LITERATURE REVIEW

SUSTAINABLE SHRIMP FARMING IN THE WORLD AND IN THE MEKONG RIVER DELTA

Project: Towards Sustainable Mangrove-Shrimp Aquaculture Through Capacity Building and Partnership in the Mekong River Delta

CBA2019-FP16-Le-CECAD

1. Background information

1.1. Shrimp farming in the world and Vietnam

Shrimp is one of the most valuable seafood commodities in the world. Shrimps and prawns dominate the aquaculture production in coastal areas, constituting more than 60% of the farmed crustaceans in the world. They are the major exports from developing countries in Latin America and Asia to the traditional markets in Europe and North America, and emerging markets like China (FAO, 2020). To meet the demand of the growing global population with rising affluence, shrimp production tripled from 1.2 million to around 4.2 million metric tons between 2000 and 2017 (Rubel et al., 2019).

Cultivation of shrimps and other aquatic species, nonetheless, is confronted by manifold sustainability issues, including environmental impacts like mangrove degradation, water quality degradation, salt-water intrusion, and disease outbreaks (Sivaraman et al., 2019), and socio-economic impacts such as water use conflicts, and privatization of natural resources (Primavera, 1997). These issues, coupled with the food safety concerns over issues like bacterial contamination and drug residues, have led to the establishment of multiple international and national standards.

Shrimp producers and exporters are increasingly compelled to satisfy many stringent standards in order to avoid port rejection and gain buyer's acceptance and trust. Multiple international organizations, including Food and Agriculture Organization (FAO) and World Wildlife Fund (WWF), have provided guidance on meeting those quality, environmental and labor standards (Suzuki and Hoang Nam, 2018). Firms, governments and organizations set up numerous schemes, notably ASC, BAP and GLOBAL G.A.P, to provide institutions for auditing and certifying the standard-meeting producers. However, it has been argued that these certifications are costly, complicated and requiring a certain level of managerial capacity, thus excluding myriad small-scale producers from accessing the certification process (Bush et al., 2013). These schemes mostly adopt technical standards which reflect the demands of powerful buyers and activists in the developed world rather than considering the local socio-economic and environmental situations of producers in the global South (Vandergeest, 2007).

Vietnam is the third largest shrimp-production countries in the world (FAO, 2020). Shrimp is the second most important aquaculture industry in Vietnam - only after catfish – with the export value of around $3.4 billion in 2017 (Rubel et al., 2019). Shrimp culture has flourished in Vietnam especially after the Doi Moi liberalization reform in late 1980s. The government allowed farmers to convert rice fields and salt pans,

especially in the Mekong Delta, to shrimp ponds to promote poverty reduction. Shrimp farming thus becomes the main livelihoods for hundred thousands of people, who are mostly small-scale farmers supplying to export-oriented processors via contracts or networks of collectors and wholesalers. Although many processing companies produce shrimps at their own farms, the amount of internally farmed shrimps only reaches around 20% of their processing capacity (Suzuki and Hoang Nam, 2018).

The total area of shrimp production is about 700,000 hectares, focusing on two main species: whiteleg shrimp (*Litopenaeus vannamei*) and black tiger shrimp (*Penaeus monodon*). The former accounts for 60% of the total production; this species only started to be farmed in the early 2000s but rapidly overtook the latter due to their advantages like high productivity, fast growth, high resilience to diseases and environmental changes (Nguyen et al., 2019). Shrimps are cultivated in different models of farming systems, namely extensive/traditional, improved extensive, semi-intensive and intensive farming, which are classified based on pond size, capital, water exchange, feeding, chemical use, and stocking density (Anh et al., 2010).

