHITE LEG SHRIMP *(Litopenaeus vannamei)* INTENSIVE FARMING

Summary

As the rapid growth of White Leg Shrimp intensive farming, Vietnam has received many warnings on quality and food safety from import markets. This chapter illustrates the results of the second survey, focus to clarify the situation of quality and food safety between two systems. The survey was conducted over study sites of Soc Trang and Ben Tre after the first survey one year later in order to analyze the differences between GAP and non-GAP systems. The research result also indicated that farmers who applied VietGAP certification could produce higher quality of shrimp products and food safety, especially less rejection from processing companies. Farmers in non-GAP system, in contrast, had more freely in usage of chemical compounds, including antibiotic as no monitoring quality program, therefore, higher ratio of rejection as the violation of pesticide residues. Differences in farming practices between VietGAP system and non-GAP system could contaminate quality of shrimp also were described in this chapter.

1. Research Questions and Objectives

A growing customer demand for high quality products has imposed manufacturers and traders have no choice but to make good and safe products. Actually quality management is dified as a set of activities and decision performed in an organization to produce and maintain a product with a desired quality level (Khoi, 2011). So, such disired quality level in the farming state is food safety, because farming practices of farmers affect directly to the food safety and stop at harvest stage. Therefore, the term of quality management in this study will focus on food safety.

Therefore, there is an urgent requirement for shrimp farms to apply aquaculture certifications as principles involved in providing possibility to control quality and safety (Principle 2: Food safety and quality). The application of VietGAP standard is very important to shrimp farming to deal with the problem of disease management regulated in Principle 3 (Quyen, et al., 2019). Although application of aquaculture standards is growing, these practices are not being fully complied with to what extent. Furthermore, there were restrictions in farmer's awareness of quality control at the farm sites because the farmers supposed that their responsibility on quality ends at selling node, immediately after harvesting. Whereas official quality management programs like HACCP do not apply in primary state/farm point. The shrimp farming industry also lacks of administrative, technical and financial capacity due to small-scale and fragmentation characteristics (Loc, 2006; UNEP, 2016). Thus, why the quality problem has been still problematic to many shrimp farms even certification applied farms? The study came up to offer two questions:

① What are quality needs for shrimp products to the farmers? and

② What kind of farming practices affect to quality of products at the farm site?

The study aims to answer above questions by setting up two objectives:

① To clarify the status of quality reported by farmers;

② To investigate the factors in farming practices resulted in unsafe products and how to improve for better quality control and safe guarantee for export.

2. Methodology

Chapter IV indicated reasons why Soc Trang and Ben Tre provinces were chosen for study. The chapter also described aquaculture and shrimp farming contexts of the two provinces. At the time of field survey, shrimp farming in Soc Trang province expands steadily VietGAP system. On the other hand, Ben Tre province locates on the other side of the MD where individual shrimp farms with non-GAP have been outstanding. Such species farming in the province is characterized by small-scale, with the majority of farms having an area less than half a ha (Nhuong, et al., 2013).

A mass survey among 100 shrimp farmers was conducted in Soc Trang (50 respondents) and Ben Tre province (50 respondents) in 2019 using semi-structured questionnaire (Appendix 4). From an official list provided by authorities, potential shrimp farmers were selected rely on stratified sampling. After that, face-to-face interviews with these farmers were carried out in local language. The “snow-ball” sampling method also was use similarly to the study one. The questionnaire was designed to gather farmer’s information and awareness on research topic, especially quality situation and farming

practices related to quality control and food safety. For that reasons, the questions were allocated into five categories:

① Respondent's profile: name, age, education level, farming experience, labor use, training, etc.

② Farming practices: production scale; pond design and preparation, seed selection and stocking management, feeding management, water monitoring, veterinary drugs and chemical use, etc.

③ Harvest and sales: selection buyers, forms of sale, harvest information, commercial size, price, volume, value, premium price for passing food safety test, etc.

④ Quality situation: buyer's requirements, safety test of products, quality rejections from processing company, ability to meet the requirements, etc.

⑤ Farmer's awareness: effect of farming practices to quality, advantages and disadvantages, future of shrimp farming, etc.

3. Respondents' Data

The majority of farmers surveyed in VietGAP applied system had long farming experience at 17.04 years and was a junior high school (45.5%). All farmers had known about shrimp quality and safety through trainings, propaganda programs and culture shrimp according to VietGAP standard but very little of them having been awarded certification due to lack of auditing cost support and no specific price premium. Actually, local government had remarkable effort to spread out VietGAP scheme at the early state such as providing training courses and toolkit transfer, partly financial support for auditing cost

thanks to several projects, companion them in VietGAP procedures. However, there are many barriers in spreading VietGAP as the real purpose of standard is not focus on financial benefit to farmers, therefore they do not have incentives and motivation to acquire and maintain VietGAP. Being members of cooperative also facilitated them to monitor quality of product better because they can learn and exchange comprehensive technique, and join in input supply contracts signed by cooperative. Farmers in non-GAP applied system are individual farms with shrimp farming experience being from six to eight years. They were relative high education at high school and undergraduate (23%). Farming technique was gathered from annual trainings organized by related authorities but unfrequently; and experience at 13.2 years.

Table 5.1 – Respondents' Characteristics

Categories	**VietGAP**	**Non-GAP**
Number	50	50
Location/Province	Soc Trang	Ben Tre
Gender (Male/Female)	69/31	70/30
Production type	Cooperative	Individual
Standard following	VietGAP	none
Certificate awarded (%)	27%	None
Average age (Years)	51	50

Shrimp experience (Years)	17 - 18	12 - 13
Shrimp species	White Leg Shrimp	White Leg Shrimp
Intensive model experience (Years)	3 – 5	6 – 8

(Source: Author's survey, 2019)

4. Quality Control in VietGAP Farming System in Soc Trang Province

4.1 Control Procedure Related to Quality and Food Safety in VietGAP Certification

The VietGAP standard consists of five principles and 45 criteria which were designed to regulate responsible aquaculture. Regarding guidance on food safety, Principle 2 is placed out with compliance criteria to regulate food safety. Moreover, some control points in other Principles associated with quality control and food safety also were inferred. The brief explanation is shown in the Table 5.2.

Table 5.2 - Brief Explanation of Control Points* and Compliance Criteria Regarding Quality and Safety in VietGAP**

Control Points	Compliance Criteria
1. Water use	-Check quality of in-take, in-pond and discharge water by themselves or services regularly (10 quality indicators) -Reservoirs have to be accounted for at least 15% of the area
2. Feed use and Feeding regime	-Dosage and feeding based on producers' instruction or guideline from professional staff with system to ensure the amount of feed given in accordance with the needs and appetite -Storage in solid shed to ensure quality of feed sacks and inspection monthly, do not use expired products
3. Drug/chemical use	-Only use products (especially antibiotics) approved by the relevant competent authority for use in aquaculture. -Using limited products: stopping use at least two weeks prior harvest for normal chemical and earlier for veterinary drugs.

* Control Points are check points that are necessary to manage production process

** Compliance Criteria: It is a desirable state of farm management for each control point, and it is an objective criterion for evaluation

	-Dosage based on producers' instruction or guideline from professional staff. -Stored in a secure lockable store and under conditions. -All expired products are discarded and recorded. -Doing diary record
4. Farm and pond sanitary pre and post-culture	-Predator control: can use equipment, chemicals and instrument during pond preparation. Only preventive methods such as purse seine, puppet… -Dredged bottom sludge: before releasing PL. -Break time between 2 crop guarantees (at least 30 days).
5. Seed and stocking	-Certified hatchery; Transportation time: does not exceed 8 hours -Free from known diseases: white spot, yellow head, slow growth syndrome -Size: PL12 (9 – 11mm); Density: 40 – 150 PLs/m^2
6. Harvest and Transportation	-Harvesting and transportation are undertaken in an appropriate manner to ensure food safety. -Documented harvest and transport where applicable are in place

(Source: Adapted from VietGAP Standard issued by MARD, 2015)

4.2 Identification of Farming Practices Related to Quality and Safety Control

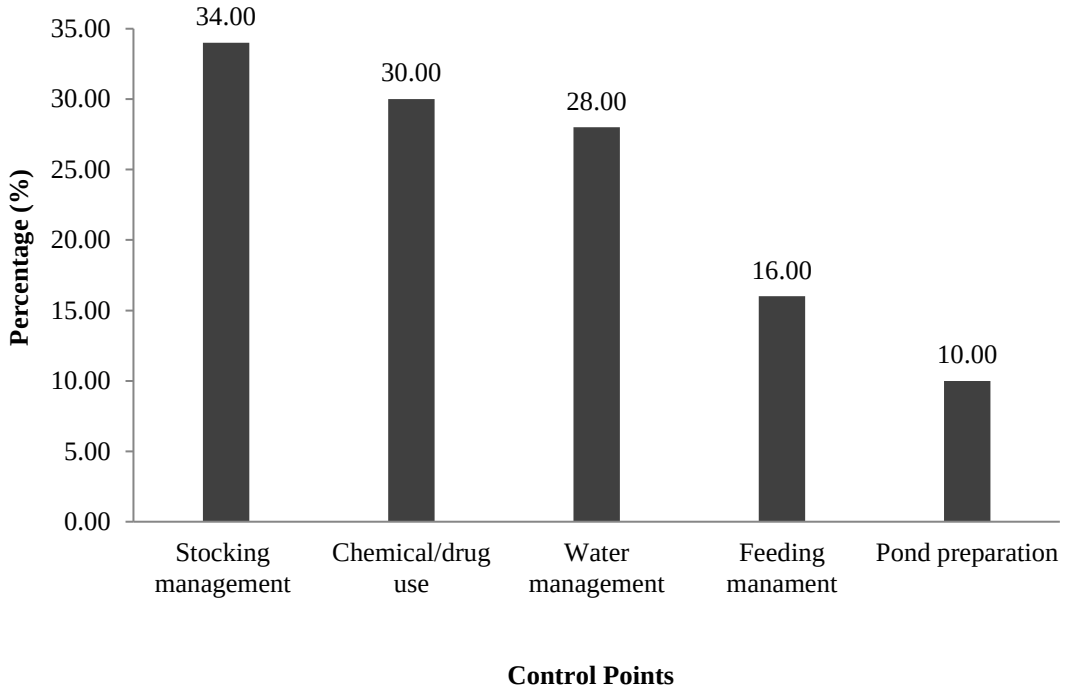


Figure 5.1 – Identifying Control Points Reported by VietGAP Applied Farmers

(Source: Author's survey, 2019)

At the on-site farm level, for success in aquaculture management and food safety control, apart from social, marketable and environmental factors, it is necessary to manage well production practices includes farm construction and design features, feeds, fertilizer, seeds, water quality, chemicals use, production technique (Quyen, et al., 2019); (FAO/NACA, 1995). Five identified control points were stocking management, knowledge in chemical use; water monitoring (identified mostly by 73% of respondents), feeding management and pond preparation (Figure 5.1). Farmers' identification regarding control points of quality management was basically like the principle of the VietGAP standard,

exception for harvest and transportation because the buyers are responsible for this stage. This means the farmer's responsibility end at the selling node.

4.3 Practices of Compliance Criteria in Quality Management of VietGAP System

Thus, how these practices in pratical situation effect to shimp quality? The farmers always attribute poor seed quality and stocking for crop failures and difficulties in quality control (Sebastian, 2009). Up to 85.5% of farmers chose virus-free PL from local hatcheries assigned through contracts signed by cooperatives. This practice helps to ensure the quality to some extent in terms of reducing disease outbreaks and production failures due to seed problems. However, still 15% broke the recommended practices to choose untested seed because of low purchasing price. Moreover, most of farmers did not know exactly which kinds of virus were tested from the PL stage. They only stated out the virus of WSSV and slow growth syndrome. Shrimp were stocked at a low density of 42 PLs/m^2 that help to reduce stress and monitor unexpected shrimp health problems, even 10% of farmers stocked below recommended density (<40 PLs/m^2). Most farmers reported ideal stocking density and shipping time does not exceed 8 hours in VietGAP standard and adherence strictly.

Chemical use such as toxic heavy metal, antibiotics and organochlorine pesticides posed serious hazards to the quality of products, especially veterinary drugs/pesticide residues for shrimp product. Famers of the province complied with the monitoring programs of VietGAP which means probiotic compounds were used priority thus decreased probability of antibiotic usage in shrimp health management (Suzuki & Vu, 2017). Most farmers used chemicals/drugs following guidance and principles of VietGAP certification

or in combination of guidance and their own experience (56%). Although there were still 44% of them base on their personal knowledge and experience in chemical using, they were confident to state out their good practice of chemicals use thank to many trainings that they already joined (Figure 5.2).

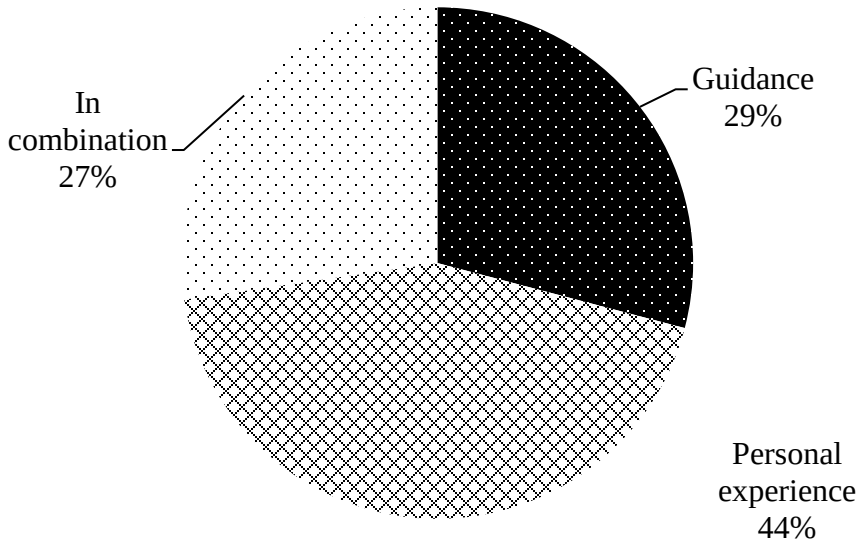


Figure 5.2 – Knowledge of Chemical Use Reported by Farmers in Soc Trang

(Source: Author's survey, 2019)

Poor water quality and monitor is one of risk factors related to disease outbreaks and yield down production (Sebastian, 2009). In charge water was kept in reservoirs, managed with chemical treatments and disinfection methods within 13 days to stabilize turbidity, facilitate growth of plankton at appropriate density because sometimes algal bloom makes bad color of shrimp, and reduce the spread of pathogens through water taking.

The area of reservoirs was 2,082 m^2 per farm, accounting for 35% of the total area and meeting the control point VietGAP (minimum area at 30% of the farm's area) (Quyen, et al., 2019). Water quality indicators (pH, dissolved oxygen, salinity, temperature, etc.) were maintained at optimum level by toolkit/chemicals (76.8%). Some farmers took in-pond water samples to check at the inspection services (3.6%) if they want more exactly results.

The impacts of feeding management on shrimp quality are expressed by the quality of feeds and the way of feeding. The majority of farmers purchased feed directly from companies or agent level 1 (67.3%) where they can ensure the quality and receive some promotion programs. Feed sacks were stored within nine days in the solid warehouse to comply with VietGAP. Multi-feed feeding was not recommended in mono-shrimp culture by expert, this means three types of feed, i.e. starter, grower and finisher with different sizes and quantity should be used separately according to shrimp farming period and guidance on the package. These practices help to produce shrimp products with high quality of meat, beautiful appearance and non-soft shell. Feeding mechanism was managed efficiently by feeding trays, low FCR at 1.11, and diary recording which was beneficial for traceability. No report of high FCR was observed.

Pond preparation is an essential stage for the reduction disease outbreaks, thus provide clean products without contamination and reaching marketable size (Quyen, et al., 2019). Bottom was ploughed regularly every two crops or after diseased crop, fried and compacted within two weeks to eliminate residual germs. However, farmers found it difficulties to control biological predators because large size of pond (2,485 m^2/pond),

shallow (1.17m) which inhibited them to design siphon pit, plastic lining and using surrounding net as recommendations in VietGAP certifications.

The farmers have considered to the role of personal farming technique in shrimp quality management. Personal technique allows them to approach advanced farming technology, modern facilities and comply fully with quality standards. The majority of farmers had long farming experience at 17.04 years and was junior high school of educational level (45.5%). The ratios of farmers who belong to primary school and high school were 40 and 14.5%, respectively. Almost farmers had known well about shrimp quality and safety through many trainings and propaganda programs of VietGAP certification (82.1%). Being members of cooperative also facilitated them to produce good quality products because they can learn and exchange comprehensive technique and join in many quality input supply contracts signed by cooperative.

The quality and safe products are come from necessary activities at the farm sites together with various sanitary and quarantine activities. The local authorities such as DoF and Extension Services have significant supports to farmers. They provide many technical training courses for producing quality products and services related to disease management and suppression. Water and shrimp material samples are taken regularly for checking and announce results widely. Many toolkits for water monitoring were transferred to farmers to monitor and adjust their actions timely. They also provide services related to manage materials such as PLs, feed and chemical compounds for. Local authority is responsible to disease management and suppression timely.

5. Current Situation of Quality Control in non-GAP Applied System

5.1 Identification of Farming Practices Related to Quality and Safety Control

Similarly, five factors of farming practices were identified by farmers and shown in the Figure 5.3 like Soc Trang province. More than 80% of respondents could identify stocking, chemical use and water monitoring easily as their direct impact dimension of these practices in quality control and food safety. Feeding management, pond preparation and personal technique/knowledge were mentioned by 12.70, 7.94 and 6.35% of respondents, respectively.

