Sustainable Supply Chain Analysis of Shrimp in Indonesia to meet European Market Demand

FINAL REPORT

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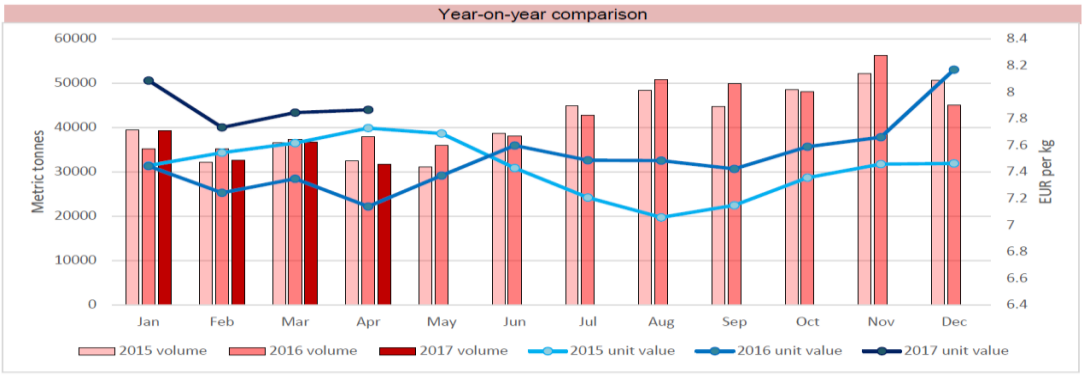
Abstract

The European market appears promising for Indonesian shrimp farmers due to the high demand for shrimp in European countries. However, the European market is not an easy market to enter. Western market tends to have specific requirements that need to be fulfilled; specifically, sustainability. This paper investigates how far the shrimp supply chain in Indonesia can comply with the demand for sustainable shrimp in the European market. To obtain an insight into the sustainable shrimp supply chain, interviews have been conducted with farmers, stakeholders, middlemen, exporters and experts. Ultimately, this paper argues that sustainable shrimp supply chain practices have not yet been fully implemented in Indonesia, seeing that numerous improvements are required. It is recommended for all the players in the shrimp supply chain to cooperate and support each other. Moreover, it is essential that an efficient sustainable supply chain is created by optimising the technology, system and networks throughout the supply chain.

1. Introduction

After the US, Europe imports the most amount of shrimp. It should be noted that Spain imported 112,600 tons with a 2% increase noted in 2016, compared with the same period in 2015, followed by France, Denmark and the UK (FOA, 2016). Most shrimps in the EU are imported from developing countries, such as Ecuador, Madagascar, Bangladesh, Thailand, Indonesia, Vietnam and India (EUMOFA, 2016). Year on year, the consumption of imported shrimp in Europe slightly increases, as revealed in Graph 1.



Source: GLOBEFISH Monthly Trade Statistics (2017)

Regarding shrimp, this indicates that gaining a significant market share in Europe would appear to be profitable. Nevertheless, to enter the European market, exporters must understand and comply with the requirements for shrimp imported into Europe, such as EU approval, transparent traceability and trustworthy certificates pertaining to catches, health and hygiene, for quality assurance purposes (CBI, 2015). Moreover, Oorschot et al. (2004), claimed clear certification is used to guarantee reliability for the consumer. In Northern Europe, organic certification is required for the niche market. Additional certification related to the sustainability of shrimp, which are commonly found in the European Union are IFS, BRC, ASC, MSC and GLOBAL GAP (CBI, 2015).

It is important to mention that the European Union (EU) also focuses on sustainability issues concerning its products (American Chamber of Commerce of Europe, 2004). Based on Kievitsbosch (2015), sustainability is crucial for building a competitive market by considering the social and environmental impact of production activities. Sustainability must be applied, not only in production processes but also in the supply chain. Sustainable supply chain means:

a. Products are produced safely and in a way that promotes good health to fulfil people's demands, so they can obtain nutritional food. This includes providing important information on products
b. Sustain financial viability and social differences in villages and cities
c. Create a continuing income from sustainable land management, not only by means of the market but also through payments for greater profit
d. Use natural resources efficiently
e. Protect the environment by reducing energy waste, using resources effectively and harnessing renewable resources
f. Assure product safety and hygiene practices in the workplace and consider social responsibility together with employee training
g. Implement high standards regarding animal health and welfare
h. Extend the availability of resources to satisfy society's demand by utilising unused land (DEFRA, 2002).

However, several countries that export shrimps have not yet entirely met European demand for sustainable shrimp production and supply chain. The CBI (2015), stated shrimp farming in Asia had been blamed for its negative effects on society and the

environment. Furthermore, shrimp farming in Indonesia has had a devastating effect on the environment. Mangrove deforestation has occurred along the coastline and land has been transformed into shrimp ponds. For example, on one island in Indonesia, 18000 ponds were built from Aceh to Lampung. It was claimed that this is the largest shrimp farm in the world. Furthermore, by increasing shrimp production, trash fish, which is used for feeding the farmed shrimp in the form of pellets will be overused. It is assumed that 900,000 tons of trash fish, which are dependent on trawling and bycatch, are necessary for fish feed (Gillet, 2008).

If Indonesia can meet demand for sustainability, it has the potential to fulfil European shrimp consumption. Gillet (2008), argued that shrimp production in Indonesia, especially for *Penaeus vannamei* (Pacific White Shrimp) has export potential, given that Indonesia can harvest more than 400000 tons of shrimp each year with household shrimp farming contributing approximately 65000. As such, if Indonesia wishes to expand its shrimp market to the European Union, it is required to create sustainable shrimp production and supply chain.

Research Objective

The objective of this research is to achieve an insight into the sustainable supply chain of shrimp in Indonesia to comply with the demands of the European market.

Research Question

- General Research Question: To what extent the Indonesian shrimp supply chain complies with the demands of European market for sustainable shrimp?
- Sub Research Question:
    1. What are the European market demands for sustainable shrimp?
    2. What changes can be made in supply chain practices in Indonesia to comply with the demands of the European market?
    3. What are the challenges and how can they be solved to comply with sustainable shrimp which is demanded by the European market?

2. Literature Review

In this literature review, a brief explanation is given with regard to sustainability complete with its indicators consisting of economic, social and environmental aspects. It is important to recognise the explanation related to sustainability, since it can explain what type of sustainability aspects the researcher will use to gather data from farmers and other respondents. Furthermore, the overview of shrimp supply chain practices is shown in the literature review in order to confirm whether the various types of shrimp farming in Indonesia has fulfilled the sustainable aspects of shrimp farming and conforms to the previous research. As considered, activities in shrimp farming will be included in the supply chain of sustainable shrimp, as the main route in shrimp supply chain. However, prior to assessing the sustainability of shrimp farming in Indonesia, the researcher needed to analyse the market demands, especially the European market concerning sustainability, which is drawn in the literature review. Finally, the obtained data will be related to the literature review.

2.1 Sustainability

Sustainability is defined as a concept which focuses on the well-being of humankind in the future by considering three crucial pillars; specifically, social, economic and environmental (Kuhlman & Farrington, 2010). Each pillar provides an example of specific topics employed to assess sustainability in the supply chain.

Sustainability Indicator	Topics	Sub topics	Description
Economic	Economic Structure	Economic Performance	GDP per Capita
	Consumption and Production Patterns	Energy and material use	The percent and intensity of material and renewable energy use
	Waste Production	Waste Generation and management	Waste Recycling and Reuse
Social	Equity	Poverty	Percent of Population Living below the Poverty Line
	Employment	Employment condition	Unemployment Rate, Child Labour

	Health	Healthcare delivery	Percent of population with access to primary health care facilities
Environmental	Oceans, Seas and Coast	Coastal Zone	Mangrove Concentration along the coast
	Aquaculture	Fisheries	Use of chemicals
	Biodiversity	Ecosystem	Protected Area as a % of Total Area

Source: United Nation Publication (2007)

There are three important side-effects related to the sustainability of shrimp farming, such as mangrove deforestation, fishmeal for shrimp feeding and water pollution. Based on Barbier and Cox, WRM and Lebel et al., (2002) in a case of shrimp farming, there are two crucial topics of sustainability caused by mangrove deforestation, in addition to environmental and social issues. According to environmental conditions, deforestation can induce erosion, increase CO_2, produce problems in the fisheries sector and furthermore, cause a shortage of clean water. These environmental problems can technically be overcome by the displacement of shrimp ponds from mangrove areas by way of open-water Integrated Multi-Trophic Aquaculture (IMTA), mangrove restoration and the use of the REDD+ program which is involved in reforestation, afforestation and forest conservation (Ahmed et al., 2017). An additional suggestion which comes from Joffre et al., (2015), states that there is a need to build a regulatory framework that illustrates the economic advantages of the integration between mangrove and shrimp production for farmers, so they recognise the importance of mangroves for shrimp cultivation. Moreover, according to social aspects, mangrove destruction also has possibility to decrease food security.

Naylor et al., (2000), commented that aquaculture activities such as shrimp farming have a detrimental effect and deplete fish supplies, as fishmeal is the main nutritional feed for shrimp. However, Cruz-Suárez (2010), offered a solution to that problem by harnessing green seaweed *(Ulva clathrate).* This specific method can decrease the ratio of commercial feed for shrimp by virtually 50%.

It should also be pointed out that shrimp farming triggers water pollution. This problem is produced by overfeeding, algal bloom due to water waste and the use of cyanide to clean the shrimp farm (Dewalt et al., 2002).

Conversely, shrimp farming activity leads to several advantages for certain communities. In coastal Mexico, shrimp farming employs approximately 600 permanents workers for 6000 ha of ponds. The employees are paid fairly, much greater than the minimum salary in the region. Moreover, they obtain free meals daily and an annual bonus. The other social advantages reported are improvements in infrastructure, for instance roads, electricity and the water supply (Dewalt et al., 2002). Paul and Vogl (2011), also concur that shrimp farming can have a positive impact on society and the economy in Bangladesh. Regarding this, it is asserted that poverty declines, whilst the food security is enhanced, and people can gain employment as middlemen and exporters.

By examining the advantages and disadvantages, Chim et al. (2009), suggested the establishment of environmental friendly facilities and continuous studies to overcome the social and ecological problems. By doing so, shrimp farmers will be more united and adaptable to current market demand. Besides that, BPS (2016) theory related to sustainable development along coastal and marine regions, can be applied to ensure sustainable development with regards to the shrimp production and the shrimp supply chain. Initially, the integration of environmental development around ponds is necessary. Consequently, waste pollution should decline seeing as harmful chemical substances are avoided during each stage of the shrimp production. The use of renewable energy also needs to be considered, together with social, economic and culture awareness. Finally, it is essential to mention that legal practices are required to enhance the performance and guarantee reliable information about shrimp production. Plus, every single stage needs to be managed to achieve sustainable development. Additionally, Smith (2008), states that the crucial elements required to develop the sustainable supply chain consist of supply chain variety and the assurance of product quality related to social, economic and environmental impacts in the supply chain. Moreover, trust among stakeholders, cooperation and strict standards are another significant aspect to generate sustainable supply chain practices. Sverdrup (2017), also stated that to overcome the problem of unsustainability, certain actions can be taken, including:

a. Each player in the sustainable market is required to focus on their own rules. In this case, the government may focus on constructing sustainable regulations, while the farmers need to set the rules concerning shrimp production based on the requirement of sustainable shrimp in the supply chain.
b. There is a need to have a better understanding of the problems which trigger unsustainability by using system analysis. By doing so, it will be easier to attain solutions to overcome the obstacles in meeting the sustainability aspects.
c. Feedback about the rules by means of active governance is crucial**.** This means that it is important for the government to know how far their regulations can fit with the farmers situation.
d. Governments need to establish clear rules related to sustainability under law. By doing so, the rules will be more legitimate and supply chain actors can clearly employ the regulation.

As such, to create sustainability in shrimp farming, there must be a close relationship between land suitability, capacity of the ponds, organisations and social aspects (Farkan et al., 2017). Similarly, sustainability can also be adopted from the Department of Fisheries' programme in Thailand. Tookwinas et al. (1999), state that the programme includes:

a. Regular shrimp farming examinations by coastal aquaculture authority holders. They are responsible for controlling diseases and technical services in shrimp farm.
b. Fulfilling European Union requirements related to water quality, red tide and farm sanitation. This activity is recorded frequently according to the timeline.
c. Controlling the quality and safety of exported shrimp in order to maintain consumer confidence.
d. Managing the water circulation and water system to preserve the sustainable shrimp farming system.

When the particular countries cannot manage sustainability, they will not be allowed to export shrimp to European countries. This occurs in Bangladesh, where the decrease in food safety standards and disorganised sustainable shrimp supply chain, meant that the EU prevented shrimp being imported from the country for several weeks. That particular action had a substantial impact on Bangladesh's economy. However, after undertaking an evaluation and rearranging the sustainable aspect, Bangladesh was

finally able to obtain access to the lucrative European market. This incident suggests that Europe considers sustainability to be a crucial factor with regards to importing products, etc, (Alam and Pokrant, 2009).

In general, not all countries can comply with the European Union requirements with respect to sustainable shrimp. In Indonesia, there are five challenges related to developing sustainable shrimp (Hanafi & Ahmad, 1999).

a. Poor shrimp culture management:
    - Shrimp feed quality is unclear, so farmers select the feed by trial-and-error. This has not only impacts on the environment, but also on economic aspects. Concerning the environment, unsuitable feed can generate more effluent, which means that the farmers can face capital loss.
    - Certification seems expensive and complicated among small farmers. It can occur due to little knowledge about adapting the certification and less knowledge about the advantage of certification.
    - There is a lack of information among small farmers concerning chemicals that are illegal in shrimp farming. This lack of information means that farmers may keep using dangerous chemicals and harm the environment.
b. Environmental issues
    - Unmanageable ponds cause several outbreaks of diseases. This indicates that when the ponds are incorrectly designed, farmers cannot handle and overcome these outbreaks.
    - There are polluted sites around ponds due to the overuse of pesticides and moreover, industry effluent.
c. Economic obstacle
    - Mining activity around the farm may endanger the quality of water. When it occurs, quality can be affected and decline. Moreover, mining activity in Indonesia cannot be stopped because the mining companies hold considerable power and it is alleged that corruption takes place too.
d. Social conflicts
    - Conflict generally occurs between paddy farmers or environmentalists and shrimp farmers because it is believed that shrimp farming activity harms the environment. There is also conflict between fishermen and shrimp farmers as

shrimp farmers use fish for feeding the shrimp, so automatically the fishermen catch fewer fish.

e. Legality
   - Scant attention is paid to creating proper regulations related to sustainable shrimp farming. If sustainable regulation is clear, strict and applicable, sustainability can be achieved easily and effectively.

2.2 Shrimp Supply Chain Practices

The shrimp supply chain can be divided into several stages, such as hatchery, grow-out, processing and transport. The hatchery stage entails Spirulina, small squid, mussels and micro-algae for feeding the shrimp larvae together with antibiotics, such as oxytetracycline, fuizolidone and EDTA (Dewalt et al., 2002). Hatcheries in China can be divided into two distinct types: industrial-scale and small-scale (family-based). The first type requires considerable investment due to the latest technology and importing brood stock from the United States which has brood stock which is of a superior quality. On the contrary, the small-scale hatchery is categorised by low capital and traditional technology resulting in lower quality shrimp seed (Cao, 2012). In this type of hatchery, seed quotas of shrimp require transparent co-management which is organised by local groups of farmers (Truong et al., 2014). For a better insight, the detailed characteristic of supply chain of shrimp which is adopted from China is shown below (Table 2) (Cao, 2012):

Stage	Intensive supply chain	Semi-intensive supply chain
Hatchery	- Import Hawaii SPF (specific-pathogen free) broodstock by air - Produce F1 (1st generation) post-larvae with higher survival & growth rates - Industrial-scale, commercial based	- Use local domesticated broodstock - Produce F2 (2nd generation) post-larvae - Small scale, family based
Grow-out	- Use F1 post-larvae - High stocking density (160-200 post-larvae/m^2) - High water exchange rate (8%-15% daily) - Frequent aeration - No fertilizer used	- Use F2 post-larvae - Medium-low stocking density (50-80 post-larvae/m^2) - Low water exchange rate (1%-3% daily) - Rare aeration

	- High feed conversion ratio (FCR), average 1.6 - Culture cycle: 100 days/crop - High unit production (8.000 kg/ha)	- Fertilizer used - Low FCR, average 0.97 - Culture cycle: 100-120 days/crop - Low unit production (2500 kg/ha)
Post-farming	- Processed as head-off, shell-on frozen shrimp - Export to US	- Processed as head-off, shell-on frozen shrimp - Sell in domestic markets

In Indonesia, farms growing shrimp seed are commonly distinguished by three main types, traditional, semi-intensive and intensive farms. In intensive farms, farmers use pellets and advanced tools like aerators to generate high yield, semi-intensive ponds use fertiliser to increase the natural water production and the traditional pond system lets the shrimps grow without any special treatment until they are harvested (Diana, 2009). According to Farkan et al., (2016), of the three methods employed, the most productive pond is the intensive pond. This is because the intensive pond is able to produce a greater yield compared to extensive and semi-intensive ponds. The yields can reach 5-15 MT/ha. The factors which trigger greater yields include skilled labour to maintain shrimp production and the use of cutting edge technology (Dewalt et al., 2002). However, intensive farming can be detrimental for the environment due to higher feed, energy and electricity consumption, besides the production of gas emissions which is equal to 23.1±(2.6 kg of SO2 equiv, 36.9 ± (4.3 kg of PO4 equiv and 3.1 ± (0.4 t of CO2 equiv. When it is related to soil condition as a result of intensive farming, soil can be damaged by an increase in effluent, produced by ammonia and the suspended solids in shrimp faeces (Cao, 2011).

Semi-intensive farming, which is different to intensive farming, may generate 1-3 MT/ha and require ponds which cover 4-10 ha (Dewalt et al., 2002). Regarding Indonesia, it was discovered that the most suitable type of farm is the medium scale semi-intensive farming (Kusumastanto et al., 1998). The reason for this is related to the risks involved semi-intensive farming, for instance shrimp harvest failure due to diseases and land limitations concerning shrimp farming, is much lower than intensive farming. In addition, semi-intensive farming may employ more unskilled labour, so that unemployment levels in the community decrease. Those are also the solutions for shrimp farmers who have limited capital to develop their farms. The last type of shrimp farming in Indonesia is traditional farming. Traditional shrimp farming requires low

quantities of feed, given that the shrimps are not only fed by commercial feed, but also by natural feed from the environment, such as wild post larvae. It also produces the lowest yield of shrimp, approximately 1 MT/ha (Dewalt et al. 2002). Diana (2009), assumed that when the intensity of shrimp farming rises, cost and effluent production will level off. It means that although traditional shrimp farming generates the least shrimp production, it is the most sustainable type of shrimp farming due to the cost and the production of less waste.

The shrimp commonly has a segmented body structure which is divided into three parts: the head, thorax and abdomen. Additionally, shrimp can be sold frozen head-on, head-off and peeled (shrimp without a skin). Nonetheless, before being spread out commercially in the market, quality is maintained by shrimp producers in two ways; specifically, harvesting and handling. Regarding harvesting, to obtain high quality shrimp, the main procedures are washing, weighing and cooling at a temperature of 0-4^{o}C, together with the addition of sodium metabisulphite to avoid melanosis and red-head, prior to be delivered to the market. Subsequently, in the second part, shrimps are cleaned, sorted and stored as frozen shrimp at -20 degrees Celsius for export standards (FAO, 2006). Processing and packaging are identified as costly stages in shrimp production due to various requirements. In Mexico, the producers need to spend 1 million USD annually for these separate stages (Dewalt et al., 2002).