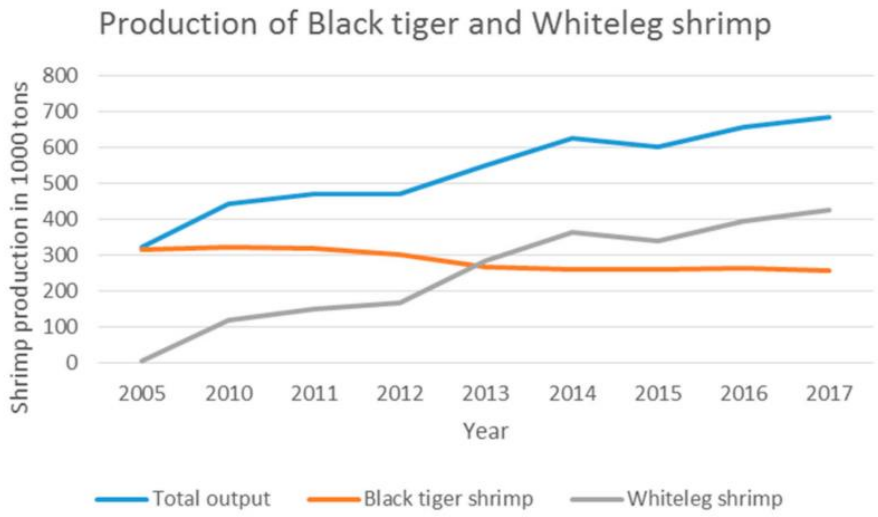

Figure 1. The production of black tiger prawn and white leg shrimp of Vietnam (2005-2017) *(Nguyen et al., 2019).*

1.2. Questions for sustainability

While playing an essential role in socio-economic development of many coastal provinces in the Mekong Delta, Vietnam's shrimp industry is unable to circumvent tremendous ecological and socio-economic challenges that jeopardizes its sustainability. Empirical and geospatial data show that the rise of shrimp farming in the region was the among the main drivers of the decline in mangrove forest, along with agriculture and urbanization (Binh et al., 2005; Tran et al., 2015). Not only the clearance of mangroves

for installing shrimp ponds, but also poor farming practices such as the discharge of polluted water and sediments, and the excessive use of feeds, chemicals and antibiotics are impairing the ecological integrity of mangrove and wetland areas (Anh et al., 2010).

The release of contaminated effluents without proper treatment can amplify the spread of disease outbreaks, for instance white spot syndrome (WSS), yellow head disease (YHD), Taura syndrome (TS), and early mortality syndrome (EMS). Along with the expansion and intensification of shrimp cultivation, disease outbreaks become more and more prevalent, leading to huge harvest loss and generating massive financial burdens on small-scale farmers. It is reported that up to 80-90% of shrimp farms in 2009-2010 were affected by diseases; many families went bankrupt and indebted (Lan, 2013). Ecological deterioration and disease outbreak risks are also impacted by the adverse consequences of climate change, including temperature increases, changing rainfall patterns, sea level rise and saline intrusion (Nguyen et al., 2019).

To tackle negative environmental impacts, augment productivity and mitigate disease risks, a host of shrimp farmers are inclined to adopt intensification, relying on technological advances in terms of feeding, drug uses, effluent treatment and water/aeration systems. Nevertheless, the access to intensification (technology, knowledge, credit) is unequal for shrimp producers: better-off farmers are more capable of investing in intensive and semi-intensive farming, yet paradoxically facing high risks of indebtedness (Hue and Scott, 2008). Conflicts over land and water uses occur between intensive and extensive shrimp farmers, as evidenced in Ca Mau and Long An province, when extensive farmers claim that their intensive neighbor farms are discharging contaminated or disease-infected water into the shared canals (Lan, 2013). It is unquestionable that the dominance of individual small-scale farmers and their lack of cooperation are the major obstacle for addressing the situation.

1.3. Government policies and sustainable shrimp certifications

The sustainability challenges that we briefly summarize above have been well-acknowledged by those public and private stakeholders involved in the shrimp industry or working on the socio-economic and ecological welfare of the region. Since shrimps are considered one of the key export commodities and economic segment (especially for the Mekong Delta) by the public and private actors, various initiatives have been launched to promote the sustainable transformation of shrimp farming. The government promulgated the master plan for the development of the shrimp industry (Decision 79

QD-TTg), along with other legislations, that provide guidelines and platforms for (summarized by (Rubel et al., 2019)):