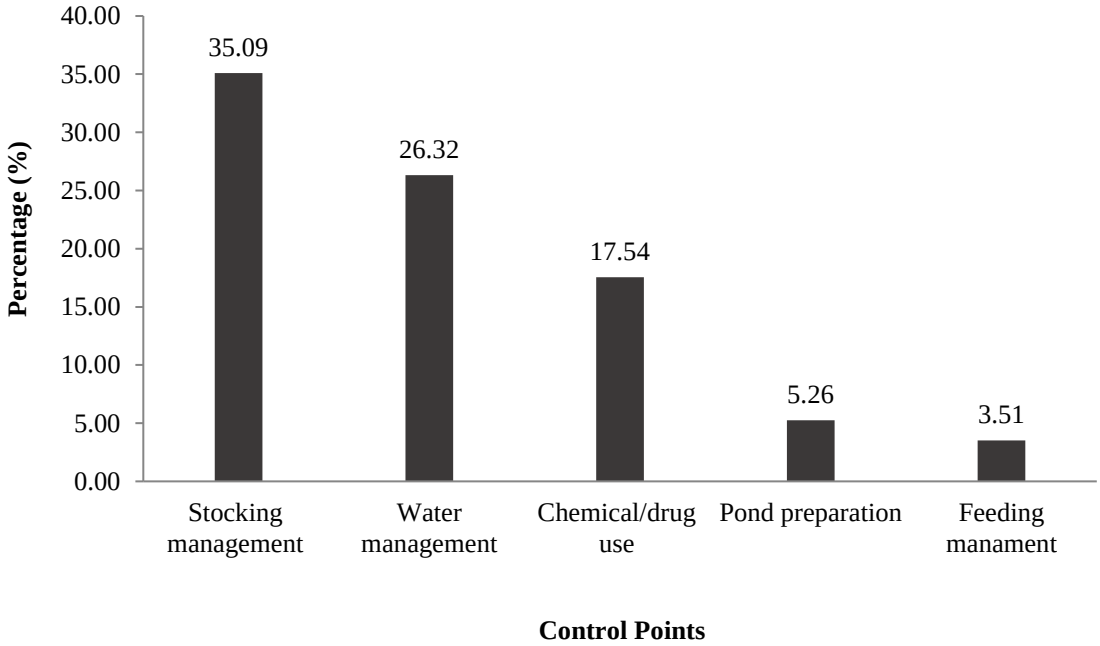


Figure 5.3 – Identifying Farming Practices to Quality Control and Food Safety Management Reported by non-GAP Shrimp Farmers

(Source: Author's survey, 2019)

5.2 Practices of Control Points in Quality Management of non-GAP System

It is opined that quality of PL is very important in success of shrimp culture (Sebastian, 2009). However, there were only 59.6% of farmers choosing seeds with disease pathogen test such as WSSV by Polymerase Chain Reaction (PCR) method although they were aware of the importance of PCR test in quality of PL because they preferred low price. It seems that the remaining 40% of farmers do not get good quality seeds. More importantly, there was a correlation between stocking density and disease outbreak. In spite of awareness on optimum density, farmers had familiar with high stocking density practice at 89 PLs/m^2 that easily lead to stress and disease outbreak. Once an outbreak occurs, chemicals/drugs were used indiscriminately and some of them are prohibited (which would result in antibiotic residue latterly). Most farmers used chemical compounds by their own personal experience (60%) without any monitor program of residue periods (Figure 5.4). Most of them did not know the properties and proper dosage. Specifically, 33.3% of farmers examined the use of antibiotics to combat bacterial diseases, 26.8% of them belongs to banned list such as ciprofloxacin, enrofloxacin, etc. there was even 22% of farmers could not remember what types of antibiotic that they used because they have almost no diary records or record for other purposes of accounting rather than traceability. It is reported that the use of antibiotic was stopped 11 days prior harvest time. However, it is required from two to four weeks to reach undetectable level for several frequent types (Shrimp Culture, 2019).

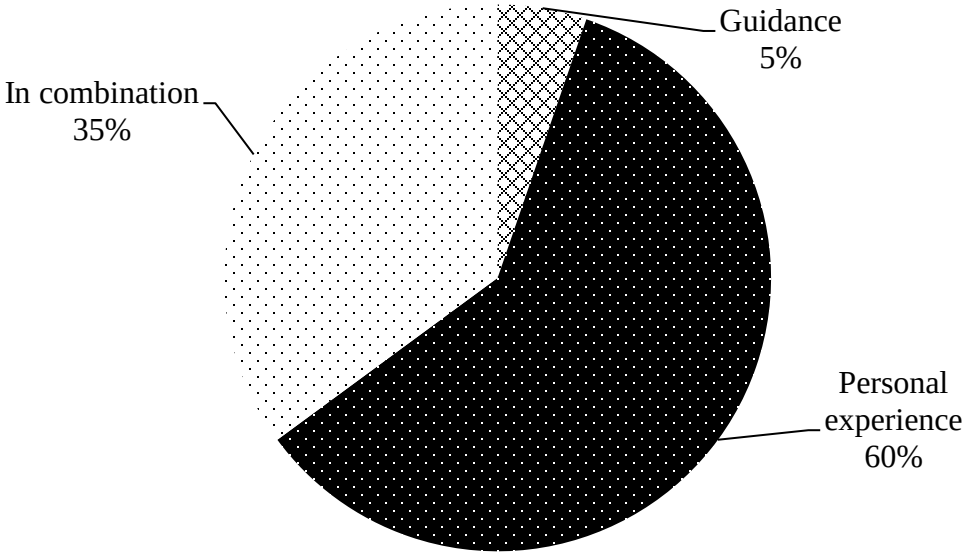


Figure 5.4 – Knowledge of Chemical Use Reported by Farmers in Ben Tre

(Source: Author's survey, 2019)

Even though having awareness on favorable water quality indicators, farmers did not test them frequently. More than 60% of respondents tested water unfrequently, yet when they saw shrimp to be suffered from water environment. These indicators included salinity; pH; dissolved oxygen; color, etc. mainly tested rely on sense of human. In-pond algae/phytoplankton density was controlled insufficiently by 30% of respondents that lead to the bad color of commercial shrimps latterly. Some of them reported the effect of algal bloom to the color of shrimp product seriously unless they can control bloom of algal timely (Figure 5.5). Water replacement in the reservoirs with proper fertilization and disinfection could reduce problem of turbidity, algal bloom and bacterial contamination.

However, only 75% of farmers stock water in the unstocking ponds, which means that they do not have separate reservoirs because of lack of land. Thus, they used grow-out ponds function as reservoirs.

Figure 5.5 – An Example Picture of Algal Blooming in the Shrimp Pond

(Source: Author's survey, 2019)

Small-scale shrimp farming in Ben Tre facilitates good practices of pond preparation and fertilization. Si-phon pit (70%) or plastic lining (30%) make it easy to deposit suspended matters and remove bottom sludge. Whereas construction of net fences surrounding ponds to prevent shrimps from biological predators and pathogen carriers such as birds, frogs, crabs, even people in some cases. Farmers generally dried bottom before stocking begin within 11 days which did not comply to recommend period. Which means drying time was too short to do disinfectants, lime, and fertilization; therefore, it was properly pathogens still remaining.

Feed and feeding management is very essential in shrimp farming, not only the quality of feed but also the way of feeding. Because of small-scale and fragmented farming, farmers usually purchase feed from level 2 agents locate near by the pond for convenient distribution (71.6%). Feed supply was stated always available; thus, they were unnecessary to keep feed sacks for long days (7.23 days). However, farmers constructed temporally sheds, even a small roof to cover feeds or no shed, which could affect to quality of feed such as molding and useless. Feeding method was a combination of feeding tray with hand feeding (60%) and machine (40%) (

Figure 5.6), respectively. Feed trays help farmers manage feeding dosage effectively as they can adjust amount immediately. However, feeding machine was recommended in feeding because such machine works whole day around, thus shrimp can eat whenever they want, and shrimps properly grow faster. However, overfeeding could be happening as feed was not consumed completely. It is important since leftover feed can contaminate water and harm shrimp and habitat, and after that effecting indirectly quality of shrimp products.

Figure 5.6 – An Example Picture of Feeding Machine Using

(Source: Author's survey, 2019)

Farmers had awareness on impact of personal knowledge and technique on quality of shrimp. The ratio of farmers who applied modern technique (i.e. feeding machine, plastic lining) was high as a consequence of relative high education level (high school and undergraduate accounted for 23% of respondents and no literature). Farming technique was gathered from annual trainings organized by related authorities such as DoF and extension services but unfrequently; and accumulation from their own experience at 13.19 years. Although most farmers had knowledge on the impact of antibiotics on quality of products, they still used occasionally in disease prevention and treatment.

6. Commercial Shrimp Sales and Quality Situation Reported by Farmers

6.1 Situation of Quality and Safety of Shrimp Produced in VietGAP System

All intensive shrimp farms usually apply full harvest method by using dragging net. Finding/contacting buyers were done a couple of days before intended harvest. The purchasing process was done at the farm gate and the buyers are responsible for shipment products and distribution. Therefore, farmers' responsibility on quality ends at selling node, immediately after harvesting. According to the survey, approximately 56% of harvest shrimp materials were sold to small traders or collectors. This is a simple – buying regime of storing and shipping shrimp after several days of filling enough a single container to the processing companies or domestic consumption. Small traders are unable to purchase shrimp products with larger volume (> 1 MT per transaction as the limitation of infrastructure). As farming operation following VietGAP certification or contracted farms, farmers had higher ability to sell shrimp directly to the processing companies or trader network of the companies if they think that they could ensure the quality and food safety within farming practices (29%). The others could sell to wholesale buyers when high yield is harvested per time. In some cases, contracted farmers, however, sell to the collectors and/or wholesalers because it is not always possible to enforce a contract between farmers and the processing companies. In Soc Trang province, 81% of shrimp were exported and only 9% were consumed domestically.

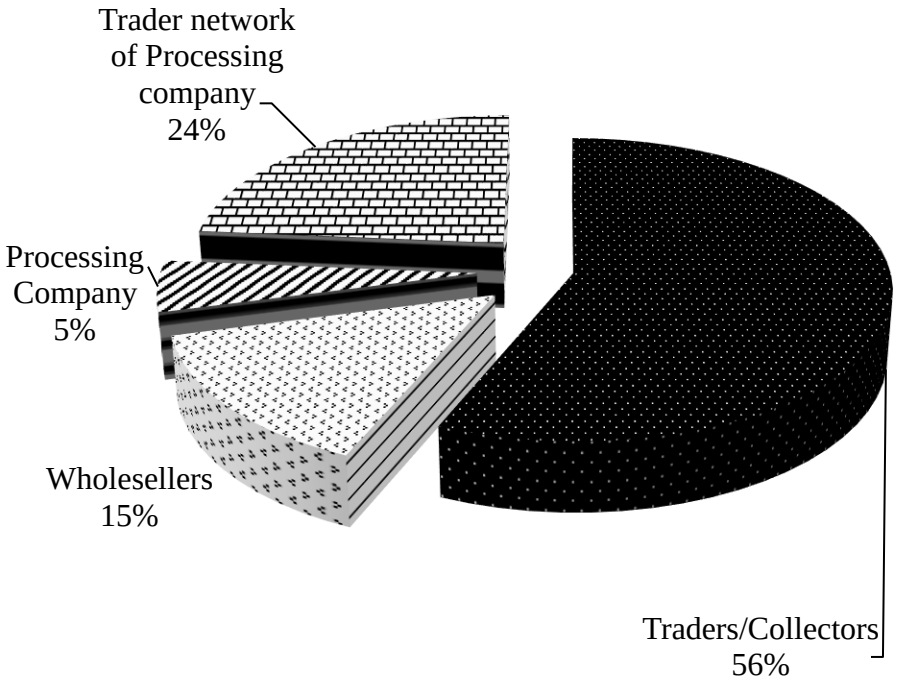


Figure 5.7 – Forms of Commercial Shrimp Sales in Soc Trang province

(Source: Author's survey, 2019)

As the majority of commercial shrimp products were exported, buyers' requirements were focusing to food safety, which means that no antibiotic residues and other contaminants were required to be ensured (55.29% respondents). For both export and domestic consumption, the buyers had the consideration on size (17.65%) - the bigger size the higher price. Brighter color was preferred rather than dark color as it makes beautiful dishes after cook. Moreover, nice appearance indicator was important to nearly 11% of buyers as they require shrimp to be intact, without losing tails or beards, no black spots,

etc. Only wholesalers required quantity to enough one container per time for them to ship directly to processing companies (2.35%).

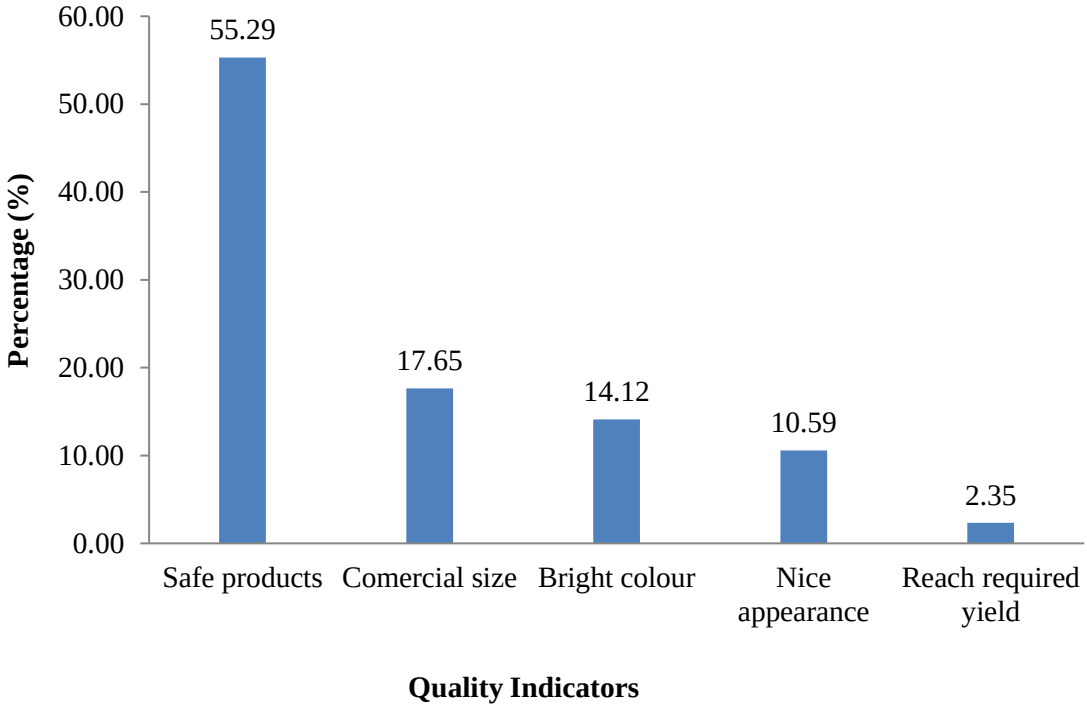


Figure 5.8 – Quality Requirements from Traders/Buyers

(Source: Author's survey, 2019)

Over 50 respondents of the survey, a total of 384 crops was harvested within previous three years (Table 5.3), of which, 50% experienced disease outbreaks (Quyen, et al., 2019). Of which, 164 successful crops (reaching commercial size of 100 individuals/kg) were tested at the processing company's lab and only three transactions of violations were recorded. The reason resulted in food unsafety reported was antibiotic residue and other contaminations, but problem related to antibiotic residue happen two previous years when farmer still not familiar with VietGAP. The rejected container could

be purchased at an average price for domestic consumption or export to markets with lower requirements. Farmers have tried to pursuing food safety test as they are hopefully acquiring an extra price for their products at $0.14US/kg. This extra price did not come from VietGAP certified products. Any shrimp transaction will be awarded an extra price if it compasses the quality test at the processing company matching the requirements of the specific import markets. The farmers assessed themselves as having a high ability to meet the quality requirements set by the buyers (80%) as they have experienced on many certification trainings and support programs from related authorities and organizations.

Table 5.3 – Situations of Quality in terms of Food Safety for Export

Categories (1, 3, 4 calculated as a sum over 50 samples)	Unit	Mean (n=50)	Standard deviation
1. No. of shrimp transactions within the last three years (cumulative calculation over 50 respondents)	Transactions	384	-
2. Percentage of disease outbreak reported	%	50	-
3. Number of transactions being quality tested	Transactions	164	-
4. Number of transactions being rejected	Transactions	3	-
5. Extra price for passing on test	$US/kg	0.14	0.01
6. Average size	Inds./kg	76	23
7. Average selling price	$US/kg	4.89	1.1

(Source: Author's survey, 2019)

6.2 Situation of Shrimp Quality and Safety Produced in non-GAP System

There were indifferences in harvest method between two systems, however, different from Soc Trang province, the shrimp industry in Ben Tre is dominated by small-scale producers with average harvest yield at just less than one MT/time. Therefore, small traders/collectors were functional who consumes 68% of shrimp products. Small traders/collectors reside in communes where allows them to collect and mix shrimp from tens of kilograms to a container for shipping to processing companies. This indirect purchasing system made it's difficult to ensure traceability from the point of origin when export. Only some farms with high harvest yield could sell shrimp directly to processing companies at 2%, and 26% of farmers sold their products to wholesale buyers who locate at the local area also but having their own construction/infrastructure for business (

Figure 5.6). For domestic consumption, 38% of shrimp products were sold from collectors, wholesalers or processors to supermarkets, local markets, and seafood restaurants. This consumed channel does not require safe products by testing but large size and fresh/alive products are most preferred.

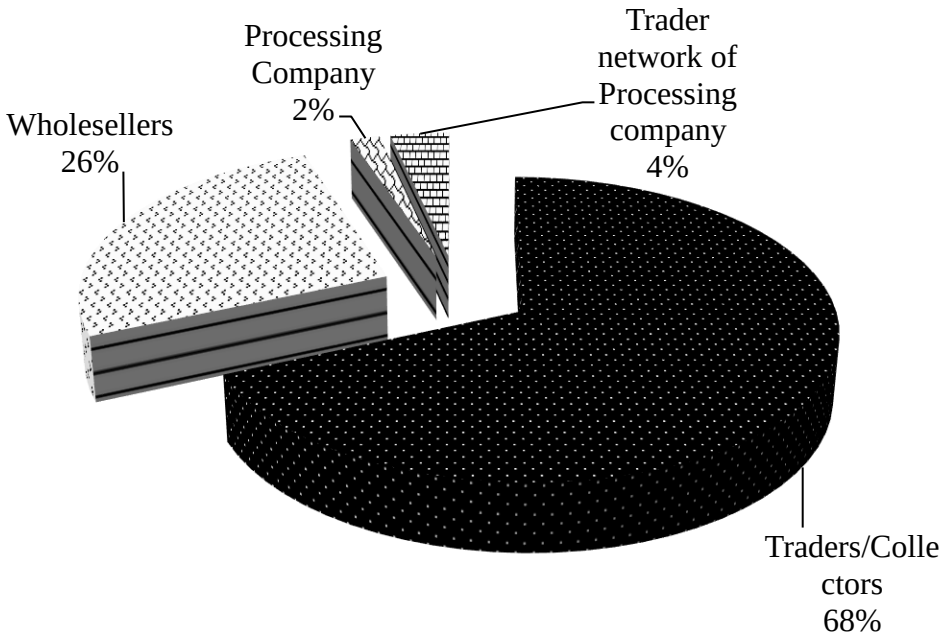


Figure 5.9 – Forms of Commercial Shrimp Sales in Ben Tre Province

(Source: Author's survey, 2019)

The Figure 5.10 shows quality indicators that buyers relied on when purchasing shrimp products. Because of high domestic consumption proportion that required shrimp still alive and fresh on the table, the buyers in this case, mainly small traders/collectors preferred bright color and nice appearance than safety being tested in the lab. And because of non-VietGAP application, farmers were more freely to apply chemicals/antibiotics. The traders knew situation clearly, so, that was a reason why they did not prioritize food safety when buying shrimp. Furthermore, commercial size and non-soft shell were stated by 15.38 and 2.2% of respondents, respectively.