For frozen cooked shrimp, shrimp is processed in an intensive way to maintain the quality. Firstly, the farmer can store the shrimp in ice, immediately after harvesting. It can preserve the quality of the shrimp until it reaches the processing plant. Next, the shrimps need to be classified. The high-quality shrimp will be washed in cold water (278K). In order to ensure the shrimps are tender, they are cooked in an ambient temperature of 372K. Afterwards, the shrimp are cooled down to 255K prior to the coating process which uses ice as the main material (Lai & Ye, 2017). As such, to maintain the quality of the shrimp along its supply chain, there is a need for clear regulation for fishermen, sufficient technology and good practice in production (Wati et al., 2013).

The shrimp supply chain cannot be separated from government intervention since in terms of Supply Chain Management (SCM), there is an absolute need for the actors involved in the supply chain to cooperate with the suppliers and stakeholders in the

entire supply chain. This is known as external cooperation and involves suppliers, the government and local communities in the supply chain (Monczka et al., 2015). Additionally, Cooper et al. (1997), stated that supply chain management is an integrative philosophy which organises the flow of materials from suppliers to the customers. In India, there is a trend in which small farmers have a partnership with the government. This has led to better management and environmental improvement as the government, in this case regulates shrimp production by reducing the waste and chemical use (Philips & Subasinghe, 2006). In other words, for the entire supply chain, it is necessary to consider Supply Chain Management (SCM), seeing that it has played a crucial role in enabling farmer to collaborate with other players in the supply chain, to achieve a win-win situation (Vural, 2015). Furthermore, Yi et al.(2016), offered another perspective to support small farmers in developing countries, especially in Indonesia, which comprises several steps:

a. The government may set the policies which encourage the development of hatcheries and feed mills facilitated by sophisticated technology, so that farmers can embrace the modernisation of shrimp farming in order to increase productivity.
b. Loans for small farmers must be more accessible to overcome the capital constraints. By doing so, small farmers can change the development of shrimp farming and include the use of high-end technology.

In the supply chain of shrimp, farmers also need to cooperate with the processor (middleman) and exporter. In Thailand, the relationship between farmers and processors is more about product traceability by way of publishing a movement document (MD). The shrimp farmer will provide the MD and give it to the processor or exporter. Next, the processor and exporter have to take the document to the Department of Fisheries with the aim of acquiring the shrimp certification (Ekmaharaj, 2006)

2.3 Market Demands (European Market) toward sustainability

Aquaculture products have been expanding both locally and globally to feed the growing population with the assumption that each person will consume one and a half kilogram of seafood in 2020 (Diana, 2009). Shrimp, for instance, is believed to be the most valued product in the global fisheries market with growth reaching more than 8% per year and twice in 20 years (FAO, 2004; Bostick, 2008). Shrimp is exported

internationally to three main markets: the United States, Japan and Europe. In this research, the European market is the principal target of the Indonesian export. Several reasons exist behind the decision to choose the European Union as an object of this research. In 2009, frozen shrimps became the most popular fisheries product exported to the European Union (Lord, 2010). In later years, demand for shrimp in the European Union achieved 25% of global imports with a value of 513,000 tons or USD 4.3 billion (CBI, 2015). Inevitably, it indicates that consumption in Europe continues to increase. Moreover, it was discovered that imported shrimp is obtained from developing countries, such as Thailand, Bangladesh, Ecuador and India. Thus, Indonesia will have a large opportunity to expand its shrimp market to European countries (Van Duijn et al., 2012).

In addition, the European currency (the Euro) appears stable in the trade market which implies that the EU's economic performance is constant. Nevertheless, there have been demand for shrimp in the European market has been affected by several factors. One of them is the prerequisite for sustainable shrimp, especially in European countries. European countries also have stringent rules correlated with import regulations. Consequently, the imported shrimps must be free from drugs, chemicals and antibiotics. Hence, the European market compels exporter countries to have a guaranteed certificate, HACCP and GSP, for instance (FAO, 2006). In Indonesia, according to Novari (2013), in a workshop on Aquaculture Certification (Table 3), there are five aquaculture certificates comprising Global GAP, Aquaculture Stewardship Council – Shrimp Aquaculture Dialogue (ASC-ShAD), Aquaculture Certification Council (ACC) which identifies itself as "BAP Certification Management", Naturland (Organic Shrimp) and Indo GAP.

No	Standards	Label
1	Aquaculture Stewardship Council – ASC Shrimps	
2	GLOBALG.A.P. Aquaculture	
3	Best Aquaculture Practices (BAP)	

4	IndoGAP	
5	Organic Certification	

Source: www.standardsmap.org

The goal of ASC is to implement the ASC certification standard, which appeared in 2014 via the market. Therefore, ASC is vital certification if farmers intend to enter the European market. However, according to Douma & van Wijk (2012), the ASC does not represent clear objectives and direction, which results in less concern for extensive shrimp farmers and exporters to embrace this certificate. The ASC also charges a substantial amount of money which is a burden for small farmers. However, stakeholders in Indonesia assume that the ASC is an appropriate certificate as the objectives of the ASC are similar to theirs. In this case, the stakeholders comprise the government and NGOs.

When farmers obtain organic certification, it indicates they have organic farming practices. Organic farming can benefit farmers in several ways, like what happened in Bangladesh (Paul et al., 2013). As a consequence of introducing organic certification, farmers in Bangladesh can increase their quality of life by earning more income. They also have contributed to a sustainable environment, which in turn, has increase their social status. Moreover, by embracing organic farming, the diseases that afflict shrimp can be reduced significantly. This means organic farming is a positive way to increase sustainability in shrimp farming. In India, organic farming is also selected as a solution for creating sustainable shrimp farming, especially regarding economic and environmental aspects (Knowler et al., 2009). As a result, shrimp can achieve a premium price by means of organic shrimp farming because it promotes shrimp which is free from chemical feeds.

The other alternative certification commonly found in Indonesia is known as BMPs (Better Management Practices). This certificate allows the user to demonstrate concern about social and environmental issues, as it is acknowledged that BMPs are the standard for farming practices with regards to creating a save environment (Kusumawati & Bush, 2015).

The Indonesia MMAF (Ministry of Marine Affairs and Fisheries) department has established both regulations and standards of certification to promote good aquaculture practices, namely "Cara Budidaya Ikan yang Baik" (CBIB) alternatively termed IndoGAP. CBIB certification does not include social standards because it focuses more on the minimum requirements of BMP which is concerned about food safety. The CBIB certification certifies most local farmers, improves practice gradually and is not strict (Van Schaik, 2010).

Fayet (2014), argued that the different implementation and certification mechanisms can enhance small farmers practices in sustainable supply chain governance systems and help them to create market access. Nevertheless, multiple standards can create confusion for buyers, farmers, etc. Oosterveer (2006), also agreed that certification and labelling are able to assist farmers in delivering information to customers as long as it can fit with the behaviour of the consumers, which these days tend to consider the ecological aspects more thoroughly.

Again, sustainable seafood products are the priority in the European market. Hence, sustainability must be applied not only in the production process, but also throughout the entire supply chain. When concern over sustainability is high, it results in extremely safe products that can be traced easily throughout the process. This makes certification and eco-labelling a pre-requisite for exporter countries to compete in the European market, particularly in Southern and Northern Europe. However, small fishermen still consider the standards associated with exporting to Europe, as well as the high import tariffs to be relatively high, which in turn creates a barrier for them in relation to exporting the shrimp (Van Duijn et al., 2012).

3. Conceptual Framework

After constructing the theoretical framework, the conceptual framework is generated.

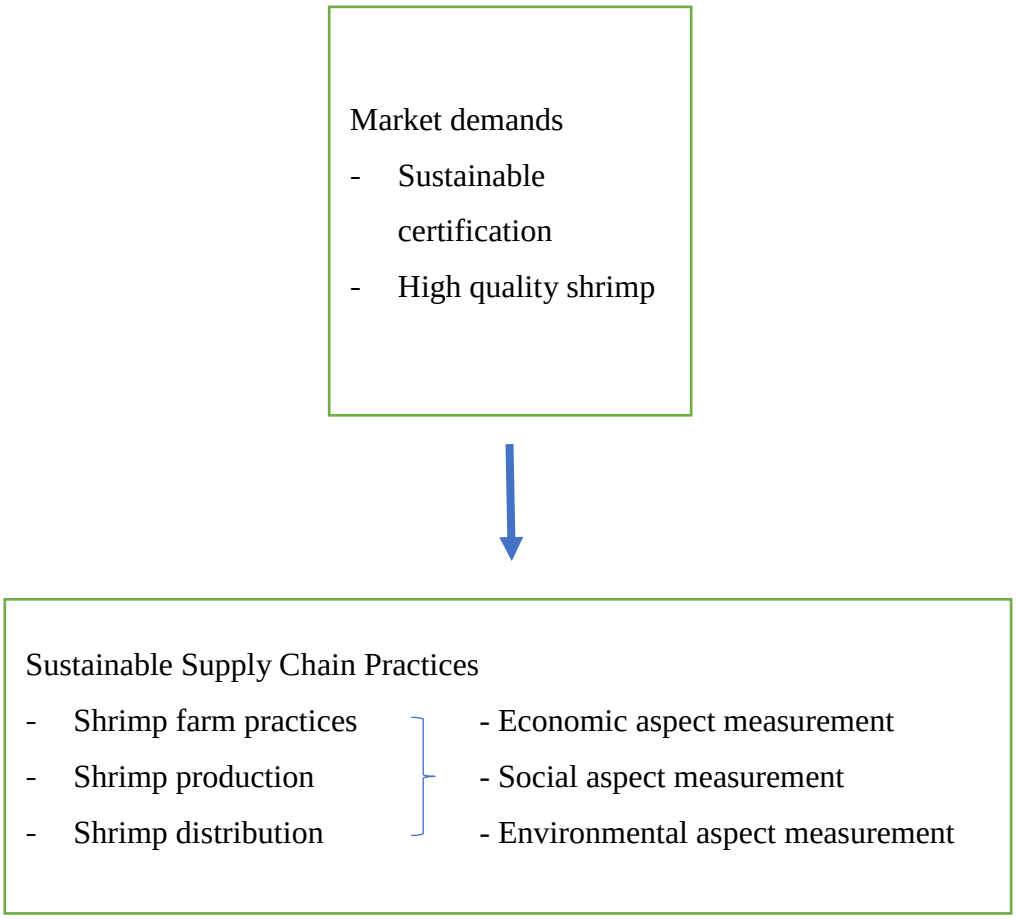


Figure 1. The conceptual framework

In the conceptual framework, the relation between market demands and sustainable supply chain practices are explained. When the European market sets sustainability as the main requirement to satisfy the market, the countries the shrimp originates from also need to consider the quality of shrimp. Those specific requirements, sustainability and high-quality shrimp, will drive the sustainable supply chain practices of shrimp consisting of shrimp farming practices, shrimp production and shrimp distribution. Each practice will then be assessed and analysed based on sustainable features, such as economic, social and environmental measures.

4. Methodology

4.1 Research Design

This study was a combination of qualitative and quantitative research. The qualitative research design comprised a case study, whilst the quantitative research design was a cross-sectional study. The cross-sectional study is selected because in this research, the researcher was identifying the condition of the population and obtaining information by connecting with the respondents (Kumar, 2011). The case study is selected for several reasons:

a. It helps researchers to explore and understand the case comprehensively in a flexible way (Gilbert, 2008).
b. There will be assumptions, suggestions and opinions from the respondents as a result of the open-ended questions asked in the in-depth interviews.
c. It suits the aim of this research, which is to gain an insight into the sustainable supply chain of shrimp so as to comply with the demands of the European market, as the case study will enable the researcher to acquire considerable information and a greater insight into the situation (Kumar, 2011).

4.2 Sample selection

In this research, the respondents are shrimp farmers, exporters, experts and stakeholders. As this study is qualitative research, the sample is selected to make the gathered information reach saturation point (Kumar, 2011). West Nusa Tenggara, a province in Indonesia, has the second lowest gross regional product per capita and has the potential be a sustainable shrimp exporter since the province is the third largest shrimp producer in Indonesia. Consequently, my research was conducted in this region. Interviews were conducted with 30 shrimp farmers, 2 exporters, 5 middlemen, 5 experts and 5 people in charge of governance (staffs, director and the assistant director). Farmers were chosen according to the type of farm they operate. The farmers who participate in traditional, semi-intensive and intensive farming are the respondents in this research. Thus, there will be 10 farmers for each specific type of farming. Exporters were selected based on their work experience. Regarding the experts, they were selected according to their experience. This means that their experience should be related to marine and fisheries issues. Additionally, people who are in charge of governance were selected from the Marine and Fisheries Department.

4.3 Data collection

a. Primary Sources

The following methods were selected as the primary sources in the research and simultaneously as empirical studies.

i. Interviews

The interview questions are designed in the style of a semi-structured interview. A semi-structured interview is where the questions will be listed prior to distributing them to the respondents. The aim of the semi-structured interview is to obtain homogenous data and in-depth information so that that data can be compared (Kumar, 2011). Face-to-face interviews were conducted with all the respondents, except exporters who were contacted by phone to obtain an information. A brief introduction was delivered prior to undertaking the interview in order to give the respondents a better understanding of the research. To procure data from local government, a focus group interview was conducted in the Marine and Fisheries Department of NTB on January 4th, 2018. The focus group interview is completed with a group of people to examine people's perceptions and experiences (Kumar, 2011). The information obtained from each interview can be seen below in Tables 4, 5, 6, 7 and 8.

a. Farmers

Table 4. The detail interview with farmers

Farmer	**Farm type**	**Location**	**Date**	**Duration of interview**
1	Traditional	Jerowaru, East Lombok	25-12-17	40:00
2	Semi Intensive	Keruak, East Lombok	31-12-17	18:19
3	Semi Intensive	Jerowaru, East Lombok	31-12-17	37:04
4	Intensive	Jerowaru, East Lombok	31-12-17	19:53
5	Intensive	Ampenan, Mataram	04-01-18	1:05:42
6	Intensive	Sumbawa	11-01-18	31:16
7	Semi Intensive	Jerowaru, East Lombok	12-01-18	1:03:32
8	Semi Intensive	Pujut, Central Lombok	13-01-18	1:35:15
9	Traditional	Batu Beronggok, Central Lombok	13-01-18	20:54

10	Traditional	Batu Beronggok, Central Lombok	13-01-18	22:50
11	Traditional	Batu Beronggok, Central Lombok	13-01-18	22:54
12	Traditional	Parak Buluk, Central Lombok	14-01-18	11:13
13	Semi Intensive	Teruai, Central Lombok	14-01-18	26:55
14	Traditional	Keruak, Central Lombok	14-01-18	23:14
15	Traditional	Kidang, Central Lombok	14-01-18	23:23
16	Traditional	Bilelando, Central Lombok	14-01-18	19:05
17	Traditional	Bilelando, Central Lombok	14-01-18	20:11
18	Traditional	Bangket Parak, Central Lombok	14-01-18	21:56
19	Semi Intensive	Bilelando, Central Lombok	14-01-18	30:14
20	Semi Intensive	Bilelando, Central Lombok	14-01-18	26:45
21	Semi Intensive	Bilelando, Central Lombok	14-01-18	23:55
22	Semi Intensive	Batu Beronggok, Central Lombok	14-01-18	32:41
23	Intensive	Sumbawa	16-01-18	44:28
24	Intensive	Mumbulsari, North Lombok	18-01-18	1:52:58
25	Intensive	Padaguar, East Lombok	18-01-18	21:21
26	Intensive	Sembelia, East Lombok	19-01-18	37:54
27	Intensive	Padaguar, East Lombok	19-01-18	49:06
28	Intensive	Jerowaru, East Lombok	20-01-18	19:51
29	Semi Intensive	Aikmel, East Lombok	21-01-18	37:33
30	Intensive	Sembelia, East Lombok	26-01-18	36:01

b. Experts

Table 5. The detail interview with experts

Expert	Position	Location	Date	Duration of interview
1	Lecturer in Fishery Department, Mataram University	Mataram	21-12-17	1:17:16
2	Lecturer in Fishery Department Mataram University	Mataram	22-12-17	35:22
3	Aquaculture Technician from Caroen Pokphand company	North Lombok	22-12-17	58:51
4	Aquaculture Technician from Matahari Sakti company	East Lombok	25-12-17	35:35
5	Aquaculture Technician from CJ CheilJedang	Mataram	10-01-18	37:13

c. Stakeholders Focus Group

Table 6. The detail interview with stakeholders

Focus Group	Position	Location	Date	Duration of interview
1	- Head of Marine and Fisheries Department NTB - Head of Coastal Resources Supervision and Management and Small Islands Department of Marine and Fisheries NTB Province - Head of Power Reinforcement. Competitiveness of Marine Products and Fishery	Mataram	29-12-17	47:58
2	Staff at Department of Marine and Fisheries Central Lombok	Keruai, Central Lombok	14-01-18	30:00

3	- Head of Fish Quarantine Center for Quality Control and Fishery Products Safety - Staff of Fish Quarantine Center for Quality Control and Fishery Products Safety	Ampenan, Mataram	23-01-18	1:03:49

d. Exporters

Table 7. The detail interview with exporters

Exporter	**Company**	**Location**	**Date**	**Duration of interview**
1	Depasena Group	Lampung, South Sumatera	19-01-18	18:17
2	-	Banyuwangi, East Java	22-01-18	40:23

e. Middlemen

Table 8. The detail interview with middlemen

Middlemen	**Location**	**Date**	**Duration of interview**
1	Senggigi Ampenan, Mataram	28-12-17	31:59
2	Fishing Harbor Hall, East Lombok	30-12-17	21:15
3	Labuhan Haji, East Lombok	30-12-17	33:59
4	Keruak, East Lombok	31-12-17	20:04
5	Labuhan Haji, East Lombok	11-01-18	31:55

ii. Observation

Before conducting the interview, participant observation was conducted. Kumar (2011) expressed that participant observation is a strategy to create a close relationship while conducting research and assists with gathering more accurate information because the researcher will be involved in the supply chain of shrimp. The observation was conducted from 18 December 2017 to 20 January 2018 in NTB, Indonesia. The observation included getting involved in cultivating and harvesting shrimp as well as monitoring the activities of the traders.

Summary of Data Collection

1. What are the European market demands for sustainable shrimp?

Table 9. Data collection regarding sub research question 1

Required question	**Research Method**
Information related to European market demand	Literature study
Information related to sustainability	Literature study

2. What changes can be made in supply chain practices in Indonesia to comply with the demands of the European market?

Table 10. Data collection regarding sub research question 2

Required question	**Research Method**
Information about the necessary changes of shrimp production practices	Literature study
Information about the necessary changes of shrimp production practices in West Nusa Tenggara	Literature study, interview and observation

3. What are the challenges and how can they be solved to comply with sustainable shrimp which the European market demands?

Table 11. Data collection regarding sub research question 3

Required question	**Research Method**
Information about the challenges that farmers' face to comply with European market	Literature study
Information about the challenges that farmers' face in West Nusa Tenggara	Literature study, interview and observation
The solution of farmers' problem to comply with the European market demand	Literature study
The solution of farmers' problem in West Nusa Tenggara to comply with the European market demand	Literature study, interview and observation

b. Secondary Sources

Secondary sources were obtained from academic articles, books, reports, journals and the Internet.