- Improving technical standards for the hatcheries and farming of *L. vannamei*
- Adopting certification schemes, for instance VietGAP, Better Management Practices (BMP) and others
- Training and enhancing the expertise of smallholders
- Nurturing cooperation among farmers, cooperatives and different actors in the supply chains, including hatcheries, producers, and processing companies
- Protecting and replanting mangrove forests, mitigating land conversion and adverse environmental impacts
- Phasing out the usage of antibiotics and chemicals in aquaculture

It is worth noting that the 2018 master plan and previous government policies do not have any bias against nor for intensification. The government indeed endorses the development of both protocols: (i) High-tech intensive, semi-intensive zones in the Mekong Delta and Central coastal provinces, (ii) Extensive, organic or ecological farming zones of *P. monodon*, with integrated models like shrimp-mangrove and shrimp-rice cultivation in Ca Mau and other Mekong Delta provinces. We concur with the diversification of shrimp farming practices, considering various biophysical and socio-economic conditions of Vietnamese wetland and coastal areas, as well as different technical requirements of *L. vannamei* and *P. monodon* (See Box 1. The ongoing debate on integrated mangrove-shrimp vs. intensive farming).

Box 1. The ongoing debate on integrated mangrove-shrimp vs. intensive farming

The mixed models of mangrove-shrimp or rice-shrimp farming have been adopted in various parts of the Mekong Delta since the 01990s (Lebel et al., 2002). Their idea can trace back to the traditional practice of extensive shrimp farming in the early 1980s (Ha et al., 2012). The practice is characterized by the low artificial stocking density (1-3 per m^2), low level of supplementary feeding, and sometimes, the usage of mangrove trees as biofilters for effluent treatment. The model appeals to shrimp farmers and policy-makers thanks to the lower investment cost than the intensive systems; and from the perspective of landscape management, protecting and integrating mangroves are for maintaining their ecological services (nursery, biofiltering, disease resilience) that benefit shrimp production (Bush et al., 2010).

However, it has been suggested that the construction of mangrove biofilters are costly but unproven in treatment efficiency (Engle and Valderrama, 2004). (Rubel et al., 2019) also argue against shrimp farming in mangrove areas, due to unfavorable pond construction, inappropriate acidic condition, higher risk of bank erosion, higher overall cost. There are few economic incentives for farmers to adhere to mangrove-to-pond ratio. Thus, many countries now stop recommending this practice, including Thailand which banned *P. monodon* farming in mangrove areas. Rubel et al. state that converting to closed, intensive *L. vannamei* farming while preserving mangrove forests is more economically and ecologically sound. (Nguyen et al., 2019) supported such argument, maintaining that closed systems like Biofloc or RAS (recirculating aquaculture systems) have advantages over the conventional "open production systems" (extensive, intensive, semi-intensive) in terms of the capacity to monitor and control the recycling of water and nutrients.

Lastly, numerous certification standards have been implemented for more than two decades, involving multiple actors and segments in the shrimp supply chains (Table 1). The most adopted ones are Good Agricultural Practices (including GlobalGAP & VietGAP), Best Aquaculture Practices (BAP), Aquaculture Stewardship Council (ASC); in addition to organic standards like Naturland, and food safety standards such as Safe Quality Food (SQF), Hazard Analysis and Critical Control Points (HACCP). Similar to other cases in the world, the trend in certification reflects the swelling market requirements as well as the efforts of state and non-state agencies in promulgating 'sustainable' patterns of agri-food production and consumption.

Table 1. Main certification standards targeting different segments in Vietnamese shrimp industry (Nguyen et al., 2019)