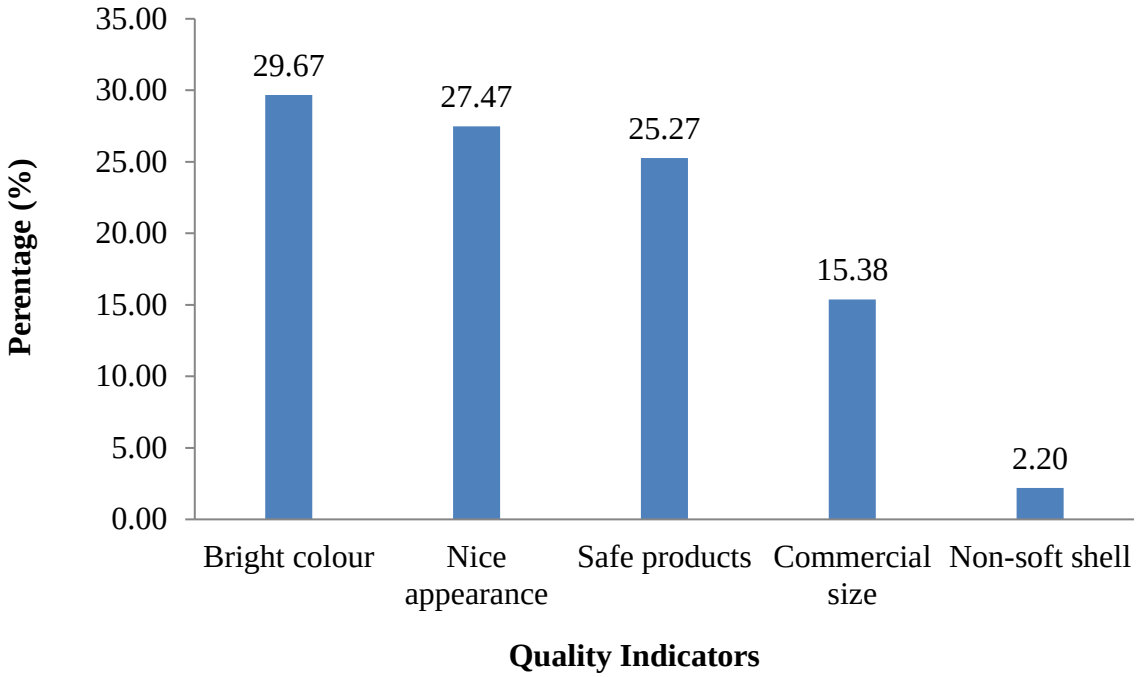


Figure 5.10– Quality Indicators from Buyers in Ben Tre Province

(Source: Author's survey, 2019)

The survey result illustrates that over 363 shrimp production crops were cultivated by 50 households within 3 years. In which, 62% of them witnessed disease outbreaks (Quyen, et al., 2019), in another words, only 38% of them generated successful crops. Therefore, the experience of having tested in lab of processing companies was insignificant (33 cases). Once producers harvest more than one MT/time with the commercial size of 100 inds./kg onward, they would apply for testing. In fact, field observations show that farmers used veterinary drugs, including antibiotics in disease prevention and treatment, and it properly caused six rejected cases (antibiotic contamination). An average price of shrimp products was reported at $4.96US/kg for the shrimp size of 73 individuals/kg.

However, farmers had motivation to produce safe products as an extra price of $0.23US/kg additionally once shrimp pass the quality test.

Table 5.4 – Situations of Quality in terms of Food Safety for Export in Non-GAP System

Categories (1, 3, 4 calculated as a sum over 50 samples)	**Unit**	**Mean (n=50)**	**Standard deviation**
1. No. of shrimp transactions within last three years (cumulative calculation over 50 respondents)	Transactions	363	-
2. Percentage of reports of disease	%	62	-
3. No. of transactions being tested	Transactions	33	-
4. No. of transactions being rejected	Transactions	6	-
5. Extra price for passing on test	$US/kg	0.23	0.03
6. Average size	Inds./kg	73	29
7. Average selling price	$US/kg	4.96	1.8

(Source: Author's survey, 2019)

7. Key Takeaways from the Study of Quality Management

There are several noticeable points from the study that need to be concerned:

① Firstly, farmers in VietGAP applied farms **have good control quality practices of shrimp** during the farming period. Several control points need to be improved such as quality of PLs, frequency of sludge removal, and pond design.

② Shrimp produced according to VietGAP standard could fulfil quality requirement from buyers with **little quality rejection** in term of export.

③ **No price premium** for VietGAP certified products are problems of VietGAP. Therefore, farmers do not have strong motivation to culture their shrimp following VietGAP resulted in very few VietGAP certification being awarded to farmers.

Chapter VI

AN EVALUATION OF VietGAP CERTIFIATION IN DISEASE CONTROL AND QUALITY MANAGEMENT

Summary

This penultimate chapter of this dissertation cross analyzes both case studies performed in VietGAP and non-GAP applied system, after that, making the evaluation on effectiveness of aquaculture certifications toward shrimp industry management and proposing feasible solution for improving management for the shrimp farming in the MD. The two systems have demonstrated great differences in not only practices of control points but also achievements in disease reported and quality of shrimp commodity. Although this information is discussed in detail in the case study chapters, here we can easily cross compare one with the other. The major points to take away from this cross analyzes is that farmers VietGAP applied system had better practices of control points related to disease and quality rather than farmers in non-GAP applied system. Although some control points in both two systems need to be complied fully, they are not really affected to the effectiveness of disease control and quality management.

Throughout the cross analysis, the performance of VietGAP in disease control and quality management is well. This achievement is displayed by less reported of disease outbreak, as well as less safety rejection due to antibiotic residue in VietGAP system. However, not all of this however has been fruit, as considering the economic efficiency. The VietGAP does not create high financial benefit as the price premium did not be

regulated for VietGAP certified products. Therefore, the farmers had no motivation to be certified this certification, and small holders have been unable to cover this cost. As a consequence, there was little farmers to be certified VietGAP.

1. Main Differences of Farming Practices regarding Disease Control

The investigation in disease controls and their results from two systems indicated in the comparison box below (Table 6.1). It is worth noted that consequence of disease control in VietGAP system is higher than non-GAP system, where less diseases were reported, and lower loss of income (half lost income compared to two thirds).

In recent years, shrimp farming has been afflicted with outbreaks of diseases accompanied to greatly undermined profitability and sustainability of operations (Khang, 2008). More farmers in non-GAP system reported diseases than those in GAP system during previous crop. Farmers in VietGAP system used to experience to disease situation as long history of shrimp farming. In another words, grow – out ponds after several crops would be contaminated and disease outbreak that need to be thoroughly renovated and dredged (Anh, et al., 2010). That have been reasons why shrimp farming in Soc Trang tending to apply standards as VietGAP and ASC since 2015 (People Committee of Soc Trang, 2018). In a similar situation, a rapid expansion of intensive shrimp farming in Ben Tre province in the recent years has caused epidemic widely (Khang, 2008) and current evidence is much diseases reported by farmers.

Among various diseases occurred during last three to five years, white spot, red body and hepatic diseases were the most common diseases (Figure 6.1). Almost current

shrimp disease problems can be categorized into two major groups: viral and bacterial. The causes of bacterial diseases are mostly Vibrio spp. Vibriosis outbreaks constitute a serious problem in intensive shrimp ponds (Anh, et al., 2010). White spot disease is the most common and serious shrimp disease affecting shrimp farms.

Table 6.1 – Compared Box of Disease Control Practices and Their Results of Two Systems

Categories	**VietGAP**	**Non-GAP**
• **Disease reported**	**50%**	**62%**
• **Profit losses**	**1/2 lose income**	**2/3 loss income**
Farm construction	Most have reservoirs and good warehouses (+)	Use unstocking ponds as reservoirs (-) Temperately warehouse (-)
Pond design	Normal	Siphon pit design (+) Using surrounding net (+)
Stocking management	Density: Low (+) Supply source: Cooperative's contracts (+)	Very High (-)
Feeding	Low FCR (+) High feed cost (-)	Higher FCR (-) Overfeeding (-)

- Water monitoring	Toolkit (+)	Self-assessment
• Sludge treatment	50% disposes correctly	79% disposes correctly
- Disease treatment	Chemical use: Low Less reporting of disease	Chemical use: High Less reporting of disease

Note: (+) represents for good farming practices; (-) represents for improper farming practices; none () represent for information provision

(Source: Author's survey, 2018)

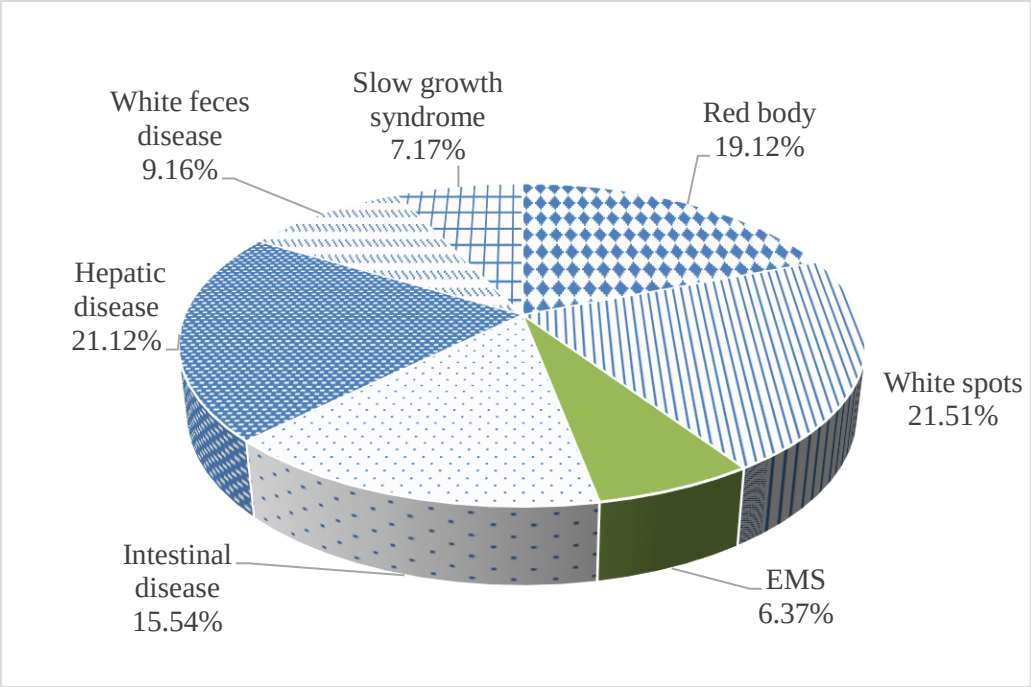


Figure 6.1 – Common Diseases during the Last Three to Five Years

(Source: Author's survey, 2018)

More farmers in non-GAP system were economic failure than GAP system with higher loss amount**.** In Vietnam, attempts to eradicate the disease have so far failed. The white spot disease was probably responsible for the major shrimp farming disasters in Ben Tre and all shrimp areas in Vietnam (Khang, 2008). diseases caused by virus such as white spots (WSSV), Red body (TSV and WSSV) and EMS (various. the disease, according to the farmers, caused substantial economic Losses Another disease that caused substantial economic losses in shrimp culture was white spot disease, caused by WSSV (Li, et al., 2016).

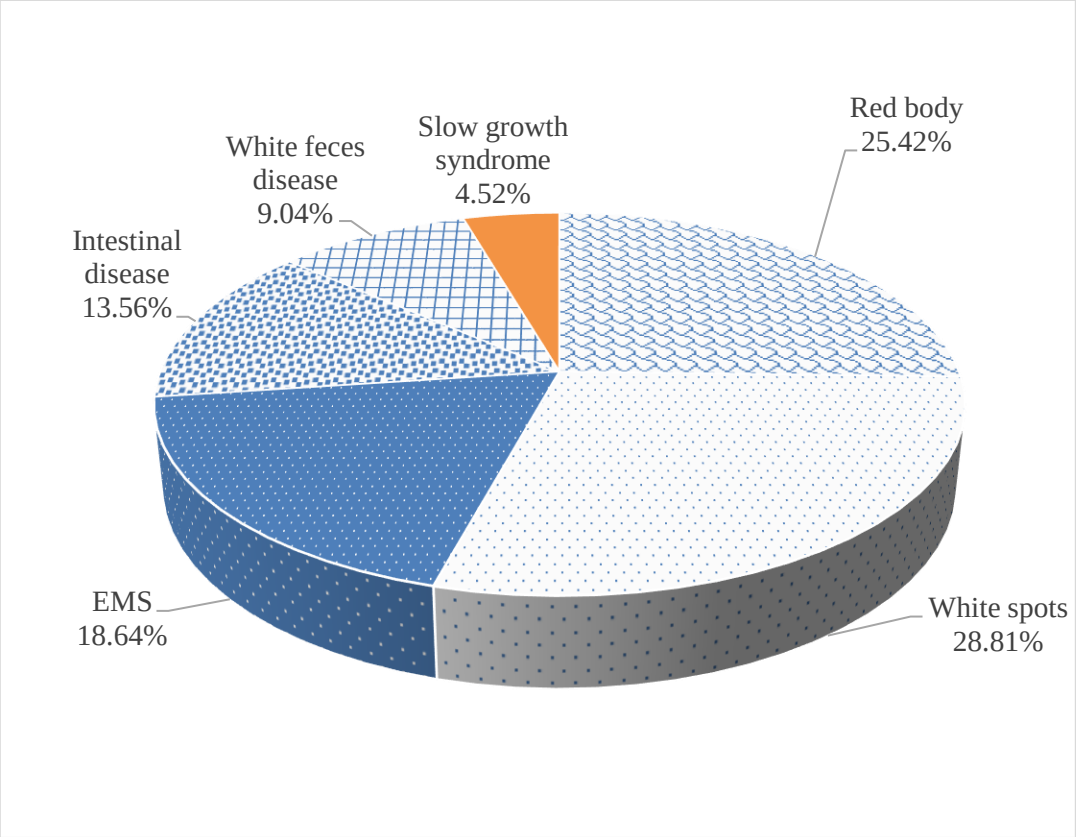


Figure 6.2 – Farmers' Perception on Serious Diseases in terms of Economic Damage

(Source: Author's survey, 2018)

The shrimp farmers in GAP system were found to have a significant amount of knowledge in practiced areas such as farm construction, water quality monitoring, stocking management, and use of chemical compounds. In non-GAP system, pond design, and bottom sludge removal were satisfactory. However, bottom sludge removal in VietGAP system, and stocking density, overfeeding, and use of chemicals in non-GAP system were found improper as they not complied fully, and some of them were unaware of proper guidelines.

Surrounding infected ponds could spread virus to other ponds easily throughout the water environment. Therefore, to avoid horizontal transmission in case of disease, it is essential to inform quickly and accurately the disease situation to managers in order to timely control the water intake and strictly control the discharge of shrimp farms. However, less disease outbreaks and illegal discharge were reported to managers. In order to deal with the situation, personal knowledge of shrimp farmers should be improved, as well as more actions from managers are need to take into account such as severe sanctions for illegal discharge practice.

The investigation in disease control from two provinces above has indicated main differences in farming practices. Some good farming practices of disease control in each province such as application of VietGAP standard, keeping water in reservoirs and monitoring water using toolkits, low stocking density in VietGAP system; In non-GAP system, grow-out ponds have si-phon and surrounding net, better treatment of bottom sludge. Some poor areas of farming practices were listed out, especially poor treatment and illegal discharge of bottom sludge in VietGAP system. Whereas high stocking density,

exceeding feeding, and using antibiotic for treatment in non-GAP system and limited awareness on sludge remove were reported in another province.

Reservoir ponds are necessary in areas where highly turbid water is available as well as overcrowding of farms occurs and intake and outfall are from the same source (AA1, 2002). However, there remains wide gap between VietGAP regulations and farmer's practices such as sludge treatment and disease declaration.

2. Main Differences of Farming Practices and Their Effectiveness in Quality and Food Safety Control

During the last decade, there has been a tremendous increase in shrimp farming in the MD where provides and exports shrimp products to hundreds of countries worldwide. The development of the industry has accompanied with problems of quality in global consumption. The farmers had significant effort to deal with the issue and the detail explanation is shown in Table 6.2.

Minor gap between what actual farmers do and principle include non-using banned chemical compounds, low stocking density, toolkit use, reservoir construction and diary record. However, it was noticed that some control points were not actual managed well as recommended principle by VietGAP applied farmers such as uncompleted tested PLs and infrequency of sludge removal. The key reason which was pointed out was lack of financial capital as farmers' monetary capacity was limited. In contrast, farmers in non-GAP applied system practiced high stocking density, little tested PLs, more free use of antibiotics, water monitoring by sensory and overfeeding occasionally.

Ratio of farmers who have consumption contract to processing companies was relatively high, at 29%. This creates little time as possible so the product does not spoil. Application of VietGAP certification could provide quality and safe products when little rejection from processing companies. In contrast, because domestic consumption in non-GAP applied system was important, small collectors were functioning well in selling channel. It was accompanied to special needs for color and appearance for shrimp rather than safe products. As the encouragement of export activity in non-GAP system, the extra price for safe product was slightly higher than that of VietGAP system. Even though low average price for non-GAP shrimp products, this difference come from the fluctuation of market price between two surveyed provinces rather than higher price from VietGAP certified product itself. Moreover, because of non-monitoring program of chemical use in non-GAP system, shrimp products were easy to be rejected when checking food safety at the laboratory up to 18.18%.