4.4 Analysis of Data

Data has been analysed based on two classifications.

- Qualitative research: Data related to qualitative research from farmers, exporters, experts and stakeholders have been translated into English because the interviews were conducted using the Indonesian language, Bahasa Indonesia. The interviews were recorded. Subsequently, the data was formulated and modified into tables, graphs and further explanations.
- Quantitative research: Raw data obtained from the respondents was edited and examined to gain clean data, minimise errors and maximise comprehensiveness and consistencies (Kumar, 2011). The data was then coded and classified according to nominal or ordinal scales prior to being translated and calculated by means of SPSS.

5. Result

5.1 Interviews with the farmers

a. Sustainability Aspect

Table 12 reveals the frequency statistics for data obtained from interviews conducted with the farmers. Virtually all the shrimp farmers have experienced an increase in income with 40% generating less than 20 million IDR, 40% obtaining more than 100 million IDR in profit and the remainder 20-100 million IDR. However, the farmers admitted that they not only generate a profit, but they can generate losses occasionally. The shrimps are mostly bought by multiple buyers, such as end consumers, middlemen and exporters. The shrimp farmers confess that they do not have any difficulties selling the shrimp because shrimp is in high demand in both local and national markets.

Most farmers build their shrimp ponds with their own money. Nonetheless, it is undeniable that some make use of bank loans as the source of their capital. Capital used to build shrimp ponds varies, depending on the type of shrimp ponds and the pond area. Renewable energy has not yet been used for shrimp farming due to a lack of interest in sustainable energy. However, BPS (2016), stated that renewable energy is required to build a shrimp supply chain that is sustainable. Shrimp effluent is thrown into the sea primarily, however the effluent also can be managed by use of the recycling process, such as

fermentation, sedimentation and use of septic tanks. Expenditure is estimated to be less than 3 million IDR per month. The pond areas that farmers have cover approximately 1-400 acres. Shrimp seed is typically bought from national hatcheries to obtain national quality standards for shrimp and to feed them. Additionally, farmers are likely to buy commercial feed produced by shrimp feed companies in Indonesia, such as CP Prima, JAPFA, Matahari Sakti, Universal Agri Bisnisindo and Gold Coin.

If the shrimp is affected by disease, most farmers replace the water ponds regularly with a combination of safe treatments to eradicate the contamination. However, the result of the treatment varies; 40% fail and 50% succeed. Farmers believe that the number of diseases to affect shrimp in the last five years has remained constant and moreover, there has been no improvement. Shrimps can be affected by white faeces syndrome, white spot syndrome and infectious myonecrosis virus. However, the availability of water for shrimp cultivation is not a huge problem for 63.3% farmers, while the remainder felt that there is a shortage of clean water in the summer. This is in accordance with Barbier, Cox and WRM and Lebel et al., (2002), who asserted that mangrove availability due to mangrove deforestation, can influence the condition of the environment, for instance a shortage of clean water, erosion and fisheries problems. Furthermore, it has been proved that the average number of mangroves planted by shrimp farmers remains low, less than 10 mangroves. The reason why farmers plant few mangroves is primarily because they do not comprehend the consequences of shrimp farming on the environment and as the soil around the ponds is sandy mangroves are unable to grow.

The abundance of water is not accompanied by water that is of good quality. It is indicated that the quality of water is still constant for the last 5 years. To maintain the ponds, shrimp farmers in NTB usually employ 1-5 labourers per pond with the age from 17 to 50 years old. The workers are paid less than the regional minimum wage, below 2 million IDR. However, each harvest day, labourers gain incentives in the form of a bonus, which is commonly 10% of the profit. Additionally, when selecting workers, shrimp farmers tend to look for experienced people. The employee is required to work under 8 hours per day in the form of shift work. Furthermore, it should be noted that shrimp farmers

divide work according to an individual's gender. For example, female workers will be placed in the office and kitchen while male workers will be employed as technical and manual labourers. Most shrimp farmers are satisfied with the work of their labourers. When the farmers gain increased benefits, they share their success by being charitable. Thus, there is little or no conflict between the shrimp farmers and the community around the shrimp farms. This concurs with what Hanafi and Ahmad (1999), stated, whereby conflict can arise between rice field farmers and shrimp farmers due to environmental effect of shrimp production.

Table 12. Frequency Table

No	Question	Option	Percentage (%)
1.	What is your family's income after shrimp farming for the last three years?	Steady	13.3
		Increase	63.3
		Other (Fluctuate/decrease)	23.3
2	How much is your income per harvest?	0-20 million IDR	40.0
		20-100 million IDR	20.0
		More than 100 million IDR	40.0
3	Who buys your shrimp?	End consumer	6.7
		Trader (middlemen or exporter)	3.3
		Combination of buyers	90.0
4	What sort of difficulties do you have with regards to selling your shrimp?	Lack of market information	-
		No difficulties	80.0
		Other difficulties (less quality/limited demand/size/prize)	20.0
5	Have you ever experienced loss? If yes, how much?	0-20 million IDR	56.7
		20-100 million IDR	16.7
		More than 100 million IDR	26.7
6	How much capital did you need to build your shrimp farm?	Less than 100 million IDR	50.0
		100-500 million IDR	13.3
		More than 500 million IDR	36.7
7	What is the source of your capital?	Self-capital	63.3
		Bank loans	26.7
		Other (multiple sources)	10.0
8	What type of energy is used on your shrimp farm?	Renewable energy	-
		Non-renewable energy	100.0
		Other	-
9	How do you manage waste?	Discard	50.0
		Recycle	16.7

		Other (fermentation/sedimentation/septic tank)	33.3
10	How much do you spend on managing your shrimp waste per month?	0-3 million IDR	100.0
		3-6 million IDR	-
		More than 6 million IDR	-
11	Total shrimp pond(s) area?	1-400 acres	70.0
		400-800 acres	20.0
		More than 800 acres	10.0
12	Where do you buy seed?	Local hatchery	3.3
		National hatchery	96.7
		International hatchery	-
13	What do you use to feed your shrimp?	Commercial feed	100.0
		Fish meal	-
		Organic feed	-
14	How do you treat shrimp diseases and manage your pond?	Using antibiotics	20.0
		Water change routines	6.7
		Combination of safe treatment	73.3
15	What were the results of your treatment?	Success	53.3
		Fluctuate	40.0
		Fail	6.7
16	What do you think about diseases in shrimp culture over the last 5 years?	Increase	33.3
		Decrease	3.3
		Average	63.3
17	Does it lack fresh water during the dry season?	Yes, it cannot be managed	6.7
		Yes, it can be managed	30.0
		No	63.3
18	What do you think about the quality of water over the last 5 years?	Increase	30.0
		Decrease	23.3
		Average	46.7
19	How many mangroves have you planted?	Never	70.0
		Less than 10	-
		More than 10	30.0
20	Do you understand the side-effects of shrimp farming on the environment?	Yes, but not much	16.7
		Yes, quite a lot	26.7
		No	56.7
21	How many labourers do you employ?	1-5	43.3
		6-20	23.3
		Other (no labourer/more than 20)	33.3
22	How old are they?	Under 17	3.3
		17-50 years old	73.3
		Other (no labourer)	23.3
23	How much do you pay them?	Under 2 million IDR	60.0
		2-4 million IDR	16.7
		Other (no labourer)	23.3

24	How do you choose your workers?	Based on the relationship	33.3
		Based on the experience	40.0
		Other (no labourer)	26.7
25	What types of incentives do you give your workers?	Bonus	63.3
		Goods	6.7
		Other (no labourer /no incentives)	30.0
26	How many hours do your labourers work each day?	Under 8 hours	66.7
		8 hours	10.0
		Other (no labourer)	23.3
27	Are you satisfied with their work?	Satisfied	73.3
		Disappointed	-
		Other (less satisfied/no labourer)	26.7
28	What have you done for your community after benefitting from shrimp cultivation?	Education	-
		Charity	100.0
		Health service	-
29	What sort of conflict arises during shrimp production?	Social conflict	13.3
		Economic conflict	3.3
		Other (no conflict)	83.3
30	Do you treat male and female labourers the same way?	Yes	-
		No	56.7
		Other (no labourer/no female labourer)	43.3

b. Economic Aspect

Table 13 shows the comparison between traditional, semi-intensive and intensive shrimp farming based on the economic aspect. It is evident that all three types of shrimp farming are profitable, seeing as the farmers believe that their personal incomes have increased since they created their shrimp farms. However, the profit varies. Traditional farming obtains the lowest profit compared to semi intensive and intensive farming. Among all three types of shrimp farms, intensive shrimp farming is the most productive, according to the yield production (Farkan et al., 2016), which can generate the highest profit. The profit earned is in line with the capital and losses gained in which intensive farming requires the most money, though it can also produce the highest losses if shrimp production experiences failure due to pond maintenance or the outbreak of disease.

It should be noted that to build a shrimp farm, farmers can self-finance for traditional and intensive farms, although for semi-intensive, most farmers secure bank loans which charge interest of 19% per year. To maximise profit, most farmers sell their shrimp to multiple buyers without any difficulties. Unfortunately, all shrimp farmers are still considering if non-renewable energy is suitable for their farms, whilst most traditional shrimp farmers discard effluent from their shrimp farming into the sea without any recycling treatment. However, semi-intensive and intensive farmers have taken action to recycle the waste produced by their shrimp farming from the fermentation process, sedimentation and using septic tanks, which means they spend less than 3 million IDR per month to manage the waste.

Table 13. Economic data in shrimp farming

No	Question	Option	Percentage (%)		
			Traditional	Semi-intensive	Intensive
1.	What is your family's income after shrimp farming for the last three years?	Steady	10.0	20.0	10.0
		Increase	60.0	70.0	60.0
		Other (Fluctuate/decrease)	30.0	10.0	30.0
2	How much is your income per harvest?	0-20 million IDR	100.0	10.0	10.0
		20-100 million IDR	-	50.0	10.0
		More than 100 million IDR	-	40.0	80.0
3	Who buys your shrimp?	End consumer	20.0	-	-
		Trader (middlemen or exporter)	10.0	-	-
		Combination of buyers	70.0	100.0	100.0
4	What sort of difficulties do you have with regards to selling your shrimp?	Lack of market information	-	-	-
		No difficulties	70.0	80.0	90.0
		Other difficulties (less quality/limited demand/size/prize)	30.0	20.0	10.0
5		0-20 million IDR	80.0	50.0	40.0

	Have you ever experienced loss? If yes, how much?	20-100 million IDR	20.0	20.0	10.0
		More than 100 million IDR	-	30.0	50.0
6	How much capital did you need to build your shrimp farm?	Less than 100 million IDR	100.0	50.0	-
		100-500 million IDR	-	20.0	20.0
		More than 500 million IDR	-	30.0	80.0
7	What is the source of your capital?	Self-capital	80.0	40.0	70.0
		Bank loans	20.0	50.0	10.0
		Other (multiple sources)	-	10.0	20.0
8	What type of energy is used on your shrimp farm?	Renewable energy	-	-	-
		Non-renewable energy	100.0	100.0	100.0
		Other	-	-	-
9	How do you manage waste?	Discard	90.0	30.0	30.0
		Recycle	-	30.0	20.0
		Other (fermentation/sedimentation/septic tank)	10.0	40.0	50.0
10	How much do you spend on managing your shrimp waste per month?	0-3 million IDR	100.0	100.0	100.0
		3-6 million IDR	-	-	-
		More than 6 million IDR	-	-	-

c. Environmental Aspect

Table 14 depicts the environmental aspect of shrimp farming with the type of traditional, semi intensive and intensive farming. Intensive shrimp farming covers the largest area in relation to shrimp ponds, which means the capacity of the ponds is larger than traditional and semi-intensive farming. Practically all the farmers buy seed from national hatcheries and feed from commercial feed companies in the market. Commercial feed is usually composed of fishmeal in different percentages, depending on the shrimp feed producers. To reduce

fishmeal usage in feeding the shrimp, Cruz-Suarez (2010), suggested using green seaweed (Ulva clathrate), which can reduce commercial feed by a half.

When disease affects the shrimp ponds, most farmers perform safe treatments. These treatments tend to be successful in preventing diseases with respect to semi-intensive and intensive shrimp farming but fluctuate for traditional shrimp farming. That can happen because most semi-intensive and intensive farmers have more technical knowledge about treating shrimp diseases. The farmers mentioned that the number of diseases has remained constant over the last 5 years, although they have tried several types of disease preventions. It is likely the semi-intensive farmers do not have any difficulties in accessing water during dry season. However, the water quality is low for semi-intensive farmers, while the others think that the water quality is medium. This could be the reason, so few mangroves are planted by traditional and intensive shrimp farmers. Moreover, traditional shrimp farmers do not have knowledge related to the negative effect of shrimp farming activity on the environment.

Table 14. Environmental data on shrimp farming

No	Question	Option	Percentage (%)		
			Traditional	Semi-intensive	Intensive
11	Total shrimp pond(s) area?	1-400 acres	100.0	80.0	30.0
		400-800 acres	-	10.0	50.0
		More than 800 acres	-	10.0	20.0
12	Where do you buy seed?	Local hatchery	-	-	10.0
		National hatchery	100.0	100.0	90.0
		International hatchery	-	-	-
13	What do you use to feed your shrimp?	Commercial feed	100.0	100.0	100.0
		Fish meal	-	-	-
		Organic feed	-	-	-
14	How do you treat shrimp diseases and manage your pond?	Using antibiotics	30.0	20.0	10.0
		Water change routines	-	10.0	10.0
		Combination of safe treatment	70.0	70.0	80.0
15	What were the results of your treatment?	Success	30.0	60.0	70.0
		Fluctuate	70.0	30.0	20.0
		Fail	-	10.0	10.0
16		Increase	30.0	40.0	30.0

	What do you think about diseases in shrimp culture over the last 5 years?	Decrease	10.0	-	-
		Average	60.0	60.0	70.0
17	Does it lack fresh water during the dry season?	Yes, it cannot be managed	20.0	-	-
		Yes, it can be managed	30.0	50.0	10.0
		No	50.0	50.0	90.0
18	What do you think about the quality of water over the last 5 years?	Increase	30.0	30.0	30.0
		Decrease	10.0	40.0	20.0
		Average	60.0	30.0	50.0
19	How many mangroves have you planted?	Never	80.0	50.0	80.0
		Less than 10	-	-	-
		More than 10	20.0	50.0	20.0
20	Do you understand the side-effects of shrimp farming on the environment?	Yes, but not much	10.0	30.0	10.0
		Yes, quite a lot	-	20.0	60.0
		No	90.0	50.0	30.0

d. Social Aspect

Table 15 describes the social aspect of traditional, semi-intensive and intensive farming. Most traditional farmers do not employ workers to manage their shrimp farms, whereas most semi-intensive and intensive farmers recruit 1-20 labourers aged 17 and 50. The farmers offer a salary that is less than 2 million IDR per month, plus a bonus each harvest. This is different to the situation that workers in Mexico face, where they are paid more than minimum wage (Dewalt et al., 2002).

The labourers are usually selected based on experience and occasionally according to their relationship with the farmers. Surprisingly, the working hours of labourers in intensive farming, semi-intensive and traditional farming is less than 8 hours per day. This might happen because of the cutting-edge technology which can help workers to work efficiently and automatically, especially in intensive farming (Dewalt et al., 2002). Traditional, semi-intensive and intensive farmers are satisfied with the work of their labourers. Therefore, when they obtain a good profit, they reward their workers and are charitable to their local community. The charity is given in the form of money and shrimps. Due

to social responsibility, it is not surprising that the farmers do not experience any conflict with their community, the economy and the environment. Regarding the female and male workers, the farmers admit they differentiate between the tasks that the female and male labourers are given.

Table 15. Social data in shrimp farming

No	Question	Option Detail	Percentage (%)		
			Traditional	Semi-intensive	Intensive
21	How many labourers do you employ?	1-5	40.0	70.0	20.0
		6-20	-	20.0	50.0
		Other (no labourer/more than 20)	60.0 (no labourer)	10.0 (no labourer)	30.0 (more than 25 labourers)
22	How old are they?	Under 17	-	10.0	-
		17-50 years old	40.0	80.0	100.0
		Other (no labourer)	60.0 (no labourer)	10.0 (no labourers)	-
23	How much do you pay them?	Under 2 million IDR	40.0	80.0	60.0
		2-4 million IDR	-	10.0	40.0
		Other (no labourer)	60.0 (no labourer)	10.0 (no labourer)	-
24	How do you choose your workers?	Based on the relationship	40.0	50.0	10.0
		Based on the experience	-	40.0	80.0
		Other (no labourer)	60.0 (no labourer)	10.0 (no labourer)	10.0
25	What types of incentives do you give your workers?	Bonus	20.0	80.0	90.0
		Goods	10.0	-	10.0
		Other (no labourer /no incentives)	60.0 (no labourer) and 10.0 (no incentives)	10.0 (no labourer), 10.0 (no incentives)	-
26	How many hours do your labourers work each day?	Under 8 hours	40.0	70.0	90.0
		8 hours	-	20.0	10.0
		Other (no labourer)	60.0 (no labourer)	10.0 (no labourer)	-
27	Are you satisfied with their work?	Satisfied	40.0	90.0	90.0
		Disappointed	-	-	-

		Other (less satisfied/no labourer)	60.0 (no labourer)	10.0 (no labourer)	10.0 (less satisfied)
28	What have you done for your community after benefitting from shrimp cultivation?	Education	-	-	-
		Charity	100.0	100.0	100.0
		Health service	-	-	-
29	What sort of conflict arises during shrimp production?	Social conflict	20.0	-	20.0
		Economic conflict	10.0	-	-
		Other (no conflict)	70.0 (no conflict)	100.0 (no conflict)	80.0 (no conflict)
30	Do you treat male and female labourers the same way?	Yes	-	-	-
		No	20.0	60.0	90.0
		Other (no labourer/no female labourer)	60.0 (no labourer), 10.0 (not sure), 10.0 (no female labourer	10.0 (no labourer), 30.0 (no female labourer)	10.0 (no female labourer)

e. Spearman significance test

Table 16. Result of the Spearman Significance Test

	Income trend	Income per harvest	Types of buyers	Loss	Capital	Capital source	Waste management	Pond area	Source of seed	Shrimp diseases	Treatment result
Income trend	1.000	-0.065	0.228	.444*	0.139	0.012	-0.258	0.113	0.038	0.089	0.101
Income per harvest	-0.065	1.000	.372*	.507**	.700**	0.260	0.342	.505**	-0.208	0.267	-0.238
Types of buyers	0.228	.372*	1.000	0.117	0.318	0.038	0.062	0.215	-0.062	0.049	-0.115
Loss	.444*	.507**	0.117	1.000	.456*	0.212	-0.074	.432*	-0.265	0.142	0.077
Capital	0.139	.700**	0.318	.456*	1.000	0.257	.396*	.719**	-0.224	-0.033	-0.279
Capital source	0.012	0.260	0.038	0.212	0.257	1.000	0.174	0.182	0.138	0.182	-0.078
Waste management	-0.258	0.342	0.062	-0.074	.396*	0.174	1.000	0.102	0.176	0.025	-.375*
Pond area	0.113	.505**	0.215	.432*	.719**	0.182	0.102	1.000	-0.240	-0.039	-0.059
Source of seed	0.038	-0.208	-0.062	-0.265	-0.224	0.138	0.176	-0.240	1.000	-0.111	-0.339
Shrimp diseases	0.089	0.267	0.049	0.142	-0.033	0.182	0.025	-0.039	-0.111	1.000	-0.255
Treatment result	0.101	-0.238	-0.115	0.077	-0.279	-0.078	-.375*	-0.059	-0.339	-0.255	1.000
Water supply	-0.185	0.269	-0.249	0.179	0.286	0.046	-0.013	.484**	-0.139	0.122	0.000
Knowledge of side-effects	0.048	#REF!	-0.280	-0.120	-0.304	-.547**	-0.351	-0.084	-0.156	-.406*	0.221
Labourers	0.224	-0.118	0.088	-0.057	0.077	0.039	-0.016	0.183	-0.035	-0.007	0.139
Age of labourers	0.163	-.422*	-0.100	-0.276	-.429*	-0.070	-0.175	-0.290	0.084	-0.078	0.251
Salary	0.031	-0.346	-0.001	-.370*	-.366*	-0.086	-0.147	-0.087	0.147	0.014	0.072
Choice of labourer	0.302	-0.078	0.113	-0.040	-0.044	0.066	-0.006	0.098	0.229	0.027	-0.007
Incentives	0.113	-.675**	-.399*	-0.212	-.612**	-0.160	-0.237	-.391*	0.139	-0.128	0.199
Working hours	0.221	-.513**	-0.032	-0.159	-.433*	-0.141	-0.141	-0.208	0.129	-0.078	0.161
Satisfaction	0.143	-.421*	-0.059	-0.293	-.484**	-0.174	-0.143	-.389*	0.112	0.000	0.138
Conflict	0.241	0.086	0.138	0.167	0.027	0.332	0.219	-0.129	.431*	-0.046	0.014