	General Types of Certification				
Specific Targets	**General Product Certification**	**Standards**	**Production System Certification**	**Processing Certification**	**Product Certification**
Farming practices	ASC, GLOBAL GAP, BAP, VietGAP	GLOBAL GAP, BAP, VietGAP	GLOBAL GAP, BAP, VietGAP	GLOBAL GAP, BAP, VietGAP	HACCP, GLOBAL GAP, BAP, VietGAP
Chemicals	ASC, GLOBAL GAP, BAP, VietGAP	BAP, GLOBAL GAP, VietGAP,	GLOBALGAP, BAP, VietGAP	GLOBAL GAP, BAP, VietGAP	HACCP, GLOBAL GAP, BAP, VietGAP
Environment	ASC, GLOBAL GAP, VietGAP, BAP ASC	BAP, GLOBAL GAP, VietGAP	GLOBAL GAP, BAP, VietGAP	GLOBAL GAP, BAP, VietGAP	HACCP, GLOBAL GAP, BAP, VietGAP
Social	ASC, GLOBAL GAP, BAP	BAP, GLOBAL GAP, Viet GAP	GLOBAL GAP, BAP, VietGAP	GLOBAL GAP, BAP, VietGAP	HACCP, GLOBAL GAP, BAP, VietGAP

Various organizations play different roles in diffusing and governing the certification schemes. Ministry of Agriculture and Rural Development (MARD) provides legal frameworks for the development of the shrimp industry and those certifications, while National Fisheries Quality Assurance and Veterinary Directorate (NAFIQAD) offers essential services including monitoring, eval

uation and accreditation of product quality. Vietnam Association of Seafood Exporters and Producers (VASEP) supports its members (exporters, processors and producers) with information, expertise and training regarding safety and quality management. Non-government organizations, universities and research institutes are involved in supplying research information and extension services to producers and policy-makers.

Box 2. Definitions of certification, standards, principles and practices (Corsin et al., 2007)

Certification is a procedure through which written or equivalent assurance states that a product, process or service conforms to specified requirements. A process of testing or auditing is conducted by a **certification body** to evaluate and certify the degree of compliance of the product/production unit to the requirements (via issuing certificates). There are different types of certifications, depending on who certification body is: **first party** (producers or producer organizations), **second party** (entities that have user interests like traders, retailers or consumer organizations), **third party** (independent firms or organizations), and **fourth party** (governmental or intragovernmental entities). The procedure of recognizing a certification body is suitable to issue certificates is **accreditation**.

Specific characteristics required for a product or production process to be certified are **standards**, which can be mandatory or voluntary. **Principles** are statements describing the philosophical basis for production, trading and consumption of a product and are aimed at guiding stakeholders towards improving the sustainability of the sector. Examples of principles are Code of Conduct (CoC) or Code of Practice (CoP). To implement principles, **practices** such as GAP and BMP are developed. Practices are 'indicative' to implementing actors, in contrast to standards which are more like 'normative' rules.

As discussed above, the main ramification of international certification schemes is the exclusion of multiple small-scale holders from the certification markets due to high investment costs and complex registration process. Given the importance of

environmental quality control, their implementation also faces enormous challenges from the dominance of individualistic small-scale farms. It has become evident that fostering collective actions and promoting shared sustainable practices among small-scale producers are critical for achieving long-term sustainable development of the industry.

The analysis drives use to one main question: What are the key principles for the sustainable practices in along shrimp supply chains? In the following parts, we will present such principles of sustainability in the shrimp industry, classified by the two concepts of Good Aquaculture Practices (GAP) and Better Management Practices (BMP). We review the main principles covered by the concepts as well as their implementation globally and domestically. In the last part, we will discuss the newly developed shrimp standards by Asian Seafood Improvement Collaborative (ASIC), the strengths and limitations of these standards and their potential implications.

2. Principles for sustainable shrimp farming practices

The two main groups of practices broadly adopted in the shrimp industry are Better Management Practices (sometimes Best Management Practices, abbr. BMP) and Good Agricultural Practices (sometimes Good Aquaculture Practices, abbr. GAP). While both concepts are used widely to define 'sustainable' practices in aquaculture, their scopes differ: GAP usually focus on practices that address food safety, whereas BMP encompass a wider range of practices related to environmental protection, social responsibility and disease management (Corsin et al., 2007).

