SHRIMP SECTOR OVERVIEW IN VIETNAM

Market study report | August 2020

Executed for ShrimpTechVietnam - Coordinated by Larive International

By ShrimpVet Research & Development Center - ShrimpVet Laboratory

SHRIMPVET LABORATORY

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List of Abbreviations

ASC	Aquaculture Stewardship Council.
ASEAN	Association of Southeast Asian Nations.
BAP	Best Aquaculture Practices.
DoF	Directorate of Fisheries.
FAO	Food and Agriculture Organization of the United Nations.
FTA	Free Trade Agreement (with the EU).
GAA	Global Aquaculture Alliance.
GlobalG.A.P.	Global Good Aquaculture Practices.
Ha	Hectare.
Nauplii	The very first stage of shrimp larvae after hatching.
PL	Post larvae.
RAS	Recirculating aquaculture system.
SOP	Standard operating procedure.
USD	United States Dollar.
VASEP	Vietnam Association of Seafood Exporters and Producers.
VietG.A.P.	Vietnam Good Aquaculture Practices.
VND	Vietnamese Dong.

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Introduction

ShrimpTechVietnam

This report was produced as part of the ShrimpTechVietnam consortium. The consortium consists of specialized companies and knowledge institutes together working on opportunities and challenges in the shrimp sector in Vietnam, with the ultimate aim to:

1. Develop the value chain.
2. Demonstrate best practice.
3. Transfer expertise.

The consortium contributes to the improvement of the local business climate and the development of the shrimp farming sector in Vietnam, increased trade & investment in the sector and showcase proved solutions.

This project is being developed in close cooperation with the Royal Dutch Embassy in Hanoi and RVO, the Dutch Enterprise Agency based in the Hague. The duration of the project is 3 years (2019–2021).

Baseline Study

The overall objective of the baseline study is to provide insight into the market and key success factors for the impact cluster.

The specific objectives of the market study include:

- Understand demand, supply, and development of the shrimp cultivation market in Vietnam.
- Establish insight into the needs of shrimp farmers and strategize accordingly.
- Review existing market development efforts in Vietnam.
- Map the existing shrimp farmers per region, to understand the actual number, their ability to grow using best practices, practical training or improved inputs and the optimal means of cooperation.
- Explore cooperation potential with existing aquaculture development programs and educational institutes.

Based on these insights, well-informed decisions will be made on how to support the local market within the regional context. The baseline study is executed by ShrimpVet.

ShrimpVet is an expert company in diagnostic services, the health status of shrimp, grow-out, broodstock and monitoring services. ShrimpVet was founded in 2014 by Dr. Loc Tran from the department of aquaculture pathology of the Nong Lam University. The company provides shrimp disease diagnostics, microalgae services, disease control (specifically EMS and AHPND) in close collaboration with research institutes, the private sector, and international organizations. ShrimpVet has some 100 employees, a central office, two labs and a small hatchery in HCMC. The company has been instrumental in finding a solution for the Early Mortality Syndrome (EMS) and has close relations with Vietnamese shrimp producers.

Executive summary

Vietnam is an attractive location for shrimp production, thanks to many years of experience in production and processing, excellent infrastructure (between hatcheries, farms, and factories), high production outputs and food safety standards, and a skilled workforce. Vietnam is home to some widely recognized seafood companies including Minh Phu Seafood Corporation, Quoc Viet, Stapimex and Camimex. Its shrimp sector is very diverse, ranging from organically produced *Penaeus monodon* (black tiger shrimp) in mangroves to the smaller-sized *Penaeus Vannamei* (whiteleg shrimp) from super-intensive farms. In the last decade, shrimp culture has rapidly developed.

Broodstock & hatchery

Shrimp hatcheries in Vietnam import their broodstock from the US and Thailand. The current shrimp broodstock suppliers are SIS (Shrimp Improvement System), Kona Bay, C.P, API (America penaeid), Benchmark holdings, and Blue genetics. Of these, SIS, Kona Bay, and C.P are the three biggest broodstock suppliers in Vietnam. In Vietnam, Viet-Uc Corporation and Research Institute for Aquaculture No. 3 (RIA3) have facilities for shrimp broodstock development via domestication programs. However, the broodstock quality is not stable and both organizations need to import broodstock from outside (Kona Bay).

There are 2,632 registered breeding and hatchery companies with a total production estimated at 90.3 Billion Post larvae (PL) annually of *Penaeus vannamei* and *Penaeus monodon*.

Farming

There are four shrimp farming methods used in Vietnam: (1) extensive, (2) semi-intensive, (3) intensive, and (4) super-intensive. The most important species for shrimp culture in Vietnam are *Penaeus monodon* and *Penaeus vannamei*.

Shrimp production covers approximately 700,000 ha in Vietnam, with a variety of farming models. These include extensive farms in mangroves, rice-shrimp crop rotation, mixed culture of different shrimp species (*Macrobrachium rosenbergii*, *P. monodon*, and *P. vannamei*), low-density semi-intensive farms (*P. monodon and P. vannamei*), intensive farms of *P. vannamei* in earthen ponds, square plastic-lined ponds, round shape steel-framed plastic-lined ponds, and indoor ponds. Intensive and super-intensive farms are estimated at 70,000–100,000 ha. On a smaller scale, there are also a few RAS systems for small-scale experimental production, and simple RAS systems using natural process and fish to treat the wastewater for reuse.

The Mekong Delta is the most important farming area, accounting for nearly 80% of overall shrimp production and home to all of the top five contributing provinces (Ca Mau, Bac Lieu, Soc Trang, Ben Tre and Kien Giang). The other 20% of shrimp production is located in various provinces from the Red River Delta in the North of Vietnam (Hai Phong, Quang Ninh, Nam Dinh, Thanh Hoa, Thai Binh) and located in central Vietnam (Ninh Thuan, Phu Yen, Binh Dinh, Khanh Hoa, ...).

Processing

In Vietnam, the Mekong Delta is an area of shrimp processing plants with the presence of big corporate entities such as Minh Phu seafood, Stapimex, Fimex, BIM Group, and Hung Vuong. They can process and export raw, cooked, and added value commodities.

Production

According to the statistical data in 2019 (Vietnam Directorate of Fisheries, DoF[1]), total shrimp production totaled at 823,851 tons. However, the figures issued by the government may not be correct due to over-reporting from local governments and the import of shrimp from India and Ecuador. Therefore, the real production of 2019 was estimated at 570,350 tons. This estimation is based on our series of interviews and meetings with influential people in the shrimp industry. From this total amount of 570,350 tons, about 150,000 tons is from *Penaeus monodon* in extensive farming (with mangrove), captured fisheries, semi-intensive farms, and mixed culture. Majority of *Penaeus vannamei* production is from semi-intensive, intensive, and super-intensive farms.

Consumption

According to our estimation, around 100,000 tons of shrimp was imported from India and Ecuador. Approximately 100,000-150,000 tons of shrimp was consumed domestically (in wet markets, restaurants, hotels, festivals, holidays, and by tourists).

Certification

Four key certification schemes are operating in Vietnam: GLOBALG.A.P., VietG.A.P., ASC, and BAP. In 2019, there were 124 ASC-certified and 192 BAP-certified facilities and farms. Currently, mainly larger producers have been certified.

Export

Vietnam is the world's second-largest shrimp supplier with 13-14% in value of the world shrimp market. Shrimp is exported from Vietnam to 100 countries which the top ten biggest markets being: the EU, The USA, Japan, China, South Korea, Canada, Australia, ASEAN, Taiwan and Switzerland, accounting for 95.9% of Vietnam's total shrimp export value. The shrimp sector contributes around 40-45% of the total export value equivalent to 3.5-4.0 billion USD per year.

There is no public data available about shrimp production for export or re-report. However, it is estimated that 85-90% of shrimp production is directly exported.

The upcoming Free Trade Agreement (FTA) with the EU will be useful for the Vietnam producers and exporter in the transportation of commodities, reduce tax and duty when exporting the products to the markets. Hence, it can improve the competitive advantages of Vietnam shrimp producers and exporters.

Table 1. Overview of the shrimp supply chain in Vietnam.

Supply chain	Key features	Reputable delegates
1. Broodstock (genetics)	The shrimp broodstock originates from the USA and Thailand.	SIS, Kona Bay, C.P, etc. (Penaeus vannamei), Moana (Penaeus monodon)
2. Hatchery	The majority of shrimp hatcheries (70-80%) is located in the central coastal provinces. Viet-Uc and C.P are the two biggest shrimp PL producers in Vietnam (occupying approximately 25% of the market (17-25 billion PL out of the total production of 90.3 billion PL). Meanwhile, PL without traceability accounts for a 30% market share of PL production.	Viet-Uc, C.P, Nam Mien Trung, Uni-President Vietnam, Hisenor (Shenglong), ShrimpVet Dr. Tom, etc.
3. Farming	Extensive, semi-intensive, intensive, and super-intensive are the common shrimp farming practices in Vietnam, leading to a total farming area of ~700,000ha. Intensive shrimp farming system is the most used method, accounting for ~80% of shrimp production of Vietnam.	Corporate farms (Viet-Uc in Bac Lieu, Minh Phu Loc – Loc An, Minh Phu – Kien Giang, Fimex, etc. They play in the industry as the shrimp producers as well as the reputable shrimp exporters.
4. Feed	The shrimp feed segment belongs to foreign companies. Meanwhile, shrimp feed accounts for around 60% of the production cost. The production cost of Vietnamese shrimp is significantly higher than for other (regional) rivals (Thailand, China, Ecuador, and India).	The big fours including: C.P (>200,000 tons), Grobest Vietnam (180,000 tons), Shenglong (>100,000 tons), Uni-president Vietnam (>100,000 tons).
5. Middlemen	Middlemen frequently play an important role. Their activities in the market consist of collecting, purchasing, transporting, standardizing, promoting, supplying, and selling products.	Brokers (wet markets), distributors, etc.
6. Processing plants	The Mekong Delta is the hub of shrimp processing plants. Processing plants have connections, policies, and mutual commitments with the shrimp producers/farmers to buy or import the materials for processing. Some processing plants invest to build large farms (hundred to a few thousands of hectare), applying modern system and technology, to have traceability and achieve international standards (Global GAP, ASC or BAP or Naturland certificates) for export purposes.	Minh Phu seafood in Hau Giang and Ca Mau (the Mekong Delta), BIM group, Fimex, Stapimex, Thong Thuan seafood, Khanh Sung seafood, etc.
7. Export	Vietnam processes and exports raw, cooked, and added-value commodities.	Minh Phu seafood Corp. is the global leader in processing and exporting shrimp products. Besides, Fimex, Stapimex, BIM group, etc. are the other players in this field.