Table 6.2 – Compared Box of Quality Safety Control in Practices between VietGAP and non-GAP applied Systems

Categories	VietGAP applied system	Non-GAP applied system
1. Stocking management: Tested - Stocking density	85.5% 41.78 PLs/m^2	59.6% 89.23 PLs/m^2
2. Chemical uses: - Anti-biotic use - Monitoring program	 None (+) VietGAP (+)	 33.3% (banned: 26.8%) (-) Experience (60%) (-)

3. Water management: - Reservoir area -Monitoring water indicators	2,082 m^2 (35%) (+) Toolkit/services (80.4%) (+)	772m^2 (19.8%) **(-)** Sensory (61%) **(-)**
4. Feeding management: - Record - FCR/ forms of feeding - Warehouse construction	Diary record: 100% (+) 1.11/manual feeding Standard shed (+)	Record book: 40.4% (-) 1.18/feeding machine Temporary roof (-)
5. Pond preparation: - Fry days - Pond design - Sludge removal frequency	12.77 days Normal Annually **(-)**	11.18 days Si-phon pit/surrounding net (+) Annually (-)
6. Distribution Channels	Processing company: 29%	Free collectors: 68%
7. Quality requirement from buyers	Safe products (55.29%) Reach commercial size (17.65%)	Bright color (29.03%) Nice appearance (26.88%)
8. % of tested transactions	164/384 = **42.7%**	33/363 = **9%**
9. Percentage of quality rejections	3/164 = **1.83%**	6/33 = **18.18%**
10. Value added for safety test - Average size and price	$0.14US/kg (70 inds./kg: $4.70US/kg)	$0.23US/kg (70 inds./kg: $4.55US/kg)

Note: (+) represents for good farming practices; (-) represents for improper farming practices; none () represent for information provision

(Source: Author's survey, 2019)

3. Cooperative's Functions

As the characteristics of fragmented small-scale of shrimp farming in the MD, it is essential that farmers be motivated to establish cooperatives or cluster management approaches. These cooperatives/collective groups are very functional in collaboration to input and outputs. Generally, the functions of cooperatives and clusters have been described and synthesized as follow:

① *Training activities:* When participating in cooperatives/cluster, the farmers gained more access to aquaculture techniques, education through training courses, technology transfer organized by the Extension services, Cooperative Union and mass organizations so raising the production efficiency. The representatives of the cooperative are responsibility to organize the training courses, classes with the aim to transfer modern culture technique, guideline regarding to culture activities. Sometime, they also organize study tours to remote provinces which help farmers to improve technique and learning. They also do some propaganda programs in cooperating to related organization with the aim to upgrade people awareness on national programs such as standard application, environmental protection, etc.

② *Transferring subsidy and supports*: The functions of aquaculture cooperatives/clusters in localities has been clearly affirmed, as a collective representative, the aquaculture cooperatives have stood out to help members have easier access to the province's support policies, subsidy, finance supports such as agricultural loans,

preferential loans, receiving partly capital support, toolkits or services from NGOs and other agencies.

③ *Governance members*: through the organization of management board, the members are executive and gathered in one unique organization, upgrade consensus among members. The management board also re-presents farmers in collaborating, attending activities as well as conducting annual meetings.

④ *Linkage/collaboration:* the cooperative and clusters improve horizontal (among farmers) and vertical coordination with input supply (hatcheries, feed mills, chemical/drug providers in order to reduce cost and get quality materials); the cooperatives act like a medium through which services to provide farm inputs. Farmers' cooperatives provide smallholder farmers with economics scale by facilitating cheaper and more efficient access to inputs. In terms of product output, the cooperatives/clusters uphold the role in marketing farm products, signing farm contracts and consumed contracts, providing market information and other economic activities are rendered to members. Farmers under cooperatives/clusters had distribution channels, better bargain to processing companies; bridging links with support agencies.

⑤ *Quality Improvement within certification application:* The implementation of cluster management in the Asia-Pacific region proved significant improvements in food safety (Ha, et al., 2013). Elective mechanism such as cooperatives and aquaculture clusters are premise to apply and pursue aquaculture certification aiming to meet the needs of global customers. The cooperative forms might assist them to comply with production-oriented quality standards. VietGAP standard are treated as group certification to farmers that

required a well-organized cooperative that could be functional to gather hundreds of small farmers, who after that could be guided in monitoring programs.

4. Farming Practices Take Away for Better Disease and Quality Control

Generally, most of shrimp farms in VietGAP applied system seemed to be functioning well, and some practices of control points in non-GAP applied system in Ben Tre seemed to be appropriate for the give situations. Factors need to be improved were indicated in Figure 6.3 and Figure 6.4 reported by farmers together with scoring the necessary or urgent. Whereas most of farms lacking adequate quality and disease procedures recommended such as aquaculture certifications of VietGAP or ASC, the VietGAP applied farms were not complied fully to the procedures in some controlled points because of limitation in awareness and production capital. Pond design and preparation in VietGAP applied system also seemed to be a problem on many farms either VietGAP applied farms or non-GAP applied farms. It was suggested that pond should be designed si-phon pits or plastic lining for easy ploughing bottom sludge, and using surrounding net to prevent shrimp from biological pathogen carriers travelling across farms. Furthermore, the frequency of sludge removal needs to be complied fully as the guidelines from VietGAP and technical guideline also. The most important action that non-GAP applied farms need to take into account is reservoir construction for better quality control also. People in non-GAP applied system thought that the use of chemicals/drugs is not create effectives on disease treatment but this control point still needs to be considered carefully unless they do not want to create more price premium from export. People in both provinces also mentioned about the improvement in stocking management (appropriate density, test

PLs, etc.) and water monitoring (using toolkits, more careful and regularly monitoring, reservoir construction, etc.).

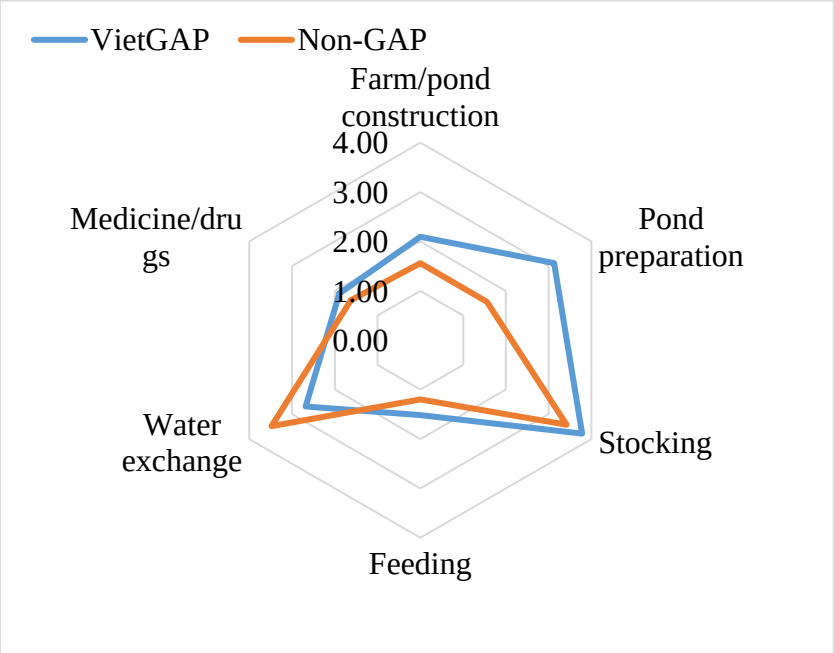


Figure 6.3 – Rada Graph that Plots Important Scores of Control Point need to improve for better Disease Control

(Source: Author's survey, 2018)

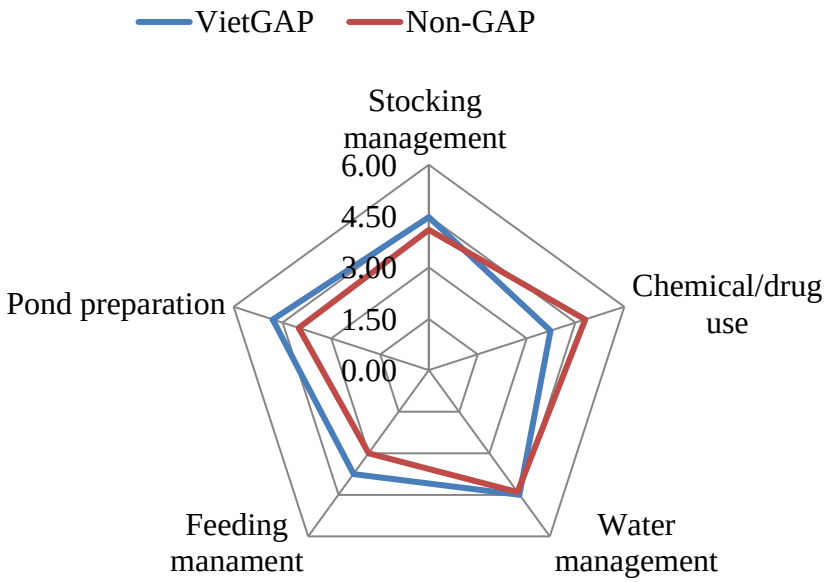


Figure 6.4 – Rada Graph that Plots Important Scores of Control Point need to improve for better Quality Management

(Source: Author's survey, 2019)

5. Evaluation of VietGAP Standard's Success

VietGAP system has made remarkable achievements in reducing diseases and quality management. Regarding disease reduction, farmers in VietGAP system reported diseases 12% lower than non-GAP system. On the other hand, VietGAP standard has gained significant achievements in quality management as farmers had capacity to generate products to fulfill quality requirements for export. Practicing VietGAP has risen up the ratio of shrimp shipments eligible for safety test, while reducing rejected ratio due to

contaminated violation. Ratio of GAP products sold to processing companies for export was relatively high that created little time as possible so the product does not spoil as shrimp products does not go through long distance and multi-agents.

However, the investigation has revealed some problems for following VietGAP standard. The survey also indicated a small number of farms being awarded certification. The reason behind it is that price premium for VietGAP certified products are not provided to farmers. Additionally, a gap between actual practices and required control points of VietGAP is also indicated. This situation shows the correlation between partly enforcement of the control points and little certification awarded.

Regarding economic advantage, the study has proved that application of VietGAP standard resulted in prevention of large losses, with the profit losses being shifted from two thirds to a haft, although farmers do not create high economic efficiency due to high investment cost requirement in construction or low production/ha. The shrimp farms saw the emergence of processing companies as an important buyer who can offer a bit higher average buying price. Meanwhile, there was no price premium for VietGAP certified products. The added value does not come from VietGAP certified product but coming from surpassing safety test matching the requirements from specific import markets. The reason is that VietGAP is not recognized in the international market, the buyers cannot sign any contract for price premium when export as the actual situation of field survey.

Speaking generally, although VietGAP is significant in disease and quality management, it is not financial benefit itself and it’s costly for farmers for acquiring certification without supporting. Moreover, VietGAP is not a target for shrimp industry because it is not recognized internationally and it does not show any proof for safety.

Therefore, the number of farmers who gave up VietGAP is increasingly. To deal with this problem, an alternative option was proposed targeting improving shrimp farming adapting international demand, that not only addressing problems of disease control and quality management, but also providing price premium for small-scale shrimp farmers -ASC scheme. The meanings of ASC for management improvement of shrimp farming will be presented in the following Chapter VII.

Chapter VII

ROLES OF ASC CERTIFICATION IN MANAGEMENT IMPROVEMENT OF SMALL-SCALE SHRIMP FARMING: A CASE STUDY OF HOA NGHIA COOPERATIVE, SOC TRANG PROVINCE

Summary

This chapter focused to analyze the current situation of ASC scheme for shrimp farmers as well as how to obtain this certification for small-scale shrimp farming in the MD. As people aware that since international consumers are looking for sustainable consumption of food safety, quality and traceability, certification schemes have emerged such as ASC. The case study was carried out at Hoa Nghia cooperative (HNC), Soc Trang province, Vietnam, the first intensive shrimp cooperative being awarded ASC certification in Vietnam. The main findings include that VietGAP was applied in the cooperative from 2014 as a premise to move up ASC and being awarded certification in June 2017. The auditing process was supported by World Wide Fund for Nature in Vietnam (WWF-VN) from early of 2015 with the participation of processing company (Stapimex – Soc Trang), international buyer (Nordic Seafood – Denmark), local authorities, independent assessment party (Control Union) and shrimp farmers. The total certified process costed $76,220US, equal to $0.22US/kg, of which, farmers contributed the most at 66.5% ($0.14US/kg) but auditing cost paid by processing company. Farmers are required to meet quality requirement for ASC products regulated in farm contract and getting total premium price

of $0.17US/kg. Thus, ASC created financial efficiency for farmers in condition of receiving support from relevant organizations and it should be replicated with the improvement in binding of farm contracts to avoid breaking easier for the further cooperatives.

1. Introduction

1.1 Background

The previous Chapters have reviewed that brackish water shrimp farming is an important industry to the country, both in terms of volume and value, which provides financial returns and livelihoods for thousands of people in the MD. In 2018, the shrimp farming area and production reached 736,000 ha, and 762,000 MT, respectively, with the revenue of shrimp export being $3.6US billion (Web portal - MARD, 2019; VASEP, 2019). Vietnamese farm-raised shrimp products are consumed internationally over 90 countries worldwide. The MD has represented more than 93% of dedicated shrimp culture area, and 85% of total production of the country (Vietnam Institute of Fishery Economics & Planing, 2015). The Black Tiger Shrimp *(Penaeus monodon)* is an indigenous species and has a long history of farming stretching back in the early 1990s in different models, whereas White Leg Shrimp *(Litopenaeus vannamei)* is an exotic species and usually cultured in intensive/super intensive system. White leg shrimp is the main product for exporting to highly sophisticated, quality and safety conscious world markets as they are short farming cycle, high readiness level of domesticated production (UNEP, 2016).

However, since the intensive white leg shrimp farming has expanded spontaneously, the international customers seem to be troubled on their shrimp consumption in terms of uncertain food safety, quality, and equity products when there are increasingly unfavorable shrimp farming conditions without quality control. In other words, markets are looking for an endorsement declaring compliance or conformity to standards and sets of certification schemes specific to aquaculture have developed and emerged over the last decade (Mohan, 2013). In response to these driven, several aquaculture certifications such as ASC, GlobalGAP, and VietGAP are designed and shrimp farmers have been encouraged to culture their shrimp following these standards aim at transforming the global seafood market and promoting safe product consumption. General features of these aquaculture certifications are focusing on assurance of the quality of food hygiene and safety, disease safety, environmental safety, social safety and traceability.

1.2 Research Questions and Objectives

Although aquaculture certifications have been growing tremendously, the certification scheme initiative in the aquaculture sector has worked the most effectively with large and advanced producers. The international standards involve high requirements, complicated auditing procedure and high cost without high return. However, shrimp farms in the MD are scattered character that increase the cost (larger yields/area are cheaper to certify). The undeveloped infrastructure also constrains the information sharing system in certifications. The farmers often lack the administrative, limited access to information, technical and financial capacity to meet the international standards. Because of small-scale production, shrimp farms in the MD find it difficulties applying such standard, as they

often lack the administrative, limited access to information, technical and financial capacity to meet the international standards (UNEP, 2016). Therefore, instead of trying to expand certifications to small holders in almost hopeless efforts, aquaculture programs have supported group certification of VietGAP for shrimp farmer groups and cooperatives and achieved remarkable success. The most critical point of public certification is that allows smallholders to organize themselves into large-scale groups to access. VietGAP standards for shrimp and *pangasius* are built based on four main principles, i.e product quality, disease safety, food safety and hygiene, environmental protection and social welfare. Therefore, VietGAP may be in line with FAO's Code of Responsible Aquaculture Code and currently applicable international standards such as GlobalGAP, and ASC (Lap, et al., 2012). However, adoption of VietGAP does not generate high monetary incentives for farmers. Because international customers are not willing to pay more for national certified products while low domestic demand (Quyen, et al., 2019). Three main import markets of Vietnamese Shrimp products (i.e EU, US and Japan) do not recognize VietGAP and GlobalGAP, exception for ASC. In response to this problem, several shrimp cooperatives have been judged to have the potential to join in ASC scheme and benchmarked transferring. However, the expansion of ASC to small-scale farmers is limited compared to current potential production capacity. Therefore, the study set out to define:

① What is the process for obtaining certificate of ASC for small-scale shrimp farming?

② What benefits does ASC scheme provide to shrimp farmers?

③ What are considerations regarding to replication of ASC to small-scale shrimp farming in the MD?

The corresponding objectives are threefold:

① To describe and clarify the operation of the cooperatives and ASC certification auditing process,

② To evaluate outcomes and difficulties of the ASC scheme brings to farmers, and;

③ To give discussion on what considerations over spreading out ASC certification to shrimp industry.

2. Methodology

The above objectives were accomplished by conducting a comprehensive case study involving the Hoa Nghia (Hòa Nghĩa) Cooperative (HNC), the first intensive shrimp cooperative to be certified ASC in the MD. An in-depth interview to the director of the cooperative was carried out in August, 2019, at Hoa Dong commune, Vinh Chau district, Soc Trang province, Vietnam (Figure 7.1). In the support side, the author made a consultation to staff from WWF-VN, an NGO to support to the process of obtaining ASC certification of the cooperative. Moreover, a short talk between author and International Collaborating Centre for Aquaculture and Fisheries Sustainability – ICAFIS also was conducted after that for the future orientation of ASC certification. WWF-VN and ICAFIS are key supporters who are responsible for the further development and expansion of ASC scheme to the small holders and shrimp cooperatives in the MD by implementing Projects related to apply aquaculture certifications in Vietnam.