	Water supply	Knowledge of side-effects	Labourers	Age of labourer	Salary	Choice of labourer	Incentives	Working hours	Satisfaction	Conflict	Male/female equality
Income	-0.185	0.048	0.224	0.163	0.031	0.302	0.113	0.221	0.143	0.241	-0.045
Income per harvest	0.269	-.514**	-0.118	-.422*	-0.346	-0.078	-.675**	-.513**	-.421*	0.086	-.451*
Buyers	-0.249	-0.280	0.088	-0.100	-0.001	0.113	-.399*	-0.032	-0.059	0.138	-.381*
Loss	0.179	-0.120	-0.057	-0.276	-.370*	-0.040	-0.212	-0.159	-0.293	0.167	-0.144
Capital	0.286	-0.304	0.077	-.429*	-.366*	-0.044	-.612**	-.433*	-.484**	0.027	-.462*
Capital source	0.046	-.547**	0.039	-0.070	-0.086	0.066	-0.160	-0.141	-0.174	0.332	-0.036
Waste management	-0.013	-0.351	-0.016	-0.175	-0.147	-0.006	-0.237	-0.141	-0.143	0.219	-.425*
Pond area	.484**	-0.084	0.183	-0.290	-0.087	0.098	-.391*	-0.208	-.389*	-0.129	-0.261
Seed	-0.139	-0.156	-0.035	0.084	0.147	0.229	0.139	0.129	0.112	.431*	-0.212
Shrimp diseases	0.122	-.406*	-0.007	-0.078	0.014	0.027	-0.128	-0.078	0.000	-0.046	0.040
Treatment result	0.000	0.221	0.139	0.251	0.072	-0.007	0.199	0.161	0.138	0.014	0.123
Water supply	1.000	-0.112	-0.009	-0.270	-0.148	0.028	-0.186	-0.221	-0.180	-0.129	-0.037
Knowledge of side-effects	-0.112	1.000	-0.198	0.022	0.042	-0.299	0.273	0.123	0.015	-0.226	0.187
Labourers	-0.009	-0.198	1.000	.689**	.695**	.826**	.436*	.561**	.574**	-0.067	0.242
Age of labourers	-0.270	0.022	.689**	1.000	.815**	.758**	.769**	.851**	.876**	0.000	.514**
Salary	-0.148	0.042	.695**	.815**	1.000	.692**	.691**	.766**	.741**	0.000	.395*
Choice of labourers	0.028	-0.299	.826**	.758**	.692**	1.000	.457*	.672**	.724**	0.186	0.232
Incentives	-0.186	0.273	.436*	.769**	.691**	.457*	1.000	.838**	.698**	0.001	.614**
Working hours	-0.221	0.123	.561**	.851**	.766**	.672**	.838**	1.000	.791**	0.099	.580**
Satisfaction	-0.180	0.015	.574**	.876**	.741**	.724**	.698**	.791**	1.000	0.061	.537**
Conflict	-0.129	-0.226	-0.067	0.000	0.000	0.186	0.001	0.099	0.061	1.000	-0.168
Male/female equality	-0.037	0.187	0.242	.514**	.395*	0.232	.614**	.580**	.537**	-0.168	1.000

Male/female equality	-0.045	-.451*	-.381*	-0.144	-.462*	-0.036	-.425*	-0.261	-0.212	0.040	0.123

Table 16 illustrates the Spearman significance test of economic, environment and social aspects related to shrimp farming. Spearman test is chosen as the researcher wants to identify the correlation between each aspect and furthermore, whether the relationship between the variable is significant or not at the level of 0.05 and 0.01. The category of each correlation can be divided as follows (Evans, 1996):

.00-.19: very week relationship

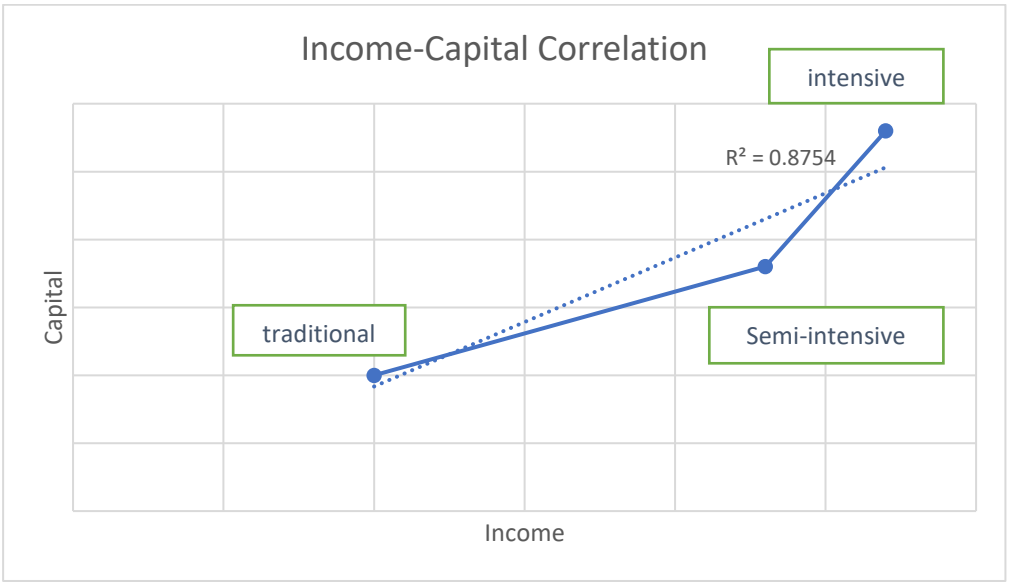
.20-.39: weak relationship

.40-.59: moderate relationship

.60-.79: strong relationship

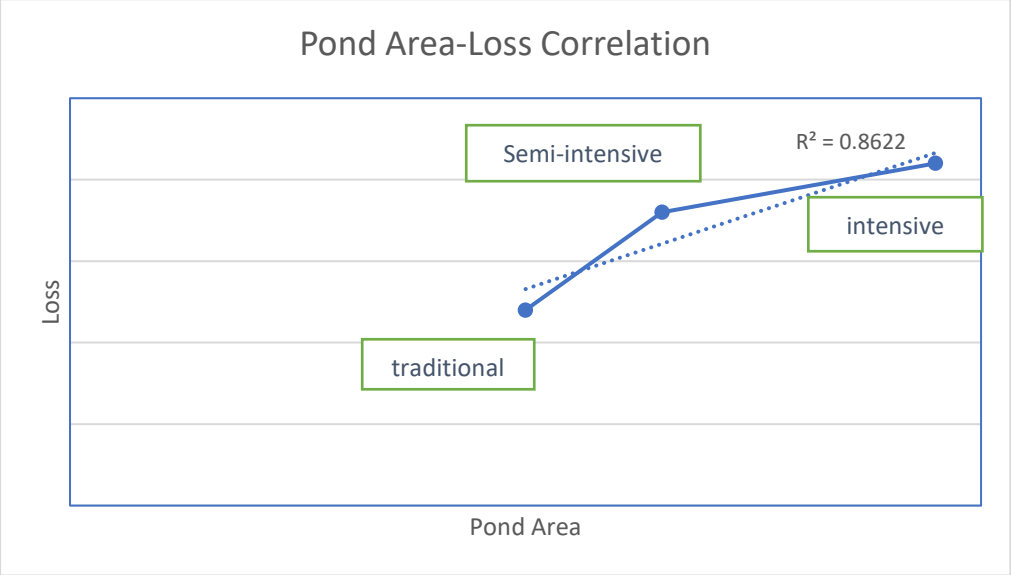
.80-1.0: very strong relationship

From the table, it can be seen that there are multiple correlations that can be described among the variable. First, there is a strong correlation between income and capital (.700), at the 0.01 significance level. This means that when farmers provide substantial amounts of capital to cultivate the shrimp, there is the possibility that they will generate a high income. This is confirmed by the intensive farmers. Intensive farmers generate a higher income when they invest more money in their farms, compared to traditional and semi-intensive farmers. The following scatter plot also reveals the correlation between income and capital.



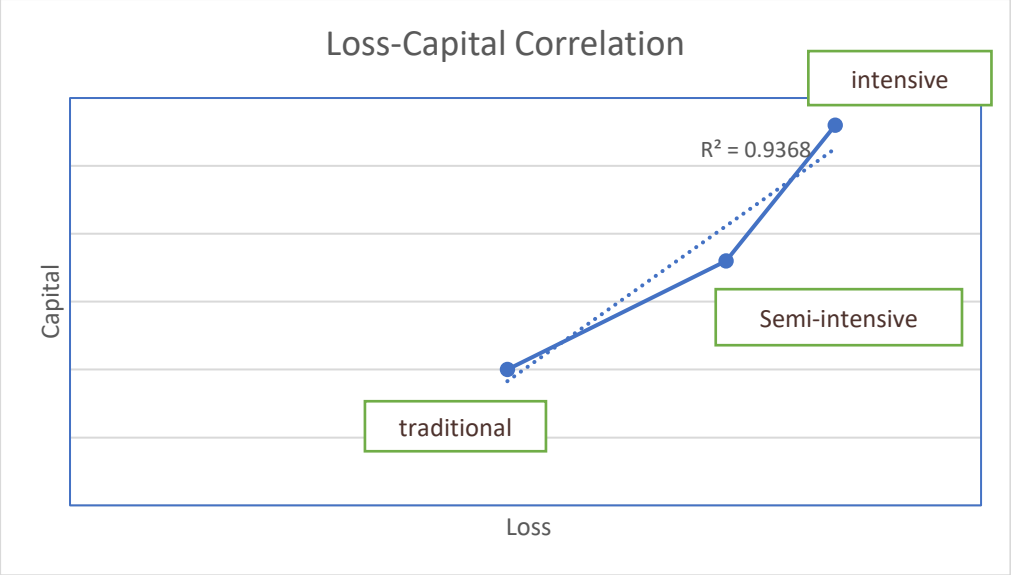
Graph 2. Correlation between shrimp farmer's income and the capital required to build the shrimp farm

Pond area and loss have a moderate connection (.432), which is significant at 0.05. It explains that there is a positive relationship between the shrimp pond area and loss of production regarding shrimp cultivation. If the pond area is large, it will accommodate more shrimps. However, if a shrimp is infected by disease, all the ponds can be contaminated, which leads to a loss of production relating to shrimp cultivation. The following scatter plot also depicts the correlation between pond area and loss.



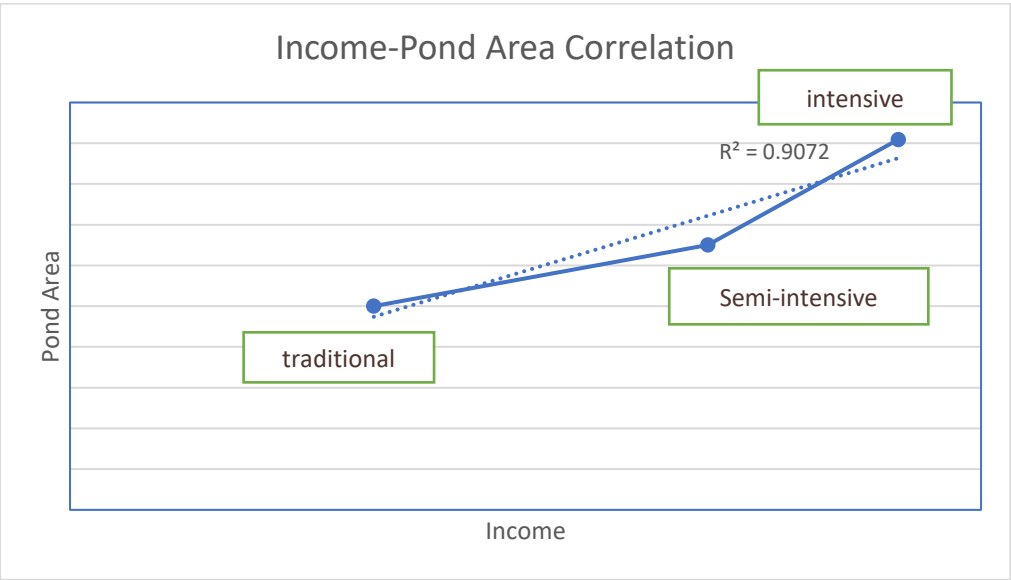
Graph 3. Correlation between the shrimp farm pond area and loss of production on the shrimp farm

Furthermore, there is a moderate relationship (.456) between loss and capital. It stands significantly at 0.05. This confirms that when the farmers provide substantial sums of capital to cultivate the shrimp, there is the possibility that they might experience considerable loss. In short, the higher the capital is the greater the possibility that the farmers experience loss or take risks. The subsequent scatter plot also presents the correlation between loss and capital.



Graph 4. Correlation between loss of production on the shrimp farm and capital required to build the shrimp farm

Fourth, it can be observed from the table that there is a moderate association between income and the shrimp pond area (.505), which is significant at 0.01. This demonstrates that when the pond area is large, shrimp farmers can regularly produce more shrimps due to high stock density per m^2, which generates a higher profit. The following scatter plot also draws a correlation between income and pond area.



Graph 5. Correlation between shrimp farmer's income and shrimp farm pond area

Fifth, there is a moderate correlation between shrimp disease and knowledge of shrimp farming's damage to the environment (-.406) at the 0.05 significance level. It can be assumed that when shrimp farmers have knowledge about how to manage shrimp farming in an environmentally friendly way, they will also recognise how to prevent and overcome shrimp diseases, which automatically reduces the number of shrimp, and vice versa.

e. Production Step

All three types of farming consist of certain steps that can generally be divided into three main steps: land preparation, shrimp cultivation and harvesting. At the beginning of the process, the pond should be cleaned of any sort of liquid and the surface exposed to the sun for 2-3 weeks with the maximum period for drying the land being around 2 months, in order to eradicate pests from previous farming. Therefore, to maintain the soil or pond acidity and to trigger the shrimps' moulting process, lime must be spread on the pond. Prior to the liming process, especially for intensive farming, leaching and pond construction are conducted to prevent water leaking during the cultivation and strengthen the dike. Before water can be added to the pond, some fertiliser is added to the soil to increase the number of plankton in the pond. Additional treatments need to be performed, for instance Super E4, $Ca(ClO)_2$, H_2O_2 and HCl treatments. Each treatment has its own function in relation to shrimp cultivation. E_4 is used to grow the plankton, as well as the fertiliser, while $Ca(ClO)_2$, HCl and H_2O_2 are used in the sterilisation and disinfecting processes to increase the quality of the water based on the microbiology level of the water.

After adding water up to 80cm-1m and ensuring the plankton content in the water is sufficient to cultivate the shrimp and moreover, that there is no other microorganism which can harm the shrimp**,** juvenile shrimp can begin to be stocked. Stock shrimp stands at the rate of 100–200 per sq. metre for intensive farming, 50–100 per sq. metre for semi-intensive and under 50 per sq. metre for the other. Lower stocking density will boost the size of the shrimp, but it can reduce the total yield poundage. Approximately 2-3 months feeding is needed prior to harvesting. For semi-intensive and intensive farming, water parameters such as dissolved oxygen, temperature, pH, salinity and plankton content are

monitored regularly to maintain water quality and prevent diseases harming the shrimp.

Most shrimp farmers usually do sampling each week prior to selling the shrimps to the buyer or middleman, so as to determine the size and quality of the shrimp. In brief, the harvesting is conducted twice to reduce the risk of shrimp mortality and produce bigger shrimp in the second harvest. The first harvesting is called partial harvesting, whereas the second harvesting is termed 'complete harvesting'.

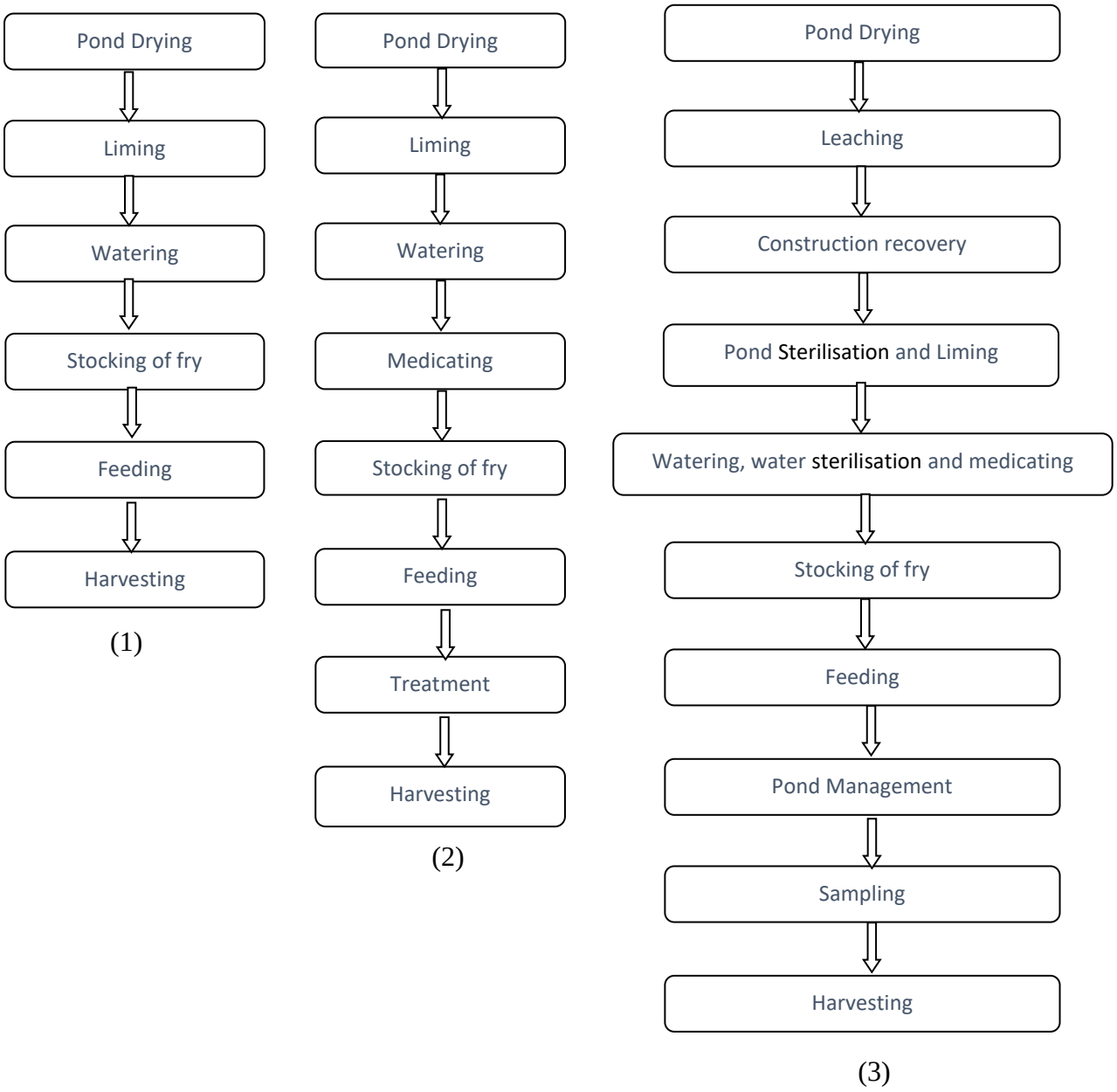


Figure 2. (1) Traditional Farm, (2) Semi-Intensive Farm, (3) Intensive Farm

f. The biggest challenges with regards to cultivating shrimp

Table 17 reveals the principal challenges for farmers relating to cultivating shrimp. It can be observed that intensive farmers do not have any difficulties in providing capital to build the shrimp farms, whereas 40% of traditional farmers and 50% of semi intensive farmers still consider capital to be their biggest challenge. This can occur because most intensive farmers are part of the privileged class and have the finance to invest in the shrimp farming. Intensive farming on average requires more than 500 million IDR in capital (intensive farmers interview).