Along with these two concepts, another important set of principles is the Code of Conduct for Responsible Fisheries, issued by Food and the Agriculture Organization of United Nations (FAO) in 1995. Owing to the mounting global concerns over social and environmental impacts of the rapidly growing shrimp industry, a Consortium was established in 1999, involving the World Bank, the Network of Aquaculture Centres in Asia-Pacific (NACA), the World Wildlife Fund (WWF) and FAO. The discussions and meetings among the members of Consortium contributed to the issuance of *International Principles for Responsible Shrimp Farming* in 2006 (FAO/NACA/UNEP/WB/WWF, 2006). The *International Principles* include eight main principles as presented below:

Principle 1: Locate shrimp farms according to national planning and legal frameworks in environmentally suitable locations, making efficient use of land and water resources and in ways that conserve biodiversity, ecologically sensitive habitats

and ecosystem functions, recognizing that other land use, people and species depend upon these same ecosystems.

Principle 2: Design and construct shrimp farms in ways that minimize environmental damage.

Principle 3: Minimise the impact of water use for shrimp farming on water resources.

Principle 4: Where possible, use domesticated selected stocks of disease free and/or resistant shrimp broodstock and post-larvae to enhance biosecurity, reduce disease incidence and increase production, whilst reducing the demand for wild stocks.

Principle 5: Utilize feeds and feed management practices that make efficient use of available feed resources, promote efficient shrimp growth, minimize production and discharge of waste nutrients

Principle 6: Health management plans should be adopted that aim to reduce stress, minimize the risks of disease affecting both the cultured and wild stocks, and increase food safety.

Principle 7: Ensure food safety and the quality of shrimp products, whilst reducing the risks to ecosystems and human health from chemical use.

Principle 8: Develop and operate farms in a socially responsible way that benefits the farm, the local communities and the country, and that contributes effectively to rural development, and particularly poverty alleviation in coastal areas, without compromising the environment.

The *International Principles* formulate the philosophical basis for the local development of sustainable shrimp-related practices. Thus, many governments and NGOs have worked on designing and disseminating their localized CoP or CoC for Better Management/Good Aquaculture Practices. In Vietnam, NAFIQAD in collaboration with US Food and Drug Administration has launched the first GAP imitative in 2002. Also, Directorate of Fisheries, MARD with the assistance of NACA have developed BMP as alternative CoP for responsible shrimp farming, which requires less technical capacity for implementation than GAP (Anh et al., 2011).

2.1. Better Management Practices (BMP)

Better Management Practices refers to practices aimed at "overall reduction of on-farm and processing impacts and, by extension, cumulative impacts of agriculture" (Tucker and Hargreaves, 2009). "Better" indicates the 'means' necessary for the continuous enhancement in environmental conditions, while "best" denotes the "goals". Therefore,

'better' is often preferred as the aquaculture practices always need to continuously improved to suit the ever-changing environment.

Based on the FAO CoC and *International Principles*, NACA and local authorities sought to develop BMP as the alternative option with less technical prerequisites than GAP. BMP should consist of simple, generally accepted practices which are aimed at fostering sustainability of shrimp farming, but not necessarily demanding a formalized evaluation and certification process (Corsin et al., 2008). It has been argued that BMP is more accessible for small-scale farmers who have less knowledge and capacities to adopt international certification standards, yet the lack of certification provide little economic incentive for farmers to follow (Ha and Bush, 2010).

While there is no fixed set of principles for BMP, some mutual key principles are described as follows (Kusumawati and Bush, 2015; Tucker and Hargreaves, 2009):

1. **Site selection**

Ponds are built along the coast or beside the estuarine reaches of rivers where there is a suitable supply of good quality seawater or brackish water. The best areas for coastal ponds are above the tidal zone on flat or gradually sloping terrain. Former agricultural land often presents excellent sites, and salt flats located behind mangrove areas usually are suitable locations. The worst sites are mangrove forests or other coastal wetlands. Sites for inland culture of marine shrimp also should be restricted to those where salinization of soil and water can be avoided. Other considerations are:

- Do not alter local hydrology
- Consider climatological, meteorological, and geological conditions
- Confirm suitable terrain and soil characteristics
- Avoid sensitive habitats (mangrove forests, seagrass beds, coral reefs, or protected marine areas)
- Avoid conflicts with other resource users