Objective

The objective of the baseline study is to provide an overview of the Vietnamese shrimp sector covering all aspects of the supply chain. With this baseline study, this report provides the ShrimpTechVietnam cluster partners with measurable indicators (broodstock genetics, hatchery, feed industry (hatchery, nursery, grow-out), processing plants, and export) to develop the detailed planning of the project. The outcomes of this study will function as a guideline for the other ShrimpTechVietnam cluster activities (demonstration and training).

Research methodology and data collection

The shrimp industry in Vietnam greatly varies in terms of farming models, farming methods and scale. The fast and continuing transition of the industry in recent years makes it difficult to have a "snap-shot" of the current situation, as it is constantly changing.

The data used in this study is based on several research papers (from 2002 onwards), official data of the Vietnam Directorate of Fisheries (DoF), Vasep, general Vietnam customs, other articles, and estimations from 2017 to 2020. Additional information was gathered through interviews and conferences with influential people and organizations in the shrimp sector.

Data sources

A. Official reports:

1. Directorate of Fisheries (DoF) https://www.fistenet.gov.vn/Home
2. Ministry of Agriculture and Rural Development https://www.mard.gov.vn/en/Pages/default.aspx
3. Provincial reports from coastal provinces of Vietnam
4. Vietnam Association of Seafood Exporters and Producers (VASEP) at http://vasep.com.vn/

B. Industry survey:

1. Feed millers: data collection from top feed mills in Vietnam including CP, Uni-President, Sheng Long, Skretting and Tongwei. The data includes feed volume, shrimp productions in different regions and throughout different farming models, and innovation methods applied in shrimp farming.
2. Farmers, corporate farms, major producers, integrated companies' interviews: data regarding farming technologies, farming models, water treatment systems, and the evolution of the farming technologies.
3. Data collected from ShrimpVet team: this includes diagnostics data collected across Vietnam, shrimp farmers using ShrimpVet's service, and ShrimpVet in-house investigation.

1.Broodstock & hatcheries

Shrimp hatchery plays a vital role in the supply chain. The seed production contributes 7–10% of shrimp production cost. At present, all the shrimp hatcheries in Vietnam still need to import shrimp broodstock from the outside (the USA and Thailand).

In 2019, a total of 212,000 vannamei (whiteleg) shrimp broodstock were imported into Vietnam from the USA, Singapore, and Thailand. In total, 5,000 pieces of monodon (black tiger) shrimp broodstock was imported in 2019. Monodon shrimp broodstock has been imported from Moana company (Moana technologies Llc from Hawaii, the USA). Formerly, wild monodon shrimp broodstock was commonly used in seed production. They are no longer, due to their low natural capture and resources, and the fact that shrimp post-larvae (PL) produced by the broodstock were not stable in terms of quality.

Hatchery feeds play a vital role in seed production. All hatchery feeds are imported or distributed. The key feature of the feed is well-formulated with high quality to meet the larvae nutrient requirements. Therefore, the hatchery feed prices are also significantly higher than the grow-out feeds or even nursery feeds used in a shrimp farm. The price ranges from 10–100 US dollars/kg. Several reputable hatchery feed suppliers are INVE, Bernaqua, Zeigler, Skretting, Biomar, Higashimaru, and Feed One.

The large hatcheries with high investment allow them to use the premium quality feed in the production. Meanwhile, the small or mid-sized hatcheries can choose reasonable feeds for their production process.

Following our estimations, there are only several hatcheries which can afford to use SPF polychaetes in the seed production. These include Viet-Uc, C.P, and Hisenor (Shenglong). However, the use of SPF polychaetes in the production chain at their hatcheries are still not being reported.

1.1. Overview of shrimp hatcheries in Vietnam

In 2019, Vietnam counted 2,362 hatcheries. Of those, 1,750 are registered black tiger shrimp hatcheries and 612 are whiteleg shrimp hatcheries. According to the statistical report by the Directorate of Fisheries in 2019, Vietnam produced a total of 90.3 billion shrimp PL of which, 23.5 billion black tiger shrimp PL and 66.8 billion whiteleg shrimp PL.

Most hatcheries in Vietnam are located (approximately 70–80%) in central coastal provinces (Binh Thuan and Ninh Thuan, see Annex Figure 33). Meanwhile, the Mekong Delta (Bac Lieu, Ca Mau, Ben Tre and other areas are home to 20% of total hatcheries.

Characterizations, advantages and disadvantages of each kind of hatcheries are described in Table 2. Figure 1 displays the design of a common small- or medium-scale hatchery in Vietnam.

Table 2. Type of hatcheries in Vietnam.

Type of hatchery	Small hatchery	Medium hatchery	Large hatchery
Ownership and operation setup	Family members serve as hatchery workers	Small cooperative	Big corporation, national agencies
Broodstock import	No. They only buy Nauplii.		Yes. They import broodstock from the suppliers from the USA or Thailand. Several firms have genetics programing.
Average of PL production	5–10 million PL/year.	Less than 200 million PL/year.	From 200 million to a few dozen billions of PL per year.
Examples for each kind of hatchery	Backyard hatcheries	Gold key, Hoang Long, Xuan Bay,...	Viet-Uc, C.P, Nam Mien Trung, Uni-president Vietnam, Hisenor (Shenglong), ShrimpVet Dr. Tom.
Proportion	The sum of the total production of small hatcheries and medium hatcheries is accounting for approximately 50% of the total produced PL in Vietnam.		PL produced by large hatcheries is accounting for another 50% total produced PL in Vietnam.
Advantages	Low production cost, low capital investment No need for experts and modern/innovative technologies. Easy in operation.		Innovative techniques and proactive steps: broodstock and larvae nutrition, algae culture, artemia enrichment, probiotics application protocol. No antibiotics use. Disease control (diagnostic labs: checking for important infectious disease pathogens from input materials: live foods (bloodworm, squid, oyster, artemia), algae quality, ... etc., to the produced PL) and strictly biosecurity protocol (disinfection of equipment and other materials). High-quality PL. High market price.
Disadvantages	Lack of disease management (unchecked input materials) and biosecurity protocol. Antibiotics abuse. Low-quality inconsistent quality of PL. Low market price.		High capital investment. Need for experts to follow up and manage throughout stages of the production procedure.

1.2. Small- and medium-scale hatcheries

There are various types of hatcheries in Vietnam with different operational procedures. In Vietnam, small and medium scale shrimp hatcheries are most common. These hatcheries are simply equipped with a water treatment system, aeration, rearing tanks or production units. Their competence in producing shrimp PL is limited. They lack innovative technologies such as a genetics program, larvae culture technology, nutrition of broodstock and shrimp larvae, probiotics application protocol, disease control, and biosecurity. Moreover, the insufficiency of investment for infrastructures is the main reason they cannot produce healthy PL with the consistent quality required for farming. Farmers only evaluate PL quality by looking at them when they buy shrimp PL from small hatcheries. Meanwhile, the commercial hatcheries use more technologically advanced methods (PCR, microbiology, etc.) to help farmers check shrimp PL before purchase.

The majority of the small- and medium-scale hatcheries do not import shrimp broodstock and only buy shrimp Naupii from other suppliers (who are capable of importing broodstock and spawning techniques), then rearing the Nauplii until marketable PL for selling. To keep survival rates high, antibiotics use and abuse is a popular application in their PL production procedures.

As for the major trends in hatcheries and their development (next three years), it is expected that the shrimp hatchery sector shall continue to improve shrimp seed production by improving genetic programs, quick growth rate, and disease resistance. The PL production based in probiotics and bioremediation will be widely applied. Production costs are expected to decrease.

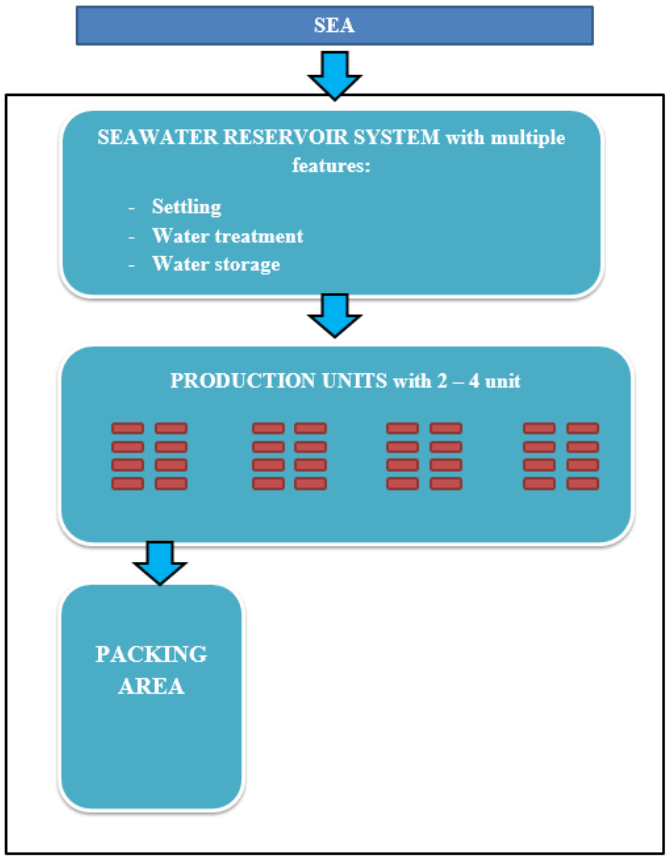

Figure 1. Design of a common hatchery in Vietnam.

