Towards implementation of traceability for shrimp supply chain in Vietnam: economic analysis and global trade potential consideration

（ベトナムにおけるエビ供給連鎖へのトレーサビリティ導入に向けて
：経済分析と国際的貿易潜在力の考察）

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ABSTRACT

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Towards implementation of traceability for shrimp supply chain in Vietnam: economic analysis and global trade potential consideration

Background and Objectives

Shrimp products play a vital role in the international trade of fisheries products. The main suppliers for shrimp products are Vietnam, Thailand, Bangladesh and other countries in Southeast Asia. Vietnamese shrimp products are mostly produced to export to global markets. The US, EU and Japan markets are the major importers, accounting 50% of total Vietnamese shrimp exported value.

As other fisheries products, the importing countries have issued the policies and regulations for specific requirements of traceability to devote the mandatory requirements for the compliance of, both domestic and imported shrimp producers. The specification of those regulations and practices in importing countries requests the responses of shrimp exporting countries to comply with those stringent requirements. Various approaches for implementation of traceability are applied policies and regulations at the major shrimp exporting countries, including Thailand, Vietnam and other Southeast Asia countries to access to international markets. However, the implementation of those policies and regulations in exporting countries are facing to the challenges due to the limitation of incentive economic benefit.

This study aims to (1) investigate the costs and benefits of traceability implementation for shrimp producers in exporting countries based on the economical examinations and (2) discuss the alternatives to enhance the implementation of traceability for shrimp products in exporting countries to meet the requirements from importing countries and consumer's needs. Our focus is on Vietnam, where the Mekong Delta accounts for only 12% of the country's geography, but plays a vital aquaculture role with 70% of total production and 60% of total export value of Vietnamese shrimp products.

Materials and Methods

Data collection To achieve the study's purposes, an overview of the traceability implementation for shrimp products in global markets was conducted based on the previous scholars and the specific policies and regulations. On the other hand, the interview survey was conducted in Mekong Delta, Vietnam, which covered all stages of shrimp supply chain, including shrimp farmers, middlemen (e.g. collectors, brokers/traders and other wholesale agents) and processors, from June to July 2017. Besides that, the information about the background of shrimp production and traceability implementation in Mekong Delta and the whole country was obtained based on the annual reports of Provincial Department of Fisheries and Provincial Department of Agriculture, Fisheries and Forestry Quality Assurances in Mekong Delta, Vietnam.

Data analysis To examine the economic implication of traceability implementation for shrimp products, the comparison of the distribution channels and movement of information along shrimp supply chain in terms of traceability, firstly, were conducted to identify the changes in supply chain of shrimp products in terms of traceability in Mekong Delta, Vietnam. Costs-benefits analysis (CBAs), then, was applied to investigate the economic influencing of traceability implementation to shrimp producers along supply chain.

The alternatives for implementation of traceability along the shrimp supply chain were discussed in several steps as follows:

✓ Investigate the willingness to implement (WTI) traceability, and the expected price of farmers for shrimp products based on the double bound choices question.

✓ Estimate the factors influencing to the expected price of shrimp farmers for shrimp products with traceability based on the Censored Regression Model (CRM).

✓ Investigate the maximum farm-gate price of the shrimp farming input's buyers.

✓ Discuss the alternatives of traceability implementation based on the experimental results from the current study.

Results and Discussion

The overview's results about traceability implementation in global markets indicated that, traceability was implemented for shrimp products under various forms. The main purposes of the implementation of traceability were to identify from whom to whom the products had been supplied for enhancing the food quality and safety. Differences countries might have the differences considerations to the traceability implementation and requirements. In global markets, the implementation of traceability in importing countries was applied for both domestic products and imported products. Therefore, to meet those requirements of importing countries, the implementation of traceability in shrimp exporting countries must be considered to access to the global markets.

The results from interview survey indicated that, 100% shrimp products in the samples, which were applied quality assurances certificates, were directly distributed from farmers to processors. While as 97.5% non-certified shrimp products in the samples were provided to shrimp processors through middlemen and the rest of 2.5% non-certified products were directly provided to shrimp processors under the contracted agreement. The movement of information along shrimp supply chain in Mekong Delta, Vietnam were depended on the distribution flows from shrimp farms to processors. The application of quality assurances for shrimp products at shrimp farmers might enhance the implementation of traceability towards to satisfy the requirements of global markets.

In current study, the CBAs approaches could not confirm the benefits of traceability implementation for shrimp producers. The main reasons were indicated because the less of the farm gate price paid for shrimp products with traceability implementation, comparing to the farm gate price of shrimp products without traceability. Based on the CBAs results, the farm-gate price for shrimp products were suggested at 10.17 USD per kg (*P. monodon* shrimp) and 6.35 USD per kg (*L. vannamei* shrimp) to balance the costs and benefits as well as to enhance the implementation of traceability.

The expected farm-gate price of shrimp farmers and the maximum farm-gate paid for shrimp products with traceability of shrimp farming input buyers were examined based on the conducted information from interview survey. The found results indicated that, shrimp farmers expected the farm-gate price for shrimp products in order to implement traceability at 10.17 USD per kg (*P. monodon* shrimp) and 6.15 USD per kg (*L. vannamei* shrimp). The expected farm-gate price of shrimp farmers for *P. monodon* shrimp was roughly homologous to the suggested price from CBAs, while the expected farm-gate price for *L. vannamei* shrimp was concordant with the conducted price of non-traceability shrimp products from the interview survey. From the shrimp farming input buyers, the maximum farm-gate price of shrimp products might be at 10.26 USD per kg (*P. monodon* shrimp) and 6.18 USD per kg (*L. vannamei* shrimp). Thus, the shrimp farming inputs might be paid a higher price to enhance the implementation of traceability. On the other hand, the application of quality assurances certificates were found as the important alternatives for the implementation of traceability along shrimp supply chain towards to meet the requirements of global markets. Towards the global markets, the traceability for shrimp products was suggested to perform with the integration to the application of quality assurances certificates.

Chapter 1. Introduction

1.1 Introduction

In recent years, the spreads of food incidents in over the world such as the affecting of mad cow disease (Bovine Spongiform Encephalopathy-BSE) from Europe; melamine scandal from China, *Escherichia coli* (*E. coli*) from Germany and dioxin contamination of chicken feed from Belgium have led to the high perception of global consumers in food safety issues (Bernard *et al*., 2002; Charlebois *et al*., 2014). This may affect to their confidence in food quality, which is the major influencing factor to the food purchased decision making (van Rijswijk and Frewer, 2012). Consumers are currently incredulous about the accuracy of information in food origins, production processes and ingredients of food products provided by producers (Lusk *et al*., 2006).

To explore the information of food quality and ingredients, consumers may search on the labeling of food products. However, the provision of information on labeling is currently depended on food producers who may not prefer to make transparently the information about the quality and safety of their produced food products to consumers and other stakeholders in food chain (Kehagia *et al*., 2007; Kher *et al*., 2010). Consumers, therefore, may be difficult to get and track the information about food quality variation. They are, then, continuously consuming the food with the ambiguous awareness of the information about quality and safety (Hobbs, 2004).

In addition to food quality and safety issues, consumers may not directly approve the food attributes at the point of sale without any experiences about their purchased food products (Nelson, 1970; Clemens, 2003; van Rijswijk and Frewer, 2012). Hence, consumers who desire to know the information of food attributes need to rely on the information provided by food producers (Houghton *et al*., 2008). The proclamation of reliable information about the quality characteristics of food products, including food origins and ingredients, becomes the important part to call the consumers' confidences. It is because this notification may enhance the ability to identify the potential risks of purchased food products of consumers (Hobbs *et al*., 2005; van der Vorst, 2006 and Kher *et al*., 2010).

The information about food quality and ingredients may enable to provide to consumers through traceability systems, which are introduced as a tool to trace and follow food chain through all stages of production, processing, and distribution (Golan *et al*., 2004; Hall, 2010; Charlebois *et al*., 2014). The principles of traceability systems, therefore, help to facilitate food producers and other stakeholders, including consumers to trace and track the accuracy of the provided information and the products affected from incidences.

Many previous studies have been conducted to exam the merit of traceability systems for both producers and stakeholders in food supply chain. Darby and Karni (1973) and Hobbs (2004) indicated that the traceability systems might support to reduce the information asymmetry between producers and consumers, which causes of market failure and abuses to defraud purchases. Thompson *et al*., (2005) addressed that traceability was an important tool to increase the trust about the food safety and quality, to protect the right to know about the purchased food of consumers and to prevent risks of unsafety food. From consumers' side,

the effective and reliable traceability systems with the shared information of food quality and ingredients might positively influenced to consumers' confidences (van Rijswijk *et al*., 2008). From the food producer's side, the application of traceability systems may promote the food suppliers for quality controls of their products (FSA, 2002). It supports to specify the liability responsibility between producers along supply chains in food incidents (Bosona and Gebresenbet., 2013). Traceability systems, then, may support to improve the reputation and reduce operating costs of food producers (Umberger *et al*., 2003; van Kleef *et al*., 2007).

Despite indicated validities, traceability systems for food products are not well established at producers' side. This is because the implementation of traceability systems may be costly for application, monitoring and maintenance procedures (Trienekens and Zuurbier, 2008; Hall, 2010). Therefore, the allocation of budgets to develop a traceability system is the major challenge for food producers who have limited productions and lack financial resources (Wakamatsu and Wakamatsu, 2017). The production costs of food products with application of traceability may be higher than the former products, so a price premium for the product is required to encourage the application of traceability from producers' side (Bjornlund *et al*., 2017).

On the other hand, from consumers' perspectives, the understanding about the concepts of traceability and what traceability means in practice may not be interested (Gellynck and Verbeke, 2001; Giraud and Amblard, 2003). Instead of that, consumers may focus on the information about the food quality and ingredients. As discussed in the previous scholars of Hobbs *et al*., (2005); Verbeke and Ward (2006), the traceability may be more value and more interested by consumers when it may provide to consumers the information related to food safety, quality and ingredients, suggesting that consumers have linked traceability to the food quality and safety issues and have not strictly demanded for the separated traceability systems when making food purchasing decisions.

Moreover, the priorities and preferences to know the information of food products of different consumers segments may be depended on the individual preferences and the broader culture range reflecting to their perspectives. The variety of consumers, therefore, have different demands in the information of products to optimize the benefits received and costs spent for food producers to implement the traceability system. For example, consumers in European countries prefer to clarify the food origin and production processes in order to enhance food safety and their confidence. Therefore, the perspectives of traceability systems in Europe markets tend to be focused much more on traceability from "farm to fork" to improve food quality through labeling of experience and food attributes (Dickinson and Bailey, 2002; Buhr, 2003; Bureau and Valceschini, 2003). In comparison, the consumers in United State (the US) are more concerned to food safety. Traceability systems in the US, therefore, have applied to enhance the US' ability to respond to disease outbreaks and to increase the country's protection system from the reflection of disease. The collected data through traceability procedures were not exchanged to other market channel members in the supply chain (Hernández-Jover, 2009).

As a consequence of those indicated above, the amount of information recorded in and the ability to trace and track of traceability systems are reflected by the objectives of implemented systems (Golan *et al*., 2004; Alexander, 2016). From the food producers' side,

the priority may be to minimize the operating costs, improve operating efficiency and quality control in order to satisfy the consideration of specific customers on food safety issues. Traceability systems with the essential function to support information management and movement within supply chain actors, therefore, have been considered sufficient (Palacios, 2001). Moreover, food producers and manufactures along the supply chain may generally deny the responsibilities after food incidents. This is because any detection about the unsafety food from consumers may negatively effect to their reputation, the quantity demanded, quantity supplied as well as the price for their products (Golan *et al*., 2004). For instance, in the United States (US), the first case of BSE was discovered in 2003. To provide appropriate answers to consumers, authorities and retailers made significant efforts to trace the origins of the infected cows to specific US farms. However, US farming organizations were against any traceability activities so as to deny any liability for the adverse effects of BSE (Pouliot and Sumner, 2013).

In contrast, consumers and food regulators with responsibility for protection of consumer's right seek to ensure the health and the right to receive the correct information about food safety and quality of consumers and to reduce food incidents (Bailey *et al*., 2018). Traceability systems, in this case, have been developed to trace the information from producers, distributors and processors to consumers.

Hence, to able to call the implementation of food traceability in order to enhance the food safety and quality issues, it is important to legalize the mandatory regulations to clarify the liability of food supply chain agents in food incident issues. Recently, traceability are implemented in the over the world under various forms, including the specific requirements in national policies and regulations and/or in the food quality assurance practices such as GLOBAL Good Agriculture/Aquaculture Practices (GLOBAL GAP), Hazard Analysis and Critical Control Points (HACCP), Aquaculture Steward Council (ASC) and etc. Basically, traceability requirements specified in those policies, regulations and practices are the recording and providing information about suppliers to identify from whom and to whom a food product has been supplied with the approaches of traceability rule "one step backward"-"one step forward" to ensure the information of food products may be exchanged through all stages of supply chain, from production, processing to distribution (Marucheck *et al*., 2011).

In national policies and regulations, traceability requirements for food products are concerned to ensure products' safety and quality in some countries. For example, traceability requirements could be found in EU 178/2002 regulation as a mandatory requirement for all food and feed products in European Union (EU) (Hall, 2010) and/or in traceability standards which were contributed by some EU countries such as France and Italy (Banterle and Stranieri, 2008b; Charlebois *et al*., 2014). The US have developed traceability systems for food products and the Country of Origin Labeling (COOL) (Caswell, 1998; Dickinson and Bailey, 2002). Japan regulates the national requirements for food safety and traceability in Japan Agriculture Sanitary Law-JAS and the availability of voluntary traceability standards, which are developed by Prefecture and local governments, cooperatives, industry groups and retailers in Japan and/or International standards organization (ISO 22005:2007) (Hall, 2010). Food traceability are strictly mandated in other countries such as Australia (National Livestock Identification System), Canada (Meat Inspection Act and Food and Drug Act) and New Zealand (National

Animal Identification and Tracing System) (Liddell and Bailey, 2001; Loreiro and Umberger, 2007; Wallace and Oria, 2010; Charlebois *et al*., 2014).

In food quality assurance practices, traceability requirements were emphasized in the GLOBAL Good Agriculture Practices (GLOBAL GAP), the Hazard Analysis and Critical Control Points (HACCP), Aquaculture steward council (ASC), Best Aquaculture Practices (BAP), ISO and etc. with the principle as the recording and keeping information of traceability rule "one-step backward" and "one-step forward" along the supply chains from food producers to processors. Besides that, the purposes of food quality assurance practices also focus on the food safety, environmental and social welfare (the detail is discussed in Chapter 2). Therefore, the application of those practices for food products plays as the commitments of food producers to consumers about the ensuring of food quality, safety and traceability (Chan, 2016; Lap *et al*., 2015). The certified food products may be attached the eco-labeling of those practices, supporting consumers identify those certified food products and other non-certified food products. The food products applied those certificates, then, are expected to be sold with higher price-premium.

The increases of food trade in global markets have resulted of the implementation of both, imported and domestic food traceability in importing countries in order to ensure food safety and protect consumer health (Dickinson and Bailey, 2002; Hobbs *et al*., 2005; Thompson *et al*., 2005). Compared with local producers within importing countries, it may be difficult for exporters to understand, access and keep up-to-date with the regulations of those countries without any government support (Wallace and Oria, 2010). The key difficulties are language differences and the lack of food control systems in exporting countries (van der Vorst *et al*., 2000; Trienekens and Zuurbier, 2008). The policymakers in exporting countries have made efforts to develop national food traceability regulations to meet the mandatory requirements of importing countries. Those regulations aim to provide general guidance for food producers in the implementation of traceability procedures (Trienekens and Zuurbier, 2008; Karipidis *et al*., 2009; Chen and Huang, 2013).

Recently, seafood becomes the commercial products for food sector products in global markets. The total imported value of seafood products is currently presented at more than 140 billion USD. The mainly imported countries of seafood products is dominated by developed countries such as the US (14.4%), Japan (10.6%), Spain (5%), French (4.7%), Germany (4.4%), Italy (4.4%), Sweden (3.4%) with the long history of seafood consumption (FAO, 2018). As with other food products, traceability requirements for seafood products in those countries are included in the traceability policies and regulations to enhance food safety and quality and to identify the origin and history of supplied products.

To meet the requirements of importing countries, various approaches for implementation of traceability are applied in Thailand, Vietnam and Malaysia, which are considered as the major seafood producers in global markets (Flaaten, 2018). For examples, Thailand implemented traceability systems for farmed seafood products to cover the movement of information for all cultured progress, from hatcheries, farms, processing plant and delivery after processing to buyers (Uddin, 2009). Malaysia has applied traceability for exported fish and fisheries products to export to the US and EU markets (SEAFDEC, 2016). In Vietnam, Directorate of Fisheries issues the Circular No.03/2011/BNN-PTNT as national

regulations of traceability for fisheries producers and business operators in fisheries industry (Lap *et al.,* 2015).

Similar as to other food producers, the implementation procedures of those policies and regulations of seafood producers in exporting countries are challenging. The lack of awareness about traceability of seafood producers has led to the limited willingness to public the information about production procedures and/or qualities of their products (Trienekens and Zuurbier, 2008; Hall, 2010). Moreover, the limitation of production scale leads to the complicated distribution flows of food products from production to processing stages with the participants of intermediates actors (Tran *et al*., 2013). It, then, causes of the difficulty for recording and keeping information activities to implement traceability systems along supply chain.

On the other hand, the more consideration of global consumers to traceability through the quality assurances certificates such as GLOBAL GAP, Hazard Analysis and Critical Control Points-HACCP, Aquaculture Steward Council-ASC, etc. have currently led to much more focusing to invest for those certificates at export side rather than the separated investment to traceability systems to minimize the costs for application. However, the application of those quality assurance certificates are costly because food producers have to pay an additional investment for the preparation to follow the specific requirements in those practices and even an extra payment for the registration fee and maintenances in advance. The origination of economic concerns such as the pricing incentives scheme of certified seafood products, thus, may be important to ensure the balance of benefits and costs, and to enhance the willingness to implement for traceability systems and practices of seafood producers along supply chain. Moreover, the challenge is found because the standards' guidelines for exporting seafood products to be accepted in various importing countries has not agreed upon yet. Differences importing countries may require the differences standards. For example, GLOBAL GAP certificates may be applied for imported seafood products in EU markets. While as, the US markets prefer to apply the BAP practices (Suzuki and Nam, 2013; Lap *et al*., 2015; Bailey *et al*., 2018). The diversity of quality assurance certificates across importing regulators led to further difficulty to cover all of requirements of seafood producers in exporting countries.

Recently, shrimp is the major product as the daily food material in over the world with 15.5% demand shared by value of seafood products (Figure 1.1a). Global shrimp production is performed in 60 countries. It is one of the fastest growing commodities in food industry with the average grow rate more than 20% from 2000s to 2016 (Flateen, 2018). India is the largest suppliers with 12% of total export-value of shrimp products in global markets. Vietnam is following with 9% (FAO, 2018). The other largest suppliers for shrimp products in global markets were Thailand, China, Indonesia, Bangladesh and Ecuador. More than 40% of shrimp products of those countries is exported to the US, Europe and Japan markets as described in Figure 1.1b. The highly increased demands have led to the specific traceability requirements relating to shrimp products in importing markets. To be able to satisfy those requirements, the shrimp exporting countries, therefore, have applied the traceability policies and regulations for shrimp products to be eligible to export to global markets.

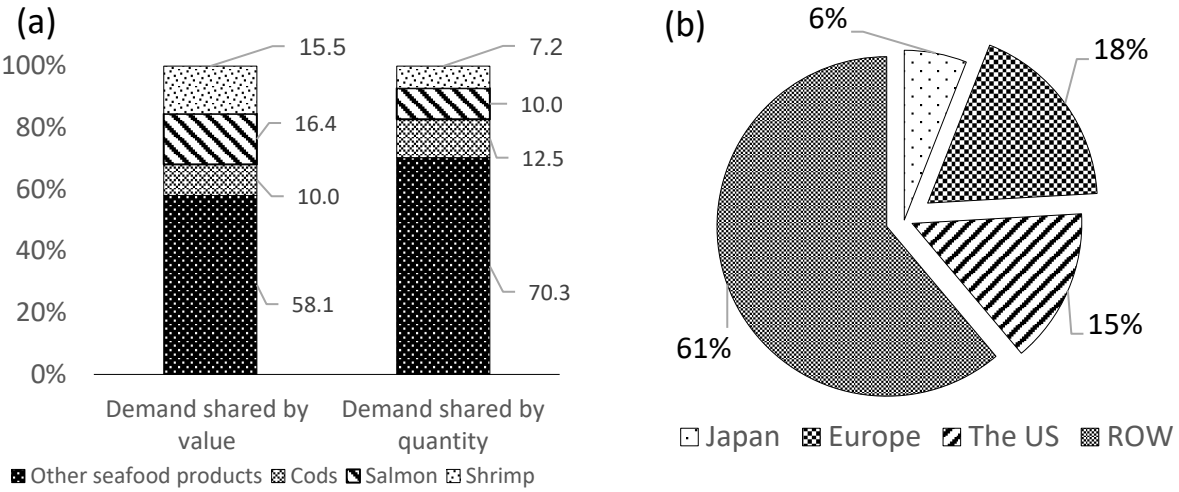


Figure 1.1. (a) The demand shared of shrimp products and (b) the main importers of shrimp products in global markets calculated from the statistical data of FAO 2018. Note: "ROW" is the abbreviation of "Rest of the World".

In 2018, Vietnam occupied top three of the shrimp suppliers in global markets (Figure 1.2). The main targets of shrimp production in Vietnam are export markets. Vietnamese shrimp products has been exported to more than 90 countries in global markets. The top ten importing markets of Vietnamese shrimp products are accounting more than 95% total shrimp export value of the whole country, namely the US (17%), EU (22%), Japan (18%), China (17%), South Korea (10%), Canada (4%), Australia (3%), ASEAN (2%), Taiwan (1%) and Switzerland (1%) (VASEP, 2017).

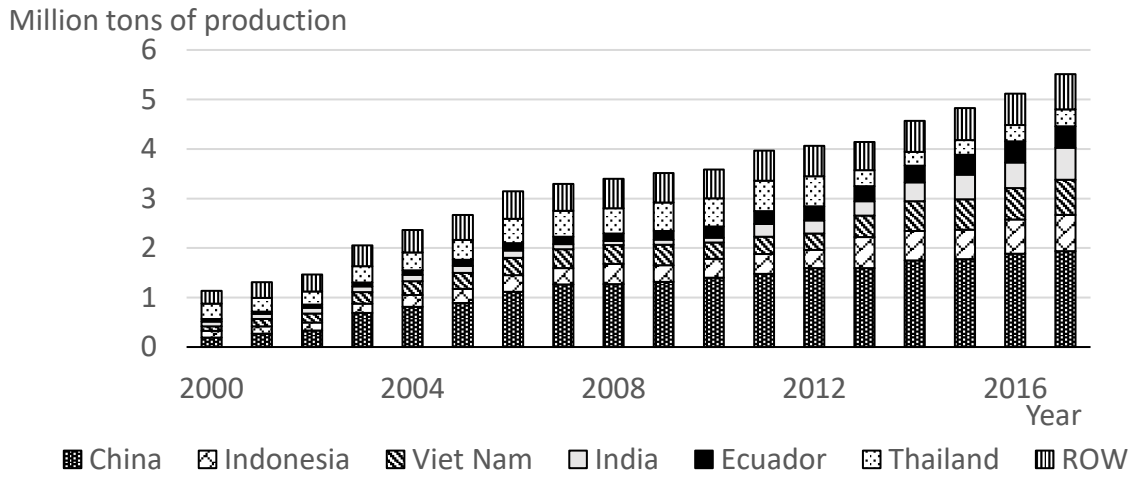


Figure 1.2. The main producers of shrimp products in over the world calculated from the statistical data of FAO 2018. Note: "ROW" is the abbreviation of "Rest of the World".

In Vietnam, shrimp products had the important role for rural development, income increasing and livelihood improving (Duc, 2009; Phuong and Oanh, 2010). According the statistical data of Vietnam GSO in 2018, Vietnam Mekong Delta (VMD) was the largest area for shrimp aquaculture activity with more than 70% of total production areas of the whole

country (Vietnam GSO, 2018). Main purpose of shrimp farmed products were export-oriented with 70%-80% of total production (Portley, 2016; Tran *et al*., 2013).

In 2017, Vietnam shrimp export value was 3.85 billion USD. The main imported markets were the US, Europe and Japan with more than 50% of total export value (VASEP, 2017). Those markets are famous with the stringent performance of traceability requirement and quality assurances certificates for imported seafood products. As indicated in the previous works of Suzuki and Nam (2013); Ha and Bush (2010) and Duc (2010), those requirements in the US, Europe and Japan markets were not only aimed to reduce the unsafety food and protect the consumer's health but also indicated as the trade barriers to restrict the imported seafood and protect domestic industry.

Vietnamese seafood products, including shrimp products, had been effected by the implementation of the quality and safety requirements from the US, Europe and Japan markets. For example, the US market imposed the HACCP certificates for imported shrimp products, and/or GLOBAL GAP and ASC certificates were required for imported shrimp products to the EU markets, have resulted to the decreases of Vietnamese shrimp quantity exported to those markets. This was because not all shrimp producers may able to satisfy the requirements in the short terms (Dong and Duc, 2012). In Japan, more than 90% of total recall cases of Vietnamese shrimp products was mostly based on the anti-biotics inspection (Suzuki and Nam, 2013). It was reflected to the reputation and Japanese consumer's confidence of Vietnamese shrimp products. However, the Vietnamese shrimp exporters were not able to respond to Japanese customers where those the anti-biotics had been come from. This was because the complicated distribution flows of farming input from farms to processing companies with the participants of middlemen and wholesale agents (Loc, 2006; Lap *et al*., 2015). Furthermore, the recall cases of Vietnamese shrimp products from global markets required the payments of compensation. In recent years, those payments are mostly paid by Vietnamese shrimp processors and exporters due to the lack information's traceability of shrimp farming input's flows along supply chain. Therefore, even if Vietnamese processors and exporters did more consideration to the application of quality assurance as global customers required, they still face to the rejected ability of their products in the global markets and paid for all of liability costs.

On the other hand, according to the statistical data of FAO (2018), the exported price of Vietnamese shrimp products to the US, Europe and Japan was higher 20%, comparing to that price of Vietnamese shrimp products exported to other countries. The high demand, coupled with the higher price of shrimp products enhance the efforts to export to those markets of not only Vietnamese shrimp exporters but also other countries' exporters. As a consequence, Vietnamese shrimp products have to compete to the shrimp products of other exporters such as Thailand, Indonesia, India, Malaysia and Ecuador (Flateen, 2018). Hence, the consideration to implement traceability and quality assurance certificates for shrimp products may enhance for the future developments of Vietnamese shrimp industry to access to global markets, especially the strictly considered markets about food safety and quality such as the US, Europe and Japan. The consideration and application of these issues may create the differentiation of Vietnamese shrimp products in global markets. Hence, towards the future, the price of certified products, therefore, is expected to be higher, comparing to the ordinary shrimp products (Dong and Duc, 2012).

To meet the requirements of traceability and quality issues from imported markets, Vietnam Directorate of Fisheries had issued the national regulation, namely Circular No.03/2011/BNN-PTNT as the guidance to implement for traceability of shrimp products. Besides that, Vietnam Good Aquaculture Practices (VietGAP) for shrimp products had been issued in 2015 based on the essential principles and guideline on Aquaculture certification of FAO, AseanGAP and other international standards (GlobalGAP, ASC and ISO). The main scopes of VietGAP focused on food safety, animal health and welfare, environmental integrity and social economics aspects and traceability.

However, the application and implementation of quality, safety and traceability for Vietnamese shrimp products are still limited. In recent years, only 12% of total shrimp production areas have been certified by agencies and international quality assurances standards (Flaaten, 2018). This was because the performance of the Circular No.03/2011/BNN-PTNT and VietGAP required the collaboration between shrimp actors along supply chain to ensure the movement of information. Among the agents of shrimp supply chain, the seafood factories and exporters were directly reflected from the requirements of global customers (Bailey *et al*., 2018). To meet the demands of global customers, seafood factories and exporters had to strictly consider about the implementation of traceability systems. However, at other stages of supply chain, the implementation of traceability systems was not considered. This was because the limitation in production scale at farms level[1], the shrimp farming inputs were provided to from farms to processing companies with the participants of middlemen and wholesale agents (Lap *et al*., 2015). It resulted of the difficulties of the recording and keeping of information at each stage along supply chain.

In order to reduce the reflection of middlemen and wholesale agents in supply chain, Vietnam Department of Fisheries (DOF), both at national and provincial level, made efforts to enhance the direct linkage between shrimp producers and processing company. In 2012, Vietnamese Government issued the Law of Cooperatives (No.23/2012/QH13) to encourage the establishment of Farm Cooperatives in agriculture and aquaculture sectors. According this Law, farmers, including shrimp farms, who participated to Cooperatives could receive sponsorships from Local Government and Provincial DOF under various forms, such as (i) be trained in the farming management and application of new technology; (ii) be promoted for the subsidies in both, cash and non-cash (e.g. seed) to cover the damages of weather and diseases; (iii) be assessed to the low-interest credit loans and (iv) be assisted to sign the contracted agreement with shrimp processors to sell the output shrimp directly.

The integration programs between processing companies and shrimp farmers may enhance for the shrimp products towards to respond the requirements of global markets about the product quality and safety issues. From shrimp farmer's side, the sponsorship support to apply for the international quality assurance certificates, which are required for shrimp products to export to global markets. Processing companies can control the quality of shrimp farming inputs under the specific requirements of product's quality in the contracted agreement. Product's quality aside, contracted agreement may even help for processing

[1] Follow the Circular No.27/2011/TT-BNNPTNT of Vietnam, the small-scale farms of aquaculture sectors included the farms where the total land area for aquaculture activity was less than two (02) hectares. Thus, almost 70 per cent of shrimp farms, not only in Mekong Delta, but also in Vietnam was small-scale farms (Tran *et al*., 2013; Loc, 2006; Suzuki and Nam, 2018; Portley, 2016).

companies to monitor the origins of shrimp farming inputs. On the other hand, under the application of international quality assurance certificates, the shrimp farmers are required to record and keep the information of production progress. The recorded information is also provided to processing companies, coupled with the shrimp farming inputs. These activities are expected to be helpful for the tracing backward and forward of information between processing companies and farmers to satisfy the traceability requirements from global customers.

In Vietnam, such integration program for shrimp products was piloted at Cai Bat Cooperative in Cai Nuoc district, Ca Mau province from 2017. Shrimp farmers of Cai Bat Cooperative signed the contract with one seafood processing company. According the contracted agreement, Cai Bat Cooperative's members were sponsored to apply for ASC certificates. In ASC application progress, all farmers at Cai Bat Cooperative were required to record the information of production progress to the recorded documents issued by contracted seafood company. Cooperative's committees are responsible to monitor the information recording procedures (Provincial Ca Mau DOF, 2018). All recorded information documents are provided for keeping and coding at the contracted seafood company. In terms of traceability, the exchanges of information between shrimp farms and seafood company may enhance the traceability implementation for shrimp products (the detail introduction about Cai Bat Cooperative is discussed in Chapter 3).

However, the extension of such works to other shrimp production areas in Vietnam is challenged. Even if this activity was performed under the efforts of Ca Mau Provincial Government to encourage the establishment of Farmed Cooperatives and to enhance the linkage between shrimp farmers and processing companies in order to apply the international quality assurance certificates for shrimp products towards to the requirements from global markets. The lack perception and awareness and the unwillingness to invest of shrimp producers along supply chain, especially shrimp farmers with the limited production scale (Ha and Bush, 2010; Lap *et al.,* 2015; Tran *et al*., 2013; Suzuki and Nam, 2018). However, the economic evaluation of the benefits of the application for quality assurance practices as well as how much the shrimp producers are willing to invest for the quality and safety practices were not scientifically answered to shrimp producers.

On the other hand, the willingness to pay for organic, safe shrimp products as well as labeled shrimp products in over the world have previously been focused in the scientific scholars such as Arquitt and Cornwell (2007); Toiba *et al*., (2012); Disdier and Marette (2012), Bergleiter and Meisch (2015). Found results of those studies almost indicated that the global consumers were willing to pay the higher price premium for shrimp products with the certified quality and safety terms. However, the answers for how the higher premium values from consumers in globalized shrimp markets could be received by shrimp producers along supply chain in export side have not been investigated yet.

Hence, to the best of our knowledge, towards the specific quality and safety requirements in global markets for shrimp products, the currently scientific works have focused on the food safety and quality terms only. The traceability of shrimp products is included in those practices as the recording and keeping information activities to ensure the traceability rule "one step backward"-"one step forward". Notably, traceability is not the

quality standards. It is tool to provide the ability to trace and track the information of products, including the information of quality and safety. Therefore, the implementation of traceability may enhance the improvement of quality and safety of the products. However, there are no currently previous scholars to clarify the requirements of traceability and quality assurances practices for shrimp products in global markets as well as to answer the ability to tracing and tracking information of shrimp products towards the traceability demanded of global customers.

Furthermore, the economic concerns to enhance the implement even for quality assurance practices and for traceability have not investigated yet. Therefore, the currently scientific studies are not able to put forward the economic incentives to ensure the balance the benefits and costs and to enhance for the implementation of traceability of shrimp producers for shrimp products towards to the global markets.

This thesis, therefore, focuses on economic implications to discuss the alternatives to implement traceability in shrimp exporting countries towards to satisfy the requirements from importing countries based on the evidences from Vietnamese shrimp products. To achieve the aim of study, the current traceability of Vietnamese shrimp products is discussed to identify the current situation of traceability application along Vietnamese shrimp supply chain. The economic gain of traceability approaches for shrimp products is investigated with the relying on the cost-benefit analysis (CBAs) framework. The willingness to implement the traceability of shrimp agents along supply chain is also investigated to obtain the expectation of shrimp agents in order to implement the traceability as well as the affecting factors to the ability to implement traceability of shrimp producers. The results of those analysis are to support for the putting forward of economic incentives to enhance the implementation of traceability for Vietnamese shrimp products. Finally, based on the found results this thesis provides the conceptual traceability systems to implement for Vietnamese shrimp products towards to the requirements of global markets. The findings of this study are an empirical evidence for shrimp exporting countries, where the traceability system are under consideration in order to export their products the importing countries.

1.2 Study questions and thesis structure

To achieve the purposive study, this thesis relies the economic evaluations to address a traceability system for shrimp products to adapt the traceability requirements in global markets based on the evidences from Vietnamese shrimp products. Ca Mau province, Mekong Delta, Vietnam (VMD), where is the main shrimp production area of Vietnam shrimp production was chosen as the main study areas (the detail is afterward presented in Chapter 3). The research questions are discussed to appropriate the study purposes as below:

Q1. Why is implementation of traceability for shrimp products considered in global markets?

Q2. What are the current situation of traceability implementation for Vietnamese shrimp products along shrimp supply chain?

Q3. What are the economic gains for Vietnamese shrimp producers along supply chain in terms of traceability application?

Q4. What are the willingness to implement (WTI) for traceability and what are affecting factors to the WTI for traceability of shrimp producers?

Q5. What are the alternatives to implement traceability system for shrimp supply chain in Mekong Delta, Vietnam?

To investigate the answers for the research questions, the thesis are structured in nine Chapters and the subsequent Chapters are outlined in below.

Chapter 2 aims to answer the necessary of traceability application for Vietnamese shrimp products. We review the variation requirements of traceability for Vietnamese shrimp products specified in importing countries as well as the specification of traceability in Vietnamese laws and regulations to respond to those in importing countries.

Chapter 3 is to introduce the natural and social economics characteristics regarding shrimp production, distribution and processing in Mekong Delta, Vietnam to provide the background of Vietnamese shrimp industry.

Chapter 4 describes the design of the data collection and the use of data in the rest Chapters in this thesis. This Chapter also briefly discusses about the statistics of sample's characteristics.

Chapter 5 conducts the data from survey data to identify the current situation of traceability along shrimp supply chain in Mekong Delta, Vietnam. To achieve this purpose, we investigate the differences in distribution channels and information movement between shrimp products along supply chain of Mekong Delta, Vietnam in terms of traceability implementation and those of ordinary shrimp products.

Chapter 6 explores the Costs-Benefits Analysis (CBA) to compare the differences in net benefits of shrimp producers along supply chain in terms of traceability application. The minimum price for shrimp products is suggested to ensure the balance of benefits and costs of traceability application for shrimp producers.

Chapter 7 investigate the willing to implement for traceability of shrimp farmers, the expected farm-gate price for shrimp products of shrimp producers along supply chain in order to implement the traceability. This Chapter also examines the affecting factors to willingness to implement (WTI) for traceability application of shrimp producers with the Censored Regression Model approaches.

Chapter 8 discuss the conceptual of traceability systems of shrimp supply chain in Mekong Delta, and the alternatives to implement the traceability systems for shrimp products based on the analyzed results from Chapter 4 to Chapter 6 and the experiences from the scientifically related works.

Chapter 9 concludes the thesis. It includes the general conclusion, the main findings and the limitations of this study and its extensions in the future studies.

1.3 Expected contributions and policy implication

The theoretical and empirical results of this thesis are designed to support the development of shrimp industry in Mekong Delta, Vietnam with the particular emphasis of traceability approaches. The economic incentives inferred in this thesis, hopefully, support not only for shrimp producers along supply chain to utilize the market negotiations power and to maximize the operating performance, but also for Vietnamese policy makers in the decision of subsidy sponsors to encourage the implementation of traceability systems in the future.

The suggestion of conceptual traceability system is expected to support the governance of shrimp industry in the exporting countries for the management of quality assurance issues. For shrimp producers along supply chain, the implementation of traceability is as the alternatives to control the quality of products, reduce operating and liability costs, and adapt the requirements of global customers. For consumers, traceability implementation for shrimp products may intend to ensure the quality products, and increase the confidence in consumption decision making progress. Furthermore, the economic implications of this thesis could be served to provide a framework for all of users who need to contribute the traceability systems for other products.

Chapter 2. Review of traceability requirements for shrimp products in global markets

2.1. Introduction

As we mentioned in Chapter 1, the traceability have been considered to enhance the food quality and safety issues. This Chapter is to discuss how traceability was defined in detail based on the previous scientifically works, specific definitions in policies and regulations issued by regulators and institution with the responsibility to protect the consumers' health. On the other hand, the necessity of traceability in food supply chain management was investigated based on the requirements of traceability specified for Vietnamese shrimp products in the global markets.

The US, EU and Japan markets are recently accounting 40% of total imported quantity for shrimp products in global markets, where are dominated as the most stringent areas considered to traceability and food quality and safety issues in global markets (Golan *et al*., 2004; Uddin, 2009; Flaaten, 2018). Either the imported shrimp products must satisfy the requirements about traceability and product's safety and quality or are not accepted in those countries. Hence, shrimp exporting countries are able to export to those countries only if they have followed and met the specific regulations and policies of those countries. Thus, the shrimp exporting countries, who are able to export their products to the US, EU and Japan markets are estimated to be restricted. In other words, the shrimp products from exporting countries is estimated to have the higher competitive advantages than other exporting countries if these products have been responded to the requirements of the US, EU and Japan markets. The exported price of shrimp products in the US, EU and Japan markets, then, is higher than that price in other markets (Dong and Duc, 2012).

For Vietnamese shrimp products, the US, EU and Japan are the main customers in global market. According to the statically data of FAO (2018), the exported price of Vietnamese shrimp products to those countries were higher about 20%, compared to the averagely exported price to other global markets. However, to be accepted in the US, EU and Japan markets, the Vietnamese shrimp products must respond the strict requirements about traceability as well as product's safety and quality specified in those countries. Therefore, in the rest sections of this Chapter, we focused on the specific traceability requirements for the imported shrimp products of those countries.

2.2 Traceability issues in food supply chain

2.2.1 Definitions of traceability

Various definitions about traceability were discussed in policies, regulations and in previous scholars. International Organization for Standardization (ISO) defined traceability as "the ability to trace the history, application, or location of an entity by means of recorded identification" (ISO 8402, 1994) and it was extended into "the ability to trace the history, application, or location of that which is under consideration" in ISO 9000:2005. In ISO 22005:2007, traceability was defined as the ability tool to trace the movement of feed and food from production, distribution and processing. Traceability systems were a technical tool to specify the history and/or location of a product and its relevant components. The European

Union (EU) issued regulation 178/2002 to determine traceability as the ability to trace and track through all stages of food chain, including production, processing and distributing. The Codex Alimentarius Commission (CAC) defined traceability as the ability to follow the movement of food through specified stages of production, processing and distribution.

From the scientific perspectives, traceability was initial defined as the ability to follow and exchange the reliable information about history of food through all stages (or parts) along supply chain from production, harvesting, transportation, storage, processing, distribution and selling (Moe, 1998; Wilson and Clarke, 1998; McKean, 2001; Dalvit *et al*. (2007). Olsen and Borit (2013) modified the definition of traceability based on ISO guidelines. Accordingly, traceability was the ability to access to any or all of related information, which was under consideration, throughout the entire life cycle with the confirmation of recorded identifications. The most informative and comprehensive definition of traceability in food industry was specified by Bosona and Gebresenbet (2013), who defined traceability as a part of logistics management that capture, store, and transmit adequate information about a food, feed, food-producing animal or substance at all stages in the food supply chain. The information of products, therefore, could be traced upward and be tracked downward at any time. Besides that, the safety and quality control of products were easily checked through traceability systems. Traceability systems might support to control food safety and quality and reduce the asymmetric of information along supply chain.

Hence, the definitions of traceability were specified in the diverse sources. In general, traceability by itself, is not information of products or quality assurance. The most important point of traceability systems is the ability to share the information among agents of food supply chain in order to trace and track of any or all of information of products through various or all of steps of supply chain, from production, processing and distribution. It may be included the origins of materials and related parts, history of processing procedures, distribution and location of the product after delivery, from growers to consumer's plate to support for the food safety and quality control and supply chain management. In this study, we relied the definition of traceability from previously work of Bosona and Gebresenbet (2013) to apply for our implication about traceability for Vietnamese shrimp products. Accordingly, traceability for Vietnamese shrimp products is a tool to trace "one step backward"-"one step forward" about the information of distributed products along supply chain, from producers' side including farmers, middlemen, wholesalers, processors to consumers in importing markets.

2.2.2 Traceability in supply chain management

The implementation of traceability systems may support to manage food supply chain and/or quality control systems. This is because the application of traceability might improve the ability to trace the product flows along supply chain (Golan *et al*., 2004). The information flows within traceability system would be shared among all stages of supply chain from production, processing and distribution based on the movement of products (Bailey *et al*., 2018). According the previous scholars related to the traceability and food quality issues, the implementation of traceability might be support not only to enhance the food safety and quality issues but also to achieve the numerous purposes in supply chain management (Table 2.1).

Table 2.1. Main purposes of the implementation of traceability, summarized from previous scholars

Focused on	Main features of traceability systems	References
Consumers' health and confidences	Ensure the ability to trace food origins, food safety and quality characteristics in order to: ✓ Reduce food incidents; ✓ Improve the reliable of provided information of food products from producers; and ✓ Clarify responsibility and liability of producers along supply chain.	Mousavi *et al*., 2002; Smith *et al*., 2005; Shanahan *et al*., 2009; Liao *et al*., 2011; Aung and Chang, 2014.
Operation performance of producers along supply chain	Support ability to trace the hazard and risks affecting to product quality along food supply chain to: ✓ Manage the inputs origins and quality;	Golan *et al*., 2004; Hayes *et al*., 2005; Mangina and Vlachos, 2005; Smith *et al*., 2005; Atkins, 2008; Negrini *et al*., 2008.
	✓ Minimize the liability costs;	Hobbs, 2003; Banterle and Stranieri, 2008b; Tamayo *et al*., 2009; Donelly and Olsen, 2012; Randrup *et al*., 2012.
	✓ Reduce costs of logistics, improve the adequate information; and	Hobbs, 2003 and 2004; Golan *et al*., 2004; Li *et al*., 2006; Bollen *et al*., 2007.
	✓ Improve the integration and cooperation between producers and stakeholders along supply chain	Rábade and Alfaro, 2006; Hall, 2010; Dabbene and Gay, 2011.
	✓ Increase willingness to pay for traceability products	Umberger *et al*., 2003.

Within the supply chain, the product flows along supply chain are the feature for the sharing information of traceability systems (Bosona and Gebresenbet., 2013). The implementation of traceability may support to follow the products flows along supply chain. Hence, the integration and cooperation among upstream and downstream producers were necessary. In other words, the correlative relationship of products and shared information flows along supply chain were the important principles for traceability implementation. Traceability systems with the essential characteristics to trace and to exchange information of products along supply chain helped for producers within supply chain to control products quality, reduce operation costs and improve business performance and reputation (Figure 2.1).

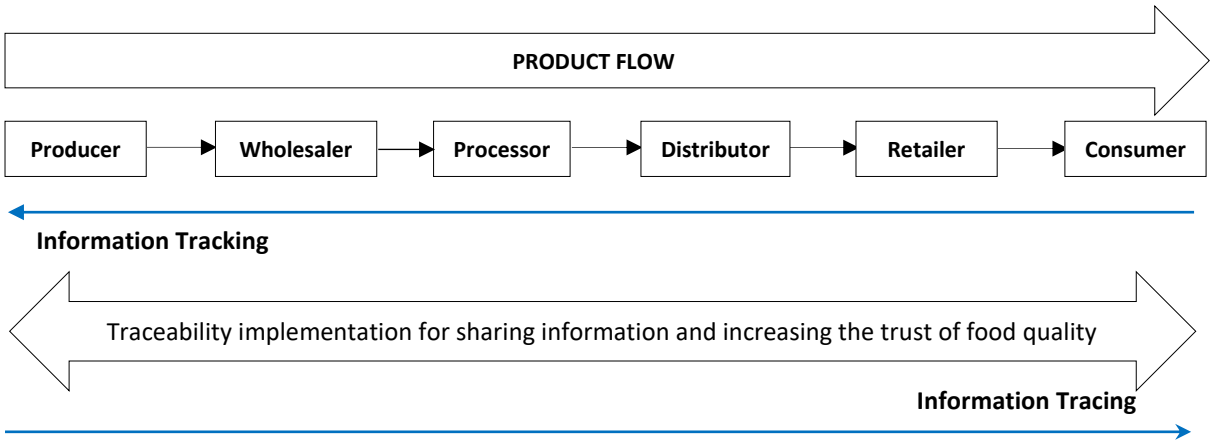


Figure 2.1. Product flow, information flow and traceability along food supply chain, illustrated from Bosona and Gebresenbet (2013); Golan *et al*. (2004); Hall (2010). Note: The black arrows indicated for the products flows along supply chain. The blue arrows presented for the traceability information along supply chain, together with products flows.

2.2.3 Business to Business (BTB) versus Consumer Facing Traceability (CFT)

The implementation of traceability systems along supply chain was depended on who the target's users of the traceability systems would be towards. Accordingly, the traceability systems might be separated to Business to business (BTB) and Consumer Facing Traceability (CFT) (Table 2.2). BTB traceability was understood as a system to transfer information between producers and manufactures along supply chain in order to assist for supply chain management and for improvement of the operation performance. While as, CFT traceability system aimed to transfer the information among producers and stakeholders, including consumers along supply chain towards to protect the right to know about the information of products of final consumers (Fuchs *et al*., 2009; Mol, 2015; Bailey *et al*., 2016).

For more details, application for BTB traceability might bring the benefits for produce within supply chain to reduce the asymmetry of information and to improve their integration and cooperation (Golan *et al*., 2004; Hobbs, 2004; Li *et al*., 2006; Rábade and Alfaro, 2006; Bollen *et al*., 2007; Dabbene and Gay, 2011; Fisk and Chandran, 1975; Leat *et al*., 1998). The information shared among producers in supply chain might help to reduce operation and liabilities costs, and to improve their business performance (Smith *et al*., 2005; Hayes *et al*., 2005; Atkins, 2008; Banterle and Stranieri, 2008a; Negrini *et al*., 2008; Tamayo *et al*., 2009; Donelly and Olsen, 2012; Randrup *et al*., 2012). Hence, the application of BTB traceability systems might support to producers along supply chain in the management of quality products based on the timelessness of shared information (Hall, 2010). BTB traceability systems were a credible tool to ensure the origin and quality of food products based on the ability to trace product flows from upstream to downstream of supply chain, and helped to improve the competition advantages and reputation for producers along supply chain.

In contrast, to transfer the information of food products from the producers along supply chain to final consumers, the demand for CFT traceability systems were increasingly considered (Aung and Chang, 2014; Bailey *et al.,* 2016). CFT traceability systems with the focusing on the transparencies and the trustfulness of recorded information, then, are

expected to be useful to control the product's line, from farm to table towards the food safety, human rights, fair labor practices and environmental protection of international customers.

Table 2.2. The goals of the implementation of BTB versus CFT traceability systems, summarized from the previous scholars

	Purposes of traceability application	Main target's users	Cited scholars
Towards to BTB systems	✓ To adapt legislation and requirements of safety and quality from customers ✓ To reduce operation costs ✓ To improve the management of operation ✓ To satisfy the requirements in global markets ✓ To improve the competitive advantages and differentiate products ✓ To achieve quality assurance certificates	Food producers and manufacturers of supply chain	Golan *et al*., 2004; Hobbs, 2004; Bollen *et al*., 2007.
Towards to CFT systems	✓ To exchange the information among producers and stakeholders. ✓ To reduce unsafety food incidents	Consumers, Civil Actors and Policy makers	Opara, 2003; Bailey *et al.,* 2016; Aung and Chang, 2014.

Hence, for both BTB and CFT traceability systems, the sharing information was the principle of traceability systems, and was depended on the purposes of its users. However, in recent years, the implementation of those systems may face to the certain challenges.

The costs for application and the balance between costs and benefits of application for producers and stakeholders along supply chain affected to the lack integration and synthesis of shared information among producers within supply chain (van der Vorst *et al*., 2000; Canavari *et al*., 2010). This is because the food producers are considered to the information of input origins and other related information such storage conditions during transportation across production, processing and distribution process to control the product's quality, minimize the operation costs and improve the operation performance. Moreover, the producers along supply chain may not be willing to share the information to the other agents and consumers because of the secrets of business. Moreover, in unsafety food incidents, the shared information through traceability may increase the ability to be detected by consumers. It may reflect to the food producers in reputation, sales price and quantity supplied (Kehagia *et al*., 2007; Kher *et al*., 2010). As a consequence, food producers in this case, may prefer the internal tool to manage the business performance and control the quality of their products only.

However, to protect the health and the right to know about the purchased food products of consumers, CFT traceability systems have been considered. In CFT traceability systems, the information of food products, including safety and quality issues, is required to be shared to among producers and stakeholders along supply chain. These activities are estimated to be costly for food producers (Wilson and Clark, 1998; Mangina and Vlachos, 2005; Chrysochou *et al*., 2009; Xiaoshuan *et al*., 2010; Ackerley *et al*., 2010; Manos and

Manikas, 2010; Kher *et al*., 2010; Salampasis *et al*., 2012; Donelly and Olsen, 2012; Schwägele, 2005; Engelseth, 2009; Xiaoshuan *et al*., 2010; Wakamatsu and Wakamatsu, 2017). This is because sharing of incorrect information to consumers and other agents of supply chain may reflect to the reputation of food producers and to the liability costs in recall cases. Food producers may need to invest the recording information systems, both in facility to recorded information and labors to ensure the confidence, timelessness and accuracy of shared information. Moreover, despite the increased consideration to food safety and quality, the consumers were not willing to pay the extra premium for a separated traceability systems of food products. Instead of this, the international quality assurance standards and practices such as GLOBAL GAP, HACCP, BAP, ASC, etc. were employed to determine its commitment to food safety and quality (van Drop, 2003; Kimura *et al*., 2008; Bosona and Gebresenbet*.,* 2013; Wakamatsu and Wakamatsu, 2017; Bailey *et al.,* 2018). Even if the implementation of traceability systems may bring the increased reputation and the benefits gain to food producers. However, those benefits may cover the costs to invest those systems are questioned. It may challenge for producers who are limited in the production scale and lack financial resources.

As consequences of these challenges, Fuchs *et al*., (2009) and Bailey *et al*., (2016) indicated an alternative for developing of the traceability systems with the integration of BTB and CFT systems based on the evidences from seafood products (Figure 2.2). Accordingly, the CFT traceability systems towards to consumers the human rights, food safety may be contributed based on the combination of the information shared from the internal traceability systems of producers (BTB system) and the application of the international quality assurances practices such as Global GAP, ASC, BAP, HACCP, and etc. In BTB traceability systems, the information of seafood products may be already recorded and exchanged among seafood producers, including the information about ingredients, quality and attributes of seafood products, from producers, distributors to processors along supply chain. On the other hand, the international quality assurance practices with the specific standards include the food safety issues, environmental protection, social welfare and traceability "one step backward"-"one step forward" (the detail is forwarding presented in this Chapter), enhancing for the consumer's health and confidences. Hence, the integration of the recorded information from BTB system and international quality assurance certificates may improve the ability to trace the information of seafood products towards the ensuring of quality and safety. Consumers may convince to the attached labeling of certified products as the commitments of the quality and safety. The information about food quality and safety may be exchanged from BTB systems of seafood producers to the international quality assurance certifiers and be provided to consumers through the portal of the international quality assurance certifiers.

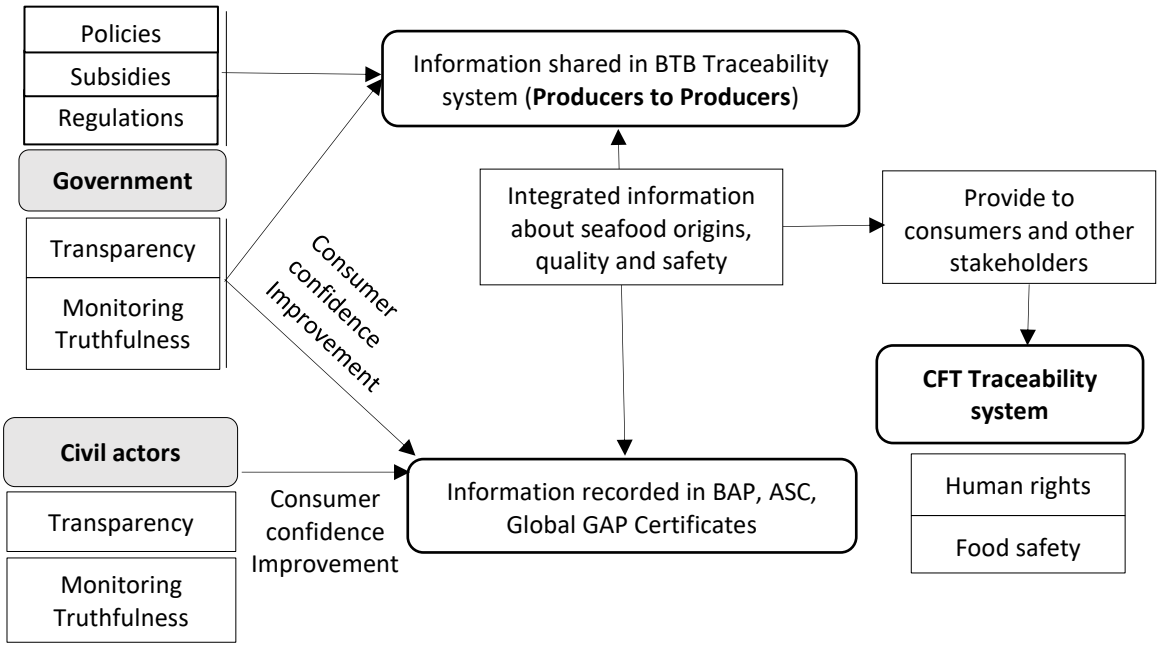


Figure 2.2. The concepts of the developing CFT traceability system with the integration between BTB traceability systems of seafood producers and application for international quality assurance standards indicated by Fuchs *et al.* (2009) and Bailey *et al*. (2016)

In this concept, Bailey *et al*., (2016) even indicated the role of Government and Civil Actors to perform this traceability systems. Accordingly, those stakeholders have the responsibility to monitor of the transparency and truthfulness of the shared information in both, BTB traceability systems among producers and international quality assurance certifiers. Besides that, the regulations and legislations were rigorous required to call the sharing of liability and responsibility of producers and stakeholders along supply chain. On the other hand, the application for quality assurances certificates was even emphasized in this concept. The implementation of traceability may enhance the ability to support for the safety and quality of products towards to consumers' health and confidence since it is simultaneously considered with the application for quality assurance standards.

2.3 The requirements of traceability in global markets for Vietnam shrimp products

We found that, in the US, EU and Japan markets, the requirements of traceability for Vietnam shrimp products in global markets were specified in the policies and regulations at national level and quality assurances certificates.

2.3.1 At national policies and regulations

We summarized the specific requirements of traceability at national policies and regulations of the imported countries markets related to Vietnamese shrimp products in Table 2.3. The results showed that the importing markets issued the requirements of traceability in various forms on food products, including imported shrimp products. Those requirements might be included in the laws of traceability such as in the US and EU markets and/or in the food safety regulations such as in Japan. However, we found that, the

traceability requirements on shrimp products were included in the requests of traceability on food and/or seafood products, instead of regulated in the separated policies and regulations.

The importing countries did not specify the format of keeping and providing information through traceability systems. Instead of that, the importing countries focused on the required information for traceability about the country of origins, name of suppliers, production methods, expired date, net weight and handling conditions. The traceability rule-"one step backward"-"one step forward" was regulated in the US and EU regulations. The information had to trace in all stages of production, processing and distribution of supply chain with any formatting of traceability systems. Table 2.4 presented the details of requirement of recording and keeping information.

US market issued the mandatory law about traceability for fisheries products, namely Country of Origin Labeling (COOL) in 2004, and became effective in 2005 to ensure consumer rights in clarifying the information about county of origin and traceability. It was the law to regulate the responsibilities of retailers in the information providing to consumers about country of origin and method of production for both domestic and imported commodities at the point of sale.

In EU markets, the major purposes of the traceability systems were to ensure that all food products were safe for European consumers, and able to track to its origin in order to prevent the risks and contaminated products (Charlebois *et al*., 2014). For fisheries and aquacultures products, EU regulation also specified the requirements of traceability in EC 1224/2009. According EC 1224/2009 (amended by EU No. 1379/2013), "all lots of fisheries and aquaculture products shall be traceable at all stages of production, processing and distribution, from catching or harvesting to retail stage". Besides that, in 2014, the new EU food labeling regulation EU 1169/2011 on the provision of food information to consumers was effective. The regulations indicated the mandatory labeling contents of imported fishery and aquaculture products in EU markets regards to traceability.

Japan developed traceability systems for domestic beef in 2002, imported and domestic rice products in 2011. Until the recent year, the separated traceability regulations and laws for imported seafood products have not issued by Japanese Government yet. However, Japan indicated the food regulation related to providing information on the food labeling around the Food Sanitation Law, Quality Labeling Standard-JAS Law (Uchida *et al*., 2013). Accordingly, Japan required the attachment of basic information about product and its manufacturers, including customer service's contact information and company's website and address, including names, addresses, and ID codes for all production facilities. Moreover, imported products had to clarify the country of origin information, name and address of the importer on the package label as well. The labeling was required to provide at the point sales from importers to other businesses in domestic market. JAS Law became a mandatory requirement for egg, milk, buckwheat, wheat, peanuts, crab, and shrimp products.

Table 2.3. Traceability implemented at national policies in the US, EU and Japan

Categories		Name of regulation	Main purposes	Target producers	Traceability rule	Recording and Keeping of information			
						Periods	Format	Place provided	Responses from producers for product recall
Regulations for seafood products, including shrimp products	US	COOL	Food safety and traceability	All stages of production, processing and distribution	One step back–one step forward	1 year	Not specified	At point of sale	5 business days
	EU	EU No. 1379 (Amended for EU legislation 1224/2009)	Food safety, traceability and sustainability	All stages of production, processing and distribution	One step back–one step forward	Not specified	Not specified	At point of sale	10 business days
		EU No. 1169	Food safety and traceability						
Regulations for food and feed products related to shrimp products traceability requirements	Japan	Food Sanitation Law (FSL) and Quality Labeling Standard (JAS)	Food Safety and providing information to final consumers	Retailers, Importers	Not specified	Not specified	Not specified	At point of sale	Not specified

Table 2.4. The required information in national regulations and practices in the US, EU and Japan markets

Mandatory requirement information	National regulations			Quality assurance certificates			
	US	EU	Japan	HACCP	GLOBAL GAP	ASC	BAP
Name of products	✓	✓		✓	✓	✓	✓
Legal name or customary name		✓					
Production method	✓	✓	✓	✓	✓	✓	✓
Drugs and chemicals used in production					✓	✓	✓
Country of production	✓	✓	✓	✓	✓	✓	✓
Defrosting method	✓	✓					
Expiry date	✓	✓	✓	✓	✓	✓	✓
Allergens		✓	✓				
List and quantity of ingredients		✓	✓	✓	✓	✓	✓
Net weight	✓	✓	✓	✓	✓	✓	✓
Name and address of business operator	✓	✓	✓	✓	✓	✓	✓
Country of origin	✓	✓	✓	✓	✓	✓	✓
Instructions for use	✓	✓	✓	✓	✓	✓	✓
Nutritional declaration		✓	✓				
Date of packaging	✓	✓	✓	✓	✓	✓	✓
Date of freezing	✓	✓		✓	✓	✓	✓
Storage instructions	✓	✓	✓	✓	✓	✓	✓
Barcode	✓	✓		✓	✓	✓	✓

2.3.2 At the international quality assurance practices

Besides national policies and regulations, importers in the US, EU and Japan also specified traceability requirements in quality assurance standards and practices such as HACCP, GLOBAL GAP, BAP and ASC. Those certificates and practices were created based on the specific regulations at national level of importing countries for food safety standards and traceability.

The main purposes and requirements of those certificates were summarized in Table 2.5. Traceability was one of the main purposes those certificates, besides food safety and quality, animal health, environmental and social responsibility. The purposes of HACCP certificates focused on food safety section only. However, the requirements about traceability information of all stages from production, distribution and processing specified in HACCP standards was also following the traceability rule “one step backward”-“one step forward” as other practices such as ASC, GLOBAL GAP and BAP certificates. The attachment of eco-labeling for certified products of those certificates not only played as the signal and commitment of producers about products quality but also could support for final consumers in the traceability about country of origin and producers’ information.

Hence, the importing countries specifically required about traceability in laws, policies, regulations and practices. The main purposes of those regulations and requirements focused on the traceability, besides food safety, environmental and social welfare. The specification of traceability rule as “one step backward”-“one step forward” required the collaboration of all stages of producers and manufactures along supply chain to record, keep and transfer the information along supply chain. As we presented, those specified regulations and

requirements were issued and might be upgraded to be concordant with the dynamics of the risks from food safety and quality towards to protect consumer' health and reduce the food incidents as well as the environmental and social welfare issues. The importing countries have not specified the format of traceability systems yet, suggesting the exporting countries may be flexible to choose the format of the implemented traceability systems based on the specific requirements about the traceability polices, regulations and practices to adapt the requests of importing countries. Our results were corresponding to the previous works of Vasileiou (2002); Poll *et al*. (2005); Baert *et al*. (2012); Charlebois *et al*. (2014).

Table 2.5. Traceability requirements specified in mandatory quality assurance practices in the US, EU and Japan markets

Issues	HACCP	GLOBAL GAP	ASC	BAP
Regulated by	US and Japan	EU	US, EU, Japan and other countries	US and EU
Main purposes	Food safety	Food safety, Environmental Social welfare and Traceability	Environmental, Social welfare, Food safety and Traceability	Food safety, Environmental Social welfare and Traceability
Target suppliers	Processors, Operators, Hatchery and Feed company	Farms and Hatchery	Farms and Hatchery	Processors, Operators, Distributors, Farms, Hatchery and Feed company
Traceable rules	One step backward-one step forward	One step backward-one step forward	One step backward-one step forward	One step backward-one step forward
Information keeping periods			2 years	
Attached Eco-label for applicants			Yes	

2.4 Vietnamese policies and regulations regarding traceability for shrimp products

The requirements of traceability for shrimp products from international markets have resulted of the correspondences of the traceability policies and regulations from Vietnamese Government to access to those markets and ensure the minimum set of standards for all of Vietnamese shrimp producers in traceability implementation procedures.

2.4.1 In national policies and regulations

In 2011, Vietnam Directorate of Fisheries issued the Circular No. 03/2011/TT-BNNPTNT (Cir.03) to legalize the regulation on tracing and recall of fishery products to meet food quality, safety and traceability requirements in global markets. This Circular was applied to organizations and individuals involve in fisheries production and business from farms to processes.