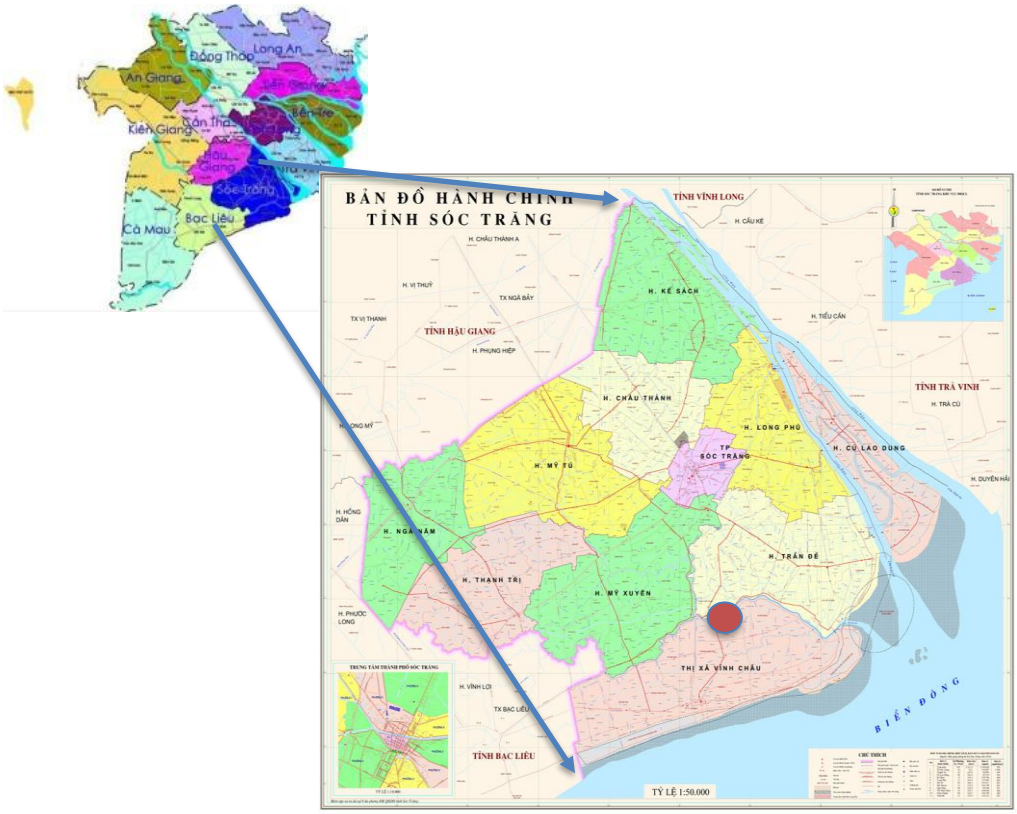


Figure 7.1 – Location of HNC in the MD

(Source: Vietnam Institute of Economics & Planning, 2015 and author's survey, 2019)

3. The Introduction of ASC Certification and ASC Scheme in Vietnam

ASC is an international independent non-profit organization that manages the world's leading certification and labelling program for responsible aquaculture founded in 2010 by Sustainable Trade Initiative-IDH joined forces with WWF Netherlands. Precursor of ASC is Aquaculture Dialogues were formally started in 2004, being paved the way by WWF-USA. ASC farm certification allocated for farm is issued by an independent

conformity assessment body (CAB). Audit Cost is determined by CAB ranging from $3,500US to $5,800US per case (Aquaculture Stepwardship Council, 2019). This auditing cost is too expensive for small-scale individual farmers. Meanwhile, for the benefits to small producers, ASC new Group Certification methodology was developed many years ago, experiencing many community consultations and 7 pilots in different countries. Finally, the group certification has been launched officially in April, 2019. This methodology allows small farmers to join together as a group to apply the ASC standard collectively. The chain of custody (CoC) certification is required at each step in the supply chain for any product carrying the ASC logo to assure that any product carrying the ASC logo or trademark can be traced throughout the supply chain. The CoC is certified via application of the Marine Stewardship Council (MSC) CoC system and eligible to carry the ASC logo after originating in ASC certified operations. In Vietnam, the ASC has grown tremendously, ranking third in the list of ASC approved labelled products by distribution country, after Norway and Chile, certifying for *Pangasius* and shrimp products. Around 135 large shrimp farms/companies and cooperatives have acquired ASC certification, with mainly focusing in the MD (Aquaculture Stepwardship Council, 2019). The first ASC certified standard was obtained in 2015 by shrimp farmer groups in Bac Lieu province for improve-extensive shrimp system. After that, linkage between HNC and Soc Trang Seafood Joint Stock Company (Stapimex) in Soc Trang province has obtained ASC certification in 2016 for intensive system (Tinh, et al., 2017)**.**

4. Outline of the Hoa Nghia Cooperative

The precursor of HNC is a shrimp farming club which was established in 2002, composing of only 15 members over adjacent area of 53.5 ha. About one year later, this club was upgraded to Cooperative and having two more members. Currently, the cooperative includes 19 members who are producing mono culture of brackish shrimp and seabass (two members and two ha) (Figure 7.2).

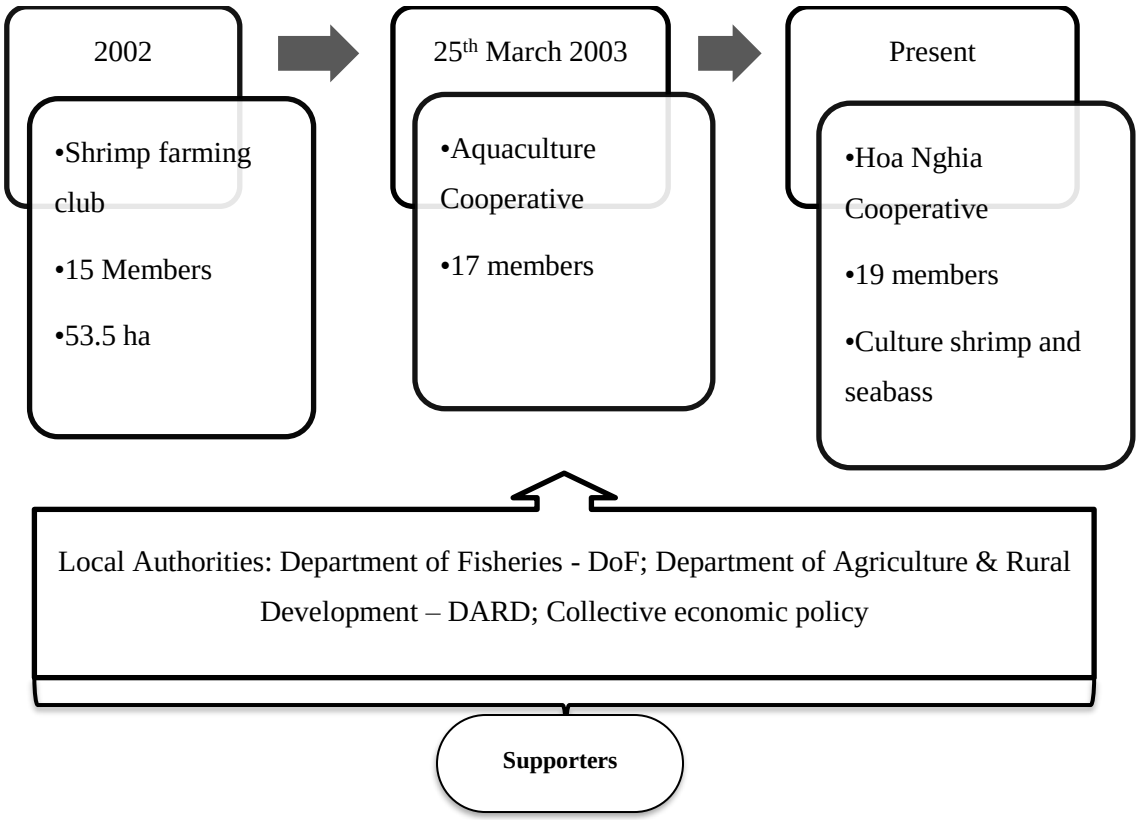


Figure 7.2 – Historical Flow Chart of HNC

(Source: Author Survey, 2019)

The cooperative is operated based on Law of Cooperative issued in 2003 and administrated by cooperative management board (CMB) elected by the cooperative's members. The CMB is made up of five members, includes a director, a vice-director, a surveyor, an accountant and a secretary. Of whom, the salary of surveyor, accountant and secretary are paid by governmental budget. To become member of the cooperative, owners of adjacent ponds will be prioritized promoting better governance. Moreover, reputable shrimp farmers who are willing to comply with operation regulations and schemes of the cooperative are appreciate. Intended farmers after that are requested to submit a voluntary form of application to the CMB and pay an initial charter capital amount at two million Vietnam Dong (VND) (equal to $91US) per ha. The CMB has monthly meeting to local authority, whereas all member gathering meeting is organized every two months. The cooperative congress is held once a year at the headquarters of the commune. Actually, the cooperative does still not own any private headquarter. Therefore, all of administrative activities have to take place at the farmer's house or borrowing the venue.

5. Pursuing Process of ASC Certification in HNC

5.1 The Auditing Process

In 2013, the cooperative first applied VietGAP standard by the support of local authorities under the Project of Coastal Resources and Sustainable Development (CRSD – funded by World Bank) and being awarded certificate successfully in 2014. By the year of 2015, WWF-VN were being on the route looking for potential cooperative for participate in ASC scheme under the Project of Promoting Better Practices and Certification for small-scale Shrimp Farming in Vietnam sponsored by DANIDA. HNC after that was the first

choice as its effectiveness in former VietGAP certified effort. After getting agreement of participation of HNC, the supporters, including local authorities, WWF-VN, conducting multiple training courses and classes aim to upgrade to ASC from a stepping stone of VietGAP for members of the cooperative. One year later, the WWF made contact to international buyers for consumption certified ASC products. The Nordic Seafood (Denmark) decided to participate in the linkage and nominated Stapimex to be involved in the process and be responsible for supplying/exporting ASC shrimp products produced by HNC. On the date of 31th May, 2016, a farming contract obligation was signed between HNC and Stapimex on ensuring of shrimp being produced complying with ASC standard and to maintain buyer-supplier relationship (Table 7.1).

Table 7.1 – Motivation for the HNC to be involved in ASC Scheme

Period	Events	Supporters	Notes
2013 - 2014	HNC was encouraged to apply and being awarded **VietGAP standard**	Local authorities	Project of Coastal Resources and Sustainable Development (CRSD)
2015	1. Meeting local authorities for choosing potential cooperatives for participating in ASC scheme: **HNC** 2. Discussing HNC: **agreed to participate** 3. **Training courses** for upgrading from VietGAP to ASC for members of HNC	WWF-VN Local authorities; WWF-VN	Project of Promoting Better Practices & Certification for Small-scale Shrimp Farming in Vietnam

Early 2016	1. Contact international buyer: Nordic Seafood 2. Nominated seafood enterprise: Stapimex	WWF-VN Nordic Seafood	
31/5/ 2016	Signing farming contract to HNC for culture shrimp according to ASC	Stapimex	

(Source: Author Survey, 2019)

The audits of ASC were started in the early 2017 with the first preparation of Social Impact Assessment (SIA) and Environmental Impact Assessment (EIA) done by WWF in collaboration with Nordic Seafood. Evaluation procedure is a set of documents which is meticulously prepared by all stakeholders. The auditing process is taken place by independent certifiers – they are so-called CAB – who are in charge of accrediting and monitoring applicants. This practice referred to as third party certification and it is widely recognized as the highest level of independent assessment. The CAB will take the decision on certification being compliant, or not (yet) compliant together with level of non-compliancy (with time – bond improvement plan). After submitting contract with ASC qualified independent certifier (Control Union), the on-site pre-audit takes place at the HNC. After getting the announced report and indicators categories that need to be modified, the final assessment was taken and ASC certification was awarded officially on July 9, 2017 (Figure 7.3). Eventually, a cooperative could be certified within four months from the moment of application. The certifier also makes the annual audits and the process will be repeated every three years (Table 7.2).

Table 7.2 – ASC Auditing Process at HNC

Period	Events	Supporters
Early 2017	1. Doing Social Impact Assessment (SIA) and Environmental Impact Assessment (EIA) for farms belong to Cooperative 2. Preparing evaluation procedure 3. Contact conformity assessment body: Control Union 4. Submitting all procedures/document to Certifier	WWF-VN/Nordic Seafood All stakeholders/participants Stapimex/WWF-VN Stapimex
Mid 2017	1. Certifier makes **on-site pre-audit**: appropriate 80% complied with requirements 2. Farmers **improve** nonconformity (3 months) 3. **Final assessment**	WWF-VN/ICAFIS Local authorities Control Union
09/07/2017	Control Union **awarded ASC** to HNC	NGOs and local authorities
2018	Annual **re-assessment**	Control Union

(Source: Author Survey, 2019)

ASC CoC CERTIFICATE

CERTIFICATE N°: CUP-C-832897-MSC-01-2018
MSC CERTIFICATION CODE: ASC-C-00428

Field of attention:

Marine Stewardship Council (MSC)
Multi site Chain of Custody
for Aquaculture Stewardship Council ASC Products

Issued to:

SOCTRANG SEAFOOD JOINT STOCK COMPANY (STAPIMEX)
220 - NATIONAL ROAD 1A, WARD 7, SOC TRANG CITY, SOC TRANG PROVINCE, PROJECT IN: VIETNAM

Standards:

MSC Chain of Custody Standard: Default Version 4.0
MSC Chain of Custody Certification Requirements V.2.0

Valid until: 14-August-2020

Control Union Peru declares to have inspected the products and/or units of the above-mentioned licensee, and have found to be in conformity with the standards mentioned above. This certificate covers the product(s) and/or unit(s) and/or process(-es) as mentioned in the authenticated annex of this certificate.

This certificate is in force until further notice, provided that the above-mentioned licensee continues meeting the conditions as laid down in the licensee contract with Control Union Peru.

Based on the annual inspections that Control Union Peru performs, this certificate is updated and kept in force. The named supplier of fish and / or fish products has been authorised to provide fish and / or fish products that are eligible to carry the ASC Logo, as certified by Control Union Peru. For the most up-to-date information visit certifications.controlunion.com, www.msc.org and www.asc-aqua.org. On these websites you can see the scope of the certification.

Date of certification:
08-July-2017

Valid from: 12-June-2018

Place and date of issue:
Lima, 12-June-2018

Aquaculture Stewardship Council

Declared by:
On behalf of the Managing Director

Edwin Velásquez
Certifier

asi accredited
ASI-ACC-049

CONTROLUNION

Control Union Peru S.A.C.
Av. Petit Thouars 4653
Piso 6, Oficina 603
Miraflores
Lima – Perú
Tel.: + 511 7190400
Fax: + 511 7190410

Figure 7.3 – The Official ASC CoC Certificate at the Stapimex

(Source: Stapimex.com.vn, 2019)

5.2 Costs Accrued by Stakeholders

The local authority has highly invested in VietGAP application since 2014. However, the budget for aquaculture development of the province is limited. Therefore, this is difficult to negotiate for using these budgets among 205 farmer groups and cooperatives of the province and they need the financial supports from private companies (Tinh, et al., 2017). The cooperation between partners should be concentrated on the linkage between strong farmer groups and private companies. There are five direct stakeholders involving in this process, i.e. farmers, international buyer (Nordic Seafood), processing company (Stapimex), supporters (WWF-VN, ICAFIS and local authorities), and the independent auditor (Control Union). The cost structure of ASC shrimp certification of the HNC is shown in Figure 7.5, Figure 7.5 and Table 7.3. The main assessment portion for getting ASC certificate was valuated at $76,219US, converting to 4,759 VND/kg or $0.22US/kg ($76,219US divided to total shrimp production of the cooperative at the year of being certified at 346,450MT). Of which, the costs of compliance with the ASC requirements constituted for 92.8% and certifying cost represented 8% of the total costs. Among cost categories of compliance, compliance cost for Principle 5 - Responsible use of feed and other resources (44%). It was followed by cost compliance for Principle 7 – social responsibility constitutes the most (32%). Auditing cost accounted for 8% of the total cost.

Considering to cost item sharing by stakeholders, 66.6% of total expenditures was supported by HNC, mainly consisting of price premium for feed and PL according to ASC. The international buyer contributed 14.1% mainly for workshops, training and partly EIA/SIA studies. More than 12% of the cost was supported by WWF-VN to fulfil mostly

EIA/SIA studies. The seafood processing company is responsible for certified audit, accounted for 7.16% of the total cost, and 0.19% of cost was contributed by the local government by providing human resources (Tinh, et al., 2017). The majority of cost with acquiring ASC certification is come from farmers' contribution. In comparison to production costs, the certifying activities can increase 5-10% of total costs for upgrading the shrimp farm according to the ASC requirement. In coming future, this cost will be lower because of for auditing cost and pond maintaining only. However, in this unique case, the processing company has paid for extra costs for auditing and remaining ASC certification and buying ASC shrimp products at premium price. Therefore, the ASC certification may reduce the net income of shrimp farmers only if the sale price and demand of ASC shrimp are not increased.

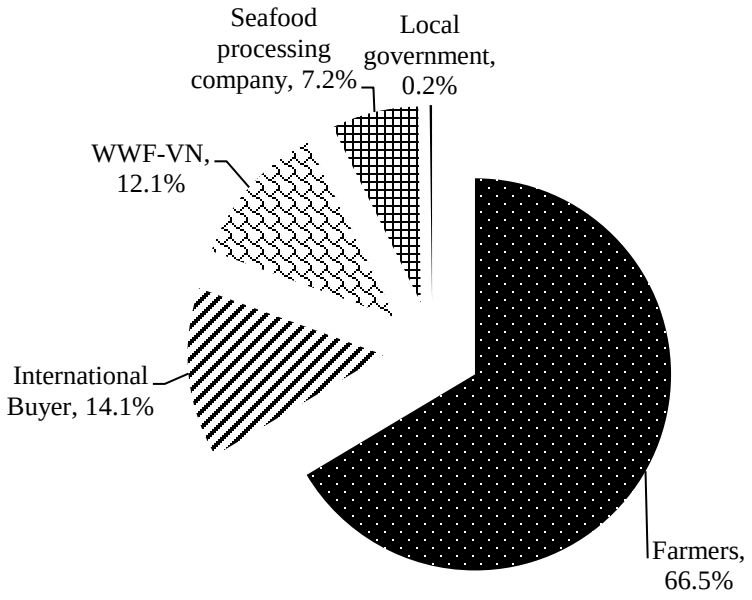


Figure 7.4 – Cost Sharing for ASC by Stakeholders

(Source: Author survey, 2019; Tinh et al., 2018)

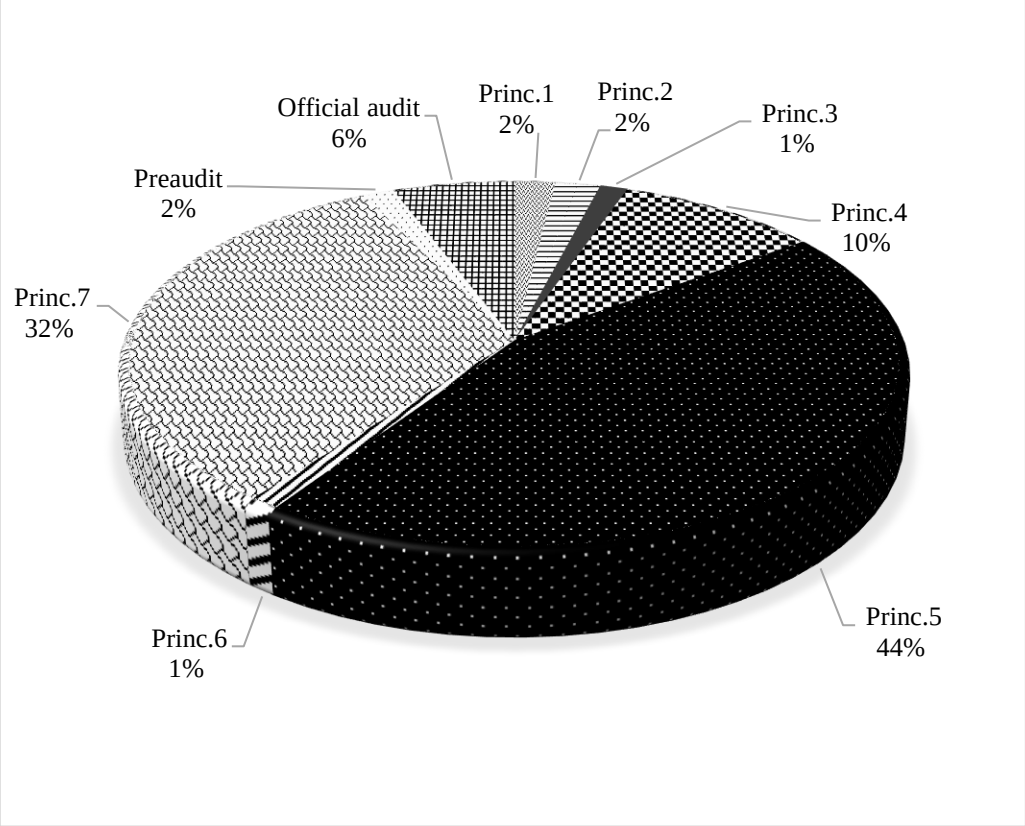


Figure 7.5 – Cost Sharing for ASC by Principles

(Source: Author survey, 2019; Tinh et al., 2018)