1.3. Top leading shrimp PL producers in Vietnam

Of all the hatcheries in Vietnam (there are many non-registered hatcheries), around 40-50% are reputable hatcheries with high production, capacity, and disease management. Table 3 shows an overview of the top shrimp PL suppliers in Vietnam.

The five main genetic breeding companies active in Vietnam are SIS, Kona Bay, C.P, Benchmark holding, and API.

Table 3. Top shrimp PL suppliers in Vietnam.

Shrimp PL suppliers	Average production (Billion PL/year)	Market share	Price (USD/1000 PL)	Distinct features
Viet-Uc	10 – 15	15%	5.0	Having domestication facilities in Binh Thuan Province, but they do not sell broodstock and still imports broodstock from Kona Bay; they only use their domesticated broodstock for in-house production.
C.P	7.0 – 10	10%	6.0	Having genetic programs originated in Thailand. High-quality shrimp PL to supply for farmers enclosing with selling feed commitment.
Nam Mien Trung	2.0 – 3.0	3%	5.0	-
Uni-president Vietnam	2.0	2%	4.0 – 5.0	-
Thong Thuan	1.0 – 2.0	1%	4.0 – 5.0	-
Grobest Vietnam	0.5	0.5%	4.0 – 5.0	-
Shenglong (Hisenor)	1.0 – 1.5	1.5%	4.0 – 5.0	-
ShrimpVet Dr. Tôm	1.0	1%	5.0	The hatchery for both research and commercial objectives.

1.3.1. Viet-Uc corporation

Viet-Uc Corporation was established in 2001 in the Binh Thuan province. Viet-Uc has 9 shrimp hatcheries across Vietnam and they are one of the biggest shrimp PL producers in Vietnam, accounting for 15-20% of the market share. Viet-Uc is known for producing high-quality PL. They deploy sale programs for shrimp farmers to accelerate the turnover of shrimp PL consumption.

Viet-Uc produces approximately 10-15 billion whiteleg shrimp PL annually with the market price proximately of 5.0 USD per 1,000 PL. At present, they only produce whiteleg shrimp PL. The black tiger PL production is at the early stage of running pilots for scale-up.

Viet-Uc operates large-scale hatcheries which are well-equipped with high financial investment in terms of infrastructures, innovative technologies, and probiotics application protocols, biosecurity protocols, and diagnostic labs for disease control. Viet-Uc does not use antibiotics. They import broodstock from an American breeding company (Kona Bay marine sources).

Figure 2. A state of the art hatchery from Viet-Uc (cited by https://www.vietuc.com, accessed on 08.6.2020).

C.P (Charoen Pokphand) Vietnam – C.P Group

C.P Vietnam (C.P) is a large integrated company belonging to the C.P group, which is a Thai conglomerate based in Bangkok, Thailand. They have been involved in aquaculture since 1993 and have become one of the biggest PL producers in Vietnam. Farmers associate C.P. PL with high-quality and having a fast growth rate. Total PL production of C.P is around 7–10 billion per year with a market price of around 6.5 USD for per 1,000 PL. Whiteleg shrimp accounts for up to 99% of total production. The production of black tiger shrimp is still in its early stage.

Figure 3. A state of the art hatchery of C.P Vietnam in Vung Tau Province, 2019.

The C.P hatcheries are well-operated with high financial investment in terms of infrastructure, genetics program (mostly Thailand and import from the other suppliers), domesticated broodstock, larvae culture technology, algae culture facility, disease control using satellite diagnostic labs, biosecurity protocol, and no antibiotics use in the production process. In the past, C.P. has sold broodstock. However, they stopped the sales of broodstock to conserve competitive advantages.

C.P made the farmers familiar with their brand and the consistently high quality of their PL. They have launched a business strategy with several obligation provisions. For instance, if farmers buy the PL of C.P, they must also buy the feeds manufactured by C.P feed mill. The total sales feed production of C.P is estimates of over 200,000 thousand tons in 2019.

C.Ps technical support team is also transferring farming technologies and giving farming instructions to their customers following C.P protocols. The application of the farming protocols ought to increase farm performances. However, the farming operation and production cost associated with these protocols are high, meaning small- and medium-sized farmers are unable to follow the exact protocols.

Figure 4. A C.P combined farming model of farmer Luu Phuoc Thanh in Dong Hai Dist, Bac Lieu province.

1.3.2. Nam Mien Trung

Nam Mien Trung is a Vietnamese private firm with its headquarters in the Binh Thuan Province (central Vietnam). They have been active in the aquaculture industry since 1997. The company and its brand are well-known, providing an estimate of 3 billion PL to the market per year. Their market price is around 5.0 USD per 1,000 PL.

Nam Mien Trung has no genetics program or breeding program. They produce shrimp PL by using imported broodstock from the U.S.A.

Their facilities are well-designed with high investment in infrastructure, machinery, and modern equipment, and no antibiotics usage. They have competence in most of the PL production process such as matured shrimp broodstock, algae culture, artemia enrichment, and disease control SOPs by

checking multiple stages of the process from the supplying materials to the final product (the produced PL).

Figure 5. An aerial view of Nam Mien Trung hatchery, 2020 (Cited by https://www.nammientrung.com, accessed 08.6.2020).

1.3.3. Other large-scale hatcheries

Total PL production of each listed company is estimated to be 1 billion per year with the market price about 4 – 5 US dollars per 1,000 PL.

Uni-President Vietnam (https://www.uni-president.com.vn) is a Taiwanese company which has been active in the aquaculture industry of Vietnam since 1999. The brand name of Uni-President's PL is "Thống Nhất". They are also a feed manufacturer for both fish and shrimp.

Figure 6. A state of the art hatchery of Uni-President in Quang Tri Province 2019.

Figure 7. Shrimp PL bag of Uni-President (Cited by https://www.thuysanvietnam.com, 2019).

Thong Thuan (https://www.thongthuanseafood.com) is a private company with 100% of Vietnamese capital investment. Their headquarters is in the Binh Thuan province. Besides operating a shrimp hatchery, they are also involved in the seafood processing, seafood export, salt industry, and Tuynel brick.

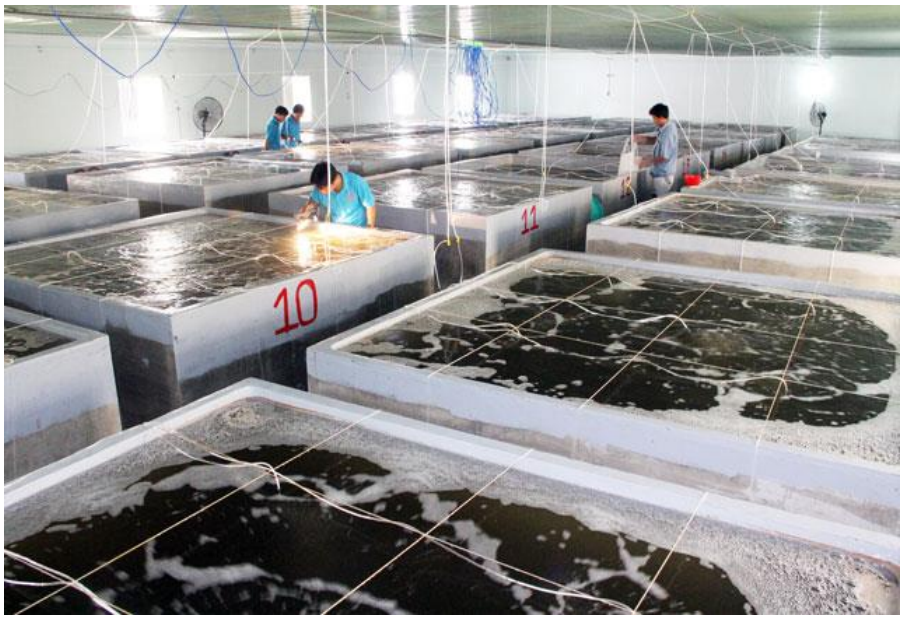

Figure 8. A view of larvae culture at Thong Thuan hatchery (source: thongthuanseafood.com).

Grobest Vietnam (https://www.grobest.com.vn) is a private company with 100% investment from Taiwan and belongs to Grobest Holdings Limited in Taiwan. The establishment in Vietnam officially operates since 2008. They are well-known in the aquafeed industry in Vietnam with a remarkable market share (approximately 20% in terms of market share).

Hisenor Vietnam Aquatic Breeding Co., Ltd (https://www.shenglongbt.com) belongs to Shenglong Biotech International. This hatchery applies high technologies with biosecurity protocols, imported disease-free broodstock, and high-quality live foods (algae, artemia, rotifers,...) to produce high-quality shrimp larvae.

Figure 9. The Hisenor hatchery of Shenglong company.

1.3.4. ShrimpVet Dr. Tôm hatchery

ShrimpVet established and operates a vertically scientific hatchery with the market brand name "ShrimpVet Dr. Tôm" at Ninh Thuan Province since 2016. The ShrimpVet hatchery has assembled parts of the PL production including biosecurity SOPs, algae culture, artemia enrichment, comprehensive disease control and larvae culture protocols.

Figure 10. An aerial view of the ShrimpVet hatchery, 2020.

Figure 11. ShrimpVet PL brand name: Dr. Tôm.

The hatchery and their diagnostic satellite laboratories were established to perform field trial researches in varieties of the aquaculture aspects to identify affordable innovation technologies in shrimp PL production and shrimp farming industry. And simultaneously, produced high-quality PL to provide for shrimp farming.

Figure 12. Shrimp broodstock.

Figure 13. Larvae culture at ShrimpVet hatchery, 2020.