Besides the national traceability regulation for shrimp products, Vietnam Department of Agricultural and Rural Development issued other regulations related to food safety and supported for implementing and monitoring of traceability for seafood products, including shrimp products. In 2013, the circular No.48/2013-BNNPTNT (Cir.08) (amended by Circular No.02/2017-BNNPTNT in 2017) was issued to regulate the mandatory for food safety controlling in seafood factories, processors, pre-processing companies and traders. This circular was based on the essential functions of HACCP standards. All information about the production process have to be kept at company at least two (02) years, including invoice of transaction.

The summaries about specific requirements of the main purposes and the information recording and keeping in regulations of Vietnamese Government were presented in Table 2.6 and Table 2.7, respectively.

2.4.2 In Vietnamese quality assurance practices

Vietnamese Good Aquaculture Practices (VietGAP) was introduced as mandatory practices for farmed pangasius (*Pangasius hypophthalmus and Pangasius bocourti*) and farmed shrimp (*P. monodon* and *L. vannamei*) in Decision No 1503/2011/QD-BNN-TCTS and Decision No.3842/2014/QDBNN-TCTS (2014) by Vietnam Department of Agricultural and Rural Development. The main scopes of VietGAP were based on the Code of Conduct of international standards such as Technical Guideline on Aquaculture certification (FAO), AseanGAP, GlobalGAP, ASC, GFSI, ISO and Codex to cover for food safety; animal health and welfare; environmental integrity and socioeconomic aspects and traceability(Table 2.6). In terms of traceability, the requirements specified in VietGAP included traceability rule “one step backward”-“one step forward” for farmed shrimp and pangasius products. Regulations about information recording and keeping were also indicated in VietGAP to enhance the eligibility of certified farms to global markets requirements (Table 2.7).

Table 2.6. Traceability specification at Vietnamese national laws and practices regards to shrimp products

Issues	Cir.48	Cir.03	Viet GAP
Main purposes	Food safety and keeping information	Food safety and Traceability	Environmental, Social welfare, Food safety and Traceability
Target suppliers	Processors, Operators, Hatchery and Feed company	Processors, Operators, Distributors, Farms, Hatchery and Feed company	Farms and Hatchery
Specified Traceable Rule	Not specific	One step back – one step forward	One step back-one step forward
Information keeping periods	2 years	1 year	2 years
Format for keeping information	Not specific	Not specific	Not specific
Attached Eco-label for applicants			Yes
Referred regulations/practices	COOL, HACCP, EU, JAS	COOL and EU	ASEAN GAP, ISO, ASC, GLOBAL GAP, BAP and specified regulations from imported countries.

Table 2.7. The required information in Vietnam national regulation and practices

Required keeping information in Vietnam regulations and quality assurance practice	At Farms		At Wholesalers/Distributors		At Processors		At Exporters	
	Cir.03	Viet GAP	Cir.03	Cir.48	Cir.03	Cir.48	Cir.03	Cir.48
Name and address of producers	✓	✓	✓	✓	✓	✓	✓	✓
Name of products	✓	✓	✓	✓	✓	✓	✓	✓
Legal name or customary name	✓	✓	✓	✓	✓	✓	✓	✓
Input used quantity	✓	✓	✓		✓		✓	
Input used origins	✓	✓	✓		✓		✓	
Name and quantity of inputs used	✓	✓	✓		✓		✓	
Name and address of input suppliers	✓	✓	✓	✓	✓	✓	✓	✓
Drugs and chemical used origins	✓	✓	✓		✓		✓	
Date of using inputs	✓	✓	✓		✓		✓	
Cultured/production methods	✓	✓	✓	✓	✓	✓	✓	✓
Environment conditions and treatment (water, pond, PH level)	✓	✓	✓		✓		✓	
Productivity/culture pond	✓	✓	✓		✓		✓	
Total harvested quantity	✓	✓	✓		✓		✓	
Date of harvest	✓	✓	✓		✓		✓	
Methods to harvest	✓	✓	✓		✓		✓	
Output healthy testing certificate	✓	✓	✓		✓		✓	
Name and address of buyers	✓	✓	✓		✓		✓	
Number approval or barcode	✓	✓	✓		✓		✓	
Whether the product has been defrosted			✓	✓	✓	✓	✓	✓
Date of minimum durability ('best-before' date)			✓	✓	✓	✓	✓	✓
Allergens			✓	✓	✓	✓	✓	✓
List and quantity of ingredient			✓	✓	✓	✓	✓	✓
Net weight			✓	✓	✓	✓	✓	✓
Instruction for use			✓	✓	✓	✓	✓	✓
Nutrition declaration			✓	✓	✓	✓	✓	✓
Date of packaging			✓	✓	✓	✓	✓	✓
Date of freezing			✓	✓	✓	✓	✓	✓
Storage conditions	✓	✓	✓	✓	✓	✓	✓	✓

2.5 Evaluate the level of compliance of Vietnamese traceability regulations to the requirements of the global markets

In this section, we evaluated the level of compliance of Vietnamese traceability regulations to those of the global markets. A comparison between traceability requirements specified in regulations and practices of the importing countries and those of Vietnam. Assessment scale was rated as "Satisfied", "Partially Satisfied" and "Not Satisfied". The "Satisfied" assessment scale "Satisfied" was applied when the traceability requirements specified in Vietnamese regulations and/or practices exactly matched those regulated of the importing markets. The "Partially Satisfied" scale was used in case of the traceability requirements specified in Vietnamese regulations/practices did not exactly match those of the importing countries but partly represented the regulations of the importing countries. The "Not Satisfied" scale was selected when the traceability requirements demanded by importing

countries' regulations were not included in Vietnamese regulations/practices. Only those requirements stipulated in importing countries' regulations were evaluated.

2.5.1 Vietnamese regulations and practices in response to the national regulations of importing markets

A comparison between the traceability regulations at national level and mandatory practices of the importing countries' markets on shrimp products and the recently implemented Vietnamese regulations was conducted to evaluate the responses of those to global markets (Table 2.8). Five main components of regulations and practices were considered including main purposes, target regulated producers/suppliers, traceability rule, the period and format of information's recording and keeping.

Regarding the main aims and target suppliers, the results show that Cir. 03 almost satisfied the specified regulations regarding traceability in the US and EU markets. In contrast, Cir. 48 was developed to ensure food safety as well as outline the procedures regarding the recording, keeping and provision of information (if required) by wholesale agents, processing companies and exporters along all stages of the supply chain. The adoption of this circular was evaluated as "Partially Satisfied" in terms of the main aims and target suppliers because it does not include traceability rule "one step backward"-"one step forward". Thus, this criterion was "Not Satisfied".

In Japan, traceability requirements for shrimp products can be found in food safety laws rather than in separate regulations. The main targets of Japanese laws are importers and retailers in Japan markets. However, to satisfy traceability and country of origin requirements, the comprehensive collaboration of exporters and other producers at all stages of the supply chain is required to record, keep and provide information relating to production, processing and distribution. Hence, in terms of the main aims, Vietnam's national regulations (Cir. 03 and Cir. 48) and quality practices (VietGAP) could satisfy Japanese food safety laws. The target supplier indicator was evaluated as "Partially Satisfied." Regarding traceability, Cir. 03 satisfied Japanese laws and Cir. 48 did not.

Regarding the period that information should be kept, the US regulations stated 1 year, and this period is unspecified in EU and Japanese law. Therefore, a comparison was not made with the relevant regulation in EU and Japan markets. For the US market, however, the Vietnamese regulations (Cir. 03 and Cir. 48) satisfied this requirement.

In contrast, the VietGAP standard was developed to apply to agriculture and aquaculture farms in Vietnam, including shrimp farms. The legislation, therefore, targeted certain stages of the production supply chains. The evaluation of this indicator showed that it "Partially Satisfied" to the US equivalents. In contrast, regulated components of VietGAP practices, in response to the requirements of national regulations of the US, EU and Japan markets, were deemed to be "Satisfied". The compliance of Vietnamese regulations on the recording and keeping of information for traceability issues is assessed in Table 2.9. Based on the results, Cir. 03 and Cir. 48 satisfy all US, EU and Japanese information regulations. At the farm level, VietGAP standards meet most of the information requirements of US, EU and Japanese national regulations.

Table 2.8. Vietnamese regulations and practices in response to national regulations in the US, EU and Japan markets

Categories	US			EU			Japan		
	Cir. 48	Cir. 03	VietGAP	Cir. 48	Cir. 03	VietGAP	Cir. 48	Cir. 03	VietGAP
Main aims	PS	S	S	PS	S	S	S	S	S
Target suppliers	PS	S	PS	PS	S	PS	PS	PS	PS
Specified traceability rule	NS	S	S	NS	S	S	NS	S	S
Information keeping periods	S	S	S	X	X	X	X	X	X
Format for keeping information	X	X	X	X	X	X	X	X	X

Note: X: not specified by importing countries. S = Satisfied; PS = Partially Satisfied; NS = Not Satisfied.

Table 2.9. Vietnamese regulations and VietGAP standards in response to information keeping requirements in the national regulations of importing markets

Mandatory information keeping in Vietnamese regulations/quality assurance practice	US			EU			Japan		
	Cir. 03	Cir. 48	VietGAP	Cir. 03	Cir. 48	VietGAP	Cir. 03	Cir. 48	VietGAP
Name of products	S	S	S	S	S	S	S	S	S
Legal name or customary name	X	X	X	S	S	S	X	X	X
Production method	S	S	S	S	S	S	S	S	S
Country of production	S	S	S	S	S	S	S	S	S
Whether the product has been defrosted	S	S	S	S	S	S	X	X	X
Expiry date	S	S	S	S	S	S	S	S	S
Allergens	X	X	X	S	S	NS	S	S	NS
List and quantity of ingredients	X	X	X	S	S	NS	S	S	NS
Net weight	S	S	NS	S	S	NS	S	S	NS
Name and address of business operator	S	S	NS	S	S	NS	S	S	NS
Country of origin	S	S	NS	S	S	NS	S	S	NS
Instructions for use	S	S	NS	S	S	NS	S	S	NS
Nutritional declaration	X	X	X	S	S	NS	S	S	NS
Date of packaging	S	S	NS	S	S	NS	X	X	X
Date of freezing	S	S	NS	S	S	NS	X	X	X
Storage instructions	S	S	S	S	S	S	X	X	X
Barcode	X	X	X	S	S	S	S	S	S

Note: X: not specified by importing countries. S = Satisfied; PS = Partially Satisfied; NS = Not Satisfied.

Table 2.10. Vietnamese regulations and practices in response to traceability requirements in mandatory quality assurance standards

Categories	HACCP			GLOBAL GAP			ASC			BAP		
	Cir. 48	Cir. 03	VietGAP	Cir. 48	Cir. 03	VietGAP	Cir. 48	Cir. 03	VietGAP	Cir. 48	Cir. 03	VietGAP
Main aims	M	S	S	PS	S	S	PS	S	S	PS	S	S
Target suppliers	S	S	PS	PS	S	S	PS	S	S	PS	S	PS
Specified traceability rule	NS	S	S	NS	S	S	NS	S	S	NS	S	S
Information keeping periods	S	NS	S	S	NS	S	S	NS	S	S	NS	S
Format for keeping information	X	X	X	X	X	X	X	X	X	X	X	X

Note: X: not specified by importing countries. S = Satisfied; PS = Partially Satisfied; NS = Not Satisfied.

Table 2.11. Vietnamese regulations and practices in response to requirements of recording and keeping information in quality practices in global markets

Mandatory information keeping in Vietnamese regulations/ and quality assurance practice	HACCP		GLOBAL GAP		ASC		BAP	
	Cir. 03	VietGAP	Cir. 03	VietGAP	Cir. 03	VietGAP	Cir. 03	VietGAP
Name and address of producers	S	S	S	S	S	S	S	S
Name of products	S	S	S	S	S	S	S	S
Legal name or customary name	S	S	S	S	S	S	S	S
Quantity of input products	S	S	S	S	S	S	S	S
Origin of input products	S	S	S	S	S	S	S	S
Name and quantity of drugs and chemicals used	S	S	S	S	S	S	S	S
Name and address of input suppliers	S	S	S	S	S	S	S	S
Origin of drugs and chemicals used	S	S	S	S	S	S	S	S
Date of use of inputs, drugs and chemicals	S	S	S	S	S	S	S	S
Culture/production methods	S	S	S	S	S	S	S	S
Environmental conditions and treatment (water, pond, pH level)	S	S	S	S	S	S	S	S
Productivity/culture pond	S	S	S	S	S	S	S	S
Total harvest quantity	S	S	S	S	S	S	S	S
Date of harvest	S	S	S	S	S	S	S	S
Harvest methods	S	S	S	S	S	S	S	S
Health certificate for outputs	S	S	S	S	S	S	S	S
Name and address of buyers	S	S	S	S	S	S	S	S
Barcode	S	S	S	S	S	S	S	S
Whether the product has been defrosted	S	NS	S	X	S	X	S	X
Expiry date	S	NS	S	X	S	X	S	X
Allergens	S	NS	S	X	S	X	S	X
List and quantity of ingredients	S	NS	S	X	S	X	S	X
Net weight	S	NS	S	X	S	X	S	X
Instructions for use	S	NS	S	X	S	X	S	X
Nutritional declaration	S	NS	S	X	S	X	S	X
Date of packaging	S	NS	S	X	S	X	S	X
Date of freezing	S	NS	S	X	S	X	S	X
Storage instructions	S	S	S	S	S	S	S	S

Note: X: not specified by importing countries. S = Satisfied; PS = Partially Satisfied; NS = Not Satisfied.

2.5.2 Vietnamese traceability regulations and practices in response to the mandatory quality practices for shrimp products in global markets

The same comparison procedure was also conducted to assess the appropriateness of Vietnamese regulations and practices in response to the mandatory practices implemented in the US, EU and Japan markets (see Table 2.10). The results confirmed that regulations regarding traceability in Cir. 03 and VietGAP were updated and responded appropriately to establish international practices, both in terms of quality assurance and traceability. However, the same was not achieved for information recording and keeping (Cir. 03). The corresponding Vietnamese regulation, stating that information must be held for 1 year (Cir. 03), was considered "Partially Satisfied".

Despite the main aims of Cir. 48, it was assessed as "Satisfied" when compared with the HACCP standard and "Partially Satisfied" for the remaining practices. Regarding traceability rule, Cir. 48 did not meet the requirements of the international standards. However, it specified that information should be kept for a period of 2 years. This met the international standards requirements. The mandatory international standards did not specify a required format that the recording and keeping of information should take. Therefore, it was not evaluated.

Vietnam's responses (VietGAP) to the mandatory quality practices regarding traceability in international markets are shown in Table 2.11. The comparison results show that VietGAP practices have responded to the specified requirements of traceability in international quality practices. At the farm level, the required information in VietGAP practices satisfy GLOBAL GAP, ASC and BAP requirements.

2.6. Discussion and conclusion

We conclude that, traceability have been considered in various definitions for food products. In whole, traceability is scientifically defined as the ability to trace and track the information of products along supply chain. Traceability systems are the tool to support for the tracing and tracking of information movement along supply chain. Notably, traceability is not the quality assurances practices. The implementation of traceability has not even meant that the quality of food products may be improved immediately. However, the principles of traceability systems are to share the information along supply chain. The notification of information to the other agents of supply chain may directly factor to the reputation of food producers to their customers. It, therefore, may enhance the provision of reliable information from producers and their liabilities about the quality and safety issues.

The breadth and the depth of traceability systems were depended on the purposes of the users. The producers' priorities are to reduce the costs, control the products' quality and improve business performance and reputation. Therefore, the traceability systems contributed from the producers' perspectives might be considered to the ability to communicate and exchange information between producers along supply chain only. In other words, producers might focus on the investments of BTB systems if they were not required any other pressures. On the other hand, the CFT traceability systems aim to protect consumers' health and confidence and reduce the food incidents, suggesting that the

communication of the shared information in those systems should be shared from producers to consumers and stakeholders of supply chain. The role of application for international quality assurance certificates have already discussed to support the performing of the implementation of traceability towards to consumer's right and to enhance the products' quality and safety.

In the policies and regulations in global markets, traceability requirements for shrimp products are recently specified. To export shrimp products to global markets, the requirements of traceability of those markets must be satisfied. Basically, in global markets, traceability is defined as a tool to record, keep and provide the information between shrimp producers and stakeholders along supply chain. The approaches of traceability rule "one step backward"-"one step forward" aim to ensure the ability to identify from whom to whom the shrimp products have been supplied. The specification of this traceability rule required the coordination of all stages the supply chain.

For shrimp exporting countries, the pressures of traceability requirements from importing countries are the factor affecting to their implementation of traceability procedures. This is because the shrimp exporting countries have to follow and satisfy all requirements of importing countries to export the shrimp products. Therefore, the implementation of traceability in shrimp exporting countries are reflected by the requirements of their targets imported markets. Differences importing countries might specify the differences requirements about traceability and quality assurance issues, suggesting that the shrimp producers in exporting countries should follow the requirements of the target markets in global markets to conduct the implementation of the traceability procedures. In recent years, we found that, an agreed format for traceability systems has not yet been specified yet, for either national regulations or quality assurance standards. Thus, the formats of traceability for shrimp products might be flexibly implemented to respond the requirements of the recording, keeping and providing information from specific importing countries.

Overall, Vietnamese Government has contributed and implemented traceability regulations for shrimp products to respond to the requirements of global customers in both national policies and Vietnam quality assurances standards (VietGAP). Those Vietnamese policies and regulations for shrimp products may enhance for the compliance of producers along supply chain, regarding traceability and quality assurance. Notably, those regulations and policies have been developed and followed to meet the demands of traceability requirements in the importing markets. Therefore, the Vietnamese shrimp producers along supply chain may comply the regulations and policies in global market whenever they have followed those Vietnamese regulations and policies. In other words, the Vietnamese regulations and policies play as the minimum guideline about traceability and quality assurance for Vietnamese shrimp products to be accepted and satisfied those requirements in global markets. In the future, the requirements about traceability implementation to enhance for dynamics of the product's quality and safety issues. Therefore, the upgrading and updating of Vietnamese regulations and requirements in traceability are essential. The Vietnamese shrimp producers are required to follow and update the changes of the requirements and regulations' systems.

Chapter 3. Background of Vietnamese shrimp industry

3.1 Introduction

As we presented in the Chapter 1, our focus is on Vietnamese shrimp products. The main production area of Vietnamese shrimp products is focused on the Mekong Delta (VMD) area where plays as the vital role in shrimp cultured activity of the whole Vietnam (as mentioned afterward in this Chapter). Before going to the advanced discussion of the rest parts of this thesis, we present an introduction of the geography and social economics characteristics of the VMD related to shrimp cultured activity. The brief description of Vietnamese shrimp industry, then, is even described as the background of the shrimp industry in this area (Section 3.2).

Among VMD area, Ca Mau province is the largest area of shrimp cultured production with the various cultured methods such as traditional extensive, semi-intensive/intensive systems, improved extensive systems based on the integrated systems of shrimp-rice, shrimp-crab, shrimp-forest, etc. (Tran *et al*., 2013). The detail about the characteristics of these cultured systems is afterward presented in this Chapter. Similar as the whole Vietnamese shrimp industry, the main target of shrimp production in Ca Mau province is to export with the concentration to apply for the quality assurance certificates to adapt the requirements of global markets such as ASC, BAP and Nature Land based on the sponsorship of Local Government.

Besides that, Ca Mau province has the numerous of large scale and small and medium processing companies (Loc, 2006). According to Provincial Department of Fisheries (DOFs) in VMD, the leaders of seafood processing companies are mostly located in Ca Mau province. Those companies are integrated both processing and exporting activities to export. Due to the centralization of the shrimp processors, the mass of other distribution agents of shrimp supply chain even round up to supply the shrimp farming inputs demanded by processing companies.

Moreover, the development and the important role of shrimp industry in Ca Mau province have factored to the improvement of governance systems in this area, comparing to other provinces in the VMD (Provincial DOFs in VMD, 2017). For examples, among VMD, only Ca Mau province has the Ca Mau Association of Seafood, Exporting and Processing (CASEP) to support the exporting shrimp activities. The main activities of CASEP were to provide and to estimate the information about the price and quantity fluctuation of shrimp farming inputs to processors, and to update the new requirements of global markets to consult and support for processors, exporters, provincial local government, and NGOs projects in Ca Mau province.

As the consequences of the above background knowledge, the feature of shrimp production in Ca Mau province may represent as a critical example for the Vietnamese shrimp industry. Ca Mau province, therefore, was chosen as the main study area of this thesis. In this Chapter, after the background of VMD, we, then, were going for the brief introduction of background of Ca Mau province as well as shrimp industry in this province (Section 3.3). The last section is to conclude of this Chapter.

3.2 VMD's physical and social economics characteristics and shrimp industry

3.2.1. Physical characteristics regarding shrimp production in the VMD

3.2.1.1 Natural resources characteristics

- **Geographical location**

The VMD's geography frontier is at latitude of 8º30'N-10º40'N and longitude of 104º26'E-106º40'E. The VMD locates in the South part of Vietnam (Figure 3.1). The total length of Mekong River is 4,880 km, the total areas of Mekong Delta (MD) Basin is approximate 795,000 km^2. This is one of the river systems of Southeast Asia, where its flows share to six countries: China (21% of total basin area), Laos (25% of total basin area), Myanmar (3% of total basin area), Thailand (23% of total basin area), Cambodia (20% of total basin area) and Vietnam (8% of total basin area) (Vietnam MARD, 2015). This river system is the biggest inland fishery site in the world (Ziv *et al*., 2012). With the harvest of 2.2 million tons of wild fish, it annually contributes worth 2.2-3.9 thousand million USD at first sale, and 4.3-7.8 thousand million USD on retail markets (Hortle, 2009).

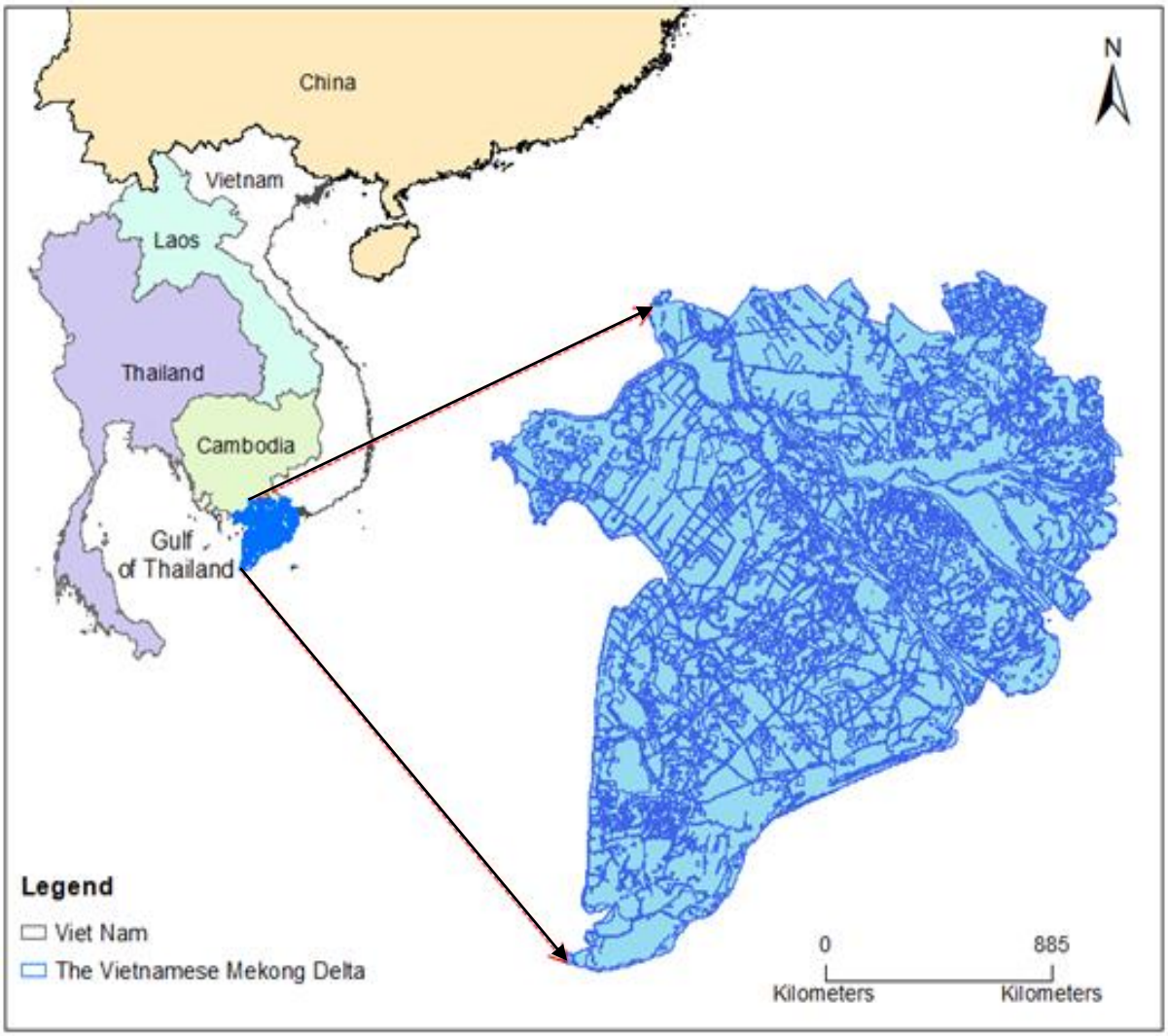


Figure 3.1. The maps of Vietnam and the VMD adapted from Google maps

There are 12 provinces and 1 central city in VMD: Long An, Tien Giang, Ben Tre, Dong Thap, Vinh Long, Tra Vinh, An Giang, Hau Giang, Soc Trang, Bac Lieu, Ca Mau, Kien Giang and Can Tho city. Among them, the provinces where have the border with Cambodia are Long An, Dong Thap, An Giang and Kien Giang. There are two provinces, which have the coastal border with Thailand Bay are Kien Giang and Ca Mau. There are six provinces have the coastal frontier with the East Sea, namely Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu and Ca Mau (Figure 3.2).

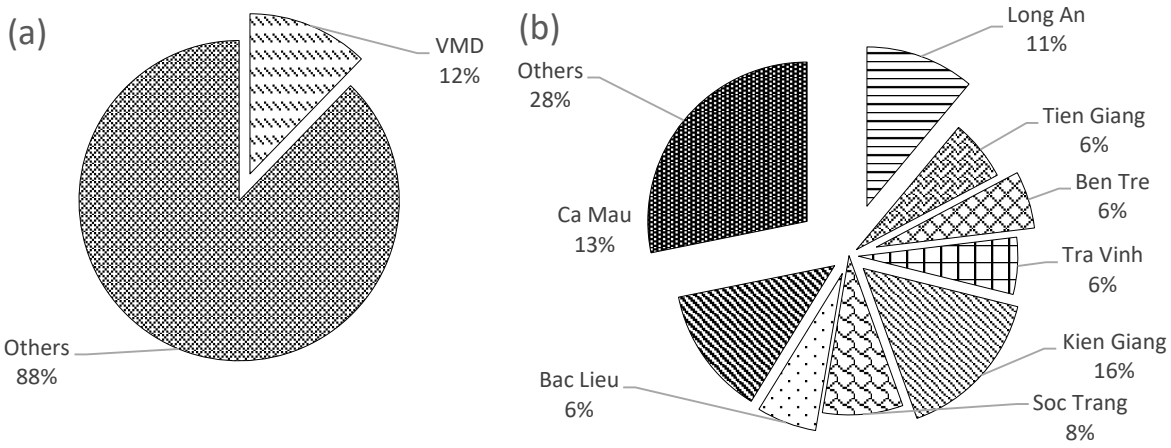


Figure 3.2. The ratio of (a) VMD and (b) VMD provinces calculated from the statistical data of Vietnam GSO 2017

Due to the geographical location, the VMD plays a vital role for aquaculture and capture fisheries development in Vietnam, not only in freshwater but also in salt and brackish water. While as the freshwater fishery can be developed along VMkD because of the affecting of MD Basin. The brackish and salt fisheries can be maintained in the provinces where have the coastal frontiers as Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, Ca Mau, Kien Giang and a part of Long An province. In the follow parts of this Chapter, due to the approached purposive of this study, the review of the natural resources conditions and social economics characteristics will be concentrated to the information which relate to the shrimp cultured industry.

❖ **Water surface used for aquaculture**

In fishery sectors, the coastal line of the VMD holds about 23% in the total of VN with 700km. It is the most important resources for capture fishery in the VMD. Besides that, it also contributes for the development of coastal aquaculture in the VMD.

Figure 3.3 describes for the used water surface for aquaculture production. The water surface for aquaculture in the VMD is equal to more the 75% from 2012 to 2016 and it tends to increase (Figure 3.3a). Among the VMD, Ca Mau and Bac Lieu provinces have the largest surface areas for aquaculture production with approximate 40% and 17% in total areas, respectively. Follows are Kien Giang and Soc Trang provinces (Figure 3.3b). According to the Provincial Department of Fisheries (DOF) in Ca Mau, Bac Lieu, Kien Giang and Soc Trang

provinces, more than 95% of total surface areas for aquaculture production in these provinces are used for shrimp cultured activity.

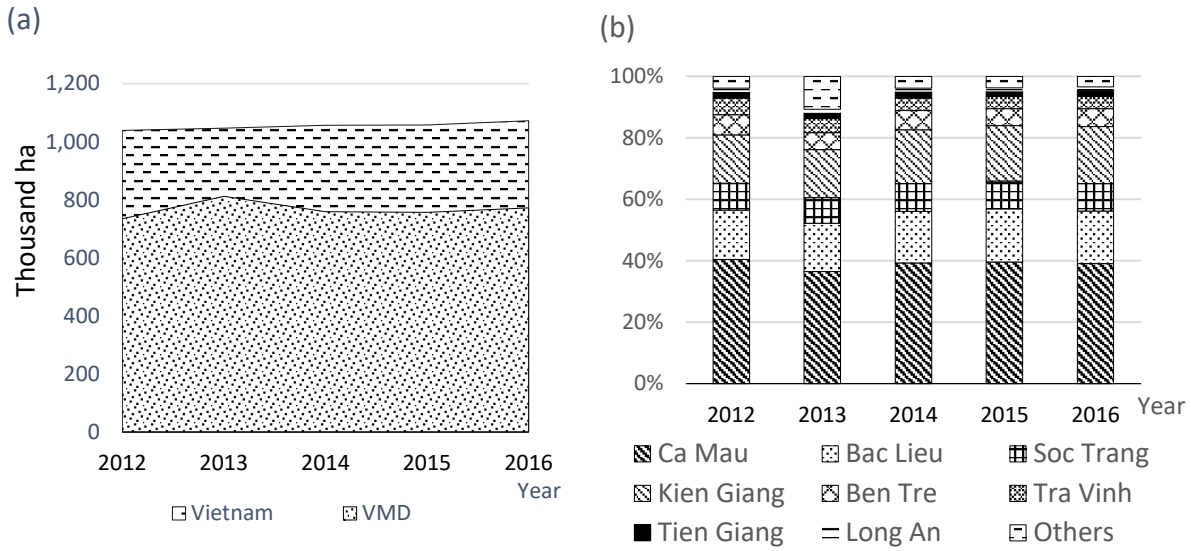


Figure 3.3. The water surface areas use for aquaculture in Vietnam and the VMD calculated from the statistical data of Vietnam GSO 2016

❖ **Weather conditions**

Temperature

The VMD has a high-base and stable temperature. The annual average temperature is approximate 26-28^{o}C and the gap in temperature of coastal provinces is insignificant (Tuan and Linh, 2015; Vietnam MARD, 2015). The amplitude of temperature may be about 2-3^{o}C among months within one year and among separated years at the same period. The lowest temperature is from September to October with the temperature amplitudes at 6-7^{o}C, comparing the average temperature of VMD. While as the highest temperature is from December of earlier year to April, with the temperature amplitudes at 10^{o}C, comparing to the average temperature of the whole VMD.

According Provincial DOF in VMD, shrimp (*Penaeus monodon* and *Litopenaeus vannamei*) and pangasius (*Pangasius bocourti*) are the main species for aquaculture activities in VMD. The range of temperature in VMD is advantage for the growth of those species. *Penaeus monodon (P. monodon)* may be able to survive in the temperature range from 28-30^{o}C, *Litopenaeus vannamei* (*L. vannamei*) may grow in the temperature range from 25-30 ºC. While as *Pangasius bocourti* may survive from 15 to 39 ^{o}C. However, the temperature amplitudes between the lowest and highest season is quite large. The adjustment of temperature conditions in the high temperature seasons, thus, becomes more important to ensure the growing rate of shrimp species.

Rain regime

The annual rainy season in VMD lasts from end of April and early of May to October when 90% of rainfall occurs. The Western-South part of VMD includes Ca Mau, An Giang, Kien Giang, Can Tho, Hau Giang, Bac Lieu and Soc Trang provinces where has the larger and more stable rainfall than the rest part. The average rainfall in VMD is approximate 1,607 mm per year. The highest rainfall occurs between August to October (15-25 rain days per month) with 250-350 mm per month. Flood and inundation occur frequently in every rain season of VMD because the VMD is located at the downstream part of MD Basin. Therefore, in rain seasons, the huge amounts of water come from MD Basin must flow through the VMD before they reach to the sea (Dongnan *et al*., 2017). This water with the large rainfall together causes of flood and inundation, which are threaten affecting to 8 provinces, 60 districts, 1,069 communes and around 10 million people directly (Vo, 2012). However, the yearly normal flood in VMD also creates the great the variation of water and alluviums of soil. It drives the higher productivity of agriculture and aquaculture ecosystems for the supplying the sediment, associated nutrients and natural fertilization for fishery and agriculture (Manh *et al*., 2014).

Wind and typhoon

In previous state, the typhoon and tropical depression in the VMD are less than coastal area in Middle and North of Vietnam (Vietnam MARD, 2015). Wind regime in VMD is affected by monsoon. In almost of rain seasons, the main direction of wind is Western-South (between May and September) and East-North (from end of September to October). The wind changes to East-South direction in dry seasons. The wind speed is also different from seasons and areas. The speed of wind is stronger in dry seasons for the provinces with East Sea border. In contrast, the provinces with border Thailand Bay have the stronger wind in rain seasons.

River and hydrological systems

The VMD is a downstream part of MD Basin. With the total length about 4,900km, the river systems in this area includes two main river systems: Hau River and Tien River.

Hau River flows through 6 provinces in VMD, namely An Giang (Chau Doc district and Long Xuyen city), Dong Thap, Can Tho, Vinh Long, Hau Giang and Soc Trang. The Hau River flows create the natural border of Dong Thap and Can Tho, Vinh Long and Can Tho, Hau Giang and Vinh Long, Tra Vinh and Soc Trang provinces.

Tien River has a deeply riverbed with many islets in the midstream. The Tien River flows through Tan Chau district of An Giang province and Hong Ngu and Cao Lanh districts of Dong Thap province; Vinh Long province, Tra Vinh province, Ben Tre province and Cai Lay district of Tien Giang province and then, reach to the sea.

Besides that, the VMD also includes other river systems with the upstream from Cambodia and the interlacement channels and canals systems. These systems play the vital role not only to withdraw the water in flood seasons but also to create the diversity and huge amounts of fisheries resources in VMD.

Salinization in dry season

The VMD is the largest area where is affected by saline instruction, comparing to other regions of Vietnam. The intruded salinity area is about 2.04 million hectares (approximate one-third to a half of cultivate land of the VMD (Tuan *et al*., 2007). In the end of flood seasons, the water from the upstream of Mekong River start to decrease, the salinity comes to the river mouths, and intrude to upstream and inland of VMD with tide together.

The highest of saline instruction occurs in April and May and the lowest is in October. The length of salinity (with the salt water 4 g/liter) is usually about 20-35 km. However, it might be 50-60 km, depends on the flow from the upstream of Mekong River and the amount of rainfall and the period of rainy season (Dongnan *et al*., 2017). The floodwater from upstream flows of MD Basin discharge the salt water back to the river mouths. In 2016, due to the Elnino phenomena affecting, the salinity with 4 g/liter salt water intruded into the inland part of VMD up to 90 km (UNDP, 2016). The salinization has influenced not only to the human life but also to agricultural and aquaculture activities due to the shortage of freshwater. The salinization increased in dry season causes of the spreads of diseases for shrimp cultured in VMD. It may lead to the higher costs for shrimp farmers to deal with this challenge. Besides that, the increases of the salinization may reduce the survive rate of shrimp species. The shrimp farming inputs supplied from shrimp farms may be decreased. It, then, may cause of the shortage shrimp farming inputs for processing companies.

3.2.1.2 Social economics characteristics

Besides natural conditions, the social economics characteristics are important for aquaculture development, including shrimp cultured industry. This section, then, aims to discuss about the social economics factors, which have the potential affecting to the development of shrimp cultured industry.

- **Population and Labor**

Population

The first discussion is to present about the population and labor characteristics. The VMD has more than 17 million of total population, equals to 19% of whole country (Figure 3.4 a). According to Vietnam GSO in 2017, the average population density in the VMD is the second crowded area of Vietnam whole country with 433 persons per km^2. This is an important condition for the development of the whole country's economy as well as fisheries sectors. This is because it affects not only to the number of employees but also to the output market and the consumption.

Among the VMD provinces, the eight provinces with the shrimp cultured activities account more than 60% of population of whole region (see Figure 3.4 b). The detail about the labors specifications is discussed in the next part.

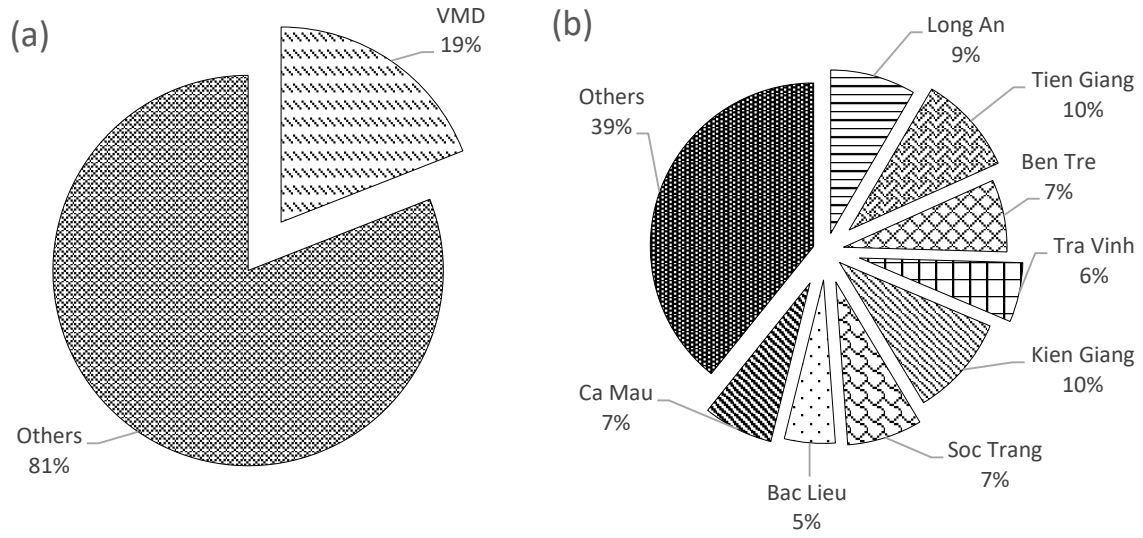


Figure 3.4. (a) The VMD population of the whole VN and (b) the population proportion of VMD by provinces, calculated from the data of Vietnam GSO 2017

Labor

The structure of labors is addressed in the Figure 3.5 (a). According to Vietnam GSO (2017), the total labors of the VMD are about 10 million persons (approximately 20% of total labor of Vietnam). Among the VMD provinces, the total employees in the provinces with shrimp cultured activity account about 60% of the VMD's total labors.

The fisheries labor's proportion of total A-F-F labors is described in Figure 3.5 (b) based on the results of rural household survey conducted by Vietnam GSO (2016). In VMD, there was about 53% of the total labors was working on the agriculture, forestry and fisheries sectors. Among A-F-F labors, there was about 18% of total A-F-F labors was working on fisheries sectors.

Age of labors may affect to the work productivity, experiences and decision-making progress in the A-F-F activities (Duc, 2008). As the statistical data of Vietnam GSO (2016), one-half of the VMD labors in fisheries sector was under 40 years old and the rests were from 40 years old and above (Figure 3.5c), indicated that the labors in fisheries activities in the VMD included multiple generation. It may be the advantages conditions to develop these activities in the future. This was because the labors included both young workers can be easier to update the new technology and/or methodology in production progress. Otherwise, the elder labors have worked in fisheries activities for long time. They can save useful experiences in the reality production, which may not be inherited for the younger labors to apply into the decision making of the production progress. They, therefore, may share and train the experiences each other in the production progress.

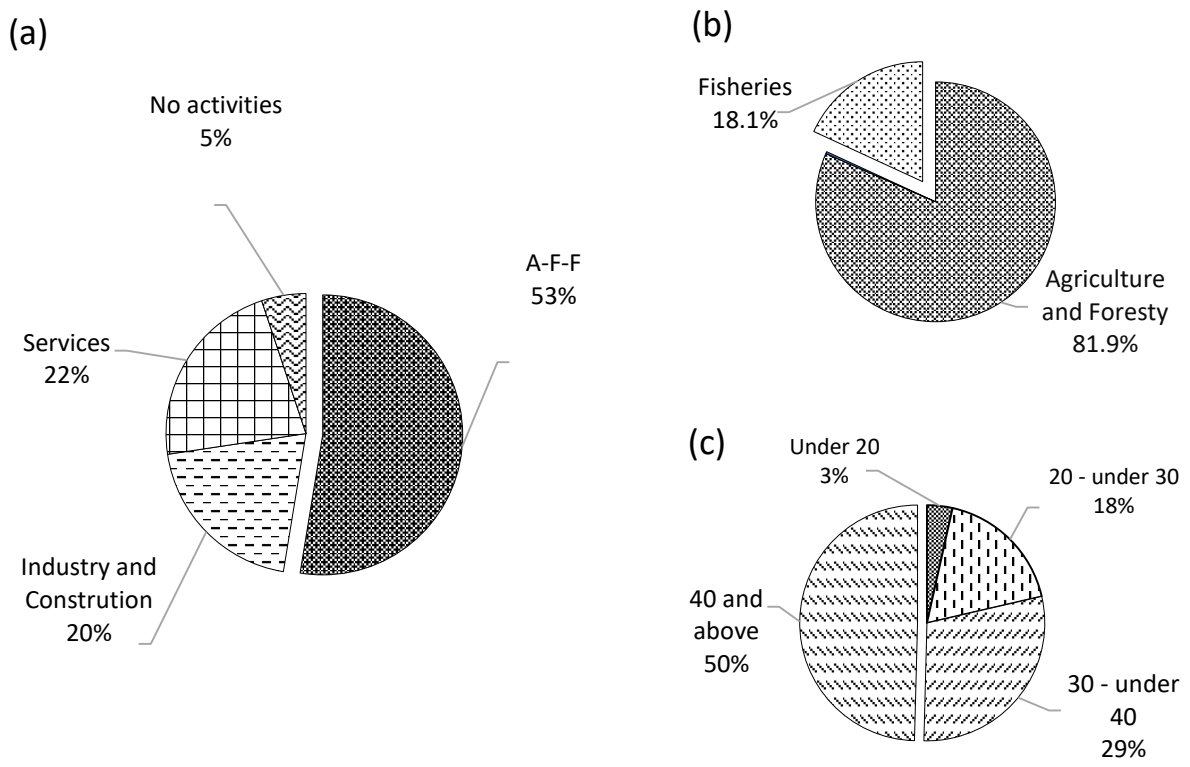


Figure 3.5. (a) Labors structure of the VMD by major, (b) the fisheries labor's proportion of A-F-F labors and (c) the age of fisheries labors

Notably, the labors in fisheries sectors are not trained the professionally technical production. According the Provincial DOFs in VMD, there is about 80% of total labors in fisheries sectors in the VMD was untrained labors of total A-F-F labors in the VMD. Those labors are almost working in the A-F-F activities based on the experiences from their family. The lack of professional training may lead to the uncommunicative perception and awareness of the improvement the new and/or high technology in the production progress.

❖ **Infrastructure**

The development of infrastructure such as electricity systems, irrigation and transportation in rural areas may provide the advantages to improve the fisheries sectors. This is because the well invested infrastructure conditions may help to reduce the time and cost of transportation. This part presents a statistic about the current situation in the infrastructure investment in Vietnam and the VMD. The data is obtained from the report of household survey conducted by Vietnam GSO in 2017. The information in this part is the comparison between 2011 and 2016. The first group of infrastructures is about the changes of electricity, irrigation systems and the transportation in rural areas of Vietnam and the VMD.

Electricity and transportation

As shown in Figure 3.6 (a), the electricity was available in 100% communes in rural areas of Vietnam in 2016. At hamlet level[2], this average ratio was also more than 97% in the whole of Vietnam. In the VMD, electricity was equipped 100% at rural areas, until hamlets level. It is an advantage condition for the development in fisheries activities, including shrimp cultured industry because the electricity demanded to use the high technology equipment in production progress.

Electricity aside, transportation was also considered. In this part, the proportion of main roads of transportation, the connection road to the central or other areas were concreted for the whole of Vietnam and the VMD between 2011 and 2016. In 2011, there was 67% of the main roads in rural areas had completely concreted until communes' level. In 2016, its ratio increased to more than 96% at the communes' level. Especially, more than 90% of the main roads at the hamlets level in rural areas of the Vietnam were invested the concretes (Figure 3.6b), creating an important condition for livelihood improvements and the advantages to develop the A-F-F activities, including shrimp cultured industry. This is because the convenience in transportation is the lever for the improvement in the performance of fisheries activities. It may reduce the transportation costs, both for input factors and output products. Besides that, the development of transportation may be cause of the increasing of logistic services, which support to reduce the time for transportation, ensure the advantages of post-harvest activities in preservation or the methods to harvest and improve the products quality (UNDP, 2016).

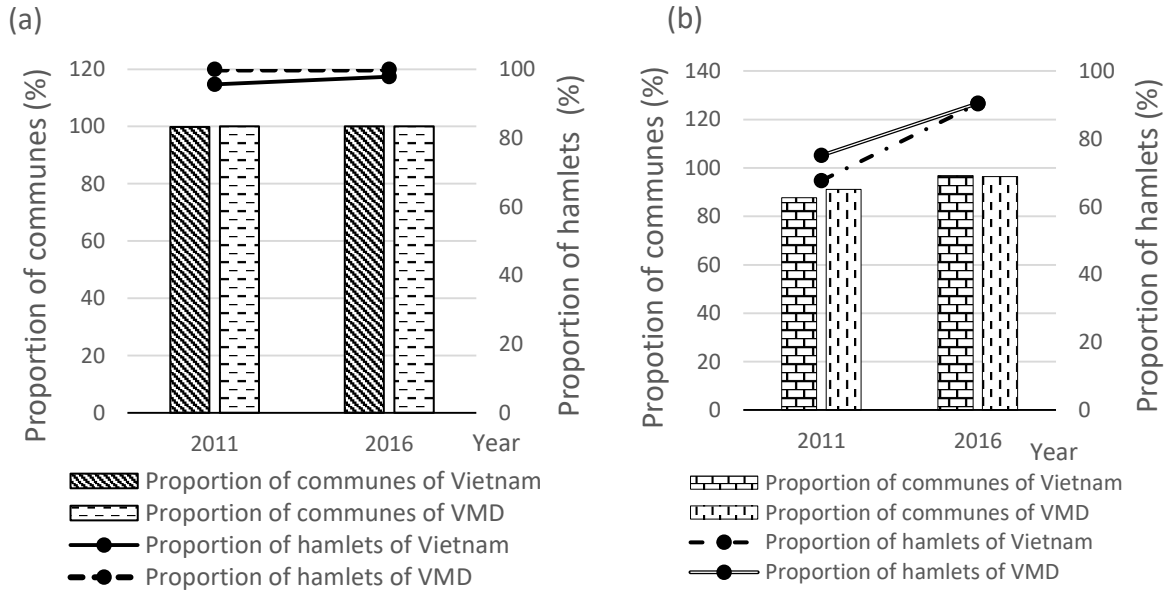


Figure 3.6. Investment for (a) electricity and (b) transportation in Vietnam and the VMD between 2011 and 2016 calculated from the data of Vietnam GSO 2017

Figure 3.7 describes the investment of irrigation systems and the water pumping station for aquaculture activity in Vietnam and the VMD. Total length of irrigation systems in

[2] In Vietnam, the administrative unit is ranking as follows: Province (National Center City) -> District (Provincial City) -> Commune -> Hamlet. Hamlet is the latest unit of administrative system of Vietnamese Government.

VMD was 38,844 km in 2011 (equals to 22.4% of the whole country) and 51,902 km in 2016 (equals to 26.9% of the whole country) (Figure 3.7). For water pumping station, comparing to the average of whole country, the VMD areas was more considered to create more advantages for aquaculture activity.

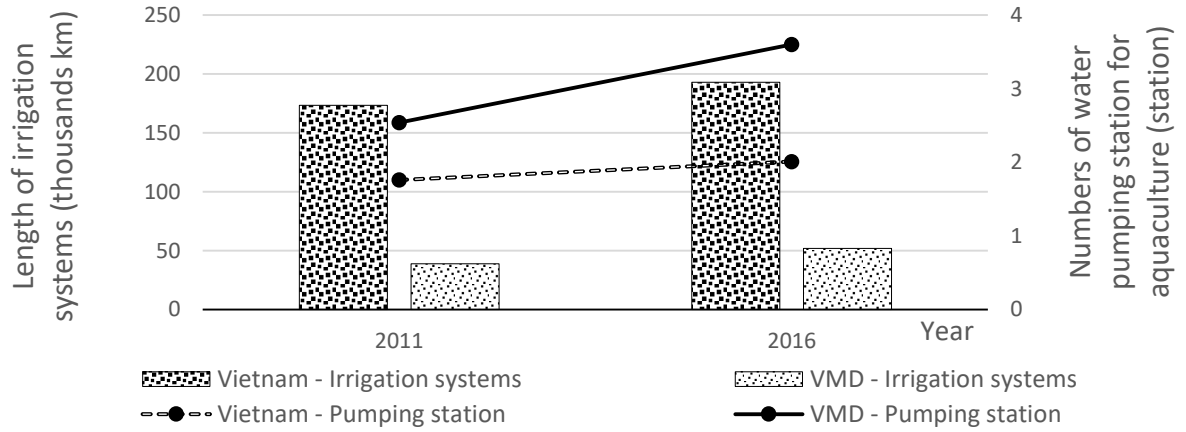


Figure 3.7. Total length of irrigation systems in VMD calculated from the data of Vietnam GSO 2017

Bank systems and the responses of credit demanded

Besides the necessary of infrastructure, the advantages in services are factored to the development of shrimp cultured activity. This section introduces the current situation of the services related to cultured shrimp industry, including bank systems, technical supports and the contribution of seafood factory based on the statistical data of household survey, conducted by Vietnam GSO in 2016.

The producers in fisheries activities in the VMD are mostly dominated as the poor people with the limited in production scale (DANIDA, 2010). Therefore, lack of capital is the most difficulty for the extension of fisheries activities in the VMD, including shrimp cultured activity. This is because they have not enough capacity to invest and/or extend their business by themselves and basically, they need to rely on the credit capital. It has resulted the important role of credit suppliers and bank systems for the shrimp producers and manufactures along supply chain to maintain and extend their business. However, it has a limitation in the available of bank services in rural areas (Figure 3.8). Between 2011 and 2016, ratio of the bank services available at the rural communes' level of Vietnam and the VMD was only approximate 20%. Therefore, shrimp producers, who want to loan the credit capital have to approach to higher administrative level, such as district and/or city and/or province levels. It leads to the disadvantages, especially for shrimp farmers due to the expenses and the time for travelling and approaching of the credit capital (Vietnam GSO, 2016).

Besides that, the response rate of total loan, comparing to total demand for fisheries activities is also the limited issue. In the whole of Vietnam, this rate tends to increase between 2011 and 2016. However, it was still indicated at 73.1% in 2016. It means that 27.9% of total demand for credit of fisheries producers had not been responded. In the VMD, the found responses' rate of credit capital from the bank was only indicated at 67% of total demand.

According the provincial DOFs in VMD, the credit capital demanded of fisheries producers may not be responded because the commercial bank and the financial institution are currently limited the disbursement to fisheries sectors, especially the shrimp sectors. This is because the shrimp cultured activity is sensitively affected by the uncertainty of the climate. The credit capital suppliers, therefore, may face to the non-performance loans of shrimp producers due to the affecting of climate conditions to shrimp cultured activity. This may explain why the informal credit still exists with very high interest rate, resulting of the increases in the interest costs and the decreases of production efficiency for the producers, who need credit capital to maintain, re-invest or extend the shrimp farms.

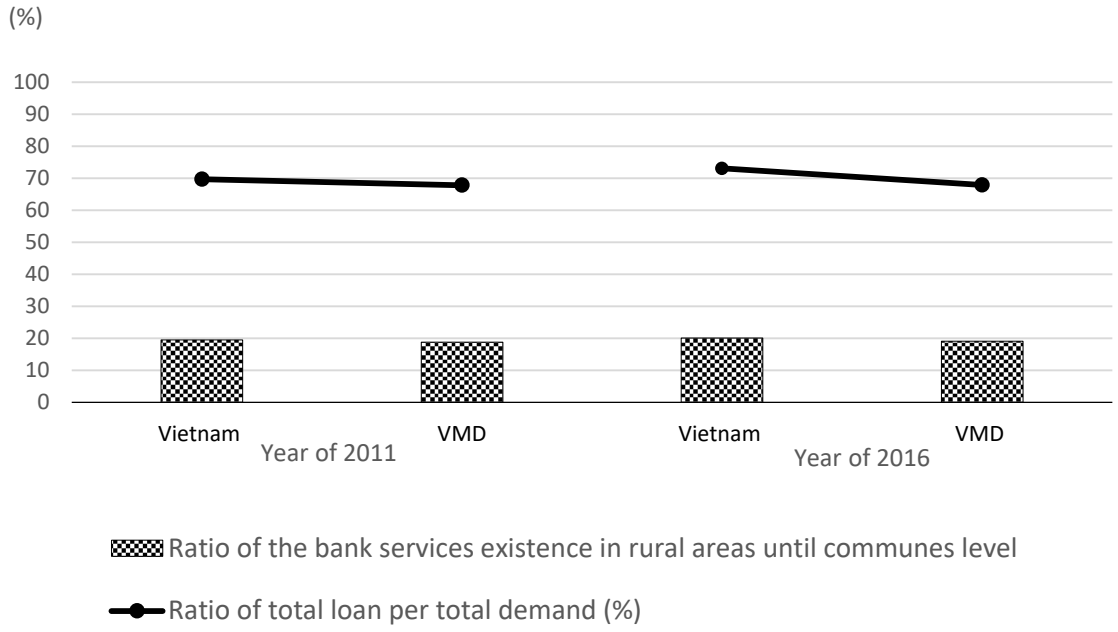


Figure 3.8. Bank systems and the responses of credit demand, calculated from the data of Vietnam GSO 2017

❖ **Technical supports**

In recent year, the unstable of climate conditions is challenging to the A-F-F activities in Vietnam. In Vietnam, the VMD is the largest area of the climate changes influencing such as the affecting of sea level rise and the spreads of salinity in the dry seasons (UNDP, 2016). Local authorities, specifically Provinces Department of Fisheries, assigned the satellite staff in communes and hamlets level of each unit administrative to create the supporting network for farmers. Those staffs would work at communes and hamlets directly and did the consultation to farmers about the production technique. Moreover, they would have the responsibility to support farmers to deal with the spreads of disease. Between 2011 and 2016, almost 90% of rural communes of Vietnam, including the VMD had at least one such satellite staff (Figure 3.9). However, until recent years, this network has not been contributed until the hamlets level yet because the salary budgets from Government is limited to employ more staffs. Moreover, the salary is not high enough to attract the professional labors in long times. It may lead to the overexploitation of those staffs in the commune level, and factor to the sufficient and timely supports for the farmers (Interviewed data from Provincial DOFs in VMD, 2017).

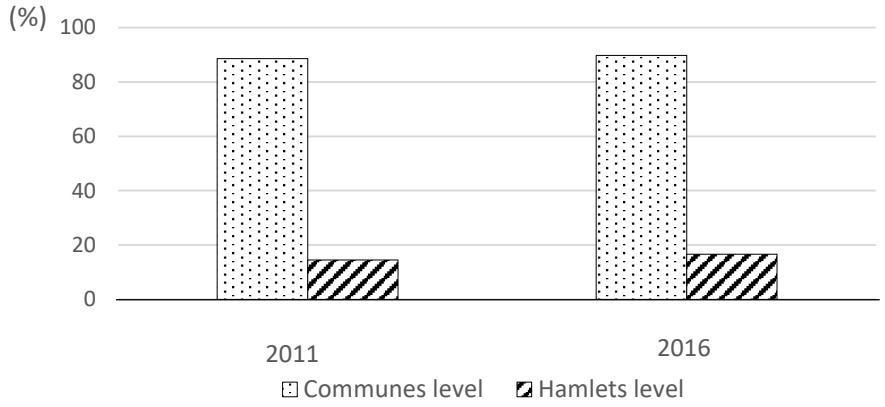


Figure 3.9. The network of satellite staff in fisheries sector calculated from the data of Vietnam GSO 2017

❖ **Seafood processing companies**

In shrimp cultured industry, the number and the distribution of processing factory and processors may affect to the changes in the demand for the quantity and the market price of input material, output and the different from the distribution channels of the whole supply chains of output products. In rural areas, the increasing of the investments of the seafood processors leads to the more conveniences and advantages for the shrimp producers. It may reduce the transportation, harvest and preservation costs. It is also useful to maintain the products quality because the time of transportation from farm gate to the factory is shorter. It, therefore, can increase the output price (Loc, 2006; Provincial DOFs in VMD, 2017).

According the data from Vietnam GSO, in 2011, the total communes had the at least one seafood processing companies of Vietnam was 783 communes. The VMD accounted about 37% with 289 communes (Figure 3.10). In 2016, VMD accounted 43% of total communes had at least one seafood processors of the whole Vietnam.

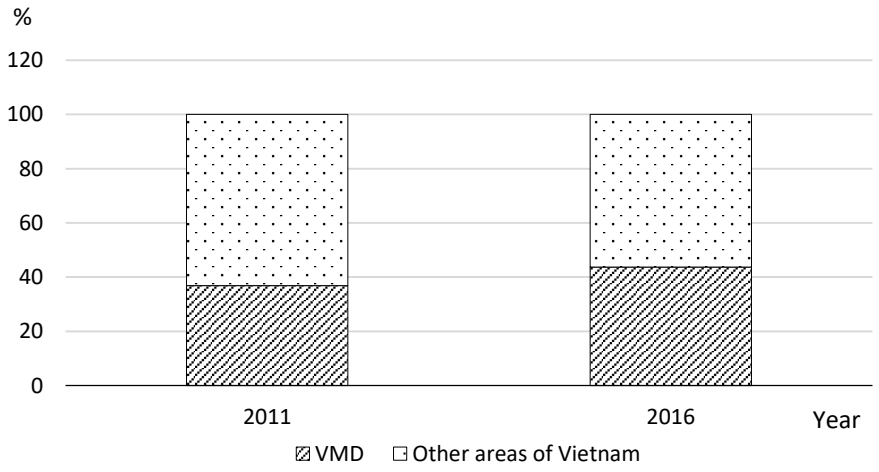


Figure 3.10. Seafood processing companies calculated from Vietnam GSO 2017

3.2.1.3 The role of fishery products in the export value and Vietnam's economy

According to Vietnam GSO in 2017, the export value of the whole country are illustrated (Figure 3.11). The export value of Vietnam was dramatically increased from 2000 to 2016. In 2016, total export volume of Vietnam was more than 176 billion USD, meaning 8% higher than 2015 and 342% higher than 2006. Accordingly, in 2016, the export values of fishery sectors were at more than 7 billion USD, accounted 4% of the total export value of whole country. Among this, the export value of shrimp products were about 2.8 billion USD in 2016, accounted more than 40% of total export value of fisheries products, indicating the important role of shrimp production in the development of Vietnam' economy.

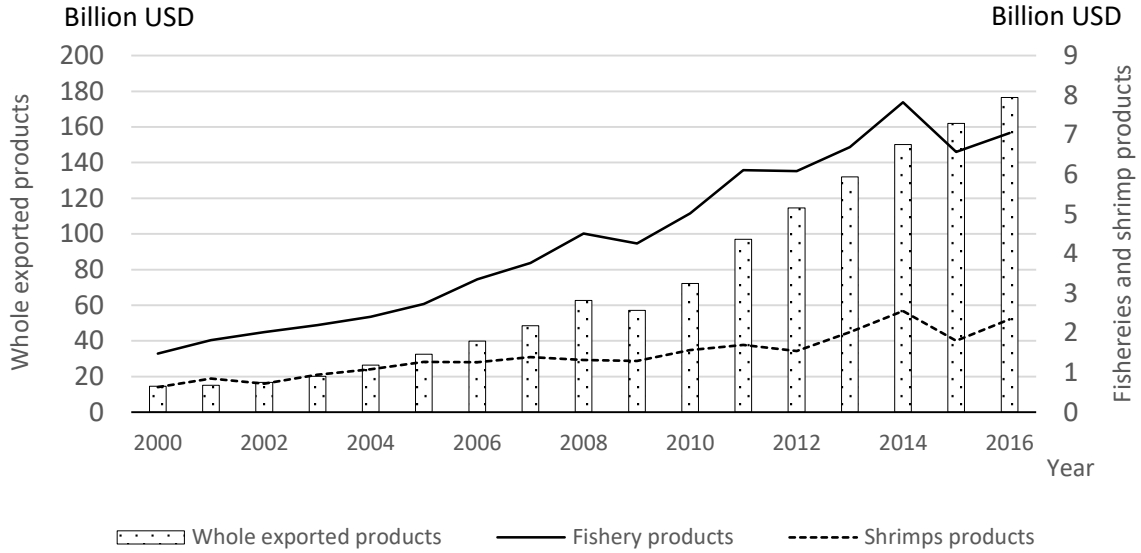


Figure 3.11. The total export value of Vietnam and fisheries sectors calculated from Vietnam GSO 2017

3.2.2 Shrimp cultured industry in VMD

3.2.2.1 Cultured methods and shrimp species

Cultured shrimp became a crucial species for Vietnam fishery exports and aquaculture became an important activity in Vietnam.

Vietnam shrimp aquaculture began from 1970s in the North of Vietnam with local species (*Penaeus merguiensis* and *Penaeus penicillatus*). However, in recent year, Black Tiger shrimp (*Penaeus monodon*) and White Leg shrimp (*Litopenaeus vannamei*) become the main species for shrimp farming. *Penaeus monodon* (*P. monodon*) shrimp farmed activity started from in 1980s. While as *Litopenaeus vannamei* (*L. vannamei*) shrimp was cultured from 2000s in the Middle of Vietnam. From 2011, *L. vannamei* shrimp started to be cultured in the VMD. The strengthening of *L. vannamei* shrimp species is the shorter cultured period, comparing *P. monodon* shrimp species (Provincial DOF interview survey in Mekong Delta, 2017). Therefore, in recent year, *L. vannamei* shrimp species becomes the main species of cultured shrimp in the VMD because shrimp farmers may reduce the risks from the fluctuation of the climates and the market as well.

About the cultured systems, from the beginning in 1970s, the most popular system of farmed shrimp activity was traditional extensive. In 1990s, Vietnamese Government implemented the national programs to extend the shrimp industry. Accordingly, the shrimp farmers had been shifted from extensive systems to other systems. As discussed by Tran *et al*. (2013), the cultured systems of Vietnamese farmed shrimp activity included three systems, namely traditional extensive, improved extensive and intensive. The differences of intensive cultured systems, comparing to the extensive systems are the higher investments, not only to the input costs, such as seed, feed, drugs and chemicals but also to the farming techniques. The differences in the cultured methods may influence to the investment decision in labor and capital, costs proportion, inputs use, output quantity, the quality management progress. Figure 3.12 describes the details of cultured methods of shrimp farmers based on the information of Provincial DOF in the VMD.