2. **Shrimp farm design and construction**

Shrimp farms should be designed and constructed in a responsible manner. Design features and good construction methods should be used to overcome site limitations and to prevent or mitigate negative environmental and social impacts. Construction should be done by reliable firms using standard and proven techniques. Farms should not be constructed in ecologically sensitive places or in places where it is impractical to correct site-related problems such as highly acidic, organic, or permeable soils. It is especially important to design and construct aquaculture facilities in a way to avoid

possible negative environmental impacts identified in the environmental impact assessment. Moreover, the construction project itself should not be the source of negative social and environmental impacts. Other requirements area:

- Reduce or eliminate impacts on mangroves
- Protect earthwork from erosion
- Avoid ecological damage and noise at pumping stations
- Prevent negative impacts during construction

3. Sourcing of broodstock and postlarvae

The capture of wild postlarvae and broodstock is considered detrimental to natural shrimp fisheries and biodiversity. In Asia, natural broodstock for black tiger prawn has become scarce and very expensive. Therefore, producers should:

- Use only farm-reared broodstock and hatchery-produced postlarvae
- Purchase only specific pathogen-free (SPF) broodstock or postlarvae
- Use stress tests to evaluate postlarvae
- Comply with import regulations for broodstock and postlarvae
- Destroy diseased broodstock and postlarvae

4. Feeds and feeding

Manufactured feed can greatly increase production and the economic feasibility of aqua- culture. Feeds also are the source of two major concerns about aquaculture. First, environmental groups are concerned about the efficiency with which marine fishmeal and fish oil are used in aquaculture feeds (including shrimp feeds). Second, feeding leads to high concentrations of nutrients and organic matter in pond waters.

Feed is expensive and it should be used efficiently to reduce production costs and conserve fish and plant meals and oils that are used to make it. Good feeds and feeding practices also are important steps toward reducing waste loads in shrimp farm effluents. Thus, the requirements are:

- Use high-quality feed (e.g. less fishmeal and fish oil, less nitrogen and phosphorus than needed)
- Use efficient feeding practices
- Maximize the contribution of natural productivity to shrimp growth
- Do not use raw fish or other animal waste as feed

5. Effluent

Effluents from shrimp farms tend to have elevated concentrations of nutrients, suspended solids, and organic matter relative to receiving water bodies. Effluent

discharged from shrimp farms also is a potential avenue for the spread of pathogens to other shrimp farms or to wild shrimp. Adoption of BMPs for site selection, farm design and construction, feeds and feed management, and pond dry-out will provide water quality benefits within shrimp ponds that should improve effluent quality. However, BMPs for reducing the volume of effluent and removing solids before final discharge can also be beneficial in preventing water pollution by coastal shrimp farms. These practices should be:

- Comply with applicable effluent standards
- Reduce water exchange
- Recirculate water on the farm during shrimp grow-out
- Reuse water discharged when ponds are drained
- Use settling basins to treat draining effluents
- Use mangrove wetlands to treat effluents
- Monitor off-site water quality

6. Salinization

Saline discharge from coastal shrimp culture facilities may sometimes enter freshwater bodies to cause salinization. Inland culture of shrimp also is possible in areas with sources of saline water, and effluents from such facilities can lead to salinization. Hence, the recommendations are:

- Do not contaminate freshwaters with saline effluents
- Do not use freshwater from wells to dilute seawater supplies
- Prevent seepage of saline pond water into groundwaters
- Do not allow excessive draw down of freshwater aquifers
- Do not discharge saline effluents into irrigation canals or onto agricultural land
- Site, design, and construct farms to prevent salinization of soils and freshwaters
- Monitor surface and groundwaters for signs of salinization
- Reuse saline waters rather than discharging
- Discharge water slowly to prevent excessive increases in receiving stream salinity
- Dispose of sediments properly Sediment

7. Pond dry-out and sediment removal

Pond sediment quality is important in shrimp culture because shrimp spend most of their lives on or burrowed in the sediment. High concentrations of organic matter can lead to anaerobic sediment that can have adverse effects on shrimp growth and survival and on the quality of harvested shrimp. Water quality in ponds with good

bottom soil quality tends to be better than in ponds with impaired bottom soils, and maintenance of good soil quality probably improves effluent quality. Moreover, disease organisms and their vectors can survive in pond sediment and infect the next crop. Pond dry-out improves conditions for decomposition of organic matter, and disease organisms and their vectors can be killed by a combination of lime treatment to raise pH and dry-out. Sediment also must be removed occasionally from basins, canals, and ponds on shrimp farms. This sediment has a salt burden and should be disposed in a manner that avoids soil and water salinization or other ecological damage.