The facility is flexibly designed and well-adapted to many kinds of trials, such as nutritional trials for shrimp broodstock and various stages of shrimp larvae, tolerance stress tests, and water quality tests. ShrimpVet is a partner of Kona Bay to run sentinel testing toward new shrimp lines include shrimp growth performance and disease tolerance. ShrimpVet has also imported shrimp broodstock from the U.S.A (SIS and Kona Bay) for seed production.

ShrimpVet Dr. Tôm currently provides the market with an estimate of 0.5 billion PL annually at the market price of 5.0 US dollars per 1,000 PL. They provide technical support programs and transfer affordable farming technologies. Through their efforts, ShrimpVet has become a familiar brand name of shrimp PL to the farmers across Vietnam. Currently, the company has started to export the PL and achieved some initial success.

Figure 14. A shrimp PL bag provides to the market.

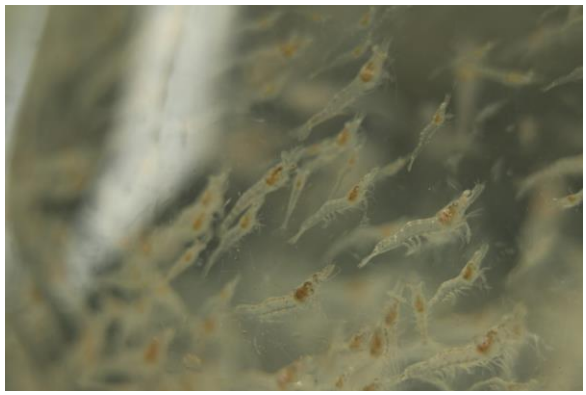

Figure 15. ShrimpVet PL ready for sale.

2.Shrimp farming

The shrimp farming area across Vietnam is estimated at 705,545 ha in 2019. Of this, 603,855 ha was Black tiger shrimp (monodon) farm and 97,865 ha whiteleg shrimp (vannamei) farm (Figure 16).

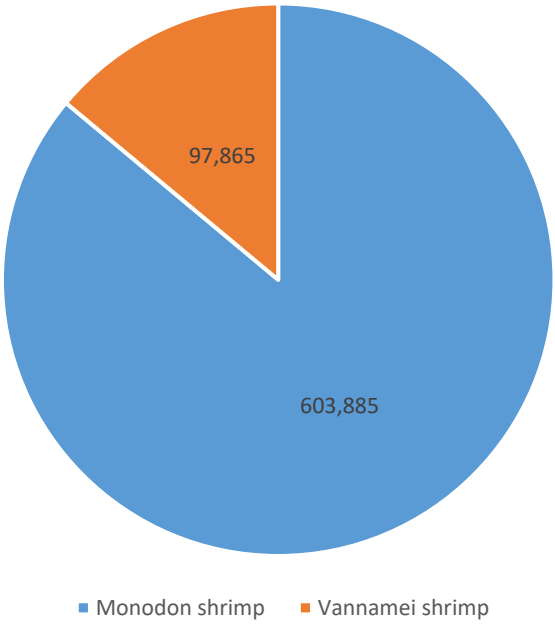

Figure 16. Farming acreage of monodon and Vannamei shrimp in ha (DoF, 2019).

Vietnam is the world's leading producer of black tiger shrimp with a production of approximately 290,000 tons per year. Black tiger shrimp is a traditional Vietnamese species, but since 2008, the country has also been cultivating white shrimp. The main farming areas are concentrated in the Mekong Delta provinces. The five provinces with the largest shrimp farming areas include Ca Mau, Bac Lieu, Soc Trang, Ben Tre and Kien Giang (Figure 17 and Figure 18).

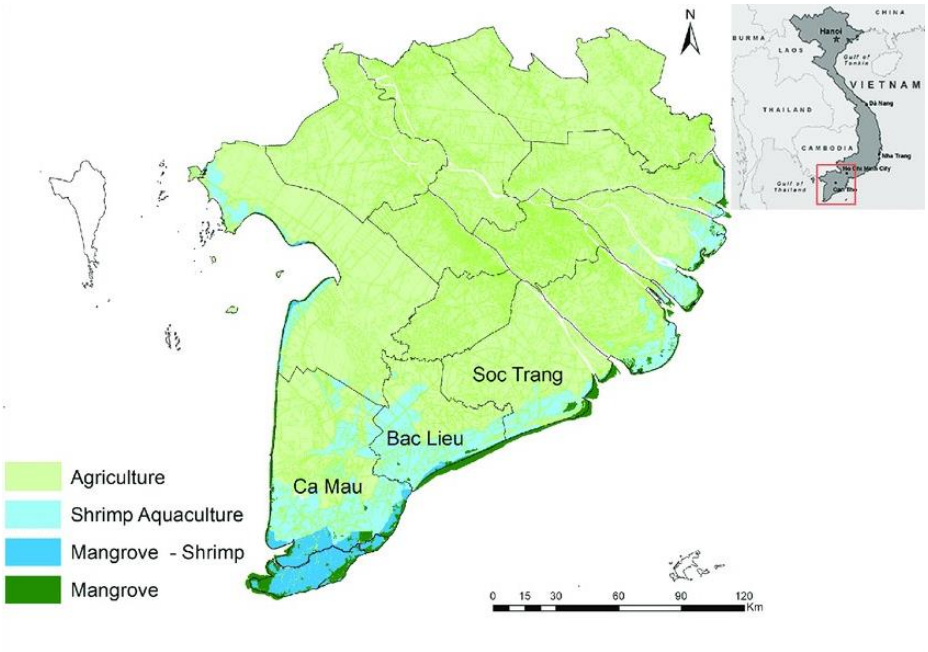

Figure 17. An overview of shrimp aquaculture in the Mekong Delta (2018).

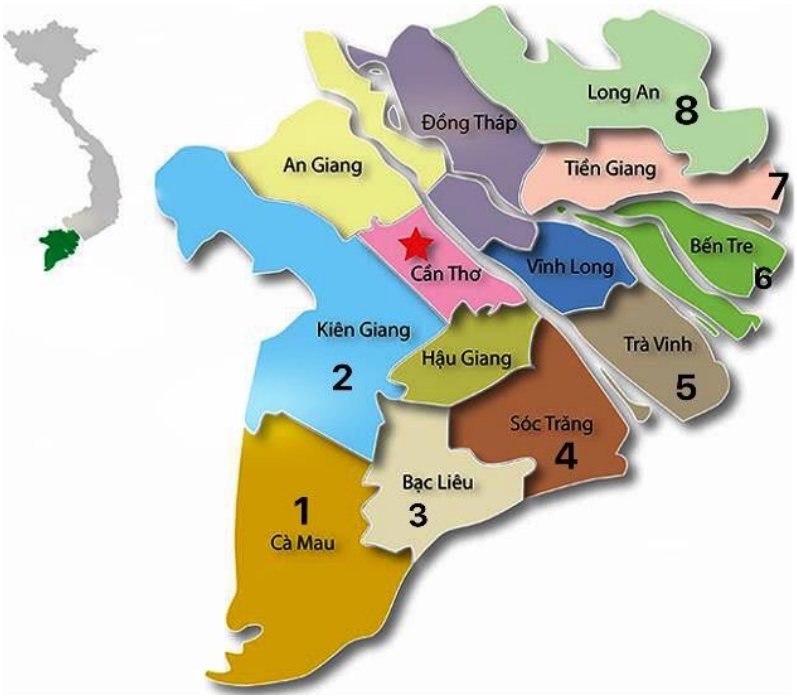

Figure 18. Shrimp farming distribution in the Mekong Delta (2019): 1,2,3,6 Monodon and Vannamei shrimp; 4,5,7,8 Vannamei shrimp only.

The main challenges farmers face are disease outbreak, seed production, and production cost:

- Disease outbreak: the farmed shrimp is more vulnerable to infected with EMS/AHPND and White spot disease in the dry season (high temperature, high salinity) and the rainy season (temperature go down and high fluctuation of water quality parameters (salinity, alkalinity, pH, minerals in the water column, etc.). Also, EHP (Enterocytozoon hepatopenaei) is frequently detected in shrimp farming.
- Seed production: over 25-30% of shrimp PL productions derive from no brand, hence no disease management (checking for shrimp infectious diseases), and eventually no traceability.

This kind of seed is sold at a very low price (0.4 – 1.3 US dollars per 1000 PL) and is usually sold in wet markets.

- Production cost: Vietnamese shrimp is well-known for its high production cost in shrimp farming, making it a the key factor for the difficulty to compete with their (regional) rivals (India, Ecuador, and others).

2.1. Shrimp farming practices

There are different shrimp farming practices with various features and requirements, each with its distinct advantages and disadvantages (Table 4).

Antibiotics and probiotics are used by farmers for improved shrimp health, disease prevention, and disease treatment. Although the usage of antibiotics is illegal, it is still frequently used, depending on the farming system. 80% of the farmers using earth ponds make use of antibiotics, compared to 20% of farmers using plastic-lined ponds. Nearly 100% of shrimp farms in Vietnam are applying probiotics in the cultivation.

The stocking density depends on the type of shrimp and farming methods. In an earthen pond, farmers can stock 30 – 150 pcs/m2. Meanwhile, the stocking density is much higher if they culture the shrimp in a plastic-lined pond (120 – 1000 pcs/m2).

Table 4. Overview of shrimp farming practices.