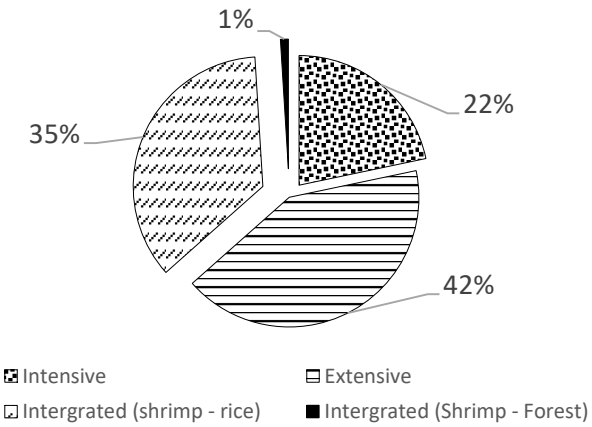


Figure 3.12. Cultured methods of shrimp farmers in Mekong Delta, Vietnam based on the statistical data of Provincial Department of Fisheries in Mekong Delta, Vietnam in 2017

According to the description of Figure 3.12, the main current cultured methods of shrimp farms in the VMD are traditional extensive (42%), improved extensive (including integrated farms such as shrimp-rice, shrimp-mangrove) with 46% and semi-intensive/intensive with 22% of total cultured area. The classification was based generally on stocking density, food supply, pond construction, water management and yield. According to Provincial DOFs in VMD, the main characteristics of each method for shrimp farms in Mekong Delta were described as follows:

- **Traditional extensive** shrimp farming system is the oldest shrimp farming practice in Mekong Delta, Vietnam and is typically applied to produce large sized and high quality for *P. monodon* shrimp. In this system, shrimp pond is not properly built, pond size is varied from 1-15 ha. Formerly, shrimp is stocked naturally during the water intake. In recent, farmers have to stock hatchery seed (Postlarvae-PL) monthly throughout the year. The densities range from 27,000-35,000 PLs per hectare per month. Water is exchanged using tide: intake during high tide and discharge during low tide. Shrimp feed is not supplied to the system, shrimp relies mainly on natural food grown in the ponds such as plants, copepods, nematodes, insert larvae, snails, etc. Shrimp is harvested partially using fyke net according to the new moon and full

moon cycle. Average productivity of this system is around 250-300 kg of shrimp per ha per year.

- **Improved extensive method** is developed from traditional extensive. Shrimp pond is annually prepared as the followings: repairing embankment; drying pond bottom for 1-2 weeks; in some case lime (usually calcium carbonate) is used to control the pH and reduce the risks from disease; waters intake; eliminating of predator (fish) by using derris root or rotenone powder. In this system, seed is relied mainly on hatchery PLs with the stocking densities is about 4-6 Pls/m^2. The seed origin and quality are more concerned to reduce the diseases due to the low-quality seeds. Most of the farmers stock crab as well (around 500-1,000 crablets per hectare). Commercial feeds are occasionally applied to the pond based on farmer's experience. Average productivity of this system is around 450-500 kg of shrimp per ha per year and 70-150 kg of crab/ha/year (if stock). In general, there was no anti-biotic and feed uses in both traditional and improved extensive methods. Therefore, those systems can be called as "eco-green" systems because the low damages to environment and, then, they may increase the eco-certification for aquaculture products (Jonell and Henriksson, 2015).

- **Intensive system** requires an advance technology and high capital, comparing to extensive systems. One crop is 6 months for *P. monodon* or 3-4 months for *L. vannamei*. The basic requirements for intensive cultured are located at a planning area of local authorities because of the effects to environment. Besides that, the waste of feed uses resulted the intensive farmers need to invest reservoir treatment systems to prevent the environment affecting and ensure that the water sources for farms is clean enough to avoid the diseases (Figure 3.13). The pond size ranged from 0.5-1 ha is suitable for this system. Shrimp is stocked once for each crop at the starting time with stocking density varies from 25-40 PLs/m^2 for *P. monodon* or 80-200 PLs/m^2 for *L. vannamei.* Due to high stocking density, the water oxygen's supply system is installed in the pond. In this type of system natural food are produced for shrimps in the beginning period by using lime and various types of fertilizer in the pond. High quality commercial feed is used to feed shrimp throughout the cultivated period. Average productivity of this system ranging from 1-6 tons per hectare per year for *P. monodon* or 5-20 tons per hectare per year for *L. vannamei.*

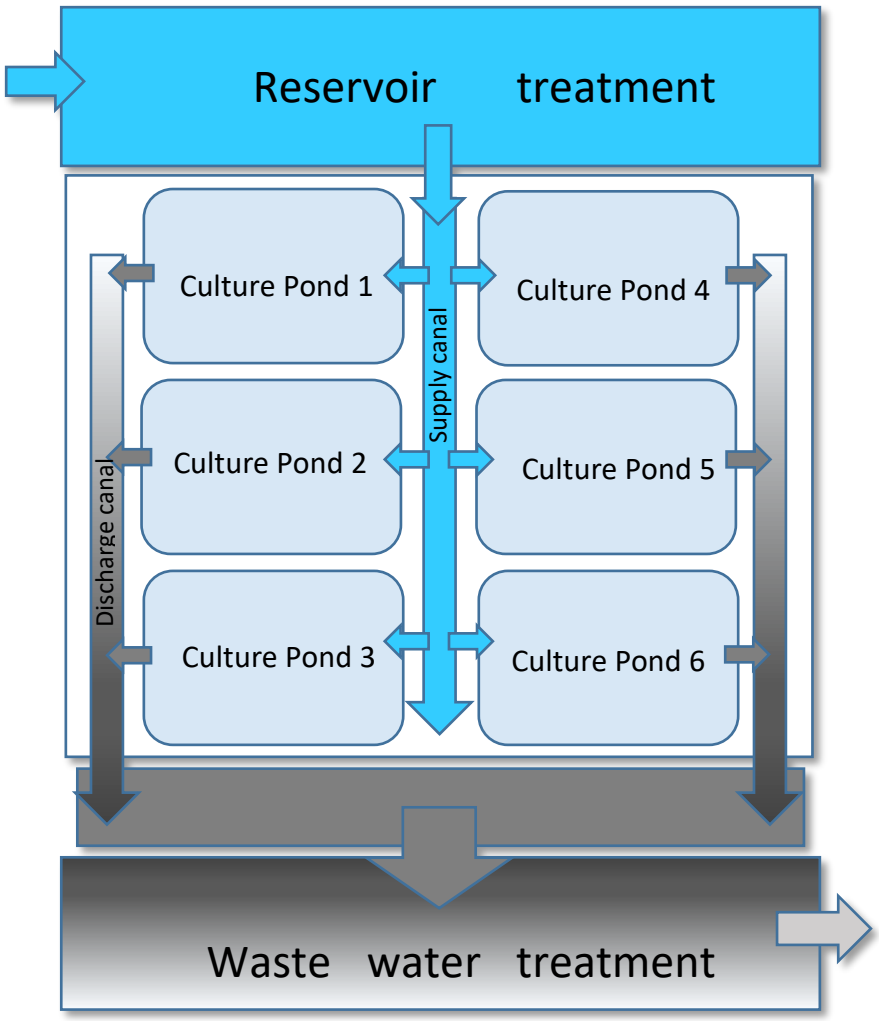


Figure 3.13. Scheme of intensive culture system illustrated from the observation on the field survey 2017

3.2.2.2 Production areas and productivity

Figure 3.14 (a) and (b) described the shrimp production in the VMD from 2011 to 2016. Basically, shrimp production areas in the VMD were increasing between 2011 and 2016. Ca Mau province is the largest area of shrimp cultures in the VMD with approximately 44% of the total production areas. Follows are Bac Lieu and Kien Giang province with 15% and 10% of the total production areas, respectively.

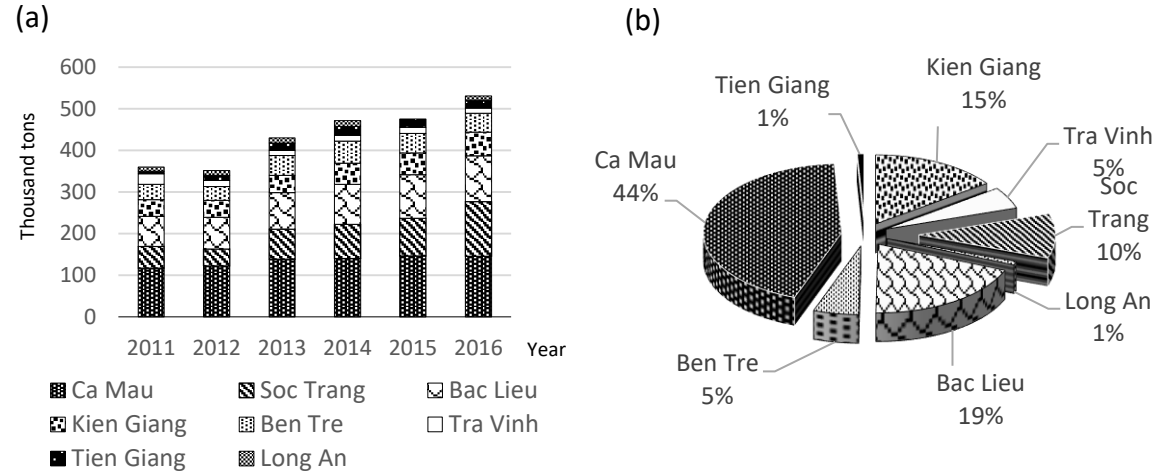


Figure 3.14. (a) Cultured shrimp production of the VMD and (b) the averaged proportion of shrimp production by province, calculated from the statistical data of Provincial Department of Fisheries in Mekong Delta, Vietnam

The average productivity of shrimp farms in the VMD was presented by methods (Figure 3.15) from 2013 to 2016. The data was calculated based on the report of Provincial DOF in the VMD in 2017. On the average, the productivity of shrimp farms in the VMD was about 1.3-1.4 tons per hectare per year (Figure 3.15).

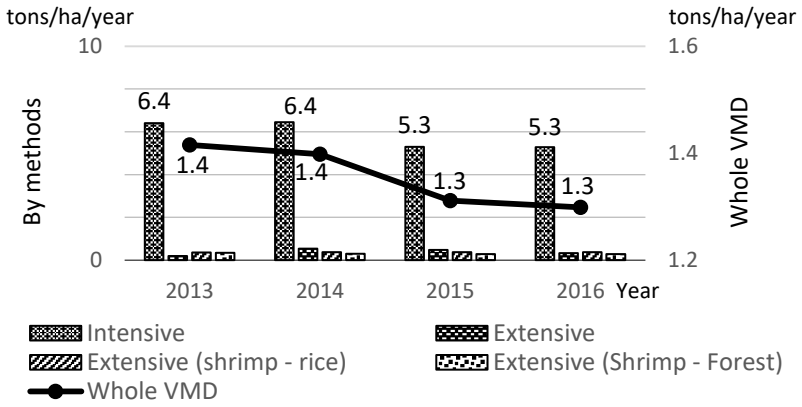


Figure 3.15. Productivity of shrimp farms in the VMD by cultured methods calculated from the statistical data of Provincial Department of Fisheries in Mekong Delta, Vietnam 2017

By province, there was three groups of productivities in the VMD. The first group included Kien Giang, Tra Vinh, Bac Lieu and Ca Mau province, where the shrimp farmed production areas were largest in the VMD, with the productivity is less than 1 ton per hectare per year. Though the shrimp farmed activities is very large. The next group belonged to Ben Tre and Soc Trang province, where the productivity is nearly the averaged productivity of the whole VMD. The last group was Tien Giang and Long An province, where the cultured shrimp production areas were smaller than other provinces of the VMD but the productivity was the highest in the VMD (Figure 3.16a). According Provincial DOFs in VMD, the differences of the cultured shrimp productivity between the provinces might be due to the differences from the cultured methods. About 80% of total production areas of shrimp farms in Bac Lieu, Kien

Giang, Tra Vinh and Ca Mau province was extensive systems, including traditional extensive and improved extensive systems. In the contrast, the productivity is higher in Long An and Tien Giang province, where the cultured methods are almost intensive systems.

The differences in the productivity might be because of the differences in shrimp species (Figure 3.16b). Calculated results indicated that the productivity of *L. vannamei* was significantly higher than *P. monodon* shrimp. *L. vannamei* shrimp only took 3-4 months per crop, and might be harvested 3-4 crops per year. While as the *P. monodon* shrimp took 5-6 months per crop. Therefore, *P. monodon* shrimp farms might conduct 1-2 crops per year only. According the Provincial DOFs in VMD, in the recent years, shrimp farmers preferred to culture *L. vannamei* shrimp in intensive systems. This is because *L. vannamei* shrimp took shorter cultured periods and it, therefore, might help to reduce the affecting of climate uncertainty risk, comparing to the *P. monodon* shrimp. Therefore, the total production areas of extensive and improved extensive systems, accounting about 78-80%, are currently applied for *P. monodon* shrimp.

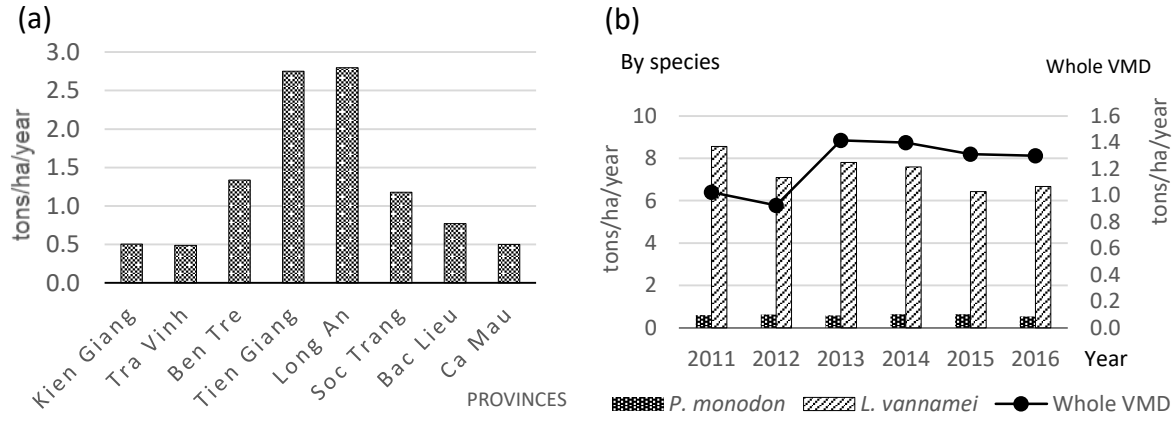


Figure 3.16. (a) Productivity of shrimp farms in VMD by provinces and (b) by shrimp species in whole VMD calculated from the statistical data of Provincial Department of Fisheries in Mekong Delta, Vietnam 2017

3.2.2.3 Markets

The main targets of processed shrimp products are exported markets (VASEP, 2017). In recent year, the development of supermarket and restaurant systems causes of the increasing in value-added shrimp products consumption in domestic market (Expert's interviewed survey, 2017). The processing companies are more concentrated to distribute the shrimp products though supermarkets, retailers and restaurants in domestic markets. In 2016, domestic markets consumed about 20% of total processed shrimp of seafood factories (VASEP, 2017).

Export is main target of shrimp cultured industry in Mekong Delta, Vietnam with 75-80% in total production (Tran *et al*., 2013; Portley, 2016). The US, the EU and Japan markets accounted more than 50% of total export value of the VMD shrimp products. Accordingly, the US market was the largest market of the VMD shrimp products (Table 3.1).

Table 3.1. The market's structure of the VMD shrimp products calculated from the data of Provincial DOFs in Mekong Delta, Vietnam, 2017

Unit: %

Categories	2012	2013	2014	2015	2016
Japan	20.9	20.7	16.8	11.0	15.0
The US	21.7	22.2	20.4	11.2	26.1
EU	11.1	12.6	17.6	14.8	13.9
Other exported markets	22.3	22.5	25.2	42.0	22.0
Domestic market	24.0	22.0	20.0	21.0	23.0
Total	**100**	**100**	**100**	**100**	**100**

From 2012 to 2016, the US, EU and Japan shrimp products export value are almost more than 50% of total export value of the VMD, However, in 2015, the export value of those markets of total was rapidly decreased to 37%, decreasing 17.8% compared to 2014. There were two main reasons were reported from the provincial DOF in VMD. First, the demand for Vietnamese shrimp products in the US markets was decreasing in 2015. Second, the increasing of USD currency led to the increasing of imported shrimp products from other countries to the US market. The Vietnamese shrimp products had to compete to the imported shrimp products from India and Indonesia in the US market. However, the difficulty was the price of imported shrimp products from Vietnam was higher than from India and Indonesia about 1-2 USD per kg. Therefore, Vietnamese shrimp products could not compete to the products of India and Indonesia imported to the US markets. On the other hand, the used currency of Vietnamese shrimp products was even USD for the transactions in Japan, EU and other international markets. Thus, the increasing of USD currency, compared to JPY and EUR led to the expensive price of imported shrimp products in those markets. Therefore, the importers of those markets asked the reduction of Vietnamese shrimp products' exported price to balance the increasing of the exchange rate between USD and JPY or EUR.

3.2.2.4 The VMD shrimp supply chain and its governance

Figure 3.18 described the distribution channels of shrimp products along supply chain in the VMD which were imitated based on the previous works of Loc (2006) and Tran *et al*. (2013) and the interview information from the shrimp experts in the VMD. The main participants into the VMD shrimp supply chain were the input suppliers such as hatcheries, feed, drugs and chemicals suppliers, shrimp farmers, middlemen including collectors, brokers/traders and pre-processing company, seafood processing factories, exporters, domestic distributors and importers.

The governance of shrimp agents along supply chain was described in Figure 3.17 based on the collected information from Vietnam GSO, Vietnam Association of Seafood Exporting and Processing (VASEP) and Provincial DOF in the VMD. Found results indicated the governance of the shrimp agents along supply chain belonged to both, national and local government. Besides that, the other organization, such as VASEP, played as the "civil actors" to support for the operation of processors and exporters. The governance of each agents of shrimp supply chain was presented as follows.

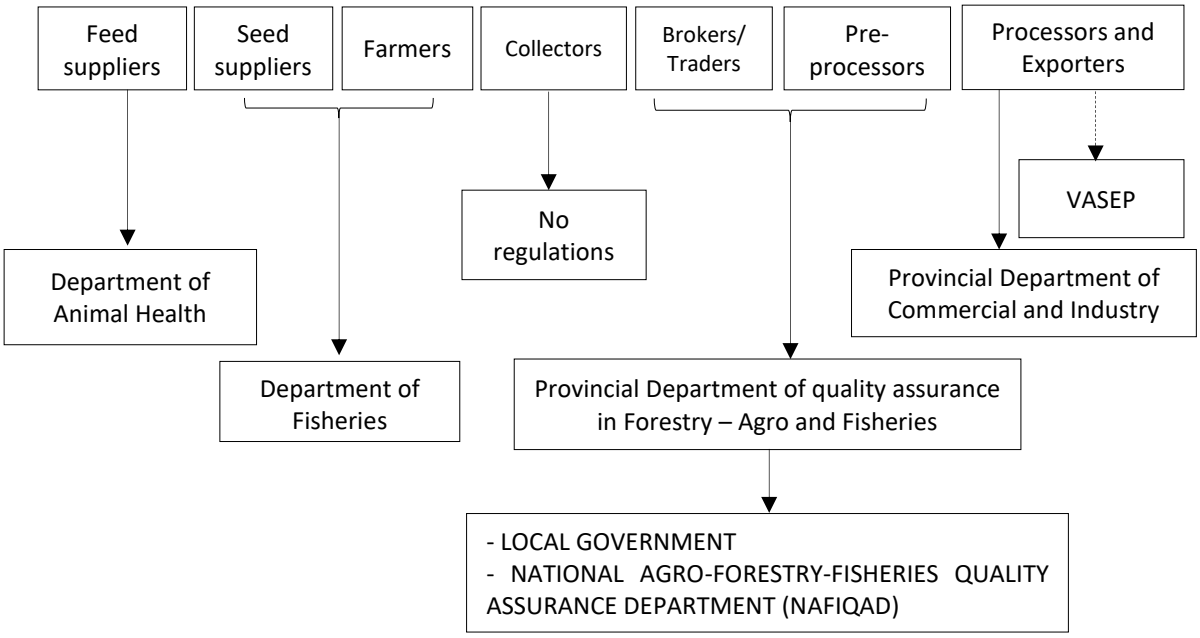


Figure 3.17. The governance systems of shrimp industry in Mekong Delta, Vietnam illustrated from the information of Provincial DOFs in VMD

- **Input suppliers**

Hatcheries

In 2016, there were about 1,196 operating hatcheries at 8 provinces had farmed shrimp activities of the VMD for both *P. monodon* and *L. vannamei* shrimp (Provincial DOF in VMD, 2017). The breed management was specified in Circular No. 26/2013/TT-BNNPTNT of Ministry of Agriculture and Rural Development (2013). Under this Circular, Provincial of Department of Fisheries was the authorized manager of hatchery operating. Besides that, hatcheries were compulsory for the business registration with Local authorities, where their factory located.

Table 3.2 showed the information about the seed production of *P. monodon* shrimp, total supply and demand for seed in the VMD until 2016s. The seed of *P. monodon* shrimp was produced from the domestic breed. On average, the domestic hatcheries of each province in the VMD covered about 57% of total demand for seed of *P. monodon* shrimp. The rest of more than 40% of total seed demand was imported from other provincial producers in other area of Vietnam. Among the VMD, Ca Mau province was the largest seed producer with 857 *P. monodon* hatcheries. Total seed production of Ca Mau province was more than 9 billion post larvae in 2016s. Bac Lieu province was also the large seed producers in the VMD, following Ca Mau province, with 6 billion post larvae per year and 159 hatcheries.

Table 3.2. Seed supply and demand for *P. monodon* shrimp in Mekong Delta, Vietnam calculated from the data of Provincial DOFs in the VMD 2017

Provinces	*P. monodon* shrimp				
	Total Hatchery	Total produced quantity (million post)	Imported from other provinces	Total demand	Imported /total demand
Kien Giang	25	379	4,740	5,119	0.93
Tra Vinh	77	900	1,040	1,940	0.54
Long An	1	118	82	200	0.41
Ca Mau	857	9,073	8,775	17,848	0.52
Soc Trang	2	300	1,700	2,000	0.85
Bac Lieu	159	6,000	3,530	9,530	0.37
Tien Giang	2	3	255	258	0.99
Ben Tre	19	72	2,178	2,250	0.97
Total	**1,142**	**16,845**	**22,300**	**39,145**	**0.57**

Supply and demand for seed of *L. vannamei* shrimp were presented in Table 3.3. In whole, about 94% of total demand for seed of *L. vannamei* shrimp in the VMD was imported from other provinces. The provincial hatcheries only covered 6% of total demand for *L. vannamei* seed with the broodstock origin was imported from the foreign countries, such as the US and Thailand.

Table 3.3. Seed supply and demand for *L. vannamei* shrimp in Mekong Delta, Vietnam calculated from the data of Provincial DOFs in the VMD 2017

Provinces	*L. vannamei* shrimp				
	Total Hatchery	Total Production (million post)	Imported from other provinces	Total demand	Imported /total demand
Kien Giang	2	720	1,660	2,380	0.70
Tra Vinh	0	0	2,680	2,680	1.00
Long An	0	0	3,200	3,200	1.00
Ca Mau	12	373	4,513	4,886	0.92
Soc Trang	0	0	15,000	15,000	1.00
Bac Lieu	29	1,500	7,500	9,000	0.83
Tien Giang	0	0	1,700	1,700	1.00
Ben Tre	11	480	5,587	5,900	0.95
Total	**54**	**3,073**	**41,840**	**44,746**	**0.94**

Hence, the challenges for the management of seed production in the VMD was the seed origins. For *P. monodon* shrimp, Ca Mau and Bac Lieu provinces are the largest seed producers of the VMD but the provincial hatcheries of those provinces only supplied 48% and 63% of total demand. For *L. vannamei* shrimp, the breed was imported from Thailand and Hawaii of the US. The number of *L. vannamei* seed producers in the VMD was still limited, and the seed origin was depended on the importing from other provinces. It led to the complex of distribution channels from the hatcheries to shrimp farms. The management of seed origins became the current challenges of Local Government and Provincial DOFs in the VMD.

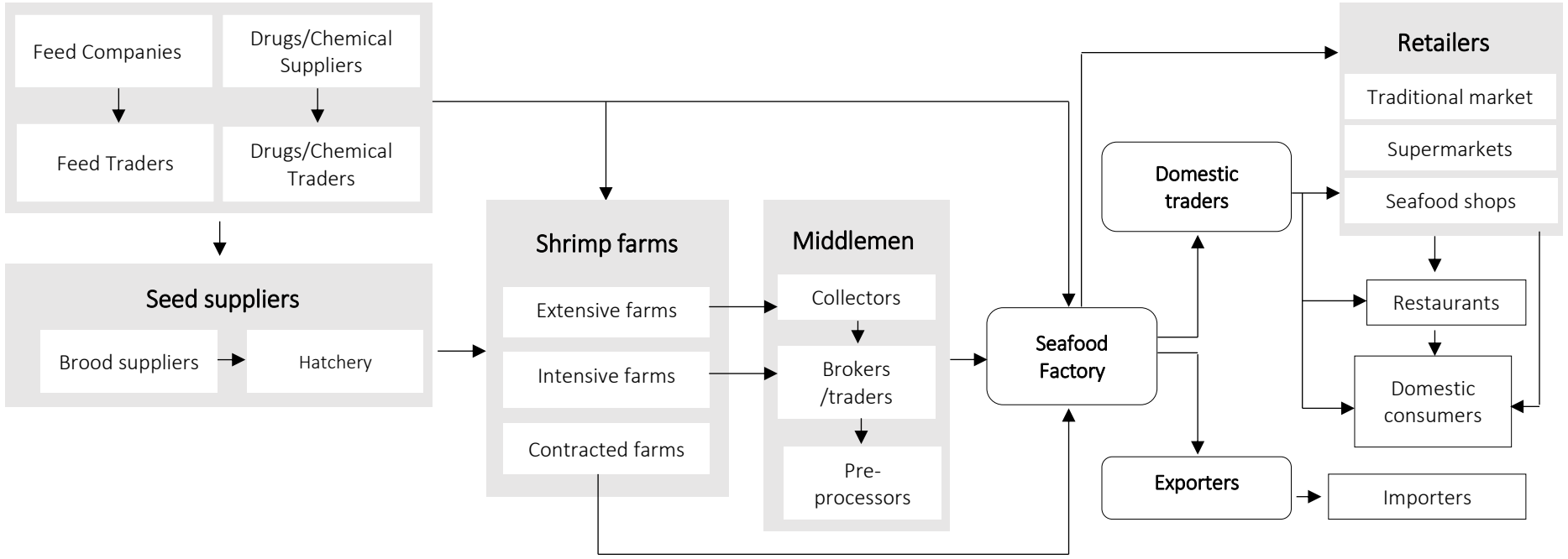


Figure 3.18.Distribution channels of shrimp products in the VMD summarized from Tran *et al*. (2013), VASEP (2015) and Experts interviewed information (2017).

Feed, chemical and drugs suppliers

Provincial Department of Animal Health monitored the operation of feed, chemical and drugs suppliers. Those input suppliers were required to register the business certificates to Local Government, where the operation was located.

❖ **Shrimp Farmers**

Farmed shrimp activities began from 1990s with small-scale production by individual farming with his or her own family land and labors. From 2010, under the Circular No.45/2010/TT-BNNPTNT, Ministry of Ministry of Agriculture and Rural Development (2010), farmed shrimp activities started to be managed in food safety and hygiene-guarantees to extend the production scale, and to change the cultured methods from traditional extensive to intensive.

Provincial of Department of Fisheries (DOF) were authorized for the management of shrimp farming. In each commune, Provincial DOF appointed a satellite staff to consult for shrimp farmers in medicine and chemical using, pond systems investment, the technically water quality management, and recording of cultured procedures information to control the diseases in the collaboration with the local agriculture extension staff (Provincial DOF in the VMD, 2017).

To encourage the development of vertical linkage between shrimp producers and manufacturers along supply chain, Provincial DOF in the VMD forced to establish the Farmed Shrimp Cooperatives under the Law of Cooperatives (No.23/2012/QH13) of Vietnam Government. According this law, the shrimp farmers participated to Cooperatives could receive the specific supporting from Local Government and Provincial DOFs. For examples, the members of Cooperatives might receive the training program for farms management and new technologies application, the subsidies for capital and seed to cover the damages of weather and diseases, and the supporting for the assessment of low interest credit and for contacting to shrimp processors for making contracted agreements with Cooperatives (Provincial DOF in the VMD, 2017). Under those efforts of both national and provincial DOF, Farmed Shrimp Cooperatives were established in shrimp production provinces such as Ca Mau, Soc Trang and Bac Lieu provinces. Those Cooperatives have signed the contracted agreement to supply the harvested shrimp to the processors directly. Under the contracted agreement, processors might provide the inputs such as seed, feed, chemical and drugs to shrimp farmers. Besides, processors also sponsored all registration and application fees in case if the Cooperatives implemented the quality assurance standards such as VietGAP, ASC and GLOBAL GAP.

❖ **Shrimp Collectors**

Collectors were the first level of traders who bought the harvested shrimp from farmers. They directly contacted to shrimp farmers, daily visited to shrimp farms by motorcycle, and purchased the harvested shrimp with very small quantity (3-20 kg per farm per day) (Provincial DOF in MD, 2017). Their business was freely operated by commune level, and the business registration was not required. However, collectors were required to supply

the name, address, phone number and identification card to the downstream buyers, such as wholesale agents and/or processing plant (Provincial DOF in the VMD, 2017). Negotiation between collectors and shrimp farmers was the family-network with verbal contract (Loc, 2006; Tran *et al*., 2013; Suzuki and Nam, 2018).

❖ **Brokers and Traders**

Wholesale agents included brokers/traders who were required to have the business registration and food safety certification before starting business (Provincial DOF and NAFIQAD in the VMD, 2017). Provincial Department of Agricultural, Forestry and Fisheries Quality Assurance (NAFIQAD) directly governed those agents based on the Circular No.08/2016/TT-BNNPTNT (2016) and Circular No. 48/2013/TT-BNNPTNT (2013) (amended in No. 02/2017/TT-BNNPTNT, 2017). The negotiation between wholesale agents and collectors might also be the verbal contracts with personal based, including the comprising of credit provision (Tran *et al*., 2013; Provincial DOF in MD, 2017). Wholesale agents recorded the information of collectors, and provided the information to processors.

❖ **Pre-processing companies**

Pre-processing companies were also one of traders in shrimp supply chain. They might buy shrimp farming inputs from collectors and/or wholesale agents. The targets customers of those companies were the processors (Provincial NAFIQAD, 2017).

However, pre-processing companies are currently operating based on the outsourcing contracted agreement with processors. Processors hire the pre-processing companies for cleansing, head-off, peel-off and other requirements. Pre-processing companies are currently governed by Provincial Agriculture-Forestry-Fisheries Quality Assurance Department under the Circular No. 48/2013/TT-BNNPTNT. They also must to register for doing business with local government and they are required the food safety certificate from Provincial NAFIQAD.

❖ **Seafood factories and processing companies**

Shrimp processing companies (processors) might include the exports activities or be separated as the seafood factories and processors, depended on the business registration with local authorities. NAFIQAD at both, national and provincial level currently governed for the quality management issues of processors and exporters under Circular No. 48/2013/TT-BNNPTNT. In 2017, total number of shrimp processors and exporters in the VMD was 160 companies (VASEP, 2017), which had the total processing capacity was more than a million tons of output per year.

The shrimp farming inputs might be provided to processors by collectors, wholesale agents and shrimp farmers with the contracted agreement. The seafood factories and processing companies also contributed the own shrimp farming input areas to control the shrimp materials quantity for the processing progress, and to manage the quality assurance of farming inputs to satisfy the quality requirements of customers from foreign markets.

According to Provincial DOF in the VMD, the processors were operating their material areas by different ways. They might hire (or buy) the land, hire labors, and invest to operate shrimp farms by themselves. The processors' staffs managed the input used, and supported the technical to hired labors. By this way, shrimp farming inputs were cultured based on the quality assurance procedure of processors. It created a completely closed supply chain from farm to processors gate. Processors might apply the international quality assurance for shrimp material areas, such as GLOBAL GAP and ASC to improve their reputation and adapt the requirements of global markets. The leaders of processors for the developing of those material areas in the VMD were Minh Phu Seafood Company (Ca Mau province), Ca Mau Seafood Exports and Services Joint Stock (Ca Mau province), Anh Khoa Seafood Company (Ca Mau province), Truc Xinh Company (Bac Lieu province), Viet Uc Seafood Company (Bac Lieu province). On average, those areas might provide about 20% of total demand for shrimp farming inputs at the invested processors. However, the most challenges to operate those areas were the limitation of the investment capacity, especially of small and medium processors (Tran *et al*., 2013; Interviewed Provincial DOF staff information, 2017; Suzuki and Nam, 2018).

On the other hand, the processors might sign a contracted agreement with shrimp farmers. In the contracted agreement, shrimp processors might specify the products specification to shrimp farmers, including anti biotic residues specific drugs and chemical level, shrimp size, seed and feed used origins, and the recording of information about production procedure to support for the traceability procedures at those processing companies. Moreover, the price of harvested shrimp was already indicated in the contracted agreement. Therefore, shrimp farmers might avoid the uncertainty of market. However, the farmers had to sell the harvested shrimp to the contracted processors, and to follow the specific of product characteristics in the contract. From the processors' side, those contracted agreement helped to control the quantity and quality of shrimp farming inputs.

However, the shrimp farmers in the VMD had not awarded the benefits of contracted agreement, especially farmers who were operating with extensive systems. In reality, shrimp farmers might negotiate the price with the collectors and other buyers to sell harvested shrimp easily. Meanwhile, the contracted shrimp farmers might not have the negotiation, and choose other buyers as well. Consequently, the contracted farmers might receive the lower price for harvested shrimp, comparing to the shrimp farmers who did not sign the contract.

In Chapter 1, we have briefly introduced the role of Farmed Shrimp Cooperatives to improve the right of both processors and farmers in the contracted agreement. In this case, cooperative's committee played the role as the spokespersons to deal the input and output price with the processors and suppliers. On the other hand, cooperative's committee had the responsibility to manage the responsibility and liability of cooperative's members in order to improve the reputation of cooperative and to be incentive for the success of contracted agreement implementation.

3.3. Overview of study area: Ca Mau province, Mekong Delta, Vietnam

3.3.1. The natural conditions and social economics characteristics

Ca Mau province is located at the southeast part of Vietnam, and have the frontier with Kien Giang province at the northern part, Bac Lieu province at the eastern part, East Sea at the southern part and Gulf of Thailand at the western part. The geography frontier of Ca Mau province is at latitude of $8^030'$N-$9^010'$N and at longitude $104^080'$E-$105^005'$E.

The total length of Ca Mau province is 5,294.87 km^2, which is equals to 1.5% of total length of Vietnam, and about 12.9% of total length of the VMD. Ca Mau province includes Ca Mau city, where is the central area of Ca Mau province, and 8 districts, namely Tran Van Thoi, Thoi Binh, U Minh, Cai Nuoc, Phu Tan, Dam Doi, Nam Can and Ngoc Hien (Figure 3.19 and Table 3.4).

Ca Mau province, together with Can Tho city, An Giang province and Kien Giang province belong to the vital economy areas of the VMD, where are the largest contributors in the development of the VMD's economy development.

Table 3.4. The administrative units of Ca Mau provinces illustrated from the data of Ca Mau Government 2018

Name of districts	Acre-age (km^2)	Administra-tive units (commune)	House-hold	Popula-tion (people)	Average per administrative units				
					Acre-age (km^2)	Popula-tion	House-hold (people)	House-hold size (people)	Popula-tion density (people per km^2)
Ca Mau	249	17	52,222	224,414	14.66	13,201	3,072	4.30	900
Nam Can	495	8	16,694	65,914	61.93	8,239	2,087	3.95	133
Dam Doi	823	16	41,729	183,648	51.43	11,478	2,608	4.40	223
Ngoc Hien	735	7	19,459	78,033	105.03	11,148	2,780	4.01	106
Cai Nuoc	417	11	32,127	138,845	37.91	12,622	2,921	4.32	333
Thoi Binh	636	12	31,875	135,966	53.03	11,331	2,656	4.27	214
Tran Van Thoi	703	13	45,603	190,081	54.06	14,622	3,508	4.17	271
U Minh	774	8	23,969	102,097	96.77	12,762	2,996	4.26	132
Phu Tan	462	9	24,149	104,193	51.32	11,577	2,683	4.31	226
Whole province	**5,295**	**101**	**287,827**	**1,223,191**	**52.42**	**12,111**	**2,850**	**4.25**	**231**

Ca Mau province has the feature climate of the VMD with the two seasons, includes dry season and rainy season. The average temperature of Ca Mau province is the highest in the VMD areas at 27.6°C. The gap of the highest and lowest temperature is from 15°C to 38°C.

In recent year, the climate changes have increased the temperature of Ca Mau province. From 2000 to 2009, the average temperature of Ca Mau province increased 0.3°C, comparing to the periods from 1990 to 1999. Similar as the whole VMD, the higher temperature may influence to the aquaculture activities in Ca Mau province, especially in dry season from February to May of every year.

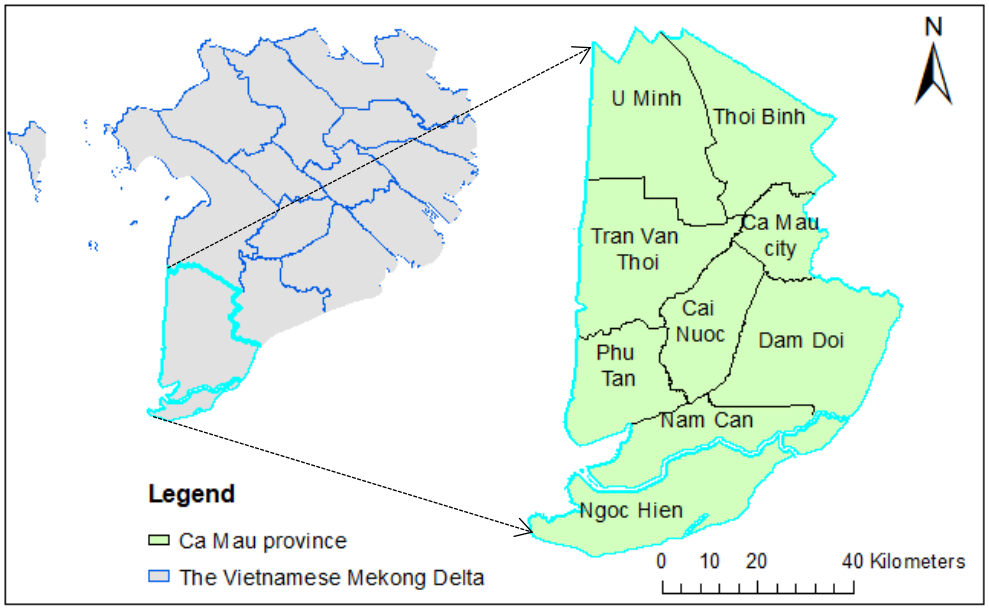


Figure 3.19. The maps of Ca Mau province adapted from Google Maps

3.3.2 Shrimp industry of Ca Mau province

3.3.2.1 Production areas and harvested quantity

Shrimp cultured is accounting more than 92% of total Ca Mau province's aquaculture activities in production area terms and approximately 55% in total production quantity terms (Table 3.5).

Table 3.5. Production areas and quantity of shrimp cultured in Ca Mau province, calculated from the statistical data of Provincial DOF in Ca Mau province 2018

	Production area		Quantity	
	Hectare	%	Tons	%
Total aquaculture	305,204	100.00	293,156	100.00
Farmed shrimp culture	280,849	92.02	160,519	54.76
Other species	24,355	7.98	132,637	45.24

As the whole VMD, *P. monodon* and *L. vannamei* shrimp are the main cultured species of shrimp farms in Ca Mau province, farming under the extensive, including traditional and improved extensive, and intensive systems.

Figure 3.20 presents the culture methods by production area (a) and quantity (b) of Ca Mau province. Accordingly, the extensive and improved extensive systems account 96% of total production area. The production area of intensive farms is 4% of total production area.

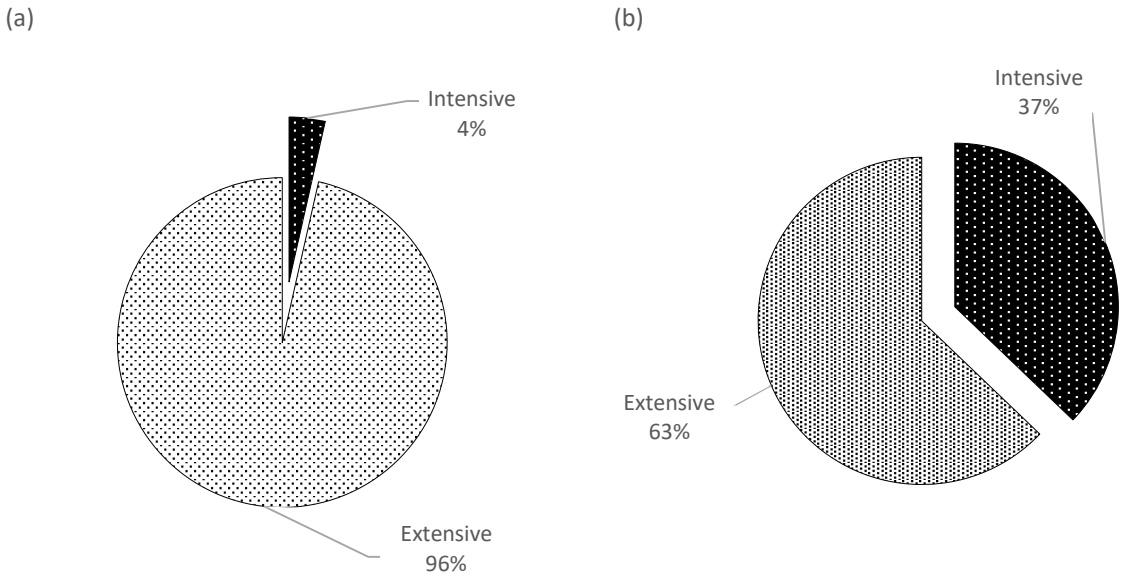


Figure 3.20. (a) Production area and (b) quantity by cultured methods of shrimp cultured in Ca Mau province calculated from the statistical data of Provincial DOF, Ca Mau province 2018

Quantity production of shrimp cultured activities is different from the cultured systems. Extensive systems account 96% of total production area but the quantity production of shrimp products from those systems is only 63%. While as, intensive farms system only accounts 4% of total production area but 37% of total quantity of shrimp products is provided from those farms. This is because the characteristics of extensive systems lead to the differences in the quantity production. Under extensive systems, farms are operated in low stock density without supplement of feed and chemical. Therefore, extensive farms provided small products quantity. While as intensive farms required the high investments on inputs such as feed, chemical and drugs. Intensive farms are also operated with high stock density in the pond systems with advance technology. The shrimp production quantity from intensive, therefore, are much higher than extensive and improved extensive systems.

We presented the production area and quantity as the district of Ca Mau province in Figure 3.21. The farmed shrimp activities are allocated in whole of Ca Mau province. Dam Doi district is the largest production area of farmed shrimp activities in Ca Mau province with 24% of total area. Followings are Thoi Binh district (18%), Phu Tan district (13%) and Cai Nuoc district (10%), respectively (Figure 3.21a).

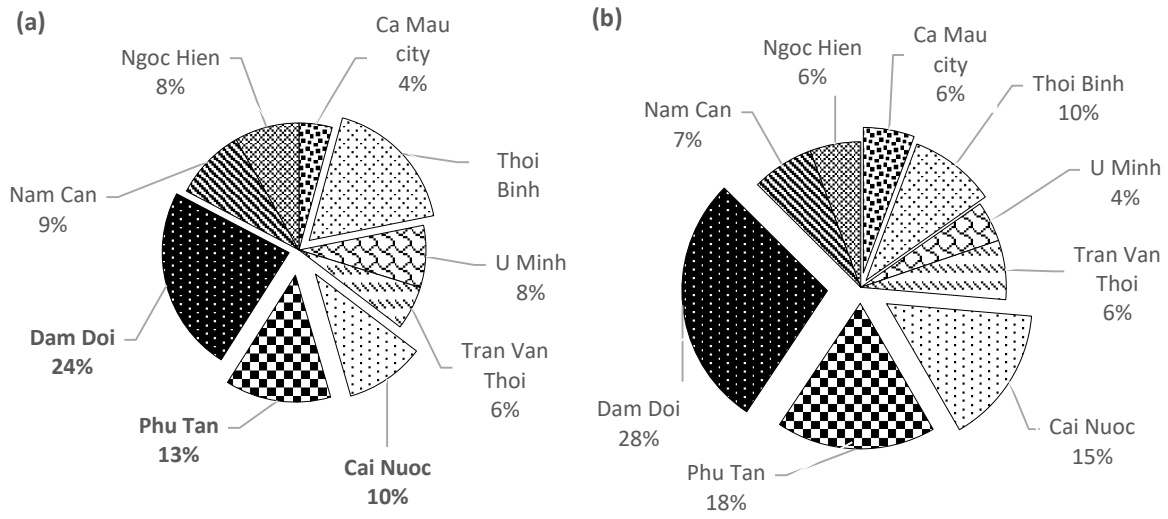


Figure 3.21. (a) Production area and (b) quantity by district of shrimp cultured in Ca Mau province calculated from the statistical data of Provincial DOF, Ca Mau province 2018

Dam Doi district also provide the largest products quantity of farmed shrimp activities in Ca Mau provinces. There are a slightly changes in positions of products quantity between Thoi Binh district, Phu Tan district and Cai Nuoc district. Thoi Binh district is the 2nd largest district of farmed shrimp production area, and following by Phu Tan district and Cai Nuoc districts (Figure 3.21a). However, Thoi Binh district only provides 10% of total shrimp products quantity of Ca Mau province. While as, Phu Tan district and Cai Nuoc district provide 18% and 15% of total products quantity (Figure 3.21b) with only 13% and 10% of total production area, respectively, suggesting the higher productivity in Phu Tan district and Cai Nuoc district, comparing to Thoi Binh district (Table 3.6). We intended that the shrimp farms in Phu Tan district and Cai Nuoc district are operating in intensive farms systems more than farms in Thoi Binh district. Therefore, the shrimp products quantity may be higher in Phu Tan district and Cai Nuoc district.

Table 3.6. Productivity of shrimp cultured in Ca Mau province by districts calculated from the statistical data of Provincial DOF, Ca Mau province 2018

Unit: ton per hectare per year

Cultured methods	Whole province	Ca Mau city	Thoi Binh	U Minh	Tran Van Thoi	Cai Nuoc	Phu Tan	Dam Doi	Nam Can	Ngoc Hien
Intensive	6.06	6.11	5.26	5.00	5.44	5.84	5.91	6.34	6.91	6.92
Improved-Extensive	0.51	0.52	0.47	0.49	0.52	0.54	0.54	0.54	0.48	0.36
Extensive	0.29	0.28	0.27	0.27	0.28		0.28	0.28	0.28	0.27
Whole province	**0.56**	**0.75**	**0.31**	**0.32**	**0.66**	**0.84**	**0.74**	**0.67**	**0.43**	**0.38**

3.3.2.2. Shrimp supply chain in Ca Mau province, Vietnam and its governances

❖ **Shrimp farmers**

According Provincial DOF in Ca Mau province, there was about 62 thousand shrimp farms are operating in Ca Mau province in 2017. Shrimp farmed activities in Ca Mau province creates about 113 thousand labors in rural areas. On average, the number of labors at shrimp farms is about 1.8 labors per farms. Among this, the family labors were about 1.79 labors per farms and hired labors are about 0.06 labors per farms (Vietnam Institute of Fisheries Economics and Planning, 2013), suggesting that the shrimp farms in Ca Mau province are almost utilizing the family labors in the shrimp farmed activities.

There are about 13% of total shrimp farmers have professional trained in shrimp farmed operation in Ca Mau province. The rest 87% of total shrimp labors are not trained labors. They are operating shrimp farms as their own experiences.

❖ **Feed, chemical and drugs suppliers**

In recent years, the origins of feed, chemical and drugs used for shrimp farmed activities are from foreign companies such as CP (Thailand); Grobest, Uni President (Taiwan) and Tongwei. Ca Mau province has about 200 traders for those inputs with providing more than 1,200 chemical and drugs products used for shrimp farmed activities. Among those products, only 50% is legalized about the quality by Department of Agricultural and Rural Development.

❖ **Seed suppliers**

Ca Mau province has more than 850 hatcheries with the total produced quantity about 9 billion postlarvae per year. However, there are 80% of those hatcheries are small-scale, resulting of challenges to monitor the operation of those suppliers. Three main seed production areas in Ca Mau province are Dam Doi, Ngoc Hien and Nam Can districts.

Table 3.7. Supply and demand for seed of farmed shrimp in Ca Mau Province calculated from the statistical data of Provincial DOF, Ca Mau province 2018

Unit: million postlarvae

Seed origins	2013	2014	2015	2016
Provincial producers	8,500	7,277	8,355	8,016
P. monodon	*8,500*	*7,223*	*7,830*	*7,643*
L. vannamei		*54*	*525*	*373*
Imported from other provinces	13,000	13,905	14,093	13,288
P. monodon	*10,000*	*8,134*	*8,927*	*8,775*
L. vannamei	*3,000*	*5,771*	*5,165*	*4,513*
Total demand	21,500	21,182	22,448	21,304
Total imported from other provinces/ Total demand (%)	60.47	65.65	62.78	62.37

The produced quantity only supplies 40% of total demand for seed quantity in shrimp farmed activities with the main species is *P. monodon* shrimp. The rest of 60% demand for

seed is still imported from other provinces and foreign countries, resulting of the difficulty in the monitoring of seed quality of Ca Mau Provincial DOF.

❖ **Middlemen**

Similar as the current situation of the VMD, shrimp collectors in Ca Mau province are the distributors of farmed shrimp products from extensive farms to processing companies. About 1,000-2,000 collectors are operating in whole province. However, the number of collectors may not be exactly calculated because those collectors are freely operating without business registration. The operation of those collectors is out of the monitoring of Province Government in Ca Mau province (Provincial DOF in Ca Mau, 2017).

There are about 350 brokers and traders are operating as the intermediates to provide shrimp farming inputs to processing companies. They are required to register their business operation at District Local Government where their business is located. Therefore, the Provincial DOF and Local Government may able to monitor the operation of brokers and traders. The shrimp brokers might buy shrimp farming inputs from both collectors and shrimp farmers.

❖ **Processors and exporters**

There are more than 32 processing companies and seafood factories are operating in Ca Mau province (DOF Ca Mau, 2017), who may process more than 250 thousand tons farming shrimp inputs per year (Table 3.8). More than 95% of those companies and factories applied the international quality assurances certificates, such as SA-8000, ISO 26000, ISO-9001, HACCP, BAP, etc. to meet the requirements of their customers in importing markets. They also invested to the internal traceability systems to manage the farming shrimp inputs and output shrimp products at their companies. Those systems may help for processing companies to provide information to the global customers.

Table 3.8. Processing quantity and value of shrimp products in Ca Mau province calculated from the statistical data of Provincial DOF and Ca Mau Association of Seafood Exporting and Processing (CASEP), Ca Mau province 2018

Category	Unit	2013	2014	2015	2016
Processed quantity	Tons per year	72,623	98,132	82,280	76,567
Value added products	*Tons* per year	*33,311*	*50,046*	*45,799*	*45,208*
Processed value	Million USD	1,043	1,285	1,000	980
Value added products	*Million USD*	*468*	*626*	*510*	*529*

3.3.2.3 Market

Processed shrimp products are provided to both domestic and exporting markets. However, Vietnamese consumers almost prefer to consume the fresh shrimp, instead of processed shrimp (CASEP Ca Mau, 2017). Therefore, there is only 10% of total processed shrimp quantity is providing to domestic consumers by local restaurants and supermarkets, indicating about 90% of total processed shrimp products from processing companies is exported.

The shrimp products of Ca Mau province are exported to more than 90 countries. The main exported markets of farmed shrimp in Ca Mau province are the US, Japan, EU and China with more than 60% of total exported value.

As the whole country in Vietnam and the VMD, to meet the requirements of global customers, traceability implementation was included in the quality assurance application such as GlobalGAP, Naturland, BAP, ASC, Selva Shrimp and VietGAP, etc. Depending on the target's markets in global market, the processing companies decided the specific certificates to apply. However, the most difficulty of the implementation of Circular 03 in Ca Mau province to ensure for the traceability rule "one step backward"-"one step forward" along supply chain is impossible because the small-scale production at farms level, together with the out of monitoring of collector's operation. It led to the difficulty in recording, keeping and moving of information along supply chain.

3.3.2.4. Quality assurances, safety and traceability issues of shrimp cultured production in Ca Mau province

As the information of Provincial DOF Ca Mau, only 6.8% of shrimp farms were certified the quality assurance certificates in 2017s, supplying about 14,000 tons of farming input per year with 4,200 shrimp farms. The details about the applied production area and number of shrimp farms are presented in Table 3.9.

The Provincial Government in Ca Mau has forced to enhance the establishment of the direct linkage between farmers and processing companies by supports to establish the Farmed Shrimp Cooperatives. The purposes of those Cooperatives are to reduce the reflecting of middlemen, such as collectors and brokers/traders in supply chain, and to trace and track the origin of farmed shrimp products from farms to processing companies. Accordingly, the members of Cooperatives are supported the working capital from other participated members and from Provincial DOF in Ca Mau province.

Besides capital, all members of Cooperative are trained about the advance technique for shrimp farmed culture with the guidance of Ca Mau DOF's staffs. Besides that, Ca Mau Provincial DOF also established the satellite staff's networks to support for those shrimp farmers when the disease occurs. On the other hand, Provincial DOF contacted to the shrimp processors to encourage the contracted agreements with those Cooperatives. Under the contracted agreements, shrimp farmers of Cooperatives may receive the sponsor the inputs such as feed, seed, chemical and drugs from processing companies, and may be ensured the price of shrimp products. Moreover, shrimp processing companies may sponsor for the costs to apply the international quality assurance certificates to respond the requirements of imported markets.

The shrimp farms members elected cooperative's committee. Committee's responsibilities are to monitor the operation of Cooperatives, including capital mobilization, negotiation with suppliers about input price and quality and coordination with Local Authorities about the training courses and offering for the subsidies and low-interest loans. All members have co-responsibilities for the loans from Government. If any member of Cooperatives is bankruptcy, other members have to pay for this payment.

One of Cooperatives was established under this activity is Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam. In 2017, Cooperative of Cai Bat, with the sponsor of Ca Mau DOF, signed the contract with X Company[3] to apply for ASC certificates with total 57 participated farmers. In ASC application progress, all farmers are required to follow the requirements of ASC standards, including production process, input uses, pond systems, water treatment and information recording and keeping, ensuring the traceability rule "one step backward"-"one step forward" of ASC certificates under the monitoring of Cooperative's Committee. This requirement of ASC standards is suggesting an advantage of traceability implementation for shrimp products. Similar as the whole country and the VMD, the small-scale shrimp farmers, by themselves, could not pay for the application of separated traceability systems. The establishment of Cooperative of Cai Bat to apply for ASC certificates might be an alternative for traceability implementation for shrimp products. In the following part of this study, Cooperative of Cai Bat was selected as the treatment case to achieve the purposive study.

Table 3.9. Application for international quality assurance certificates at shrimp farms in Ca Mau province, calculated from the data of Provincial DOF Ca Mau province 2017

Category	Total shrimp cultured production	International QA* application		Non-QA*
		Other certificates	ASC**	
Production area (hectare)	280,849	18,897	200	260,849
Numbers of shrimp farms	62,000	4,143	57	57,800

Note: *QA is abbreviation of "Quality assurance certificate"; **ASC certificate was only applied in Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province in 2017.

❖ The ASC application procedures in Cooperative of Cai Bat, Cai Nuoc district, Ca Mau province

✓ *The introduction of ASC standard's principles for shrimp products*

ASC was found by WWF and IDH (Dutch Sustainable Trade Initiative) in 2010. It is an independent and non-profit organization. ASC standards was developed with the compliance with International Social and Environmental Accreditation and Labelling (ISEAL) and United Nation Food and Agriculture Organization guidelines about the Environmental and Social Standards. The main bodies of ASC are to focus on the minimizing the environmental impacts of aquaculture activities, the commitment to customers about the responsibility of producers for quality of certified products and the rights of workers.

ASC certificates is issued based on the evaluation of fully independent Third-Party audits (Certifiers), namely Accreditation Services International GmbH (ASI) to determine the eligibility to sell certified product into a recognized chain of custody, and be allowed for carrying of ASC logo for seafood products. ASC, therefore, is a reliable certification for aquaculture products. Aside HACCP and Global GAP certificates, ASC was accepted, and became mandatory requirements of importers in various global markets such as the US, EU, Japan and other markets.

[3] The name of contracted processor was hidden as they required.

To apply for ASC certificates, farmers need to registration, and pass the assessment procedures of certifiers to get the official certificates. The principles of ASC standards for shrimp products were included in ASC shrimp standard V1.0, issued in March 2014 as presented in follows.

- Principle 1: Certified shrimp farms are legally contributed. Accordingly, farmers must follow the national and local laws and regulations in which their operation takes place. This principle aims to ensure the starting point of certified shrimp farms under the compliance of the legislative national and local laws' systems and regulations of the country where their farms are located.

- Principle 2: ASC standards also focus on the biological diversity and preservation of healthy ecosystems. This principle regulated that, the operations of shrimp farms have to be conjointly considered with the conservation biodiversity and important natural ecosystems. In Vietnam, certified farms are required to registration to assess the impacts of farms activities to environmental and ecosystems of the region where farms are located. Especially, shrimp farms sited in mangrove ecosystems cannot be awarded ASC certificates if they were established after May 1999. Farms were established from May 1999 and before can be issued ASC certificates. However, they have to ensure their social responsibility by growing mangrove in restoration mangrove areas equal to 50% of total farm areas under the monitoring of local authorities.

- Principle 3: Farms have to be developed with the consideration for social communities. The operations of shrimp farms must be based the assessments of social impacts to avoid the negative impacts on local communities, such as reducing in using of public land, water resources or threatening livelihoods. Farms are also required to verify a conflict policy for local community.

- Principle 4. Farms operate with the considerations of responsible practices for labors. This principle aims to ensure the right of labors who are working at shrimp farms based on the core principles of the International Labor Organization (ILO). Accordingly, farms are not be allowed to hire workers who are under 18 years old. Besides, labors have the right to receive the full salary and benefits, including work environment health and safety conditions, as the contract agreement. Moreover, labors are also ensured to have a freedom of movement outside after working hours.

- Principle 5: ASC certified shrimp have to be cultured with a responsible manner about health and welfare. Farms have to address an operational health plan to prevent disease, including bound for spreading of pathogens within farms to monitor emerging of pathogens and to avoid cross contamination. In more details, certified farms are required to control the inputs (e.g. water sources, feed and post larvae), minimize the entry of intermediately pathogenic agent (e.g. animals, crabs, etc.) into farms and create a good environmental condition (e.g. pond treatment and adequate feed).

- Principle 6: Beside health and welfare of cultured shrimp, the origins of broodstock are also regulated in ASC standards. Farms are required to keep and able to show the logbook with including of sowing date information. Management of escaped shrimp from farms to

wild environment are also considered to avoid the transfer exotic pathogens and establishment of non-native populations in areas where escaped shrimps are being farmed. Moreover, farmers must provide certificates to prove that they are professionally trained in shrimp farmed knowledge.

- Principle 7: The last principle indicates the requirements of resources using in an environmentally efficient and responsible manner, including feed, land, water, energy and etc. to improve the overall efficiency of production systems and reduce the wastes.

In addition, ASC-certified shrimp farms are required to have the contracted agreements to sell the harvested shrimp with a shrimp processing company which legislatively operate under the national laws of the country where their business takes place. Besides that, the certified ASC farms are also required the recording and keeping all information of production progress to assist for tracking of the origins of shrimp products in case of food incidents occurs, aside the above principles. All recorded information has to provide to the contracted processors at the harvested date, together with the shrimp products. This requirement aims to ensure the information of shrimp products are "one step backward"-"one step forward" traced from shrimp farmers to the shrimp processors. The recording and keeping of the information are one of the compulsory assessment's scale to be awarded the certificates.

Hence, the certified ASC shrimp products with the attached logos of ASC are considered as the notification for shrimp consumers in the product's quality, safety and the responsibility of shrimp producers in the environmental and social welfare issues. The requirements of information's recording and keeping include in the ASC standards are estimated to support for the implementation of traceability for shrimp products from farms to processing.

Notably, to be awarded ASC certificates, shrimp farmers must pass all of assessment procedures of ASC's certifiers based on the above principles. On the other hand, to apply for ASC certificates, shrimp farmers need to pay for the application costs, including registration and audits fees at 150 million VND ($\sim 6{,}667$ USD[4]).

Moreover, to prepare for the application for ASC certificates, shrimp farmers need to prepare and invest the infrastructures to respond all of above principles of ASC standards such as the separated electricity and water systems for shrimp farmed activities to ensure that activities have not reflected to the daily life of locally social communities. On the other hand, to meet the requirements of ASC standards on the environmental considerations, shrimp farmers need to invest to the pond treatment and waste management, etc. to ensure the manner operation of shrimp farms have not negatively impacted to the natural environments and ecosystems and to prevent shrimp' health from the diseases. To respond to the principles on social welfare, such as the labor's right, shrimp farmers also need to spend the payments for labor's instrument and insurances for hired labors, etc. As we already discussed, in whole, shrimp farms in Vietnam are mostly limited in the production scale and

[4] The exchange rate is USD/VND=22,500, based on the statistical data of Vietnam State Bank during our conducted survey in Mekong Delta, from June 10th to July 10th, 2017 (the details about the survey were presented in Chapter 4).

lack capital. They tend to utilize their own resources such as land and labor to operate shrimp farms. The family labors at shrimp farms therefore, may be under 18 years old and have no any insurances as well as the labor protection's instruments. Therefore, under ASC application procedures, shrimp farmers may be lack labors and need to invest to those infrastructures.

The application costs and the investments of the above infrastructures became the barriers for shrimp farmers to apply for ASC certificates. This is because shrimp farmers do not have enough capacity to pay for those costs. As a consequence, they operate their shrimp farms without the application for ASC certificates as well as other quality assurances certificates.

- ✓ ***Application for ASC certificates at Cooperative of Cai Bat***

For application of ASC certificates, shrimp farmers of Cooperative of Cai Bat have received a low-interest loan with 17,778 USD[5] from Ca Mau Government to cover ASC certificate application and registration fees, investment of infrastructures and working capital addition. The sponsors from processing company aim to invest pond (cultured, filter and sedimentation), infrastructure, labors safety and waste reservoir systems. Shrimp farmers of Cooperative are also compensated from X Company for the seed costs (< 45 days from stocking date[6]) due to the damages from climate.

The farmers participated to Cooperative of Cai Bat are required to record the information, and follow the specific treatment of quality products as requirements of ASC certificates. At harvest date, all recording documents have to be provided to X Company, who signed the contracted agreement with Cooperative of Cai Bat to keep and record to their internal traceability systems.

To control the quality and origins of input uses at shrimp farms, X Company also specified the input suppliers to the shrimp farmers of Cooperative. All members of Cooperative, therefore, used the same input origins. X Company negotiated to the input suppliers to give the free credit of the input payment to shrimp farmers. It means that, shrimp farmers did not need to pay for the input used at the transaction date of inputs. Instead of that, those payments would be paid to the input suppliers at the harvested date of shrimp products. For farmers, this commercial loan supported for the limitation in capital to extend and maintain their farms.

All harvested shrimp of Cooperative members is required to sell to X Company. The price is based on both, farm-gate price in market at harvested date and negotiation with Cooperative's committee. Besides that, X Company committed about the price premium for

[5] The total loan was 400 million Vietnamese Dong (VND). The exchange rate is USD/VND = 22.500 (Vietnam State Bank). Hence, in USD, total loan was 17,778 USD and was divided for all members of Cooperative (57 farms) with the cost of capital was 4 percent per year,

[6] As the explanation of Cooperative's committee, within 45 days from stocking date, the survival rate of post larvae was mostly reflected by climate uncertainty. Therefore, to support for shrimp farmers, the Cooperative's committee negotiated this compensation from X Company.

farms of Cooperative after ASC certificate is officially awarded in 2018[7]. Following their commitment, shrimp farmers of Cooperative can receive additional premium as 0.22 USD per kg, comparing to the former products without ASC certificates.

The sponsorship is supported to shrimp farmers to apply for ASC standards. However, ASC certificates have to be re-registered every 3 years, the fees for the maintaining and monitoring of ASC certificates are estimated from 2017 to 2023. All payments to maintain the ASC certificates are assumed that farmers will pay by themselves. This is because during the survey, the costs to maintain and re-register for ASC certificates had not been mentioned in the contract agreements between Cooperative and X Company yet. The Committee of Cai Bat Cooperative had to negotiate to X Company after ASC certificates had been awarded in 2018 or apply for other sources of sponsorship. The detail about the application and maintaining costs for ASC certificates at Cooperative of Cai Bat in Cai Nuoc district will be presented in Chapter 6.