A further challenge that traditional and semi-intensive farmers face is with regard to the water supply. The lack of advanced technology to pump the water from the sea to the ponds for that type of shrimp means that the water supply is occasionally limited. Regarding intensive farming, the water supply can be managed easily thanks to the cutting-edge facilities that intensive farmers own.

In relation to traditional and semi-intensive farming, there is no issue pertaining to labour management given that both types of farms have fewer labourers compared to intensive farms, which can employ up to 100 employees. However, three shrimp farmers stated shrimp diseases are the greatest challenge. Until now, they have not yet found any treatment which can eradicate shrimp diseases completely. It is indicated that inappropriate pond management is the main reason for disease outbreaks (Hanafi & Ahmad, 1999). As such, what shrimp farmers can do is combine safe treatments to attempt to eliminate the diseases. The second biggest challenge for intensive farming is electricity since large ponds require higher voltage to operate paddlewheel aerators, which is expensive to generate. This means intensive farming is less sustainable, seeing that the consumption of electricity is higher than traditional and semi-intensive farming (Dewalt et al., 2002). Furthermore, if access to electricity is limited, the shrimps cannot gain sufficient oxygen to survive in the ponds.

Table 17. The biggest challenges shrimp farmers face

Type of Farm	The biggest Challenges
Traditional	Capital, diseases, water supply, shrimp feed, weather, technical problem

Semi Intensive	Capital, diseases, water supply, weather, technical skills
Intensive	Diseases, labour management, electricity

g. Government expectation

Table 18 shows the government's expectation of each type of farmer. Both traditional and semi-intensive shrimp farmers require comprehensive support from the government, such as facilities, feed and seed subsidies, whereas very few intensive shrimp farmers need clear regulation related to the legalisation and sustainability of shrimp farming. Those requirements are according to the statement made by BPS (2016), in which legal production is important to increase the performance and obtain trustworthy information related to the sustainable shrimp supply chain. Therefore, the government needs to provide understandable regulation for shrimp supply chain players, including shrimp farmers (Sverdrup, 2017). It should be mentioned that the remaining intensive shrimp farmers (60%) do not have any expectation of the government since they have the ability to manage their shrimp farms independently. They are already supported by large companies which offer a win-win solution for their shrimp cultivation. For example, a company will offer free technical assistance about how to cultivate shrimp properly. **To compensate for the free service,** intensive farmers are required to buy the seed and shrimp feed which **is** produced by the company.

Yet again, traditional and semi-intensive shrimp farmers state that to build appropriate shrimp farms which are sustainable requires additional support, given that they do not have the ability to acquire the best facilities. This is due to a lack of capital as the facilities are expensive for traditional and semi-intensive farmers to purchase. Moreover, to afford expensive shrimp seed and feed, traditional and semi-intensive farmers obviously require loans from a bank or friends/family. That is the reason why both farmers ask the government to provide them with shrimp seed and feed subsidies. Furthermore, it is particularly important for semi-intensive farmers to obtain loans that do not have excessive interest, such as loans offered by Bank Indonesia, which is approximately 19% per year. High interest rates have reduced the maximum

profit that they generate. As such, it is recommended that the government provides farmers with loans that comprise low interest rates.

Table 18. Farmer's expectations of the government

Type of Farm	Expectation
Traditional	Full support, facilities, feed and seed subsidies
Semi-intensive	Low loan interest, facilities; feed and seed subsidies
Intensive	Clear regulation and no expectation

5.2 Expert interview

The following table (Table 19) describes the opinions of experts connected to the steps that shrimp farmers can take to fulfil European market demand. Each step is applied to the three types of shrimp farming: traditional, semi-intensive and intensive.

Table 19. Steps to fulfil European market demand based on expert opinion

Expert	Steps to achieve European market demand
Expert 1	- To make farmers adhere to sustainable shrimp practices, the government must provide sufficient information related to sustainable shrimp farming - To improve the performance of the sustainable supply chain, regulation must be understandable - Hiring local workers to trigger social responsibility
Expert 2	- Information connected to management practices, environmental assessment and social consideration are crucial to maintain sustainability - It is necessary for farmers to have certified seed and feed to perform standard levels of shrimp processing - Farm management must be the priority
Expert 3	- Sustainable shrimp production practices can be introduced by providing knowledge associated with feed management - Cutting-edge technology is crucial to support the sustainable supply chain - Farm normalisation should be completed
Expert 4	- There is a need for technicians to offer farmers a good service and help farmers achieve sustainable shrimp production - Farmers must avoid the use of antibiotics and harmful chemicals - Quality of water needs to take into consideration as sustainable water supply. Ahmed et al., (2017), suggested that it can be

	achieved by the use of open-water Integrated Multi-Trophic Aquaculture (IMTA) and REDD+ program.
Expert 5	- Clear instructions can help farmers understand how shrimp can be produced sustainably - It is crucial to have a short supply chain to maximise shrimp quality - It is essential to consider human resources, land and weather conditions

5.3 Exporter interview

The following table (Table 20) illustrates the opinion of the exporters connected to shrimp export activity.

Table 20. Opinions of exporters connected to shrimp export

Exporter	Opinion related to shrimp export
Exporter 1	- To export the shrimp, the main requirements that must be fulfilled are certification and traceability - The exportation of shrimp is monopolised by large companies - Shipping by sea is more appealing - Organised cooperation among supply chain players is necessary. Suppliers and stakeholders collaborate to create a sustainable supply chain known as external cooperation (Monczka et al., 2015). The main challenge related to exporting shrimps is fulfilling the certification from the country of origin. - To export shrimps to European countries, the major challenge is traceability, as the government in Indonesia is less concerned about this significant point
Exporter 2	- The key to exporting shrimp abroad is traceability and safe packaging - Shrimps with zero contaminant are in demand in the market - Air freight is expensive, but it is faster than other transportation methods used to transport shrimp - The main obstacle to exporting shrimps is the strict customer requirements, like providing shrimp which are homogenized and a specific size - To export shrimps to the EU, the main challenges are traceability and the intense level of competition, as the European market offers profitable market to sell the shrimps

5.4 Stakeholder interview

Table 21 reveals the opinions of the stakeholders related to what the government have accomplished to help shrimp farmers achieve sustainable shrimp farming. Support in the form of facilities, training and assistance from the government is commonly applied to traditional and semi-intensive shrimp farms, while intensive farming receives support for shrimp pond legalisation and certification. This is due to the complexity of the certification process which can be triggered by poor shrimp culture management (Hanafi & Ahmad, 1999).

Table 21. Opinions of stakeholder on their role in helping shrimp farmers

Stakeholder	Opinion related to government aid for shrimp farmers
Stakeholder 1	Sustainability is the way that the region can maintain its resources so that the younger generation can use them. To achieve it, the government have already given the farmers: - Support (grant for small farmers, seed subsidy, shrimp farming assurance) - Facilities (excavators) - Training (technical assistance) - Programme (socialisation connected to legality and certification, and land certification)
Stakeholder 2	Sustainability is the condition where there is no illegal exploitation of the environment. To achieve sustainable shrimp farming, the government have given: - Facilities (excavators, seed, feed, roads) - Programme (thermo king car to maintain the temperature of the shrimp) - Training (comparative study) - Support (grant, seed subsidy)
Stakeholder 3	Sustainability ensures that shrimp production is environmentally friendly. To attain sustainable shrimp farming, the government have offered: - Programme (Free product certification) - Training (HACCP implementation) - Support (disease inspection)

5.5 Middlemen interview

The following table (Table 22) depicts the role of the middlemen as traders in the shrimp supply chain.

Table 22. Abilities of the middlemen as traders in the shrimp supply chain

Middleman	Opinions related to the middleman's ability as a trader
Middleman 1	- The tools that I need to transport the shrimp from farmers to the local market are a pickup truck, styrofoam and ice. By preserving the shrimps in ice, directly after harvesting means the quality is preserved (Lai & Ye, 2017). - The maximum of shrimp bought is 1 ton/harvest - Direct selling method - The main challenge as the middleman is managing the inventory when the market is sluggish
Middleman 2	- The tools that I need to transport the shrimp from farmers to the market nationally are a pickup truck, styrofoam and ice - The maximum capacity of shrimp bought is 0.5 ton/harvest - Direct selling method - The key challenge as a trader is market saturation
Middleman 3	- The tools that I need to transport the shrimp from farmers to the local market are a pickup truck, styrofoam, freezer and ice - The maximum capacity of shrimp bought is 4 ton/harvest - The main obstacle as the middleman is managing the availability of the shrimps when demand is high
Middleman 4	- The tools that I need to transport the shrimp from farmers to the local market are a pickup truck, styrofoam and ice - The maximum capacity of shrimp bought is 1 ton/harvest - Direct selling method - The principal challenge as the middleman is maintaining the quantity of the shrimp when demand is high and low
Middleman 5	- The tools that I need to transport the shrimp from farmers to markets locally and nationally are a pickup truck, styrofoam and ice - The maximum capacity of shrimp bought is 0.4 ton/harvest - Direct selling method - The main challenge is the restricted bidding opportunity since the national company has set up a basic price for shrimp when I - sell the shrimp outside the island

6. Discussion

6.1 European market demands for sustainable shrimp

In general, to enable the shrimp to be sold in Europe, there are requirements that should be completed (European Commission, 2018):

a. The exporting country should be on the list of authorised countries. Additionally, 166 countries have been approved by the European Union to export their aquaculture products. Indonesia is one of those countries. The list is made according to evaluation undertaken by the European Union Food and Veterinary Office to meet EU standards.

b. Shrimps are cultivated by registered farms or authorised vessels. Therefore, the origin of the shrimp should be evident and traceable.

c. Shrimps are processed by appropriate and standard processing methods which are authorised by central government like the Ministry of Aquaculture, etc. This aims to provide shrimp which is free from contaminants. Contaminants are defined as the existence of unwanted substances composing cadmium, mercury, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs). The country of origin must send an annual report to the European Union regarding the residue management.

d. Shrimps are certified by way of genuine certification which is required by the European Union, for instance ASC, HACCP, etc. Shrimp certification also needs to be approved by the government to combat illegal fishing and a catch certificate must be accompanied by fish imported or trans-shipped to the European Union. Exporters must request a catch certificate for catches destined for the European Union. If a country fails to adhere to the European guidelines to prevent and eliminate illegal, unreported and unregulated (IUU) fishing, it risks a temporary ban from the seafood market in the European Union.

e. Shrimps must have food labelling which contains commercial symbolisation and the scientific names of each species, information related to the production method, catch area (sea, fresh water, aquaculture, mixed), facilities employed to catch the fish product (trawls, dredges, seines, etc), country of origin, net weight in kg, expiry

date, exporter information, shrimp specification (size, freshness, etc) and defrosting information. Certification label seafood products, such as ASC which is the most important certification regarding aquaculture, has rapidly gained market share in several European markets in recent years. Countries in Europe, especially the Netherlands, are the leading markets for sustainable seafood.

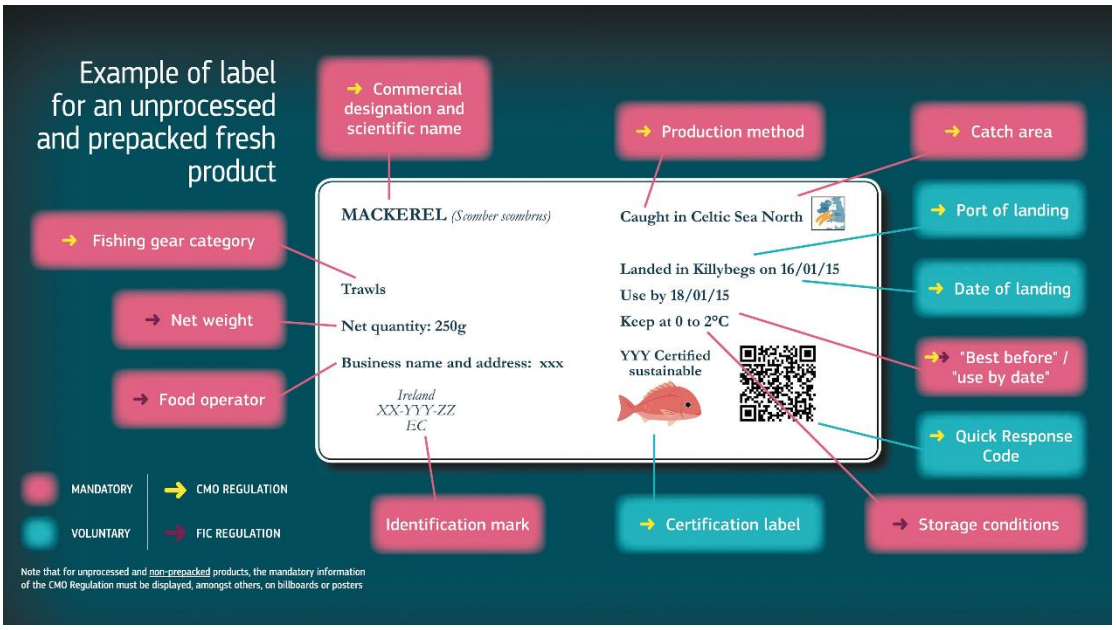


Figure 3. Sample label for an unprocessed and pre-packed fresh fish product (CBI)

f. Nutritional value information must be attached to the shrimp label. Furthermore, energy value, fat content, saturates, carbohydrates, sugars, protein and salt per 100g or per 100ml should be provided at least.

Specific regulation related to the traceability which is required to achieve sustainable shrimp, can be found in Council Regulation (EC) No 1224/2009 of 20 November 2009 establishing a community control system for ensuring compliance with the rules of the common fisheries policy, amending Regulations (EC) No 847/96, (EC) No 2371/2002, (EC) No 811/2004, (EC) No 768/2005, (EC) No 2115/2005, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007, (EC) No 676/2007, (EC) No 1098/2007, (EC) No 1300/2008, (EC) No 1342/2008 and repealing Regulations (EEC) No 2847/93, (EC) No 1627/94 and (EC) No 1966/2006.

6.2 The necessary changes in supply chain practices in Indonesia in order to comply with the demand for sustainable shrimp in the European market

Prior to describing important changes in shrimp supply chain practices, it is important to recognise the current supply chain practices of shrimp in NTB, Indonesia. The following figure illustrates current practices regarding the shrimp supply chain in Indonesia.

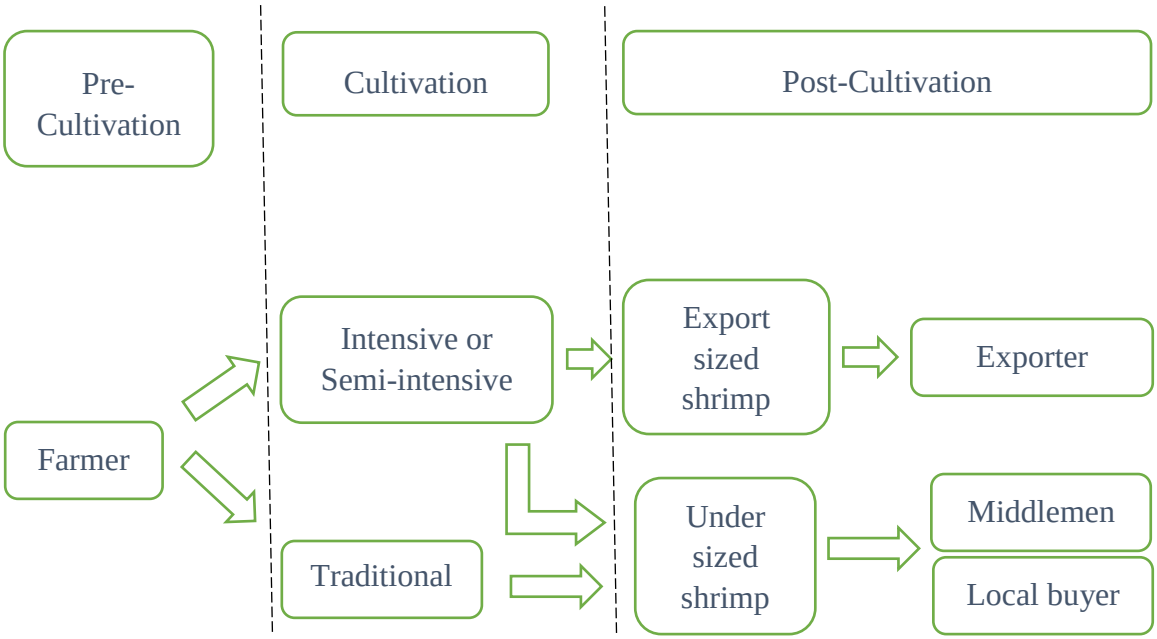


Figure 4. Current supply chain of shrimp in NTB, Indonesia

The shrimp supply chain in Indonesia is divided into three parts. First, before producing the shrimp, farmers should prepare the seed, feed and facilities that are required to operate in shrimp farming. This is termed 'pre-cultivation'. Seed and feed are obtained from national hatcheries and commercial feed companies. Similar to shrimp feed manufacturers in Thailand (Ongsritrakul and Hubbard, 1996), shrimp feed companies in Indonesia have numerous facilities, such as multiple types of laboratories: chemistry laboratories, etc, for analysing the shrimps chemically and microbiologically, besides the latest technology for each processing and shrimp centre in many cities in Indonesia.

The second component is the cultivation of shrimp. Shrimp farmers in Indonesia commonly use 3 types of shrimp farm; specifically, traditional, semi-intensive and intensive (see Figure 4) (Diana, 2009). All the shrimp farms have a period of cultivation that lasts for around 3-4 months.