Farming systems	Extensive	Semi-intensive	Intensive	Super-intensive
Advantages	➢ The earthen pond is common. ➢ Uses the advantages of natural seed production via the water supply. ➢ Shrimp fully depend on the availability of natural food in the pond (without feeding). ➢ Easy to manage and with low production cost. ➢ Mostly partial harvest.	➢ The earthen pond is also common. ➢ PL sourced from wild or a shrimp hatchery. ➢ Stocking density is approximately 20–50 pcs/m^2. ➢ Shrimp are fed several cereal by-products, natural feeds in the pond, and additional feeds. ➢ Low production cost. ➢ Partial harvest and complete harvest.	➢ Earthen pond or plastic-lined pond ➢ Stocking density: 50–70 pcs/m^2. ➢ Shrimp are fed commercial feeds during culture. ➢ Water exchange will periodically be applied at a moderate level. ➢ Partial harvest and complete harvest.	➢ Greenhouse, RAS (recirculating aquaculture system). ➢ Stocking density: 150 – 500 pcs/m2 ➢ Shrimp are fed with high-quality commercial feeds which can be supplemented with probiotics, prophylaxis, immunostimulants, and other supplements. ➢ High water exchange ➢ Diseases are controllable and manageable. ➢ Very high productivity. ➢ Very high survival rate (80–90%).

Disadvantages	➢ Seed production is seasonable and not stable. ➢ Productivity is unpredictable and low. ➢ High risks for diseases outbreak. ➢ Very low survival rate (~3%).	➢ Productivity is unpredictable and low. ➢ High risks for diseases outbreak. ➢ Low survival rate (~30%).	➢ High productivity ➢ Diseases are preventable and manageable. ➢ High survival rate (60 – 80% depending on the pond, earthen or plastic-lined).	➢ Very high capital investment. ➢ Applying high technologies can be difficult for farmers to manage.
Provinces	Ca Mau, Bac Lieu, Quang Ninh, Thai Binh, Nam Dinh, etc.	Ca Mau, Bac Lieu, Soc Trang, Kien Giang, Tien Giang, Long An, Can Gio, Quang Ninh, Quang Ngai, etc.	Bac Lieu, Ca Mau, Soc Trang, Kien Giang, Ben Tre, Dong Nai, Ninh Thuan, etc.	Bac Lieu, Ben Tre, Ca Mau, Vung Tau, Kien Giang, etc.
Production shares	5 – 10%	5 – 10%	75 – 80%	5%

2.2. Extensive and semi-intensive shrimp farming

The following two **traditional extensive shrimp farming systems** dominate production in the Mekong Delta:

1. Integrated mangrove farming
2. Improved extensive farming.

Integrated mangrove farming (Figure 19) systems are located in the buffer zone, behind the full protection of the coastline. The improved extensive systems are located in the economic zone, farther inland than the coastal buffer zone. Both systems are characterized by large ponds (3–10 ha), consisting of a raised platform in the center of the pond (a shallow water area that takes up to 60–80 % of the total pond area), a ditch around the platform, which takes up 20–40% of the total pond area and surrounding dikes. With the integrated mangrove systems, mostly *Rhizophora* mangrove trees are planted on about 50–70% of the platform area.

There was proximately 200,000 ha of shrimp-mangrove farming system in the Mekong Delta in 2019 (Vasep, 2019). Of this, Ca Mau Province accounts for 40 – 50% of the farming acreage with 82,000 ha concentrated in the districts: Ngoc Hien, Nam Can, Phu Tan, and Dam Doi. The production of this system is estimated at 100,000 – 150,000 ton per year and most of the production is Black tiger shrimp. The average shrimp production of this system is 1 – 2 ton/ha depending on the tidal zones. In 2017, Minh Phu seafood Corp. has established a shrimp-mangrove system (an entity named as "DNXH Minh Phu") with the orientation of conserving environmental diversity and improving this traditional shrimp farming system.

Improved extensive farming: (Figure 19) aquatic plants (*Scirpus littoralis* and *Typha* species), seaweeds (*Enteromorpha, Chaetomorpha, Cladophora*, and *Gracilaria*) or mangrove trees are planted or allowed to develop naturally on the platform. These plants are good for the environment and create excellent habitat for shrimp, fish and especially mud crabs. In these systems, wild shrimp, fish and crabs flow

into the ponds through tidal water exchange during the full moon and new moon. Also, hatchery-reared giant tiger shrimp postlarvae are stocked at two to four per square meter, two to eight times a year, throughout two seasons (December–April and June–November). Mud crabs, blood cockles (*Anadara granosa*) and some brackish water fish are also stocked at low density to make use of natural food and for diversification of products and income. Almost no supplemental feed is utilized in these systems. Two to three months after stocking, shrimp are partially harvested on every new moon and full moon as the pond water flows through a net on an outgoing tide.

The production of this farming system is significantly lower than the integrated mangrove farming. It produces around 200-500 tons per year. Annual shrimp production is about 300–400 kilograms per hectare. Large giant tiger shrimp (over 50 grams each) account for 50–70% of the harvest. The rest are other wild shrimp, such as the banana shrimp (*P. merguiensis*) and Indian shrimp (*P. indicus*). Mud crabs are also regularly harvested from these ponds.

With simple techniques, low capital investment, environmental friendliness, regular harvests, little disease and few economic risks, integrated mangrove ponds occupy 50,000 hectares, while the improved extensive shrimp farming system occupies 330,000 hectares. Further improvements in farming techniques are needed for these systems to achieve better shrimp survival rates, production and income.

Rice-shrimp (Figure 19): Rotation of rice and shrimp production is very typical in the Mekong Delta and currently occupy more than 160,000 hectares. In these systems, giant tiger shrimp are cultured in the dry season with brackish water, and rice is cultivated during the rainy season with fresh water.

In the shrimp/rice rotation systems, the 3–4-month shrimp crop is cultured in the dry season and a traditional variety of rice is planted during the rainy season. Due to enhanced soil fertility after the shrimp crop, very limited or no fertilizer is used for rice cultivation. Rice production can reach 3 to 5 tons per hectare per crop. Giant freshwater prawns (*Macrobrachium rosenbergii*) are also normally stocked during rice cultivation at low stocking densities (1 to 2 prawns per square meter) with some feeding. Prawn production is about 50–100 kg/ha/crop (Tran Ngoc Hai et al, 2015).

Traditional systems (Figure 19) are surrounded by a deep ditch on the inside of the pond along the dike and have shallow water levels (30 cm) on the platform. Improved systems are prepared by machines, and have deeper water (70–80 cm) over the platform. In the traditional systems, shrimp are stocked at low densities (2 to 5 shrimp per square meter), feeding is intermittent and management is simple. The estimation of the traditional farming systems is around 400,000 – 500,000 ha in the Mekong Delta. Shrimp yields of 200–300 kilograms per hectare per crop are normal. In improved systems, shrimp are stocked at higher densities (6 to 8 shrimp per square meter), fed commercial feeds and water quality is carefully managed. These ponds yield 800–1,500 kilograms per hectare crop.

Figure 19. (A) Mangrove-shrimp farming system; (B) improved extensive shrimp farming system; (C) rice-shrimp farming system; (D) intensive shrimp farming system. (Photo by Tran Ngoc Hai, Pham Duc, Vo Nam Son, Truong Hoang Minh, and Nguyen Thanh Phuong in 2015

Figure 20. Super intensive farm (greenhouse in Bac Lieu, 2018), photo by Viet-Uc company.

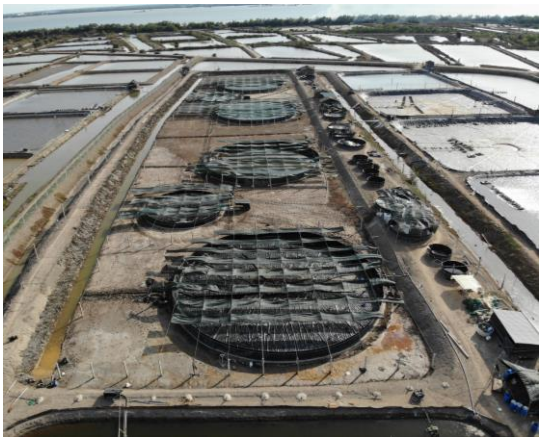

Figure 21. Super intensive farm (plastic round shape, steel frame tanks at ShrimpVet farm in 2020), photo by ShrimpVet.

Intensive farming system

The output of intensive shrimp farming represents approximately 80% of the total shrimp production in Vietnam. Intensive shrimp farming (Figure 19) is the dominant farming system used in coastal areas, such as Soc Trang and Bac Lieu in the Mekong Delta and the central coastal areas of Vietnam. The production area under intensive practices is estimated to be around 61,000 hectares. Farmers in Vietnam grow both *Penaeus monodon* (black tiger shrimp) and *Penaeus vannamei* (whiteleg shrimp) in the intensive system. However, many farmers tend to shift to the culture of *Penaeus vannamei* when they have sufficient access to finance and input materials.

Super-intensive farming system

Super-intensive indoor shrimp farming (Figure 20 and Figure 21) is a rather recent development that started in Vietnam in 2011 with some trials in Bac Lieu province (The Mekong Delta). Even though it requires very high investment costs, it is a possible future direction of development. Stocking densities are much higher compared to other production systems and the farms are completely isolated from their surroundings, with ponds being located in a green-house. This can be very beneficial for the water quality in natural waterways when discharge water is treated properly. So far, super-intensive farming is only practised with *Penaeus vannamei* (whiteleg shrimp) and not with *Penaeus monodon* (black tiger shrimp) or other species.

Table 5. Key features of intensive farming versus super-intensive farming.