3.4 Conclusion

The contents of this Chapter included two main parts, utilized to introduction the background of Vietnamese shrimp industry in the main production areas, VMD for the whole and Ca Mau provinces as well as the geography characteristics and social economics conditions of that areas. From the results of this Chapter, we concluded that, the VMD is the largest areas of shrimp production in the whole of Vietnam. Among VMD, Ca Mau province is the most important role for shrimp cultured activity for both production area and quantity area. On the other hand, the features of shrimp production industry in Ca Mau province have the similar characteristics of the whole country of Vietnam and the VMD, suggesting that the conducting survey in Ca Mau province may be utilized to represent for the whole VMD. The results of this Chapter are useful to apply for the description of the study areas designs in the Chapter 4, and the discussion in the later Chapters of the study so far.

[7] During the survey, Cooperative of Cai Bat was under ASC application progress. All members changed the cultured systems and technology to adopt ASC requirements. Cai Bat Cooperative was in the revision progress as the guidance of ASC certifiers. The certificate is officially awarded in the early of 2018.

Chapter 4. Study design and data collection along Vietnamese shrimp supply chain: evidences from Ca Mau province, Mekong Delta, Vietnam

4.1 Introduction

In the previous Chapter, the Vietnamese shrimp production in the VMD and Ca Mau province were reviewed. Based on this background, the rest parts of this thesis would be developed by construction of case study for empirical evidences on the topic. The case study of Ca Mau province was referred to the contribution of tentative study areas into the development of traceability for shrimp industry in the VMD.

In this Chapter, Section 4.2 presented the materials and methods for conducting the survey along shrimp supply chain. Section 4.3 described the characteristics of collected sample and its associated sub-samples. Section 4.4 was used to discuss the process for data collection and the use of data in the next Chapters.

Notice that these collected data are field data only for Chapter 5, 6, 7, 8 and 9. Others needed data were mentioned in detail in the related Chapters.

4.2 Materials and methods for conducting the survey along shrimp supply chain

4.2.1 Interview survey

The prioritized study's purpose was focused on the implementation of traceability along shrimp supply chain based on the point of entry of each agent. The interview survey was conducted to collect the information of the agents of shrimp supply chain, including shrimp farmers, middlemen (i.e. shrimp collectors, brokers and traders' companies and pre-processing companies), processors and exporters with the evidences from Ca Mau province, Mekong Delta, Vietnam.

Before the interview survey started, we did the interview with the Provincial DOF's staffs, who were monitoring the shrimp cultured activities in Mekong Delta, Vietnam to obtain the background of Vietnamese shrimp industry of the whole VN and VMD, and the traceability requirements of global market for Vietnamese shrimp products. Besides that, we also interviewed 2 specialists in shrimp cultured production, working for Fisheries and Aquaculture Research Institutions in Vietnam to obtain the current situation and the challenges of traceability implementation for shrimp products in Mekong Delta, Vietnam. The draft of questionnaires for the mass survey along shrimp supply chain, then, were designed.

The interview survey was conducted from June 10th to July 27th, 2017 in Cai Nuoc district, Phu Tan district and Ca Mau city. The ASC certificates were empirically applied at Cooperative of Cai Bat in Cai Nuoc district. Therefore, Cai Nuoc district was the target's study area to obtain the information of shrimp agents under ASC application. To compare to the shrimp products without ASC application ASC, Phu Tan district and Ca Mau city were chosen based on the supports of Provincial Department of Fisheries, Provincial Department of Agriculture-Forestry-Fisheries Quality Assurance (NAFIQAD) in Ca Mau. Phu Tan district and Ca Mau city are the frontier districts with Cai Nuoc district in Ca Mau province. Therefore, the

geographical features of those areas are not very different. The sampling conducted in those areas might reduce the bias due to the affecting of natural as well as social conditions.

For shrimp farmers, the mass interview survey by structure questionnaires was conducted. For other agents along supply chain (i.e. collectors, brokers, traders' companies, pre-processing companies and processors), the information were obtained by the in-depth interviews.

❖ **For shrimp farmers**

The interview survey was carried out with the supports of 7 students of College of Economics, Can Tho University. Before that, all students are trained how to do the interview in one week. After training, we did the pre-test survey for 10 shrimp farmers in Ca Mau province to practice and correct the questionnaires. The detail procedures were presented as follows.

For ASC farms, the survey were conducted at Cooperative of Cai Bat in Cai Nuoc district based on the supports of Cooperative's Committee.

For shrimp farmers without ASC certificates, the target shrimp farms for both *P. monodon* and *L. vannamei* shrimp were randomly conducted from the introduced lists of DOF Ca Mau without separated scale and cultured methods. Based on the introduced list, we chose with the step of five shrimp farms for once targeted farm. In survey progress, the cases of targeted farmers' absences were skipped to change to the next farms in the targeted list. We did the survey in Phu Tan district and Ca Mau city from June 10th, 2017 to July 10th, 2017 as the permission of district's local authorities. In Cai Nuoc district, the survey was conducted under the local government permission from July 15th, 2017 to July 27th, 2017. Besides the farmers who are applying ASC in Cooperative of Cai Bat, the target non-ASC shrimp farms (both *P. monodon* and *L. vannamei* shrimp) were randomly conducted from the introduced lists of DOF Ca Mau without separated scale and cultured methods. Based on the introduced list, we chose with the step of five shrimp farms for once targeted farm. In survey progress, the cases of targeted farmers' absences were skipped to change to the next farms in the targeted list.

Total 114 shrimp farmers were separated to 32 and 82 farmers with and without Aquaculture Stewardship Council (ASC) application, respectively. The structure of sampling was presented in Appendix 4.1.

Each group of farmers was interviewed by using several separated parts of a single questionnaire. In whole, the first part was the social-economic characteristics of respondents. The second was the farming performance and productivity to calculate the production cost, revenue and profit of shrimp farms. The third part included two sub-section: (i) the management of information at shrimp farms and (ii) the changes of farms activities and farms' productivity after application for ASC certificates. The (ii) sub-section of the third part was only asked for group of farmers' applications for ASC certificates. The fourth part was focused on the perception, awareness and the willingness to implement for traceability systems of shrimp farmers. Due to the length of questionnaires and the information had to be detailed,

it took one half hours for each respondent. The structure of questionnaire was described in Figure 4.1.

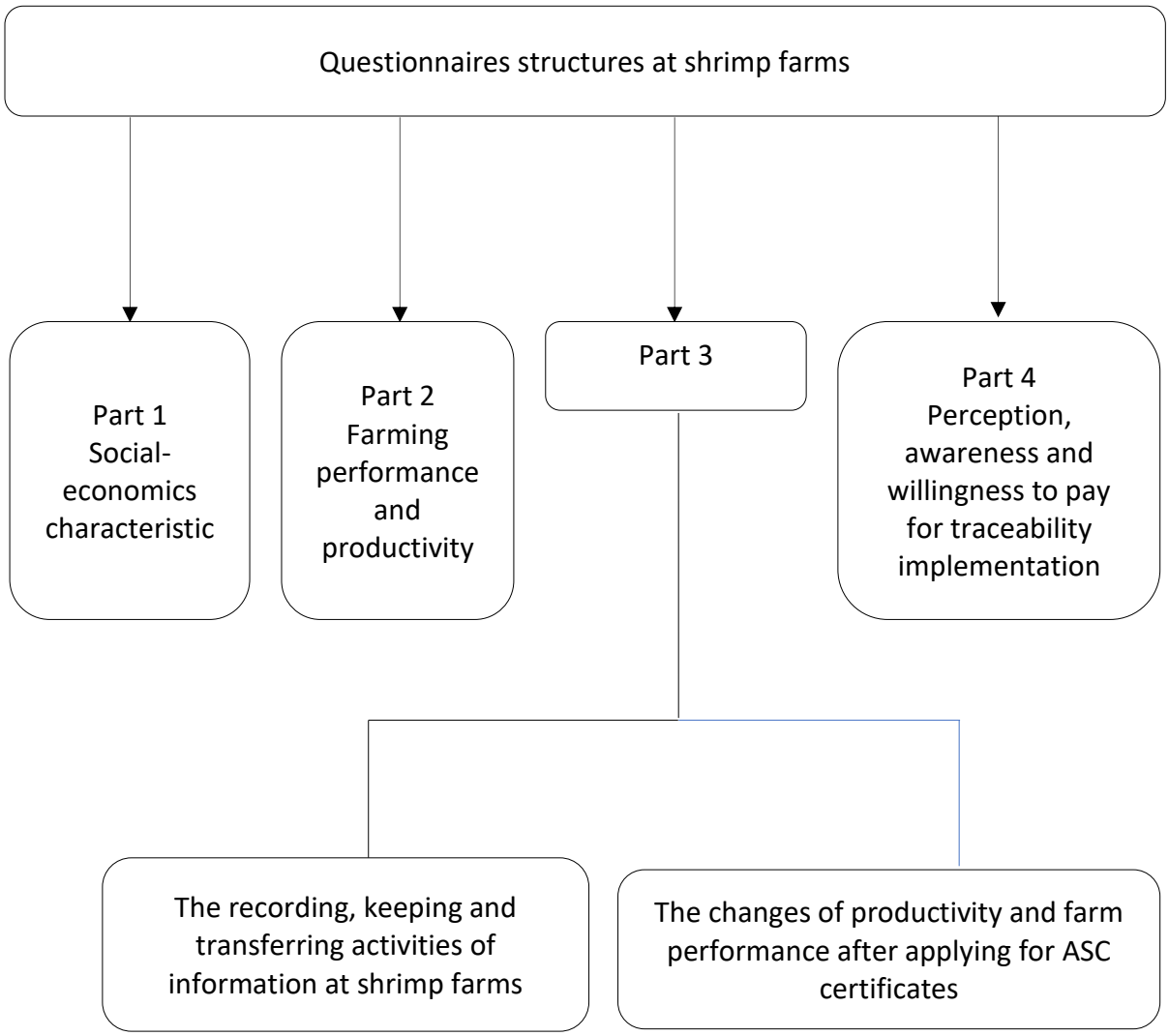


Figure 4.1. The structure of questionnaire. Note: The blue lines indicated for the parts of questionnaires were only asked for the ASC shrimp farmers.

We used the information in the first part to demography the survey sample. On the other hand, the social economics characteristic could be the important influencing determinants to their farm decisions, costs, benefits and profits, which related to the evaluation in later parts of this thesis.

To identify the differences in distribution products' flows and movement of information along shrimp supply chain in terms of traceability, we used the conducted information of the second and the third parts to compare the differences in the products flows of shrimp products provided by two groups of shrimp farmers, with and without ASC application. The movement of information for shrimp products along supply chain was also compared to identify the differences in the information flows between differences distribution shrimp products' flows.

The achieved information in second and third parts were to conduct cost-benefit analysis of the influencing of traceability to shrimp supply chain in terms of traceability. In the second part, the information regarding the farm productivity such as input used quantity, price and output quantity and price and the distribution flows of shrimp products were concentrated to conduct to be able for the calculation of farms' productivity in the later of the thesis. In the third part, the management of information activities, such as recording and keeping information as well as the contents of recorded information at shrimp farms were considered in order to obtain the movement of information from shrimp farms to other agents along supply chain.

The latest part aimed to collect the perception and awareness about traceability, the willingness to implement for traceability and the expected price for shrimp products in terms of traceability implementation of shrimp farmers. The procedures to collect the information were described as follows.

- ✓ **To conduct the perception and awareness about traceability of shrimp farmers**

The procedures to investigate the perception and awareness of shrimp farmers about traceability were described in the Figure 4.2. During the interview of the experts in shrimp production in the VMD, we found the perception about traceability was one of the influencing factors to the willingness to implement traceability of the farmers. In our survey, we defined the shrimp farmers, who might answer the correct answer about traceability as "the tool to trace the information of shrimp products" based on their own-understanding, have awarded about the traceability system. The conducting procedures of the perception and awareness about traceability were presented in Figure 4.2.

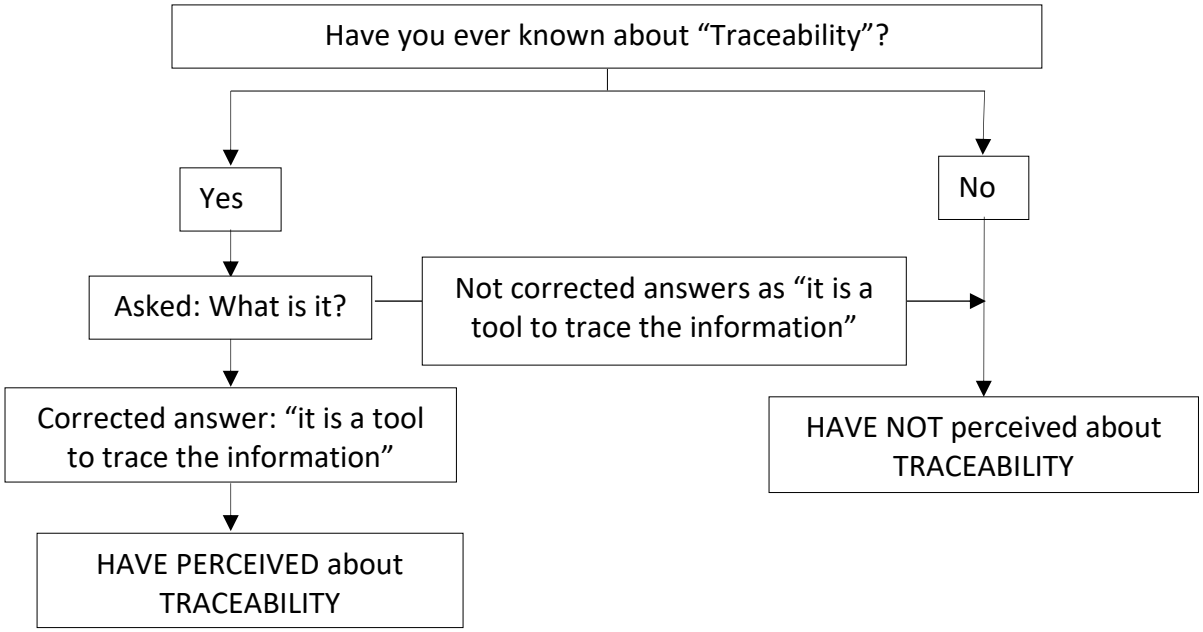


Figure 4.2. Conducting procedures of the perception and awareness about traceability

✓ **To conduct the willingness to implement (WTI) the traceability of shrimp farmers**

The procedures to obtain the WTI of shrimp farmers were described in the Figure 4.3. As our experiences in the pre-test survey, the decision to implement the traceability of shrimp farmers might be changed before and after we explained about traceability. Therefore, in the interview survey we double-asked for shrimp farmers the same question to confirm the WTI traceability for their farms, before and after our explanation about traceability systems. The explanation about traceability implementation at shrimp farms was focused on the recording, keeping and transfer the information activities of shrimp farmers. The potential benefits and costs of those activities also clearly explained.

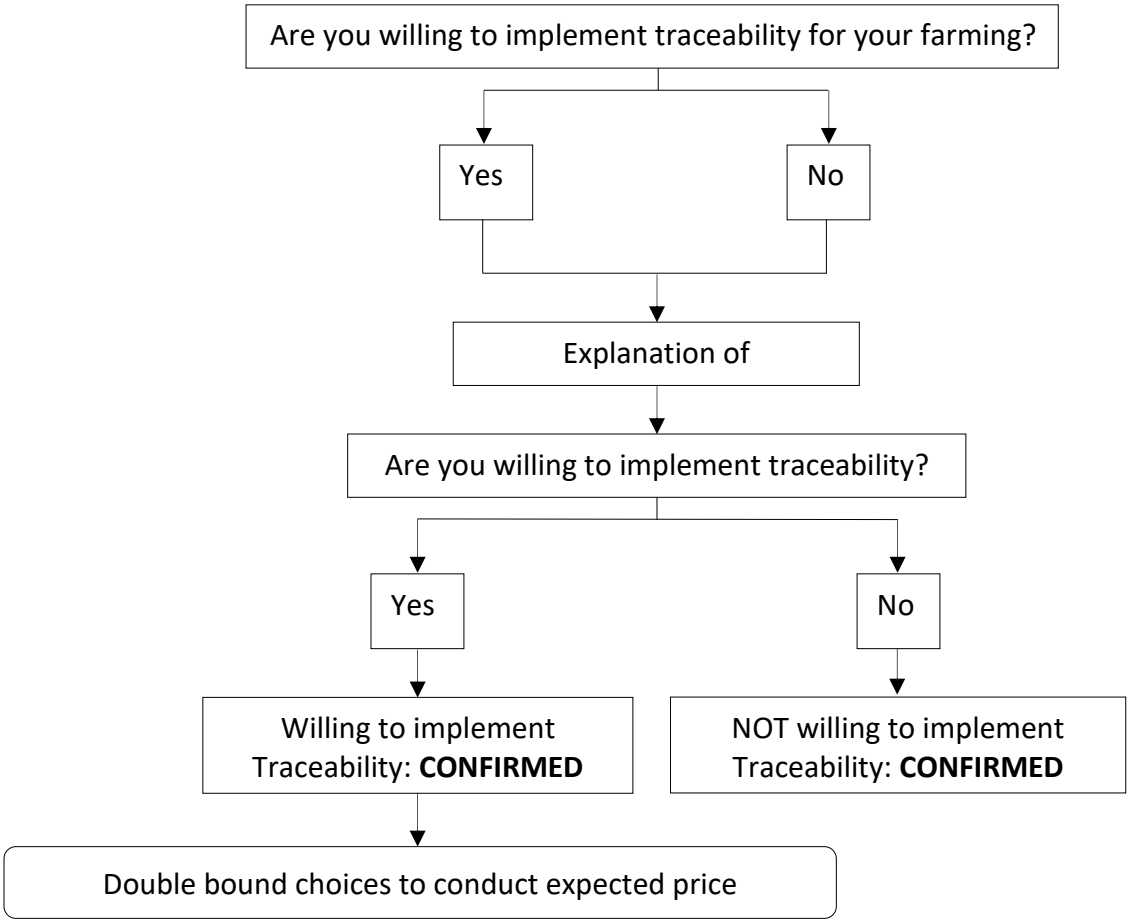


Figure 4.3. Conducting procedures of the willingness to implement traceability of shrimp farmers

The shrimp farmers who answered he/she will implement traceability in both questions is defined as the one is WTI traceability. Otherwise, we did not confirm their WTI for traceability. The shrimp farmers, who were WTI the traceability, were continuously asked for the expected price for shrimp products in terms of traceability application by double bound choices question.

✓ **To conduct the expected price for shrimp products in terms of traceability of shrimp farmers**

The procedures to conduct the expected price for shrimp products in terms of traceability of farmers by double bound choices question were presented in Figure 4.4.

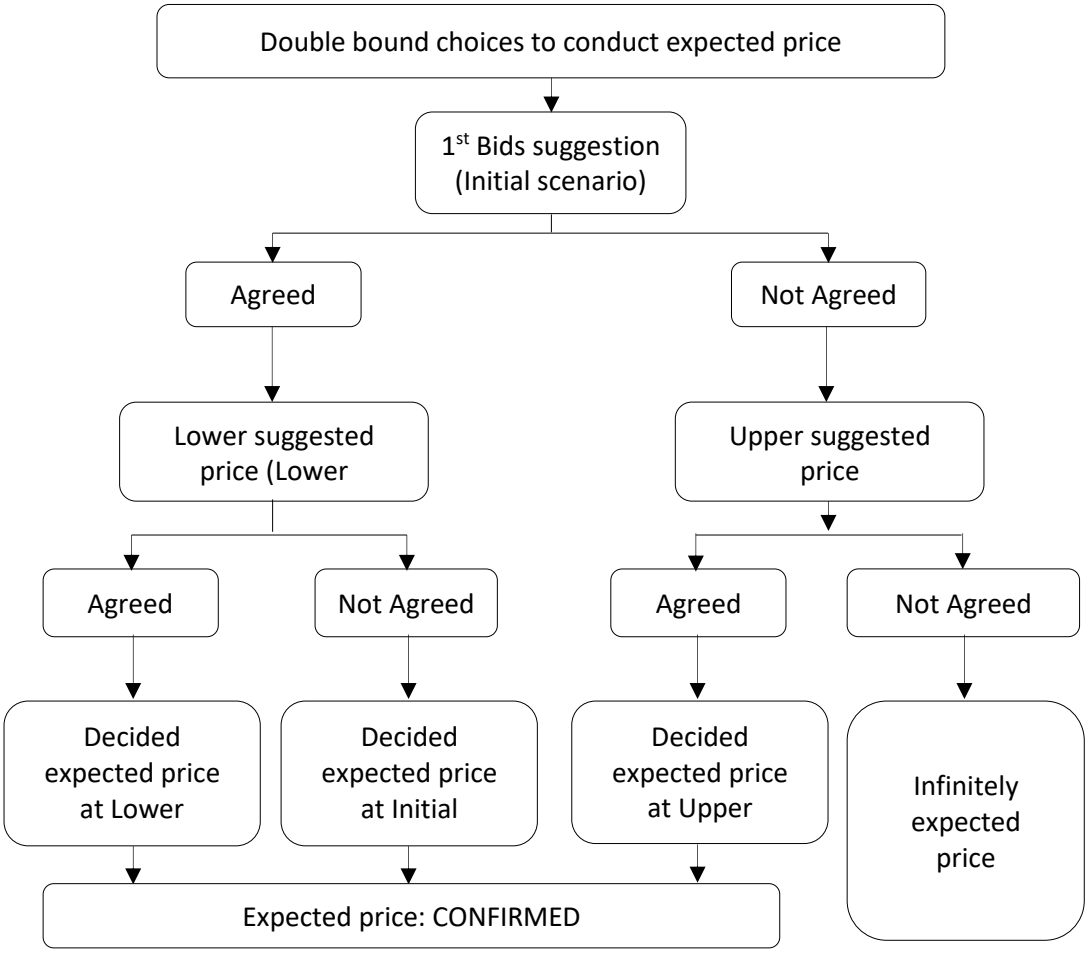


Figure 4.4. The conducting procedures of the expected price for shrimp products of shrimp farmers

To conduct the answers of this question, five double-bound choices scenarios were designed in questionnaires, which were separated by shrimp species (*P. monodon* and *L. vannamei*). Each farmer was randomly asked one of five scenarios to decide the expected price for shrimp products in terms of traceability. The first bid (initial) price scenarios was designed based on the daily reported farm-gate price of Provincial DOF in Ca Mau province and CASEP, together with the consultation of Ca Mau DOF' staffs (Table 4.1).

Table 4.1 The designs of price scenarios in questionnaires

Unit: USD per kg

P. monodon shrimp			*L. vannamei* shrimp		
1st bid	Down	Upper	1st bid	Down	Upper
5.33	4.44	6.22	3.56	3.11	4.00
6.67	5.56	7.78	4.44	3.78	5.11
8.44	7.11	9.78	5.78	4.89	6.67
10.67	8.89	12.44	7.56	6.44	8.67
13.33	11.11	15.56	9.78	8.44	11.11

Note: The exchange rate was USD/VND= 22.500 based on the statistical data of Vietnam State Bank.

In the survey, if the farmers agreed with the 1st bid (initial), the second bid was reducing to the lower price (down price) than the 1st bid. Otherwise, the price of second bid price was higher (upper) scenario. Table 4.2 described for the conceptual to decide what the expected price for shrimp products of shrimp farmers was in our survey.

Table 4.2 The conceptual decision making of expected price for shrimp products of shrimp farmers based on the double bound choices survey

Procedures	1st Bid	(Up)	(Down)	Combine	Expected price
5 random	Y		Y	YY	Down
scenarios of bid	Y		N	YN	1st Bid
	N	Y		NY	(Up)
	N	N		NN	Not confirmed

The last question of the questionnaire was to get others opinion from shrimp farmers (if any).

❖ **For other agents in shrimp supply chain**

Based on the addresses of interviewed shrimp farmers and the point of entry along supply chain of other agents, the rests of field survey focused on the conduction of information of collectors, brokers, traders' companies and processors.

✓ **Collectors** were connected through phone numbers provided by farmers to ask for the interview. The interviews included fourth parts. The first part was general operation information such as capital, infrastructures, operating organization and business experiences). The second part indicated about how to manage the input, including price, quantity, quality, origin and information of buyers. The next part belonged to output management, including the price, quantity, quality, the information of customers; the output quality requirements from buyers, how to response these requirements. The last part contented the traceability issues, including perception, implementation, challenges, and the requirements of customers.

✓ **Brokers and traders/pre-processing companies and processors** were contacted based on the indicated information from shrimp collectors. DOF Ca Mau and NAFIDA Ca Mau,

then, confirmed the list of brokers, traders/pre-processing companies and processors. After that, Provincial Ca Mau DOF and NAFIQDA supported for the contacting to those agents.

Total 5 brokers, 3 traders/pre-processing companies and 6 processors were contacted. However, we could not have the collaboration from all of them. Finally, only 2 processors, 1 broker and 2 traders/pre-processing companies were visited. The conducted information included the general information of company, how to manage the input quality and original, the information of input suppliers, input quantity and price, output quantity and price, the information of buyers; what requirements from buyers, how to adapt these requirements, how to manage the output quality, how to implement and manage the traceability system. The interview contents also included 4 parts by in-depth communication with the owners or the managers, who directly managed for the products quality controlling and traceability application in the companies.

4.2.2 Sample and sub-sample characteristics

4.2.2.1 For shrimp farms

Total 114 shrimp farms are visited[8]. We separated the farms by kind of cultured shrimp as in Table 4.3. There were 71 (62.3%) *P. monodon* shrimp farms and 43 (37.8%) *L. vannamei* shrimp farms included in the 114 samples. In terms of ASC application, there were 32 (28.1%) of shrimp farms in samples were applying for that certificates for both *P. monodon* and *L. vannamei* shrimp species.

Corresponded to the previous scholar of Tran *et al*. (2013), found results of current study indicated that, extensive and intensive systems were the main cultured methods of shrimp farmers. Total 48 (42.1%) farms were under extensive system. The rest of samples, 57 farms (approximate 58% of total samples) was intensive farms. The differences in cultured methods between *P. monodon* and *L. vannamei* shrimp species. While as almost extensive farms of our sampling were *P. monodon* farms (44 farms of 48 samples, approximately 91.7%), intensive system was chosen by *L. vannamei* shrimp farms (39 farms, about 68.42%)[9].

For *P. monodon* shrimp, total 55 (77.5%) farms of 71 samples were individual farms. The shrimp farmers of those farms did not participate to cooperatives and/or farmers' organizations. The results also represented that, 61 (85.9%) of 71 samples farms did not sign the contracted agreement with the shrimp buyers. For recording and keeping information indicators, a similar result was indicated since 57 (80.3%) farmers of 71 samples were found that they did not record any information in production progress. In our sampling, there were only 9 (12.7%) farms of total 71 samples in the sampling under application for ASC certificates.

[8] The details of sample's structures were presented in Appendix 4.1,

[9] The characteristics of extensive and intensive systems in the VMD were presented in Chapter 3.

Table 4.3 Sampling characteristics summarized from interview survey 2017

Category		Whole sampling			*P. monodon* shrimp			*L. vannamei* shrimp		
		Total (N=114)	With ASC (N=32)	No ASC (N=82)	Total (N=71)	With ASC (N=9)	No ASC (N=62)	Total (N=43)	ASC (N=23)	No ASC (N=20)
Cooperative's member	No	73	0	73	55	0	55	18	0	18
	Yes	41	32	9	16	9	7	25	23	2
Contracted agreement	No	80	0	80	61	0	61	19	0	19
	Yes	34	32	2	10	9	1	24	23	1
Recording and keeping information	No	74	2	72	57	0	57	17	2	15
	Yes	40	30	10	14	9	5	26	21	5
Cultured Method	Extensive	48	8	40	44	5	39	4	3	1
	Intensive	66	24	42	27	4	23	39	20	19

The limitation of production scale might affect to the participants to cooperatives of shrimp farmers. From our survey, *P. monodon* farmers did not perceive the role of cooperatives because they did not need to invest more capital and high technology, especially extensive farms. They only used family labor and the output shrimp was daily harvested. The harvested quantity was from 0 to 20 kg per day. It also results of lacking concentration to sign the contracted agreement with shrimp buyers and information recording about the production progress.

For *L. vannamei* shrimp farms, there were 23 (53.5%) farms of total 43 samples in our sampling were applying ASC certificates. All those farmers were even the members of Cooperative of Cai Bat. There were total 39 (90.5%) farmers of 43 samples were chosen the intensive systems for their farms. This could be explained because the *L. vannamei* shrimp species are mostly cultured under intensive systems method (as introduced in Chapter 3). Thus, our sampling was concordant with the background of shrimp production in the VMD and Ca Mau province.

To apply ASC certificates, the mandatory requirements were the information recording of the cultured progress at shrimp farms. Besides that, shrimp farmers, who were applying the ASC standards, participated to Cooperative of Cai Bat to allocate the application costs and to get the sponsors from both, Ca Mau Government and processing companies. Our sampling included 26 samples (58.1%) of total 43 *L. vannamei* samples, participated to Shrimp Farm Cooperatives. Among of those samples, there was 23 samples were applying for ASC certificates.

The situation was homogenous for the contracted agreement and recorded information indicators. Total 24 (55.8%) and 26 (60.5%) samples of total 43 *L. vannamei* farms in the sampling contracted the agreements to processing companies, and recorded the information progress, respectively. All samples under ASC application progress were found that they signed the contracted agreement, and recorded of information.

❖ **Statistics of sub-sampling characteristics**

The statistics of sampling characteristics were described in Table 4.4. We also compared by *P. monodon* and *L. vannamei* shrimp species. The sub-statistics aimed to differentiate group of farms with and without ASC application.

In whole sampling, the average age of shrimp farmers were about 51 years old. The total years of school attending were about 8 school years[10]. Almost shrimp farmers did not have a professional training in shrimp cultured activity. Three main reasons of doing shrimp farms were specified such family inheritances, following other farmers and no choices for other activities (Information from survey, 2017). While the experiences in shrimp cultured of *P. monodon* farmers were more than 13 years, it was almost 10 years for *L. vannamei*, suggesting a reasonable result because *L. vannamei* began to be raised in the VMD from 2008 (as mentioned in Chapter 3).

Table 4.4 The sub-sample's characteristics by shrimp species and ASC application situation of shrimp farms in the samples

Category		Whole samples			*P. monodon* shrimp			*L. vannamei* shrimp		
		Total (N=114)	With ASC (N=32)	No ASC (N=82)	Total (N=71)	With ASC (N=9)	No ASC (N=62)	Total (N=43	ASC (N=23)	No ASC (N=20)
Age	Mean	51	53	51	51	56	51	50	51	49
	SD.	11	11	11	12	10	12	11	11	11
Education	Mean	8	8	8	8	9	7	8	8	9
	SD.	3	3	3	3	4	3	3	3	4
Experiences	Mean	12*	11	13	13	12	13	10	10	10
	SD.	5	6	5	5	6	4	6	6	5
Household size	Mean	4	4	4	4*	5	4	4	4	4
	SD.	2	2	1	2	2	1	2	2	1
Number of Shrimp labors	Mean	2*	2	2	2*	3	2	2	2	2
	SD.	1	2	1	1	2	1	1	1	1
Land/pond	Mean	7,173	5,944	7,653	9,385	13,583	8,775	3,522*	2,954	4,175
	SD.	7,659	7,852	7,577	8,904	11,981	8,317	1,948	1,211	2,419

Notes: (1) * indicated statistical significance level at $p<0.05$, using t-test for comparing means; (2) SD was abbreviation of "standard deviation"; (3) The Wilcoxon rank-sum test was used to compare medians; it showed the same results except for Land/pond of total sampling and the number of shrimp labors of *P. monodon* shrimp. Land/pond of total sampling showed statistical significance at $p<0.05$, using Wilcoxon rank-sum test. While as number of shrimp labors of *P. monodon* shrimp showed no statistical significance, using Wilcoxon rank-sum test; (4) a indicated statistical significance level at $p<0.05$, using Wilcoxon rank-sum test. (5) All tests were conducted to compare the differences means (using t-test) or differences medians (using Wilcoxon rank-sum test) of two groups of shrimp farms, ASC and non-ASC, for whole samples and for each shrimp species.

Household size of our sampling was approximately 4 persons for both *P. monodon* and *L. vannamei* farms. All household members might do shrimp farms together, or might have

[10] The education systems in Vietnam includes primary school (1^{st}-5^{th} school years), secondary school (6^{th}-9^{th} school years), high school (10^{th}-12^{th} school years), university and professional training.

other agricultural and non-agricultural activities. Among them, the average number of labors working for shrimp farm activities was about 2 persons. For *P. monodon* shrimp, we found the statistical differences between ASC and non-ASC farms in the household size and number of labors working for shrimp cultured activities (p<0.05). Under the ASC application procedures, the average labors of *P. monodon* farms were up to 3 labors, comparing to those of non-ASC farms (p<0.05). The reasons were found that, *P. monodon* shrimp farms with ASC application progress tended to change cultured methods from traditional extensive to improved-extensive and intensive cultured methods. It might result of the differences in demand for the labors. Moreover, we found from the interview survey the fact that, the shrimp farmers decided to apply for ASC certificates because shrimp cultured activity was their main income, and mostly, they had no other livelihood activities. All members of household was the shrimp labors. Therefore, the number of shrimp labors in ASC farms might be higher than non-ASC farms.

We also presented the land used for one cultured pond for both *P. monodon* and *L. vannamei* farms. For *P. monodon* farms, about 9,385 m^2 of the average land was used for one cultured pond. We could not confirm the statistical differences between ASC and non-ASC farms for using land per one cultured pond. It might be because the cultured systems applied for *P. monodon* shrimp were extensive systems. In the interview survey, we found the ASC farms were expected to change the cultured methods from extensive to intensive. However, those changing was still in the progress, and the fact that, the farmers could not completely change immediately.

For *L. vannamei* shrimp, we found the statistical significance in land used for one cultured pond between ASC and non-ASC farms (p<0.05).The average of land used per cultured pond for *L. vannamei* shrimp farms was more than 3,500 m^2. However, the farmers, who were under ASC application, spent about 2,950 m^2 while as the non-ASC farms invested more than 4,000 m^2 for one cultured pond. We found that *L. vannamei* farmers under ASC certificates application might be trained the cultured technology, including how to construct and utilize the land and other infrastructures investments.

4.2.2.2 For collectors

Total 2 collectors were visited in Phu Tan district and Ca Mau city. They daily came to extensive farms, and bought *P. monodon* shrimp. The farm-gate price was negotiated with farmers before coming. They contributed the family network with the shrimp farmers. However, collectors had to guarantee that the negotiation price was equals to the prices paid by other collectors at the transaction date. Otherwise, shrimp farmers might sell to other buyers. The results of our survey were concordant with the information of Provincial DOF.

4.2.2.3 For brokers and Traders

Total 2 brokers were visited in Phu Tan district and Ca Mau city. They were one of wholesale traders of shrimp supply chains. They were required for business registration to get the business permission from Local Authorities. Besides that, they were required to apply food safety certificates from Provincial Quality Assurance of Agriculture, Forestry and Fishery Department (NAFIQDA).

The shrimp traders included traders' companies and pre-processing companies, we conducted the information from 2 companies, namely Phu Hung Company and Nam Viet Company with the arrangement of Provincial Ca Mau NAFIQDA. Under regulations of Vietnamese Government, a pre-processing company could operate as a trader and pre-processing company but there was no vice versa. A trader company could not be operated as a pre-processor. As the results, at the beginning, the main activities of Phu Hung Company were shrimp traders. They bought shrimp from collectors and brokers and then, sold to processors. However, in recent year, their operating was as pre-processing shrimp products. Their main activities were head-off, tail-off and skin-off shrimp under outsourcing contract with seafood factory and processing companies, including X Company, who contracted with Cooperatives of Cai Bat in our sampling.

Nam Viet Company was established in 2008. Similar as Phu Hung Company, they currently worked as a pre-processing company with the outsourcing contracts with X Company and Minh Phu Company in Ca Mau province. They received shrimp material from processors, and then, pre-processed (e.g. head-off, tail-off and skin-off) and returned as contracted with processors.

4.2.2.4 Processing Companies

To achieve the purposive study, our first target processor was X Company, who was contracting with Cooperative of Cai Bat. As the information of Provincial DOF Ca Mau, the X Company was one of the largest processing and exporting company for shrimp products in Ca Mau province. Besides that, to compare the differences in the information management and traceability implementation of X Company from the others, KHANH AN company was even visited in the survey.

- **X Company**

X Company is one of largest processors in Ca Mau which can supply all kinds of frozen shrimp products for both *P. monodon*, *L. vannamei*, such as Peeled and deveined (PD), Peeled un-deveined shrimp (PUD), Peeled, deveined tail-on (PDTO), Head on shell on (HOSO) in block, individual quick freezing (IQF), Semi-block or other requirements from foreign and domestic customers with capacity about 4,000-5,000 tons per year. Besides shrimp products, X Company also provide other frozen products such as squid, cuttlefish, octopus or value-added high-quality products such as Surimi, NOBASHI shrimp in Block or IQF, or in Tray with capacity about 2,000-8,000 tons per year.

X Company contributed the cultured area in Dam Doi district, Ca Mau province, where provide 20% of total demand for shrimp material of their own company. They also sponsored for Cooperative of Cai Bat to apply for ASC certificates in 2017. The shrimp farming inputs were also supplied by collectors, brokers, and other shrimp farmers through contracted agreement.

The main foreign markets of X Company are Europe, Greek and UEA. Domestic market was holding about 10-15% of total output products in 2017. In recent years, X Company has

applied for the international quality assurance certificates to satisfy the requirements from foreign countries such as GLOBAL GAP, HACCP, Good Manufacturing Practices (GMP) and ISO 22000:2005.

X Company established department of quality assurance to inspect the antibiotics, chemical, microbiological, metal and additives residues of farming inputs before processing. After processed, the output are even re-inspected for chemical, microbiological, metal and additives residues before be packaged and stored. Differences global markets might suppose the differences residue level of chemical, microbiological, metal and additives residues. Therefore, the level of antibiotics and other matters of inspection procedures are depended on the negotiation between X Company and their global markets.

The organization of X Company was described as Figure 4.5:

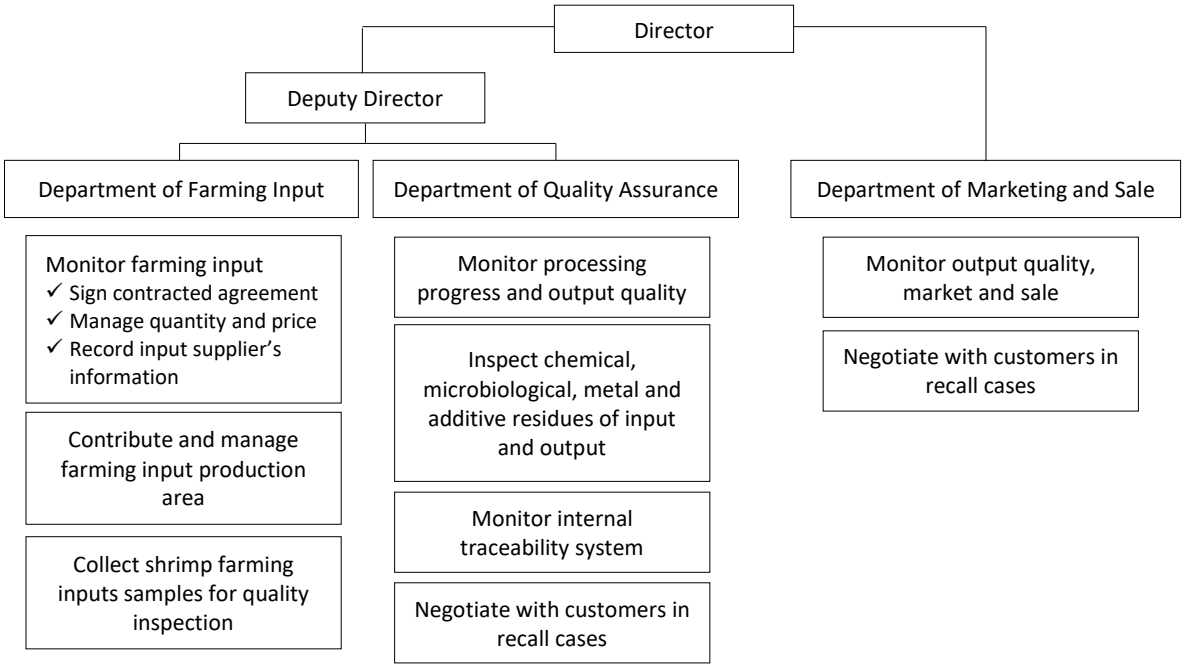


Figure 4.5. X Company organization

❖ Khanh An Import and Export Seafood Company (KAMEXCO)

The initial operation of KAMEXCO was a pre-processing factory of seafood products. In 2009, KAMEXCO was developed to processing and exporting company. This company had invested the high-quality operation systems of processing and trading of seafood products to adapt the requirements of domestic and foreign markets. The main global customers of KAMEXCO are Europe (30%), Southeast Asia countries (20%), Korea (20%) and Middle East countries (20%). The domestic market is currently holding about 10% in total sale.

KHANH AN company contributed the domestic agencies to distribute the products to domestically consumers. In September 2016, KAMEXCO applied HACCP certificates for their quality management systems to satisfy the requirements from global customers.

Difference from X Company, KAMEXCO did not contribute their own material area yet. KAMEXCO almost bought input shrimp from collectors and brokers. *P. monodon* of extensive farms were almost provided by collectors and brokers in Rach Cheo Commune, Phu Tan district, Ca Mau province. Both *P. monodon* and *L. vannamei* intensive farms were provided by brokers in Phu Tan, Dam Doi, Ngoc Hien and Nam Can districts.

On the other hand, KAMEXCO did not contribute the internal department of quality assurance. Therefore, the chemical, microbiological, metal and additives residues of farming inputs and outputs are tested at Quality Assurance (QA) Inspection Centers. However, KAXIMEX has to spend the fees for the inspection procedures. As a consequence, not all inputs and outputs are inspected. Instead of that, KAXIMEX will ask the QA Inspection Centers to test the antibiotics and other issues only if the customers required.

The operation structure of KAMEXCO was shown as follows:

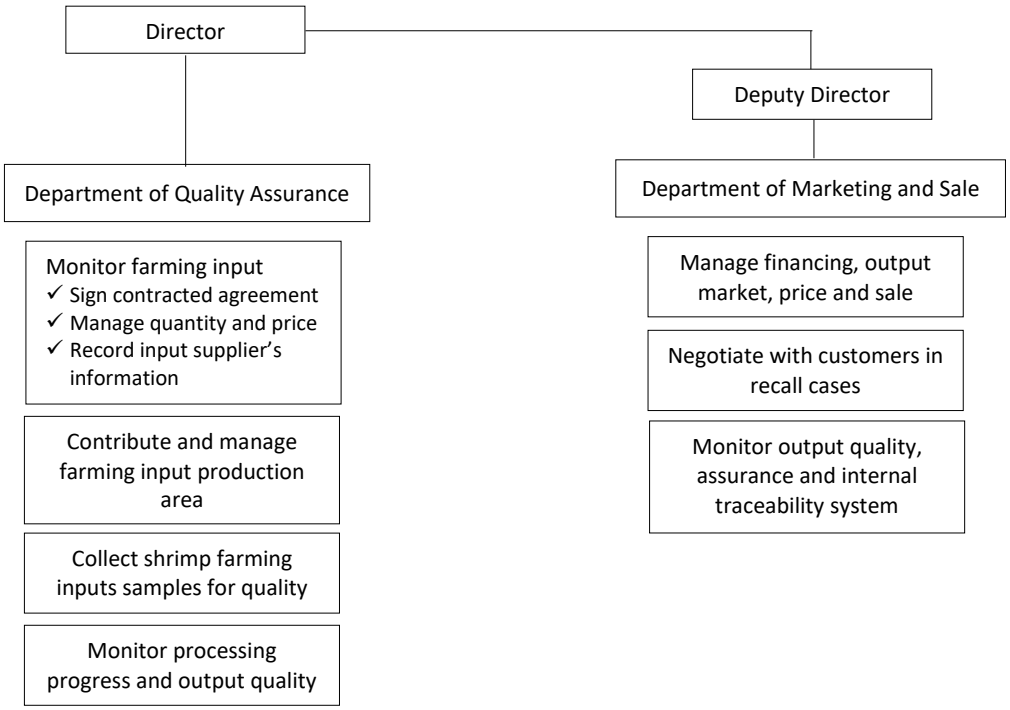


Figure 4.6. KAMEXCO Company organization

4.3 Some discussions on data and the use of data in the next Chapters

The advantages of our survey were the kind support from Local Government and Provincial DOF and NAFIQDA in the VMD, especially Provincial Ca Mau DOF and NAFIQDA. Therefore, the interview of all agents along shrimp supply chain had been conducted with the sufficiently information. Especially, based on the efforts of DOF and NAFIDA Ca Mau, the samples were obtained by tracking along shrimp supply chain in Ca Mau province to ensure the next evaluations about current situation of traceability application for shrimp products.

The assumption of choosing the study sites and conducting the survey was based on the purposive of current study. We considered the investigation shrimp agents at their entry

point along supply chain in terms of traceability. The strength of our study, comparing to previous works, was that the conducted information was collected by the tracing and tracking along shrimp supply chain. It meant that, we could emphasize from whom and to whom the shrimp products would be distributed along supply chain. It would be utilized for our forward discussion in this thesis.

In during the survey, we found traceability systems were strictly applied as the internal information management tools of processing companies, who were directly reflected by the traceability requirements of global markets. The requirements about traceability for shrimp products, in fact, were not recognized by other upstream agents of supply chain (i.e. shrimp farmers, collectors, brokers, trader's companies and pre-processing companies). Therefore the separated traceability systems had not been considered yet at those agents. However, those shrimp agents, especially shrimp farmers, perceived the role of application for international quality assurances for their products. Traceability was understood as a requirement included in those standards, besides the food safety, environmental and social welfare. The main reason was explained because of the requirements of recording and keeping information in the international quality assurances, such as ASC certificates as our study. Therefore, the understanding of shrimp farmers about traceability was mostly the international quality assurance standards. Based on this, two groups of shrimp farmers, ASC and non-ASC, were conducted in our samples. The next discussions of this thesis, therefore, would be based on the conducted samples. The suitable assumptions would be presented in the related Chapters.

Accordingly, the investigation of distributions flows and the movement of information in the next Chapter (Chapter 5) mainly included the comparisons of differences between two sub-samples, with and without ASC application. Similarly, the CBAs were even applied to compare the costs, profits and farm efficiency between ASC farms at Cooperative of Cai Bat and other non-ASC farms.

Notably, in our sampling, there were 6 interviewed farmers could not provide the information about the productivity of shrimp farms. Therefore, we excluded those observations to the sampling to obtain the analyzed results in Chapter 5 and Chapter 6. Thus, in these Chapters, we only used the conducted information of 108 shrimp farmers in the survey, instead of 114 shrimp farmers.

Finally, in our sampling, the information of input suppliers such as hatcheries, feed companies and chemical and drugs suppliers could not be conducted in the survey due to the limitation of the permission to interview from those companies. Thus, in the rest analyzed parts of this study, the details of those inputs suppliers could not be presented.

Appendix 4.1. The structure of sampling

Category	Data of whole Ca Mau province				Collected Sampling				***Extraction rate (%)		
	Total shrimp cultured production	International QA* application		Non-QA*	Whole sampling	International QA* application		Non-QA*	Whole sampling	International QA* application		Non-QA*
		Other certificates	ASC**			Other certificates	ASC**			Other certificates	ASC**	
Production area (hectare)	280,849	18,897	200	260,849	1,584	0	138	1,446	0.56	0.00	69.00	0.55
Numbers of shrimp farms	62,000	4,143	57	57,800	114	0	32	82	0.18	0.00	56.14	0.14

Note: *"QA" was the abbreviation of quality assurance certificates; ** ASC certificates were only applied in Cooperative of Cai Bat; ***The extraction rate was the ratio between collected samples and the data of whole Ca Mau province.

Chapter 5. Shrimp supply chain management in terms of traceability: the evidences from Ca Mau province, Mekong Delta, Vietnam

5.1 Introduction

The last Chapters presented the background of study areas, and how we designed the field survey to conduct the data. In this Chapter, we investigated the current state of traceability implementation for shrimp products along supply chain with the evidences of Ca Mau provinces, Mekong Delta, Vietnam. The distribution flows and the movement of information along shrimp supply chain, which were collected from the field survey in Ca Mau province was used to compare the differences of those categories in terms of traceability implementation. The next section was to present the shrimp supply chain in terms of traceability based on our survey in Ca Mau province, Mekong Delta, Vietnam. The management and movement of information along shrimp supply chain, then, were indicated. Section 5.3 aimed to discuss about the current situation of traceability implementation for shrimp products along supply chain in the Mekong Delta, Vietnam. Section 5.4 presented the conclusion of this Chapter.

5.2 Shrimp supply chain in terms of traceability: the evidences from Ca Mau provinces, Mekong Delta, Vietnam.

The shrimp supply chain of Ca Mau province was described in Figure 5.1. Found results indicated that, the distribution flows of shrimp products from shrimp farms were depended on the cultured methods, contracted agreement situation and the application for ASC certificates progress. The information of shrimp products along supply chain would be moved and exchanged together with the distribution flows. The details were presented as follows.

5.2.1 For the shrimp products provided by the non-ASC shrimp farms to processing companies

We found the distribution channels and information flows of shrimp products from non-ASC shrimp farms were completely depended on the cultured methods of shrimp farms.

5.2.1.1 Distributions flows

- ***From extensive farms*** **(See Flow (1) in Figure 5.1)**

Based on the results of our sampling, the distribution flow of output shrimp products from extensive farms was the most complicated flow of shrimp supply chain in Mekong Delta, Vietnam. The farms under extensive cultured system did not signed the contracted agreement to provide the output shrimp to their buyers.

The output shrimp products from extensive farms, firstly, were distributed to collectors, who were operating at very small-scale, and freely to enter to shrimp industry. In our survey, we found the concordance situation with the information of Provincial Ca Mau DOF, collectors directly contacted to extensive farms, and visited extensive farms by

motorcycle to purchase output shrimp every day. The collected quantity of shrimp products was about 2-10 kg per day per farm.

From collectors, the shrimp products, then, was provided to brokers or traders, who were locating within district, where included the communes of collectors' operation. The transaction between collectors and both, upstream (farmers) and downstream (brokers or traders) agents were the family-network with verbal contract.

However, in the shortage season of shrimp farming inputs, especially in September and October of every year, collectors might provide about 70-75% of total collected quantity to brokers/traders. The rest 25-30% of total collected shrimp farming inputs from extensive farms would be provided to processing companies directly. In this case, processing companies contacted to collectors, and negotiated the higher price paid to collectors to buy the shrimp inputs. The additional premium paid by processing companies to collectors was about 0.09-0.22 USD per kg[11].

- ***From intensive farms*** **(See Flow (2) and (3) in Figure 5.1)**

The shrimp products from intensive farms might be provided to processing companies with and without the participant of middlemen (collectors and brokers/traders) agents along supply chain. However, based on our sampling, only 2.5 percent of total intensive farmers, who were not applying for ASC certificates, chose to sell directly their harvested shrimp to processing companies under contracted agreements. The shrimp farmers signed the contracted agreement might avoid the uncertainty of output shrimp price, which was specified in the contracted agreements. However, the contracted farmers were required a strictly specification about the anti-biotic and other chemical residues. Two days before the harvested date, processing companies collected small amount of shrimp as a sample to test for the anti-biotic residues. If the anti-biotic was discovered, the price would be reduced at least 0.09 USD per kg (~ 2,000 VND per kg), comparing to the specified price in the contract.

About 97.5 percent of shrimp products from intensive farms without application for ASC certificates were providing to processing companies through the brokers and traders. One week before harvest date, shrimp farmers contacted to the shrimp brokers and traders to negotiate the price based on the fluctuation of shrimp market. The brokers and traders would pay for the costs to harvest and transport.

[11] Approximately 2,000-5,000 VND per kg. The exchange rate USD/VND = 22,500.

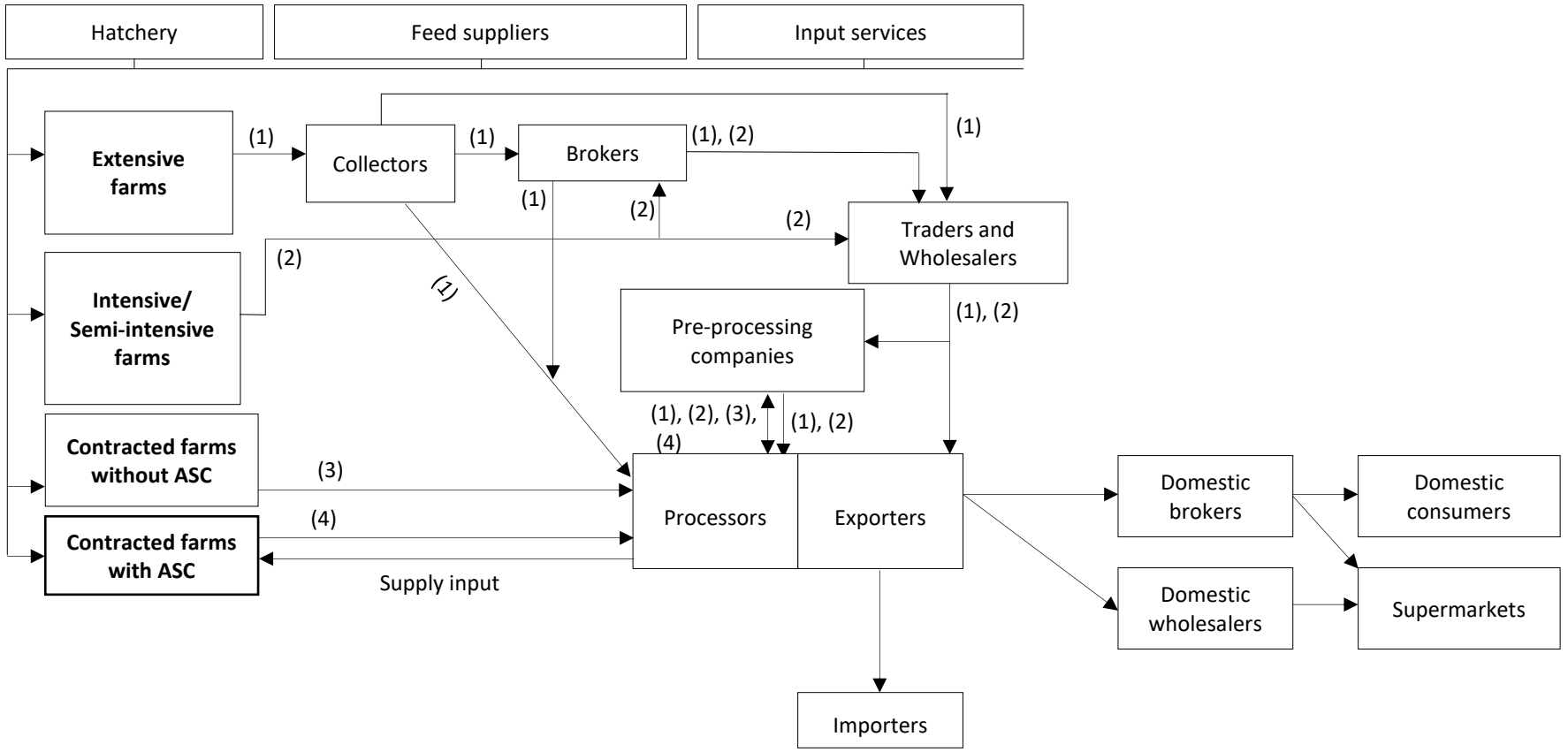


Figure 5.1. Shrimp supply chain in Ca Mau provinces.

5.2.1.2 Information flows and traceability

Hence, the first destination of shrimp products came from non-ASC shrimp farms were to the collectors (for extensive farms) or to the brokers and traders (for intensive farms). In terms of traceability, the information had to be recorded at shrimp farms, and be provided to collectors and/or brokers and traders. However, based on the results of our survey, the non-ASC shrimp farms did not consider to the recording and keeping of information for shrimp products at their farms. It led to the barriers for the traceability implementation of shrimp supply chain.

At farm stages, remind the compared results of the information recording and keeping indicator between ASC and non-ASC shrimp farms in Chapter 4, only 30 farms (~ 26%) of our sampling recorded the information of production progress. Among those, for the group of non-ASC farms, only 10 shrimp farms (about 9%) of total sampling implemented the information recording and keeping. However, the contents of the recorded information at those farms included cost of inputs used and the output quantity only. The purposes of recording were to manage farm efficiency. That recorded information, thus, was not provided to the shrimp collectors or brokers and traders.

5.2.2 For the shrimp products provided by ASC shrimp farms to processing companies

5.2.2.1 Distributions flows

Flow (4) of Figure 5.1 described the distribution flow of ASC farms. The ASC farmers participated to Cooperative of Cai Bat, Cai Nuoc district, Ca Mau province, Vietnam to receive the pre-payment under input investment forms from contracted processors, who also sponsored all fees to apply for ASC certificates. Besides that, shrimp farmers in the Cooperative could access the low-interest rate loan from the Local Government. However, as we introduced in Chapter 3, differences from non-ASC shrimp farmers, the shrimp farmers participated to Cooperative of Cai Bat were required to follow the specific quality products of ASC standards under the monitoring of processors and cooperative's committee. All of harvested shrimp at farms stage must be provided to processors as the contracted agreement. Any cheating, both in the production process and the products' quantity was not allowed.

The negotiated price was recognized as the farm gate price of shrimp market at harvest date. So far, since the ASC application progress had been completed, and was officially certified[12], the price would be added at least 0.09-0.22 USD per kg (~ 2,000-5,000 VND per kg). Hence, the benefits of ASC application were shared for both processor and farmer side. The processors could ensure the source of shrimp material with high quality. The farmers' rights were almost protected by cooperatives' committee negotiation. Besides that, the sponsors from processors helped to resolve the lack capital and the uncertainty in price, too.

[12] During the survey, Cooperative of Cai Bat were under ASC application progress. The official certificates are tentatively awarded in the early of 2018.

5.2.2.2 Information flows and traceability

We found that, the ASC shrimp farmers were required to record and keep the information about production progress. The processors specified the products' quality and the forms of recording documents to shrimp farmers. The contents of those specification were strictly followed the specific standards in ASC certificates to ensure for the satisfying of requirements at global customers, including the traceability rule "one step backward"- "one step forward" from farms to processors and exporters.

At harvested date, the shrimp farmers provided the recording forms to processors. The information, then, was recorded to internal database, and was used for inputs-outputs traceability procedures at processing company. Remind that, the ASC shrimp farmers were the Cooperative of Cai Bat's members. The cooperative's committee had the responsibility on the truth of recorded information. The production progress of shrimp farmers at Cooperative of Cai Bat was also monitored by the cooperatives committee to ensure for the satisfying of shrimp products about the quality requirement as indicated in ASC standards.

5.2.3 The product and information flows from processing companies to global customers

Processing companies paid strictly concerning to the application for traceability systems in order to adapt the requirements from customers at importing countries. The interviewed results from Company X and KAXIMEX Company about the management the product's flows and traceability from input to output were described as follows (see Figure 5.2, too).

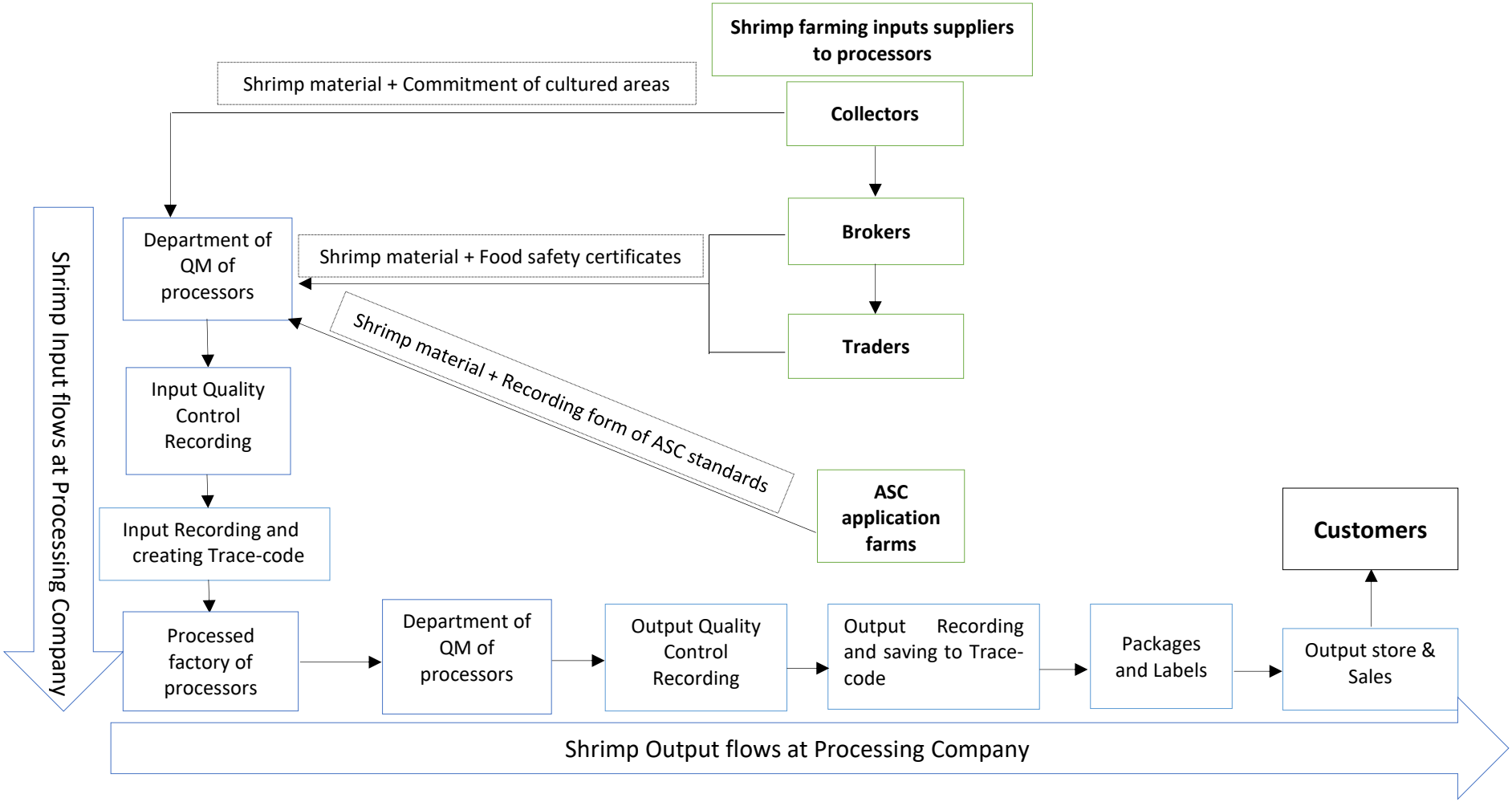


Figure 5.2. Input-Output flows, Information management and Quality Control procedures at Processing Company. Note: QM indicated for "Quality Management"; the blue shape indicated the management procedures of input-output products flows and information at processing companies. The green shape indicated the shrimp farming input suppliers of processing companies. The black arrows indicated for the product's flows from shrimp farming inputs suppliers to processing companies and their customers.

5.2.3.1 The management of input flows and its information

All of input shrimp had to pass the quality control recording which was audited by Department of Quality Management and then, was recorded the information to the internal traceability systems. Processors required to suppliers, such as collectors, brokers and other middlemen (e.g. traders, wholesalers and pre-processing companies), the providing of information, including the invoices and transaction documents13. Based on that information, processors could track the information of shrimp products until the brokers and their suppliers.

A trace-code, which was used was used for the whole of traceability management procedures from input shrimp, processing and distribution, was created to each lots of shrimp input to separate the shrimp products by suppliers. An example of trace code was presented in the Table 5.1:

Table 5.1. The format of input trace-code at Processing Company, obtained from the interview of processors in 2017

Example of input traced-code: CADEEFFF or VADEEFFF or QADEEFFF						
C	V	Q	A	D	EE	FFF
P. monodon shrimp of intensive or semi-intensive farms	*L. vannamei* shrimp	*P. Monodon* shrimp of extensive farms	Suppliers code (internal managed lists)	Located area of suppliers/cultured area (internal managed lists/commitment)	Numerical order of input shrimp lots within a day of one supplier	Numerical order day of input shrimp lots within one year

For example, one of input trace-code of Company X created as “Q9102032”, where “Q” indicated for *P. monodon* shrimp was cultured in extensive farms; “9” indicated for the code of input suppliers, created by processors (according Company X, “9” was coded for the name of a traders’ company in Phu Tan district, Ca Mau province); “1” indicated for located area of suppliers (in this case, it meant Phu Tan district, Ca Mau province); “02” presented this input was the second lots provided to Company X in the date 01/02/2017; “032” indicated for the numerical order of day 01/02/2017.