The third factor is post-cultivation. When the shrimp is harvested, there will be under sized shrimp and export sized shrimp. Under sized shrimp has a size which is more than 100 (size category), meaning that 1kg comprises more than 100 shrimps. This type of shrimp is sold to middlemen at a low price before the shrimp is distributed to the local market. Export sized shrimp is around 20-70 in size, farmers sell the shrimp to the exporters via national traders. National traders choose the shrimp from the ponds during harvesting day. Subsequently, they select shrimp based on the size and quality before the shrimp is stored in cold storage in the thermo-king cars. It needs 20-25 hours approximately to distribute shrimp from NTB to the export company in another province, East Java. NTB has not been able to store and export their own shrimp because NTB does not have an export port and local cold storage yet (Stakeholder 3). Moreover, a short supply chain is necessary to maintain the quality of the shrimp (Expert 5).

To comply with the demands of the European market concerning sustainable shrimp, several changes which are necessary. Sustainable shrimp can be implemented when each of the actors collaborate cooperatively (Experts 1, 4 & 5, Exporter 1). Cooperation is necessary to ensure labelling and certification is undertaken quickly. In Indonesia, the government has established standard certification, namely CBIB, which stands for "Cara Berbudidaya Ikan yang Baik". In English, it is known as Good Aquaculture Cultivation. CBIB was developed to encourage farmers to show more concern on environmental, economic and social aspects. Since 2010, the government has harmonised the concept of CBIB and FAO Guidelines for Aquaculture Certification, ASEAN Guidelines for Food Fish and ASEAN Shrimp Alliance (ASA) and Shrimp GAP to bolster product competitiveness in the national and international market (Stakeholder 1). This is quite similar to Thailand. In Thailand, the government created the Thai Code and Conduct Standard (Nissapa et al., 2002) and GAP programme (NACA, 2017) to comply with the hygiene standards for aquaculture products and prevent antibiotic application in aquaculture practices.

To maintain the quality of shrimp, it is necessary to have a short supply chain and build cold storage places for shrimp on each island (Expert 5).

Chkanikova et al. (2014), assumed that a short supply chain can be achieved by introducing eco-labelling to the supply chain players, since in eco labelling, products are bought from local farmers without interference from the middleman. This will make traceability and direct communication with farmers easier.

6.3 The challenges and solutions in relation to complying with the sustainable shrimp demands of the European market

Shrimp farmers in NTB face difficulties in marketing their shrimps nationally and internationally due to the geographical distance to Europe. In this case, it is more about maintaining the quality of shrimp when it is distributed from one island to another. A long supply chain can trigger prohibitive costs regarding shrimp distribution and low-quality shrimp. Moreover, the lack of accessibility to small villages due to limited transport routes has made the distribution and quality of shrimp deteriorate (Expert 3).

Next, information related to sustainability and the European market remains inadequate among shrimp farmers (Expert 1). Stakeholders said that they have given information related to sustainability to the farmers, although the farmers believe that the government has never given them any information about sustainability. However, by looking at their responses, it was discovered that farmers do not fully understand sustainability due to their lack of knowledge about the side-effects of shrimp farming on the environment. Mol (2014), said that accurate information related to sustainability is quite difficult to obtain given that the source of information is occasionally different. This can confuse the supply chain players regarding defining what sustainable shrimp farming is. The survey revealed that each stakeholder has different perceptions related to sustainable shrimp farming. Consequently, shrimp farmers have less interest in performing sustainable shrimp farming practices because they do not understand the value of these specific practices.

To overcome the challenges related to fulfilling sustainable shrimp practices, there are many solutions that supply chain players can take.

Increasing the quantity of training, socialisation and programmes for creating sustainable shrimp farming can encourage shrimp farmers to be more aware of sustainable shrimp farming (Stakeholders 1 & 3). These activities can have an impact on shrimp farmers understanding of sustainability and good pond management (Ha, Bush et al., 2012). Conversely, the government should treat shrimp farmers as partners to achieve sustainable shrimp farms rather than easy targets to benefit from certification or regulation. In this case, shrimp farmers and the government should find a win-win solution to achieve the sustainable shrimp supply chain. For instance, by giving seed and feed subsidies to shrimp farmers, the production of sustainable shrimp can be enhanced. This can stimulate the production of shrimps according to the government regulation. As such, farmers can generate profit and the goal of the government to create a shrimp supply chain that is sustainable can be achieved.

Collaboration among all supply chain players is ultimately important to improve the quality and quantity of sustainable shrimp. It can start by developing a multi-stakeholder federation and flexibility (continuity) of shrimp production, which are arranged by global governance, besides maintaining the intensity of inspections so standards are met so that there is integration in all aspects of sustainability (Bostrom, 2015). Additionally, continuous coordination with NGOs which organises the certification, like ASC by OXFAM Novib, is also necessary because they can provide in-depth information related to sustainable fishing, encourage shrimp farmers to comply with sustainability and provide knowledge about the international market when shrimp farmers meet the certification standard.

Furthermore, Heli and Babri (2014), suggest corporate codes of ethics for the suppliers to support the sustainable supply chain. The codes should be translated easily by the suppliers. In Sweden, the CEO of a company regularly informs employees how to implement corporate codes of ethics related to the sustainable supply chain. This is supposed to be adapted to the shrimp supply chain in Indonesia. Furthermore, exporters as the bridge between farmers and consumers in Europe, should be able to give

information about the meaning of sustainability to the supply chain players. As such, the sustainable supply chain can be established comprehensively.

Lengthy supply chains can be overcome by improvements in technology, systems and networks (Jain & Benyoucef, 2008). Transportation technology employed for logistical reasons to preserve shrimp quality is vital to keep the sustainable supply chain. By doing so, the cost and energy can be more efficient. Furthermore, the technology related to payments is also necessary to maintain the relationship between farmers and suppliers, and even with buyers. To create an effective system, the schedule of each activity in the supply chain should be more integrated. For instance, the schedule for harvesting shrimp should be integrated with the schedule for trader activity. Additionally, to build the network and close relationships among participants in the supply chain, information flows related to the sustainable shrimp supply chain should be distributed optimally.

7. Problems and Limitations

- Since this research has used the case study method, the information collected cannot be used to make a generalisation regarding the issues shrimp farmers face in relation to complying with European demands. Farmer's issues related to sustainability in Indonesia cannot be generalised to those in other countries. However, it can be generalised to other provinces in Indonesia given that the environment, economy and social aspects are similar.
- Research has been conducted in one province in Indonesia, West Nusa Tenggara where white leg shrimp (Litopenaeus *Vannamei*) is farmed, since this type is the most common commodity in the province. Therefore, the data cannot represent the supply chain of shrimp in another location in Indonesia.
- No exporters are available in West Tenggara Barat, which meant that the researcher had no exporters to interview. To tackle this problem, the researcher contacted exporters from another province (Java). As the exporters come from large companies, only two were willing to be interviewed.

- The target of 70 respondents, consisting of 50 farmers, 5 experts, 5 exporters, 5 stakeholders and 5 middlemen had to be reduced to 45, consisting of 30 farmers, 5 experts, 2 exporters, 3 stakeholders and 5 middlemen because there were restrictions related to obtaining information from them, for instance, the researcher required more time to conduct the research and contact the respondents.

8. Conclusion

1. Shrimp farms in Indonesia consist of three types of ponds, such as traditional, semi-intensive and intensive. Semi-intensive farming is suitable due to the sustainable aspects; specifically, environmental, economic and social factors. This result is consistent with the statement of Kusumastanto et al., (1998), which suggested that the most appropriate type of shrimp farm for Indonesian shrimp farming is medium scale semi-intensive farming. Shrimp farmers in Indonesia face many problems when they try to comply with sustainable shrimp which is demanded by the European market, some of which are high capital, less awareness and less support from the government. If these obstacles can be removed, it is predicted that farmers in Indonesia can export sustainable shrimp to European countries.
2. To achieve the sustainable supply chain of shrimp, farmers in Indonesia need to do several activities, such as:
    a. The regulation related to sustainable shrimp production must be clear and understandable for farmers
    b. A sustainable shrimp foundation needs to be created
    c. It is recommended that farmers own certified seed and feed to set shrimp processing standards
    d. The latest technology in shrimp production is required given that this can influence the quality of shrimp. For example, the type of paddlewheel aerator can affect the quantity of oxygen in the pond
    e. Shrimp feed must be prebiotic and not contain any antibiotics and banned chemical compounds
    f. The short supply chain can preserve the quality of shrimp because fresh shrimp is more appealing to customers

g. Cooperation between supply chain players is vital to maintain the availability of high quality shrimp
h. As Indonesia is an archipelago, cold storage is beneficial for each island to create the short supply chain.

3. The obstacles to complying with sustainable shrimp are:
   a. The European market places certification as the most crucial aspect to determine the quality of products, especially shrimp. In Indonesia, shrimp certification among farmers remains rare. The reasons for this are:
      - Farmers are not interested in certification because it is expensive for them. For instance, to manage shrimp waste, farmers have to spend a great deal of money, which means that it is generally unaffordable.
      - Bureaucracy in Indonesia is extremely complicated which affects farmers awareness about certifying their shrimp. This is supported by Hanafi and Ahmad (1999), who claim that the complexity of certification in shrimp farming can happen due to the lack of knowledge regarding the certification process.
   b. Farmers on the small islands receive less support from the government, which is a huge challenge for them. For instance, the failure to provide shrimp farmers with loans, as well as the lack of feed and seed subsidies. Meanwhile, Yi et al. (2016), suggested that the government should provide loans for small farmers, so that shrimp farmers can fulfil European market demands.
4. The challenges that farmers face to comply with sustainable shrimp can be solved by the following steps:
   a. Increase farmers awareness in connection with shrimp certification by regular socialisation, training and meetings with the government.
   b. Cooperation with specialists, such as companies with an excellent reputation in handling shrimp is a must, to improve the quantity and quality of shrimp. Furthermore, cooperation with the government and suppliers can be more advantageous (Monczka et al., 2015).

9. Recommendations

The following recommendation are proposed:

a. The government is required to offer small shrimp farmers full support, by means of low interest loans, feed and seed subsidies and suitable facilities.
b. Cooperation between supply chain shrimp payers is crucial to bolster sustainable shrimp farms, seeing as the sustainability issues are not a simple case that can be solved by an independent group or organisation. There should be partnerships among all the shrimp supply chain players.
c. Design an efficient sustainable supply chain by optimising technology, systems and networks throughout the supply chain.
d. Further research related to the sustainable supply chain which involves importers or buyers from the European market is required, given that this research lacks information from those supply chain participants.

References

Ahmed, N., Cheung, W. W., Thompson, S., & Glaser, M. (2017). Solutions to blue carbon emissions: Shrimp cultivation, mangrove deforestation and climate change in coastal Bangladesh. *Marine Policy*, *82*, 68-75.

Alam, S. N., & Pokrant, B. (2009). Re-organizing the shrimp supply chain: aftermath of the 1997 European union import ban on the Bangladesh shrimp. Aquaculture Economics & Management, 13(1), 53-69.

American Chamber of Commerce of Europe, 2004. European Union Environmental Guide 2004. American Chamber of Commerce of Europe, Brussels, Belgium.

Barbier, E. B., & Cox, M. (2002). Economic and demographic factors affecting mangrove loss in the coastal provinces of Thailand, 1979–1996. Ambio, 31, 351–357.

Bostick, K. (2008). NGO approaches to minimizing the impacts of aquaculture: A review. In M. Holmer, K. Black, C. M. Duarte, N. Marba`, & I. Karakassis (Eds.), Aquaculture in the ecosystem (pp. 227–250). Berlin: Springer.

Boström, M., Jönsson, A. M., Lockie, S., Mol, A. P., & Oosterveer, P. (2015). Sustainable and responsible supply chain governance: challenges and opportunities. Journal of Cleaner Production, 107, 1-7.

BPS-Statistics Indonesia. (2016). Statistics of Marine and Coastal Resources. BPS, Jakarta.

Cao, L., Diana, J. S., Keoleian, G. A., & Lai, Q. (2011). Life cycle assessment of Chinese shrimp farming systems targeted for export and domestic sales. *Environmental science & technology*, *45*(15), 6531-6538.

Cao, L. (2012). *Farming shrimp for the future: a sustainability analysis of shrimp farming in China* (Doctoral dissertation, University of Michigan).

CBI (2015). CBI Product Fact Sheet: Frozen cultured Vannamei shrimp in Europe. Retrieved from https://www.cbi.eu/market-information/fish-seafood/trade-statistics/

Chim, L., Brun, H. L., & Le Moullac, G. (2009). MARINE SHRIMP FARMING. Fisheries and Aquaculture-Volume IV, 28.

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: more than a new name for logistics. *The international journal of logistics management*, *8*(1), 1-14.

Cruz-Suárez, L. E., León, A., Peña-Rodríguez, A., Rodríguez-Peña, G., Moll, B., & Ricque-Marie, D. (2010). Shrimp/Ulva co-culture: a sustainable alternative to diminish the need for artificial feed and improve shrimp quality. Aquaculture, 301(1), 64-68.

DEFRA 2002 The strategy for sustainable farming and food: facing the future, 51 pp. London, UK: DEFRA Publications

DeWalt, B. R., Ramírez Zavala, J. R., Noriega, L., & González, R. E. (2002). Shrimp aquaculture, the people and the environment in coastal Mexico. Report prepared under World Bank, NACA, WWF y FAO Consortium program on shrimp farming and the environment. Work in Progress for Public Discussion, 73.

Diana, J. S. (2009). Aquaculture production and biodiversity conservation. *Bioscience*, *59*(1), 27-38.

Douma, M., & van Wijk, J. (2012). *ASC certified shrimp: Can extensive shrimp farming benefit? A case study of Indonesia* (No. 2012/46).

Ekmaharaj, S. (2006). Aquaculture of marine shrimp in Southeast Asia and China: major constrains for export. Secretariat, Southeast Asian Fisheries Development Center.

EUMOFA (2016) The EU Fish Market 2016 Edition. Retrieved from www.eumofa.eu

European commission (2018). Shrimps. https://trade.ec.europa.eu/tradehelp/shrimps. Retrieved on 23rd of March 2018

Evans, J. D. (1996). Straightforward statistics for the behavior sciences. Pacific Grove: Brooks/Cole Publishing.

FAO. (2004). Aquaculture production, capture production, commodities. Yearbooks of fishery statistics summary tables. Rome: FAO.

FAO, 2006. Cultured Aquatic Species Information Programme. Penaeus vannamei. Cultured Aquatic Species Information Programme. Text by Briggs, M. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 7 April 2006. [Cited 18 October 2017]. http://www.fao.org/fishery/culturedspecies/Penaeus_vannamei/en

FOA (2016). Global farmed shrimp production in 2016 remains stagnant or lessens. Retrieved from http://www.fao.org/in-action/globefish/market-reports/resource-detail/en/c/880760/

Farkan, M., Djokosetiyanto D., Sjarief Widjaja R., Kholil & Widiatmaka. (2016). Carrying capacity analysis of area of sustainable shrimp cultivation based on land suitability and water availability in coastal bay of Banten Indonesia. International Journal For Research In Biology & Pharmacy. ISSN: 2208-2093. Vol 2, Issue-3

Farkan, M., Setiyanto, D. D., & Widjaja, R. S. (2017, January). Assessment area development of sustainable shrimp culture ponds (case ctudy the gulf coast Banten). In *IOP Conference Series: Earth and Environmental Science* (Vol. 54, No. 1, p. 012077). IOP Publishing.

Fayet, L., & Vermeulen, W. J. (2014). Supporting smallholders to access sustainable supply chains: lessons from the Indian cotton supply chain. *Sustainable Development*, *22*(5), 289-310.

Fink, A. (1998). Conducting research literature review: from paper to internet. Thousand Oaks: SagePublications.

Gillett, R. (2008). Global study of shrimp fisheries (Vol. 475). Rome: Food and Agriculture Organization of the United Nations.

Globefish, F. A. O. (2017). Monthly Trade Statistics.

Ha, T. T. T., Bush, S. R., Mol, A. P., & van Dijk, H. (2012). Organic coasts? Regulatory challenges of certifying integrated shrimp–mangrove production systems in Vietnam. Journal of Rural Studies, 28(4), 631-639.

Hanafi, A., & Ahmad, T. (1999). Shrimp Culture in Indonesia: Key Sustainability and Research Issues. In *ACIAR PROCEEDINGS* (pp. 69-74). ACIAR; 1998.

Harland, C. M., Lamming, R. C., Walker, H., Phillips, W. E., Caldwell, N. D., Johnsen, T. E., ... & Zheng, J. (2006). Supply management: is it a discipline?. International Journal of Operations & Production Management, 26(7), 730-753.

Helin, S., & Babri, M. (2015). Travelling with a code of ethics: a contextual study of a Swedish MNC auditing a Chinese supplier. Journal of Cleaner Production, 107, 41-53.

Jain, V., & Benyoucef, L. (2008). Managing long supply chain networks: some emerging issues and challenges. Journal of Manufacturing Technology Management, 19(4), 469-496.

Joffre, O. M., Bosma, R. H., Bregt, A. K., van Zwieten, P. A., Bush, S. R., & Verreth, J. A. (2015). What drives the adoption of integrated shrimp mangrove aquaculture in Vietnam?. *Ocean & Coastal Management*, *114*, 53-63.

Kievitsbosch, J. (2015). Building the Sustainable Supply Chain: Trust, Transparency, and Contracts as Building Blocks-A theoretical, and empirical analysis of SMEs in the Norwegian industry (Master's thesis, NTNU).

Knowler, D., Philcox, N., Nathan, S., Delamare, W., Haider, W., & Gupta, K. (2009). Assessing prospects for shrimp culture in the Indian Sundarbans: a combined simulation modelling and choice experiment approach. *Marine Policy*, *33*(4), 613-623.

Kuhlman, T., & Farrington, J. (2010). What is sustainability?. Sustainability, 2(11), 3436-3448.

Kusumastanto, T., Jolly, C. M., & Bailey, C. (1998). A multiperiod programming evaluation of brackishwater shrimp aquaculture development in Indonesia 1989/1990–1998/1999. *Aquaculture*, *159*(3), 317-331.

Kusumawati, R., & Bush, S. R. (2015). Co-producing Better Management Practice standards for shrimp aquaculture in Indonesia. *Maritime Studies*, *14*(1), 21.

Lai, X., & Ye, B. (2017). The intelligent control strategy of frozen cooked shrimp production process and energy step utilisation. *Energy Procedia*, *123*, 10-14.

Lebel, L., Nguyen, H. T., Amnuay, S., Suparb, P., Urasa, B., & Le, K. T. (2002). Industrial transformation and shrimp aquaculture in Thailand and Vietnam: Pathways to ecological, social, and economic sustainability? Ambio, 31, 311–323.

Lord, M. J. (2010). Indonesia's trade access to the European Union: Opportunities and challenges.

Mol, A.P.J., 2014. The role of transparency in governing China's food quality: a review. Food Control 43, 49e56.

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2015). *Purchasing and supply chain management*. Cengage Learning.

NACA, Network of Aquaculture Centres in Asia-Pacific (2017). Government plicy and enabling environment for aquaculture feed production in Thailand. https://enaca.org/?id=910&title=government-policy-and-enabling-environment-for-aquaculture-feed-production-in-thailand Retrieved on 26th of March 2018.

Naylor, R. L., Goldburg, R. J., Primavera, J. H., Kautsky, N., Beveridge, M. C., Clay, J., ... & Troell, M. (2000). Effect of aquaculture on world fish supplies. Nature, 405(6790), 1017-1024.