Indicators	Intensive farming practice	Super-intensive farming practice
Average stocking density	➢ P. vannamei: 70-90 PL/m2 ➢ P. monodon: 35-40 PL/m2	➢ P. vannamei: 200-500 PL/m2
Average productivity	➢ P. vannamei: 6-15 tons/ha/year ➢ P. monodon: 2-8 tons/ha/year	➢ 40-80 tons/ha/crop
# of crops per year	2-3	3
# of days per crop	➢ P. vannamei: 90-100 days ➢ P. monodon: 110-140 days	85-105
Harvesting season (seasonality)	➢ All year round with peaks from February to March (Mekong Delta), June to July (central Vietnam) and from September to October (both areas)	All year round
Type of farmer	➢ Small-scale farms and corporate farms	➢ Corporate farms: (Viet-Uc, Minh Phu, Tana farm of Fimex, BIM group.
Potential risks	➢ Abuse of antibiotics and chemicals ➢ Product adulteration after harvest ➢ Water pollution of adjoining water bodies ➢ Neighborhood conflicts due to resource exploitation and water pollution ➢ Long and complicated supply chains	➢ Disease outbreaks

2.3. Wastewater treatment systems

In Vietnam, the majority (80–90%) of the farms does not use any wastewater treatment systems. Regarding the investment cost for a wastewater treatment system, it is difficult to state an exact number. To build a wastewater system and operate it could cost the farmer or producer around 5 to 50 US dollars/ha (from primitive to innovative systems). More and more farms are investing in (innovative) wastewater treatment systems, including:

1. Wastewater treatment pond with Tilapia
2. Tilapia polyculture (shrimp-Tilapia)
3. Blood cockle cultivation
4. Biogas systems
5. Recirculation Aquaculture Systems (RAS)

No wastewater treatment (traditional system) (Figure 22): Currently, the majority of shrimp farms (80–90%) are releasing untreated water directly into the river or sea. There are no enforcement and clear standardized criteria from the government towards the wastewater in aquaculture. The wastewater of shrimp pond will be released into a settling pond, organic matters will be settled, then be automatically drained out to the river.

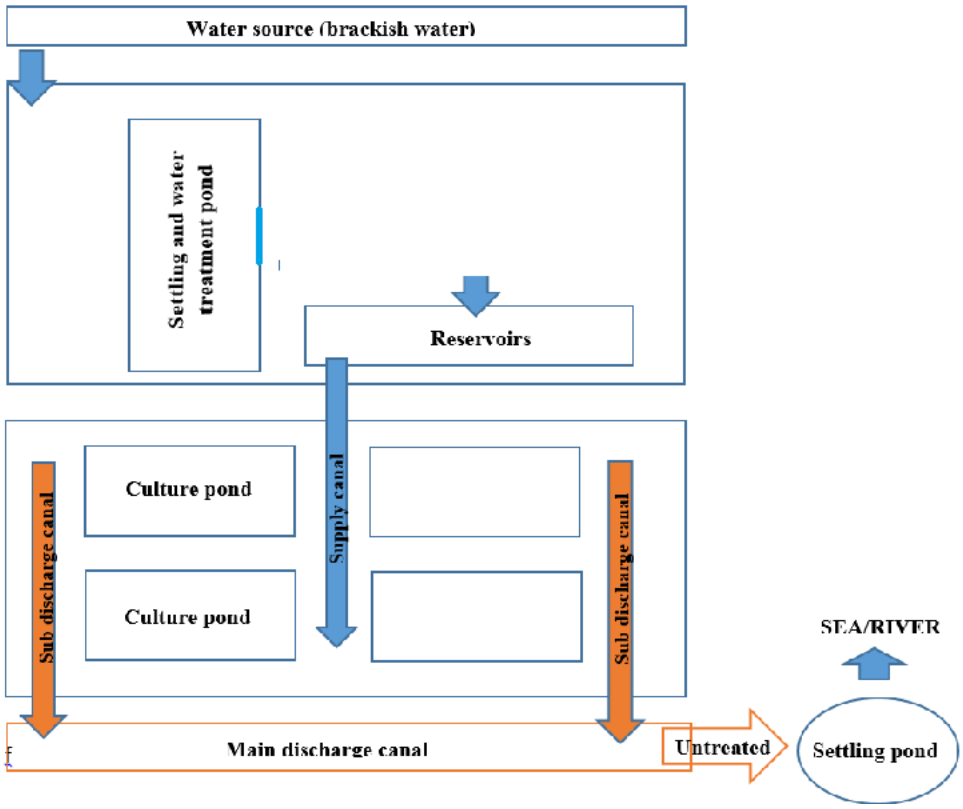

Figure 22. Untreated wastewater, traditional system.

Innovative wastewater treatment (innovation systems): Innovation technologies in wastewater treatment are currently being initiated into the shrimp farming sector. There are several innovative models applied to treat wastewater including integrated tilapia culture, blood cockle cultivation, and biogas system. Recirculating Aquaculture System (RAS) is also applied in shrimp farm, but just performing in small-scale and demonstration farms which invested by foreign investment (Ben Tre, Bac Lieu provinces, the Mekong Delta).

Wastewater treatment pond with Tilapia (Figure 23, Figure 24 and Figure 25): After around 30-45 days of culture, wastewater of shrimp pond will be pumped into a tilapia pond for treatment purpose. As the nature of tilapia, they will consume the phytoplankton and zooplankton in the upper water column.

They work as a natural filtration system to make wastewater sanitation. After 7 days, the treated water can be re-used in the shrimp pond. The growers who apply this practice are satisfied with the increased productivity (both for shrimp and tilapia), the reduced the disease outbreaks (EMS/AHPND and White spot disease), and the reduction in the use of chemicals in the shrimp farm (*Yang Yi and Kevin Fitzsimmons, 2002)*.

Figure 23. Tilapia culture for treating detritus and wastewater.

Figure 24. Re-used of wastewater from Tilapia pond.

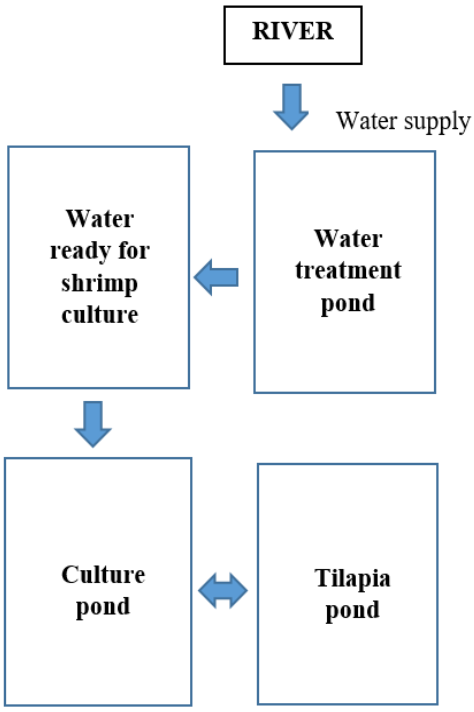

Figure 25. Treated wastewater by applying an independent Tilapia pond.

Tilapia polyculture (Figure 26 and Figure 27): Another model is Tilapia polyculture (Shrimp-Tilapia). Several Tilapia cages will be installed in the shrimp pond. The growers do not need to feed them with artificial feeds or commercial feeds. Tilapia can consume available nutrients presented in shrimp waste, organic matters, plankton, small crustaceans, and even dead shrimp. This reduces disease prevalence, removes potential vectors and bacterial infection at shrimp farms (*Yang Yi and Kevin Fitzsimmons 2002).*

Figure 26. Tilapia cage is placed in the middle of the shrimp pond for treating wastewater.

Figure 27. Tilapia cages are placed around the shrimp pond for treating wastewater.

Blood cockle cultivation: The model of culture blood cockle in extensive and intensive farms is an effective way to treat wastewater naturally. Blood cockles can filter organic matter present in the wastewater of shrimp ponds, thereby increasing the water quality.

Figure 28. Extensive shrimp farming combined with blood cockle.

Figure 29. Blood cockle harvested through the blood cockle cultivation farming model.

Biogas systems: Other farmers use the biogas system to treat the sediments of the shrimp ponds and transform them into the biogas production for using. The biogas production by anaerobic digestion produces methane that can be used as a renewable energy source.

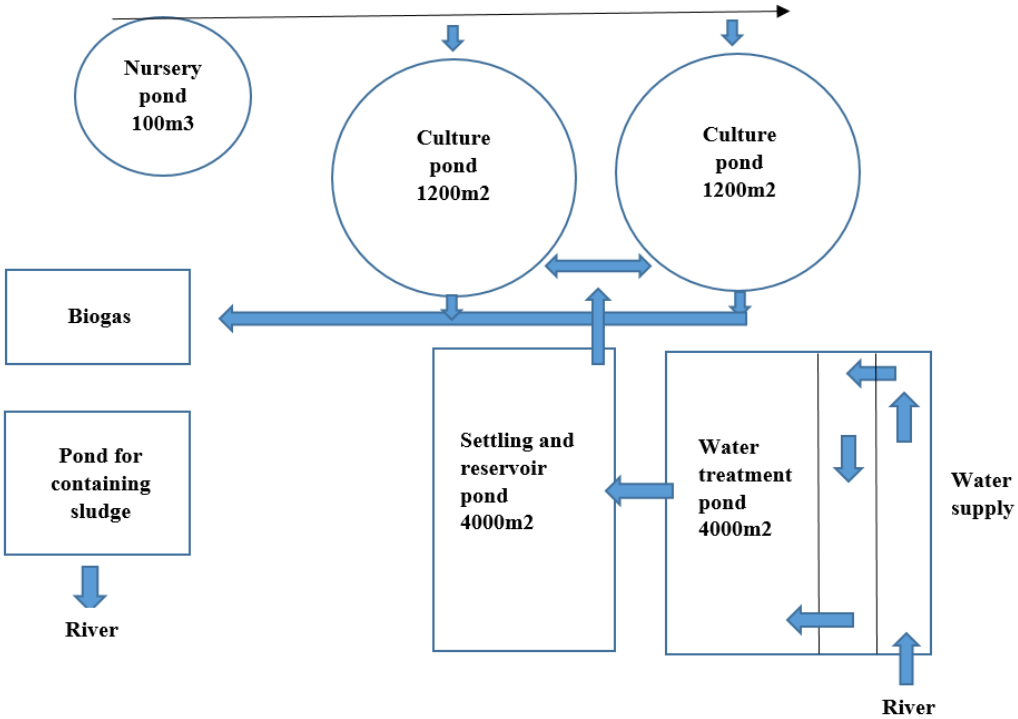

Figure 30. A model of wastewater treatment by applying a biogas system.

Figure 31. Application of biogas in wastewater treatment of an intensive shrimp farm (Tien Giang Province, 2018).