Table 7.3 – Detail Cost Structure for ASC Certified Shrimp Standard at HNC

No.	Cost Items	Cost ($US)	%
I	**Cooperative/Farmers**	**50,690**	**66.5**
1	Certificate of land use	81.8	0.11
2	Regulation tables, map; outline of cooperative, etc.	136.4	0.18
3	Nets around the ponds	1,636	2.15
4	Premium price for feed according to ASC	30,000	39.4

5	Premium price of larvae according to ASC	16,364	21.5
6	Book-records and keeping documents	2,472	3.24
II **7**	**Seafood processing company - Stapimex** ASC certified shrimp audit	**5,455**	**7.17**
III	**WWF-VN**	**9,191**	**12.1**
8	Certificate for food security for shrimp aquaculture	136.4	0.18
9	Pre-audit for ASC certified shrimp standard	1,418	1.86
10	Workshops, training course for improving capacity	1,000	1.31
11	EIA studies	3,909	5.13
12	SIA studies	2,727	3.58
IV 13	**Local Government:** Human resource	**147.3**	**0.19**
V	**International buyer**	**10,736**	**14.1**
10	Workshops, training courses for improving capacity	3,091	4.06
11	EIA studies	1,546	2.03
12	SIA studies	909.1	1.19
14	Studying on flood-peak	1,818	2.39
15	Monitoring HNC before & after having certificate	1,555	2.04

16	Commitment on environmental protection	1,818	2.39
	Total	**76,218.9**	**100**

(Source: Author survey, 2019; Adapted from Tinh et al., 2018)

6. Production and Sale in Farming Contract of ASC Scheme

VietGAP platform allows shrimp farms that have achieved national certification to transition to ASC base on a handbook of "ASC-VietGAP benchmark guidance document: shrimp", launched by ASC, WWF and MARD (WWF, et al., 2018). The handbook identified areas of overlap between the standards as well as outline information what they need to meet the requirements, thereby streamlining the ASC scheme (Table 7.4). In general, there are many areas of overlap between ASC and VietGAP. The detail information on VietGAP Principles and Guidelines was indicated in the Decision No. 4835/QĐ-BNN-TCTS of the MARD: ''Issue the guidelines for Application of VietGAP Standards for Commercial Farming of White Leg Shrimp (*P. vannamei*), Tiger Shrimp (*P. monodon*)'' (2015) (Ministry of Agriculture and Rural Development, 2015). The difficult tasks belong to WWF for EIA and SIA. In farmers' production side, farmers can now focus on the areas of differences in Principle 5 – shrimp health management with stricter requirements of water monitoring, use of chemical compounds and traceability by recording.

Table 7.4 – Correlation between ASC and VietGAP and Key Additional Requirements in ASC-VietGAP Benchmark by ASC Principles

ASC Principles	VietGAP 5 Principles (24) *	Additional Requirement	Guidance
1. Legal aspect	Principle 1 (6)	Transparency of legality	Evidence
2. Farm sites	Principle 1 (6) Principle 4 (4)	**EIA**	Contact WWF Groundwater is not allowed
3. Social and communities	Principle 5 (4)	**SIA** Labour use	Contact WWF
4. Farm operation responsibly	Principle 3 (6) Principle	Employer and labor regime	
5. Shrimp health management	Principle 2 (4) Principle 3 (6)	**In-charge water; Survival rate; Non-use antibiotic Water treatment**	**Strainer with appropriate size** **List of antibiotic and disinfectant**
6. Broodstock, Post Larvae	Principle 3 (4)	Escape management	Escape management system Do not use GMO seeds
7. Resources and environment	Principle 4 (4)	**Traceability of input materials**	Contact WWF; **Book record** of usage of materials

*Note: * the numbers in () represents for number of criteria for each principle*

(Source: Adapted from WWF-VN, MARD and ASC, 2018)

Currently, after being awarded ASC, the Stapimex is keeping the certification to show the proof of ASC certified products when exporting. The farmers manage their farms compliance to ASC principles by themselves under the monitoring of CMB. The professional staff from DoF, extension services and WWF-VN monthly checks their practices at the farm site. Their advisory over ASC compliance is given to farmers via training course and meetings organized by collaboration between CMB and local authorities. In 2018, members and manage over 66.5 ha of intensive shrimp farming and 2 ha of seabass culture, providing 197.2 MT of ASC certified shrimp products and 50 MT of seabass product (Non-ASC), generated $270,000US and $54,500US, respectively.

From 2013, WWF-VN has organized linkages between shrimp farmer groups and seafood processing companies. By mid-2016, these linkages have been upgraded to farming contracts of ASC certified shrimp production signed by HNC and Stapimex at higher relations that were funded by the WWF and supported by local authorities. This contract is a commitment of company with small-scale farmers to produce and consume responsible and sustainable shrimp. The contract consists of commitment that shrimp is guaranteed to comply with ASC standard and is certified by a third party with specific requirements of commercial shrimp products as follow:

① Shrimp products must reach the commercial size at 25 to 150 inds./kg in order to meet the global customers' need;

② Moisture standards set by importers are checked at the factory based on specific international import markets;

③ Farmed shrimps are not contaminated with antibiotics in excess of the standard allowed by the processing factory;

④ Farmers have to announce their time of shrimp harvest to the company three days in advance.

According to the contract, the company takes shrimp sample for checking at the lab of the company and sizing because small-scale farmers are not capacity and professional skill for testing shrimp quality. The result will be announced farmers after having result and release the price tag according to commercial size. The cooperative has a team member who is sufficiently qualified to act as a primary agent in loading and shipping shrimp products to the company but he mentioned on the limited infrastructure and business capacity that inhibits his competitive advantage compared to free traders. The processing company bears the costs of preserving and shipping from farm to company.

7. Price Premium and Interests in the Farming Contract to Farmers

In the farming contract signed between HNC and Stapimex, an article on price premium is stated as follow: "ASC certified shrimp products are bought at a premium price of 15% compared to shrimp price on the market". However, in practically, Stapimex only bought ASC certified shrimps at a premium price of 2,000 VND/kg additionally (equaling to $0.1US) compared to ASC non-certified shrimp. The reason stated here is because of the fluctuation of prices of ASC certified shrimp products on the international markets. Meanwhile, the seafood processing company was able to assist with annual funding of $15,900US with the aim for maintaining ASC certification. This support amounts is very

important for the cooperative in the future when WWF-VN will turn support to other cooperatives. More importantly, the processing company is responsible for auditing cost to the third party. This is an essential interest for shrimp farmers when they are un-willing to pay extra cost from production even for international standard.

However, that farming contracts were stated at high risk of breaking in practical situation. In fact, shrimp aquaculture sector has a high risk of failure up to 50% as stated in the Chapter IV because of disease outbreaks. Once farmers succeed in production, the private traders will find them and offer higher price in comparison to processing company's offer. As the visible incentive, farmers break contract in a tendency way. In practically, it happened regularly over 30% of the contracted farmers. Thus, the reasons are partly that the contract's binding is not yet strict and unfair competition from buyers.

8. Collaboration Development within ASC Certified Shrimp Cooperative

After signing the farming contract of ASC certified shrimp production, HNC and Stapimex established the linkage mechanism therefore improving the operation capacity and business activity of the cooperative. Facilitating horizontal and vertical collaborations among not only multiple direct actors (farmers, input suppliers, processing company, international buyer) but also indirect actors (NGOs, Government, trader network, etc.) are presented in Figure 7.6. Horizontal coordination between producers could improve their operation and management capacity in order to comply with international standard. However, input suppliers provide larvae, feed and equipment has brought benefit for both sides as reducing of input material cost for cooperatives and improvement the transparency

and traceability along the value chain. Furthermore, the quality of input material and harvested shrimp products are guaranteed by the shrimp producers and related actors. The government plays their roles in human resource support during training courses, technique transfer, legality and policies supporting the linkage. In turn of processing companies and international buyers, the trade name of ASC shrimp products has been promoted. In the hand side of economic, small-scale farmers can get higher farm gate price, improving management ability steadily. The quality of the shrimp materials has been monitored and improved through directly buying at farm gate and directly transporting materials to the processing plants due to a reduction of the number of intermediate actors in the ASC shrimp value chain (these good highlighted points could be seen at HNC).

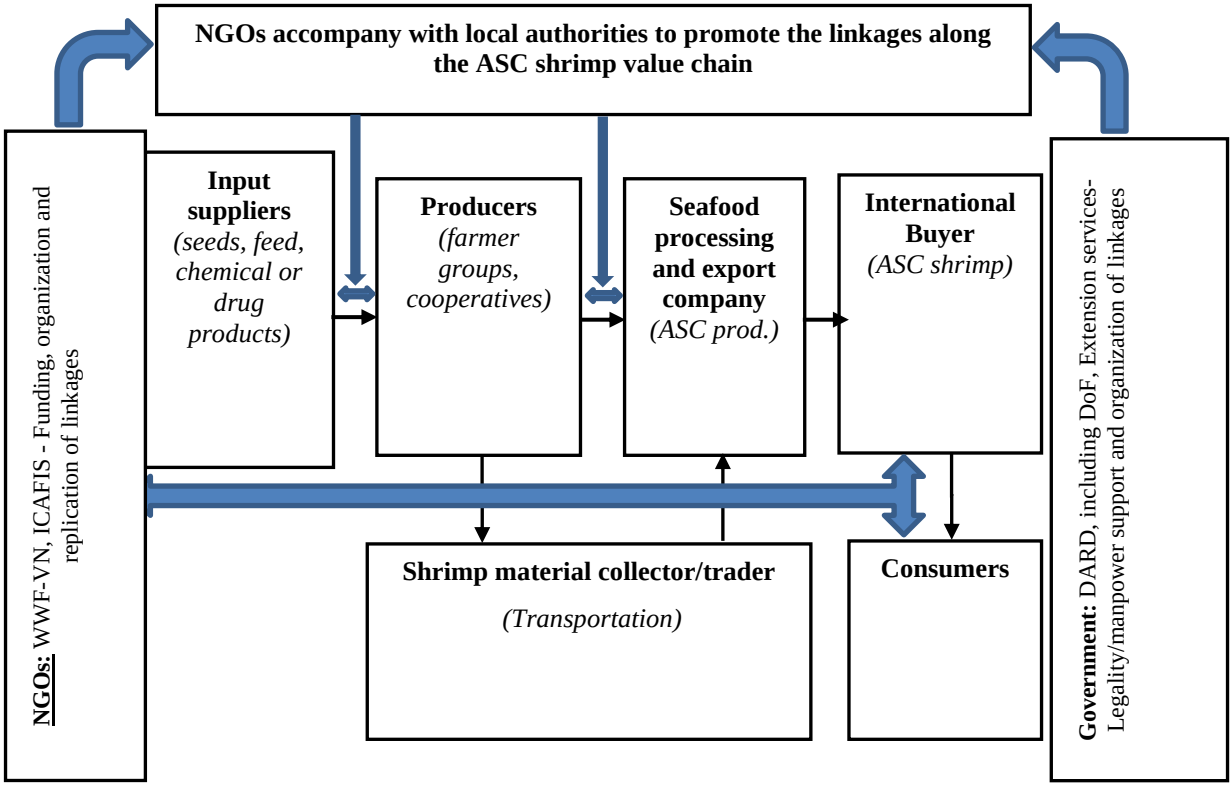


Figure 7.6 – Linkages Created by WWF-VN in ASC Certified Shrimp HNC

(Source: Author survey, 2019; Tinh et al. 2018)

9. Outcomes and Difficulties

9.1 Outcomes of ASC Scheme

The HNC has some advantages in participating in ASC scheme with effective CMB. Moreover, high consensus among team members was recorded. The cooperative is medium size makes it possible to control culturing shrimp following ASC effectively. The cooperative has adopted VietGAP before, so they had experience in approaching aquaculture certification. Importantly, the cooperative is supported actively from NGOs and government to be joined in ASC Scheme.

The analysis of certification cost above was 4,759 VND/kg, of which, farmers shared 66.5%, equaling to 3,141 VND/kg or $0.143US per kg. Considering to the buying price premium committed in the farming contract at 2,000 VND/kg, together with financial support of 350 Million VND per annum, approximately 1,775 VND/kg (350 Million VND/197.2 MT). So, total price incentive that farmers received was 3,775 VND/kg ($0.172US), higher than paying. It was concluded that ASC certification for shrimp farming in HNC is a profitable case in condition of receiving funding of auditing cost as well as annual funding for maintaining certification support from processing company but at very little incentive.

9.2 Difficulties in Pursuing ASC Certification based on Shrimp Cooperative

The emergence of ASC scheme in HNC has created a successful case to replicate for the MD. However, there were some difficulties for operating an international group certification for a cooperative as follow:

Firstly, the contract between HNC and Stapimex is tending to be broken because of competition with local brokers in buying ASC products. The ASC certified shrimp products being considered as "clean" products; therefore, the other shrimp collectors are willing to buy at a slightly higher price compared with premium price in faring contract (only 2,000 VND/kg). This impacted the decision of shrimp farmers for selling their shrimp. A shrimp farmer in cooperative even spoke that "I will sell the ASC shrimp for buyer who pay the higher farm gate price even my cooperative has signed sale contract with processing company".

Secondly, operation ability of the cooperative in term of business services is weak. In fact, shrimp harvest production per farm was still low due to small-scale farming. This issue can raise the costs of purchasing and shipping for processing company. Actually, there is a cooperative's member responsible for collecting and transporting shrimp material to the company. But his business ability and services are weak in competition with local collectors at the present time.

Thirdly, it is a challenge initially from limitation of infrastructure. HNC locates at remote area that inhibits farmers in collecting and shipping materials and products. The majority of roads are under development and too narrow for a shipment container to travel through. So, shrimp materials have to be transported via small trucks. Moreover, the CMB operates administrative activities without headquarter such as hall, square or office. The director of HNC concerned on the further operation and would like to call for supporters for office construction.

Finally, the cooperative adopted ASC passively. Initially they did not proactively seek ASC by themselves. Because they have scrupulosity of high requirement of

international standard as well as the low-price premium while lacking of capacity in production and money, and auditing procedure. They only agreed to join with the supports from NGOs and government, especially in terms of certifying cost and documents related to audit procedures. It seems to be difficult to extend ASC to other cooperatives/shrimp farmers with supports. But it is possible to follow this route with the similar way of supports as the HNC has gain with some improvements as shown in the Recommendations.

10. Required Conditions for Spreading ASC Scheme to Small-scale Shrimp Farming in the Mekong Delta

Generally, the culture shrimp according to a national standard such as VietGAP certifications is potential to deal with problem of quality and food safety for shrimp product. However, there was several control points did not practice well in comparison to the principles and criteria in standards and little farms being acquired the certificate. Moreover, VietGAP does not accomplish with the problem of price premium to farmers. ASC certification Scheme has been targeted as such certification is recognized globally and price premium attachment within farming contracts, is necessary to improve shrimp industry in the MD. Therefore, to be awarded VietGAP certification to target of acquiring ASC is a feasible solution to ensure full compliance of quality management and price premium through farming contract for farmers when exporting.

In order to replicate ASC for small-scale shrimp farming in the MD and Vietnam in the future, the application of VietGAP standard is necessary as it set a stepping stone as a premise to benchmark ASC as the target set by managers to improve shrimp industry. At

the initial stage, any small-scale shrimp household want to join in VietGAP, they are required to be a member of a cooperative or farmer group where were targeted to be acquired VietGAP first. All of small-scale shrimp farms which were certified ASC are member of cooperative and has applied VietGAP as a preparation to achieve the global standard for responsible aquaculture (Aquaculture Stepwardship Council, 2019). Attract the participation of NGOs, government, local authority, processing company, international buyer and the independent assessment party into the program. Farming contracts for the further certified cooperatives need to be improved in order to enhance price premium, avoid unfair competition from free traders and farmers breaking the contract.

11. Key Takeaway from the Case Study of ASC Certified Cooperative

① The cooperative has long stretch history and upgrading to join in international certification scheme. The cooperative has medium size and is operated by the management board elected by farmers.

② The auditing process took around four months and costed around $0.22US/kg with the highest contribution of farmers. However, the official audit cost was paid by processing company. The farmers still received the financial benefits but at low incentive.

③ ASC scheme in HNC has set a milestone for shrimp farming in the MD. The successful auditing process need be supported from related stakeholders and organizations.

Chapter VIII

FINAL CONCLUSIONS AND RECOMMENDATIONS

Summary

The final chapter of the thesis summarizes the findings of three studies. The main confirmation is that dramatically development of White leg shrimp in intensive system has stimulated situations of disease outbreak and food safety for exporting shrimp product. In the context of small-scale and fragmented shrimp farming in the MD, organizing shrimp farms by the forms of cooperatives/clusters, after that approaching and adopting to aquaculture quality certifications such as VietGAP and ASC latterly is the feasible solutions to address the problems. Thus, knowing that the roles of aquaculture certifications in disease control and quality management were observed with two researches focus on how the VietGAP has been doing in Vietnam. The research result shows that farmers in VietGAP applied system control disease and manage quality better farmers in non-GAP applied system. They were equipped clear procedure with full principles and criteria that they properly based on. Unfortunately, sometime and somehow, they did not comply fully with the controlled points guided in the procedure and limitations in economic efficiency when VietGAP could not offer high price premium. The ASC can address these problems mentioned above and are going on to benchmark from VietGAP in recent years onward.