Nissapa, A., & Boromthanarat, S. (2002). A case study on institutional aspects of shrimp aquaculture in Thailand. *Report prepared under the World Bank, NACA, WWF and FAO Consortium Program on Shrimp Farming and the Environment. Work in Progress for Public Discussion. Published by the Consortium*.

Novari, C. (2013) Aquaculture Certification in Indonesia [pdf slides]. Workshop on Aquaculture Certification. Retrieved from www.daotao.vasep.com.vn

Ongsritrakul, S., & Hubbard, L. (1996). The export market for Thai frozen shrimps in the European Union. British Food Journal, 98(8), 24-28.

Oosterveer, P. (2006). Globalization and sustainable consumption of shrimp: consumers and governance in the global space of flows. *International Journal of Consumer Studies*, *30*(5), 465-476.

Phillips, M. J., Rohana, P. S. (2006). FAO, NACA, UNEP/GPA, WB, and WWF Consortium on Shrimp Farming and the Environment receives the Green Award for its International Principles for Responsible Shrimp Farming. FAO Aquaculture Newsletter No. 36, 46-47

Paul, B. G., & Vogl, C. R. (2011). Impacts of shrimp farming in Bangladesh: challenges and alternatives. *Ocean & Coastal Management*, *54*(3), 201-211.

Paul, B. G., & Vogl, C. R. (2013). Organic shrimp aquaculture for sustainable household livelihoods in Bangladesh. *Ocean & coastal management*, *71*, 1-12.

Smith, B. G. (2008). Developing sustainable food supply chains. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *363*(1492), 849-861.

Sverdrup, H., Koca, D., & Ragnarsdottir, K. V. (2017). Defining a free market: drivers of unsustainability as illustrated with an example of shrimp farming in the mangrove forest in South East Asia. *Journal of Cleaner Production*, *140*, 299-311.

Tookwinas, S., Boonyarapalin, M., Choongam, C. & Poongern, J. (1999). On farm quality assurance for shrimp production in Thailand, in papers Presented at the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture. Bangkok, Thailand 8-11 December 1997, FAO Fisheries Report No. 572 (Rome: Food and Agricultural Organization of the United Nations {FAO}), Suppl. Pp. 111-122.

Truong, H., Lyne, M., & Woodford, K. (2014). Managing water pollution to revitalise the shrimp supply chain in tam giang cau hai lagoon, vietnam. *UMK Procedia*, *1*, 50-56.

United Nations. Department of Economic. (2007). *Indicators of sustainable development: Guidelines and methodologies*. United Nations Publications.

Van Duijn, A. P., Beukers, R., & Van der Pijl, W. (2012). The Indonesian seafood sector; a value chain analysis. CBI & LEI, part of Wageningen UR.

van Oorschot, M., Kok, M., van der Esch, S., Janse, J., Rood, T., Vixseboxse, E., ... & Vermeulen, W. (2014). Sustainability of international Dutch supply chains-Progress, effects and perspectives. PBL, (1289).

Van Schaik, M. (2010). Global-local linkages in shrimp aquaculture certification–The approaches of NGO networks and the challenges in Indonesia.

Vural, C. A. (2015). Sustainable Demand Chain Management: An Alternative Perspective for Sustainability in the Supply Chain. *Procedia-Social and Behavioral Sciences*, *207*, 262-273.

Wati, L. A., Chang, W. I., & Mustadjab, M. M. (2013). Competitiveness of Indonesian shrimp compare with Thailand shrimp in export market. *WACANA, Jurnal Sosial dan Humaniora*, *16*(1), 24-31.

WRM (2002). Mangroves. Local livelihoods vs. corporate profits. In H. Fonseca (Ed.), World rainforest movement. Uruguay:Montevideo.

Yi, D., Reardon, T., & Stringer, R. (2016). Shrimp aquaculture technology change in Indonesia: Are small farmers included?. *Aquaculture*.

Appendices 1: List of Questions for shrimp farmers interview

QUESTIONNAIRE

The aim of this activity is to help shrimp farmer embrace sustainability

PERSONAL IDENTITY

1. **Name** _____
2. **Age** _____
3. **Sex** _____
   Jenis Kelamin
4. **Tribe** _____
5. **Address** _____
6. **Education level** _____
7. **Number of family dependents** _____

ECONOMIC ASPECTS

1	What is your family's income after shrimp farming for the last three years? a. steady b. increase c. other (fluctuate/decrease)
2	How much is your income per harvest? a. 0-20 million IDR b. 20-100 million IDR c. more than 100 million IDR
3	Who buys your shrimp? a. End consumer b. Trader (Middlemen or Exporter) c. Combination of buyers
4	What sort of difficulties do you have with regards to selling your shrimp? a. Lack of market information b. No difficulties c. other difficulties, please mention:
5	Have you ever experienced loss? If yes, how much? a. 0-20 million IDR b. 20-100 million IDR c. more than 100 million IDR
6	How much capital did you need to build your shrimp farm? a. less than 100 million IDR b. 100-500 million IDR c. more than 500 million IDR
7	What is the source of your capital? a. self-capital

	b. bank loans c. other sources, please mention:
8	What type of energy is used on your shrimp farm? a. renewable energy b. non-renewable energy c. other energy, please mention:
9	How do you manage your waste? a. discard b. recycle c. others, please mention:
10	How much do you spend on managing your shrimp waste per month? a. 0-3 million IDR b. 3-6 million IDR c. more than 6 million IDR

ENVIRONMENTAL ASPECTS

1	Total shrimp pond(s) area? a. 1-400 acres b. 400-800 acres c. more than 800 acres
2	Where do you buy seed? a. local hatchery b. national hatchery c. international hatchery
3	What do you use to feed your shrimp? a. commercial feed b. fish meal c. organic feed
4	How do you treat shrimp diseases and manage your pond? a. using antibiotics b. water change routines c. combination of safe treatment
5	How were the results of your treatment? a. success b. fluctuate c. fail
6	What do you think about diseases in shrimp culture over the last 5 years? a. increase b. decrease c. average
7	Does it lack fresh water during the dry season? a. yes, it cannot be managed b. yes, it can be managed c. no
8	What do you think about the quality of water over the last 5 years? a. increase b. decrease c. average

9	How many mangroves have you planted? a. never b. less than 10 c. more than 10
10	Do you understand the side effects of shrimp farming on the environment? a. yes, but not much b. yes, quite a lot c. no

SOCIAL ASPECTS

1	How many labourers do you employ? a. 1-5 b. 6-20 c. more than 20
2	How old are they? a. under 17 b. 17 to 50 c. Other
3	How much do you pay them? a. under 2 million IDR b. 2-4 million IDR c. Other
4	How do you choose your workers? a. based on the relationship b. based on the experience c. Other
5	What types of incentives do you give your worker? a. bonus b. goods c. Other, please mention:
6	How many hours do your labourers work each day? a. under 8 hours b. 8 hours c. Other
7	Are you satisfied with their work? a. fully satisfied b. satisfied c. disappointed
8	What have you done for your community after benefitting from shrimp cultivation? a. education b. charity c. health service
9	What sort of conflict arises during shrimp production? a. social conflict b. economic conflict c. other, please mention:
10	Do you treat male and female labourers the same way? a. yes

	b. no c. other

PRODUCTION STEP

1	Please describe the step of cultivating the shrimp completely.
2	What is your biggest challenges to produce shrimp?
3	What do you expect from government according to your shrimp production?

Appendices 2: **List of Questions for an expert interview**

1	What are current production practices of shrimp in Indonesia?
2	What are current production practices of shrimp in Indonesia?
3	Is there positive impact of current production practices of shrimp in Indonesia?
4	Is there negative impact of current production practices of shrimp in Indonesia?
5	Is there positive impact of current distribution practices of shrimp in Indonesia?
6	Is there negative impact of current distribution practices of shrimp in Indonesia?
7	What can be done to increase the quality of shrimp?
8	What can be done to encourage shrimp farmers to embrace sustainable shrimp production practices?
9	What changes in supply chain practices are needed to comply with the sustainable shrimp as a demand of European market?
10	Which type of shrimp farm is more suitable for farmers in Indonesia? Why?
11	Can you explain what farmers should do to start sustainable shrimp production?
12	What do you think about the shrimp certification in Indonesia?
13	What kind of suitable certification for farmers?
14	Is there any obstacle to have shrimp certification for farmers?
15	In your opinion, is it possible for small farmers to comply with the sustainable production practices?
16	Do you have any suggestion to improve sustainable production practices to meet EU market?
17	Do you have any suggestion to improve sustainable distribution practices to meet EU market?
18	In your opinion, what should expertise do to help farmers increase their shrimp production and quality?
19	Do you think farmers in Indonesia can broaden their market after complying with the sustainable aspects?
20	For hatchery, which one is the best based on sustainable aspect, importing the breeds or getting them from the local hatchery?

Appendices 3: **List of Questions** for an exporter interview

1	What are the current trend of exported shrimp?
2	Do you have some obstacles when export the shrimp?

3	Which countries do you target for exporting the shrimp?
4	Have you ever exported shrimp to EU?
5	Do you find any obstacles to export shrimp to EU?
6	How do you maintain the quality shrimp from farmers?
7	How do you manage the stability supply for market demand?
8	Do you find being exporter is beneficial for you?
9	Do you need support from government?
10	Do you some suggestion for farmers to increase the quality of their shrimp?
11	How do you choose your client?
12	How do you build your relationship with shrimp farmers?
13	Do you think being exporter is profitable for you?
14	How do you deliver the shrimp to destination country?
15	What do you think of sustainability?
16	What are the hardest requirements of shrimp from imported country?
17	How do you solve those problem?
18	When you export the shrimp, how many farmers are involved as your client?
19	Do you think the export regulation in Indonesia is good enough for now?
20	If not, what do you expect from government to support the exporter?

Appendices 4: **List of Questions for stakeholders' interview**

1	What government can do to help shrimp farmers widen their aquaculture?
2	Does government have program to improve supply chain of shrimp?
3	Is there special training for farmers to increase their skills?
4	If yes, what kind of training and how often?
5	What kind of loan ado government offer to help farmer?
6	How much the interest of each loan?
7	Is there any subsidy for shrimp farmers?
8	Is there regulation related to sustainability?
9	In your perspective, what is sustainability?
10	Do current shrimp production practices include in sustainable practices?
11	What kind of improvement do you expect from shrimp farmers?
12	What do you think the biggest challenges for comply with the sustainable shrimp production practices?
13	What do you think of sustainability?
14	Is there any socialization from government related to sustainability?
15	What is the main requirement for farmers to export their shrimp?
16	Do you think sustainable supply chain is profitable for farmers?
17	Do you think sustainable supply chain is profitable for government?
18	Is there any improvement of shrimp production from past to present?
19	If farmers get any obstacle to comply with imported shrimp requirements, what government can do next?
20	What government can do to help shrimp farmers widen their market?

Appendices 5: **List of Questions for traders or middlemen interview**

1	How you select the farmer to be your client?
2	How is the basic price of shrimp that you get from the farmers?
3	How much the profit do you get per kg shrimp?

4	How you build your relationship with the farmers?
5	How do you transport the shrimp from farm to your storage place?
6	Where do you store the shrimp from farmers?
7	What kind of storage do you have?
8	What is the capacity of your storage?
9	Are you trading the shrimp locally or nationally or internationally?
10	How do you determine the price of shrimp?
11	Who are the actors in supply chain cooperated with you, beside the farmers?
12	What are the challenges becoming middlemen?
13	How do you overcome the problems?
14	Who is your target market?
15	How do you broaden your market?
16	How do you manage your inventory?
17	How do you find and select target market?
18	What do you expect form shrimp farmers in the future?
19	How many tons of shrimp do you buy from farmers for one harvest?
20	What are the materials do you need for shrimp preservation?

Appendices 6: **Frequencies**

Statistics

		ID	income	Other income	Income per harvest	buyers	difficulties
N	Valid	30	30	30	30	30	30
	Missing	0	0	0	0	0	0

Statistics

		Other difficulties	loss	capital	Capital source	Other sources
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0

Statistics

		Type of energy	Other energy	Waste management	Other waste management	Waste spending
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0

Statistics

		Pond area	seed	feed	Shrimp diseases	Treatment result
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0

Statistics

		Disease development	Water supply	Water quality	mangroves	Knowledge of side effect
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0

Statistics

		labors	Other quantity of labor	Age of labor	Other age	salary	Other salary
N	Valid	30	30	30	30	30	30
	Missing	0	0	0	0	0	0

Statistics						
		Labourer selection	Other requirements	incentives	Other incentives	Work hours
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0

Statistics						
		Other work hours	satisfaction	Other satisfaction	CSR	conflict
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0

Statistics				
		Other conflict	Male female equality	Other equality
N	Valid	30	30	30
	Missing	0	0	0

Appendices 7: Frequency Table

ID					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	intensive	10	33.3	33.3	33.3
	semi intensive	10	33.3	33.3	66.7
	tradisional	10	33.3	33.3	100.0
	Total	30	100.0	100.0	

income					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	steady	4	13.3	13.3	13.3
	increase	19	63.3	63.3	76.7
	other	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Other income					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		24	80.0	80.0	80.0
	decrease	3	10.0	10.0	90.0
	fluctuative	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

Income per harvest					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20 million (IDR)	12	40.0	40.0	40.0
	20-100 million (IDR)	6	20.0	20.0	60.0
	more than 100 million (IDR)	12	40.0	40.0	100.0
	Total	30	100.0	100.0	

buyers					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	direct consumer	2	6.7	6.7	6.7
	trader (middlemen or exporter)	1	3.3	3.3	10.0
	combination of buyers	27	90.0	90.0	100.0
	Total	30	100.0	100.0	

difficulties					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no difficulties	24	80.0	80.0	80.0
	other difficulties	6	20.0	20.0	100.0
	Total	30	100.0	100.0	

Other difficulties					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		24	80.0	80.0	80.0
	large quantity requirement	1	3.3	3.3	83.3
	less quality of product	1	3.3	3.3	86.7
	limited quantity	1	3.3	3.3	90.0
	price	2	6.7	6.7	96.7
	size	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

Loss					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-20 million (IDR)	17	56.7	56.7	56.7
	20-100 million (IDR)	5	16.7	16.7	73.3
	more than 100 million (IDR)	8	26.7	26.7	100.0
	Total	30	100.0	100.0	

Capital					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 100 million (IDR)	15	50.0	50.0	50.0
	100-500 million (IDR)	4	13.3	13.3	63.3
	more than 500 million (IDR)	11	36.7	36.7	100.0
	Total	30	100.0	100.0	

Capital source					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	self-capital	19	63.3	63.3	63.3
	bank loans	8	26.7	26.7	90.0
	other	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

Another source					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		27	90.0	90.0	90.0
	combination of loans	1	3.3	3.3	93.3
	multiple source	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

Type of energy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	non-renewable energy	30	100.0	100.0	100.0

Other energy					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		30	100.0	100.0	100.0

Waste management					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	throwing them away	15	50.0	50.0	50.0
	recycling	5	16.7	16.7	66.7
	other	10	33.3	33.3	100.0
	Total	30	100.0	100.0	

Other waste management					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		20	66.7	66.7	66.7
	fermentation	1	3.3	3.3	70.0
	sedimentation	7	23.3	23.3	93.3
	septic tank	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

Waste spending					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-3 million (IDR)	30	100.0	100.0	100.0

Pond area					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-400 acre	21	70.0	70.0	70.0
	400-800 acre	6	20.0	20.0	90.0
	more than 800 acre	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

seed					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	local hatchery	1	3.3	3.3	3.3
	national hatchery	29	96.7	96.7	100.0
	Total	30	100.0	100.0	

feed					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	commercial feed	30	100.0	100.0	100.0

Shrimp diseases					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	using antibiotics	6	20.0	20.0	20.0
	water change routines	2	6.7	6.7	26.7
	combination of safe treatment	22	73.3	73.3	100.0
	Total	30	100.0	100.0	

Treatment result					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	success	16	53.3	53.3	53.3
	sometimes fail and sometimes success	12	40.0	40.0	93.3
	fail	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

Disease development					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	increase	10	33.3	33.3	33.3
	decrease	1	3.3	3.3	36.7
	average	19	63.3	63.3	100.0
	Total	30	100.0	100.0	

Water supply					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes, it cannot be handled	2	6.7	6.7	6.7
	yes, it can be handled	9	30.0	30.0	36.7
	no	19	63.3	63.3	100.0
	Total	30	100.0	100.0	

Water quality					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	increase	9	30.0	30.0	30.0
	decrease	7	23.3	23.3	53.3
	average	14	46.7	46.7	100.0
	Total	30	100.0	100.0	

mangroves					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never	21	70.0	70.0	70.0
	more than 10	9	30.0	30.0	100.0
	Total	30	100.0	100.0	

Knowledge of side effect					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes, but not much	5	16.7	16.7	16.7
	yes, quite much	8	26.7	26.7	43.3
	no	17	56.7	56.7	100.0
	Total	30	100.0	100.0	

labors					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5	13	43.3	43.3	43.3
	5-20	7	23.3	23.3	66.7
	other	10	33.3	33.3	100.0
	Total	30	100.0	100.0	

Other quantity of labor					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		20	66.7	66.7	66.7
	around 100	1	3.3	3.3	70.0
	around 25	1	3.3	3.3	73.3
	around 54	1	3.3	3.3	76.7
	no labor	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Age of labor					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	under 17	1	3.3	3.3	3.3
	17-50	22	73.3	73.3	76.7
	other	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Other age					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		23	76.7	76.7	76.7
	no labor	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

salary					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	under 2 million (IDR)	18	60.0	60.0	60.0
	2-4 million (IDR)	5	16.7	16.7	76.7
	other	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Other salary					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		23	76.7	76.7	76.7
	no labor	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Labor selection					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	based on the relationship	10	33.3	33.3	33.3
	based on the experience	12	40.0	40.0	73.3
	other	8	26.7	26.7	100.0
	Total	30	100.0	100.0	

Other requirement					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		23	76.7	76.7	76.7
	no labor	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

incentives					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	bonus	19	63.3	63.3	63.3
	goods	2	6.7	6.7	70.0
	other	9	30.0	30.0	100.0
	Total	30	100.0	100.0	

Other incentives					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		21	70.0	70.0	70.0
	no incentives	1	3.3	3.3	73.3
	no labor	7	23.3	23.3	96.7
	nothing	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

Work hours					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	under 8 hours	20	66.7	66.7	66.7
	8 hours	3	10.0	10.0	76.7
	other	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

Other work hours					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		23	76.7	76.7	76.7
	no labor	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

satisfaction					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	satisfied	22	73.3	73.3	73.3
	other	8	26.7	26.7	100.0
	Total	30	100.0	100.0	

Other satisfaction					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		22	73.3	73.3	73.3
	less satisfied	1	3.3	3.3	76.7
	no labor	7	23.3	23.3	100.0
	Total	30	100.0	100.0	

CSR					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	charity	30	100.0	100.0	100.0

conflict					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	social conflict	4	13.3	13.3	13.3
	economic conflict	1	3.3	3.3	16.7
	other	25	83.3	83.3	100.0
	Total	30	100.0	100.0	

Other conflict					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	16.7	16.7	16.7
	no conflict	25	83.3	83.3	100.0
	Total	30	100.0	100.0	

Male female equality					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	17	56.7	56.7	56.7
	other	13	43.3	43.3	100.0
	Total	30	100.0	100.0	