Figure 32. Application of biogas in wastewater treatment of a super intensive shrimp farm (Nhon Trach district, Dong Nai Province, 2019).

2.4. Feed

An overview of the major players in the feed industry and their production can be found in Table 6.

Table 6. An overview of the shrimp feed industry in Vietnam (2019).

Feedmills	Estimation of average production/volume (tons)
C.P	>200,000
Grobest Vietnam	180,000
Shenglong	>100,000
Uni-president Vietnam	>100,000
Tongwei	50,000 – 70,000
Skretting Vietnam	25,000 – 30,000
C.J	10,000
Cargill Vietnam	20,000
Dehues	10,000
Tomking	10,000

3. Production

According to an estimation of the Directorate of Fisheries, shrimp production until April 30th 2020 (the first 4 months of 2020) was for 168,600 tons.

The Black tiger prawn (*P. monodon*) and whiteleg shrimp (*P. vannamei*) farms in the Mekong Delta account for 94.3% and 75.8% of the farming acreage across the country, respectively. Farms in the Mekong Delta produce 94.7% and 74.4% of the total domestic black tiger and whiteleg shrimp production, respectively. The exact number of shrimp farmers or active farming ponds in each province is difficult to state, as it heavily fluctuates because of various factors (diseases, investment, missing statistical data from the government, etc.).

The leading shrimp producers are located in the provinces Bac Lieu (the largest producer), Ca Mau, Tra Vinh, and Kien Giang, respectively. A map of Vietnam, including names of its coastal provinces, can

be found in the Annex (Figure 33). Table 7 provides an overview of farming acreage and shrimp production of Vietnam in 2019.

Table 7. An overview of farming acreage and shrimp production of Vietnam in 2019 (DoF, 2020).

No.	Province	Farming season	Black tiger shrimp		Whiteleg shrimp	
			Acreage (ha)	Production (tons)	Acreage (ha)	Production (tons)
1	Quang Ninh	April to October (to avoid the cold season from November to March)	2,000	1,304	2,469	4,000
2	Hai Phong		1,721	26	85	293
3	Thai Binh		2,600	-	253	-
4	Nam Dinh		2,450	2,300	940	4,000
5	Ninh Binh		1,985	564	260	934
6	Thanh Hoa		3,734	1,000	350	4,000
7	Nghe An	February to October (to avoid the cold season, floods, and typhoons from November to January)	104	-	2,170	-
8	Ha Tinh		500	500	2,250	3,938
9	Quang Binh		-	-	-	-
10	Quang Tri		401	1,065	860	4,072
11	TT Hue		326	275	58	637
12	Da Nang		-	-	44	-
13	Quang Nam		-	-	-	-
14	Quang Ngai		-	-	-	-
15	Binh Dinh	Maybe year around, however, it is influenced by the erratic weather, disease outbreaks, and salinity intrusion.	1,409	-	790	-
16	Phu Yen		213	272	1,900	8,578
17	Khanh Hoa		435	230	1,574	4,930
18	Ninh Thuan		-	-	-	-
19	Binh Thuan		31	247	1,046	8,135
20	Ba Ria – VT		3,375	3,125	532	4,499
21	HCMC		-	-	2,560	9,900
22	Long An		-	-	-	-
23	Tien Giang		2,221	2,750	2,074	17,300
24	Ben Tre		25,550	6,250	11,050	0,750
25	Tra Vinh		25,663	14,345	7,756	53,423
27	Bac Lieu		125,301	97,321	10,321	52,909
28	Ca Mau		259,680	98,700	7,304	75,800
29	Kien Giang		125,056	58,972	2,820	23,754
I	The Mekong Delta (% of total)		563,471	278,338	41,325	223,186
			96%	96%	69%	79%
II	Total		**584,755**	**289,246**	**59,466**	**281,102**

The negotiation position of shrimp farmers in the industry is slightly weak, as they depend on both input material suppliers (feed, seed, chemicals, probiotics,...) and output channels (brokers, processing plants,...). Table 8 shows an overview of the production cost, market price, and revenue for shrimp.

Table 8. Shrimp production cost, market price, and revenue based on shrimp sizes.

	Whiteleg shrimp (Vannamei)	Black tiger shrimp (Monodon)

Size (g/shrimp)	Price (VND/Kg)	Production cost (VND/Kg)	Revenue (VND/Kg)	Price (VND/Kg)	Production cost (VND/Kg)	Revenue (VND/Kg)
10.0	90,000	75,000	15,000	120,000	100,000	20,000
20.0	110,000	80,000	30,000	135,000	105,000	30,000
30.0	140,000	95,000	55,000	150,000	110,000	40,000
40.0	170,000	110,000	60,000	180,000	120,000	60,000
50.0	200,000	115,000	85,000	220,000	130,000	90,000
70.0	250,000	130,000	120,000	260,000	140,000	120,000

4. Certifications

Since starting in the early 1990s, the shrimp industry in Vietnam has grown in scale and quality of technical management and traceability. Also, management of environmental impacts has evolved throughout the entire supply chain, starting with hatcheries, feed mills, farms and processing plants leading to export through the modern cold storage facilities. At present, there are around 200 shrimp processing plants approved by the European Commission with periodic inspections on-site in Vietnam.

The most reliable evidence of the safety and sustainability of shrimp farming is the increasing number of certifications schemes for good aquaculture practices put forth by international standard bodies[3]. At present, there are over 30 certification schemes and eight key international agreements relevant to aquaculture certification ([3]FAO, 2007). Certifications aim to provide transparency on sustainability and production standards. Four key certification schemes are operating in Vietnam: [4]GLOBALG.A.P., [5]VietG.A.P, [6]ASC, and [7]BAP. To achieve these certifications, farms must be built and operated based on the criteria:

- Compliance with the law (legal compliance).
- Conservation of natural environment and biodiversity.
- Conservation of water resources.
- Preserve diversity of wild species and populations.
- Responsible use of feed and other resources.
- Animal health (no use of antibiotics and unnecessary chemicals).
- Social responsibility (e.g. no child labor, worker health and safety, freedom of assembly, community relations).

In 2019, there were 124 ASC certified and 192 BAP-certified facilities and farms ([8]VASEP, 2019). Currently, mainly larger producers have been certified.

The ASC standard has a strong presence in Europe, targeting specifically shrimp. The Global Aquaculture Alliance (GAA) has a strong presence in North America and targets shrimp and feed specifically within its BAP standards. VietG.A.P. is Vietnam's national certification standard, acting as an entry standard into international certification schemes such as GLOBALG.A.P., ASC, and BAP ([9]Marschke & Wilkings, 2014). Three of the standards, GLOBALG.A.P., ASC, and BAP are private international standards with certification performed via independent, accredited third-party certification bodies. VietG.A.P., in contrast, is an example of first-party certification: the government developed the standard and also manages the certification process through its national certification body QUACERT ([9]Marschke & Wilkings, 2014).

Table 9 shows details about the key aquaculture certifications in Vietnam.

Table 9. Key aquaculture standards operating in Vietnam.

Standard	Certifier	#Producers	Details	Certification's logo
GLOBAL G.A.P.	GLOBAL G.A.P	20 GLOBAL G.A.P.-certified farms (Until Dec-2019)	GLOBALG.A.P.'s began in 1997 as EUREPGAP, an initiative by retailers belonging to the Euro-Retailer Produce Working Group. British retailers working together with supermarkets in continental Europe become aware of consumers' growing concerns regarding product safety, environmental impact and the health, safety and welfare of workers and animals. Today, GLOBALG.A.P. is the world's leading farm assurance program, translating consumer requirements into Good Agricultural Practice in a rapidly growing list of countries – currently more than 100. Business to business, no label.	
Vietnamese Good Agriculture Practices (VietG.A.P)	QUACERT	97 VietG.A.P.-certified farms (until Dec-2019).	Established in 2011, VietG.A.P. (Vietnamese Good Agriculture Practices) is Vietnam's national guidelines for Good Aquaculture Practices. Compliance with VietG.A.P. guidelines reduces the certification fees for other certification programs i.e., GLOBALG.A.P., and ASC. Business to business and business to consumer, label. VietG.A.P. Practices good agriculture production in Vietnam is based on 4 criteria, such as Standard on production techniques; Food safety including measures to ensure no chemical contamination or physical contamination during harvesting; Working environment aims to prevent abuse of the labor of farmers; and Product traceability.	
Aquaculture Stewardship Council (ASC)	Aquaculture Stewardship Council (ASC)	124 ASC-certified facilities (until May-2020)	Established in 2010 by the World Wide Fund for Nature (WWF) and the Dutch Sustainable Trade Initiative (IDH) to provide a world-leading certification program for the aquaculture industry. The ASC's mission is to transform aquaculture towards environmental sustainability and social responsibility using efficient market mechanisms that create value across the chain. ASC aims to be the world's leading certification and labelling program for responsibly farmed seafood. The ASC's primary role is to manage the global standards for responsible aquaculture, which were developed by the WWF Aquaculture Dialogues. Business to consumer, label.	

Best Aquaculture Practices (BAP)	Global Aquaculture Alliance (GAA)	192 BAP-certified facilities (until Dec-2019)	Founded in 1997, the Global Aquaculture Alliance (GAA) developed the BAP-standards and is a not-for-profit industry trade association. GAA's certification body certifies shrimp popular in the USA. BAP-standards include criteria for finfish and crustaceans, salmon, mussel, shrimp, pangasius. GAA has also developed a feed standard. Business to consumer, label. The BAP program drives continued improvements via high standards that deliver significant benefits industrywide. The BAP standards cover aquaculture facilities for a variety of finish and crustacean species, as well as mussels. The Best Aquaculture Practices standards have been developed and administered by the Global Aquaculture Alliance (GAA).	

Vietnam is working towards VietG.A.P. certification for black tiger shrimp and white leg shrimp ([5]VietG.A.P, DoF, 2020). There is a possibility that this national standard can better account for local conditions as compared to its international counterparts; however, this remains to be seen as VietG.A.P. is in its infancy ([9]Marschke & Wilkings, 2014).