1. Conclusions

1.1 Disease Control

VietGAP provided better disease outbreak management and economic safety for farmers. In other words, fewer farmers in VietGAP applied system reported diseases and economical damage than those in nọn-GAP applied system. VietGAP applications allow farmers to control disease better throughout multiple categories of farming practices, i.e. construction of reservoirs and better warehouses, low density, using toolkits. Only one third farmers relied on chemicals or drugs in disease treatment.

However, it should be noted that farmers usually did not comply fully with the regulations of sludge treatment or disease and iillegal sludge discharge reporting to their managers in the VietGAP system. Considering economic terms, VietGAP's role is not to generate high profit, but rather to provide insurance against loss due to disease outbreaks.

1.2 Quality and Food Safety Management

Five factors in farming practices that could contaminate quality of shrimp were identified, including stocking management, chemical usage, water management, feeding management, and pond preparation. In VietGAP applied farms, no gap between actual practices and criteria in GAP such as stocking density; reservoir construction; chemical use; diary recording and using toolkits/services in monitoring water were reported. However, several management points need to be complied fully such as quality of PLs, sludge removal, and pond design. On the other hand, in non-GAP applied farms, only point of pond design was practiced well. It is necessary to improve management points of quality

of PLs, high use of antibiotic, little keeping record, sensory water monitoring, reservoir construction, and unfrequently sludge removal.

Shrimp products in VietGAP system were required higher in terms of food safety due to export-oriented industry. Farmers have high capacity to produce quality products with small proportion of rejection thanks to VietGAP application. In non-GAP system, quality needs from buyers varied depending on consumption routes. Ratio of tested shrimp was highly rejected due to antibiotic residue violations. But no price premium was the major problem of VietGAP.

1.3 ASC Scheme: The Panacea for Small-Scale Shrimp Farming

HNC is the first intensive shrimp cooperative being certified ASC in the MD. The cooperative has long stretch history from the farmer club to a cooperative and upgrading to ASC latterly. The cooperative has medium size being operated effectively by the CMB elected by members. The participation of HNC in ASC scheme is passively under the active aid of WWF. The auditing process took around 4 months from the moment of application to certifier and costed around $76,219US, equal to $0.22US/kg with the highest contribution of farmers for re-building farms according to ASC. The pre-audit and official audit cost were assisted by WWF-VN and processing company. The successful auditing process needs supports from WWF-VN, ICAFIS, Stapimex, local authorities, Nordic Seafood and Control Union.

Price premium for certified products and annual support at $0.17US/kg were significantly financial outcomes for the cooperative. Get involved in linkages of shrimp supply chain-oriented export between HNC and private company STAPIMEX can be

considered as a successful linkage. However, this incentive was low because the processing companies offered buying price lower than regulated price in the farming contract. The famers, therefore, tend to break the contract easily when the competition in price was offered from free traders. The lesson learns here is the necessity to select a good cooperative with high potential in order to create a sustainable linkage. The farming contracts also need to be improved for the tighter binding.

In conclusion, ASC scheme could address problems of finance (Price premium, farming contract, and auditing cost) that VietGAP left for small-scale farmers. A feasible three-step procedure was proposed to improve the management of small-scale shrimp farming as shown in the Recommendations.

2. Recommendations

The operation of ASC schemes in a recent year has addressed above problems, especially issue of distribution and consumption of certified shrimp products worldwide with price premium being regulated in the farming contracts for farmers. The implementation of ASC scheme in Vietnam has a very steep mountain in order to achieve the success unless getting familiar with VietGAP prior going to international certification. And this process has become a feasible route to improve management of small-scale shrimp farming in the MD. Therefore, it is possible and feasible to improve the management of shrimp industry base on the route below (Figure 8.1):

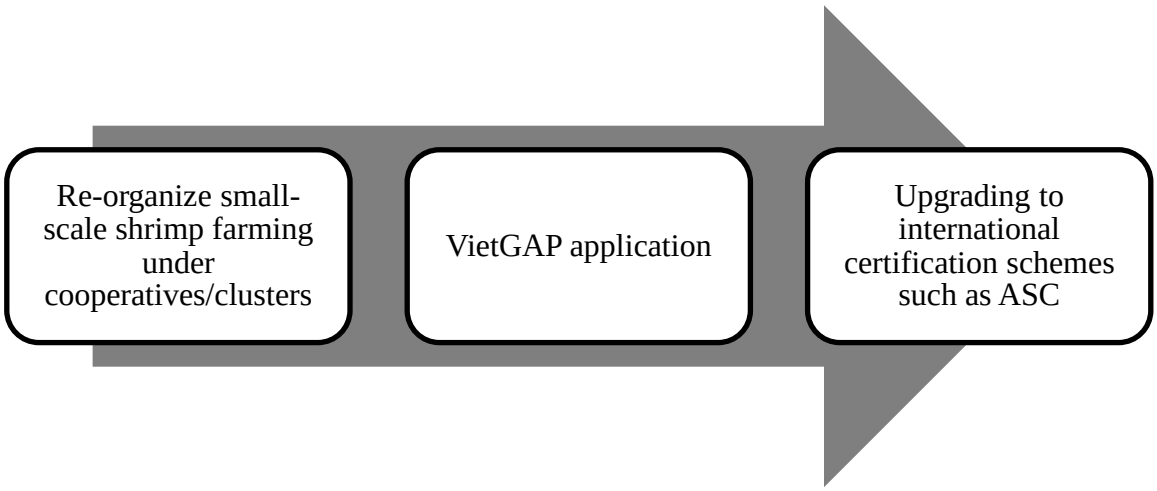


Figure 8.1 –Management Improvement Route of Small-Scale Shrimp Industry for the MD

(Source: Developed by Author, 2019)

Step 1: Re-organize Small-scale Shrimp Farming under Cooperatives/Clusters

Looking at the characteristics of the shrimp industry in the MD where small-holders remain limited to adopt and comply with aquaculture certifications as individual practices are often not reflected in collective practices (Ha, et al., 2013), organizing small-holders in some forms of collective, therefore, seem as an effective means of fostering requisite level of upgrading capacity to cope with aquaculture certification. The case studies of disease control and quality management have shown the function of VietGAP; therefore, in order to culture shrimp according to either VietGAP or other certifications, small-scale shrimp farmers are necessary to be member of a cooperative or aquaculture cluster. This is the first step in the route to enter pathway of international market integration. In this first step, some actions need to be taken into account include:

① The first action is that organizing training courses and propaganda programs of transfer information on collective policy with the aim to illustrate the benefits of these policies.

② Developing a transparent mechanism on the responsibilities and rights of the people involved in cooperatives/clusters.

③ Attracting farmers to join in cooperatives/clusters by offering variety supports, including internal supports and external supports through local authority governance.

④ Upgrading governance capacity of management board and fisheries managers in the local provinces.

Step 2: VietGAP Application for the Cooperatives/Clusters

The meanings and efficiency of VietGAP were illustrated in Chapter IV, V and VI, especially in terms of disease and quality management. By stimulating shrimp cooperatives/clusters in step 1, it provides opportunities for small-holders farmers to get familiar with aquaculture certifications. The MARD issued a range number of policies and program targeting application of national quality standard of VietGAP. In the farmers' side, order to encourage the participation of them in this scheme, more supports including technique and finance need to be transferred via cooperative's operation.

Step 3: Upgrading ASC Certification Scheme

VietGAP have showed its meanings, however, without significant financial benefits for farmers for doing VietGAP, the Vietnamese government's aspirations for creating market-oriented export, and WWFs of enabling small-holder involvement in ASC.

The related individuals and organizations should track and manage the operation of cooperatives/clusters regularly and pick up potential collective organization after that for upgrading ASC certification. The achievement of ASC scheme to small-scale requires external intervention in providing technique to build capacity for improving production and comply with international standards together with financial benefits. Therefore, developing collaboration among related individuals and organizations to promote functions of the cooperatives/clusters, attracting more supports from these organizations (Mohan, 2013).

3. The Future Prospect of Shrimp Farming

Regarding to Vietnamese shrimp industry, a great prospect to develop has been concluded. The export remains top market for shrimp consumption and certification schemes has become a unique pathway for shrimp products to enter global markets. When looking over the progress of aquaculture certification schemes in Vietnam, the farmers have adapted in this driven so far from implementation of national standards to international standards in order to produce shrimp products associated with the needs of the global market, improve the quality and branding of Vietnamese shrimp products together with systematic thinking and global value chain approaches. Although there are several constraints in this progress, it is believed that the Vietnamese shrimp industry has great development prospect to be continue in the future.

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APPENDICES

Appendix 1. Aquaculture Area by Provinces in the MD over Remarkable Years (Thousand ha)

Provinces	**2000**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Long An	3.4	9.4	10.8	8.9	9.0	8.7	8.7	8.2
Tien Giang	8.4	13.1	14.1	14.4	15.4	15.7	12.6	15.8
Ben Tre	29.3	42.5	43.1	47.7	44.8	47.1	42.4	45.2
Tra Vinh	52.6	32.8	29.1	40.4	36.9	30.8	29.5	30.4
Vinh Long	1.4	2.4	2.5	2.4	2.6	2.4	2.4	2.4
Dong Thap	1.9	4.8	5.5	5.7	5.9	6.0	5.8	5.8
An Giang	1.3	2.4	1.8	1.8	2.5	2.4	2.5	2.5
Kien Giang	34.6	123.1	114.6	115.5	126.9	132.9	136.2	143.5
Can Tho	12.6	12.8	12.6	11.7	11.0	11.4	10.9	8.4
Hau Giang	..	6.4	6.4	6.6	6.5	7.1	6.8	7.1
Soc Trang	41.4	71.5	67.1	64.8	68.2	68.4	68.8	69.5
Bac Lieu	54.0	125.4	125.2	117.8	127.9	127.5	130.6	131.8
Ca Mau	204.4	296.1	296.5	296.5	295.8	298.1	299.8	301.4
The MD	**445.3**	**742.7**	**729.3**	**734.1**	**763.4**	**758.5**	**757.0**	**772.0**

Source: *(General Statistics Organization, 2017)*

Appendix 2. Checklist for Key Informant Panel Interview (Study 1)

CHECKLIST FOR KEY INFORMANT PANEL INTERVIEW

Dear Sir/Madam, my name is Nguyen Thi Kim Quyen, a lecturer from College of Aquaculture and Fisheries, CTU and doctoral student of United Graduate School of Agriculture Science, Kagoshima University, Japan. I am studying management of shrimp industry. The objective of the study aims to develop feasible improvement in terms of quality control and disease management of shrimp farming practices in the Mekong Delta. Could You please tell me related information as following questions. Your answers and profile will be only served for the study and secretly storage. Sincerely thank!

Date:……..

Interviewer:……

Name:……..Phone number:……
Age:…….Gender: *1. Male; 0. Female*
Office: ……
Position:……
Address:……

I. Current situation of shrimp industry

1. Could You please give the information on current situation of shrimp industry of the province of the previous years (2017):

Shrimp farming models	**No.of households (household)**	**Areas (ha)**	**Production (tons/year)**	**Value provided (Million VND/year)**
Total shrimp farming				
- Intensive/semi intensive *(Vanamei)*				
- Intensive/semi intensive *(Monodon)*				
- Improve extensive				
– Extensive (monodon)				
– Others……..				

2. Farming schedule (Red line for main crop)

Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Intensive *Vanamei*												
Intensive *Monodon*												

Improve extensive												
Rice-shrimp												

3. Describing briefly history of shrimp farming of the province:……
……
……
……
……..
4. Which model is promoted by the provinces? Reasons?.....
……
……
……..
5. Which shrimp species is proposed by the provinces? Reasons?.....
……
……
6. What are the advantages and disadvantages of shrimp culture of the provinces?.....
……
……
……

II. Disease management

7. How are the situations of shrimp disease at the current years? Please providing the information in table below (information of 2017)

Name of disease	Occur after…days of stocking (days)	Symptoms	Outbreak Area (ha)	Prevention measures	Treatment measures	Financial damage (Mill.VND)
Red body disease						
White spot symdrome disease (WSSV)						
Early Mortality Syndrome (EMS)						
Empty stomach disease						
Other……						

Other…….						

8. How is the situation of shrimp disease in comparison to 5 years ago: *1: Significant decrease; 2: decrease; 3: remain stable; 4: Increase; 5: Significant increase. Level of decrease/increase: ……..%. If the answer is 1, 2, 4 and 5, please citing the reasons for that:*……
……
……

9. What are the supports provided for farmer from your institute in terms of **disease control**:

Services	**Yes/No (1 or 0)**	**Frequencies (times/year)**	**Efficiencies (1 – 5)**	**Reasons if answer is 1 and 2**
–Technical practices trainings and transfers				
– Disease prevention and treatment method				
– Monitoring the practices				
– Financial supports				
– Expanding regulations and laws				
– Providing of equipment/tools, drugs/chemicals related to disease				
– Others……...				
– Others……..				
– Others…….				

Note: For efficiencies: 1: Very bad; 2: bad; 3: medium; 4: good; 5: very good

10. Which are advantages and disadvantages in disease management of shrimp industry of the provinces?.....
.....……
…….....

11. What are you suggest for better effective disease control practices?.....
……
……

Date:…. /…../2018

Thank You very much for your cooperation!

Interviewer:……. Interviewee:…….

Appendix 3. Questionnaire for White Leg Shrimp Farmers (Study 1)

Code:

QUESTIONNAIRE FOR SHRIMP FARMERS

Dear Sir/Madam, my name is Nguyen Thi Kim Quyen, a lecturer from College of Aquaculture and Fisheries, CTU and doctoral student of United Graduate School of Agriculture Science, Kagoshima University, Japan. I am studying management of shrimp industry. The objective of the study aims to develop feasible improvement in terms of disease management of shrimp farming practices in the Mekong Delta. Could You please tell me related information as following questions. Your answers and profile will be only served for the study and secretly storage. Sincerely thank!

1. General information

1.1. Name:……1.2. Gender: *1. Male 0. Female*

1.3. Age:……1.4. Address:…….

1.5. Phone number:……....1.6. Ethic group:…….

1.7. Educational level: *0. illiteracy 1. Primary 2. Secondary 3. High school 4. College/university 5. Other:……..*

1.8. Family members :……(persons); Number of female:…….persons

1.9. No. of people involve in shrimp farming :……(persons); no. of female:…….(persons)

1.10. Production type: *1. Household; 2. Cooperatives; 3. Cooperation in group; 4. Company; 5. Other*

1.11. Number of permanent labors:….people/crop;

1.12. Number of temporary labors:….people/crop

1.13. Shrimp culture process: *1. Normal 2. VietGAP 3. GMP 4. ASC 5. GlobalGAP 6. Other……*

Year of applying:…….

Benefit 1 of when applying process:……

Benefit 2 of when applying process:……

Drawback 1 of when applying process:……

Drawback 2 of when applying process:……

1.14. Aquaculture Experience :……(years); 1.15. Shrimp farming experience :……(years)

1.16. Experience of current shrimp farming model :……..(years)

2. Shrimp farming activity

2.1. Site selection and farming construction

2.1.1. Total farm area:…… m^2; 2.1.2. Shrimp farming area:…… m^2

2.1.3. Number of ponds:……(ponds);

2.1.4. Average pond area……m^2

2.1.5. Distance from canal/river:……m;

2.1.6. Depth of pond:……m

2.1.7. Ownership: *1. Home land 2. Renting land*;

2.1.8. Area of setting pond (If any):……m^2

2.1.9. Number of setting ponds:……(ponds)

2.1.10. Area of treatment pond (if any)……m^2;

2.1.11. No. of treatment pond:……(ponds)

2.1.12. Farming schedule (year of 2017)

Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Crop 1												
Crop 2												
Crop 3												

2.1.13. List out any tools/equipment for shrimp farming

Tool/equipment	**Number (units)**	**Value (new purchasing) (1,000 VND)**	**Number of years can be used (years)**
1. Machine			
2. Aeration system			
3. Electricity system			
4. Storage construction			
5. Pond construction			
6. Land renting cost/year			
7. ……			

2.2. Culture technique

a) Pond preparation

a.1. Pond improvement method: *1. Liming 2. Mud dredging 3. Other……..*

a.2. How long from pond preparation to stocking:……days

a.3. Which factors make up good pond preparation? *1. Good at technique;2. Technique transfer from extension unit; 3. Personal experience; 4. Quality of lime and machine; 5. Other……..*

b) Fingerling and stocking

b.1. Sources of shrimp seeds: *1. Local hatcheries; 2. Seed traders/nursing site in the Mekong delta; 3. Seed traders/nursing site in the Mekong delta; 4. Other……*

b.2. Reasons for choosing these source:……..

b.3. Quarantine or not? *1. Yes; 0. No*

b.4. How can you check shrimp seed that without pathogens? *1. Uniform of size; 2. Well appearance; 3. Swimming ability; 4. Having quarantine; 5. No banned antibiotics'; 6. Other……*
b.5. How long to ship shrimp seed to stocking:……..hours
b.6. Stocking density:……fries/m^2; b.7. Size:……(PL)
b.8. Which indicators/standards that You rely on in purchasing shrimp seed?.....
b.9. Quality of shrimp seed in comparison to 3 – 5 years ago: *1. Much decrease; 2. Decrease; 3. No change; 4. Increase; 5. Much increase*

c) Feed

c.1. Does feed traders assure quality of feed: *1. Yes 0. No*
If Yes, how:……
c.2. FCR (feed conversion ratio):……; c.3. Branch of pellet:……
c.4. Ratio of protein:…….%; 5. Feeding regime: ……

d) Water exchange and water/wastes treatment

d.1. Sources of water: *1. Main river; 2. Canals; 3. Pumping of ground water; 4. Tap water; 5. Other…*
d.2. Frequency of water change (days/time):……; d.3. Ratio of water exchange:……%
d.4. Evaluation of water quality: *1. Very bad; 2. Bad; 3. Medium; 4. Good; 5. Very good*
d.5. Water quality in comparison to 3 – 5 years ago: *1. Much decrease; 2. Decrease; 3. No change; 4. Increase; 5. Much increase*
Reasons for changes:……..
d.6. Water/waste treatment

Categories	Treatment (1. Yes; 0: No)	Treatment measure	Efficiency of treatment (*1. No; 2. Medium; 3. Good*)
Wastewater treatment			
Mudding waste treatment			
Solid waste treatment			
Disease/dead shrimp			
Other……			

2.3. Harvest and selling

2.3.1. Harvest production/crop:……tons;2.3.2. Harvest size:……shrimps/kg
2.3.3. Selling price:……1,000đ/kg
2.3.4. Consume sources

Source	**Quantity (% of productivity)**	**Price (1,000đ/kg)**	**Market size (individuals/kg)**	**Quality test** ***(1. Yes; 0. No)***
Traders				
Whole traders				
Processing company				
Other…….				