5.2.3.2 The management of output flows and its information

As the collected information from interviewed processors, basically, the information management procedure at output stage was similarly as input stage. The processed output had to be passed of the quality control recording before being packaged. Each lots of output was defined the same code with the trace-code of input shrimp to trace information of input-output flows at companies. Then, the information was loaded into the internal traceability systems include trace-code, size, quantity, color, time of soaking (for processing step with additives).

The output products of processing companies included frozen and value-added shrimp products. For frozen products, such as Head on shell on (HOSO) and Head less shell on (HLSO)

[13] The recorded information included name of suppliers, date, type of shrimp (*P. monodon* and *L. vannamei* shrimp), size, quantity, price, quality-testing results.

products, the output shrimp products were provisional packaged to carton containers and/or lots with the printed label on each container or lots. Each container included the output shrimp's batches with the printed trace-code on each batch (Picture 5.1). The trace-code would be printed on each batch of the containers and/or lots. The information included in the label and trace-code was described as Figure 5.3 and Figure 5.4.

Picture 5.1. Package stages at KHANH AN Company. Note: The red outline shape indicated for the Containers/Lots where included the numerous batches; the white outline shape indicated for the batches of products.

Khách hàng (Name of customers): EAST FISH - #19
Thị trường (Market): United Arab Emirates (UAE)
Nhà sản xuất: Name of processors and exporters: X Company, Vietnam
Địa chỉ (Address): AAA, B Hamlet, C district, Ca Mau province, Vietnam*
Điện thoại (Phone number): +84 ....*
SẢN PHẨM (PRODUCTS): + T/HOSO/IQF
+ Quy cách (Batch specification): 1 Kg x 10 (10%)**
Mã số lô (Lot code): VN817/U008
Số lượng (Number of lots): 2,003 CTN
Bao bì (Package): "THÙNG CARTON DÁN DECAL (CARTON WITH DECAL)"
Ngày sản xuất (Produced Date): 20, 21, 22/04/2017

Figure 5.3. An example of printed label on the containers of shrimp products before export, information provided by X Company. Note: * represents the address of COMPANY X. "AAA", "B", "C" and phone number are the personal contact of Company X, which was hidden as they required. ** shows that the weight of each batch was 1kg. The container include 10 batches with ice grazing 10%. "#19" is the customer's code, created by processing companies. "T" shows that the container was provisional packaged. "HOSO" is abbreviation of "Head on shell on". "IQF" is abbreviation of "Individually quick frozen".

Figure 5.4. The information included in the printed trace-code on output shrimp's batches, information provided by X Company and KAMEXCO. Note: The meaning of texts in the boxes was explained as follows: "Q9102032" is the trace-code; "31-40" is size of shrimp, "GRADE" is the color of package shrimp; "Q/HOSO" indicates for the *P. monodon* shrimp (extensive cultured systems)/Head on shell on.

At the point of sales, retailers would be decided which the information provided to final consumers. In general, only country of origin and expire date were printed on the labelling of retailers. Others information was only accessed by retailers. For value added products, the label was printed on the products, included the contact's information such as website, name of processors, phone number, etc.

The information management procedure at output stage was similarly as input stage. The processed output had to be passed of the quality control recording before being packaged. Each lots of output was defined the same code with the trace-code of input shrimp to traceability information of input-output flows at companies. Then, the information was loaded into the internal traceability systems include trace-code, size, quantity, color, time of soaking (for processing step with additives). Then, the information of printed label on the output lots included name of processor, country of origin (Vietnam), name of customer, name of material suppliers (only for frozen product), cultured area (only for frozen product), type of shrimp, type of product, size, quantity, processing date, output code and trace-code.

Hence, the printed trace-code on each batch of output shrimp products might assist for the traceability from shrimp farming inputs suppliers to processing and distribution. For processors, the trace-code supported to track the information about shrimp farming inputs in the recall cases until their suppliers, and cultured areas. However, for frozen products, the printed information was only available within shrimp processors, exporters and the importers. The providing of information toward to final consumers in global markets belonged to the decision of retailers. For value added products, the final consumers could access to products information through processors labelling. Besides that, final consumers also could search more information about shrimp processors and exporters from their website.

Figure 5.5 summarized the current situation of traceability along shrimp supply chain in Mekong Delta, Vietnam based on the results of our survey in Ca Mau province.

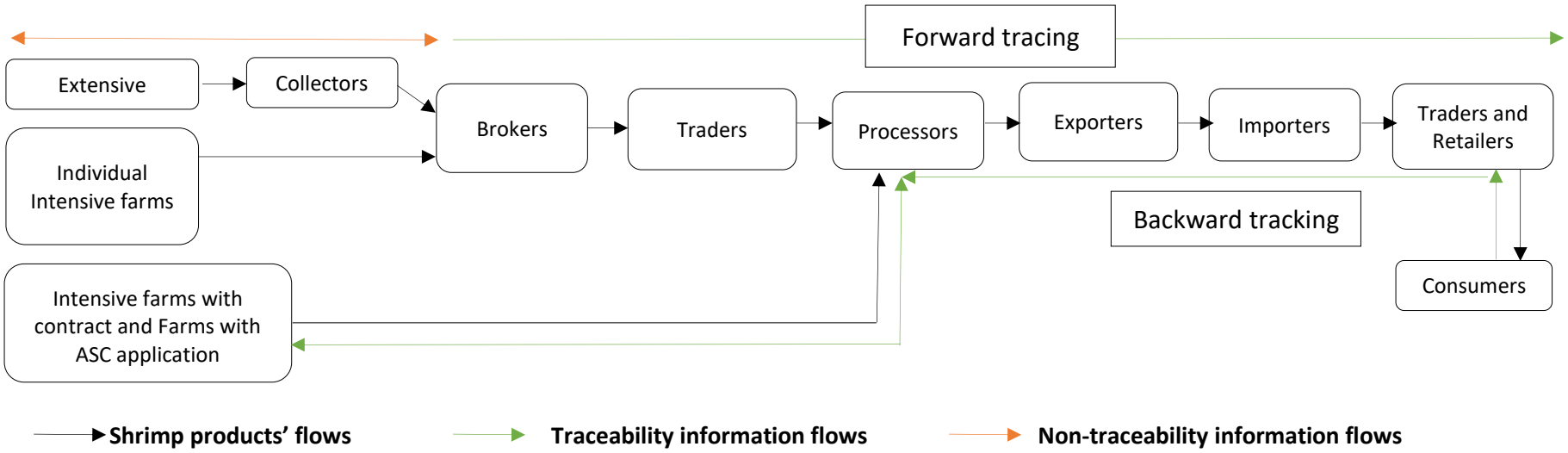


Figure 5.5. Traceability along shrimp supply chain in Ca Mau Province

5.3 Discussion

5.3.1 The bias of traceability information from processing companies to upstream agents of supply chain

As the results of survey in Ca Mau province, from processing stage to upstream agents of supply chain, such as shrimp farmers and shrimp farming inputs suppliers to processors, the traceability of information along shrimp supply chain was depended on the distribution flows of shrimp products. The tracking of information from processing companies might be available until cultured areas based on the identified information of shrimp farming inputs suppliers. The internal systems at processors could support for the rule "one step backward"-"one step forward" between processors and their shrimp farming input suppliers.

The shrimp farming inputs directly provided to processors by shrimp farmers with contracted agreement, including ASC shrimp farmers and the contracted farmers might be tracked the information between shrimp farmers and processors. However, to apply for ASC certificates, the shrimp farmers in our sampling were still relying the sponsorship of processors because those farmers were not payable for the costs of ASC application. Therefore, in this case, shrimp processors were the most important actors, reflecting to the performing of ASC certificates application, as well as traceability implementation.

On the other hand, the collectors and brokers operated separately in cultured areas, and were required to commit about the cultured areas of shrimp farming inputs to processors. Therefore, based on the trace-code and recorded information, shrimp processors might track the information of shrimp products until the cultured areas, which indicated the operation areas of collectors and brokers. It might help for processors, especially in recall cases, to search the reasons of contamination, and to respond to global customers.

However, the results from our survey indicated that, the transaction between shrimp farmers and middlemen, such as collectors and/or brokers along shrimp supply chain were found as the familiar network. Our results corresponded to the previous works of Loc (2006); Kusumawati *et al.* (2013) and Lap *et al*. (2015). We found that, the shrimp farmers did not consider to the complicated requirements of product's quality, safety and traceability in the negotiation with collectors and/or brokers/traders. Especially, the extensive farms with daily small harvested quantity, an instance of selling to collectors was much more convenient than the contracted agreement with the shrimp processors. The recording and keeping of information were not considered at collectors. Besides that, the collectors and/or brokers were not specified the requirements of recorded information to shrimp farmers. Thus, shrimp farmers did not be motivated to record and keep the information of production progress.

On the other hand, we also found that, the shrimp flows came to processors through middlemen were complicated. Processors were able to track for the shrimp products by cultured area, which was defined as the operated location of those middlemen based on their commitment (collectors) and/or business registration (brokers/traders)[14]. However, there was no regulations and managements from Local Authorities and Government in Vietnam to

[14] See the details about the governance of shrimp supply chain agents in Mekong Delta in Chapter 3.

monitor the operated areas of those agents. A broker registered the business permission in a district might come to other district to buy shrimp farming inputs if they offered better price. Hence, if processors defined the cultured area, the information about the shrimp material would be bias.

Similarly, collectors operated by commune within a district. Hence, the shrimp farming inputs from collectors in a commune of a district, theoretically, would be collected from shrimp farmers within that commune and provided to the located brokers in that district (see Figure 5.6). However, if those collectors could negotiate the higher price with the brokers of other districts, they would distribute the shrimp to those brokers. On the other hand, collectors also might move to other communes or other districts to collect shrimp farming inputs of extensive farms freely. The Local Authorities might not manage that procedures because the collectors did not need to register the business permission. At the point of sale the shrimp farming input to brokers, collectors were required the name, address, phone number and identification number. Brokers might keep all information of collectors, and provided to processing company. However, based on the survey results, we found that, the shrimp farming inputs would be separated by products' size at collectors and brokers/traders' stages. Thus, brokers/traders and/or processors might not confirm which farms the shrimp farming inputs come from.

In cases of collectors directly provided the collected shrimp to processing companies, collectors were also required to provide the similar information as at the brokers, coupled with the commitment about cultured areas[15]. Processors could trace back the information of shrimp farming inputs until cultured areas based on the commitment of collectors. However, in reality, the information, which was provided in the commitment, was not exactly, and the processors could not control the operated areas of collectors as we presented.

[15] Processing companies in our survey defined the cultured areas of shrimp farming inputs as the district where collectors collected shrimp of extensive farms.

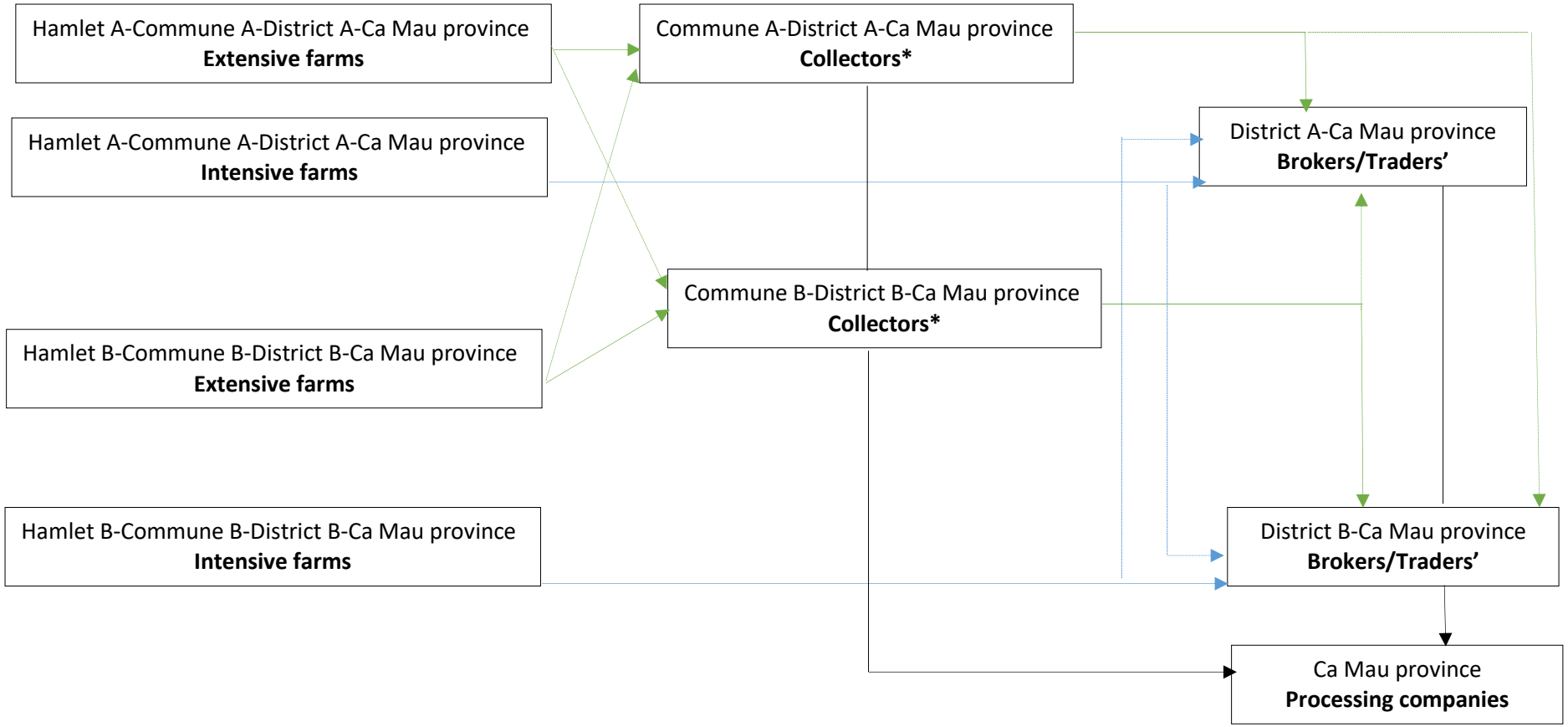


Figure 5.6. Products flows of non-ASC shrimp products, presented from survey 2017. Note: the continuous arrows indicated for the shrimp products as the traceability information flows of processing companies. The dash arrows presented for the shrimp products flows in reality, and it was out of traceability information flows of processing companies. The blue (both continuous and dash) arrows indicated for shrimp products flows from extensive farms to other agents of supply chain. The green (both continuous and dash) arrows indicated for shrimp products flows from intensive farms to other agents of supply chain. The black arrows indicated for shrimp products flows from collectors and brokers/traders' companies to processing companies. * At collectors and Brokers, shrimp products were separated by size.

5.3.2 Processing companies were the transporters of traceability requirements from global customer

In this chapter, we also found that, among the shrimp supply chain agents in Mekong Delta, Vietnam, processing companies were directly reflected by the requirements about the quality assurance and traceability of global customers. As a consequence, traceability system at processing companies were strictly considered as the internal information management systems. That systems supported to control the quality assurances of the input and output products as the specific requirements of importing countries at processing companies.

Probably, the integration and negotiation between shrimp farmers and collectors and brokers were the familiar relationship as we presented. However, we found that, the processing companies played as the drivers of those integrated situations along shrimp supply chain. This was because shrimp farming inputs before provided to processing companies had to follow the quality's product specification and requirements of traceability of those processors (Figure 5.7). Thus, the requirements of global customers about the product's quality, safety and traceability would not come to shrimp farmers, collectors and brokers/traders' companies in local side of supply chain directly. Instead of that, the shrimp processing companies might be the intermediates to transfer those requirements from global customers to supply chain's agents in local side. Our results were suggesting that, if the processors strictly specified the requirements of shrimp processors relating to traceability to other agents such as farmers, collectors and brokers, the corporation of those agents was expected to improve.

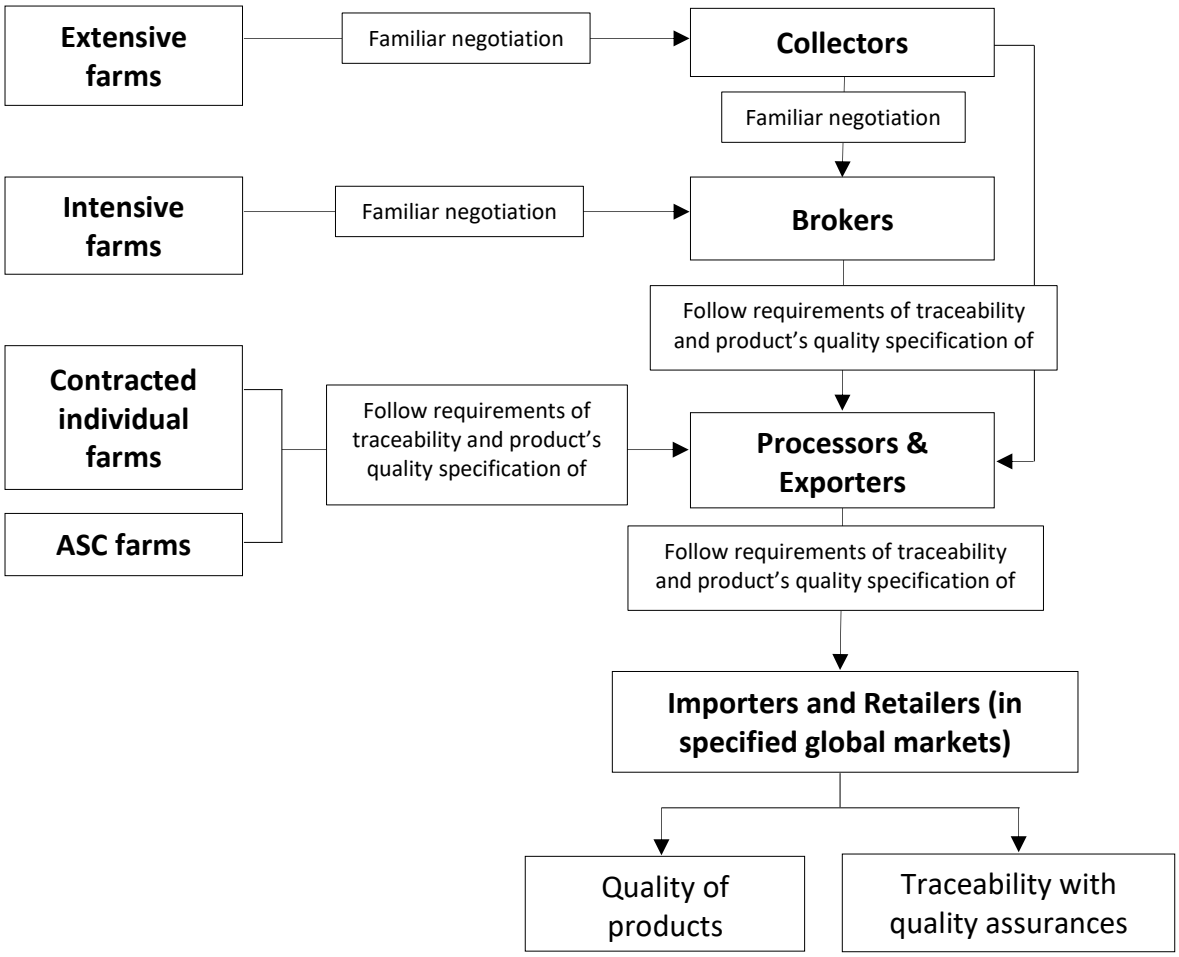


Figure 5.7. The negotiation along supply chain in Mekong Delta presented from survey 2017

5.3.3 Right to provide information to consumers at point of sale belong to retailers

From processors to downward agents of supply chain such as exporters, importers and retailers, the recorded information of shrimp products at processing companies can provide to those agents in global markets. The information of processors may track through the printed label on the products. The information of shrimp products could be easily traced "one step forward"- "one step backward" across processing companies and exporters, importers or retailers in global markets to identify from whom and to whom the shrimp products had been supplied.

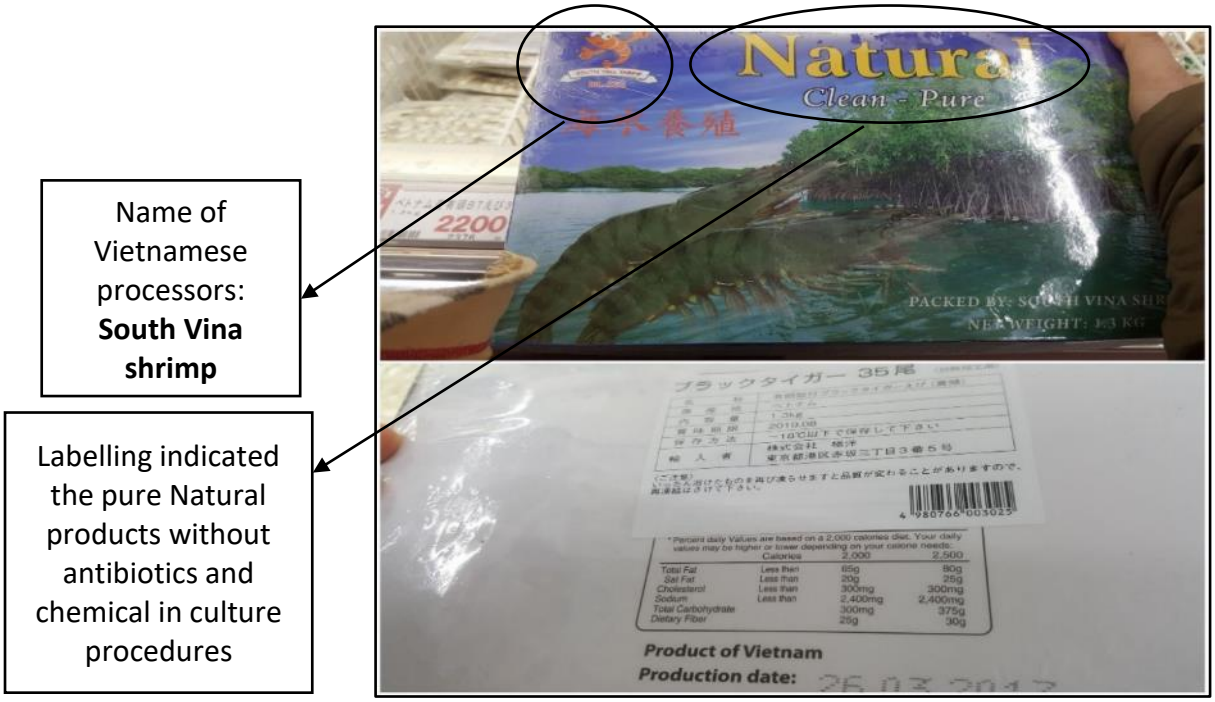
However, towards to consumers in global markets, the current requirements from customers in global markets were not specified the format of traceability systems. The required information to provide to consumers in global markets were focused on the name of the products, country of origin, storage conditions and expired date through printed labels of products. As we earlier mentioned, for frozen output products, the name of processing companies might probably not be provided to the consumers (Picture 5.2).

Information on label (In Japanese)		Translated into English	
名称	ブラックタイガー（養殖）	Name	Black tiger shrimp (cultured)
原産地	ベトナム	Country of origin	Vietnam
内容量	230g (10 尾)	Weight	230 g (10 individuals)
賞味期限	枠外表面ラベルに記載	Best before	Printed on the package
保存方法	枠外表面ラベルに記載	Storage	Printed on the package
輸入者	株式会社シジシージャパン 〒169-8531 東京都新宿区大久保 2-1-1	Importer	CGC Japan Co., Ltd. 2-1-1, Ohkubo, Shinjuku, Tokyo, Japan

Information on label (In Japanese)		Translated into English	
名称	えび	Name	Shrimp
原材料名	ブラックタイガーエビ（ベトナム産）	Species	Black tiger shrimp (Vietnam)
内容量	500 グラム	Weight	500 g
賞味期限	枠外に記載	Best before	Printed on the package
保存方法	-18℃以下で保存	Storage	Store in a place under -18℃
凍結前加熱の有無	加熱してありません	Heated or not	Not heated
加熱調理の必要性	加熱してからお召し上がりください	Need to heat or not before eating	Heat before eating
原産国名	ベトナム	Country of origin	Vietnam
輸入者	株式会社ジャパン.フード・サービス 兵庫県西宮市平松町 2 番 32 号	Importer	Japan food service Co., Ltd. 2-32, Hiramatsu-cho, Nishinomiya-shi, Hyougo, Japan

Picture 5.2. An example of Vietnamese shrimp (HLSO) in Japan market without the name of processors on the label

According to the interviewed processors, their company's name could be noticed to consumers in global markets in case of value-added shrimp products such as Tempura and Nobashi products, and/or other special specification such as the shrimp products were growing in the forest-shrimp integration system (Picture 5.3), which was an organic culture system without using antibiotics and chemical in culturing progress (Provincial Ca Mau DOF, 2018).



Picture 5.3. An example of Vietnamese shrimp (HOSO) in Japan market with the name of processors

However, we found that, the providing of shrimp products information in global markets was mostly depended on the right of retailers in importing countries. They might able to choose which information would be provided to consumers and regulators based the requirements of "right to know" about the information of purchased. We found the name of Vietnamese processors did not be printed on the labelling, even of Nobashi shrimp products (Picture 5.4).

Information on label (In Japanese)		Translated into English	
名称	ブラックタイガー（養殖）(加熱用)	Name	Black tiger shrimp (cultured) (heat before eating)
添加物	pH 調整剤	Additives	pH adjuster
原産地	ベトナム	Country of origin	Vietnam
内容量	199g（8 尾）	Batch specification	199 g (8 individuals)
賞味期限	枠外表面ラベルに記載	Best before	Printed on the package
保存方法	枠外表面ラベルに記載	Storage	Printed on the package
輸入者	株式会社シジシージャパン 〒169-8531 東京都新宿区大久保 2-1-1	Importer	CGC Japan Co., Ltd. 2-1-1, Ohkubo, Shinjuku, Tokyo, Japan

Picture 5.4. An example of Vietnamese Tempura shrimp in Japan market without the name of processors

On the other hand, towards to global markets, the Vietnamese shrimp processors were required to apply the quality assurances certificates such as HACCP, ASC, GLOBAL GAP and BAP. Those certificates labels were required to commit for the quality of shrimp products to global customers. In addition, the certified products were required to record and keep of production information to enhance the approaches of traceability rule “one step backward”-“one step forward”.

Thus, our results suggested that, the shrimp products in Mekong Delta, Vietnam might probably not need to invest to the separated traceability systems. This was because global customers, in fact, did not put the strict consideration on that. Instead of that, they were focusing on the quality and safety issues of shrimp products. Traceability was understood as the tool to trace the information of shrimp products distributed among processors and downstream agents (i.e. exporters, importers, distributors and retailers) of shrimp supply chain and to identify the potential risks of shrimp products in recalls cases from processors to their farming inputs’ suppliers (i.e. shrimp farmers, collectors and brokers/traders). Our results were corresponding to the results of previous works of Hobbs *et al*. (2005) and Verbeke and Ward (2006). Hence, the application for the quality assurances certificates may be the commitment of Vietnamese shrimp producers about the product’s quality. Besides

that, the relying on the requirements of recording and keeping information indicated in those certificates might be enough to be satisfied the requests of global customers (Fuchs *et al.,* 2009 and Bailey *et al*., 2016).

5.4 Conclusions

We had presented the current situation of traceability application along shrimp supply chain in Mekong Delta, Vietnam with the evidences from Ca Mau provinces. Traceability became a strictly requirements for shrimp producers along supply chain to response the regulations from global markets. Based on the conducted information from interview survey, we found that, the traceability systems were partly implemented along shrimp supply chain, where the information could be traced and tracked among shrimp producers along supply chain. The traceability of shrimp products was different from the distribution flows, which mostly depended on the cultured methods.

To respond the requirements of global markets, the processors' forces might be the critical factors of traceability implementation for shrimp products along supply chain in Mekong Delta, Vietnam. Processors were even directly reflected by the requests of global customers. Therefore, processors would be the intermediates to transfer the requirements from global customers to the shrimp farming inputs providers. Hence, the specification about the product's attributes based on the requirements of global customers from processors to shrimp farming inputs suppliers might probably improve the attention, and call for the compliance in order to implement the traceability procedures along supply chain.

As our results, the recording and keeping information of ASC standards might enhance the traceability for shrimp products in order to adapt the requirements of global markets. Recent perspectives for the integrated traceability and the quality assurance standards of global customers might suggest the important role of the application for quality assurances certificates for Vietnamese shrimp products.

Chapter 6. Costs-benefits of traceability implementation for shrimp farms: the evidences from Ca Mau province, Mekong Delta, Vietnam

6.1 Introduction

In Chapter 5, we presented the current situation of traceability implementing for shrimp products in Mekong Delta, Vietnam with the empirical results of Ca Mau provinces. Based on those indicated results, the traceability implementation for shrimp products in Mekong Delta, Vietnam in order to adapt the requirements of global markets was considered to the application of quality assurance. On the other hand, remind that, the main targets markets of Vietnam shrimp products were global markets, especially Japan, European and the US, where international quality assurances certificates became more consideration in recent years. Thus, the application of international quality assurances might be considered towards the implementation of traceability in the future.

However, about 88% of total shrimp production in Mekong Delta, Vietnam had not certified by any international quality assurances yet. Among 12% of total shrimp products certified by international quality assurances, it is only 4% ASC-certified, 1% Global GAP certified, 4% BAP certified and 3% Nature land certified (Boyd *et al.,* 2018). The challenges of application for those international certificates were the costs for application, and the balance between costs and benefits from the application progress.

This Chapter, therefore, aimed to identify the affecting of quality assurance application to costs and benefits of shrimp farmers with the evidences of Ca Mau provinces, Mekong Delta, Vietnam based on the framework of costs-benefits analysis (CBAs). For the details, CBAs framework was applied to exam the differences in revenue and costs, including production costs and ASC application costs between two separated groups, non-ASC and ASC farms. The finally expected result of this Chapter was the suggestion of a minimum price for shrimp products to balance the costs and benefits of shrimp farmers in order to apply for quality assurance forwarding to the implementation of traceability. In this chapter, we only used the information of 108 shrimp farms of total conducted samples for the examination of CBAs analysis.

6.2 Assumption and standardized data procedures

Before going for the investigation of the purposive chapter, some assumptions and the procedures to standardize the collected data were indicated based on the specific features of this study as follows:

6.2.1 Assumptions

1. In this study, family labor cost was included in production costs as one of variable costs of shrimp farms. It might be calculated by one of two assumptions. First, we assumed it might be equals to the wages if family labors worked for alternative activities in fisheries and agricultures sectors. Second, if the farmers did not have experiences for working out of shrimp farm, family labor cost was assumed at market price to hire labor for shrimp farms operation.

2. We assumed that shrimp farmers would pay for the costs regarding ASC certificates application by themselves from 2018. During our survey in 2017, Cooperative of Cai Bat was under ASC application progress. The official ASC certificates was tentatively awarded in 2018. Government and Company X sponsored the costs of assessment, registration and application. However, the costs to maintain ASC certificates and re-registration fees in the next years (from 2018) had not been considered yet.

3. Following to the second assumption, we only considered about the changes of costs regarding the application and maintaining of ASC certificates. The changes of other factors were eliminated, including land and human resources of farms, farming conditions (e.g. cultured methods, shrimp species, etc.). All of production costs, farm gate price and output quantity of shrimp farms were also fixed. Costs, revenue and farm efficiency were identified based on the collected data in 2017. However, to maintain the ASC certificates, shrimp farms need to re-register for the ASC certificates after 3 years. On the other hand, in our survey, we found that, all infrastructures to prepare for ASC application procedures must be reinvested after 5 years. In this study, we estimated the costs and benefits for the application and maintenance of ASC certificates at shrimp farms until the beginning of the sixth year since the ASC certificates were re-registered for two times and all of infrastructures have been recovered.

4. The weather conditions might influence to the quantity of output shrimp as well as input used in shrimp farms, such as seed, feed, drug and chemical (Portley, 2016). However, for simplicity, the affecting of weather to quantity of output shrimp and input used in shrimp farms was also ignored in this study.

5. Within one year, farmers might operate more than one crop. During our survey, we found that shrimp farmers might not remember the information of all crops. In this approach, the information of revenue and costs were calculated based on the latest finished crop in 2017 before conducting survey only.

6. In this study, we assumed that, all payments to apply for ASC certificates were same for every shrimp farm, and the sponsorships were assumed to be averagely divided to all ASC farms at Cooperative of Cai Bat as we observed from the survey Verhaegen and Huylenbroeck (2001) addressed that, the investment and/or adaptation of an innovative system, such as international quality assurances (e.g. ASC certificates as our study) might be different due to the farms' conditions. Farmers, who had well invested into their farms in management practices, the costs to make the changes as ASC requirements might be less than in other farms. The major changes might lead to the differences in overestimation of benefits and costs. In this study, we ignored those differences to be concordant with the interviewed survey.

6.2.2 Standardization of data

Due to the difference in biological characteristics of *P. monodon* and *L. vannamei* and the differences in cultured methods in our samples, we standardized the database to compare and conduct CBAs in the future sections as follows.

1. In this study, we chose the intensive systems as the baseline to standardize the data of revenues and costs of extensive shrimp farms. The data of output quantity and costs were calculated at the unit of "USD per 1,000m^2 per crop". Period for one crop was depended on the cultured shrimp species and cultured methods. Remind that, extensive farms operated monthly stocking and then, daily harvest. Number of harvested days was about 20 days per month, together with the tides. Different from extensive, farms under intensive systems had one time for harvesting within one crop. The average of crop period was 6 months for *P. monodon* shrimp and 3-4 months for *L. vannamei* shrimp. The differences in period of one crop led to the differences in way of investment for infrastructures, and use of land for farms and/or allocation of costs. Hence, the period for one crop of *P. monodon* shrimp is assumed at 6 months and this of *L. vannamei* shrimp was 3 months. Accordingly, for *P. monodon* extensive farms, the total costs were calculated from the monthly data multiplied to 6 months. The total harvested quantity was calculated by the total quantity of 20 days per month multiplied to 6 months. The farm-gate price of those products was assumed equals to the average price received by farmers from the conducting survey date to the previous 20 days.

2. To estimate the value of family land for one crop, we assumed that the family land could be used within 50 years, follow the regulation in Law 45/2013/QH13 on Land of Vietnam Government[16]. This was because shrimp farmers might use their own land (family land) and/or hire land to operate farms. Family land might be invested by own farmers for long time ago or it may be inherited from farmers' parents. In the field survey, it was found that, the time for using family land was not exactly informed unless the farmers sold it. Accordingly, the family land of shrimp farms was valued by follow function: $L_F = V_F/50/k$, where L_F was the depreciated value of family land, V_F was market price of total family land during conducting survey, k was the number of crops per year.

3. The value of hired land was depreciated as the function of $L_R = V_R/k$, where L_R was the total payment for hiring of one crop, V_R was the total fee for rent in one year and k was the number of crops per year.

4. Infrastructures for one crop were calculated by the function of $I_i = M_i/n/k$, where I_i was the depreciated value of the *i* th infrastructure used in shrimp farm; M was the price of the *i* th infrastructure at current year based on the valuation of farmers; n was total years could be use from the current years and k was the number of crops in one year (*i* = 1,.., *n*). However, in some cases, the farmers could not evaluate the value of infrastructures. In these cases, we assumed the value of the infrastructures at those shrimp farms at the market prices.

[16] According this Law, "the terms for land allocation, recognition of agricultural land use rights for households and individuals directly engaged in agricultural production in 50 years". Therefore, the right to use agricultural land of farmers is issued within 50 years. After that, farmers are required to re-registration for the right to use their land with local authorities.

6.3 Identification of production costs, revenue, profit and farm's efficiency

6.3.1 Costs

- ✓ **Production costs**

Production costs per one crop of shrimp farms include fix and variable costs. Accordingly, fix costs were defined as the costs, which had not change with level of output within one year or at least within one crop. Fix costs of shrimp farms included land for farm areas (both family and hired land) and infrastructures (mesh, water pump, fan systems, etc.). While as, variable costs were defined as the total costs of the variable inputs at each level of output. For shrimp farms, variable costs included seed, feed, drug, chemical, pond and water treatment, interest, electricity, transportation, labor (both family and hired) and others (DANIDA, 2010).

- ✓ **ASC application and maintenance costs**

Regarding to implement traceability, the shrimp farmers were applying of ASC certificates at Cooperative of Cai Bat, Cai Nuoc district, Ca Mau province as our samples. To apply ASC certificates, the shrimp farmers need to pay for the application and maintenance costs. ASC certificates could be available within 3 years after awarded. Besides that, those farmers were also required to invest for preparation of ASC application procedures. Those investments included the payments for electricity systems, labor safety instruments, pond systems, water systems and waste management systems (as we introduced in Chapter 3). Each mentioned payment supposed a different re-investment schedule. All costs regarding the application progress was divided into each crop.

As introduced in Chapter 4, during our survey, Cooperative of Cai Bat had 57 participated members. The application costs for registration and the costs to prepare for application progress as requirements of ASC standards at Cooperative of Cai Bat were listed as follows. The information was calculated based on the administration documents of Cooperative's committee.

- Application and Audit fee: 150 million VND (～6,667 USD) for 57 members of Cooperative. Hence, the cost would be 116.96 USD per farm. This payment would be repaid after 3 years.

- Preparing for application costs for one farm in 2017:

+ Electricity system: 5 million VND (～222.22 USD). It had to be repaired after 5 years.

+ Water systems: 5 million VND (～222.22 USD). It had to be repaired after 5 years.

+ Waste management systems: 2.25 million VND (～100 USD). It had to be re-paid every year.

+ Labor safety systems: 2.6 million VND (～115.6 USD). It had to be re-invested after 1 year

+ Pond systems: 10 million VND (～444 USD) for first crop of application progress, addition fees for the next crops was 2.25 million VND (～100 USD) per crop.

The total costs to apply for ASC certificates and the source for the payment at Cooperative of Cai Bat in 2017 were presented in Appendix 6.1.

Cooperative of Cai Bat received the sponsors under the forms of low interest rate loan from Local Government at 4% per year. Shrimp farmers would start to pay the interest cost from 2018. On the other hand, it was assumed that the shrimp farmers could not pay for the ASC application costs by themselves. Thus, in cases if there were no sponsorships, shrimp farmers had to take all application costs as a loan to apply ASC certificates. In case of participated farmers of Cooperatives, X Company offered a free interest sponsorship. Hence, costs for using of sponsored capital from this company was included as the sponsorship, too. The interest rate was assumed at 4% per year, which was same as the Loan from Government.

Based on the collected information above, we calculated the costs to apply ASC certificates in 2017 at Cooperative of Cai Bat. Notably, the ASC shrimp farmers of Cooperative of Cai Bat received the sponsorship from Government and processing company to cover all of payments for ASC application in 2017. Therefore, the total costs paid by shrimp farmers to apply for ASC in 2017 were zero. After that, we estimated the costs to maintain the ASC certificates for *P. monodon* and *L. vannamei* farms from 2018 to 2023, based on the collected data in 2017. The costs of application and audit of ASC certificates would be averagely divided for 57 members of Cooperative of Cai Bat as we assumed. These payments was firstly pay in 2017, and would be re-paid in 2020 and 2023 to re-register the ASC certificates. Other costs for preparation procedures to apply for ASC certificates would be valued at the point of accrual as above lists (Table 6.1).

Table 6.1. Costs for ASC application and maintenance at Cooperative of Cai Bat in 2017 and 2018-2023, calculated and estimated based on the interview survey 2017

Costs	2017	2018-2019	2020	2021-2022	2023
Costs for one year (USD per farm)					
Application and Audit	117.0	0.0	117.0	0.0	117.0
Electricity systems	222.2	0.0	0.0	0.0	222.2
Water systems	222.2	0.0	0.0	0.0	222.2
Waste management	100.0	100.0	100.0	100.0	100.0
Labor safety	115.6	115.6	115.6	115.6	115.6
Pond	444.0	100.0	100.0	100.0	100.0
Interest cost of Government Loan*	0.0	12.5	12.5	12.5	12.5
Interest cost of Processors sponsor*	0.0	42.6	42.6	42.6	42.6
Total costs without sponsorship	**1,221.0**	**383.2**	**500.1**	**383.2**	**944.6**
Sponsor by Government	156.0	0.0	0.0	0.0	0.0
Sponsor by Processing Company	1065.1	42.6	42.6	42.6	42.6
Total costs with sponsorship	**0.0**	**328.1**	**445.0**	**328.1**	**889.5**
Total crops per year					
P. monodon	2.0	2.0	2.0	2.0	2.0
L. vannamei	3.9	3.9	3.9	3.9	3.9
Total costs with sponsorship for one crop (USD per farm per crop)					
P. monodon	0.0	164.0	222.5	164.0	444.7
L. vannamei	0.0	84.6	114.7	84.6	229.2

Note: *The detail of interest cost of Government Loan and Processor sponsor were described in Appendix 6.2.

Hence, the description of total costs in shrimp farms in terms of traceability was described in Figure 6.1:

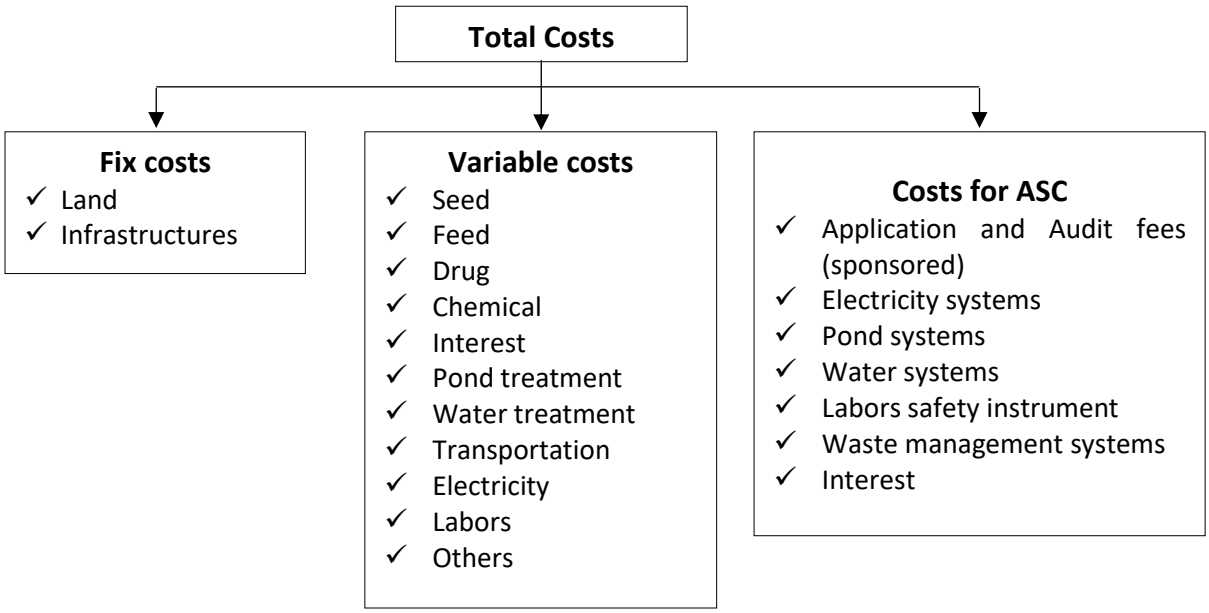


Figure 6.1. Conceptual total costs at shrimp farms

✓ **Factor affecting to production costs**

The priority purpose of the CBAs was to compare the differences in net benefit of the application for ASC certificates. The shrimp farms, therefore, were separated by ASC and non-ASC farms. Besides that, the results of CBAs were represented with the subsequences of shrimp species. However, the results of CBAs could not clarify the differences in benefits of application for ASC certificates by cultured method of shrimp species in advance because the number of observations for each species in our samples was not able to calculate and compare by cultured methods. In fact, in shrimp farms, the uses of variable and fix inputs were also depended on cultured methods as discussed in Chapter 2. For example, the differences between extensive and intensive farms were the uses of seed, feed, drug, chemical and labor costs. While as those cots of intensive farms might be very high. The investments of infrastructure such net, water pump, pond systems and electricity systems are also different between differences cultured methods. In this Chapter, we applied the Generalized Linear Model (GLM) to clarify the affecting of cost compositions and farm's conditions such as cultured methods, ASC application and shrimp species to total production costs of shrimp farms. The applied GLM model was described in following function:

$$C = \beta_0 + \sum_{i=1}^{n}(\beta_1 X_i + \beta_2 ASC_i + \beta_3 M_i + \beta_4 K_i + \beta_5 ASC_i * X_i + \beta_6 M_i * X_i + \beta_7 K_i * X_i);$$

where, C was defined as total costs, ASC (1 if farms are ASC application progress; 0 = otherwise); M cultured methods (0 = extensive farms, 1 = intensive farms) and K cultured shrimp species (0 = *P. monodon*; 1 = *L. vannamei*) to estimate the affecting of those factors to total costs.

X_i was defined as the cost composition of the ith input, $i = (1, \dots, n)$, including seed, feed, chemical and labor family costs, were included in GLM models to test the affecting of

those costs to total costs of shrimp farms (Table 6.2). The costs of those inputs were found as the four largest cost compositions of shrimp farms (as presented in detail afterward of this Chapter). The Akaike information criterion (AIC) was used to test the statistical relationship between the total production costs and the explanatory variables at $p < 0.05$. The log likelihood was examined as the indicator of the goodness of fit.

Table 6.2. Descriptive statistics of the variables used in the GLM models

Variable	**ASC (n=79)**	**Non-ASC (n=29)**	**Whole samples (n=108)**
	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*
Total cost (C)	2,885.01	2,057.45	2,279.66
	(*1917.16*)	(*3,380.33*)	(*3,070.39*)
Seed cost (X_1)	247.46	117.17	152.15
	(*174.48*)	(*175.81*)	(*184.02*)
Feed cost (X_2)	1,364.71	1,036.53	1,124.65
	(*1,326.27*)	(*1,948.33*)	(*1,802.45*)
Chemical cost (X_3)	104.36	112.76	110.50
	(*148.08*)	(*199.95*)	(*186.81*)
Family labor cost (X_4)	649.68	404.66	470.45
	(*427.70*)	(*641.53*)	(*599.83*)
ASC	1	0	0.27
			(*0.45*)
Shrimp species (K)	0.76	0.24	0.38
(1 = *L. vannamei*; 0 = *P. monodon*)	(*0.44*)	(*0.43*)	(*0.49*)
Method (M)	0.90	0.59	0.68
(1 = Intensive; 0 = Extensive)	(*0.31*)	(*0.49*)	(*0.47*)

6.3.2 Revenue

Revenue was calculated by unit price times to output quantity. In other words, both of the unit price and output quantity would factor to the total revenue of shrimp farmers. On the other hand, in terms of traceability, the shrimp products with certified ASC might get the premium at 0.09-0.22 USD per kg from 2018 as the commitment of processing companies. Therefore, the revenue of shrimp products in terms of traceability were calculated as described in the Figure 6.2.

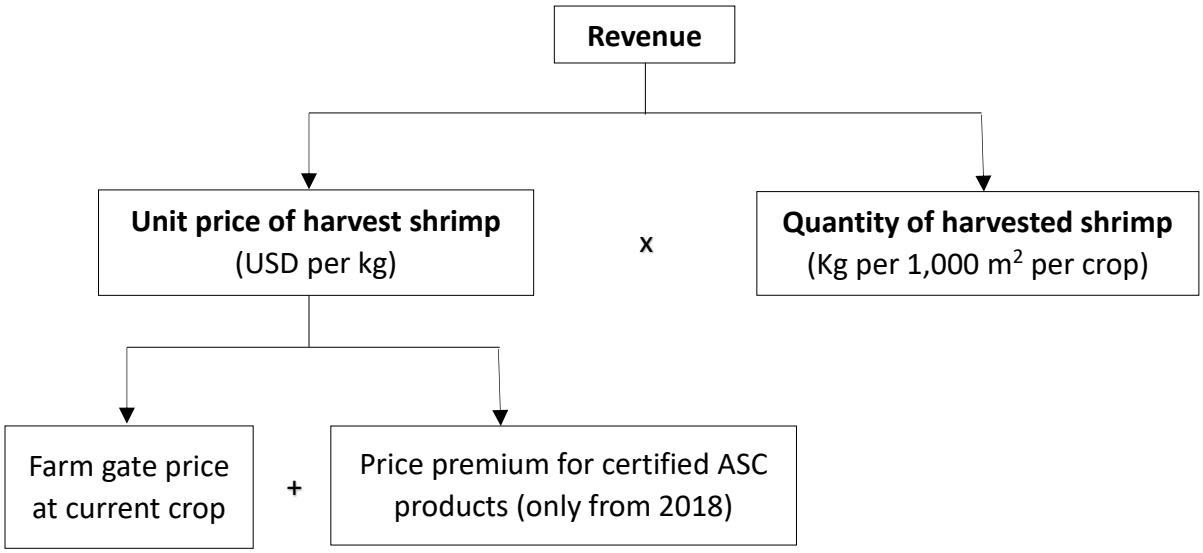


Figure 6.2. Conceptual revenue at shrimp farms

6.3.3 Profit, income and farm efficiency

Profit was the differences between revenue and costs, including family labor costs. While as income was the gaps of revenue and total costs without family labors costs (Tien and Thong, 2014).

In this study, we included family labor costs into production costs to estimate the profit based on our assumption. The lower family labors costs might be an important signal to evaluate the farm management efficiency and create a higher profit (Dan, 2017). However, in our study, we found shrimp farmers mostly used their own labors, instead of hired labors. The shrimp farmers chose shrimp farmed activity because they had no choices to do other activities. Shrimp farmed activity, therefore, played as one of their main sources of income. The shrimp farmers, by themselves, did not consider about the family labors cost to estimate their own profit. In other words, family labor cost was a non-cash cost and shrimp famers did not pay the money for this cost. In reality, shrimp farmers paid more consideration to the income indicator than profit indicator. Thus, profits estimation aside, we, then, excluded the family labor cost to production costs to calculate income of shrimp farmed activities. Income indicator might allow to identify the differences of the monetary amount, which received by shrimp farmers from shrimp farmed activity and other activities.

We also applied the farm efficiency ratios to be able for evaluation the performance of farm management as addressed by Flaaten (2018). The included ratios were profit per total costs and income per total costs, which represented how much profit or income farmers could earn per one USD of invested costs. It was measured by the profit or income divided by total costs. The value of those ratios was larger than one if one USD of costs could create more than one USD of profit or income. Otherwise, a lower than 1 ratio indicated that one USD of invested costs created less than one USD of profit or income. The profit and income were the largest motivation affecting to the activities and decision-making process of farmers (Morris and Young, 2000). Therefore, higher values of those ratios were expected because it indicated a better efficiency from invested costs of shrimp farmers. In this study, we based on the

collected data of the latest crop in 2017. Due to the costs of application for ASC certificates were sponsored by government and processing company, we did not include those costs to calculate the farm efficiency.

6.4 Costs-benefits analysis (CBAs) framework of international quality assurance certificates application: the case of ASC certificates' application at Cooperative of Cai Bat, Cai Nuoc district, Ca Mau province, Vietnam

In this section, we introduced the concepts of CBAs approaches as an analytical framework to estimate the costs and benefits of international quality assurance certificates with the evidences from application of ASC certificates at Cai Bat Cooperative in Cai Nuoc district, Ca Mau province, Vietnam. The framework of CBAs might be applied to estimate what counts as costs and benefits of one or a number of specific investment's opportunities whereby the costs presented for the increases of the costs and the decreases of revenue. In contrasts, the benefits were to describe for the decreases of the costs and the increases of revenue of those investments. The net benefits were the differences between the costs and benefits, would be the criteria to evaluate the performance of the investments (Mishan and Quah, 2007).

As we presented in Chapter 3, the application of ASC certificates might create various benefits for shrimp farmers, such as the sponsorship from both local government and the contracted processors and the price premium for certified products. However, it also required the extra costs, such as the payment for application process and/or other production costs to meet the requirements of ASC standards as well as to maintain the rewarding of certificates in the future. The concepts of costs and benefits were presented as follows.

6.4.1 Concepts of costs and benefits in CBAs from the changes in production costs to adapt the requirements of ASC standards

To apply ASC certificates, the shrimp farmers had to pay more for the application and maintenance costs. Those costs aside, the ASC application procedures might cause of the changes of production costs of shrimp farmers. The changes in production costs of ASC application might be lower or higher, comparing to the without application situation. In this study, during our survey, the application of ASC was under application procedures at the Cooperative of Cai Bat in 2017. These procedures, in fact, were not completed yet. It, thus, was impossible to compare before and after of ASC application. Instead of that, we compared the changes in production costs of both ASC and non-ASC farms to identify the differences of those costs in ASC and non-ASC farms. The difference in the production costs between ASC and non-ASC farms was the costs of the CBAs if its results was larger than zero. In contrast, it would be considered as the benefit.

In this study, we expected a lower value of those costs. In the other words, we expected the application of ASC might help to reduce the production costs and to create the benefits for shrimp farmers. As we found in the interview survey, and earlier presented, the input's costs of ASC farms such as seed, feed, drug and chemical might be changed. It was because under ASC application, the negotiation for a lower input price of cooperative's committee with input's suppliers. Specially, to monitor the input's origins and quality, X Company specified the input suppliers for the members of Cai Bat Cooperative. With the uses

of higher quality inputs, especially seed, farmers can improve the survival rate of cultured shrimp (Provincial Ca Mau DOF, 2017). The improvement of farm management skills to prepare for ASC application might be helpful for shrimp farmers to utilize efficiency in uses of labors, land, infrastructures and other costs as well. Besides that, shrimp farmers received the sponsorship from X Company, not only for ASC application costs, but also for input costs. It helped shrimp farmers to extend and/or maintain their farms operation. This sponsorship supported to shrimp farmers for dealing with lack capital. In contrast, shrimp farmers might need to loan credit capital from both, formal and informal organizations with high rate interests.

6.4.2 Concepts of costs and benefits in CBAs from the changes in revenue of ASC farms

Under ASC application, farmers were guaranteed for the uncertainty of the market price by contracted agreement with processing company. Morris and Young (2000) addressed that, a higher price was the best motivation to encourage for the application of quality assurance at farm stages of supply chain. We, therefore, assumed that the received farm gate price of farmers under ASC application progress must be higher than the price paid to common farmers in order to enhance to application for ASC certificates.

Besides that, under ASC application, shrimp farms applied a strict production procedure to adapt the requirements of ASC standards. Moreover, ASC farmers were also trained the farms' management skills to improve the farm efficiency. On the other hand, the processing company specified the input suppliers to ensure the good quality of input used. Those activities were expected to create a higher output quantity for shrimp farms.

The changes in revenue of application for ASC certificates, therefore, might come from both of the differences of unit price and output quantity.

- ✓ **Differences of price premium**

During our survey in 2017, ASC certificates had not issued for farmers yet. Therefore, the shrimp farmers did not get the premium for certified products. The price premium in the latest crop as our study was the received farm gate price only. We, therefore, compared the differences in the farm gate prices paid to ASC and non-ASC farms.

However, as the commitment of X Company, the price premium for ASC certified shrimp products would be 0.09-0.22 USD per kg (~2,000-5,000 VND per kg) from 2018. Since the case of all other factors were fixed as our assumption, the farm-gate price received by ASC farms from 2018 was equals to the sum of farm-gate price in 2017 and the committed premium. In this study, the committed premium from processing company was applied with the highest range at 0.22 USD per kg to estimate and to compare the differences of revenue between ASC and non-ASC farms from 2018.

- ✓ **Differences of output quantity**

On the other hand, to prepare for ASC application procedures, farmers were trained for advanced technology, not only to adapt the requirements of ASC standards but also to improve productivity and farm management skills, such as reducing waste in input uses,

minimizing the damages of diseases, etc. Therefore, under ASC application procedures, on average, the output quantity per 1,000m^2 of farms were expected to be higher than non-ASC farms. The differences in output quantity between ASC and non-ASC farms were assumed to be fixed during our analysis.

6.4.3 Net benefits of the application for ASC certificates of shrimp farmers

The net benefits for the application of ASC certificates were the differences between the benefits and the costs in CBAs concepts. In this study, the application of ASC certificates charged the costs for ASC applications and maintenances to shrimp farmers. It meant that shrimp farmers must paid more the extra cost to apply ASC certificates. However, the application of ASC was even expected to help for the changes in production costs and revenue as we presented above. We expected the net benefits of CBAs approaches were larger than zero. In other words, the reduction in production costs and the increases in revenue at ASC farms might cover the payments for application and maintenance of ASC certificates.

Let defined the basic for comparative net benefits function between ASC and non-ASC farms:

$$\Delta\pi = \underbrace{((P_A + P_P) * Q_A - P_{NA} * Q_{NA})}_{\Delta PQ} - \underbrace{((I_A * e_A - I_{NA} * e_{NA})}_{\Delta Ie} + C_A)$$

where $\Delta\pi$ was the net benefits of application for ASC application; P_A farm gate price of ASC farms; Q_A harvested quantity of ASC farms; P_{NA} farm gate price of non-ASC farms; Q_{NA} harvested quantity of non-ASC farms; I_A used quantity of inputs at ASC farms; e_A price of input used at ASC farms; I_{NA} used quantity of inputs at non-ASC farms; e_{NA} price of input used at non-ASC farms; P_P price premium from company processing for certified ASC products from 2018; C_A costs for ASC application;

Hence, ΔPQ and $\Delta P'Q$ were represented for the differences in the revenue between ASC and non-ASC farms; while as ΔIe the differences in the production costs between those farms in 2017 and from 2018, respectively.

Table 6.3. The evaluation of the benefits from ASC application

Results of comparison	Description		Conclusion of CBAs
	2017	From 2018	
$\Delta\pi > 0$	$\Delta PQ > \Delta Ie$	$\Delta PQ > (\Delta Ie + C_A)$	ASC application created more benefits: Confirmed
$\Delta\pi < 0$	$\Delta PQ < \Delta Ie$	$\Delta PQ < (\Delta Ie + C_A)$	ASC application created more benefits: Not confirmed
$\Delta\pi = 0$	$\Delta PQ = \Delta Ie$	$\Delta PQ = (\Delta Ie + C_A)$	ASC application created more benefits: Not confirmed

6.4.4 The conceptual function to suggest the balance price

Based on the results of CBAs approaches, the price of shrimp products in order to balance the costs and benefits of the application of ASC certificates would be suggested based on the following concepts:

$$P_S = P_F - \Delta\pi$$

where P_S presented for the suggested price, P_F indicated for farm gate price was received of ASC farms, conducted in the latest completely crop from our survey. $\Delta\pi$ indicated for the "*Net Benefit*" of the results of CBAs approaches.

Hence, the suggested price (P_S) would be less than the farm gate price (P_F) if the net benefit ($\Delta\pi$) was larger than zero. Otherwise, it would be higher than the farm gate price (P_F) if the net benefit ($\Delta\pi$) were less than zero (Table 6.4).

Table 6.4. The identification of suggested price

Net Benefits ($\Delta\pi$)	Estimated results of suggested price
> 0	Suggested price (P_S) < Farm gate price (P_F)
< 0	Suggested price (P_S) > Farm gate price (P_F)
=0	Suggested price (P_S) = Farm gate price (P_F)

6.5 The results of production costs, revenue, farm efficiency and CBAs approaches from the interview survey at Ca Mau province, Mekong Delta, Vietnam

6.5.1 For *P. monodon* farms

6.5.1.1 The structures of production costs

The results of our sampling indicated the structure of variable costs and fix costs in *P. monodon* farms as Table 6.5. The results also showed that, variable costs accounted more than 99% of total costs in both ASC and non-ASC *P. monodon* farms. While as fix costs were less than 1% of total costs. We also found that, shrimp farmers with ASC application spent more money for variable costs than non-ASC farms. This result might be explained because farms with ASC application progress was changing the cultured systems from extensive to intensive cultured method, which required more investments, especially the spending in the costs for seed and feed inputs.

Table 6.5. Description of production costs in *P. monodon* shrimp farms

Production Costs	ASC (N=7)		Non-ASC (N=60)		Differences between ASC and non-ASC farms
	in USD*	%	in USD*	%	in USD*
Fix costs	3.22	0.19	2.86	0.19	0.36
Variable costs	1,690.58	99.81	1,533.11	99.81	157.47
Total	1,693.80	100.00	1,535.97	100.00	157.83

Note: *USD per 1,000 m^2 per crop.

✓ **Variable costs**

The Figure 6.3 described the structure of variable costs for one crop of *P. monodon* shrimp farms. Accordingly, feed cost was the largest cost of *P. monodon* shrimp farms, both for ASC and non-ASC farms. However, in non-ASC farms, the proportion of costs for feed was about 47%, while as it was only 38% in the ASC farms. Similarly, the costs of drug and chemical were at approximately 10% in ASC farms. This proportion was found at 17% in non-ASC farms. The water treatment cost in total production costs was also found the smaller proportion in ASC farms, comparing to non-ASC farms. The differences of those costs' proportion between ASC and non-ASC farms might be because the farms in application for ASC progress was well trained in farm management skills to utilize the inputs used such as feed, chemical and drug as we earlier mentioned. Moreover, this result might be explained because the chemical and drug used were also limited to follow the standards of ASC certificates.

However, we found the ASC farms had considered to the other variable costs as described follows. Family labor cost was about 36% in ASC farms, but it was indicated about 25% in non-ASC farms. The costs for seed accounted about 6.5% of total variable costs in ASC farms, while as it was only 4.8% in non-ASC farms. The proportion of costs for electricity and hired labors were also higher in ASC farms, comparing to non-ASC farms. The application of ASC certificates might factor to the differences in structures of those variable costs. For example, ASC farms were required to use the good quality with the health's testing certificates as requirements of processors. As we already mentioned, cooperative's committee might negotiate a good price. However, the price of seed used by ASC farms might be still higher than the normal seed without quality consideration. One more reason might be the changing in the cultured methods from extensive to intensive. The seed costs, thus, accounted a higher proportion in ASC farms. The changing of cultured systems might also lead to the high consideration to electricity system, and the higher demand for labor costs.

The others of variable costs included interest, pond treatment and transportation. However, those costs were very small in both ASC and non-ASC shrimp farms. The absolutely value of each variable cost would be presented later.

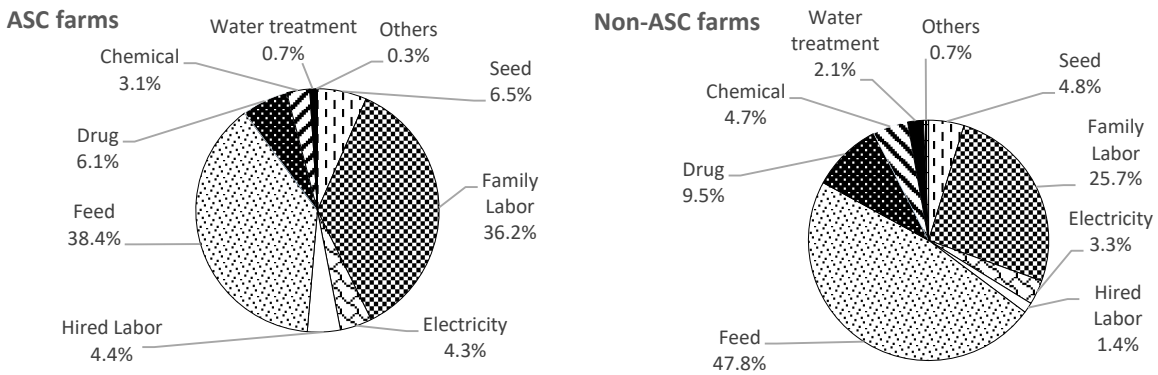


Figure 6.3. The structure of variable cost in *P. monodon* shrimp farms calculated from the interview survey 2017

✓ **Fix costs**

Table 6.6 presents the fix costs composition of *P. monodon* farms for both ASC and non-ASC farms infrastructures hired land and family land were included in fix costs. ASC farms spent more money for fix costs than non-ASC farms. We found the farmers with ASC application invested more infrastructures as the requirements of ASC standards. Therefore, the proportion of infrastructure cost in ASC farms was also higher than non-ASC farms. The rest of fix costs were the spending for land costs.

Table 6.6. The structure of fix cost in *P. monodon* shrimp farms calculated from survey 2017

Fix costs	ASC (N=22)		Non-ASC (N=19)		Differences between ASC and non-ASC farms
	in USD*	%	in USD*	%	in USD*
Infrastructures	2.22	68.92	1.74	60.64	0.48
Land Hired	0.00	0.00	0.24	8.21	-0.24
Land Family	1.00	31.08	0.89	31.15	0.11
Total	3.22	100.00	2.86	100.00	0.36

Note: *USD per 1,000 m^2 per crop.

6.5.1.2 Farm efficiency

The comparison of efficiency between ASC and non-ASC shrimp farms was presented in Table 6.7. Farms under ASC application need to spend more costs than non-ASC farms. We found that, the total costs of ASC farmers were about 10% higher than the farms without application for ASC certificates.