According to [7]Marschke & Wilkings, (2014), ASC criteria place a stronger emphasis on social dimensions of sustainability such as employment conditions and gender relations than either GLOBALG.A.P. or VietG.A.P. (although GLOBALG.A.P. draws on national legislation for most legal requirements). From an environmental perspective, GLOBALG.A.P. addresses the use of wild seed in fish farming, directly prohibiting this practice, which is important for sustainability reasons but may not be realistically achievable for small producers. The standard can provide a higher price than the current market price for the shrimp farmers or producers. A commitment can be made between farmers and processors. Sometimes, the market price is significantly lower than the commitment price with the acceptable shrimp quality. The processors may have a choice to achieve their optimum profitability. The processors want to buy shrimp from the farms which have certificates to have traceability for their products.

Both ASC and VietG.A.P. require compliance with minimum wage laws, which is a significant concern for small producers, while GLOBALG.A.P.'s Risk Assessment on Social Practices (GRASP) places initial assessment on local legislation. The ASC also allows for less rigorous requirements for smallholders concerning Environmental Impact Assessments (the ASC standard sets out different methodologies and requires different levels of support for small farms and large farms when conducting impact assessments). Finally, factors related to traceability, geographical coordinates, and record-keeping require a degree of compliance across all three standards.

Key recommendations

1. The key developments expected in the shrimp production sector:
   - Reducing production cost.
   - Reducing pollution from the shrimp farming industry.
   - Using high-tech (more automatic and AI) and comprehensive approaches to establish shrimp farming protocol.
   - Enhancing shrimp production and shrimp export.

2. The key challenges in the sector right now:
   - High production cost.
   - Environmental pollutions and conflicts of interest.
   - Disease outbreaks and erratic weather due to the impacts of climate change.

3. ShrimpVet's advice for sector development in the next three years:
   - Improving/applying disease control protocols and biosecurity for all the supply chain from broodstock, PL production, feed, and farming, to processing and export.
   - Applying innovative protocols (fermented soybean, functional feeds, etc.) in shrimp farms.

4. How can the ShrimpTechVietnam consortium contribute to these developments?
   - From our point of view, the ShrimpTechVietnam consortium can involve to develop and promote a complete production value chain from the hatchery to farming. The focus should be on the elimination of antibiotics, the use of biotechnologies, a low ecological footprint (carbon, wastewater, water re-use, ...), and generally more environmentally friendly and sustainable production.

5. The sector, five years from now:
   - Fast growth shrimp lines will be developed.
   - Disease resistance shrimp lines will also be developed.
   - More adaptive with the ecosystem, erratic weather, and salinity intrusion.
   - Increasing innovative shrimp farms and corporate farms.
   - Processing and shrimp export will grow with approximately 20% when the FTA with the EU becomes effective.

References

1. Directorate of Fisheries (DoF) (https://www.fistenet.gov.vn/Home), 2020/ trien-khai-nhiem-vụ-phat-trien-nganh-tom-nuoc-lo-nam-2020.
2. Shrimp News. World Aquaculture (the quarterly magazine of the World Aquaculture Society. Editor–in–Chief, John Hargreaves. Innovation in Seed Production and Farming of Marine Shrimp in Vietnam. Tran Ngoc Hai, Pham Minh Duc, Vo Nam Son, Truong Hoang Minh and Nguyen Thanh Phuong. Volume 46, Number 1, Page 32, March 2015.)
3. Corsin, F., Funge-Smith, S., Clausen, J., & Fao, B., 2007. A qualitative assessment of standards and certification schemes applicable to aquaculture in the Asia-Pacific region. FAO Region office for Asia and the Pacific, Bangkok.
4. GLOBALG.A.P. The GLOBALG.A.P. Aquaculture Standard 2020 (https://www.globalgap.org/uk_en/for-producers/globalg.a.p./integrated-farm-assurance-ifa/aquaculture/ [accessed (20.5.2020)]
5. VietGAP. Guidelines Directorate of Fisheries. 2020. (https://tongcucthuysan.gov.vn/vi-vn/hệ-thống-văn-bản/-bộ-nn-ptnt/chi-tiet/014538/2020-05-19/du-thao-tcvn-thuc-hanh-nuoi-trong-thuy-san-tot-tai-viet-nam-vietgap)_[accessed 20.5.2020].
6. Aquaculture Stewardship Council. ASC Shrimp Aquaculture Standard, Version 1.1, March, 2019 (https://www.asc-aqua.org/what-we-do/our-standards/farm-standards/the-shrimp-standard/) [accessed 20.5.2020].
7. BAP. BAP Standards & Guidelines, 2020 (https://www.bapcertification.org/Standards) [accessed 20.5.2020].
8. VASEP (Vietnam Association of Seafood Exporters and Producers), 2020. Certification [online]. Ho Chi Minh City. http://seafood.vasep.com.vn/702/onecontent/certifications.html [accessed 20.5.2020].
9. Marschke, M., & Wilkings, A. (2014). Is certification a viable option for small producer fish farmers in the global south? Insights from Vietnam. Marine Policy, 50, 197–206. doi:10.1016/j.marpol.2014.06.010.

Annex

Figure 33. Map of Vietnam and its coastal provinces.

Table 10. Additional evaluation of costs and benefits

Criteria	Costs	Benefits
GLOBALG.A.P. (www.globalgap.org)	The GLOBALG.A.P website reports the following fees to be paid by producers or groups of producers: ➢ Retail & Food Service Membership with annual turnover: • 5 billion € and less >> 5,000€. • 5 to 15 billion € >> 7,000€. • More than 15 billion € >> 9,000€. ➢ Individual Supplier Membership: 1,550€	➢ Reduced food safety risks using HACCP-based reference standards. ➢ Reduced cost by avoiding the proliferation of buyer requirements and shifting of GLOBALG.A.P. retailer and foodservice members towards supplying products from GLOBALG.A.P. approved sources. ➢ Avoiding excessive regulatory burdens. ➢ Achieving global harmonization. ➢ Increasing the integrity of farm assurance schemes worldwide by defining and enforcing a common level of auditor competence, a common

	➢ Group Supplier Membership: 2,550€ ➢ Supplier Membership Extension: 525€ ➢ Associate Membership: 1,550€ Academic Membership: 1,550€	level of verification and action on noncompliances and by harmonizing interpretation of compliance criteria.
VietG.A.P. (www.quacert.gov.vn)	The QUACERT Website reports the following fees to be paid by producers or groups of producers: ➢ Certification registration fee: $350/certificate ➢ Audit fee: $350/working day.	➢ The Vietnamese Department of Fisheries declares that compliance with the Vietnamese shrimp quality program leads to the following benefits: premium prices, minimized environmental impact, improved sustainability of the sector and less conflict with NGOs, in addition to better acceptance of the product by buyers. • The product easily penetrates the market. • Product has a higher price. • Occupied the consumer's confidence in the quality of products. • Helping consumers recognize the product is safe and takes care of environmental and social responsibility. • Limiting risk due to diseases. ➢ Save productivity costs due to measurable chemicals, food, etc.
ASC (www.asc-aqua.org)	According to the ACC Website, to be certified, facilities have to pay an annual fee depending on the value of ASC certified seafood (in British pound sterling, converted to USD at 1.31USD). There are three scales of ASC certified seafood: ➢ 0-170,312 USD: 207 USD annual fee ➢ 170,313-432,331 USD: 1,048 USD annual fee ➢ >432,331 USD: 2,096 USD annual fee.	➢ The main difference between the ASC farms and the non-ASC farms is costs with more investment costs, particularly up front, but also higher avoided costs (or cost savings) specifically in inputs (chemicals). Overall, in the study, ASC farm financial situation was positive, but inconclusive as discussed below. Details of some of the differences: ➢ Chemicals - costs (down) • fewer chemicals -> less out of pocket • Higher quality -> higher $ but more effective so less $ • Direct purchasing for traceability -> reduced costs ➢ Infrastructure Costs (up) • Higher pond preparation costs • Higher repairs ➢ Certification Costs (up) • Application, training, and certification assessment cost ➢ Bank Interest Costs (up)

		➢ Revenues: Higher revenues were observed in ASC certified shrimp farms with various contributing factors - higher selling prices – ASC certification, larger size, and reduced middlemen. Profits (revenue fewer costs) ranged from + 3% to +123% in the ASC shrimp farms in the study. ➢ Social benefits • higher labor costs on farm • improved social benefits for individuals • improved community relationships
BAP (www.bapcertification.org)	According to the BAP Website, to be certified, facilities must pay: (1) A US$500 processing fee. (2) An inspection fee to certifiers (most recently to be paid directly to the ACC) composed of two parts: (i) a daily consultation rate which can vary from US$400 to US$800/day depending on the country in which the facility is located. Generally, certifiers are said to spend several days evaluating a shrimp farm or facility and to decide whether the facility meets the requirement for certification. (ii) Actual expenses encountered by the ACC certifier, including the cost of travel, lodging, meals, and communications (fax, Internet, etc.). Plant exported: ➢ <1,000 tons of finished products: Min. US$2,000 ➢ >1,000 tons of finished products: US$2/ton (max. US$8,000) Recertification costs to the business annually: US$1,000 for a processing fee and certifier-related fees for site inspection and review.	➢ Although so far there are no reports of better prices being paid for ACC-certified products, in 2005 Wal-Mart, the largest retailer in the world, entered into a partnership with GAA and ACC by declaring that all the foreign shrimp suppliers should be certified as compliant to BAP. In early 2006, Darden ➢ Restaurants declared their intention to require GAA certification from their shrimp suppliers and, with the acceptance of ACC-certified products also by Lyons Seafood Ltd. (one of the major seafood suppliers in the United Kingdom); this scheme seems to be rapidly establishing itself in the market place. External benefits such as environmental protection and social sustainability would also appear to be associated with compliance with the scheme although no actual evidence is available yet.