Other equality					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		17	56.7	56.7	56.7
	no female labor	5	16.7	16.7	73.3
	no labor	7	23.3	23.3	96.7
	not sure	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

Appendices 8: The biggest challenges to cultivate shrimp

Farmer	Type of farm	Biggest Challenges
1	Traditional	Disease and oxygen capacity
2	Traditional	Shrimp seed and technical problem
3	Traditional	Water supply and shrimp feed
4	Traditional	Capital and weather condition
5	Traditional	Capital
6	Traditional	Shrimp feed and weather condition
7	Traditional	Water supply
8	Traditional	-
9	Traditional	Capital and diseases
10	Traditional	Capital
11	Semi intensive	Capital and diseases
12	Semi intensive	Capital and diseases
13	Semi intensive	Being discipline
14	Semi intensive	Water supply
15	Semi intensive	Capital
16	Semi intensive	Capital and diseases
17	Semi intensive	Capital and the technical skill
18	Semi intensive	-

19	Semi intensive	Diseases and weather condition
20	Semi intensive	Diseases
21	Intensive	Diseases and weather condition
22	Intensive	Diseases
23	Intensive	Electricity problem
24	Intensive	Seed and the regulation
25	Intensive	Diseases
26	Intensive	Labor management
27	Intensive	Diseases
28	Intensive	Diseases and electricity problem
29	Intensive	Capital and technical skill
30	Intensive	Shrimp and labor management

Appendices 9: The expectation from government

Farmer	Type of farm	The Expectation
1	Traditional	Facilities (water pump) and Infrastructure
2	Traditional	Seed subsidy and training for shrimp cultivation
3	Traditional	Feed subsidy, and facilities (wheel aerator and genset diesel)
4	Traditional	Low loan interest and facilities
5	Traditional	Facilities
6	Traditional	Full support
7	Traditional	Full support
8	Traditional	-
9	Traditional	Low loan interest and facilities
10	Traditional	Facilities (wheel aerator) and training for shrimp cultivation
11	Semi intensive	Low loan interest and facilities
12	Semi intensive	Full support
13	Semi intensive	Support (low loan interest and facilities)
14	Semi intensive	Low loan interest, feed and seed subsidy
15	Semi intensive	Facilities
16	Semi intensive	Feed subsidy
17	Semi intensive	Support and training for shrimp cultivation
18	Semi intensive	-
19	Semi intensive	Facilities
20	Semi intensive	-
21	Intensive	-
22	Intensive	-
23	Intensive	-
24	Intensive	Support by providing a clear regulation
25	Intensive	-
26	Intensive	-
27	Intensive	-
28	Intensive	Support by providing a clear regulation
29	Intensive	Cooperation
30	Intensive	Focus on their role

Appendices 10: Interview with the Experts

Questions	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
1 What are current production practices of shrimp in Indonesia?	Farmers utilize probiotic as a pond treatment. Most farmers have semi intensive and intensive shrimp ponds	It is influenced by disease and environment	It is dominated by three type of shrimp farming, and it depends on the type of shrimp feed, whether natural feed or not	Production practices in suburb area is still less contaminated than in big city	Most of shrimp production are contaminated by various diseases
2 What are current distribution practices of shrimp in Indonesia	Shrimps are distributed to another island, especially Java and they have a contract for it.	It depends on a demand from abroad, especially America, Europe and Asia	Shrimps are distributed to another island, especially Java and Bali	There is a selection for export shrimp based on shrimp size and quality before it is distributed to other country	Without any obstacle to distribute shrimp from farmers o distributor
3 Is there positive impact of current production practices of shrimp in Indonesia?	The use of probiotic can create feed efficiency	Environment: - Reduce the number of illegal fishing in the sea - For intensive farming, there is waste recycling which make the sea not pollute Social - Land efficiency Economic - The income of shrimp farmer is increase	Land efficiency	-Increase job opportunity for local people -Trigger new shrimp farmer as the knowledge is given to local people	-Increase job opportunity for local people
4 Is there negative impact of current production practices	However, the price of feed is much higher	Environment: - If there is no waste management, there	Environment: Waste is increased on the land. The more	Most of shrimp farm are lack of pond deposition of waste	-without prebiotic treatment, environment around

of shrimp in Indonesia?		will be pollutant in the sea which influence chemical component of sea, such as the increasing of nitrite	intensive shrimp farming is, the more side effect it can give to environment		shrimp ponds can be contaminated
5 Is there positive impact of current distribution practices of shrimp in Indonesia?	Market certainty and technical assistance from the company	It can increase the income of entrepreneur and shrimp farmers	High technology in shrimp preservation while it is distributed can preserve the quality of shrimp well	Shrimp can be an export product	-export orientation
6 Negative impact of current distribution practices of shrimp in Indonesia	High quality shrimp is marketed centrally which triggers price monopoly	Monopoly pricing between supplier and buyer	Distribution activity is little bit costly since Indonesia is archipelago country, distribution from one island which doesn't have shrimp preservation to other island which has high technology of shrimp preservation. Besides, the transportation route is still limited	The price of Indonesian shrimp export depends on the price of India and Thailand shrimp, high competition	-high amount of investment
7 What can be done to increase the quality of shrimp?	Implementation of good shrimp farming practices, high quality of shrimp feed and ponds management	Supporting facilities, pond location must be far away from industry area and make a selection of high quality seed and feed.	1. Seed selection 2. Maintain water quality 3. Feed management	Seed selection, probiotic, standard shrimp production, like seed certified	-no antibiotics -prebiotics treatment
8 What can be done to encourage shrimp	Provide them a sufficient and	Give them information related to good	Introduce the sustainable shrimp	Technician need to give the best service	-Give a guidance to follow the instruction

farmers to embrace sustainable shrimp production practices?	understandable information related to shrimp farming	management practices in shrimp cultivation, environmental impact assessment and social consideration to keep sustainability.	production to farmers, feed management	to farmers and support farmer to generate high profit, which later this can trigger farmer to achieve sustainable production	to achieve sustainable shrimp production -support human resources capability
9 What changes in supply chain practices are needed to comply with the sustainable shrimp as a demand of European market?	Less complicated regulation and establishment of sustainable shrimp foundation	Certification of seed and feed, Holding processing standard	Increase the technology in shrimp production practices	Shrimp must be fed without antibiotics and another dangerous chemical (pesticide)	-Short supply chain -provide a cold storage for each island -marketing -integration between the supply chain player -post harvest handling
10 Which type of shrimp farm is more suitable for farmers in Indonesia? Why?	Semi intensive to keep the environment	Farm which has standard operational procedure and it depends on the economic condition of farmers. Traditional is better for sustainable shrimp farming	Semi intensive farm to keep the environment	Intensive to obtain high value	Semi intensive to obtain sustainable aspects
11 Can you explain what farmers should do to start sustainable shrimp production?	Employing local workers, profitable, and environmentally friendly	Management ponds should be a priority	There should be a recovery for shrimp farm/ farm normalization,	Consider the quality of water and the availability of water for the future and land capability	-capital -well prepared of human resources, land, weather prediction,

12 What do you think about the shrimp certification in Indonesia?	Certification is only occupied by big company, not small farmers.	Indonesia has certification based on the request of abroad	Certification is held by farmers only because the customers in abroad require it	Certification needs high capital and the certification is something new in Indonesia	Seed certification is more dominant in Indonesia
13 What kind of suitable certification for farmers?	Seed certification	Environment certification	HACCP	CBIB because ISO is harder to be achieved	Seed certification
14 Is there any obstacle to have shrimp certification for farmers?	Farmers do not concern on certification because they think certification is costly	Incomplete data of government and less farmer awareness of certifying the shrimp	High capital	High capital	High capital and complicated bureaucracy
15 In your opinion, is it possible for small farmers to comply with the sustainable production practices?	It is possible, but they will require more capital to fulfill the standard of sustainable shrimp production	It is still impossible	It is possible as long as the type of farm is traditional to generate organic shrimp	It is possible, as long as there is integration among the supply chain player, start from government, supplier, farmers and others.	Yes, it is possible
16 Do you have any suggestion to improve sustainable production practices to meet EU market?	Farmers should meet the quantity and food safety requirements by giving them sufficient information regarding EU market	Decrease dense stocking of shrimp from 500 m2 to 100m2 for intensive farm	Farmers need to concern about environmental, economic and social aspects	The facilities need to be increased, certification, water quality is good by sterilization, and waste management	Shrimp cultivation system in Indonesia need a full support from government, the quality should be increased, surveillance of shrimp farming activity
17 Do you have any suggestion to improve sustainable	Farmers need to fulfill standard operational practice, like cold	Infrastructure safety	Infrastructure, transportation	Infrastructure	Facilities

distribution practices to meet EU market?	storage, long term contract.				
18 In your opinion, what should expertise do to help farmers increase their shrimp production and quality?	Increase the quantity of research, publication and forum meeting with the farmers	Decrease dense stocking of shrimp to decrease the potential of disease spreading	There is a program to do community service, like training and research yet it has not been optimal due to lack of land, it is only theory.	Giving a suggestion to use feed and seed certified	-Giving an advice to create community with a purpose to make integration between shrimp farmers
19 Do you think farmers in Indonesia can broaden their market after complying with the sustainable aspects?	Yes, indeed. Collaboration between all players is a must	Yes, indeed. Specially to market the shrimp to Europe	Yes, sure. It can happen by maintaining the quality of shrimp, social responsibility and environmental consideration	Yes, indeed. Because Indonesia has high potential to export the shrimp	Yes, sure
20 For hatchery, which one is the best based on sustainable aspect, importing the breeds or getting them from the local hatchery?	Getting the seed from local hatchery. It can support local potential.	Both of them are good, it is valued based on the shrimp production and the standard that company use.	Local hatchery is better, because: 1. it can recruit local people which have a potential, 2. potential contamination is less 3. it is much cheaper	Imported hatchery because it has high quality based on company's recommendation	Local hatchery with international standard and quality

Appendices 11: Interview with the Exporter

Questions	Exporter 1	Exporter 2
1 What are the current trend of exported shrimp?	It is dominated by intensive farming	Free from residue and another dangerous chemical
2 Do you have some obstacles when export the shrimp?	Shrimp certification is complex to fulfill	The strict requirement of customer
3 Which countries do you target for exporting the shrimp?	Malaysia, Taiwan, Japan, Europe and Los Angeles	Korea, America, Japan, Hongkong, Europe
4 Have you ever exported shrimp to EU?	Yes	Yes
5 Do you find any obstacles to export shrimp to EU?	Yes, especially traceability	High competition and traceability
6 How do you maintain the quality shrimp from farmers?	Keep the shrimp fresh by giving good packaging	Intense control and use safe packaging for shrimp
7 How do you manage the stability supply for market demand?	Keep contact with the customers and producers daily to supply the shrimp efficiently	Keep looking for the shrimp to fulfill the order and the contract
8 Do you find being exporter is beneficial for you?	Yes. As an exporter, I do not need to undergo fail harvest. My responsibility is making a link between	Sometimes I gain profit, but sometimes I suffered from a loss

	farmers and customers worldwide.	
9 Do you need support from government?	Yes, like secretary of commerce to get legal permit	No
10 Do you have some suggestion for farmers to increase the quality of their shrimp?	Farmers should have sustainable shrimp farming to fulfill bio security aspects	Farmers need to have shrimp certification to determine the quality of shrimp easily
11 How do you choose your client?	Based on their bidding and their standard	Based on their requirements
12 How do you build your relationship with shrimp farmers?	Upholding symbiotic mutualism	Keep in touch
13 Do you think being exporter is profitable for you?	Yes, since being exporter, I can make business network	Not really
14 How do you deliver the shrimp to destination country?	Deliver it by sea shipping, equipped with cold storage and container	Shipping by plane is faster although it is little bit expensive
15 What do you think of sustainability?	Building an integrated system to preserve the quality	Continues profit
16 What are the hardest requirements of shrimp from imported country?	Uniform shrimp color	Specific size of shrimp, especially size 40
17 How do you solve those problem?	Reject the order	Looking for it until I get it

18 When you export the shrimp, how many farmers are involved as your client?	More than 10 farmers	Around 5 farmers
19 Do you think the export regulation in Indonesia is good enough for now?	Not really good because it is complicated	It is good enough because the regulation is clear
20 If not, what do you expect from government to support the exporter?	Build an integrated system of shrimp cultivation	No

Appendices 12: Interview with the Stakeholders

Questions	Stakeholder 1	Stakeholder 2	Stakeholder 3
1 What government can do to help shrimp farmers widen their aquaculture?	Give a support, facilities, like excavator to design the pond	Many kinds of facilities, like excavator, seed, feed, road construction around the shrimp ponds.	Help to inspect the disease of shrimp cultivation
2 Does government have program to improve supply chain of shrimp?	Shrimp farming program, Land certification	Procurement of thermo king cars for storage	Product certification
3 Is there special training for farmers to increase their skills?	Yes	Yes	Yes

4 If yes, what kind of training and how often?	Technical assistance, for the first three harvest	Comparative studies, once a month	HACCP implementation, 1-2 times/year
5 What kind of loan ado government offer to help farmer?	No loan, but a grant for small farmers	No loan, but a grant	No loan
6 How much the interest of each loan?	-	-	-
7 Is there any subsidy for shrimp farmers?	Seed subsidy and farming assurance	Seed subsidy	No charge certification
8 Is there regulation related to sustainability?	Environment arrangement, CBIB	Environment arrangement	Shrimp should be free from dangerous chemical and antibiotics
9 In your perspective, what is sustainability?	Effective resources utilization for young generation	Free of natural resource exploitation	Environmentally friendly
10 Do current shrimp production practices include in sustainable practices?	Yes, especially traditional shrimp farming	Not fully implemented	Yes, thanks to high technology
11 What kind of improvement do you expect from shrimp farmers?	They can change the type of shrimp farming from traditional to semi intensive with a purpose to obtain high profit	They can change their mind set to be more sustainable	Understand the meaning of sustainable cultivation of shrimp, the importance of food safety
12 What do you think the biggest challenges for comply with the	Lack of citizen awareness and human resources	Lack of citizen awareness and not fully supported by government	Lack of shrimp processing unit

sustainable shrimp production practices?			
13 How to solve those challenges?	Increase the socialization about sustainability and give the training. If they do not follow the regulation related to sustainability, they get fine.	Increase the quantity of meeting between the farmers and government	Build Export port and local cold storage
14 Is there any socialization from government related to sustainability?	Yes, it is more about legality and certification	Yes, it is related to CBIB certification	Yes, it is related to food safety
15 What is the main requirement for farmers to export their shrimp?	CBIB certification	CBIB	HACCP, CBIB
16 Do you think sustainable supply chain is profitable for farmers?	Yes, sure. Farmers can export their shrimp abroad, especially to Europe.	Sure. But for now, farmers only have ability to market their shrimp locally and nationally.	Yes, indeed. They can export their shrimp worldwide
17 Do you think sustainable supply chain is profitable for government?	Yes. Government can get income from the export activity through certification.	Yes. Tax can be imposed by government when they are able to export their shrimp	Yes. Government can set their own tariff for export product.
18 Is there any improvement of shrimp production from past to present?	Technology and the type of farming are evolved.	Yes. They have been able to increase shrimp quantity and quality.	A larger quantity of shrimp

19 If farmers get any obstacle to comply with exported shrimp requirements, what government can do next?	Increase the socialization and training	Cooperate with good reputation private company regarding shrimp to induce the high quantity and quality of shrimp	Increase the facilities, the support and training.
20 What government can do to help shrimp farmers widen their market?	Provide better facilities	Make a link between buyer and farmers	Train them to comply with the customers' requirement.

Appendices 13: Interview with the Middlemen

Questions	Middlemen 1	Middlemen 2	Middlemen 3	Middlemen 4	Middlemen 5
1 How you select the farmer to be your client?	All farmers who want to sell their shrimp can be our client	Based on the system of shrimp farmers, whether they give me the contract to buy their shrimp or not.	Based on their capacity	Based on the contract	All farmers who want to sell their shrimp can be our client
2 How is the basic price of shrimp that you get from the farmers?	50.000 IDR	35.000-45.000 IDR	46.000 IDR	40.000-47000 IDR	50.000 IDR
3 How much the profit do you get per kg shrimp?	3.000 IDR/kg	5.000-15.000 IDR/kg	4.000-6.000 IDR/kg	3.000-10.000 IDR/kg	Min. 2.000 IDR/kg
4 How you build your relationship with the farmers?	Communication intensely	Being loyal middlemen	Give a loan to farmers who need capital	Keep the trust	Give a loan to farmers who need capital
5 How do you transport the shrimp	A pickup truck	A pickup truck	A pickup truck	A pickup truck	A pickup truck

from farm to your storage place?					
6 Where do you store the shrimp from farmers?	In the box made of Styrofoam	In the box made of Styrofoam	In the box made of Styrofoam	In the box made of Styrofoam	In the box made of Styrofoam
7 What kind of storage do you have?	Only the Styrofoam	Only the Styrofoam	Styrofoam and freezer	Styrofoam	Styrofoam
8 What is the capacity of your storage?	In total, 1 ton, each styrofoam consists of 30 kg shrimp	In total, 500 kg, each styrofoam consists of 30 kg shrimp	Minimum 1 ton, maximum 4 ton	0.7-1 ton, each styrofoam consists of 35 kg shrimp	300-400kg
9 Are you trading the shrimp locally or nationally or internationally?	Locally	Locally and nationally	Locally	Locally	Locally and nationally
10 How do you determine the price of shrimp?	Based on the size and the quality	Based on the size and the quality	Based on the size and the quality	Based on the size, the quality and freshness	Based on the size and the quality
11 Who are the actors in supply chain cooperated with you, beside the farmers?	Farmers and consumer	Farmers, consumers and exporters	Farmers and consumers	Farmers and consumers	Farmers and consumers
12 What are the challenges becoming middlemen?	Over quantity of shrimp in specific month	In the high demand, shrimp quantity is low, and vice versa	In the high demand, shrimp quantity is low, and vice versa	In the high demand, shrimp quantity is low, and vice versa	When I sell the shrimp nationally, I cannot make a bidding, bcz there is a standard of price.
13 How do you overcome the problems?	Give a discount to customers	Lowering the price	Set the price lower	Lowering the price	Not only sell shrimps nationally, but also locally
14 Who is your target market?	Customers, small retailer and hotel	Customers, small retailer, exporters	Customers and small retailer	Customers and small retailers	Customers and retailers

15 How do you broaden your market?	Visiting the market and build relationship with the customers there	Survey the local market and contact the supplier in other province	Visiting the market, make a survey and build relationship with the retailer and customers	Visiting the market and build relationship with the customers there	Survey the market
16 How do you manage your inventory?	Direct selling	Direct selling	Direct selling and store in Freezer	Direct selling	Direct selling and store in styrofoam with ice
17 How do you find and select target market?	No selection	Trustworthy	Choose the market which needs high demand of shrimp	Trustworthy	Based on the area of customer live
18 What do you expect form shrimp farmers in the future?	Increase the quality of shrimp	Increase the quantity in the season where high demand is demanded and quality of shrimp	Produce high quality of shrimp	Increase the quantity in the season where high demand is demanded	Increase the quality of shrimp
19 How many tons of shrimp do you buy from farmers for one harvest?	1 ton/harvest	500 kg/harvest	1-4 tons/harvest	0.7-1 ton/harvest	300-400kg/harvest
20 What are the materials do you need for shrimp preservation?	Ice and Styrofoam	Ice and Styrofoam	Ice, Styrofoam and freezer	Ice and Styrofoam	Ice and styrofoam