Revenue was the multiplication results of farm gate price and output quantity, which of those increasing led to the positive affecting to the revenue. The result indicated that, output quantity was higher at 6.67% in ASC farms, comparing to non-ASC farms, indicating a positive signal of ASC application to create the higher revenue.

However, the recent results showed that, the increasing of output quantity could not compensate for the less of farm gate price paid to ASC farmers, comparing to non-ASC farmers. Found results showed that, on average, ASC farms received farm gate price at 8.98 USD per kg for *P. monodon* shrimp. While as, the received price of non-ASC farms was about 10.39 USD per kg. Hence, the farm gate price of ASC *P. monodon* shrimp farms less than 1.41 USD per kg in 2017 (~ 13.5%), comparing to the non-ASC farms. It resulted of the less revenue of ASC farms than non-ASC farms at 280.75 ($\sim 7.81\%$) USD per 1,000 m^2 per crop. The higher in costs and less than in revenue of ASC farms result of the less profit at 438.58 (~21%) USD per 1,000 m^2 per crop than in non-ASC farms.

Income indicator was calculated by the excluding of family costs from production costs. It was the exactly monetary value which received by shrimp farms. Shrimp farmers, therefore, might have more considered in income indicator than profit. In our sampling, family labor cost in ASC farms was higher than non-ASC farms at 217.42 (~ 55%) USD per 1,000 m^2 per crop. In this study, ASC farms were changing the culture systems from extensive to intensive. It required the higher demand for shrimp labors in ASC farms. We, found that,

ASC farms could get about more than 2,232 USD per 1,000m^2 per crop for income. While as, non-ASC farms get the more than 2,453 USD per 1,000m^2 per crop. The differences of income category between ASC and non-ASC farms had reduced after excluding family labor cost, comparing to profit indicator.

We now present for the farm efficiency ratios within one crop of two groups of shrimp farms. The results of our sampling indicated that, profit per total costs ratios of ASC and non-ASC farms were at 0.96 and 1.34, respectively. It meant that, for one invested USD into production costs, ASC farms got 0.96 USD in profit only. Otherwise, for everyone invested USD into production costs, non-ASC farms created 1.34 USD in profit.

Similarly, the income per total costs ratio also indicated a higher result in non-ASC farms. Our results showed that, ASC farms only created 1.32 USD for every USD paid for production costs. Meanwhile, non-ASC farms got 1.6 USD for each invested USD into total costs. The differences in profit per total costs and income per total cost ratios could confirm the role of family labors in shrimp farms. Farmers maintained shrimp farms operation as one of income sources for their livelihood.

Table 6.7. Efficiency of *P. monodon* shrimp farms calculated from survey 2017

Unit: USD per 1,000 m^2 per crop

Categories	ASC	Non-ASC	Differences between ASC and non-ASC farms
Fix costs	3.22	2.86	0.36
Variable costs	1,690.58	1,535.97	154.62
Production costs	**1,693.80**	**1,535.97**	**157.83**
Unit price	8.98	10.39	-1.41
Output quantity	369.11	346.04	23.07
Revenue	**3,314.61**	**3,595.36**	**-280.75**
Profit	**1,620.81**	**2,059.39**	**-438.58**
Family labor cost	611.57	394.15	**217.42**
Income	**2,232.38**	**2,453.54**	**-221.16**
Efficiency			
Profit/production costs* (times)	0.96	1.34	-0.38
Income/production costs* (times)	1.32	1.60	-0.28
Profit per unit of output* (USD per kg)	4.39	5.95	-1.56
Income per unit of output* (USD per kg)	6.05	7.09	-1.04

Note: *The unit was presented as text in the parenthesis.

6.5.1.3 CBAs analysis

This section presented the results of CBAs analysis for two groups of *P. monodon* shrimp farms, with and without ASC application. The revenue and price premium were investigated before the changes in production costs of ASC and non-ASC farms were presented. Finally, the calculation of net benefits of ASC application would be presented.

✓ **The differences of revenue**

Table 6.8 presents the calculated revenue for one crop of shrimp farms with and without application for ASC farms based on the data of our survey in 2017. The revenue from 2018, then, was estimated based on the committed price premium of the X Company.

Table 6.8. The difference of revenue between ASC and non-ASC farms: the case of *P. monodon* farms

Categories	Unit	ASC		Non-ASC	Differences between ASC and non-ASC farms	
		2017	From 2018		2017	From 2018
Unit price	USD per kg	8.98	9.20*	10.39	-1.41	-1.19
Output quantity	Kg per 1,000 m^2	369.11	369.11	346.04	23.07	23.07
Revenue	USD per 1,000 m^2	3,314.61	3,395.81	3,595.36	-280.75	-199.54

Note: * The value was presented based on the current farm-gate price (8.98 USD per kg) plus the committed premium of X Company (0.22 USD per kg).

The indicated results were not as expectation since the ASC shrimp farmers could not receive the higher price in 2017. From 2018, even if we assumed the farmers would get the price premium as the commitment of the X Company, the farm-gate price of *P. monodon* shrimp of ASC farms does not equal to the received price of non- ASC farms. We found the improvement of output quantity under ASC application. However, the higher revenue of ASC farms could not be confirmed, comparing to non-ASC farms due to the less of farm gate price.

Hence, the revenue of ASC farms was found to be lower than non-ASC farms. The differences in revenue between ASC and non-ASC farms, therefore, were a negative value. The differences in revenue were used to apply for CBAs analysis. The negatively different revenue between ASC and non- ASC farms, thus, would factor to the decreases of net benefits in CBAs analysis. The details would be discussed in the next sections of this Chapter. However, we firstly addressed the comparison of production costs composition to clarify the costs and benefits of ASC application in CBAs framework in the next section. The reduction in costs of ASC farms might be defined as a benefit of CBAs framework. Otherwise, the increasing in costs was a cost of CBAs.

✓ **The differences of production costs**

Table 6.9 presented the differences of production costs between ASC and non-ASC farms to clarify the changes of each production cost composition.

In whole, ASC farmers paid the higher production costs at 157.8 ($\sim 10\%$)USD per 1,000 m^2 per crop, comparing to non-ASC farms. Found results, again, were not concordant as we expected. Among production costs, the differences of labors costs, both family labor and hired labor costs between ASC and non-ASSC farms were highest. Following was the seed, transportation, infrastructure, electricity and family land. Notably, the family labor cost was one of the main compositions of production costs in shrimp farms. Thus, its higher rate might

have the significant affecting to the differences of production costs of *P. monodon* shrimp farms between ASC and non-ASC farms. Then, the larger differences of production cost might influence the net benefits in CBAs analysis.

Table 6.9. The differences of production costs between ASC and non-ASC farms of *P. monodon* shrimp

Categories	ASC (N=7)	Non-ASC (N=60)	Differences between ASC and non-ASSC farms	
	in USD*	in USD*	in USD*	%
Family Labor	611.6	394.2	217.4	55.2
Hired Labor	73.9	21.5	52.4	243.6
Seed	110.6	73.2	37.4	51.1
Electricity	72.0	50.7	21.3	42.0
Transportation	2.9	2.2	0.7	31.2
Infrastructure	2.2	1.7	0.5	27.9
Family Land	1.0	0.9	0.1	12.2
Hired Land	0.0	0.2	-0.2	-100.0
Interest	0.1	1.2	-1.0	-88.3
Others	0.2	3.1	-2.9	-93.0
Pond treatment	1.3	4.2	-2.9	-69.5
Water treatment	12.7	32.2	-19.6	-60.7
Chemical	51.7	72.7	-21.0	-28.9
Drug	103.8	145.5	-41.7	-28.7
Feed	650.0	732.5	-82.5	-11.3
Total costs	**1,693.8**	**1,536.0**	**157.8**	**10.3**

Note: * USD per 1,000 m^2 per crop.

However, we also found ASC farms could save the rest of production costs such as feed, drug, chemical, pond treatment, water treatment, interest, hired land and other production costs. The lower production costs of ASC farms were the positive signals because it created the higher value of net benefits in CBAs analysis framework. It also presented the efficiency of input used of ASC farms. Especially, feed costs were the highest payment of total production costs in shrimp farms, but was lower under ASC application. Other important costs such as drug, chemical and water treatment were also less in ASC farms, compare to non- ASC farms. It might be explained because the shrimp farms under ASC application were trained the skills of farm management, and must invest to their farm operation as the requirement of ASC standards. Therefore, the uses of land resources and infrastructure might be better controlled in ASC farms.

- **Net benefit**

The results of CBAs indicated the negative value of net benefit (Table 6.10). It meant that, if the other affecting factors were fixed as our assumption, the application of ASC could not create the benefits for *P. monodon* shrimp farms as the expectation even though farmers received the sponsorship and price premium from processing company and Local Government.

Table 6.10. The results of CBAs analysis for *P. monodon* shrimp farms

Unit: USD per 1,000 m^2 per crop

Categories		2017	2018-2019	2020	2021-2022	2023
Revenue and premium	ASC	3,314.61	3,395.81	3,395.81	3,395.81	3,395.81
	Non-ASC	3,595.36	3,595.36	3,595.36	3,595.36	3,595.36
	ΔPQ	-280.75	-199.55	-199.55	-199.55	-199.55
Production costs	ASC	1,693.80	1,693.80	1,693.80	1,693.80	1,693.80
	Non-ASC	1,536.00	1,536.00	1,536.00	1,536.00	1,536.00
	ΔIe	157.80	157.80	157.80	157.80	157.80
ASC costs pay by farmers	C_A	0	164.04	222.52	164.04	444.74
Net benefit	$\Delta\pi$	-438.55	-521.39	-579.87	-521.39	-802.09
Unit benefit (USD per kg)*		-1.19	-1.41	-1.57	-1.41	-2.17

Note: *The quantity of ASC farms were 369.11 kg per 1,000 m^2 per crop.

6.5.2 For *L. vannamei* farms

This part described the detail of production costs, revenue, farm efficiency and the results of CBAs analysis for *L. vannamei* shrimp farms.

6.5.2.1 The structure of production costs

In terms of production costs structure, the situation of *L. vannamei* farms was almost similar as *P. monodon* farms. For both ASC and non-ASC farms, variable costs accounted about 99% of total costs, while as fix costs were only 1% of total production costs (Table 6.11)

Table 6.11. The structure of production costs in *L. vannamei* shrimp farms

Production costs	ASC (N=22)		Non-ASC (N=19)		Differences between ASC and non-ASC farms
	in USD*	%	in USD*	%	in USD*
Fix costs	8.93	0.27	39.08	1.05	-30.15
Variable costs	3,255.10	99.73	3,665.16	98.95	-410.07
Total	**3,264.03**	**100**	**3,704.24**	**100**	**-440.21**

Note: *USD per 1,000 m^2 per crop.

However, differences from *P. monodon* farms, *L. vannamei* farms under ASC application spent less monetary value for both variable and fix costs than non-ASC farms. As our results, ASC farms invested more than 3,264 USD per 1,000m^2 only. Meanwhile, non- ASC farms spent more than 3,700 USD per 1,000 m^2 for one crop, indicating a positive signal for *L. vannamei* shrimp farms under the application for ASC certificates progress because the saving of production costs might be resulted of the higher efficiency in input used of ASC farms.

✓ **Variable costs**

A half of total variable costs in *L. vannamei* farmers of our sampling was the feed cost. This result was reasonable because *L. vannamei* shrimp was mostly cultured in intensive systems, even though with or without application for ASC certificates. Therefore, not only the costs for feed, but also seed, drug and chemical costs were more considered.

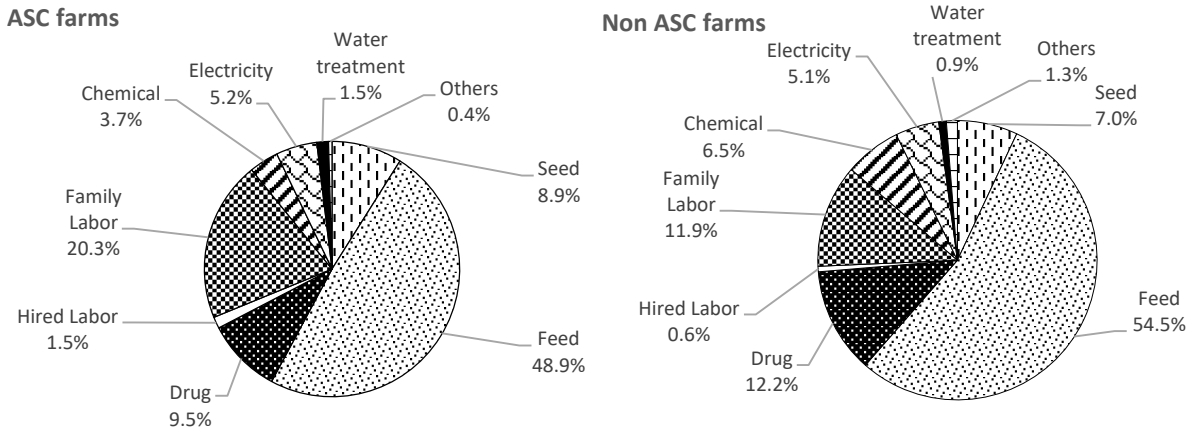


Figure 6.4. The structure of variable costs in *L. vannamei* shrimp farms

The indicated results in Figure 6.4 also presented the differences in the structure of variable costs between *L. vannamei* shrimp farms with and without application for ASC certificates. Similar results as *P. monodon* shrimp farms, we found the feed cost proportion in ASC farms was lower, comparing to the non-ASC farms. The costs for drug and chemical also accounted a higher proportion than non-ASC farms. However, the proportion of seed cost was higher in ASC farms, comparing to non-ASC farms. The proportion of other variable input factors such as electricity, water treatment, interest, pond treatment and transportation were almost similar between ASC and non-ASC farms.

Labor costs in *L. vannamei* farms also included family and hired labors. In our samples, total labor's cost accounted about 22% in ASC farms, and 13% in non- ASC farms. Among this, family cost accounted almost cost for labors with 20% in ASC farms and 12% in non-ASC farms.

✓ **Fix costs**

Infrastructures and family land were the main fix costs in *L. vannamei* farms in our sampling. As described in Table 6.12, the ASC farms spent less money for fix costs than non-ASC farms. On average, ASC farms spent about 9 USD per 1,000 m^2 for one crop, while as non-ASC farms need more than 39 USD per 1,000 m^2 for one crop. The differences in fix costs between ASC and non-ASC farms were at more than 30 USD per 1,000 m^2 for one crop.

The fix costs in both ASC and non-ASC farms were indicated with the similar structure. Infrastructure is the largest fix costs at about 76-77%. Meanwhile, the family land accounted about 14-15%. Both ASC and non-ASC farms hired the land to operate farms. This cost accounted about 9% and 7% in ASC and non-ASC farms, respectively.

Table 6.12. Fix costs in *L. vannamei* shrimp farms

Fix costs	ASC (N=22)		Non-ASC (N=19)		Differences between ASC and non-ASC farms
	in USD*	%	in USD*	%	in USD*
Infrastructures	6.8	76.07	30.16	77.18	-23.36
Land hired	0.81	9.1	2.71	6.94	-1.90
Land family	1.32	14.82	6.21	15.88	-4.89
Total	**8.93**	**100**	**39.08**	**100**	**-30.15**

Note: * USD per 1,000 m^2 per crop.

6.5.2.2 Farm efficiency

This part was to present the farm efficiency of *L. vannamei* farms. Basically, the analyzed procedures were similar as the *P. monodon* farms. The production costs were lower in ASC *L. vannamei* shrimp farms. However, we found that the unit price and output quantity of ASC farms were less than non-ASC farms as indicated in Table 6.13. In the details, the revenue of *L. vannamei* ASC farms was about 4,618 USD per 1,000 m^2 in one crop. Meanwhile, non-ASC farms could get more than 5,829 USD per 1,000 m^2 for revenue in one crop. Thus, the revenue of ASC farms was lower at 1,210 USD per 1,000 m^2 (~20.7%), comparing to non-ASC farms.

Table 6.13. Farm efficiency in *L . vannamei* shrimp farms

Categories	ASC	Non-ASC	Differences between ASC and non-ASC farms
	in USD	in USD	in USD
Fix costs	8.93	39.08	-30.15
Variable costs	3,255.10	3,665.16	-410.07
Production costs	**3,264.03**	**3,704.24**	**-440.21**
Unit price	5.44	6.18	-0.74
Output quantity	**849.17**	**943.16**	-93.99
Revenue	**4,617.79**	**5,827.79**	**-1,210.00**
Profit	**1,353.76**	**2,123.55**	**-769.79**
Family labor cost	661.80	437.84	223.97
Income	**2,015.56**	**2,561.38**	**-545.82**
Efficiency ratios			
Profit/production costs* (times)	**0.41**	**0.57**	-0.16
Income/production costs* (times)	**0.62**	**0.69**	-0.07
Profit per unit of output* (USD per kg)	1.59	2.25	-0.66
Income per unit of output* (USD per kg)	2.37	2.72	-0.34

Note: *The unit was presented as text in the parenthesis.

The calculation results of profit, income and farm efficiency indicators showed that, in current crop, both ASC and non-ASC farms could get the profit from *L. vannamei shrimp* operation. However, the profit and income of ASC farms were still less than non-ASC farms. The calculated results of farm's efficiency indicators showed the differences between ASC and non-ASC farms. For ASC farms, for one USD of invested production costs, farmers could earn 0.41 USD for profit and 0.62 USD for income. Non-ASC farmers could earn more than 0.57 USD of profit and 0.69 USD for one invested production costs.

On average of our samples, profit and income per unit output shrimp of ASC and non-ASC farms were also calculated. Based on the indicated results, we found that, for one kilogram of output *L. vannamei* shrimp, ASC farms received about 1.59 USD profit and 2.37 USD income. Non-ASC farms received the higher values of those indicators. As presented in Table 6.13, for each kilogram of output *L. vannamei* shrimp, the profit and income of ASC farms were lower at 0.66 USD and 0.34 USD, respectively, comparing those of non-ASC farms.

6.5.2.3 CBAs analysis

The results of CBAs framework for *L. vannamei* shrimp farms were presented in this section. We firstly presented the differences of revenue ASC and non- ASC farms in 2017. The revenue from 2018 was estimated with the commitment of price premium from processing company. The details were presented in Table 6.14 of the next sub-section.

We, then, investigated the comparison of production costs between ASC and non-ASC farms. Finally, the net benefits were aggregated based on the calculated of revenue, production costs, coupled with the costs of ASC application.

- ✓ **Differences of revenue**

The revenue of ASC *L. vannamei* farms was less than the revenue of non-ASC farms at about 20% in 2017. From 2018, even though the certified ASC shrimp might get the price premium from processing company, the estimated revenues were lower than the non-ASC shrimp farms at approximately 17.5% (Table 6.14).

Table 6.14. Differences of revenue between ASC and non-ASC farms of *L. vannamei* shrimp calculated and estimated based on the data from survey 2017

Categories	Unit	ASC		Non-ASC	Differences between ASC and non-ASC farms	
		2017	From 2018		2017	From 2018
Unit price	USD per kg	5.44	5.66	6.18	-0.74	-0.52
Output quantity	Kg per 1,000 m^2	849.17	849.17	943.16	-93.99	-93.99
Revenue	USD per 1,000 m^2	4,617.79	4,804.60	5,827.79	-1,210.00	-1,023.18

- ✓ **The differences in production costs**

As showed in Table 6.15, on average, we found ASC *L. vannamei* shrimp farms might save approximately 440 USD per 1,000 m^2 per crop in the latest crop of our survey, comparing to non-ASC farms. Among this, the largest costs saved at ASC farms included the input's costs such as feed, chemical and drug. However, ASC farms must spend more for family labor, seed, hired labor and water treatment costs.

Table 6.15. The differences of production costs between ASC and non-ASC farms of *L. vannamei* shrimp, calculated from interview survey 2017

Production costs	ASC	Non-ASC	Differences between ASC and non-ASC farms	
	in USD*	in USD*	in USD*	%
Family Labor	661.8	437.8	224.0	51.2
Seed	291.0	256.1	35.0	13.7
Hired Labor	47.2	23.3	23.9	102.8
Water treatment	47.8	32.2	15.6	48.6
Others	7.7	2.0	5.7	280.1
Transportation	0.2	0.4	-0.2	-40.9
Hired Land	0.8	2.7	-1.9	-70.0
Family Land	1.3	6.2	-4.9	-78.7
Interest	0.2	6.8	-6.6	-97.8
Electricity	169.6	185.7	-16.1	-8.7
Infrastructure	6.8	30.2	-23.4	-77.5
Pond treatment	6.2	37.5	-31.3	-83.4
Chemical	121.1	239.3	-118.2	-49.4
Drug	310.1	447.6	-137.5	-30.7
Feed	1,592.1	1,996.6	-404.5	-20.3
Total costs	**3,264.0**	**3,704.3**	**-440.2**	**-11.9**

Note: * USD per 1,000 m^2 per crop.

✓ **The net benefits**

Table 6.16 presented the results of CBAs framework for *L. vannamei* shrimp farms. We also showed the calculation of CBAs for one crop in 2017, and the estimation from 2018-2023. From the results, we also found that, the application of ASC certificates could not create the benefits for *L. vannamei* farmers as expectation, even if farmers could get the sponsorship from processing company.

Table 6.16. The results of CBAs of *L. vannamei* shrimp calculated from the survey 2017

Unit: 1,000 m^2 per crop

Categories		2017	From 2018			
			2018-2019	2020	2021-2022	2023
Revenue and premium	ASC	4,617.8	4,804.6	4,804.6	4,804.6	4,804.6
	Non-ASC	5,827.8	5,827.8	5,827.8	5,827.8	5,827.8
	ΔPQ	-1,210.0	-1,023.2	-1,023.2	-1,023.2	-1,023.2
Production costs	ASC	3,264.0	3,264.0	3,264.0	3,264.0	3,264.0
	Non-ASC	3,704.2	3,704.2	3,704.2	3,704.2	3,704.2
	ΔIe	-440.2	-440.2	-440.2	-440.2	-440.2
ASC costs pay by farmers	C_A	0.0	84.6	114.7	84.6	229.3
Net benefit	$\Delta\pi$	-769.8	-667.5	-697.7	-667.5	-812.2
Unit benefit (USD per kg)*		-0.9	-0.8	-0.8	-0.8	-1.0

Note: * The output quantity of ASC farms were 849.17 kg per 1,000 m^2 per crop.

6.5.3 The suggestion of balanced price

Based on the results of the CBAs analysis, the suggested balance prices for both *P. monodon* and *L. vannamei* shrimp species (Table 6.17).

Table 6.17. The suggestion of the price for shrimp products calculated from the analyzed results.

Unit: USD per kg

Shrimp species	Categories	2017	2018-2019	2020	2021-2022	2023
P. monodon	Unit benefit	-1.19	-1.41	-1.57	-1.41	-2.17
	Unit price	8.98	8.98	8.98	8.98	8.98
	Suggested price	10.17	10.39	10.55	10.39	11.15
L. vannamei	Unit benefit	-0.91	-0.79	-0.82	-0.79	-0.96
	Unit price	5.44	5.44	5.44	5.44	5.44
	Suggested price	6.35	6.23	6.26	6.23	6.40

In our assumption, we ignored the changes of farm gate price at current crop. Based on the results of CBAs analysis in the study, the net benefit of application for ASC certificates was less than zero. Thus, the price of shrimp products under application for ASC certificates should bé higher than the currently received price in order to balance the costs and benefits of the application for ASC certificates. In the details, the farm gate price of *P. monodon* shrimp products under ASC application should be paid at 10.17 USD per kg in 2017. Since the costs for application of ASC certificates was assumed to be paid by shrimp farmers from 2018, the price should be decided from 10.39-11.15 USD per kg for balancing the costs and benefits for ASC shrimp farms, comparing to non-ASC farms.

For *L. vannamei* shrimp products, we suggested the farm gate price of certified ASC products should be decided at 6.35 USD per kg in 2017s. From 2018, the price should be from 6.23-6.4 USD per kg to balance for the costs and benefits of shrimp farmers under ASC application.

Hence, as the commitment of X Company, from 2018, the farm-gate price of ASC certified shrimp products would be paid at 9.20 USD per kg for *P. monodon* shrimp and 5.44 USD per kg for *L. vannamei* shrimp products. Comparing to our suggested price, those committed price was not enough in order to ensure the balance in the costs and benefits for shrimp farmers under application for ASC certificates.

6.5.4 Aggregation of both shrimp species

6.5.4.1 Farm efficiency

The earlier parts of this Chapter conducted the differences in farm efficiency that caused of application of ASC certificates for both shrimp species, *P. monodon* and *L. vannamei*. Table 6.18 and Figure 6.5 presented for the aggregation of the unit price, production costs and profit of ASC and non-ASC farms in for *P. monodon* and *L. vannamei* shrimp products.

As described in Table 6.18 and Figure 6.5, on average, the unit fix costs of both shrimp species were very small, compare to total production costs. Our results were corresponded to the previously works on the production costs of Vietnamese shrimp farms of Ling *et al*. (1999); Hasan (2007) and DANIDA (2010) whereby the fix costs of shrimp farms was found from 1-5% of total production costs. These results meant that, even if the output quantity was increased, the reduction of production costs was negligible. Thus, the unit production costs curve were described as horizontal curve as in Figure 6.5 (a) and (b) for both shrimp species, *P. monodon* and *L. vannamei* shrimp.

Table 6.18. The differences in unit price, production costs and profit between ASC and non-ASC farms by shrimp species

Unit: USD per kg

Categories	*P. monodon*			*L. vannamei*		
	ASC	Non-ASC	Differences between ASC and non-ASC farms	ASC	Non-ASC	Differences between ASC and non-ASC farms
Price	8.98	10.39	-1.41	5.44	6.18	-0.74
Production costs	4.59	4.44	0.15	3.84	3.93	-0.08
Profit	4.39	5.95	-1.56	1.59	2.25	-0.66
Profit/production costs* (times)	0.96	1.34	-0.38	0.41	0.57	-0.16
Output quantity* (kg per 1,000 m^2)	369.11	346.04	23.07	849.17	943.16	-93.99

Note: *The unit was presented as text in the parenthesis.

The unit price received by ASC farms was lower, compare to non- ASC farms for both shrimp species, *P. monodon* and *L. vannamei* shrimp. The presented unit price curves of Figure 6.5 confirmed the less unit price of ASC certified products than non-ASC certified products. Despite of the addition of premium, the unit price paid to ASC farms was still lower than the unit price of non-ASC shrimp products.

For *P. monodon* shrimp farms, the application for ASC certificates created a good signal with the higher in output quantity. However, the less of unit output price caused of the lower profit of *P. monodon* ASC farms. For the case of *L. vannamei*, both unit price and output quantity of ASC farms were lower than non-ASC farms. The additional price premium to the price also could not create the better situation for ASC farms.

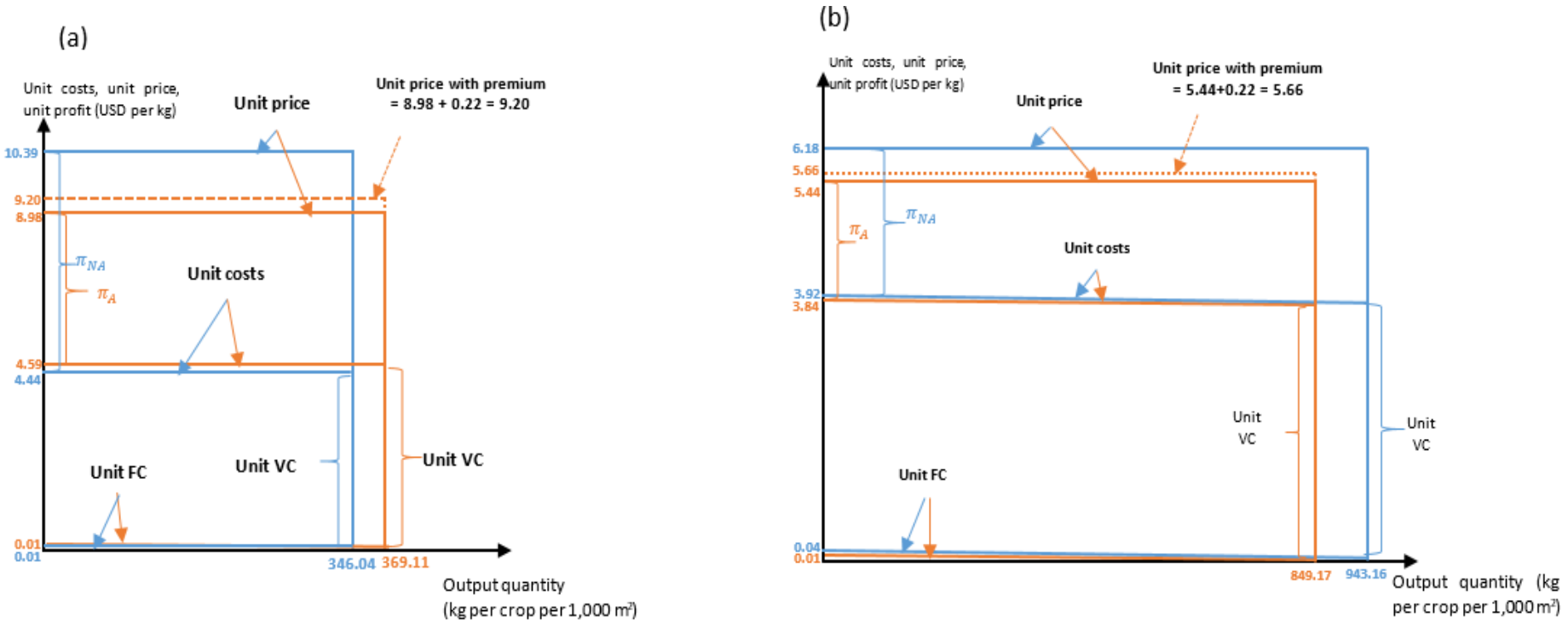


Figure 6.5. (a) The unit price, unit costs, unit profit and output quantity of *P. monodon* shrimp and (b) those indicators for *L. vannamei* shrimp summarized from the analyzed results of this Chapter. Note: the orange color presented for ASC farms' indicators; the blue color presented for non-ASC farms' indicators; A was the abbreviation of ASC farms, NA was the abbreviations of ASC farms; **π** was defined as unit profit; FC was the abbreviation of fix costs; VC was the abbreviation of variable costs.

6.5.4.2 The results of CBAs analysis and the suggested price

We applied the framework of CBAs analysis to estimate the benefit of application for ASC certificates to shrimp farms, comparing to non-ASC farms. We summarized the estimation of net benefits from CBAs for *P. monodon* and *L. vannamei* shrimp species as presented in Table 6.19.

Table 6.19. The summarized of ASC application cost and net benefits of CBAs by shrimp species

Unit: *USD per 1,000m2 per crop; **USD per kg

Categories	Shrimp species	2017	2018-2019	2020	2021-2022	2023
ASC application costs pay by farmers*	*P. monodon*	0	164.04	222.52	164.04	444.74
	L. vannamei	0	84.56	114.7	84.56	229.25
Net benefit*	*P. monodon*	-438.58	-521.41	-579.89	-521.41	-802.11
	L. vannamei	-769.21	-667.54	-697.1	-667.5	-812.23
Unit ASC cost**	*P. monodon*	0.00	0.44	0.60	0.44	1.20
	L. vannamei	0.00	0.10	0.14	0.10	0.27
Unit benefit**	*P. monodon*	-1.19	-1.41	-1.57	-1.41	-2.17
	L. vannamei	-0.91	-0.79	-0.82	-0.79	-0.96
Suggested balance price**	*P. monodon*	10.17	10.39	10.55	10.39	11.15
	L. vannamei	6.35	6.23	6.26	6.23	6.40

The application for ASC certificates led to the negative benefit for shrimp farms of both two species, *P. monodon* and *L. vannamei* shrimp. In other words, the shrimp farms had to deal with the higher costs to apply for ASC certificates, both in production costs and cost for application in cases if the sponsorship from processors would be unavailable. However, the received price of certified products was not high enough to cover the increasing of those costs. Therefore, the discrimination in the farm gate price of the certified products with the non- ASC products should be considered, not only to balance the costs and benefits of application for ASC but also to enhance the shrimp farmers to apply for the ASC certificates.

However, in the CBAs approaches, we found that, ASC farms might save the costs of input factors such as feed, chemical, drug, pond treatment and water treatment costs, comparing to those of non-ASC farms. We supposed that shrimp farmers with application for ASC certificates were trained the advance technology in shrimp cultured activity, supporting them in the uses of inputs factors. Our results were suggesting that, maybe, the application of ASC certificates might not currently create the benefits to shrimp farms. However, the reduction of input's costs noticed a possible signal in the future to help to improve the performance of shrimp farms under ASC application.

6.5.4.3 Factor affecting to production costs of shrimp products

Before going to present the results of GLM models, we found the probability distribution of total cost variable was Poisson distribution. The basic principle of the variable with Poison distribution was equi-dispersion. This mean that the mean of the variable was equals to its covariance. However, the fact that the variable used with Poisson distribution might be over-dispersed because the covariance was normally larger than the mean of

variable. For GLM model with over-dispersion variables, the overestimates of $\mathbb{Z}$ ratio of estimated parameters in the results may be a problem. To adjust the bias of over-dispersion problem, GLM model with negative binominal distribution could be used to replace to GLM model with Poisson distribution (Gujarati, 2004).

In this study, the results of GLM with Poisson distribution indicated the Pearson dispersion statistic of total cost function at larger than 1. This result confirmed the existence of the over-dispersion. Therefore, GLM model with negative binominal distribution was used to adjust the over-dispersion problem. The coefficients resulting from the GLM models of total cost function by using Stata 11.0 software (Table 6.20).

Table 6.20. The affecting factors to production costs in shrimp farms: the estimated results of GLM model

Variables	Coefficient
ASC	0.019
Shrimp species	0.011
Methods	4.085*
Seed	0.018*
Feed	0.005*
Chemical	0.078*
Family labor	0.009*
Seed*method	-0.018*
Feed*method	-0.005*
Chemical*method	-0.077*
Family labor*method	-0.009*
Constant	3.194*
AIC	14.261
Log likelihood	-758.071
Observation included	108

Note: * indicated statistical significance levels at 5%.

Based on the results of GLM models, we found the interaction effects of cultured methods and costs for seed, feed and family labor $(p < 0.01)$ to the production cost. The interaction of chemical cost and cultured method was also indicated the significant influence to production costs $(p < 0.01)$. Thus, the GLM results confirmed that, there was the interaction affecting of cultured method to the changes of total production costs. The affecting of costs composition to production cost may be different between differences cultured systems.

From the GLM models, the costs for major inputs such seed $(p < 0.05)$, feed $(p < 0.01)$, chemical $(p < 0.05)$, and family labor $(p < 0.01)$ positively effected to total production cost of shrimp farms. This result indicated that the increasing of those costs resulted of the increasing of production cost.

6.6 Discussion

6.6.1 Uncertainty indicators

The application of ASC certificates was expected to increase the revenue of shrimp farmers because of the increasing of price premium and the output quantity. However, in this study, the revenue of ASC farms, for both *P. monodon* and *L. vannamei* farms, was less than non-ASC farms. In our sampling, the comparison between unit price of shrimp products with ASC and non-ASC application presented the lower unit price of products with ASC application, both cases of *P. monodon* and *L. vannamei* shrimps at 13.57% and 11.97%, respectively. Even though we supposed the farmers got the highest sponsorship as the commitment of processing companies from 2018, the unit price of ASC certified shrimp products was still less than the ordinary products.

Unit price aside, output quantity was also expected to increase under ASC application. However, in our sampling, only *P. monodon* farms could improve the output quantity about 6.7%. The improvement of output quantity in *P. monodon* farms could not cover the negatively different price between ASC and non-ASC farms. For the case of *L. vannamei* farms, the output quantity of *L. vannamei* farms under ASC application was lower 9.97%, comparing to non-ASC *L. vannamei* farms. The application of ASC certificates could not get the higher revenue for shrimp farmers.

The higher of production costs factored to the negatively estimated benefit of CBAs analysis for both *P. monodon* and *L. vannamei* shrimp farms. Under ASC application progress, even though ASC farms could save some production costs component as expected. However, in the comparison of production costs between ASC and non-ASC farms, the increasing of production costs is larger than of those reductions.

However, the results of CBAs framework in this study were investigated with the eliminating the changes of other conditions as our assumptions, including production costs, price and output quantity. Meanwhile, in reality, those factors might change as the fluctuation of the market and other conditions such as weather and diseases. Moreover, the application of quality assurance, such as ASC certificates for farms might not create the benefit for the producers in short terms, at least within the first crop of application. The benefit might come later through the price premium since the customers had awarded about the differences between certified and ordinary products (Bjornlund *et al*., 2017).

Besides that, the increasing of production and ASC application costs were also required for ASC farms. In this study, based on CBAs framework, we compared the production costs between ASC and non-ASC farms for both *P. monodon* and *L. vannamei* shrimp farms. We found that, for the production costs, the increasing due to application for ASC certificates were higher than the decreasing. This result meant that, farmers under ASC application might probably need more money to invest for farms' operation than non-ASC farms, suggesting that shrimp famers were bearing more production costs to apply for ASC certificates. The sponsorship from processing companies and government in 2017 might cover the fees to apply ASC. Farmers did not to pay any more for those fees. However, the price of shrimp products received by ASC farmers was not high enough to cover the increasing of production

costs, even though committed premium of processing company for ASC certified products from 2018s was included.

Especially, among the identified production costs, the main payments for farmed shrimp operation were the costs for family labor and input factors such as feed, seed, chemical and drug. The costs for input factors were calculated based on the provided information of shrimp farmers in our survey. However, the costs for family labor were estimated at market price to hired labor for shrimp farms or the received wages from other activities in case the operation of shrimp farms was stopped. In the previous studies of Dan (2017), Bjornlund *et al.,* (2017), the value of family labor cost was assumed at a half of market price to hire labor. In reality, the family labor costs were the non- cash cost so that the shrimp farmers did not have to pay for this cost. In the sampling of this study, cultured shrimp was the main income source of farmers. Farmers worked on the own shrimp farms without hired labors, especially in extensive farms. Thus, our assumption at market price aimed to ensure that the wages of farmers from shrimp farms were similar to other activities to maintain their daily livelihood. As our calculation, family costs were one of the main costs in shrimp farms, for both *P. monodon* and *L. vannamei* farms.

6.6.2 Production costs may be different by cultured methods

Based on the results of GLM model, we confirmed the affecting of cultured methods to production costs of shrimp farms. Our results were corresponded to the previous scholars of Ling et al., (1999). Accordingly, the intensive shrimp farmers would spent larger production costs, comparing to extensive farms. Maybe, in the CBAs approaches of this study, we could not currently confirm the benefits of the application for ASC of shrimp farms by separated shrimp species analysis. However, the affecting of cultured methods to the production costs might factor to the decision-making procedures of shrimp farmers in each cultured system. These results would be helpful for the discussions in the next Chapters of this study whereby the decision making of shrimp farmers would be expected to be one of the determinations for the implementation of traceability systems.

6.7 Conclusion

The aims of this Chapter were to identify the farms performance and the benefit of application for ASC certificates for *P. monodon* and *L. vannamei* shrimp farms.

Based on the analyzed results of this Chapter, we concluded that, the ASC shrimp farmers could not gain the higher profit as well as the farm's performance, comparing to non-ASC farms for both *P. monodon* and *L. vannamei* shrimp farms. To get the better profit, shrimp famers might reduce the production costs and/or increases the revenue by improvement of both output quantity and farm-gate price. For production costs, in whole, the application of ASC certificates required the higher investments for production costs. Found results of this Chapter even indicated that the fix costs accounted small rate (approximately 1% of total production costs), suggesting more than 98% of total production costs was variable costs. In other words, the increases of output quantity might not create the economics of scale for shrimp farmers. To improve the revenue, the received price of shrimp products became an important factor. However, we found the farm-gate price of shrimp products with ASC

application was lower at approximately14% for *P. monodon* shrimp and 12% for *L. vannamei* shrimp products, comparing to non-ASC shrimp products. Therefore, the current results of this Chapter indicated the lower profit of ASC farms, compare to non-ASC farms.

However, found results indicated that, under ASC application, we found that, shrimp farmers might save some cost's compositions in total production costs, especially input's costs such as feed, chemical and drug costs, suggesting the better utilization of input uses at ASC farms. This result represented the positive signals for shrimp farms in the future. This was because those costs were the main costs of shrimp farms, especially of intensive farms. The reduction of those costs was expected to create the lower production costs and improve the farm's performance for ASC shrimp farms in the future crops.

On the other hand, we found the influencing of cultured methods to the changes of cost composition in shrimp farm operation. Probably, we might not conduct the CBAs analysis of the ASC application for shrimp farmers by cultured methods. However, our results might suggest the differences in culture methods might lead to the differences of production costs composition, which significantly factored to the decision-making progress and the willingness to implement for traceability of shrimp farmers, would be discussed in the next Chapter.

Appendix

A6.1 Costs for ASC application at Cooperative of Cai Bat in 2017

Costs	Total members	Cost per farm (USD)	Total amount of payment (USD)	Payers/Sponsors (USD)		
				Loan	Processors	Farmers
Application and Audit	57	116.96	6,666.67	6,666.67	0	0
Electricity	57	222.22	12,666.54	2,222.22	10,444.32	0
Water	57	222.22	12,666.54	0	12,666.54	0
Waste management	57	100	5,700	0	5,700	0
Labor safety	57	115.6	6,589.2	0	6,589.2	0
Pond	57	444	25,308	0	25,308	0
Total for all members			**69,596.95**	**8,888.89**	**60,708.06**	**0**

A6.2 Cost of capital of Loan from Government

Unit: USD per year

Categories*	2017	2018	2019	2020	2021	2022	2023
Total Loan from Government	17,778.0	17,778.0	17,778.0	17,778.0	17,778.0	17,778.0	17,778.0
Interest rate per year (%)		4	4	4	4	4	4
Interest per year		711.12	711.12	711.12	711.12	711.12	711.12
Total farms	57.0	57.0	57.0	57.0	57.0	57.0	57.0
Interest per year per farm		12.48	12.48	12.48	12.48	12.48	12.48
Pay by farmers		12.48	12.48	12.48	12.48	12.48	12.48

A6.3 Cost of capital of the sponsorship from processing company

Unit: USD per year

Categories	Unit	2017	2018	2019	2020	2021	2022	2023
Total Sponsor	USD	60,708.1	60,708.1	60,708.1	60,708.1	60,708.1	60,708.1	60,708.1
Interest rate per year	% per year		4	4	4	4	4	4
Interest per year	USD per year		2,428.32	2,428.32	2,428.32	2,428.32	2,428.32	2,428.32
Total farms	Farms	57.0	57.0	57.0	57.0	57.0	57.0	57.0
Interest per year per farm	USD per farms		42.6	42.6	42.6	42.6	42.6	42.6
Pay by farmers	USD per farms	0	0	0	0	0	0	0
Sponsor from Processing Company	USD per farms	0.00	42.6	42.6	42.6	42.6	42.6	42.6

Chapter 7. The willingness to implement traceability of shrimp agents along supply chain: the evidences from Ca Mau provinces in Mekong Delta, Vietnam

7.1 Summaries of the implementation of traceability systems for shrimp products in Mekong Delta, Vietnam

As we found in Chapter 5, the application of ASC certificates at shrimp farms might enhance the ability to implement the traceability for shrimp products along supply chain. This was because the shrimp products under application of ASC certificates were directly provided to the contracted processors, created the advantages to trace and track information between shrimp farms and processors. On the other hand, the recording and keeping information of ASC farms as the specification of processors even supported to implement the traceability systems because those information would be exchanged to processors, and might be provided to global customers through the internal traceability systems of shrimp processors. Besides that, the ASC certificates were one of the mandatory quality assurance certificates for shrimp products to export to global markets. Hence, the incentives of ASC certificates application may enhance the implementation of traceability system for shrimp products towards to global markets.

In Chapter 6, in order to enhance for the application of quality assurance certificates we presented the costs and benefits of the quality assurance certificates application for shrimp products shrimp farm stage with cost-benefit analysis approaches based on the experience of ASC application in Ca Mau province, Vietnam. However, based on the results, we could not confirm the benefits of the ASC certificates application for shrimp farmers as we expected. The reason was found that the farm-gate price of shrimp products paid to ASC farmers was low, comparing to non-ASC farms. While as the application of ASC certificates led to the higher production costs at shrimp farms. Even though we found the shrimp farmers under ASC application might reduce the input's costs such as feed, chemical and drug. However, the increases in other production costs and the lower farm-gate price caused of less benefits for ASC farms. We suggested the higher farm-gate price paid to shrimp farmers, comparing the current price as our case study. However, the question was that our suggested price might or might not match to the expected price of shrimp farmers in order to enhance the application for ASC and/or other quality assurances certificate towards implementation of traceability system.

In this Chapter, we aimed to estimate the expected farm gate price for answering the willingness to conduct the traceability activities as the requirements of processing companies. On the other hand, the maximum price could be paid to shrimp farmers at farm gate by the buyers of shrimp farming inputs, including middlemen (collectors and brokers/traders) and processing companies. The results of this Chapter were expected to allow for the discussion of the alternatives to contribute traceability systems for shrimp products along supply chain in Mekong Delta, Vietnam.

7.2 Measurement of expected price for shrimp products in terms of traceability along supply chain

The aim of this section was to discuss the analysis framework to estimate the equilibrium price between shrimp producers along supply chain in Mekong Delta, Vietnam. For the estimation, some assumptions were proposed as presented below.

Assumptions

1. To conduct the purposes of the study, the expected price for shrimp products of shrimp producers in terms of traceability would be estimated under the unchanged assumption of other factors. We, therefore, concentrated to the changes of shrimp product price in terms of implementation for traceability only.

2. We assumed that the cost for application of traceability in so far was equals to the costs to apply for ASC application certificates (as presented in Chapter 5). In recent years, traceability systems were not separately applied for shrimp products along supply chain yet. Instead of this, the vertical integrated linkage was established between shrimp farmers and processing companies as the evidences of Cooperative of Cai Bat in Ca Mau province, Mekong Delta, Vietnam as our case study. The establishment of the Cooperatives was supported to apply for the ASC certificates, which included the traceability rule "one step backward"- "one step forward" as the requirements for shrimp products with the ASC application.

Moreover, the changes of production costs, revenue and farm efficiency of shrimp products in terms of traceability application would be assumed as same as the case if application for ASC certificates as well. The estimated results of cost-benefit analysis from Chapter 6 were also used in this Chapter to discuss the minimum price for shrimp products in terms of traceability should be paid to shrimp farmers to enhance the balance the profit between shrimp farmers and other agents along shrimp supply chain in Mekong Delta, Vietnam.

3. In this study, we assumed that, shrimp farming inputs were only passed through one collector and one broker before coming to processing companies for simplicity. As we presented in Chapter 5, shrimp products from farmers passed through the middlemen, such as collectors and brokers before coming to processing companies, or were directly provided to processing companies for shrimp products under application for ASC certificates. The shrimp products which were firstly provided to those middlemen might be passed through the complicated stages before distributed to processing companies

4. The expected price for shrimp products in terms of traceability of each agent along supply chain would be estimated based on the distribution flows. Therefore, the price received by farmers would be equals to the amount payment of middlemen (or processing companies) paid to farmers to buy the shrimp at farm gate.

Accordingly, shrimp farmers would expect to receive the higher price from the buyers, while as their shrimp buyers (i.e. middlemen and/or processing companies would expect the less price as much as possible. Thus, the expected price of shrimp farmers would present for the minimum price whereby they were willing to accept to sell the shrimp products. In

contrast, as the expectation of the middlemen (or processing companies), their expected prices for shrimp products in terms of traceability would be the maximum price whereby they were able to pay for shrimp farmers after excludes their operating costs and expected profit.

However, due to the limitation of collected data from survey, the operation costs of middlemen and processing companies could not be conducted in detail as those conducting of shrimp farms. The maximum prices for shrimp products paid to shrimp farmers, therefore, would be backward calculated from the conducted information of processing companies in our survey. Accordingly, the operation costs were assumed at the highest rate, while as the sales price and expected profit rate was assumed at lowest rate as the processing companies proposed.

Besides that, based on the distribution flows of shrimp products, the costs of processing companies also included the payments for middlemen, such as collectors and brokers/traders to buy shrimp from those agents. Those payments also were assumed at highest rate as the processing companies informed.

5. The exported products of interviewed processing companies in the sampling were diversified (as introduced in Chapter 4). However, in this Chapter, we only concentrated the evidences of HOSO (head on sell on) and HLSO (head less sell on) shrimp products for both *P. monodon* and *L. vannamei* species to estimate the maximum price that could pay for shrimp farming inputs by the interviewed processing companies. We chose those products as our evidences because they were the main exported products of processing companies, not only in our samples but also in Vietnam, to global markets. In recent years, about 80% of total exported shrimp products of processing companies in global markets were the HOSO and HLSO products.

7.2.1 The minimum expected price measures at shrimp farms

7.2.1.1 Theoretical framework

Without traceability application, shrimp market was assumed as competitive market, where so many shrimp producers could easily entry into or exit from the market. The shrimp producers, therefore, were price takers. The buyers were indifferent as to which seller's products they bought. There had no control over of output price. Shrimp producers only maximized profit by making the decision what the output quantity to produce.

Figure 7.1 showed the decision of shrimp producers in both short run and long run. Because of the perfectly competitive conditions, the shrimp producers faced to a perfectly elastic demand curve so that the revenue of each additional unit of output would be equal to the price. Hence, the producers could earn a maximization profit when marginal revenue (MR_0) = marginal cost (MC_0) = output price (P^0_{SR}). The shrimp producers in competitive market made their business decision by comparing the marginal change in output effect to marginal profit.

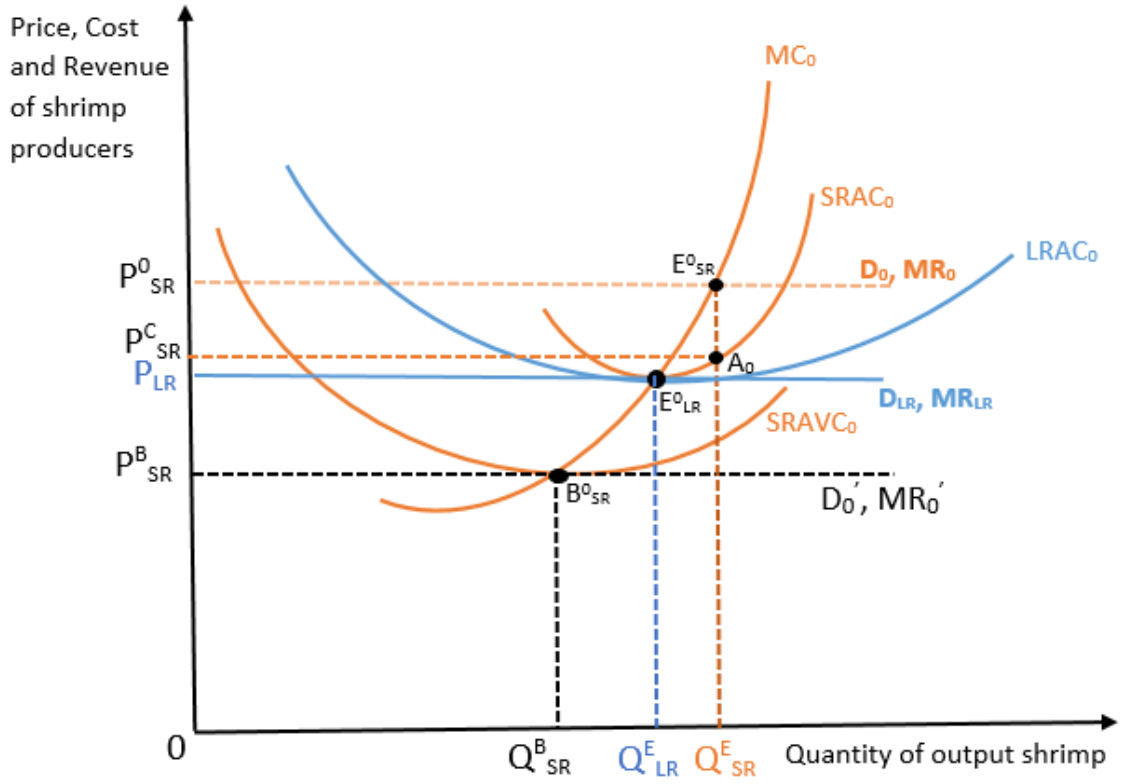


Figure 7.1. Short-run and long-run equilibrium of shrimp producers without traceability application

In short run within one year or at least within the current crop, the market demand curve was assumed as D_0. Shrimp producers could earn a maximization profit at E^0_{SR}. Total profit would be area $P^0_{SR}E^0_{SR}A_0P^C_{SR}$. The fluctuation of market might probably drop the price of shrimp products. Since shrimp producers could not change in some input factors and farm conditions such as land, technology, shrimp species and cultured methods. The shrimp producers, therefore, might remained at Q^B_{SR}. At this point, the price of output shrimp (P^B_{SR}) still covered the average variable costs ($SRAVC_0$) per unit of output shrimp. Otherwise, the shrimp producers would stop their farm operation.

In long run, all of input factors could be changed, the producers would invest to their farms where the price (P_{LR}), at least, could cover the average costs ($LRAC_0$) per unit of output shrimp. The equilibrium quantity was Q^E_{LR}. In long run, the profit was equals to zero.

With traceability application, shrimp market still had so many producers when the decision of individual producers had negligible effects on total market. However, the entry of individual producers into or exit from the shrimp market with traceability application was easily, but was not free because the application costs were required to implement traceability systems (Golan *et al.*, 2004). For example, the traceability systems had not been separately applied at shrimp producers in Mekong Delta yet, but were included in the application for the quality assurances certificates. The shrimp producers faced to the barriers to entry into the market because some of them might not deal with the application costs of traceability systems. The individual entered to farmed shrimp activity with the application of ASC

certificates might not be profitable due to the large payments for application procedures. In the pilot program to apply ASC certificates at Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam, shrimp producers had to participate to Cooperatives to deal the application costs by the sponsorship from local government and processing company.

However, in terms of traceability implementation together with ASC application, the shrimp producers at Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam could differentiate their shrimp products. The application of ASC certificates might be a commitment of the product's quality of shrimp producers. Besides that, the requirements of recording and keeping information for application for ASC certificates supported to provide the production information to the buyers.

Thus, in this case, shrimp markets might not operate as the perfectly competitive market, but as monopolistic competition market. Now, the shrimp producers might be the price makers, rather than price takers as in perfectly competition market. The price of output shrimp with traceability application was higher than perfectly competition conditions.

Figure 7.2 described the decision-making conditions of shrimp producers with traceability application in the short run. The demand curve (D_1), therefore, had a downward slopping, and was less elastic than without traceability application. The marginal revenue curve was also downward slopping. The maximization profit rule was still at the point where marginal revenue (MR_1) = marginal cost (MC_1).

In theoretical, the shrimp producers with traceability application could create the differentiated products. Then, the equilibrium price was defined at P'_1, rather than P_1. As monopolistic competition conditions, the equilibrium point would be $E'_{1,}$ rather than E_1, with a higher price and a lower output quantity. In short run, the maximization profit was area $P'_1E'_1E_1P_1$. The shutdown point was B^1_{SR}, where indicated the lowest price to maintain the farms' operation. Hence, the impacts of traceability application could be easily evaluated by comparing the difference between maximization profit point of with and without traceability application or in the other words, we could compare the difference between the area $P^0_{SR}E^0_{SR}A_0P^C_{SR}$ and $P'_1E'_1E_1P_1$ in Figure 7.1 and Figure 7.2, respectively. The comparing of the output price and quantity in shutdown point between with and without traceability system application could describe the capacity with market price uncertainty conditions.

Traceability system could make the differences in output products through the traceability information. For example, shrimp producers could prove the differentiated in their products through traceability systems such as no antibiotics or application for quality assurance certificates, etc., the price of output shrimp might be higher than the former products. However, remind that, application of traceability, by itself, did not factor to the changing of the output quantity directly. The recording and keeping of information through traceability systems might support the producers in the farm management and improvement the productivity in so far.

On the other hand, in reality, shrimp producers in Mekong Delta, Vietnam could easily sell output shrimp to the market. Thus, even though with or without traceability application, the supply quantity of shrimp farmed products was not different. This meant that the output

quantity was still supplied at Q^{E}_{SR}, where the marginal revenue was equals to the price (P_1= P^{0}_{SR}) that the producers' viewpoint at a horizontal demand curve and equals to marginal cost.

However, the output price decision of traceability products was different from the ordinary products. With the application of traceability systems, shrimp producers could decide the price at P'_1. Now, the shrimp producers could make the comparing between the equilibrium price situations, P^{0}_{SR} and P'_1. If the unchanging of other factors were assumed, the shrimp producers would decide to invest traceability system if the difference of P'_1 and P^{0}_{SR} could cover the costs of traceability application and their expectation about the increasing in profit through traceability application. The higher expectation of shrimp producers for the increasing in profit through traceability application would result of the higher expected value of P'_1 (Tucker, 2008). P'_1, thus, indicated for the minimum price, where the shrimp producers were willing to implement (WTI) for the traceability systems. The difference between P'_1 and P^{0}_{SR} presented for the value of WTI for traceability application of shrimp producers. The value of expected price, P'_1, would be higher if the value of WTI were higher, and otherwise. Remind that, the value of WTI for traceability systems were negatively reflected by the awareness, perception and willingness to accept to implement the traceability systems of shrimp producers. In other words, shrimp producers who had more awareness and perception about the traceability systems, were supposed to increase the willingness to implement the traceability systems. The increasing of the willingness to implement the traceability systems, then, reflected to the decreases of the value of WTI and the minimum price P'_1 in so far.

In the long run (Figure 7.2), like perfectly competitive market, the other competitors could be attracted by the higher output price, and decided to apply for traceability systems. The supplying for shrimp products with application for traceability would be increased. Then, the shrimp producers, who already applied traceability, would pay the cost to maintain and improve the traceability systems, and would compete to new comers. Thus, the average cost in long run ($LRAC_1$) would be higher than in the short run. However, in the long run, shrimp producers could adjust the investments for farms operation, both in input factors and output quantity to maximize the profit. Therefore, with implementation of traceability systems, the output quantity might be reduced to Q_1^{E}, rather than Q^{E}_{SR} (Figure 7.1 and Figure 7.2) in short run. The equilibrium point was at E'_1.

However, so far, in case if traceability systems could become a mandatory requirement for shrimp products. Shrimp producers were required to apply for traceability systems, the shrimp products with traceability application, then, were not differentiated. Hence, the shrimp markets might be back to competitive markets, where the demand curve for shrimp products with traceability systems was perfectly elastic (D_{LR}). The shrimp producers might make the operation decision at point B_1^{LR}, where the output price with traceability application might be lower than P'_1.

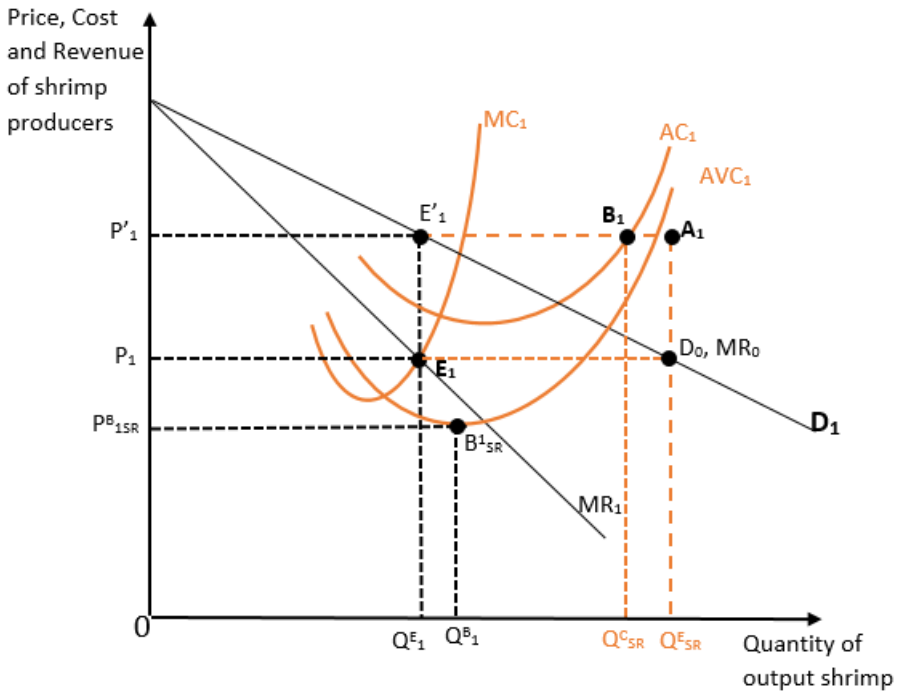


Figure 7.2. Short run equilibrium of shrimp producers with traceability application

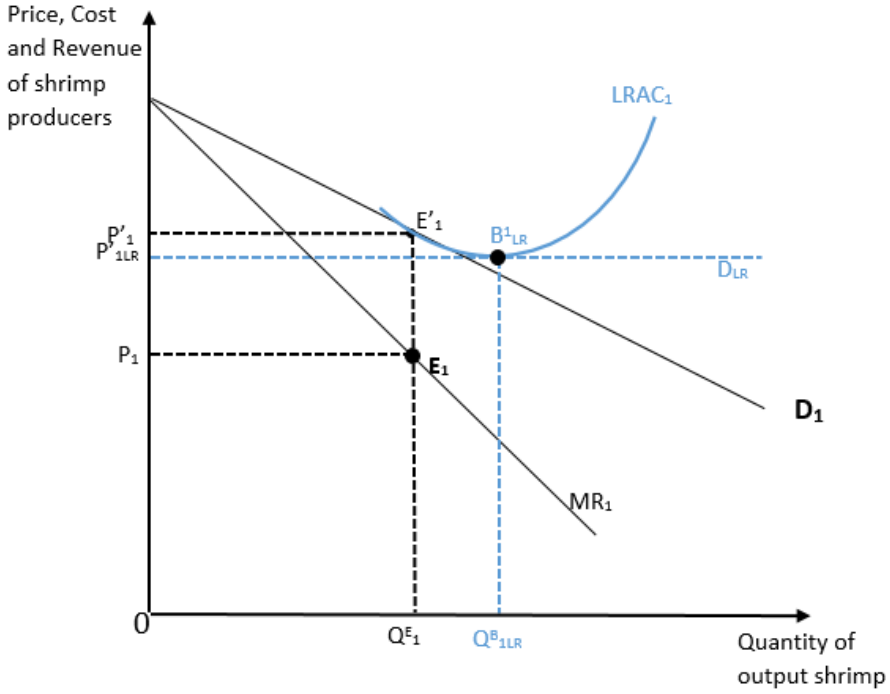


Figure 7.3. Long run equilibrium of Vietnam shrimp producers with traceability application

7.2.1.2 The willingness to implement and the expected price for shrimp products of shrimp farmers for traceability application

The willingness to implement (WTI) for traceability systems of shrimp farmers was investigated based on the conducted experimental survey in Ca Mau province, Mekong Delta, Vietnam. As introduced in Chapter 4, the shrimp farmers were double asked for the willingness to implement to traceability system with the same question: "Will they apply for traceability system?" as their understanding about traceability application for shrimp products, and re-asked after our explanation about the traceability systems. The WTI of shrimp farmers for traceability system was conducted if the shrimp farmers answered "Yes" after the traceability system was already explained.

The answers of minimum expected price for the output products of the shrimp farmer *i* th was conducted by double bound choices questions (as described in Chapter 4) if he/she confirmed for willingness to implement for the traceability system after we explained about traceability system. The minimum price, which was proposed by shrimp farmers, indicated the expectation for the application of traceability.

The average expected price of shrimp farmers in the sampling was conducted as the follows function:

$$P_E = \frac{\sum_{i=1}^{15} P_{E_i} \times n_i}{N} \qquad \text{(Equation 7.1)}$$

where, P_E was defined as the average expected price of shrimp farmers from the sampling; $P_{E_i} (i = 1, \dots, 15$[17]$)$ the chosen sub-price of shrimp farmers from five scenarios in survey (see in Chapter 3); n_i the number of shrimp farmers confirmed at the same P_{E_i} price; N total number of shrimp farmers in the sampling confirmed the expected price.

7.2.1.3 The affecting factors to the expected price of shrimp producers in order to the traceability application for shrimp products

In this section, the factors affecting to the expected price of shrimp producers in order to apply traceability systems would be estimated. The Censored Regression Model (CRM) was applied with the basic function:

$$y_i = \begin{bmatrix} a & \text{if } x_i \le a/\beta \\ \beta x_i + u_i & \text{if } a/\beta <_i^* x_i < b/\beta \\ b & \text{if } x_i \ge b/\beta \end{bmatrix} \text{(Equation 7.2)}$$

[17] In survey, the double bound choices technique to conduct the expected price of shrimp farmers for shrimp products in terms of traceability. Five scenarios of minimum price with the separately by shrimp species were randomly used to ask the shrimp farmers. For each scenario, we prepared three sub-prices to ask shrimp farmers (first bid, upper price and lower price). Thus, with 5 scenarios, there was total 15 sub-prices scenarios chose by farmers.

where a was the left censored limit and b was the right censored limit of the dependent variables. In case if a and b are infinitive, the dependent variable is not left-censored or right-censored, respectively.