3. Disease management and drugs/chemical usage

3.1. Could you please report the disease outbreak of the nearest crop?

Name of disease	**Occur after stocking (days)**	**Clinical manifestations**	**Treatment measures**	**Efficiency of treatment (1 – 5)**	**Productive damage (%)**	**Financial damage (Mill.VND)**
Red body disease						
White spot symdrome disease (WSSV)						
Early Mortality Syndrome (EMS)						
Empty stomach disease						
Other disease……						
Other……..						

Note: efficiency of treatment: 1: No efficiency; 2. Very low efficiency; 3. Low efficiency; 4. Neutral efficiency; 5: Good efficiency

3.2. Disease situation in comparison to 3 – 5 years ago: *1. Much decrease; 2. Decrease; 3. No change; 4. Increase; 5. Much increase*

If answer is 4 or 5, please citing out reasons:…….

……

…….....

3.3. Which farming practices have effected to the disease occurrence and how?

Practices	**Explain how**	**Ranking score of impacts (1-5)**
- Site selection		
- Pond preparation		
- Seed		
- Feed		
- Water		
- Supporting from related authorities		
- Knowledge and experience		
- Other……..		
- Other……		

3.4. Preparation and chemical/drug usage

Groups of chemicals/drugs	**Using purposes**	**Providers**	**Purchasing cost (1,000VND/crop)**
Herb extract group:			

Probiotics			
Nutritional supplement			
Disinfection and treatment			
Other			

3.5. Safety in using chemicals/drugs

Criteria	**1: yes; 0: no**	**Criteria**	**1: yes; 0: no**
Had knowledge about health and environmental risks associated with use of chemicals		Using appropriate glove when directly treat water	
Knowledge on banned chemicals		Cleaning any equipment and tools after using chemicals	
Applying protective methods within handling		Recording of chemical use	
Using appropriate glove when handling chemicals		Had knowledge on residual time in chemical usage	
Other 1……..		Other 2	
Other 3		Other 4	

4. Financial indicators (for nearest crop)

Categories	**Value (Million VND)**
Fix cost	
Variable cost	
+ Fuel (electric, water, petrol, gasoline,…)	
+ Pond renovation	
+ Hiring labor	
+ Harvest and transportation	
+ Loan interest	
+ Other fee (test,……)	
+ Marketing, deal	
+ Cheap perishable items	
+ Other cost……	
Total production cost	
Revenue	
Net profit	

5. Supporting services related to disease management

5.1. Please give the information on trainings that You have received within the past 3 years:

Trainings	**Date**		**Number of participation times**	**Organization[1] (1 – 5)**	**Applicability (1 – 3)**
In terms of seeds					
In terms of drugs/chemicals					
In terms of disease treatment					

In terms of environment/water					
In terms of quality standard application					
Other…… ……					
Other…… ……					

Note: [1]: 1: University/research institutes; 2: Provincial/district aquaculture and fisheries authorities; 3: Extension; 4: Feed/chemical providing companies; 5: Other……..
[2]: 1: Not good; 2: Medium; 3: Good

5.2. Desires associated to trainings:……

5.3. Sample test from authorities

Number	**Sample**	**Yes (X)**	**Frequency of sample collection (times/year)**	**Feedback/supports after testing**
1	Waste water			
2	Surounding water			
3	Disease shrimp			
4	Raw shrimp			
5	Feed			
6	Chemicals			
7	Other…….			

6. People' awareness related to shrimp farming and disease control

6.1. What are your advantages in shrimp disease control?

6.1.1……..
.....
6.1.2……
……..
6.1.3……
……

6.2. What are your advantages in shrimp disease control?

6.2.1……..
.....
6.2.2……
……
6.2.3……
……

6.3.What are your suggestions for these issues?

6.3.1……..
.....
6.3.2……
……
6.3.3……
……

Date:…. /…../2018

Thank You very much for your sharing!

Appendix 4. Questionnaire for Interviewing Shrimp Farmer about Situation of Quality and Food Safety in Farming Practices (Study 2)

QUESTIONNAIRE FOR INTERVIEWING SHRIMP FARMER

Good morning/afternoon, I am (name) working for CTU. I research on issues regarding fisheries socio-economics and management analysis that aim to improve quality and food saftety of shrimp product, competitive advantage as well as fisheries sustainable development. If you do not mind, please tell me some information related to your work. I ensure that your answers will be secret.

I. GENERAL INFORMATION

1. Name of interviewee: ……

2. Personal information:

2.1. Age: ……... ……

2.2. Sex: 1. Male 2. Female

2.3. Ethnic group: 1. Kinh 2. Khmer 3. Chinese 4. Others……..

2.4. Experience for shrimp production: …….. (years)

2.5. Telephone number: Table: …….. Cellphone: …….

3. Education level: …… ……..

4. Size of household: …..…… persons

5. Total labors participating in shrimp production: …… persons

5.1 Information on hiring labors

Indicators		**Male (1)**	**Female (2)**
1. Labors	Person	(5.11.)	(5.21.)
2. Education level/job training		(5.21.)	(5.22.)
3. Kinds of job		(5.31.)	(5.23.)
4. Position/label (technician, engineer..)		(5.41.)	(5.24.)
5. How long/years of experience	Year	(5.51)	(5.25.)
6. Salary (for day salary)	VND/day	(5.61)	(5.26)
7. How many working days/month	days	(5.71)	(5.27)
8. Salary (for month salary)	VND/month	(5.81)	(5.28)
9. How many working months/year	Month	(5.91)	(5.29)
10. Insurance (1.Yes 2. No)		(5.10)	(5.20)
11. Jointing in Labor Union (Y/N)		(5.1A)	(5.2B)

6. Location: Province: …….; District: …….

7. Main sources of income from: 1. Shrimp; 2. Rice; 3. Others: …….

II. SHRIMP PRODUCTION IN 2018

8. Culture area in 2018? …… (ha) Culture of last crop:…….(m^2); Average pond area:……m^2

1. Number of crops/year :……(crops)
2. Quality certification? 1. Non-certification; 2. VietGAP; 3. ASC; 4. Other……
3. Year of implementation certification……..
4. Being certified: 1. Yes 0 No
5. Member of cooperative? 1. Yes 0 No

9. Pond preparation and fertilization

1. How and where to dispose the bottom sludge? .....
……..

2. Do You check some soil indicators (pH, alkalinity, soil conditions, …)?…….

When and how…….

…….

3. Do you dry the pond bottom and how? 1. Yes; 0 No.....

4. Please specify liming activity? .....

5. Do You keep water in reservoirs before pumping? 1. Yes; 0 No,How long …….(days)

6. Optimum water depth before stocking? .....(m)

7. Optimum days before stocking? .....(days)

8. List the chemicals/drugs using during pond preparation and fertilization? .....

…….

9. How to fertilize ponds? .....

10. Do and how green algae ultimately lead to a collapse of pond? 1. Yes; 0 No.....

……

11. Do and how organic fertilizers may contaminate pond water? 1. Yes; 0 No
……

10. Checking shrimp seed quality:

1. Check/investigation of seed quality? 1. Yes 2. No

2. If yes, who is investigator? ……..

3. Where to buy shrimp **seed**? 1. Local hatcheries; 2. Central region; 3. Agent of central hatcheries locate at the province; 4. Hatcheries in the MD (Pls. specify……

4. What kinds of diseases were tested? .....

5. How to transport and stock shrimp seed?.……

…….

6. Do you apply and how separate weak seed, employ formalin treatment? ……

……

7. Stocking density :……(PLs/m^2)

11. Feeding controls

1. Where to buy shrimp **feed**? 1. Company; 2. Level 1 feed agent; 3. Level 2 feed agent; 4. Other (Pls. specify……)

2. Do you evaluate suppliers according to feed quality, availability, rate, etc. ……

3. Do you maintain adequate reserve stock of feed? .....

4. How many kinds of feed and suppliers you use?.....(types)

5. Whether meal quantity is decided on the basis body weight? .....

6. How long for storage of feed? Where? Any records? .....

……

7. Using feeding machine? 1. Yes; 0. No.

Any feed leftover? If answer is Yes, please specify % of remaining and reasons why? ....

8. Feed conversion ratio (FCR) on the last crop: …….

12. Water quality management

1. How and frequency of water exchange?.....

Support of culture technique? 1. Yes 2. No
If yes, what support? …….

2. Who support? 1. Extension staff; 2. Local staff; 3. Others (Pls. specify……)

3. Do you know about the recommended amount/percentage of water exchange/time?

1. Yes; 0. No How much:…….(%)

4. Do you know favorable pH for shrimp? 1. Yes; 0. No., how much: ……..

How to adjust pH? .....

5. List out water quality parameters evaluated and frequency? (pH, t, color, transparency, BOD,..)……

6. How to monitoring in-pond water? 1. Visual; 2. Toolkit; 3. Services; 4. Other: ……

7. Describing details the operation of aeration.....

13. Use of chemical for shrimp diseases by: 1. Guidance 2. Experiences 3. Both

1. If answer 1, who guides? ……..

2. Form of guidance: 1. Documents; 2. Training3. Others: Pls. specify……

3. Do you know the uses of some drugs (antibiotic) are banned in aquaculture? Please specify name, dosage, reasons to use…….

.....

4. How carefully do you apply in transporting and using of chemical? .....

5. Is there any surveillance program to monitor compliance with limits on residues? ....

6. Other……

14. Loan for shrimp production? 1. Yes 2. No

1. If yes, how much …….Mil VND
2. Loan for what?

1. Buying shrimp seed

2. Buying shrimp feed

3. Pool preparation

4. Machinery purchase

5. Others (Pls. specify ……)

3. Which source of loan? Interest (%/month) Loan period (month)

1. Agri bank 14.31a……. 14.31b…….

2. Poor/Policy bank 14.32a……. 14.32b…….

3. Join stock bank 14.33a……. 14.33b…….

4. Private loan 14.34a……. 14.34b…….

5. Relatives borrowing 14.35a……. 14.35b…….

6. Others (Pls. specify …….)

4. Reasonable loan period? 1. Reasonable 2. Unreasonable

+ Reasons of unreasonable? ……

……

15. Which factors in farming practices could contaminate shrimp products and how? Please list out and giving the score of effect from 1 – 5 (the lowest to the highest)

Production factors	**How to effect**	**Score of effect (1-5)**
15.1.	15.11.	15.12.
15.2.	25.21.	15.22.
15.3.	15.31.	15.32.
15.4.	15.41.	15.42.
15.5.	15.51.	15.52.
15.6.	15.61.	15.62.
15.7.	15.71	15.72

16. Production costs (last crop)

1. Average culture period of time/crop…….. (months)

2. List of costs (Unit: 1.000VND/crop)

No	Items	Description	Total costs
1	Land taxes/ pool rent		
2	Pond construction Depreciation cost/crop		
3	Purchasing of machine/tools/equipment Depreciation cost/crop		
4	Pool/field preparation		
5	Seed		
6	Fuel/electricity		
7	Chemical/drug/vitamin		
8	Industrial Feed		
9	Home-made feed		
10	Harvest		
11	Home labor	Day/crop*labor cost/day	
12	Hired labor	Day/crop*labor cost/day	
13	Transportation		
14	Loan Interest		
15	Communication cost		
16	Quality checking		

17	Minor repairs, perishable materials		
	Total cost		
	Output/crop (tons)		

17. Any other support? 1. Yes 2. No
If yes, what kind of support?

1. Financial support
2. Shrimp distribution (input-output process)
3. Other support: Pls. specify…… ……

+ Who support? ..... ……..

III. SELLING ACTIVITIES AND QUALITY SITUATION

18. Selling shrimp and quality situation

1. Shrimp quantity sold in the last three years: 2018: …… …(kg); 2017: ……(kg); 2016: ……..(kg)

2. Who buys your shrimp? 1. Collector (small trader) 2. Wholesalers 3. Trader network of processors 4. Processor 5. Others…….

3. Reasons for selling above chose buyer? ……

4. Gear used for harvesting? Who is responsible for this?.....

5. Time taken for harvesting?.....(hours)

6. Forms of consumption: 1. Alive shrimp; 2. Ice using: amount, quality, ratio, suppliers…….

7. How many times was shrimp product tested within 3 years?..... (times)

8. Where was shrimp tested: ……

9. How much for price premium in case of passing test :…….....(VND/kg)

10. How many times was shrimp product rejected?..... (times)

11. Reasons for rejected?.....

12. Conditions for shrimp to be checked for quality?.....?

19. Form of selling (last crop):

1. Form of payment: 1. Cash once; 2. Cash twice; 3. By contract; 4. Others: ……

2. Forms of contract: 1. Oral; 2. Documents; 3. Others……

3. Form of selling: 1. Buyers find you 2. You find buyers 3. Both

4. If answer 2, how? ……

5. Detail on selling activity:

Sizing (Inds./kg)	**Ratio (%)**	**Selling price** (1.000VND/ kg)	**Profit/kg** (1.000VND/ kg)
1. Kind 1……			
2. Kind 2…….			
3. Kind 3……..			
4. No classification			

20. Quality criteria of buyers on the harvested shrimp?

1…….

2……..

3……..

21. And your response of shrimp quality? 1. Good 2. Just ok 3. Not good

Reasons of "Not good" answer: …… ……

…….....

22. How to assess shrimp quality? 1. Sensory; 2. Chemicals; 3. Lab test; 4. Others……..

23. Who decides shrimp price? 1. Buyers 2. You (farmer) 3. Bargain

24. Which policies to affect your production? 1. Yes 2. No

1. Policy regarding environment?…….

2. Policy regarding quality? ……..

3. Policy regarding Bank? ……..

4. Policy regarding increasing culture area? ……

5. Other policies: …….

IV. FARMERS' PERSPECTIVE ON QUALITY CONTROL AND FUTURE

25. Advantages and disadvantages of shrimp production?

Advantages	**Disadvantages**	**Solutions**

26. Do you have any quality problems in the shrimp raised, what are they?.....
……
27. What are your suggestions for better quality control?.....

……

28. What is your expectation about shrimp industry development?

1. ……..

2. …….

3. ……..

The questionnaire is completed; thank you very much for your cooperation!

Appendix 5: Check list for shrimp cooperative (Study 3)

QUESTIONNAIRE FOR SHRIMP COOPERATIVE

Dear Sir/Madam, my name is Nguyen Thi Kim Quyen, a lecturer from College of Aquaculture and Fisheries, CTU and doctoral student of United Graduate School of Agriculture Science, Kagoshima University, Japan. I am studying management of shrimp industry. The objective of the study aims to develop feasible improvement in terms of quality control and disease management of shrimp farming practices in the Mekong Delta. Could You please tell me related information as following questions. Your answers and profile will be only served for the study and secretly storage. Sincerely thank!

Date:…….. Interviewer:……

Name:……..Phone number:……

Age:…….Gender: *1. Male; 0. Female*

Position:……

Address:……

I. COOPERATIVE BACKGROUND AND INFORMATION

1. When was the Cooperative established?
2. What were the purposes and missions of Cooperative?
3. What is the current size of Cooperative management board (officers and management committee)?
4. What is the current size of Cooperative (members and area)?
5. Who are members of Cooperative?
6. How have changes in size of Cooperative within previous time?
7. Please describe the history of Cooperative from initial establishment to the current?

II. ABOUT THE OPERATION AND PRODUCTS

8. What are conditions to be member of Cooperative?
9. What do you do to attract new farmers joining the cooperative?
10. What is managed mechanism of the cooperative over members? Please describe detail.
11. What are the sharing production and area in terms of models and species?

Farming models	**Species**	**No. of crop/year (crop)**	**Area (ha)**	**No. of member**	**Production (ha)**

12. Who buy shrimp products of Cooperative?
13. What are structure and selling method of shrimp products harvested by Cooperative?

III. ON THE ASC CERTIFICATION TOPIC

14. When did shrimp farmer apply ASC standard?
15. When is ASC certificated?
16. What model and species are ASC certificated? Please describe detail the sharing of ASC products in the cooperative.
17. Why did cooperative seek ASC certification?
18. Are there historical numbers for ASC harvest by cooperative?
19. Describe the auditing process for ASC certification
20. What are functions of cooperative in certificating of ASC standard?
21. What kind of work was required for the pre-assessment of ASC?
22. How was the assessment and yearly audits performed?
23. What were the costs for ASC certificate, including pre-assessment, initial assessment, yearly audits, etc.?

24. What did the cost come from (farmers' responsibility, support, project, etc.)?
25. What are the subsidy or supports that Cooperative receive for ASC certification?

IV. MANAGEMENT IMPROVEMENT BY ASC CERTIFICATION

26. What is success of ASC bringing to farmers in term of disease management?
27. How ASC applications help to improve disease outbreak?
28. What is success of ASC bringing to farmers in term of quality management?
29. How ASC applications help to improve quality of shrimp products?
30. Do the ASC products generate a price premium?
31. Do ASC certificated products increase? Why?
32. Do you think that ASC certification improve shrimp industry? In which way?

V. FUTURE PERSPECTIVE

33. Do you think that ASC is the best way to improve shrimp industry? Why?
34. What are main difficulties of the cooperative?
35. Do you maintain or spread out ASC certification in the future?
36. What do you do to fulfill your plan toward ASC certification?

Date:…. /…../2019

Thank You very much for your cooperation!

Interviewer:……. Interviewee:…….

Appendix 6: List of banned antibiotics in VietGAP standard

No.	Name of chemicals/antibiotic	Subjects applied
1	Aristolochia spp and preparations from them	Feed, veterinary medicine, chemicals, environmental treatment substances, disinfectant cleaners, preservatives, hand creams in all stages of seed production and aquaculture.
2	Chloramphenicol	
3	Chloroform	
4	Chlorpromazine	
5	Colchicine	
6	Dapsone	
7	Dimetridazole	
8	Metronidazole	
9	Nitrofuran (bao gồm cả Furazolidone)	
10	Ronidazole	
11	Green Malachite (Blue Malachite)	
12	Ipronidazole	
13	Other Nitroimidazole	
14	Clenbuterol	
15	Diethylstilbestrol (DES)	
16	Glycopeptides	
17	Trichlorfon (Dipterex)	
18	Gentian Violet (Crystal violet)	
19	Group of Fluoroquinolones (prohibiting use in production, trading, and export into the US and North American markets)	
20	Trifluralin and preparations contain Trifluralin	

(Adapted to Circular No. 15/2009 / TT-BNNPTNT; Circular No. 20/2010 / TT-BNNPTNT and …….)

END DISSERTATION./.