Remind about the double bound choices survey in this study, the expected price was infinite where the shrimp farmers did not agree with both suggested price of each scenarios in the questionnaires. Accordingly, the cumulative CRM for the expected price of shrimp producers to apply traceability system was described as follows:

$$P_{Ei} = \begin{bmatrix} \beta X_i + u_i & \text{if } X_i \geq a/\beta \\ \infty & \text{if } X_i < a/\beta \end{bmatrix} \text{(Equation 7.3)}$$

where, P_{Ei} the expected price of the *i* th shrimp farmer in the sampling for application for traceability system; ; a the lower limit of expected price was chosen by shrimp farmers in the survey; X_i explanatory variables; β the parameter of explanatory variables; $u_i \sim N(0, \sigma^2)$ error terms.

Likelihood Ratio Chi-Square (LR-chi2) statistic was used to test the statistical relationship at 0.05 level. The log likelihood was examined as the indicator of the goodness of fit. In CRM, the dependent variable y may be either left-censored, right-censored, or both left-censored and right-censored. The lower and/or upper limit of the dependent variable in left-censored and/or right-censored can be any number, respectively (Arellano-Valle and Genton, 2008; Henningsen, 2011). The normal distribution of the residues was assumed. This meant that the error terms u_i had a zero mean and constants variance. The abnormality of error terms and the heteroskedasticity might result of the bad bias of Censored Regression Model estimated model. In this study, the White's test was applied to test the existence of heteroskedasticity. In case if the heteroskedasticity was existed, the heteroskedasticity robust inference procedure in order to adjust standard errors to make them valid in the presence of heteroskedasticity (Gujarati, 2004).

The explanatory variables were included to the expected price of shrimp farmers for the products with traceability application based on the conceptual groups of determinants suggested by Lusk and Norwood (2008). Accordingly, the expected price for output products of farmers were determined by the influencing factors, which might be reflected to change of the production costs, the valuation of consumer, the negotiating power of farmed producers and buyers. The descriptions of the explanatory variables were described in Table 7.1.

To achieve the purpose of this study, the application of ASC certificates was firstly included in the model as one of the explanatory variables that factored to the expected price of shrimp farmers. The important role of application of ASC certificates in the implementation of traceability system was discussed with the evidences of the application for ASC certificates of shrimp farmers at Cooperative of Cai Bat, Cai Nuoc district, Ca Mau province in the previous Chapters of this study. The shrimp farmers, who were application for ASC certificates, participated to Cooperatives to share the costs for application. This participation, then, led to improve the ability to negotiate with both suppliers and buyers in the input and output price. The ASC certified shrimp products had also reflected to the evaluation of shrimp buyers. Remind that, the ASC certified shrimp products were committed the premium price at 0.09-0.22 USD per kg. On the other hand, we found that, one hundred percent of ASC shrimp

farmers were willing to invest for traceability systems (would be discussed in detail in the forward sections). Shrimp farmers, who were applying for the ASC certificates, might have better awareness about the necessary of traceability implementation for shrimp products, comparing to the non-ASC farmers. Therefore, we intended the application of ASC certificates might influence to reduce the expected price of shrimp farmers for shrimp products with traceability implementation.

Besides that, the willingness to implement for traceability systems of shrimp producers was also added to the CRM model to test its influencing to the expected price of shrimp producers for traceability shrimp products as the discussed in the conceptual theoretical part. The willingness to implement for traceability systems of shrimp farmers were supposed as a negative influencing factor to their expected price for traceability shrimp products.

The farm gate price of shrimp products paid by the buyers, either middlemen or processing companies, to shrimp farmers to buy shrimp products at farm stage was also included to the model as the valuation of shrimp buyers for farmed shrimp products. Besides that, the farm gate price plays as the references for shrimp farmers to address their expected price to accept for traceability application. The expected price of shrimp farmers was supposed to increase if they received the higher price for shrimp products in the latest crop.

We added the other farming conditions, such as shrimp species and cultured systems to the model to test the affecting of those factors to the expected price of shrimp farmers as suggested by Duc (2010) and as already discussed in Chapter 6. Besides that, the production scale also resulted of the differences in the investments for farms operation, the distribution channels of output products or the choosing for output buyers of shrimp farmers (Suzuki and Nam, 2018). Large-scale farmers have more power to negotiate about the price with the buyers, comparing to small-scale farmers. In this study, to exam the influencing of farming scale to the expected price of shrimp farmers for traceability shrimp products, the total land used for shrimp farms was included as one of explanatory variable. The shrimp farms used more land was intended to expect a higher price for their products.

The total variable cost accounted more than 98% (as we discussed in the Chapter 6) of total production costs in both *P. monodon* and *L. vannamei* shrimp farms. The changes of variable costs, therefore, might lead to significantly changes of total production costs and the decision making for in shrimp farms activities. In this study, total variable cost was also intended to positively influential to the expected price for traceability shrimp products of shrimp farmers. Shrimp farms paid more for the variable costs may expect higher price for their shrimp products.

Social and psychological characteristics, including gender of household head, education proficiency levels and the experiences of shrimp farmers were included into the model because of their role in decision making for the shrimp farm activities, such as the implementation of traceability systems (Coughenour and Swanson, 1992; Frey and Stutzer, 2002 and Duc, 2009 and 2010).

Finally, the differences in cultured systems and shrimp species have also reflected to the distribution flows of shrimp products as we discussed in previous Chapters. Those factors also influenced to the differences in decision making for investment for shrimp farm operation and spending of production costs in shrimp farms as found in Chapter 6. In this Chapter, the interaction influencing of interaction variables, including total land used for shrimp farm and cultured methods and shrimp species and willingness to implement traceability. Besides that, in the experimental survey, we found the shrimp farms in the ASC certificates were almost the *L. vannamei* shrimp farms. While as the price of *P. monodon* and *L. vannamei* shrimp was different so that the farm gate price of shrimp products might be different between ASC and non-ASC farms. Therefore, in this study, we also included the interaction variable between farm gate price and the application of ASC certificates to test its influencing to the expected price of shrimp farmers for traceability shrimp products.

Table 7.1. The description of explanatory variables in Censored Regression Model

Variables	Mean (SD)
Application of ASC certificates	0.27
(1 = yes, 0 = no)	(0.45)
Willingness to invest traceability	0.639
(1 = yes, 0 = no)	(0.482)
Gender of household head	0.926
(1 = male, 0 = female)	(0.263)
Total year worked on farmed shrimp	12.148
(years)	(5.175)
Shrimp species	0.380
(1 = *L. vannamei, 0 = P. monodon)*	(0.488)
Total land used for shrimp farm	15.46
(Unit: 1,000 m^2)	(10.62)
Farm gate price	8.549
(USD per kg)	(2.966)
Cultured methods	0.676
(1 = Intensive, 0 = Extensive)	(0.470)
Education proficiency of respondents	7.759
(total participated school years from elementary [a])	(3.267)
Variable costs per unit	6.90
(USD per kg)	(6.97)

Note: [a]In Vietnam, the elementary proficiency is 1^{st}-5^{th} grade, junior high school is 6^{th}-9^{th} grade, high school education is 10^{th}-12^{th} grade, junior colleges proficiency is 3 years, bachelors' proficiency is 4 years, master education includes 2 years and doctoral program is 4 years**;** SD was abbreviation of standard deviation.

7.2.2 The maximum expected price paid by processing companies to shrimp farmers measures

In the last section, the measurement of the minimum price which was expected by shrimp farmers in order to implement for the traceability for shrimp products at farm stage. This section presented the measurement framework to estimate the maximum price could be paid by processing companies for shrimp farmers. The framework was contributed based the distribution flows of shrimp products, coupled with the conducted information of processing companies in our experimental survey.

Sales price was defined as the received price at the gate of processing companies for their output products.

For the shrimp farming inputs provided by collectors, the processing companies need to pay the commission for both the collectors and brokers to collect shrimp products, besides tax and costs for operation. Processors did not have to pay for the transportation costs because collectors transport farming input shrimp to processing companies. On the other hand, processors spent the costs for storage of shrimp farming inputs from collectors.

In reality of our study, there was an interested point because processing companies in the sampling did not buy shrimp farming inputs at brokers. However, they need to pay for shrimp brokers to legalize the documents in order to track the information of shrimp farming inputs. Remind that, the operation of shrimp collectors was free without business registration. Although the processors were required the commitment about the cultured area of shrimp farming inputs from collectors, the commitment of collectors could not be used as the official documents in order to track information of shrimp farming inputs. Based on the commitment of shrimp collectors, processing companies, then, asked for the legalization of the cultured areas from brokers, who were working with the monitoring of Provincial NAFIQAD and registered for the food safety certificates. The maximum price of shrimp processing companies was estimated as the Equation 7.4:

Maximum Price
= Sales Price - Expected profit - Tax and Operating costs - Payments for Collectors
– Payment for Brokers – Storage costs (Equation 7.4)

For the shrimp farming inputs provided by brokers, the maximum price of processing companies might able to pay to shrimp farmers was described as the Equation (7.5). Similar as the case of the shrimp farming inputs were provided by collectors, processing companies also need to pay for the costs for storages of shrimp inputs before processed.

Maximum Price
= Sales Price - Expected profit - Tax and operating costs - Payments for Brokers – Storage costs
(Equation 7.5)

For the shrimp farming inputs directly provided by farmers, processing companies need to pay the costs for transportation and storage besides the operating costs. However, the important point was that processing companies might save the payments for the collectors and brokers/traders. On the other hand, the shrimp farming inputs flow was helpful to track the shrimp farming inputs because the processing companies might able to control the origins of shrimp inputs until shrimp farm stage.

Based on the results of our survey, the suppliers of shrimp farming inputs in this case included the contracted shrimp farmers and ASC farmers. The function to estimate the maximum price of processing companies paid for those farmers was described in Equation (7.6) and (7.7), respectively. For ASC farms, the processing companies need to pay to sponsor for shrimp farmers in ASC progress.

Maximum Price
= Sales Price - Expected profit - Tax and other costs - Transportation costs - Storage costs
(Equation 7.6)

Maximum Price pay to ASC farms
= Sales Price - Expected profit - Tax and other costs – Invested to shrimp farms
- Transportation costs - Storage costs (Equation 7.7)

7.3 Results

7.3.1 The willingness to invest (WTI) and the expected price for shrimp products to apply for traceability of shrimp farmers in Ca Mau province, Mekong Delta, Vietnam

This section aimed to present the WTI and the expected price for shrimp products in order to apply for traceability of shrimp farmers based on the results of experimental survey in Ca Mau province, Mekong Delta, Vietnam. The section included two sub-sections. The WTI for the application of traceability would be investigated. The expected price of shrimp farmers for the shrimp products in order to apply for traceability, then, would be summarized.

7.3.1.1 WTI for traceability application

The shrimp farmers in the sampling were asked the same question about the willingness to invest for traceability application with and without our explanation, respectively. Based on the results, we found the changes in the willingness to invest of shrimp farmers for traceability after clearly explanations. For detail, there was about 74 of 114 shrimp farmers in the sampling confirmed to invest to the traceability as their own understanding. While as, total number of shrimp farmers agreed to apply for the traceability after our explanation was increasing to 96 of 114 shrimp farmers (as described in Figure 7.4a).

The roles of application for quality assurance certificates (e.g. ASC certificates) in order to implement traceability were discussed in the last Chapters. In this Chapter, we also found the relationship between application for ASC certificates in shrimp farms and the willingness to implement traceability of shrimp farmers. As showed in Figure 7.4(b), 32 (100%) ASC shrimp farms of our sampling confirmed that they were willing to implement the traceability system for their shrimp farms. The results of this Chapters confirmed the important of application for ASC certificates in orders to implement for traceability at shrimp farms stage.

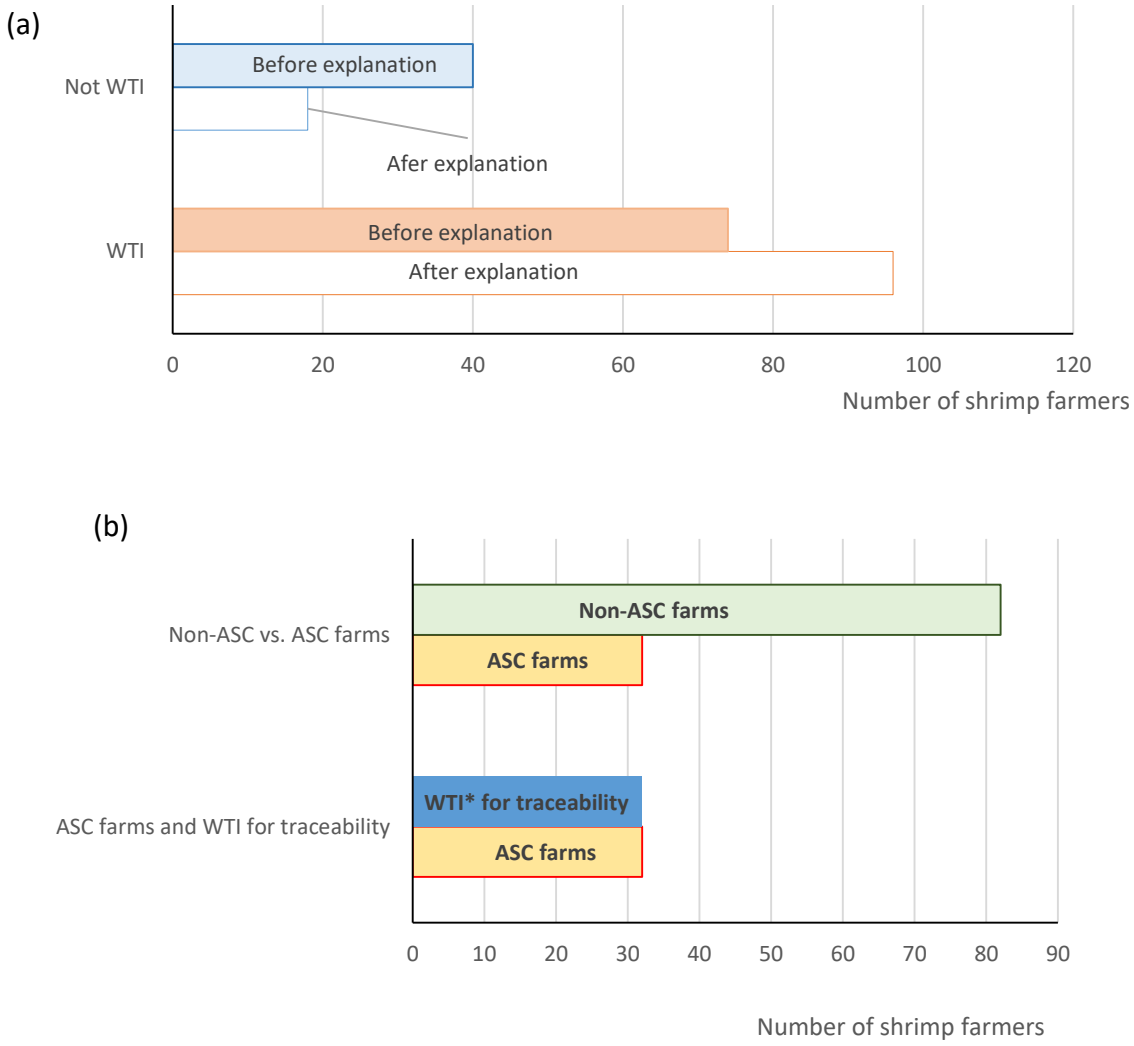


Figure 7.4. (a) The WTI for application of traceability of shrimp farmers before and after the explanation about traceability in survey and (b) the WTI for application of traceability of shrimp farmers vs. the application for ASC certificates. Note: * number of ASC farms were willing to implement for traceability; vs was abbreviation of versus.

7.3.1.2 The expected price of shrimp farmers for shrimp products in order to apply for traceability

This section presented the investigation of the minimum expected price of shrimp farmers for shrimp products in order to apply for traceability based on the collected data of our survey with the framework of Equation (7.4).

In the survey, we found total 97 shrimp farmers confirmed the willingness to invest the traceability systems (as showed in Figure 7.4). In this sub-section, the results were separately presented by shrimp species as following.

❖ **For *P. monodon***

In the survey, total 54 farmers of *P. monodon* shrimp farms confirmed the WTI after we clearly explained about traceability. All of those farmers were asked for the expected price for shrimp products in order to apply for traceability. The choices were randomly chosen within five bidding price scenarios as introduced in Chapter 3.

Table 7.2. The confirmed of shrimp farmers for the expected price in the survey

Choices	1st Bid*	Lower*	Upper*	Combination				Decision of Expected price (Number of shrimp farmers)				
				YY	YN	NY	NN	At 1st Bid	At Lower	At Upper	Infinitely	Total
1st	5.33	4.44	6.22	2	0	1	14	0	2	1	14	17
2nd	6.67	5.56	7.78	2	1	1	4	1	2	1	4	8
3rd	8.44	7.11	9.78	0	2	5	3	2	0	5	3	10
4th	10.67	8.89	12.44	1	2	3	1	2	1	3	1	7
5th	13.33	11.11	15.56	7	4	2	0	4	7	2	0	13
Numbers of shrimp farmers				**12**	**9**	**12**	**21**	**9**	**12**	**12**	**21**	**54**

Note: * Unit: USD per kg. YY was the abbreviation of "Yes-Yes" respondents, who agreed with both the 1st did and lower bid orders. YN was the abbreviation of "Yes-No" respondents, who agreed with the 1st bid order but not agree with the lower bid order. NY was the abbreviation of "No-Yes" respondents, who did not agree with the 1st bid order but agree with the upper bid order. NN was the abbreviation of "No-No" respondents, who did not agree with both the 1st did and upper bid orders.

The results of double bound choices survey (Table 7.2) the survey indicated that there were total 21 of 54 shrimp farmers agreed with the 1st bidding as our suggestion. We, then asked the lower bidding. Total 12 shrimp farmers agreed with the lower bidding, while as 9 shrimp farmers did not agree.

We also found 34 shrimp farmers did not agreed with our 1st bids. The upper prices, then, were suggested. The results showed that, total 12 shrimp farmers agreed with the upper suggestion. While as the rest of farmers did not confirm for the application of traceability as our suggested bids.

Table 7.3. The expected price of shrimp farmers for *P. monodon* products

Choices	1st Bid		Lower		Upper	
	Suggested Price (USD per kg)	Confirmed Obs. (N=9)	Suggested Price (USD per kg)	Confirmed Obs. (N=12)	Suggested Price (USD per kg)	Confirmed Obs. (N=12)
	(1)	(2)	(3)	(4)	(5)	(6)
1st	5.33	0	4.44	2	6.22	1
2nd	6.67	1	5.56	2	7.78	1
3rd	8.44	2	7.11	0	9.78	5
4th	10.67	2	8.89	1	12.44	3
5th	13.33	4	11.11	7	15.56	2
Average expected price = 10.17 (USD per kg)						

The expected price was decided based on the choices of shrimp farmers as described in Table 7.3. The average expected price for *P. monodon* shrimp products of farmers was summarized at 10.17 USD per kg, suggesting that shrimp farmers might pay the attention to the application for traceability if the received price for *P. monodon* shrimp products would be at 10.17 USD per kg.

❖ **For *L. vannamei***

There were total 42 farmers agreed to apply for traceability with the explanation. The expected price was conducted with the same procedures as the *P. monodon* shrimp farmers. The double bound question was applied with five scenarios to be randomly suggested to the farmers as described in Table 7.4.

Table 7.4. The confirmed of *L. vannamei* shrimp farmers for the expected price in the survey

Choices	1st Bid*	Lower*	Upper*	Combination				Decision of Expected price (Number of shrimp farmers)				
				YY	YN	NY	NN	At 1st Bid	At Lower	At Upper	Infinitely	Total
1st	3.56	3.11	4.00	0	1	3	4	1	0	3	4	8
2nd	4.44	3.78	5.11	1	3	3	4	3	1	3	4	11
3rd	5.78	4.89	6.67	3	2	3	1	2	3	3	1	9
4th	7.56	6.44	8.67	3	4	1	0	4	3	1	0	8
5th	9.78	8.44	11.11	6	0	0	0	0	6	0	0	6
Numbers of shrimp farmers				**13**	**10**	**10**	**9**	**10**	**13**	**10**	**9**	**42**

Note: * Unit: USD per kg. YY was the abbreviation of "Yes-Yes" respondents, who agreed with both the 1st did and lower bid orders. YN was the abbreviation of "Yes-No" respondents, who agreed with the 1st bid order but not agree with the lower bid order. NY was the abbreviation of "No-Yes" respondents, who did not agree with the 1st bid order but agree with the upper bid order. NN was the abbreviation of "No-No" respondents, who did not agree with both the 1st did and upper bid orders.

Found results indicated total 26 of 42 shrimp farmers agreed at the 1st bids as we suggested in questionnaire. Among those farmers, there were 13 agreed with the suggested price in the bound of lower bid. While as the rest of them did not agree with the lower bound.

On the other hand, there were 19 of 42 *L. vannamei* farmers responded "No" at our 1st bids. The bid of second bound, thus, was increased to upper scenarios. We, then, found that, total 10 shrimp farmers had agreed with the price in upper bound. The rest of 9 farmers still did not agree with the upper bid.

The expected price for *L. vannamei* shrimp products of farmers was presented in Table 7.5. Based on the responses of shrimp farmers in the double bound choices, the expected price for *L. vannamei* shrimp products was proposed at 6.15 USD per kg. *L. vannamei* shrimp farmers might interest to the application of traceability if the output price would be paid at least 6.15 USD per kg.

Table 7.5. The expected price of shrimp farmers for *L. vannamei* products

Choices	1st Bid		Lower Bid		Upper Bid	
	Suggested Price (USD per kg)	Confirmed Obs. (N=10)	Suggested Price (USD per kg)	Confirmed Obs. (N=13)	Suggested Price (USD per kg)	Confirmed Obs. (N=10)
	(1)	(2)	(3)	(4)	(5)	(6)
1st	3.56	1	3.11	0	4.00	3
2nd	4.44	3	3.78	1	5.11	3
3rd	5.78	2	4.89	3	6.67	3
4th	7.56	4	6.44	3	8.67	1
5th	9.78	0	8.44	6	11.11	0
Average expected price = 6.15 (USD per kg)						

7.3.2 Affecting factors to the expected price in order to apply for traceability of shrimp farmers in Ca Mau province, Mekong Delta, Vietnam

Table 7.6 summarized the coefficients resulting from the Censored Regression Model (CRM) of the expected price for shrimp products of shrimp farmers in terms of traceability application. The result of CRM model indicated significance of the independent variables at 0.01 level with the LR chi2 test value at 35.52. The log likelihood of the fitted model was indicated at -230.35.

The correlation between the estimated and observed values of the expected price for shrimp products in terms of traceability was estimated at 0.48. The multiple squared of this indicates showed the values share about 23.04% (0.48^2 = 0.2304) of their variance with the expected price shrimp products in terms of traceability. The estimate of the expected price model confirmed the existence of heteroskedasticity. The results of the White test rejected the null hypothesis of homoscedasticity at 0.05 level. Therefore, the heteroskedasticity robust inference procedure was used in the model.

The coefficient of application for ASC certificates variable was negatively influenced to the expected price of farmers for shrimp products in order to apply for traceability (p <0.01). This result corresponded as our hypothesis since the application for ASC certificates played a significantly role in the procedures to implement the application for traceability. Once shrimp farmers were applying for ASC certificates for their farms, they perceived, and were willing to implement traceability for their farms. Therefore, the expected price might be lower, comparing to other farmers. In other words, the reduction of expected price indicated the higher probability to accept to invest for traceability of ASC shrimp farmers.

Moreover, the statistical significance of the interaction variable between farm gate price and application for ASC certificates (p <0.01) was suggesting that if the price paid to shrimp farmers with application for ASC certificates was higher, they would expect the lower price for their products in order to implement for traceability. Those results of our study corresponded to the studies of Trienekens and Zuurbier (2008) and Karipidis *et al.* (2009), suggested that the farmers with the quality assurance certificates would be more willing to implement for traceability, comparing to the other farmers. Our results might support for the

public encouragement, not only of ASC certificates, but also of quality assurance certificates for shrimp products in Vietnam.

Table 7.6. The results of CRM models

Variables	Description	Coefficient
Intercept		-6.35
X_1	Application of ASC certificates	-5.84*
X_2	Willingness to invest traceability	7.00*
X_3	Gender of household head	-1.94
X_4	Total year worked on farmed shrimp	0.13
X_5	Shrimp species	2.10
X_6	Total land used for shrimp farm	0.28*
X_7	Farm gate price	-0.41
X_8	Cultured methods	6.33*
X_9	Education proficiency of household head	-0.11
X_{10}	Variable costs per unit	0.22*
X_{11}	Total land used for shrimp farm × Cultured methods	-0.29*
X_{12}	Shrimp species × Willingness to invest traceability	-5.74*
X_{13}	Farm gate price × application of ASC certificates	-1.54*
Number of observations		108
Prob.>F		0.00
LR chi2		35.52
Log likelihood		-230.35
Correlation values		0.48

Note: * indicate statistical significance levels at 5%.

Table 7.7 presented the reduction of expected price of ASC farmers for the shrimp products with traceability implementation with the changes of farm gate price of shrimp products. We based on the results of CBAs analysis in Chapter 6 with CBAs analysis since the found farm gate price of shrimp products with ASC application in the latest crop was lower than non-ASC shrimp products at 13.57% and 11.99% for *P. monodon* and *L. vannamei* shrimp products, respectively. We supposed that the farm gate price of ASC farms was increased at 13.57% and 11.99% as the results of CBAs analysis. If the changes of other factors influencing were eliminated, the reduced expected price of shrimp farmers, then, was calculated using the coefficient presented in Table 7.6 with the increasing of the farm-gate price scenarios as indicated in CBAs analysis and the expected price indicated by the double bound choice survey.

Table 7.7. Reduced profit in rice farming and key constraints

Species	Percent increased farm gate price of ASC farms (%)	Percent of reduced expected price (%)	Reduced expected price[a] (USD per kg)
P. monodon shrimp	13.57	1.75	9.99
L. vannamei shrimp	11.99	3.57	5.94

Note: [a]The reduced expected price of *P. monodon* shrimp farmers was calculated by 10.17-10.17*1.75%=9.99 (USD per kg). Similarly, the reduced expected price of *L. vannamei* shrimp farmers was calculated by 6.15-6.15*3.57=5.94 (USD per kg).

The willingness to implement for traceability system also significantly contributed to the expected price for shrimp products of farmers (p <0.01). The estimated coefficient of this variable was positively indicated that, shrimp farmers, who were willing to implement for traceability, expected to be paid a higher price for their products. This result did not correspond to our hypothesis and previous work of Rahman *et al*. (2017). We hypothesized that the highly perceived operational benefits of traceability of farmers was positively related to traceability systems implementation. In our study, the shrimp farmers might not really be familiar with traceability even we clearly explained about it as a system, which aims to record and transfer the production information from their farms to the buyer products, and support to manage the farm operations and improve the quality of shrimp products through the recorded information in so far. However, the shrimp farmers might directly connect the information management through traceability system to the increasing of shrimp products quality. They, therefore, expected that the price for shrimp products might be higher with traceability systems. Our results might suggest the price's incentives for shrimp farmers might call their compliances to implement the traceability procedures.

Other possible explanation was that, among 96 shrimp farmers of the samples were willing to implement for traceability, there were 42 *L. vannamei* shrimp farms. The fact that, the farm-gate price of *L. vannamei* shrimp was lower than *P. monodon* shrimp products. The expected price of shrimp farmers might be reflected by the differences in cultured shrimp species, *P. monodon* or *L. vannamei* shrimp. In CRM, the statistical influencing of shrimp species to the expected price for shrimp products with traceability was not found. However, the statistical relationship between this interaction variable to the expected price for shrimp products indicated that, *L. vannamei* shrimp farmers with the willingness to implement for traceability, would expect a lower price for shrimp products with traceability (p <0.05).

Found statistical contributions of total land used (p <0.05) and the spending of variable costs (p<0.05) for shrimp farms to the expected price of shrimp farmers in order to implement for traceability were suggesting the important role of those factors in order to implement for traceability of shrimp farmers. The land used and the spending of variable costs for shrimp farms presented for the investment to shrimp farms operations, suggesting that the increased investments of the input factors might lead to the higher expectation of shrimp farmers for the price of shrimp products. Our results corresponded to the previous scholar of Trienekens and Zuurbier (2008) who suggested the positive reflection of production costs to the expectation of producers in the implementation of traceability and quality assurance certificates. In addition, the results of CRM model also significantly indicated the positive relationship of cultured methods (p<0.05) to the expected price of shrimp farmers for products to implement the traceability, supposing that the intensive shrimp farmers expected the higher price for implementing traceability, comparing to extensive farms. This result might be explained because shrimp farms under intensive cultured systems was required more investments, comparing to extensive farms.

However, the negatively significant influences of the interaction variable between total land used for shrimp farms and cultured methods in the CRM model (p <0.05) suggested that if the land used of intensive farms activities was increased, the expected price for shrimp products in order to implement traceability was reduced. The total land used was the indicator to separate the scale of shrimp farms based on the regulation of Vietnamese

Government. On the other hand, our sampling found 24 shrimp farmers of 32 ASC farms were intensive systems. As the conducted information from the survey, the ASC shrimp farmers were revising from extensive systems to intensive systems. Our results were similar as the suggestions of Jonell and Henriksson (2015), who supposed that the extension in land used forwarding the intensive production systems might guarantee the acceptance ability to apply for quality assurance certificates, improve the willingness to implement traceability of those farmers, and reduce the expected price of shrimp farmers.

7.3.3 Maximum price

In the last section, the expected price in farmer's side was estimated at the minimum level. The aim of this section was to estimate the maximum price which might be paid to shrimp farmers after the payment for middlemen, operating costs and the expect profits of processors were excluded to the sale price at processing companies gate.

The estimation was conducted based on the collected data from 2 visited processors in our sampling with the assumptions of this Chapter. The results were separately presented by shrimp species.

Based on the conducted survey, the expected profit, operation costs and the payment for collectors and brokers of processing companies were summarized as in the Table 7.8.

For P. monodon shrimp products

The maximum price of *P. monodon* shrimp products to pay to shrimp farmers was estimated in Table 7.9 with different groups of suppliers provided the shrimp farming input to processing companies, including: collectors, brokers and farmers by using the Equation (7.4), (7.5), (7.6) and (7.7)

Remind that, in our sampling, KHANH AN Company only collected shrimp farming inputs from collectors and brokers. While the suppliers for shrimp farming input to X Company included collectors, brokers and farmers through the contracted agreement with both, ASC and non-ASC farms.

As the conducted data, the sale prices of *P. monodon* shrimp products at companies' gate were 13.5 and 13.2 USD per kg in X Company and KHANH AN Company, respectively.

The obtained information in the survey indicated that, the possible price paid to shrimp farmers between X Company and KHANH AN Companies, basically, was not significantly different.

Table 7.8. The expected profit, operation costs and the payment to collectors and brokers of processors

Processing companies	Shrimp species	Expected profit	Operation costs[a]				Payment for middlemen (USD per kg)	
		USD per kg	Processing and sale (% of sale price)	Transportation[b] (USD per kg)	Storage[b] (USD per kg)	Invested to shrimp farms (% of sale price)	Broker	Collector
X Company	*P. monodon*	0.44	20	0.05	0.05	3	0.02	0.31
	L. vannamei	0.31	22	0.05	0.04	4	0.13	
KHANH AN	*P. monodon*	0.31	20		0.07		0.02	0.44
	L. vannamei	0.22	20	0.05	0.05		0.16	

Note: [a]operation costs included tax; [b]transportation and storage of shrimp inputs before processed.

As introduced in Chapter 4, KHANH AN Company was established in 2009. Comparing to X Company and other companies with similar scale as X Company in Ca Mau province and Mekong Delta, KHANH AN Company was defined as small Company. Therefore, to compete to the large company such as X Company, KHANH AN Company need to pay the higher payment for the middlemen to collect the shrimp farming inputs, especially in the shortage seasons of farming inputs, especially the payment for the collectors.

The proportion of operating costs of KHANH AN Companies, though, was higher than X Company. However, the estimated results indicated that the absolutely value of operating costs in KHANH AN Company was lower than the X Company. We have confirmed the reasonable of this estimated result, and found that, the KHANH AN Company did not have to pay to pre-process farming inputs to pre-processing companies as the X Company.

The results showed that, for the shrimp products were distributed from farmers to both, X Company and KHANH AN Company through collectors and brokers, the maximum price could be paid to shrimp farmers at farm gate from 9.7-10.1 USD per kg. The estimated results also revealed that, if shrimp farmers signed the contracted agreement to provide the shrimp farming input to processors, the received prices could be higher, comparing to the products distributed through collectors and brokers/traders.

In terms of traceability, the maximum price for shrimp farming inputs from shrimp farmers under ASC application was estimated at lower level, comparing to those inputs were distributed under contracted agreement from non-ASC application farms to the X Company. As described in Table 7.9, for the non-ASC certified shrimp farming inputs, the average profit at X Company was expected at 0.44 USD per kg. In order to ensure the quality assurances and traceability of shrimp farming inputs from shrimp farms to Company, X Company reduced the expected profit rate to 0.31 USD per kg to allocate for investment to shrimp farmers in order to sponsor the application for ASC certificates. However, the reduction in expected profit was not enough to compensate the investment for shrimp farmers to apply ASC certificates. This effected to the maximum price could be paid to shrimp farmers under ASC application progress.

Table 7.9. The maximum price resulting of *P. monodon* shrimp products

Unit: USD per kg

Shrimp farming input suppliers to processing	Sale prices	Expected profit	Operation costs[a]			Invested to shrimp farms	Payment for middlemen		Maximum price
			Processing and sale	Transportation[b]	Storage[b]		Broker	Collector	
Collectors									
X Company	13.50	0.44	2.70		0.05		0.02	0.31	9.98
KHANH AN	13.20	0.31	2.64		0.07		0.02	0.44	9.72
Brokers									
X Company	13.20	0.44	2.64	0.05	0.05		0.02		10.00
KHANH AN	13.20	0.31	2.64	0.05	0.07		0.02		10.11
Farmers									
X Company for contracted farms	13.50	0.44	2.70	0.05	0.05				10.26
X Company for ASC farms	13.50	0.31	2.70	0.05	0.05	0.41			9.99

Note: [a]operation costs included tax; [b]transportation and storage of shrimp inputs before processed.

For L. vannamei shrimp products

The maximum price for *L. vannamei* shrimp products based on the information from the processor's side was also suggested (Table 7.10). Based on the results of our conducted sampling, the *L. vannamei* shrimp products were distributed from farms to processing companies through two main flows, included: (i) from shrimp farmers to processors through shrimp brokers and (ii) directly provided from shrimp farmers to processors under the contracted agreement, including the farmers under application for ASC certificates.

The shrimp farming inputs source of KHANH AN Company was still from the brokers only. While as, X Company bought shrimp farming inputs from both, shrimp brokers and farmers.

Similar as the case of *P. monodon* shrimp products, X Company also shared the expected profit to support for shrimp farmers under ASC application. However, the investment for shrimp farmers in order to apply for ASC certificates was higher than the allocated profit of X Company. Thus, for *L. vannamei* shrimp products application for ASC certificates, the possible maximum price paid to farmers was lower than the former farmers under the contracted agreement.

On the other hand, in the results, we found the price of X Company could be paid to individual shrimp farmers under contracted agreement at 6.18 USD per kg. This price was much higher than the shrimp farming inputs were distributed through middlemen before came to processing companies.

Table 7.10. The maximum price' results of *L. vannamei* shrimp products

Unit: USD per kg

	Sale prices	Expected profit	Operation costs[a]				Payment for brokers	Maximum price
			Processing and sale	Transportation[b]	Storage[b]	Invested to shrimp farms		
Brokers								
X Company	8.44	0.31	1.86	0.05	0.04		0.13	6.05
KHANH AN	8.22	0.22	1.64	0.05	0.05		0.16	6.10
Farmers								
X Company for contracted farms	8.44	0.31	1.86	0.05	0.04			6.18
X Company for ASC farms	8.44	0.22	1.86	0.05	0.04	0.34		5.94

Note: [a]operation costs included tax; [b]transportation and storage of shrimp inputs before processed.

7.4 Incentive concerning the implementation of traceability for Vietnamese shrimp products of shrimp farmers: differentiation of farm gate price of shrimp products was the most important consideration

The analyzed results of this Chapter indicated the expected price of shrimp farmers for their products in order to implement traceability, and the maximum price could pay for shrimp farmers of the buyers along supply chain. Found results of this Chapter confirmed the presented results in Chapter 6, and were suggesting the price of shrimp products should be increased in order to encourage the implementation for traceability of shrimp farmers. We summarized the price scenarios for *P. monodon* and *L. vannamei* shrimp as the Figure 7.5.

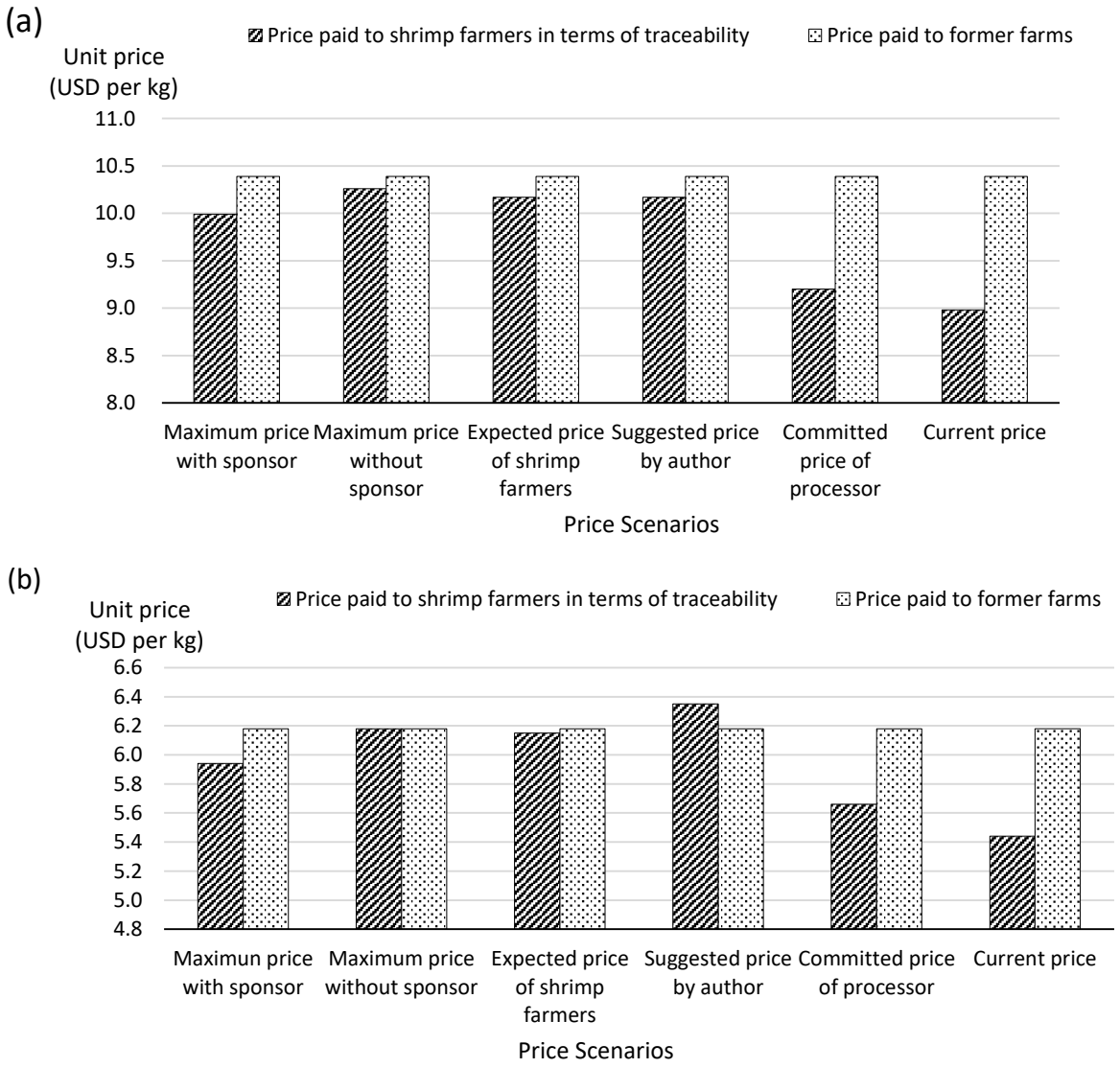


Figure 7.5. (a) The expected price of shrimp farmers, the maximum price paid by shrimp buyers, the suggested price by author, the committed price of processor and the price received by farmers at latest crop for *P. monodon* and (b) for those indicators of *L. vannamei* shrimp

Remind the results of CBAs analysis in Chapter 6, the price of shrimp products was suggested at 10.17 and 6.35 USD per kg for *P. monodon* and *L. vannamei* shrimp species,

respectively. However, as our results, the received price of shrimp farmers under ASC application progress was at 8.98 USD per kg for *P. monodon* shrimp and 5.44 USD per kg for *L. vannamei* shrimp, comparing to 10.39 USD per kg for *P. monodon* shrimp and 6.18 USD per kg for *L. vannamei* shrimp, which were received by non-ASC farmers.

In this Chapter, the double bound choices survey was applied to conduct the expected price of shrimp farmers in order to implement traceability. For *P. monodon* shrimp, we found that the expected price of shrimp farmers, which was informed based on the results of double bound choices survey at 10.17 USD per kg, was exactly equals to the suggested price with CBA analysis in Chapter 6. Our results might suggest which price should be considered, not only to balance the costs and benefits to implement the traceability, but also to match the expectation of shrimp farmers to call for their attention of traceability implementation. For *L. vannamei* shrimp, the expected price of shrimp farmers was found at 6.15 USD per kg. This result was indicating a lower value, comparing to the suggested price with CBAs analysis at 6.35 USD per kg. However, we found that, the expected price of *L. vannamei* shrimp farmers in order to implement the traceability was very close to the received price of non-ASC farmers, which was indicated at 6.18 USD per kg based on our data from experimental survey.

The comparison between expected price and the received price of shrimp farmers in terms of traceability implementation also informed the price of shrimp products in terms of traceability paid to farmers in the latest crop should be increased in order to be incentive the perspective of shrimp farmers in traceability implementation.

However, the price of shrimp products along supply chain could not be decided with the consideration from the farmers' side only if the downstream buyers (collectors, brokers and processors) along supply chain were not able to pay for the expected price. It meant that, the price should be set up at the point where the expectation of shrimp farmers was considered, but was able to be paid by the buyers along supply chain. In this Chapter, we also investigated the maximum farm gate price, which could be paid to shrimp farmers after excludes the operation costs of downstream buyers along shrimp supply chain.

Found results indicated that, the maximum price could pay for shrimp farmers of downstream buyers along supply chain was depended on the distribution flows of shrimp products. The shrimp products, which were passed through the collectors and brokers before came to processors, were suggesting a lower price paid to farmers, comparing to the products directly provided to shrimp processors by contracted agreement. Based on the indicated results, we found that, the maximum price of the processor could be paid to shrimp farmers for the contracted shrimp products were able to adapt the expectation of shrimp farmers. For detail, shrimp farmers with the contracted agreement could be paid by processors until 10.26 and 6.18 USD per kg for *P. monodon* and *L. vannamei* shrimp, respectively. Those maximum prices were able to cover the expectation of shrimp farmers for both *P. monodon* (at 10.17 USD per kg) and *L. vannamei* (at 6.15 USD per kg) species. Moreover, the interested point was indicated since the maximum price paid to the contracted *L. vannamei* shrimp farmers of processors was exactly equals to the received price of non-ASC shrimp farmers. Thus, our results might confirm the role of the direct linkage between shrimp farmers and processors contribution, not only to implement the traceability system, but also to improve the received price of shrimp farmers, and support to processors in management of input shrimp quality.

Moreover, the statistical results of CRM model also confirmed the application for ASC certificates might lead to the reduction of the expected price of shrimp farmers, and increase the willingness to implement the traceability. However, the increases in farm-gate price of certificated products should be considered to encourage the application of quality assurance certificates of shrimp farmers. Moreover, the found significant contributions of the factors of perception, awareness and willingness of shrimp farmers about traceability to their expected price suggested that, total spending of processors paid to shrimp farmers, such as price premium and sponsorship, should be remarked in the contracted agreement. This expected to attract the concerning of shrimp farmers, and to encourage for and call the attention of shrimp farmers on the implementation of traceability. Otherwise, the shrimp farmers might pay attention on the price only, and supposed that the received price was not high, comparing to the price of ordinary products and their expectation.

As showed in Figure 7.5, the committed prices of processors for shrimp products with ASC certificates were obtained at 9.2 USD per kg for *P. monodon* and 5.66 USD per kg for *L. vannamei* shrimp. As presented in Chapter 5, those committed prices does not ensure the benefits of shrimp farmers in order to implement the traceability. We should remind that, the shrimp farmers in our sampling, who were under application for ASC certificates, received the sponsorship from the processors to cover the application costs. The total received price of shrimp farmers, in this case, included the price premium for the products and the sponsorship. Thus, the committed price paid to shrimp farmers of processors might be lower than the price paid to other shrimp farmers, who did not receive the sponsorship from processors. In our results, the maximum price, after excluding of the sponsorship, might be paid to ASC shrimp farmers until 9.99 USD per kg and 5.94 USD per kg as investigated from processor, rather than 9.2 and 5.66 USD per kg for *P. monodon* and *L. vannamei* shrimp, respectively as the current commitment. Those maximum prices, incidentally, were concordant with the reduced expected price calculated from CRM results (Table 7.7) if the price of ASC shrimp products would be increased at 13.57% for *P. monodon* and 11.99% for *L. vannamei* shrimp. Based on those results, we found that, the expected price of shrimp farmers was not exceeded the affordability of shrimp processors. The expected price was mostly matched to the proposed price of processors. We, therefore, suggested the increasing of the price paid for certified shrimp products should be considered by processors in order to the balance the benefits, and to stimulate the motivation to apply for quality assurances of shrimp farmers.

Besides that, the results of CRM model also indicated the positive relationship of cultured methods and investment factors, such as the spending of variable costs and the land used for shrimp farms to the expected price of shrimp farmers. Farmers, who have to invest and/or spend more for those factors expected more for the price of shrimp products. Since the implementation of traceability might increase the cost for the application, the shrimp farmers, thus, might not willing to implement. However, found negatively influencing of the interaction factors between cultured methods and investment factors (e.g. land used for shrimp farms) was also suggesting that the investments forward to intensive systems might reduce the expected price, and improve the attention and willingness to implement the traceability of shrimp farmers. This result might support to remark the role of the cooperatives in the implementation of traceability. In case the application costs of the quality assurance certificates could not be covered by the individual farms, the promotion for the

establishment of cooperatives to call for the corporation between the shrimp farmers and other stakeholders along supply chain, and to support for the traceability implementation as well (Verhaegen and Huylenbroeck, 2001).

7.5 Conclusion

This Chapter presented the willingness to implement and the expected price for shrimp products in order to implement the traceability systems of shrimp farmers. The influencing factors to the expected price of shrimp farmers were even investigated. On the other hand, we also identified the maximum farm-gate price could be paid by shrimp farming inputs buyers (e.g. middlemen and/or processors) to shrimp farmers. We concluded that, the status of application for ASC certificates at shrimp farms was the most important factor, which constrained to reduce the expected price of shrimp farmers for shrimp products in terms of traceability. In other words, if the changes of other factors were eliminated, our result suggested that the application for ASC certificates might enhance the willingness to implement the traceability of shrimp farmers. To encourage the application for ASC certificates, the farm-gate price of shrimp products paid to shrimp farmers should be increased to balance the costs and benefits of the application with the consideration to both, the expectation of shrimp farmers and the maximum willingness to pay of shrimp farming inputs buyers along supply chain, including middlemen and processors.

We found that, the perspectives of shrimp farmers about traceability might influence to the traceability implementation. However, the result was not concordant with our expectation. This was because the shrimp farmers who confirmed the willingness to implement for traceability expected a higher price of shrimp products, suggesting the constraints of the traceability implementation. We supposed that the shrimp farmers were concerning about the costs of application and implementation for traceability since the benefits of traceability are not well understood. As our results, the current investments of shrimp farmers to production costs, including fix cost (e.g. land) and variable costs may inhibit the willingness to implement the traceability of shrimp farmers. In this study, the shrimp farmers were limited in the production scale so that any increasing in the production costs may against their desires. Therefore, the economic incentives of the traceability implementation, including improvements of the product's price and sponsoring from the government and/or shrimp farming inputs buyers, are the most important factors to enhance the willingness to implement the traceability.

This Chapter raised the question about the reflection of extension in production scale at shrimp farmers to the traceability implementation. This was because we found that, the investments of land used for farms to extend the production scale of intensive shrimp farmers might enhance the traceability implementation. Accordingly, if we considered to the factors that might support for the extension of production scale towards the intensive cultured methods such as the establishment of the Cooperatives to integrate the production between shrimp farmers, this would point to improve of traceability implementation. This result might be useful for our future discussion to implement traceability systems for shrimp products in the next Chapter.

Chapter 8. Alternatives for the implementation of traceability along shrimp supply chain in Mekong Delta, Vietnam towards the global markets

8.1 Background

In Chapter 5, the state of traceability application along shrimp supply chain was presented based on the experiments from Ca Mau province of Mekong Delta, Vietnam. Accordingly, the consumers of shrimp products at global markets have to rely on the provided information of retailers to know the information of shrimp products, and could not track the information of shrimp products through all stages of supply chain, from shrimp farms to distribution and processing companies. On the other hand, the international certificates have been developed from 1990s (Uddin, 2009) in order of ensuring food safety and protecting consumer confidences at global markets level. Nowadays, the famous certificates such GLOBAL GAP, ASC, BAP and HACCP, are increasingly being demanded since the food safety is receiving highly considerations. Additions, the formatting of traceability systems have not been specified in global markets yet. Instead of that, traceability was defined as any activities in which to recall the information of the products along supply chain.

Also found in Chapter 5, the transparency of information along shrimp supply chain in Mekong Delta, Vietnam was depended on the distribution flows from shrimp farms to processors, which were reflected by the cultured methods and the application for quality assurances certificates situation. Among the supply chain agents, processors were the important actors to carry out the traceability along supply chain. The invested traceability system was supported to them in the controlling of the quality assurance and the managing of inputs-output information flows from their shrimp farming inputs suppliers to their customers. The processors also were directly reflected by the pressures about traceability and quality assurances requirements from global customers.

On the other hand, we also found that, the specific requirements about the quality assurance and traceability of processors might integrate the corporation of other agents along supply chain, including shrimp farmers and middlemen (e.g. collectors and brokers), who were required to follow the requirements of processors to sell the shrimp farming inputs. At farms stages, our results indicated that, the requirements of information recording and keeping in ASC standards with the approaches of traceability rule “one step backward”- “one step forward” were effective to enhance the implementation of traceability for shrimp products from farms to processors.

To enhance the application for quality assurances for shrimp products, we applied the CBAs approaches to identify the costs and benefits of the application for quality assurances certificates with the evidences of Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam in Chapter 6. The results of CBAs approaches could not confirm the application for ASC certificates created the benefits for shrimp farmers. The price paid for shrimp products with ASC application was the significant matter to enhance the application of those certificates. Results in Chapter 7 confirmed the application for ASC certificates and the price incentives for certified shrimp products were negatively influencing to the expected prices for shrimp products in order to implement traceability systems of shrimp farmers. In other words,

if the price paid to shrimp farmers application for ASC certificates was increased, the willingness to implement the traceability would be increased.

In this Chapter, we discussed the alternatives to implement the traceability for shrimp products along shrimp supply chain based on the results indicated in the previous Chapters. The next section was utilized to suggest the conceptual traceability systems for shrimp supply chain in Mekong Delta Vietnam. The challenges and alternatives to overcome suggested conceptual systems were discussed in Section 8.3. The conclusion of the Chapter would be presented in Section 8.4.

8.2 The conceptual traceability systems for shrimp supply chain in Mekong Delta Vietnam

Based on the results, we suggested the conceptual system of traceability for shrimp supply chain in Mekong Delta, Vietnam towards to global markets as presented in Figure 8.1. According to our suggestion, in recent year, shrimp producers along supply chain in Mekong Delta may not need to invest a separate traceability system. Instead of this, the traceability may be performed with the integration to the application of quality assurances certificates. The required information in order for traceable requirements may be filtered from the recorded information in the application progress of quality assurance certificates based on the information management systems at processing companies.

Thus, the application of quality assurances certificates plays as the important alternatives to overcome our suggested conceptual system. The recorded information in management system at producers along supply chain can be synchronized with the required information of quality certificate standards. The producers may monitor of those synthesis to decide which information should be provided in order to respond the requirements of traceability issues of specific customers in global markets.

To perform this system, the governance of the trustfulness of recorded information may be authorized by the collaboration of Local Governments, such as Provincial Department of Fisheries and Provincial of Agricultural, Forestry and Fisheries Quality Assurances Department. Besides that, the monitoring of quality assurance certifiers may also enhance the improvement of qualification of the recorded information.

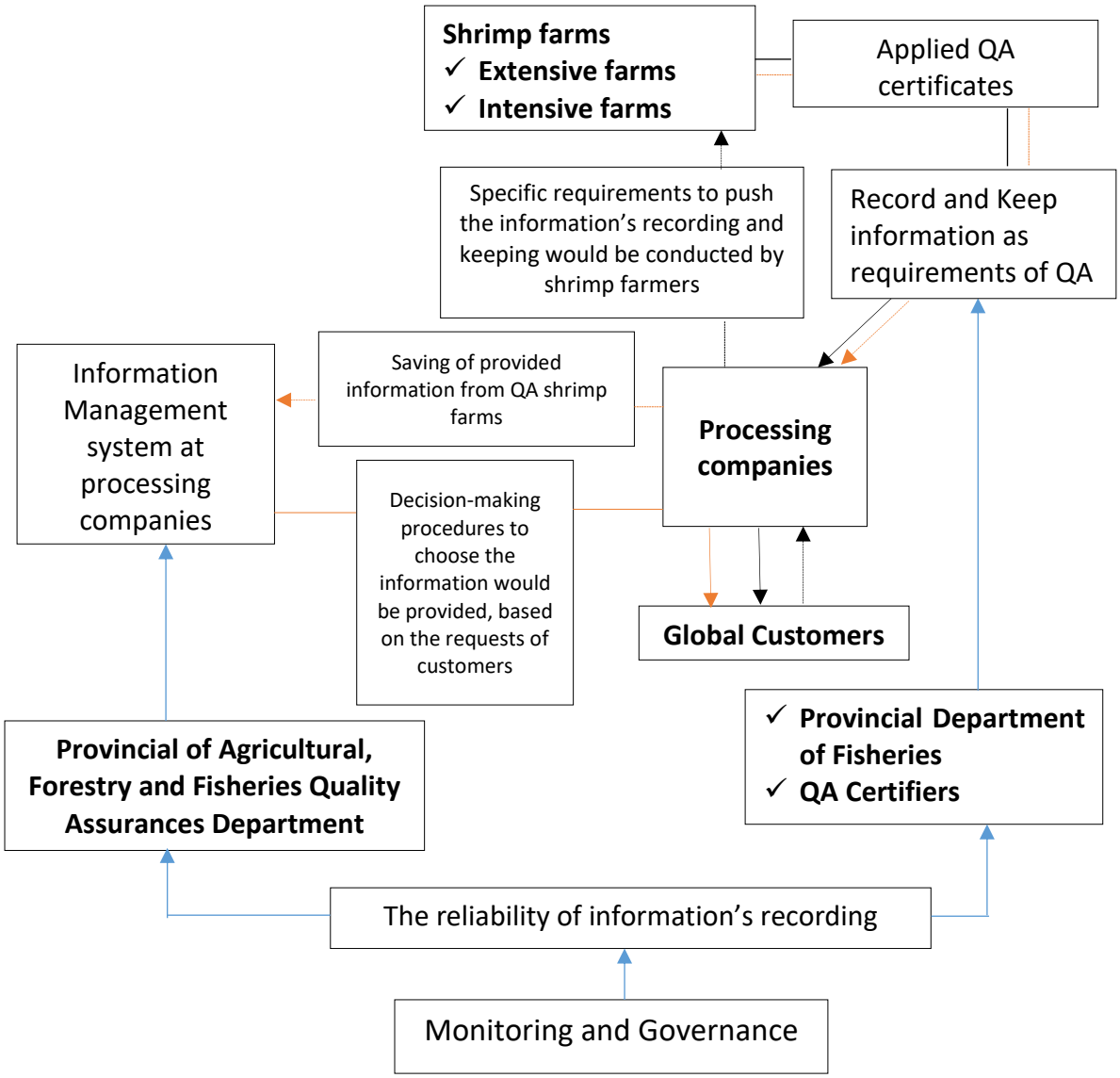


Figure 8.1. Conceptual traceability systems towards the global markets for shrimp products in Mekong Delta, Vietnam. Note: The continuously black arrows presented for shrimp products flows along supply chain. The blue arrows indicated for the governance and monitoring for traceability systems. The continuously orange arrows presented for the information flows from processors to their customers. The dash orange arrows represented for the information flows from farmers to processing companies. The dash black arrows indicated for the requested information flows from global customers to shrimp farmers through processors. QA was the abbreviation of quality assurance certificates. The bold text in shape indicates for the stakeholders in supply chain.

8.3 Overcome the integration of traceability and the application of quality assurance certificates: challenges and alternatives

8.3.1 The challenges of the integration between traceability and quality assurances certificates along shrimp supply chain in Mekong Delta, Vietnam

In our above suggestion of the conceptual traceability systems for shrimp products in Mekong Delta, Vietnam, the application of quality assurances certificates plays as a possible alternative forwarding to implement traceability forwarding to adapt the requirements of

global markets. Our results were roughly concordant with the Vietnamese policy makers' perspectives for shrimp industry (Interviewed data from Provincial DOFs in VMD, 2017). Accordingly, the extension of quality assurances certificates application for shrimp products became the most priority considerations. However, the application of quality assurances and the integration between quality assurances certificates and traceability to perform our suggestions were challenging with the difficulties as following.

- ✓ **Lack regulations to legalize the linkage between farmers and processors**

In this study, we found the contracted negotiations between processors and farmers were a positive solution to implement traceability along shrimp supply chain because the shrimp farming inputs were directly distributed from farmers to processors. Processors might propose the product specification, and require the recording of information. On the other hand, the performance of contracted agreement at Cai Bat Cooperative as our case study might support to the application of ASC certificates at shrimp farms stage. The application of ASC certificates was the essential affirmation of shrimp products about the quality, safety and traceability to global customers. From the analyzed results in Chapter 7, we found the shrimp farmers under contracted agreement with processors might be paid a higher price, comparing to shrimp farmers without the contracts. For shrimp products came from shrimp farmers to processing companies directly, the maximum farm-gate price might be decided at 10.26 USD per kg (*P. monodon* shrimp) and 6.18 USD per kg (*L. vannamei* shrimp), while as the maximum farm-gate prices could be paid for shrimp products distributed through middlemen were only 9.72-10.11 USD per kg (*P. monodon* shrimp) and 6.05-6.10 USD per kg (*L. vannamei* shrimp).

However, as we observed in interview survey and presented in Chapter 5, shrimp farmers preferred to sell harvested shrimp to middlemen, such as collectors, brokers/trader's companies, rather than to processing companies under contracted agreement. We found that, the farmers could be ensured the price under the contract but it might be lower than the price at the harvest date. Moreover, the specification about products quality, especially anti-biotic residues, under contracted agreement was strictly considered. Thus, shrimp farmers must face to the risks of reduction price because of the discovery of anti-biotic residues. Instead of that, the farmers, who did not have contract, could sell harvest shrimp to brokers and traders with the higher price. Moreover, in recent years, lack of liability regulations is causes of the difficulties in the performing of negotiation between farmers and processors. Shrimp farmers might broken-down the contract without any compensation if the price at harvest date was higher offered than the negotiated price in the contracts

- ✓ **The limitation of shrimp producers' perspectives about the role of quality assurances application**

We discussed about the role of establishment of Shrimp Farms Cooperatives in order to share the cost for application of quality assurance certificates and to support to the implementation of traceability in Chapter 7. The results of this study also confirmed the application of ASC standards at Cooperatives of Cai Bat in Cai Nuoc district, Ca Mau province might help for shrimp products to meet the requirements of global customers about product' quality and safety. The requirements of recording and keeping information at shrimp farms in ASC standards were the essential condition to support for the implementation of

traceability along supply chain towards to global markets. The processors might control the quality of shrimp farming inputs, and ensure the precise of movement information through the contracted agreement with the Cooperatives.

However, the balance between costs and benefits of application for quality assurance was not confirmed with CBAs analysis as presented in Chapter 6 because the price of the certified products paid to shrimp farmers was low, and not enough to cover the production costs increased due to the quality assurance application. The analyzed results of Chapter 7 from both farmers and shrimp buyers along shrimp supply chain indicated that, the current farm-gate price of shrimp products should be increased to satisfy the expectation of shrimp farmers to implement the traceability. As indicated in Chapter 7, the expected price of shrimp farmers were 10.17 USD per kg (*P. monodon* shrimp) and 6.35 USD per kg (*L. vannamei* shrimp) From the processing companies, in cases of they did not have to sponsor any costs for application procedures, the maximum farm-gate price might be decided at 10.26 USD per kg (*P. monodon* shrimp) and 6.18 USD per kg (*L. vannamei* shrimp). In this study, the shrimp farmers at Cai Bat Cooperative could not pay the costs to apply for ASC certificates by themselves and rely on the sponsorship of the contracted processing company (X Company). In this cases, Company X confirmed that, they could pay the maximum price for shrimp products until 9.99 USD per kg (*P. monodon* shrimp) and 5.94 USD per kg (*L. vannamei* shrimp). Hence, the processing companies had enough ability to pay more to shrimp farmers for enhancing the implementation of traceability, comparing to the conducted farm-gate price from our survey[18]. An increase of the farm-gate price to discriminate between shrimp products with and without application of quality assurance certificates was expected to call the attention on and the perception of shrimp farmers, which were positively significant factors influencing to the expectation of shrimp farmers in order to apply for the quality assurances and implement for the traceability as indicated in Chapter 7.

Moreover, the fact that, to apply ASC or other international quality assurance certificates, the application fees included USD 5,000-10,000 per farm or cultured area. As our case study, the application cost of ASC certificates at Cai Bat Cooperative was at more than 6,660 USD. Besides that, shrimp farmers had to pay other costs for the application's preparation procedures. The total costs for international certificates application, therefore, were impossible for shrimp farmers. They had to rely on the sponsorship of processing companies. Our results were concordant with the previous scholars of Lap *et al.,* 2015; Portley, 2016. The same situation was also found in others seafood exporting countries such as Indonesia, Myanmar, Cambodia, Laos and Bangladesh (Tunxi and Ying, 2015; Uddin, 2009).

On the other hand, the extension and maintaining of the application for quality assurance certificates require the awareness and corporation of both shrimp farmers and processors. As the pilot program at Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam, the application costs are sponsored by processors. However, the capacity for sponsorship of processors are limited. In this study, we investigated two processors with differences operating scale. X Company is one of the largest seafood exporters in Ca Mau province. Therefore, X Company have enough capacity to sponsor for the ASC application of

[18] The conducted farm-gate price in survey was found at 8.98 USD per kg (*P. monodon* shrimp) and 5.44 USD per kg (*L. vannamei* shrimp) in 2017. From 2018, the committed price of X Company would be at 9.20 USD per kg (*P. monodon* shrimp) and 5.66 USD per kg (*L. vannamei* shrimp).

shrimp farmers at Cooperative of Cai Bat. Otherwise, KHANH AN Company was established in 2009 with the smaller scale, comparing to the X Company. KHANH AN Company could not pay the sponsorship to shrimp farmers as the X Company.

Moreover, under ASC application progress, shrimp farmers must follow the complicated production procedures as the requirements of ASC standards. They also had to spend more time to record and fill the traceability forms (Tran *et al.,* 2013; Suzuki and Nam, 2018). This challenge was also found in Thailand, Bangladesh, Philippines and Laos. To facilitate for shrimp farmers and other participants who were implemented traceability procedures for getting the fair price, Thailand and Philippines Governments had opened auction markets, where played the role as a part of supply chain to distribute the aquaculture products from farms to processors or retailers (Uddin, 2009; Tunxi and Ying, 2015). However, the problem was identified that, due to the limitation of traceability database, the buyers could not identify the differences of harvested products with and without implementing traceability systems.

8.3.2 Can the collectors and brokers be bypassed to the supply chain in the implementation traceability procedures?

The above traceability system was suggested based on the integration with the application for quality assurance certificates. The traceability activities roughly performed with, and relied on the requirements of information recording of quality assurance standards. Besides that, the linkage between shrimp farmers and processing companies was established. The corporation and compliance of shrimp farmers to the forces of processors were also required in order to transfer the information from shrimp farmers to processors. The synthesis and recording of information, then, were performed with the management system of processing companies. The role of shrimp processors was highlighted in order to force the integration and corporation of shrimp farmers. The shrimp products with application for quality assurances were directly provided to processors. The participants of collectors and brokers, therefore, would be bypassed to exclude their negotiation power in shrimp supply chain.

However, as we already discussed, in reality, the application for quality assurance certificates for shrimp products in Mekong Delta, Vietnam were facing to the challenges. Especially, the complicated distribution flows of shrimp products, the limited production scale of shrimp farmers and the pressures of the shortage in shrimp farming inputs of processors became the barriers to apply the quality assurance certificates and implementation for traceability as the suggestion.

Remind the results of Chapter 5, X Company invested shrimp farming inputs area at Cooperative of Cai Bat with the application for ASC certificates. However, in recent year, this area only respond about 20% of total demand for shrimp farming inputs of the X Company. The result corresponded to the previous studies of Suzuki and Nam (2018), Crona and Bodin (2010) and Loc (2006). The main sources of shrimp farming inputs of processors, finally, was provided by shrimp brokers and collectors, required the additions of payment of commissions for those agents. It led to the increasing in operation costs of shrimp processors. In our survey, the shrimp farmers without application for ASC certificates might even receive the higher

price, comparing to the ASC shrimp farmers. This was because they might sell the shrimp products to collectors and brokers. Notably, the farmers at Cooperative of Cai Bat in Cai Nuoc district signed the contracted agreement to the X Company and could not sell their harvested shrimp to other buyers. In contrast, the shrimp farmers did not participate to Cooperative might freely choose the buyers to sell the harvest shrimp. The non-ASC shrimp farmers, therefore, might receive the better price. As the consequences, shrimp processors could not push any specification and requirements about the quality of shrimp farming inputs as well as the information's recording. To buy the shrimp farming inputs, the processors had to be depended on the collectors and brokers, who had the better contacts with shrimp farmers.

The bypassing of shrimp collectors and/or brokers as our suggestion, therefore, were mostly impossible because the dependences of both, shrimp farmers and processors on the collectors in shrimp supply chain. The processors with the pressures of shrimp farming inputs shortage to maintain the business could not specify and force the requirements to their shrimp farming input's suppliers. The traceability of shrimp products from shrimp farmers to processors along supply chain, thus, would be suspended if the shrimp products were provided to processors through the collectors, who are currently not monitored by local government.

Our study's results were corresponding to what Bailey *et al*. (2016) indicated about the application for Fair Trade certificates for artisanal yellowfin tuna (*Thunnus albacares*) in Indonesia[19], which was obligatorily required for exporting to the US market. Yellowfin tuna's Fisher Cooperatives were established to contribute the direct linkage between fishers and processors, and application for Fair Trade certificates (Figure 8.2). The processors paid the costs of application for Fair Trade certificates, and were the Fair-Trade certificates holders. The implementation partners of Fair Trade were the Yellowfin Tuna Fisher' Cooperatives with the specific requirements and monitoring of processors. The non-members of Fisher's Cooperatives could not sell the yellowfin tuna to the processors, and those products might not be exported.

However, the success of Fair-Trade certification for yellowfin tuna in Indonesia was questioned. The fishing industry had long been culturally facilitated by the presence of local collectors, who played a central role in not only trading of Yellowfin Tuna products, but also

[19] Indonesia is one of tenth largest tuna catchers in over the world. The main targets of tuna fishing in Indonesia are exporting markets. Similar as other developing country, Indonesia faces the challenges to register and license all fishing vessels and record all the catches coming from hundreds of thousands of small-scale vessels. However, the specific requirements of quality assurances and traceability were increasingly considered in the global markets, challenging the tuna fishing in Indonesia.

Maluku (Moluccas) province has greatly contributed to provide tuna catch under the artisanal fishing methods, which are daily applied to catch the small quantity (0-3 fishes per fisher per day) of Yellowfin Tuna. In 2014, USA launched Fair Trade (FT) seafood program with the initial certification of an Indonesian Yellowfin Tuna on Buru and Ambon islands of Maluke province. The main purposes of FT standards were focused on the empowerment to supports fishers in developing the necessary skills to effectively negotiate with the buyers, the economic development to increase income of fishers by ensuring a transparent and stable trading relationship with buyers, the social responsibility to protects the human rights of those involved in the fishery and the environmental stewardship to adopt responsible fishing practices and protect biodiversity, including through data collection and monitoring, recognizing that small-scale fisheries often face challenges with data availability and management.

providing fishers with access to capital, infrastructure and essential services (Froese and Proelss, 2012; Gulbrandsen, 2012; Ponte, 2012; Bush *et al*., 2013; Christian *et al*., 2013). They established the familiar networks with the fishers, who daily captured very small quantity of Yellowfin Tuna.

Moreover, the daily harvested quantity of yellowfin tuna in Indonesia was very small (from 0 to 3 fishes per fisher per day), and must be pre-processed before selling to processors. The yellowfin tuna products were directly provided from fishers to processors, also need to be locally pre-processed. Thus, to eliminate the presences of collectors to supply chain, processors must pay for the investment of pre-processing factories, which was operating by the local collectors. Processors, therefore, chose to hire the local collectors to pre-process the yellowfin tuna products.

Thus, to perform Fair-Trade certificates, the existence of Yellowfin Tuna collectors in Indonesia was accepted, rather the bypassing along the supply chain to call the corporation and integration from the collectors. To monitor the collectors, the Cooperatives of Collectors were encouraged, and played as the transporters and pre-processors (market partners) of Yellowfin Tuna products to processors. The certification holders were still the processors. However, with the establishment of Cooperatives of Collectors, the processors could collect the Yellowfin Tuna products from both, Fisher Cooperatives and Cooperatives of Collectors. The processors, then, might specify the quality of products to Cooperatives of Collectors and Fisher Cooperatives, and manage the quality of the products directly based on the requirements of the global customers.

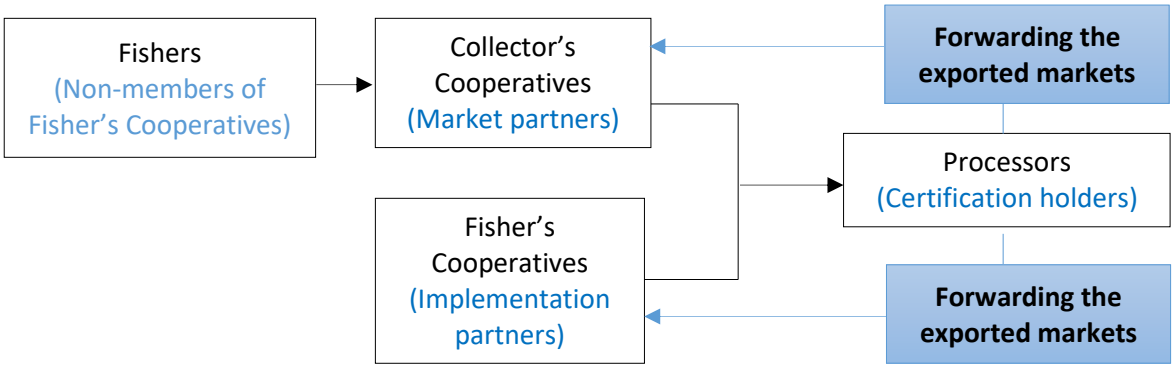


Figure 8.2. The framework of implementation for Fair Trade certificates of yellowfin tuna products in Indonesia imitated from Bailey et al. (2016). Note: the black arrows presented for the distribution flows of yellowfin tuna. The blue arrows indicated for the specific requirements activities and the monitoring of processors for Collectors and Fishers Cooperatives.

All procedures of the application for Fair-Trade certificates were supported by Indonesian Government to improve the national regulations and Laws of Cooperatives. On the other hand, Indonesian Government also sponsored the facilitate and credit for the Cooperatives in order to encourage the application of Fair-Trade certificates procedures, which were mainly performing by the forces of the processors and the corporation of fishers and collectors. The Fair-Trade committee was also established, and played as the "Civil

Actors" to support, reflect and update the requirements in Fair Trade certificates in order to perform and maintain for the application procedures.

8.4 Discuss the traceability implementation procedures for shrimp products in Mekong Delta, Vietnam

The focused purposes of this study are to discuss the alternatives to implement traceability for shrimp products along supply chain in Mekong Delta, Vietnam forwarding the requirements of global markets. As our suggested conceptual systems, the application for the quality assurance was the essential feature to implement the traceability for shrimp products along supply chain. The main ideas of this conceptual systems were suggesting with the developing the direct linkage between processors and shrimp farmers, and the elimination of shrimp collectors and brokers in supply chain. However, the performance of our suggested systems might face to the current challenges as we earlier discussed.

The current situation of shrimp supply chain indicated in Mekong Delta is suggesting the impossibility of instance of traceability systems with the bypassing of collectors and brokers, who were the familiar partners of shrimp farmers, especially extensive farmers. This situation was also concordant with the case of Yellowfin Tuna fishing in Indonesia, where the local collectors played as the conductors of the supply chain. Remind the results in Chapter 5, the traceability of shrimp products was depended on the distribution flows, which were reflected by the status of application for quality assurance at shrimp farms and their cultured methods.

The experiences and evidences of the Fair-Trade certificate application for yellowfin tuna products in Indonesia as introduced above were suggested a conceptual alternative for the small-scale productions in order to apply and achieve our study's purposes. The contribution of Fisher's Cooperatives was valid to apply for Fair Trade certificates in Indonesia, corresponding to the shrimp productions in Mekong Delta, Vietnam. We already found the establishment of Shrimp Farms Cooperatives might call for the sponsorship and sharing costs to apply for quality assurance certificates, such as the pilot program to apply ASC certificates in Cooperative of Cai Bat, Cai Nuoc district, Ca Mau province, Vietnam. We, therefore, explored the applied framework for Fair-Trade certificates of yellowfin tuna in Indonesia for discussion the specific traceability activities to overcome our suggested conceptual system (Figure 8.3).

In whole, we suggested the traceability activities based on the current distribution flows. The role of processors were still the main drivers of traceability activities along shrimp supply chain. In other words, we suggested that processors would refer and update the requirements about product's quality, safety and traceability of global customers. Processors were even the intermediates to transfer and specify those requirements to shrimp farming input suppliers. Those requirements should be specified in the contracted agreements between shrimp farming input's suppliers and processors to clarify the liabilities and responsibilities of both processors and shrimp farming inputs suppliers in order to call for the contracts' compliance and corporation of those agents.

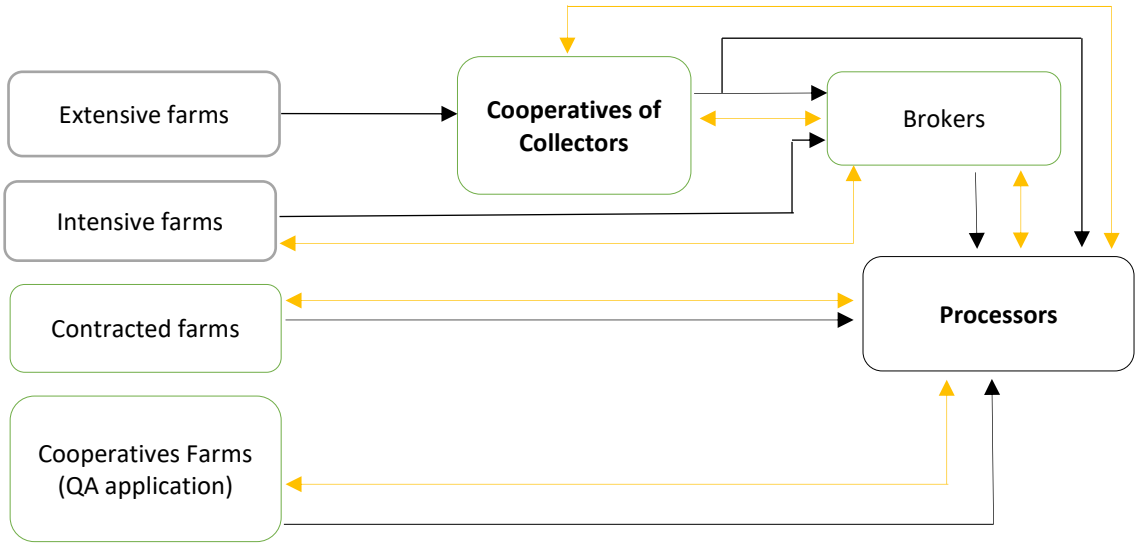


Figure 8.3. Traceability activities framework based on the current distribution flows. Note: the black arrows presented for the shrimp product's flows to processors. The orange arrows indicated for traceability information between shrimp agents in supply chain. The green shape indicated for the agents of supply chain who had responsibility for the recording and keeping information of shrimp farming products, and for providing to processors. QA was the abbreviation of "quality assurance certificates".

Hence, for the shrimp products provided to processors from Shrimp Farm's Cooperatives with quality assurance application, we reserved our initial suggestion of the integration between traceability implementation and application for quality assurances in order to forward the requirements of global markets based on the presented justification in earlier Chapters of this study. The shrimp farmers were supposed as the implementation partner for traceability activities based on the specific requirements about recording and keeping information in quality certificates standards with the monitoring of cooperative's committee and processors. However, to perform those activities, the fair price of quality assurance certified shrimp products paid to farmers should be considered to balance the costs and benefits for shrimp farmers, and to call the attraction of the application for quality assurance as discussed in Chapter 7. The costs of application for quality assurance certificates should be even concerned. This was because in case of Vietnamese shrimp industry, the shrimp farmers could not pay for those costs by themselves, and had to rely the sponsorship from processors. However, as we already discussed, the sponsorships of processors were limited because the small processors could not spend for those. To deal with this situation, the concerning to create the integration between shrimp processors to share the sponsorship might be considered as suggested by Young and Hobbs (2002) and Chkanikova and Kogg (2018). However, the performance and developing of this kind of integration were required the corporation of processors in Vietnamese shrimp industry, which were not familiar for Vietnamese shrimp processors (Loc, 2006).

For the non-certified shrimp farmers, but directly provide the shrimp products to processors through the contracted agreement, we suggested the processors should clarify the responsibility of the recording and keeping the information to shrimp farmers in the contracted agreement. The recorded information, then, could be exchanged to processors.

Similarly as the cases of shrimp products with quality assurance application, once the information had been successfully provided to processors, the internal traceability system at processors might support to decide the providing information to the global customers, depending on the requirements.

There were no currently national laws in Vietnam specified the regulations to monitor the operation of individual collectors as we already mentioned. However, the Law of Cooperatives was issued in 2012. It was currently improving to encourage the developing of Cooperatives in agricultural and aquaculture sectors, including shrimp industry (Interviewed data from Provincial DOFs in VMD, 2017). We suggested the construction of Cooperatives of Shrimp Collectors for the shrimp products provided to processors through collectors and brokers. This was because the bypassing of those agents to the current supply chain was impossible as we presented. The operation of Cooperatives of Collectors must follow the specific regulation in Vietnamese Law of Cooperatives, and must register for the business. The governance and monitoring of those Cooperatives, therefore, would be possible instead of the individual operation. The recording, keeping and providing information as the requirements of processors would belong to the Cooperatives of Collectors and/or Brokers, who would operate under the laws, and register the business certificates with the Local Government. The information about the shrimp farming inputs would be tracked until Cooperatives of Collectors and/or Brokers, and still could not be tracked the information of shrimp farmers. However, the construction of Cooperatives of Collectors as our suggestion might improve the responsibilities of shrimp collectors participated to Cooperatives to record and provide the information of shrimp products to the processors, with the monitoring of the cooperative's committee. The processors might specify the requirements of information recording to Cooperatives of Collectors and/or Brokers whereby the responsibilities and liabilities about the specific regulations would be clarified in the contracted agreement.

Notably, in this case, we supposed that, the collectors must be required to participate to the Cooperatives, which was not compulsorily specified in the Vietnamese national regulations. Thus, to perform this alternative, we suggested that the Vietnamese Government should concern about the developing of the national regulation about the monitoring of shrimp collector's operation. The regulation should be focused on the establishment and construction of Cooperatives of Collectors, and the specific regulation to obligatory push the participants of collectors to the Cooperatives, instead of the concerning to monitor the operation of individual collectors.

Maybe, this suggestion was not satisfied to the current requirements of global markets about the product's quality and safety because we accepted the existence of collectors and the shrimp farmers without application the quality assurance certificates in supply chain. However, in order to implement the traceability, our alternatives system may allow for the forward tracing and backward tracking about the information of shrimp products along supply chain.

As a consequence, the application of quality assurance certificates should be the priority alternative to integrate to the traceability implementation for shrimp products. So far, we assumed that the shrimp farmers with the establishment of Shrimp Farms Cooperatives might pay the costs to apply for quality assurance certificates by themselves,

rather than reply on the sponsorship of contracted processor as the farmers of Cai Bat Cooperative in our case study The recording, keeping and transferring of information would be implemented by shrimp farmers with the monitoring of Shrimp Farm Cooperatives' Committee, who undertook the responsibility in the trustfulness of the recorded information. In this case, the Shrimp Farms Cooperatives might freely choose the shrimp processors to sign the contracted agreement to sell the harvest shrimp, instead of compulsory providing to only one contracted processor as in the current. They, therefore, might probably negotiate the higher price of shrimp products with the processors. From the processors' side, they might have to compete to other processors to buy the shrimp farming inputs from shrimp farmers. In this case, The Cooperatives of Collectors and/or Brokers, who have the familiar negotiation with shrimp farmers, might be better for the seeking of shrimp farming input from shrimp farmers. Thus, processors might rely on the Cooperatives of Collectors and/or Brokers to assist them to offer the contracted agreement with shrimp farmers. The role of Cooperatives of Collectors and/or Brokers in the supply chain, in this case, was expected as the distributors of both, shrimp products and information about Shrimp Farms Cooperatives to the processors. The processors might update the requirements of global customers, not only in quality assurance but also in terms of traceability, such as which information should be recorded, kept and provided to the customers to specify to Shrimp Farms Cooperatives and Cooperatives of Collectors and/or Brokers as well (Figure 8.4).

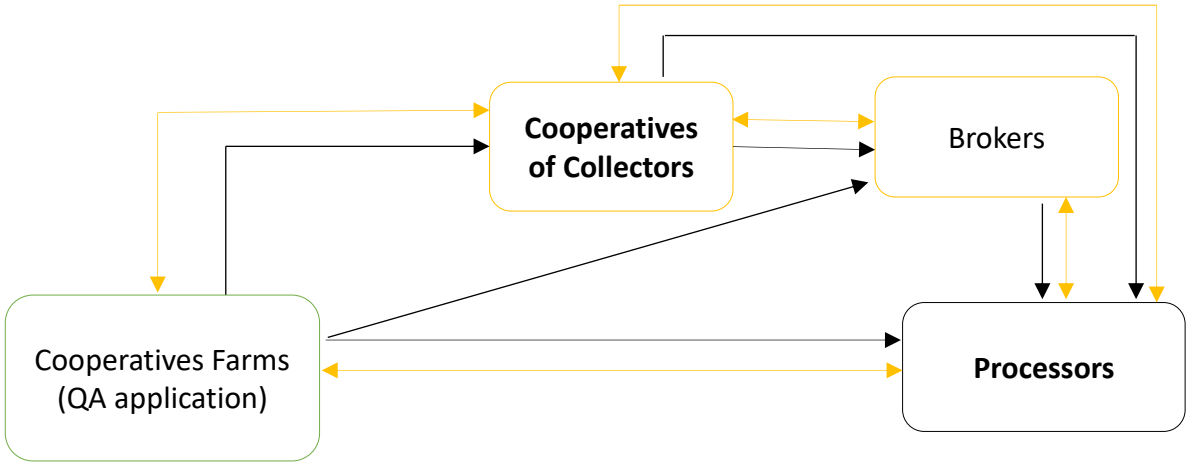


Figure 8.4. Traceability activities framework in case farmers pay the costs for QA application. Note: the black arrows presented for the shrimp product's flows to processors. The orange arrows indicated for traceability information between shrimp agents in supply chain. The green shape indicated for the agents of supply chain who had responsibility for the recording and keeping information of shrimp farming products, and for providing to other agents of supply chain. The orange shape presented for the transporters of information of shrimp farming products from farmers to processors. QA was the abbreviation of "quality assurance certificates".

8.5 Conclusion

We have discussed the alternatives of traceability implementation for Vietnamese shrimp products in this Chapter. We concluded that the traceability system implemented for Vietnamese shrimp products based on the synthesis and integration with the specific requests of recording and keeping information in quality assurance certificates may enhance to adapt the requirements of global markets. Notably, the performing of Shrimp Farm Cooperatives played an important role to call for the sharing and sponsoring the costs to apply for quality assurance certificates. To implement the integrated traceability systems for shrimp products along supply chain with the quality assurance certificates, the investment of internal traceability systems at processors would be the premise to carry out the qualitative implementation procedures of the traceability in the future. From the perspectives of shrimp farmers, the strict specification about the requirements of processors, relating to the traceability would call their compliances to apply the traceability and quality assurances practices for their shrimp products.

Probably, the application of quality assurance certificates may be applied to all of shrimp farms in the future to forward to the adaption of the requirements of exporting markets, and become practical to implement traceability systems as our discussion. The performance of this system may eliminate the reflection of middlemen in shrimp supply chain in order to reduce the intermediates costs spent for them. However, recent characteristic of shrimp products at farm stages was small-scale production, suggesting the mandatory participants of shrimp middlemen in the distribution flows along supply chain. The bypassing of the middlemen to the shrimp supply chain was currently impossible because those agents were the main distributors to transfer shrimp products from farms to processors. Incentives of established Cooperatives of Collectors might enhance the improvement of the traceability activities along shrimp supply chain for shrimp farms and individual middlemen.

Chapter 9. Conclusion and recommendations for future research

9.1 Introduction

This study was implemented in eight steps, and was presented in nine Chapters. The first seven Chapters provided the introduction, objectives and research questions (Chapter 1), the requirements of traceability for shrimp products in global markets (Chapter 2), the background of Vietnamese shrimp products (Chapter 3), the study design and data collection survey (Chapter 4), the shrimp supply chain in terms of traceability with the evidences of Ca Mau provinces, Mekong Delta, Vietnam (Chapter 5), the CBAs framework and its application to identify the affecting of traceability application to shrimp farmers in Ca Mau province, Mekong Delta, Vietnam (Chapter 6), the willingness to implement the traceability along shrimp supply chain (Chapter 7), and the alternatives of traceability implementation for shrimp supply chain (Chapter 8). This chapter draws conclusions and provides main findings, as well as the limitation of this study, and the suggestion for future studies. Chapter 9 is divided into introduction, conclusions of research products, and limitation and suggestion for future studies. Next is a section on the changes that have taken of the study. The final section presents recommendations for further research.

9.2 Main findings and conclusions

The most important aim of this study is to answer the question how a traceability system should be implemented in shrimp exporting countries toward to adaption of global markets' requirements, with the evidences of Vietnamese shrimp products in Mekong Delta, Vietnam. The main findings relate to (1) the current situation of traceability systems in global markets; (2) the policies and regulations of traceability for shrimp products in exporting countries; (3) the role of international quality assurance certificates in traceability implementation; (4) price affecting to enhance the implementation of traceability; (5) the bypassing of shrimp collectors to supply chain; and (6) the role of processors in traceability implementation along supply chain.

9.2.1 A completed traceability systems has not been specified in global markets

We have presented about the requirements of traceability for shrimp products in global markets in Chapter 2, focusing on the requirements of Japan, EU and the US markets, where are the most important imported markets of Vietnamese shrimp products. In whole, an agreed format for traceability systems has not yet been specified yet, for either national laws or quality assurance regulations in global markets. At the global level, the development of traceability requirements of importing countries have taken and specified in diverse forms, including in policies and regulations. The main aims of those regulations and requirements are traceability, besides food safety, environmental and social welfare. The specification of the traceability rule "one step backward"-"one step forward" in those policies and regulations requires the coordination of the whole supply chain.

As we presented in chapter 2, the amount of information recorded in and its ability for tracing and tracking in traceability systems were depended on the purposes of user's systems. The priority considerations of food producers and manufactures are to improve

operating efficiency and quality control. Therefore, from their perspectives, the implementation of traceability systems aims to manage and transfer information between producers and manufactures only. In contrast, consumers, government and civil actors seek to ensure consumers' health and to reduce food incidents with regard to sustainable development. Traceability systems in this case have been developed to ensure for the tracing of the product's information from production to consumption via distribution.

We also found that, the right to provide the product's information in global markets belonged to retailers at the point of sale. The printed label on the shrimp products at retailers' stage was mostly focused on the consideration of consumers in global markets, including the information of retailers and country of origins of products, rather than all information of supply chain from farms, distribution to processing. Therefore, the traceability systems under the rule "one step backward"- "one step forward" to identify from whom to whom the shrimp products have been supplied, in fact, was not necessary from the consumer's perspectives.

9.2.2 Shrimp exporting countries have considered to the implementation of traceability for shrimp products

As the results of Chapter 2, we conclude that, shrimp exporting countries, including Vietnam have contributed and implemented traceability regulations to respond to global requirements. Those regulations have been developed and followed to meet the requirements of traceability in the importing markets. In the future, the growing concerns in traceability requirements probably reflect to put forward the innovative pressures of the customers in global markets. Therefore, the continuous efforts of shrimp producers and manufactures in Vietnam and other exporting countries would be demanded to maintain the responses of traceability policies and regulations to the requirements of importing countries.

9.2.3 Application for international quality assurance certificates is essential to implement traceability towards global markets

We found that, the distribution flows are directly reflected to the movement of information and traceability of shrimp products along shrimp supply chain. Accordingly, culture methods and the quality assurance certificates of shrimp farmer's possession are the most important factors influencing to the distribution flows along supply chain. At Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam, the possession of the ASC certificate allowed provide the shrimp products to processors directly. It helps to eliminate the participants of middlemen, such as collectors and brokers, to the supply chain.

Actually, to eliminate the middlemen, especially collectors to the supply chain, processors and shrimp farmers can consider signing the contracted agreement to provide the shrimp farming inputs from farms to processing companies directly. However, in that case, shrimp products have not been certified by the quality assurance certificates. Those products cannot satisfy the requirements of global markets in quality and traceability. Therefore, the application for quality assurances certificates application is necessary, not only because these certificates are currently obligatory for shrimp products to export to global markets, but also the certified shrimp products were cultured under the specific quality controlling procedures

in those certificate' standards. Thus, the quality of certified shrimp products were well controlled, and ensured to meet the requirements of global markets.

The traceability of shrimp products is considered to be depended on the forces of processors through the internal traceability systems invested at their companies. This system is a tool to control and manage the information of shrimp inputs and outputs of shrimp processors whereby the information of shrimp farming inputs is recorded and tracked. Thus, if the information of shrimp products was sufficiently provided by the shrimp farming input's suppliers, the processors can record and provide that information as the requirements of their customer's information of shrimp products. This result intended to the extension of application for international quality assurance certificates because the traceability rule "one step backward"- "one step forward" specified in ASC standards is estimated to support for tracing and tracking the information of shrimp products along supply chain, and to adapt the current regulations and policies of importing countries.

9.2.4 Price of shrimp products is the important factor influencing to enhance the implementation of traceability

The effect of international quality assurance certificates to the traceability implementation for shrimp products towards to the requirements of global markets was discussed in this study. However, in our case study, we did not confirm the benefits of ASC certificates application for shrimp farmers at Cooperative of Cai Bat in Cai Nuoc district, Ca Mau province, Vietnam, comparing to the non-ASC shrimp farmers with the approaches of CBAs analysis. The most important matter was indicated because the farm-gate price of shrimp products paid to the ASC shrimp farmers was not enough to cover the increases costs for application procedures as well as was not enough to be incentive the application of that certificates at shrimp farms.

Based on the results of CBAs approaches, we suggested a higher minimum price should be set up for certified ASC shrimp products in order to balance the costs and benefits of ASC certificates application. In details, for *P. monodon* shrimp, the farm-gate price was suggested at 10.17 USD per kg. Our suggestion was exactly concordant with the expected price of shrimp farmers in order to implement the traceability as we conducted from the interview survey. Moreover, this suggested price was not exceeded the maximum price (10.26 USD per kg) could be paid by processors. Therefore, to enhance the application for quality assurance at shrimp farmers, we recommended that, the farm-gate price of *P. monodon* shrimp products should be considered at least 10.17 USD per kg, rather than 8.98 USD per kg as we found in our survey.

Similarly, for *L. vannamei* shrimp, our suggested price was at 6.35 USD per kg. It was higher than the expected price of shrimp farmers and the maximum price could be paid by processors. From the results, we conducted the expected price of shrimp farmers at 6.15 USD per kg, and the maximum price could be paid from processors was at 6.18 USD per kg, which was exactly equals to the price of non-ASC certified shrimp products obtained from our survey. Notably, this price was higher than the price farm-gate price of ASC certified shrimp products (5.44 USD per kg). Hence, from this result, we also suggested the farm-gate price of *L. vannamei* shrimp products with ASC application should be decided at higher range. At least,

it should be equals to the non-ASC shrimp products. Hence, the role of the participation to the Cooperative and application for quality assurance are estimated to be emphasized because the shrimp farmers can recognize that, if they participate to the Cooperatives, they can receive the same price for shrimp products as ordinary farms, coupled with other sponsors from Local Government and processors.

9.2.5 Eliminate middlemen in supply chain is impossible and the establishment of Cooperatives is as an alternative to implement traceability

The application for quality assurance certificates was only in the pilot procedures and its extension is still challenging due to the shrimp farmers are not payable for the application costs of those certificates, and are relying on the sponsorship of the processors. While as the price incentives of certified products are not currently sufficient to call for the shrimp farmers' perspectives as we already presented, the supply chain of shrimp products in Mekong Delta, Vietnam is completely depended on the collectors and brokers, who established the familiar negotiation network with the shrimp farmers.

On the other hand, the current governance systems of Vietnamese Government had not issued to monitor the operating of collectors. As our case study, there were about 2,000 collectors in whole of Ca Mau province, Mekong Delta, Vietnam, and the Local Government cannot count the exactly number. Those collectors mostly lack knowledge of traceability, quality and safety. Therefore, the information' recording of shrimp products was ignored whereby the shrimp products distributed by those collectors cannot track until the original farm. The necessary of monitoring and governance for those collectors suggested the developing of collector's Cooperatives in order to push the participants of individual collectors to the Cooperatives. Even if shrimp products passed through those Cooperatives still cannot be tracked until the original farm, the establishment of Cooperatives can improve the liabilities and collaboration of collectors to comply with the requirements of processors about the products quality and traceability.

9.2.6 Processing companies are the intermediates to transfer the traceability's requirements from the global markets to shrimp farming inputs

From the results of study, we conclude that, to respond the requirements of quality, safety and traceability of global customers, the integration and cooperation of the whole agents of shrimp supply chain are essential. However, processing companies are directly affected by the changing and upgrading of those requirements. They, then, are considered as the intermediates to transfer those requirements from global customers to other agents along supply chain such as shrimp farmers, collectors, brokers and traders' companies. To call for the collaboration of shrimp farmers and other agents, the shrimp processors are suggested to specify and clarify the requirements and compliances about the recorded information and product quality to shrimp farming inputs suppliers, based on the updated requirements of global customers. The processors, with the feature of internal traceability systems within their companies, can control the information and quality of the shrimp products if the recorded information from shrimp farming inputs suppliers is utilized.

9.3 Limitation and suggestion for future research

The main targets of Vietnam's shrimp industry are exporting markets. Therefore, the implementation of traceability for shrimp products is very important to access and maintain the market shares of Vietnamese shrimp products in the global. Recent shrimp supply chain in the Mekong Delta, Vietnam as our case study includes the producers and distributors in primary production stages such as feed suppliers, hatcheries, farms, collectors, and wholesale buyers, the processors and exporters, the importers, distributors, retailers and consumers. The focus of the current research has been on the Vietnamese side, with an emphasis on the implementation of traceability. Some attention has been paid to primary production due to the complex of distribution flows among the agents along supply chain and the perspectives about traceability of those agents.

We found that, in the current situation, processors and exporters in the Mekong Delta, Vietnam is showing progress with respect to ensuring shrimp product quality, safety and traceability to respond the requirements of global markets. The alternatives of traceability implementation in entire of shrimp supply chain towards the global markets has been scientifically discussed based on the empirical results of shrimp supply chain in Mekong Delta, Vietnam. However, some limitations have been found and it is necessary to be focused on the further research.

The application of international quality assurance certificates was found as an important role to support the implementation of traceability. Accordingly, the main purposes of the international quality assurances certificates included the food safety, environmental, social welfare and traceability as the rule "one step back"-"one step forward" Thus, to be awarded those certificates, the shrimp products must to be considered on both, product's quality and traceability. The current study focuses on the implementation of traceability for shrimp products based on the specific feature's traceability in quality assurances certificates. However, we have not conducted the specific requirements of product's quality and safety controlling procedures in quality assurances certificates. Therefore, further scientific research regarding the quality and safety controlling procedures in primary production stages to adapt the specific requirements of those certificates needs to be focused.

On the other hand, the role of shrimp processors in the traceability implementation has been discussed in this study. They are the intermediaries to transfer the traceability requirements from global markets to the primary production stages. They are also the sponsors to encourage the application of quality assurances certificates at shrimp farms. In the future research, we suggest the consideration of scientific works on the contribution the linkage and collaborates, not only vertical linkage between shrimp farmers and processors, but also the horizontal collaborates between processors to share the liabilities and responsibility and improve the competitive advantages and reputation.

The establishment of Cooperatives, both at shrimp farms' stage and collectors' stage has been indicated in this study as an alternative to enhance the application for the quality assurances certificates to support the implementation of traceability. From shrimp farmers, this study was explored based on the assumption whereby that the sponsorship from Local Government and processors was averagely divided to all members of Cooperatives as we

observed in the survey. In fact, each farm has the different features so that the sponsorship should be considered to allocate to each farmer based on their farming conditions. Moreover, we only suggested the farm-gate price in order to enhance the participant to Cooperative of shrimp farmers who desire to apply for quality assurances. However, for other shrimp farmers, we cannot confirm the concordances of our suggested price with their expectation to participate to Cooperative. From shrimp collectors, we have ignored the discussion about how to call for their participant to the Cooperatives. It is estimated to be a challenge because their current operation is free to the governance of Local Government. Therefore, in future research, we strongly recommend the scientific works on the governance and organization mechanism, as well as the economic efficiency of Cooperatives and the willingness to participate to the Cooperatives of shrimp farmers and collectors should be concerned. Notably, the Cooperative is an alternative to implement our suggested traceability systems. Therefore, careful consideration on those topics should be given to whether our alternatives can be overcome or not.

Lastly, this thesis was focused on the economics examination to identify the changes of shrimp farmer's performance under the quality assurances certificates towards the implementation of traceability, and ignored the changes from other factors. Therefore, in short-term, this study is valid as the basic platform for such strategies and decision-making progress of shrimp farmers to implement the traceability system. In connection with it, there is a need to rethink about the future researches to reach the changes of shrimp farmer's performance under the application for quality assurances certificates with the simultaneous consideration on the changes of other factors in long-term. Moreover, this is because the requirements of international quality assurances certificates will be upgraded in the future. Therefore, those future researches from this study's proposal are useful for Fisheries Industry, the local governments and policy makers, and for all shrimp supply chain stakeholders to forward to the global markets. They will help to improve shrimp quality and safety throughout the chain as well as help fisheries experts to direct further improvement of the seafood supply chain.

REFERENCES

Ackerley, N., Sertkaya, A. and Lange, R. (2010). Food transportation safety: characterizing risks and controls by use of expert opinion. Food Protection Trends 30:212-222.

Alexander, E. S. (2016). Traceability and reputation in supply chains. International Journal of Production Economics 177:149-162.

Arellano-Valle, R. B. and Genton, M. G. (2008). On the exact distribution of the maximum of absolutely continuous dependent random variables. Statistics and Probability Letters 78:27–35.

Arquitt, S. P. and Cornwell, T. B. (2007). Micro-macro linking using system dynamics modeling: an examination of eco-labeling effects for farmed shrimp. Journal of Macromarketing 27:243-255.

ASC (Aquaculture Stewardship Council) (2015). "Certified Fisheries." Final reports and audits for shrimp fisheries. Retrieved from: http://www.asc-aqua.org/index.cfm?act=tekst.itemandiid=4andiids=204andlng=1#bbxnwtmkaxma. Accessed on: November 25th, 2018.

Atkins, P. (2008). Fear of animal foods: a century of zoonotic. Appetite 51:18-21.

Aung, M. M. and Chang, Y. S. (2014). Traceability in a food supply chain: Safety and quality perspective. Food Control 39:172-184.

Baert, K., van Huffel, X., Jacxsens, L., Berkvens, D., Diricks, H., Huyghebaert, A. and Uyttendaele, M. (2012). Measuring the perceived pressure and stakeholder's response that may impact the status of the safety of the food chain in Belgium. Food Research International 48:257-264.

Bailey, M., Bush, S. R., Miller, A. and Kochen, M. (2016). The role of traceability in transforming seafood in the global South. Current Opinion in Environmental Sustainability 18: 25-32.

Bailey, M., Packer, H., Schiller, L., Tlusty, M. and Swartz, W. (2018). The role of social corporation responsibility in creating a Seussian world of seafood sustainability. Fish and Fisheries 19:782-790.

Banterle, A. and Stranieri, S. (2008a). Information, labelling, and vertical coordination: an analysis of the Italian meat supply networks. Agribusiness 24:320-331.

Banterle, A. and Stranieri, S. (2008b). The consequences of a voluntary traceability system for supply chain relationships. An application of transaction cost economics. Food Policy 33:560–569.

BAP (Best Aquaculture Practices) (2015). "Find Certified Facilities." Database of BAP-certified facilities. Retrieved from: http://bap.gaalliance.org/find-certified-facilities. Accessed on: November 25th, 2018.

Bergleiter, S. and Meisch, S. (2015). Certification standards for aquaculture products: bringing together the values of producers and consumers in globalised organic food markets. Journal of Agricultural and Environmental Ethics 28:553–569.

Bernard, A., Broeckaert, F., De Poorter, G., De Cook, A., Hermans, C., Saegerman, C. and Houins, G. (2002). The Belgian PCB/dioxin incident: analysis of the food chain contamination and health risk evaluation. Environmental Research 88:1-18.

Bjornlund, H., van Rooyen, A. and Stirzaker, R. (2017). Profitability and productivity barriers

and opportunities in small-scale irrigation. International Journal of Water Resources Development 33:690-704

Bollen, A. F., Riden, C. P. and Cox, N. R. (2007). Agricultural supply system traceability, part I: role of packing procedures and effects of fruit mixing. Biosystems Engineering 98:391-400.

Bosona, T., and Gebresenbet, G. (2013). Food traceability as an integral part of logistics management in food and agricultural supply chain. Food Control 33:32-48.

Boyd, C. E., McNevin, A. A., Davis, R. P., Godumala, R. and Mohan, A. B. (2018). Production methods and resource use at *Litopenaeus vannamei* and *Penaeus monodon* farms in India compared with previous findings from Thailand and Vietnam. Journal of the World Aquaculture Society 49:551-569.

Buhr, B. L. (2003). Traceability and information technology in the meat supply chain: implications for firm organization and market structure. Journal of Food Distribution Research 34:13–26.

Bureau, J. C. and Valceschini, E. (2003). The European food labeling policy: successes and limitations. Journal of Food Distribution Research 34:69-76.

Bush, S. R., Toonen, H., Oosterveer, P. and Mol, A. P. J. (2013). The 'devils triangle' of MSC certification: balancing credibility, accessibility and continuous improvement. Marine Policy 37:288-293.

Canavari, M., Fritz, M., Hofstede, G. J., Matopoulos, A. and Vlachopoulou, M. (2010). The role of trust in the transition from traditional to electronic B2B relationships in agri-food chains. Computers and Electronics in Agriculture 70:321-327.

Caswell, J. A. (1998). Valuing the benefits and costs of improved food safety and nutrition. Australia Journal of Agricultural and Resource Economics 42:409-424.

Chan, K. (2016). Manual on Good Agricultural Practices (GAP). Asian Productivity Organization, Tokyo, Japan. 252.

Charlebois, S., Sterling, B., Haratifar, S., and Naing, S. K. (2014). Comparison of global food traceability regulations and requirements. Comprehensive Reviews in Food Science and Food Safety 13:1105-1123.

Chen, M. F. and Huang, C. H. (2013). The impacts of the food traceability system and consumer involvement on consumers' purchase intentions toward fast foods. Food Control 33:313-319.

Chkanikova, O. and Kogg, B. (2018). Sustainability governance service providers: the role of third-party product certification in facilitating corporate life cycle management. International Journal Life Cycle Assess 23:1383–1395.

Christian, C., Ainley, D., Bailey, M., Dayton, P., Hocevar, J., LeVine, M. and Jacquet, J. (2013). A review of formal objections to Marine Stewardship Council fisheries certifications. Biological Conservation 161:10-17.

Chrysochou, P., Chryssochoids, G. and Kehagia, O. (2009). Traceability information carriers: the technology backgrounds and consumers' perceptions of the technological solutions. Appetite 53:322-331.

Clemens, R. (2003). Meat traceability and consumer assurance in Japan. MATRIC Briefing Paper 03, MBP 5, Iowa State University. 9.

Coughenour, C. M. and Swanson, L. E. (1992). Determinants of farmers' satisfactions with farming and with life: a replication and extension. Southern Rural Sociology 9:45-70.

Crona, B. and Bodin, Ö. (2010). Power Asymmetries in Small-Scale Fisheries: a barrier to Governance Transformability?. Ecology and Society 15:32. Retrieved from: http://www.ecologyandsociety.org/vol15/iss4/art32/.

Dabbene, F. and Gay, P. (2011). Food traceability systems: performance evaluation and optimization. Computers and Electronics in Agriculture 75:139-146.

Dalvit, C., de Marchi, M. and Cassandro, M. (2007). Genetic traceability of livestock products: a review. Meat Science 77:437-449.

Dan, T.Y. (2017). Rice intensive cropping and balanced cropping in the Mekong Delta. Vietnam-Economic and Ecological Considerations. Ecological Economics 132:205-212.

DANIDA-Danish International Development Agency (2010). The fisheries sector in Vietnam: a strategic economic analysis. Report commissioned by Royal Embassy of Denmark in Vietnam Fisheries Sector Programme Support (FSPS) II.

Darby, M. R.and Karni, E. (1973). Free competition and the optimal amount of fraud. Journal of Law and Economics 16:67-88.

Dickinson, D. L. and Bailey, D. (2002). Meat traceability: Are U.S. consumers willing to pay for it?. Journal of Agricultural and Resource Economics 27:348-364.

Disdier, A. C. and Marette, S. (2012). Taxes, minimum-quality standards and/or product labeling to improve environmental quality and welfare: Experiments can provide answers. Journal of Regulatory Economics 41:337-357.

Donelly, K. A. M. and Olsen, P. (2012). Catch to landing traceability and the effects of implementation-a case study from the Norwegian white fish sector. Food control 27:228-233.

Dong, K. T. P. and Duc, N. M. (2012). The impacts of non-tariff barriers on the export price of Vietnamese catfish. In H.T. Toan et al. (Editors.)-IFS 2012: Sharing knowledge for sustainable aquaculture and fisheries in the Southeast Asia. Can Tho City, Vietnam. Agriculture Publishing House. 315-326.

Dongnan, L., Di L., Jianshi Z., Hui L. and Yang H. (2017). Observed changes in flow regimes in the Mekong River basin. Journal of Hydrology 551:217-232.

Duc, N. M. (2008). Farmers' satisfaction with aquaculture-A logistic model in Vietnam. Ecological Economics 68:525-531.

Duc, N. M. (2009). Economic contribution of fish culture to farm income in Southeast Vietnam. Aquaculture International 17:15-29.

Duc, N. M. (2010). Application of econometric models for price impact assessment of antidumping measures and labelling laws on global markets: a case study of Vietnamese striped catfish. Reviews in Aquaculture 2:86-101.

Engelseth, P. (2009). Food product traceability and supply network integration. Journal of Business and Industrial Marketing 24:421-430.

FAO (2018). Fisheries commodities and trade. Retrieved from http://www.fao.org/fishery/statistics/global-commodities-production/query/en. Accessed on: September 10th, 2018.

FAO-Food and Agriculture Organization (2018). National aquaculture sector overview. Retrieved from: http://www.fao.org/fishery/countrysector/naso_vietnam/en

Fisk, G. and Chandran, R. (1975). Tracing and recalling products. Havard Business Review 53:90-96.

Flaaten, O. (2018). Fisheries and Aquaculture Economics (2nd edition). Aquaculture: Plant and Industry Management. Retrieved from: https://bookboon.com/en/fisheries-and-aquaculture-economics-ebook. 250-266.

Frey, B. S. and Stutzer, A. (2002). What can economists learn from happiness research? Journal of Economic Literature 40:402-435.

Froese, R. and Proelss, A. (2012). Evaluation and legal assessment of certified seafood. Marine Policy 36:1284-1289.

FSA (2002). Traceability in the food chain: A preliminary study. UK: Food Standard Agency. Retrieved from: http://www.adiveter.com/ftp_public/articulo361.pdf. 51.

Fuchs, D., Kalfagianni, A. and Havinga, T. (2009). Actors in private food governance: the legitimacy of retail standards and multi-stakeholder initiatives with civil society participation. Agriculture and Human Values 28:353-367.

Gellynck, X. and Verbeke, W. (2001). Consumer perception of traceability in the meat chain. Agrarwirtschaft, 50:368-374.

GGAP (Global GAP) (2015). Database. Retrieved from: https://database.globalgap.org/globalgap/search/SearchMain.faces?init=1. Accessed on: November 20th, 2018.

Giraud, G. and Amblard, C. (2003). What does traceability mean for beef meat consumer?. Food Science 23:40-64.

Golan, E., Krissoff, B., Kuchler, F., Calvin, L., Nelson, K. and Price, G. (2004). Traceability in the US. Food Supply: economic theory and industry studies. Agricultural Economic Report No.830 USDA/ERS. Retrieved from: https://ageconsearch.umn.edu/bitstream/33939/1/ae040830.pdf. 46.

Gujarati, D. (2004). Basic Econometrics (4th Edition). McGraw−Hill Companies, New York, USA.

Gulbrandsen, L. H. (2012). Dynamic governance interactions: evolutionary effects of state responses to non-state certification programs. Regulation and Governance 8:74-92.

Ha, T. T. T. and Bush, S. R. (2010). The transformations of Vietnamese shrimp aquaculture policy: Empirical evidence from the Mekong Delta. Environment and Planning C: Government and Policy 28:1101-1119.

Hall, D. (2010). Food with a visible face: traceability and the public promotion of private governance in the food system. Geoforum 41:826-835.

Hasan, M. R. (editor). (2007). Economics of aquaculture feeding practices in selected Asian countries. Aquaculture Management and Conservation Service. Fisheries and Aquaculture

Management Division. FAO Fisheries and Aquaculture Department. http://www.fao.org/3/a1456e/a1456e00.htm.

Hayes, B., Sonesson, A. K. and Gjerde, B. (2005). Evaluation of three strategies using DNA markers for traceability in aquaculture species. Aquaculture 250:70-81.

Henningsen, A. (2011). Estimating censored regression models in R using the censReg package. Institute of Food and Resource Economics. University of Copenhagen, Denmark.

Hernández-Jover, M., Schembri, N., Toribio, J. and Holyoake, P. (2009). Evaluation of the implementation of new traceability and food safety requirements in the pig industry in eastern Australia. Australian Veterinary Journal 87:387-396.

Hobbs, D. A., Warne, M. S. J. and Markich, S. J. (2005). Evaluation of criteria used to assess the quality of aquatic toxicity data. Integrated Environmental Assessment and Management 1:174-180.

Hobbs, J. E. (2003). Traceability in meat supply chains. CAFRI: Canada Agricultural Economics Society 4:36-49.

Hobbs, J. E. (2004). Information asymmetry and the role of traceability systems. Agribusiness 20:397-415.

Hortle, K. G. (2009). Biophysical Environment of an International River Basin. Chapter 9-Fisheries of the Mekong River basin. 197-249. Retrieved from: https://doi.org/10.1016/B978-0-12-374026-7.00009-7.

Houghton, J. R., Rowe, G., Frewer, L. J., van Kleef, E., Chryssochoidis, G., Kehagia, O. and Strada, A. (2008). The quality of food risk management in Europe: perspectives and priorities. Journal of Food Policy 33:13-26.

Jonell, M. and Henriksson, P. J. G. (2015). Mangrove-shrimp farms in Vietnam-comparing organic and conventional systems using life cycle assessment. Aquaculture 447:66-75.

Karipidis, P., Athanassiadis, K., Aggelopoulos, S. and Giompliakis, E. (2009). Factors affecting the adoption of quality assurance systems in small food enterprises. Food control 20:93-98.

Kehagia, O., Chrysochou, P., Chryssochoidis, G., Krystallis, A. and Linardakis, M. (2007). European consumers' perceptions, definitions and expectations of traceability and the importance of labels and differences in these perceptions by product type. Sociologia Ruralis 47:400-416.

Kher, S. V., Frewer, L. J., de Jonge, J., Wentholt, M., Davies, O. H., Luijckx, N. B. L. and Cnossen, H. J. (2010). Experts' perspectives on the Implementation of Traceability in Europe. British Food Journal 112:261-274.

Kimura, A., Wada, Y., Tsuzuki, D., Goto, S., Cai, D. and Dan, I. (2008). Consumer valuation of packed foods: interactive effects of amount and accessibility of information. Appetite 51: 628-634.

Kusumawati, R., Bush, S. R. and Visser, L. E. (2013). Can patrons be bypassed? Frictions between local and global regulatory networks over shrimp aquaculture in East Kalimantan. Society and Natural Resource International Journal 26:898-911.

Lap, D. X, Lai, T. P. and Luan, P. M. (2015). Current situation of quality assurance standards application in Vietnam Aquaculture. International Collaborating Centre for Aquaculture and Fisheries Sustainability (in Vietnamese). 17.

Leat, P., Marr, P. and Ritchie, C. (1998). Quality assurance and traceability-the Scottish Agri-Food industry's quest for competitive advantage. Supply chain management 3:115-117.

Li, S., Visich, J. K., Khumawala, B. M. and Zhang, C. (2006). Radio frequency identification technology: applications, technical challenges and strategies. Sensor Review 26:193-202.

Liao, P. A., Chang, H. H. and Chang, C. Y. (2011). Why is the food traceability system unsuccessful in Taiwan? Empirical evidence from a national survey of fruit and vegetable farmers. Food Policy 36:686-693.

Liddell, S., and Bailey, D. (2001). Market opportunities and threats to the U.S. pork industry posed by traceability systems. The International Food and Agribusiness Management Review 4:287-302.

Ling, H. B, Leung, S. P. and Shang, C. Y. (1999). Comparing Asian shrimp farming: the domestic resource cost approach. Aquaculture 175:31-48.

Loc, V. T. T. (2006). Seafood supply chain quality management: the shrimp supply chain quality improvement, perspective of seafood companies in the Mekong Delta, Vietnam. Doctoral dissertation. University of Groningen, Groningen, Netherland.

Loreiro, M. L. and Umberger, J. W. (2007). A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-of-origin labeling and traceability. Food Policy 32:496-514.

Lusk, J. L. and Norwood, F. B. (2008). A survey to determine public opinion about the ethics and governance of farm animal welfare. Journal of the American Veterinary Medical Association 233:1121-1126.

Lusk, J. L., Brown, J., Mark, T., Proseku, I., Thompson, R. and Welsh, J. (2006). Consumer behavior, public policy, and country of origin labeling. Review of Agricultural Economics 28:284-292.

Mangina, E. and Vlachos, I. P. (2005). The changing role of information technology in food and beverage logistics management: beverage network optimization using intelligent agent technology. Journal of Food Engineering 70:403-420.

Manh, N. V., Dung, N. V., Hung, N. N., Merz, B. and Apel, H. (2014). Large-scale suspended sediment transport and sediment deposition in the Mekong Delta. Hydrol. Earth Syst. Sci. 18:3033–3053. Retrieved from: www.hydrol-earth-syst-sci.net/18/3033/2014/.

Manos, B. and Manikas, I. (2010). Traceability in the Greek fresh produce sector: drivers and constraints. British Food Journal 112:640-652.

Marucheck, A., Greis, N., Mena, C. and Cai, L. (2011). Product safety and security in the global supply chain: Issues, challenges and research opportunities. Journal of Operations Management 29:707-720.

McKean, J. D. (2001). The importance of traceability for public health and consumer protection. Revue Scientifique et Technique 20:363-371.

Mishan, E. J. and Quah, E. (2007). Cost-Benefit Analysis (5th edition). Basic concepts of benefits and costs. Routledge, New York, USA and Canada. 21-55.

Moe, T. (1998). Perspectives on traceability in food manufacture. Trends in Food Science and Technology 9:211-214.

Mol, P. J. A. (2015). Transparency and value chain sustainability. Journal of Cleaner Production 107:154-161.

Morris, C. and Young, C. (2000). “Seed to shelf”, “teat to table”, “barley to beer” and “womb to tomb”: discourses of food quality and quality assurance schemes in the UK. Journal of Rural Studies 16:103-115.

Mousavi, A., Sarhadi, M., Lenk, A. and Fawcett, S. (2002). Tracking and traceability in the meat processing industry: a solution. British Food Journal 104:7-19.

Negrini, R., Nicoloso, L., Crepaldi, P., Milanesi, E., Marino, R., Perini, D. and Marsan, P. A. (2008). Traceability of four European protected geographic indication (PGI) beef products using single nucleotide polymorphisms (SNP) and Bayesian statistics. Meat Science 80:1212-1217.

Nelson, R. (1970). Information and consumer behaviour. Journal of Political Economy 78:311-329.

Olsen, P. and Borit, M. (2013). How to define traceability. Trends in Food Science and Technology 29:142–150.

Opara, L. U. (2003). Traceability in agriculture and food supply chain: a review of basic concepts, technological implications, and future prospects. Food, Agriculture and Environment 1:101-106.

Palacios, M. R. H. (2001). Study of the quality management system and product traceability in a fish processing company. United Nations University-Fisheries Training Programme. Retrieved from: http://www.unuftp.is/static/fellows/document/mariaritaprf.pdf.

Phuong, N. T. and Oanh, D. T. H. (2010). Stripped catfish aquaculture in Vietnam: a decade of unprecedented development. In: De Silva S. S. and Davy F.B. (Editors): Success stories in Asian aquaculture. Springer, Dordrecht, Netherlands. 131-147. Retrieved from: https://doi.org/10.1007/978-90-481-3087-0_7.

Poll, C., vogt Nielsen, K., Rubik, F., Jørgensen, M. S. and Jensen, M. L. (2005). Development of Indicators for an Integrated Product Policy-Report for European Commission. Brussels, Belgium: IPU, CASA and IÖW. 330.

Ponte, S. (2012). The Marine stewardship council (MSC) and the making of a market for ‘Sustainable fish’. Journal of Agrarian Change 12:300-315.

Portley, N. (2016). Report on the shrimp sector: Asian shrimp trade and sustainability. Asian Shrimp Trade and Sustainability. Sustainable Fisheries Partnership 1-74.

Pouliot, S. and Sumner, D. A. (2013). Traceability, recalls, industry reputation and product safety. European Review of Agricultural Economics 40:121-142.

Rábade, L. A. and Alfaro, J. A. (2006). Buyer-supplier relationship's influence on traceability implementation in the vegetable industry. Journal of Purchasing and Supply Management 12:39-50.

Rahman, A. A., Singhry, H. B., Hanafiah, M. H. and Abdul, M. (2017). Influence of perceived benefits and traceability system on the readiness for Halal Assurance System implementation among food manufacturers. Food Control 73:1318-1326.

Randrup, M., Wu, H. and Jørgen, B. M. (2012). On the track of fish batches in three distribution networks. Food Control 26:439-445.

Salampasis, M., Tektonidis, D. and Kalogianni P. E. (2012). TraceALL: a semantic web framework for food traceability systems. Journal of Systems and Information Technology 14:302-317.

Schwägele, F. (2005). Traceability from a European perspective. Meat Science 71:164-173.

SEAFDEC (2016). Traceability of fish and fishery products-aquaculture products. The Stakeholders Consultation on Regional Cooperation in Sustainable Fisheries Development Towards the ASEAN Economic Community, March 1st-2nd, 2016, Bangkok, Thailand.

Shanahan, C., Kernan, B., Ayalew, G., McDonnell, K., Butler, F. and Ward, S. (2009). A framework for beef traceability from farm to slaughter using global standards: an Irish perspective. Computer and Electronics in Agriculture 66:62-69.

Smith, G. C., Tatum, J. D., Belk, K. E., Scanga, J. A, Grandin, T. and Sofos, J.N. (2005). Traceability from a US perspective. Meat Science 71:174-193.

Suzuki, A. and Nam, V. H. (2013). Status and constraints of costly port rejection: a case from the Vietnamese frozen seafood export industry. IDE Discussion Paper No.395. Retrieved from: http://hdl.handle.net/2344/1219. 47.

Suzuki, A. and Nam, V. H. (2018). Better management practices and their outcomes in shrimp farming: evidence from small-scale shrimp farmers in Southern Vietnam. Aquaculture International 26:469-486.

Tamayo, S., Monterio, T. and Sauer, N. (2009). Deliveries optimization by exploiting production traceability information. Engineering Applications of Artificial Intelligence 22:557-568.

Thompson, M., Sylvia, G. and Morrissey, M. T. (2005). Seafood traceability in the United State: current trends, system design and potential applications. Comprehensive Reviews in Food Science and Food Safety 4:1-7.

Tien, N.V. and Thong, P. L. (2014). Analyzing economic efficiency of the lotus farms in Dong Thap Province (in Vietnamese). Journal of Sciences-Can Tho University 30:120-128.

Toiba, H., Umberger, W. J., Wahida, R. S. and Minot, N. (2012). Indonesian consumers' choice of food retail formats: are traditional food retailers being "crowed out"?. ISHS Acta Horticulturae 1006: IV International Symposium on Improving the Performance of Supply Chains in the Transitional Economies.

Tran, V. N., Bailey, C., Wilson, N. and Phillips, M. (2013). Governance of global value chains in response to food safety and certification standards: the case of shrimp from Vietnam. World Development 45:325-336.

Trienekens, J. and Zuurbier, P. (2008). Quality and safety standards in the food industry, developments and challenges. International Journal Production Economics 113:107-122.

Tuan, L. A. and Linh, N. T. N. (2015). Impacts of climate change into rice production in the Mekong Delta, Vietnam. Workshop Proceedings sharing case studies implemented by

VNGOs and supporting policy on advocacy on climate change adaptation in Vietnam. 103-118.

Tuan, L. A., Hoanh, C. T, Miller, F. and Sinh, B. T. (2007). Flood and salinity management in the Mekong Delta, Vietnam. In Challenges to sustainable development in the Mekong Delta: Regional and national policy issues and research needs. Retrieved from: https://hdl.handle.net/10568/37375. 15-68.

Tucker, B. I. (2008). Economics for today's world (5th edition). Chapter 3: Market demand and Supply 52-57. Thomson South-Western. Transcontinental-Beauceville Quebec, Canada.

Tunxi, F. L. and Ying, C. J. (2015). Technical compilation of traceability systems for aquaculture products in the ASEAN region. Japanese Trust Fund V: Traceability systems for aquaculture products in the ASEAN region 2010-2015. Marine Fisheries Research Department (MFRD) Programmes. Southeast Asian Fisheries Development Center (SEAFDEC).

Uchida, H., Cathy A. Roheim, C.A., Wakamatsu. H. and Anderson, C.M. (2013). Do Japanese consumers care about sustainable fisheries? Evidence from an auction of ecolabelled seafood. Australian Journal of Agricultural and Resource Economics 58:263-280.

Uddin, M. T. (2009). Value chains and standards in shrimp export from Bangladesh and Thailand to Japan: A comparative study on safety compliances. Asia-Pacific Journal of Rural Development 19:89-106.

Umberger, W. J., Feuz, D. M., Calkins, C. R. and Sitz, B. M. (2003). Country of origin labeling of beef products: US consumers perceptions. Paper presented at FAMPS Conference, Washington DC, USA.

UNDP (2016). Vietnam drought and saltwater instrusion: Transitioning from emergency to recovery analysis report and policy implications. UNDP-United Nations Development Programme. 17.

van der Vorst, J. G. A. J. (2006). Performance measurement in agri-food supply-chain networks: An overview. In C.J.M. Ondersteijn et al. (Editors.): Quantifying the agri-food supply chain. Dordrecht, Springer, Netherlands. 15-26.

van der Vorst, J. G. A. J., Beulens, A. J. M. and van Beek, P. (2000). Modelling and simulating multi-echelon food systems. European Journal of Operational Research 122:354-366.

van Drop, K. J. (2003). Beef labelling: the emergence of transparency. Supply Chain Management: An International Journal 8:32-40.

van Kleef, E., Houghton, J. R., Krystallis, T., Pfenning, U., Rowe, G., van Dijk, H., van der Lans, A. and Frewer, L .J. (2007). Consumer Evaluations of Food Risk Management Quality in Europe. Risk Analysis 27:1565-1579.

van Rijswijk, W. and Frewer, J. L. (2012). Consumer needs and requirements for food and ingredient traceability information. International Journal of Consumer Studies 36:282-290.

van Rijswijk, W., Frewer, L .J., Menozzei, D. and Faioli, G. (2008). Consumer perceptions of traceability: A cross-national comparison of the associated benefits. Food quality and Preference 19:452-464.

VASEP-Vietnam Association of Seafood Exporters and Producers (2017). Sector profiles-shrimp. Retrieved from: http://seafood.vasep.com.vn/669/onecontent/sector-profile.htm. Accessed on: November 5th, 2017.

Vasileiou, K. (2002). Towards a framework for assessing the sustainability of supply chains: the case of potatoes in Britain. Doctoral dissertation, Cranfield University, Silsoe, UK. Retrieved from: http://hdl.handle.net/1826/3587.

Verbeke, W. and Ward, W. R. (2006). Consumer interest in information cues denoting quality, traceability and origin: an application of ordered probit models to beef labels. Food Quality and Preference 17:453-467.

Verhaegen, I. and van Huylenbroeck, G. (2001). Costs and benefits for farmers participating in innovative marketing channels for quality food products. Journal of Rural Studies 17:443–456.

Vietnam GSO-Vietnam General Statistics Office (2016). Statistical yearbook of Vietnam 2016, Hanoi, Vietnam: Statistical Publishing House. Accessed on: October 30th, 2016.

Vietnam GSO-Vietnam General Statistics Office (2017). Statistical yearbook of Vietnam 2017, Hanoi, Vietnam: Statistical Publishing House. Accessed on: September 20th, 2017

Vietnam Ministry of Agriculture of Rural Development-Vietnam MARD (2015). Planning for blackish shrimp culture in Mekong Delta, Vietnam towards to 2030s (in Vietnamese). Retrieved from: https://www.fistenet.gov.vn/Portals/0/BAO%20CAO%20TOM%20NUOC%20LO.pdf. 148.

Vo, K. T. (2012). Hydrology and hydraulic infrastructure systems in the Mekong Delta, Vietnam. In: The Mekong Delta System 49-81. DOI: https://doi.org/10.1007/978-94-007-3962-8_3.

Wakamatsu, M. and Wakamatsu, H. (2017). The certification of small-scale fisheries. Marine Policy 77:97-103.

Wallace, R. B. and Oria, M. (2010). Enhancing Food Safety: the Role of the Food and Drug Administration. National Academy of Sciences, USA.

Wilson, T. P. and Clarke, W. R. (1998). Food safety and traceability in the agricultural supply chain: using the Internet to deliver traceability. Supply Chain Management. 3:127–133.

Xiaoshuan, Z., Jian, Z., Feng, L., Zetian, F. and Weisong, M. (2010). Strengths and limitations on the operating mechanisims of traceability system in agro food, China. Food Control 21:825-829.

Young, L. M. and Hobbs, J. E. (2002). Vertical linkages in agri-food supply chains: changing roles for producers, commodity groups, and government policy. Review of Agricultural Economics 24:428-441.

Ziv, G., Baranb, E., Nam, S., Rodríguez-Iturbed, I. and Levin, S. A. (2012). Trading-off fish biodiversity, food security, and hydropower in the Mekong River Basin. Proceedings of the National Academy of Sciences, 109:5609-5614.