- Dry and lime bottom soils to enhance organic matter decomposition
- Treat wet soils to destroy vectors of disease and enhance organic matter decomposition
- Dispose of sediments properly
- Treat black water from cleaning pond bottoms by sedimentation

8. Predator control

High concentrations of shrimp in ponds provide attractive foraging opportunities for certain species of birds, reptiles, mammals, and fish. Predacious fish also can cause serious losses. In addition, predators indirectly affect shrimp production by serving as vectors for infectious diseases. Birds and other animals may move infected shrimp from one pond to another or spread pathogens in regurgitated stomach contents or fecal material. Total exclusion of predators is impractical at shrimp farms, and predator control techniques must be employed. Effective control usually relies on a combination of management approaches. Overall, the best approach is integrated pest management where pests are identified, the type and level of damage is assessed through regular monitoring, and control methods are chosen that are appropriate for the predator and level of damage.

9. Facility operation and maintenance

Shrimp producers must store and handle fertilizers, liming materials, feeds, fuels, lubricants, and other chemicals. They also must operate tractors, trucks, aerators, and other equipment. This equipment and the farm infrastructure should be maintained properly. These general operations necessary to support specific pond management tasks should be done safely and in an environmentally responsible manner.

- Collect and dispose of solid waste on a regular basis and in a responsible manner according to all applicable state and federal regulations
- Maintain all equipment in good working condition

- Use and store petroleum products to prevent contamination of the environment
- Use and store chemicals to prevent contamination of the environment
- Oxidize sodium metabisulfite solutions completely before discharging them to natural waters
- Develop a response plan for spills of petroleum products, pesticides, and other hazardous materials
- Develop a record-keeping system

2.2. Good Aquaculture Practices (GAP)

According to (FAO, 2003), Good Aquaculture/Agricultural Practices are defined as "approach that improves environmental, economic and social sustainability of on-farm production and results in safe and quality food and non-food agricultural products". While the scope of GAP has been broadened to cover the three pillars of sustainability (economic, environmental, social), the international understanding of GAP usually refers to the practices necessary for producing high-quality food complying with food safety requirements (Tien and Griffiths, 2009). GAP approach seeks to minimize the risks of contaminating food products with biological pathogens (bacteria, fungi, viruses, parasites) and chemicals (pesticide residues, heavy metals, nitrate content).

GAP covers production based on site selection, land use, fertilizer, water, pest and disease control, collection, packaging, storage, field sanitation, and product transport, etc. to develop sustainable agriculture with the aim of ensuring:

- Safe for food
- Safe for producers
- Environment protection
- Traceability of the product

GAP standards for safe food focus on the following four criteria:

a. Standard for production techniques

The aim is to use as few pesticides as possible, in order to minimize the impact of chemical residues on humans and the environment:

- Integrated Pest Management (IPM)
- Integrated crop management (ICM).
- Maximum Residue Limits (MRL) in products.

b. Food safety standards

These standards include measures to ensure the absence of chemicals, contamination or physical contamination at harvest:

- Risk of biological infection: viruses, bacteria, molds
- Chemical hazard.
- Physical risk.

c. Working environment

The aim is to prevent the abuse of farmer labor:

- Means of health care, first aid, workers' toilets
- Training and training for workers
- Social welfare.

d. Traceability

GAP focuses heavily on traceability. If something goes wrong, the supermarkets have to really be able to solve the problem and recall the defective products. This standard allows us to identify problems from the production to the sale of a product.

GAP has the following *benefits*:

- Food safety: as the certified food has lower amount of residues than the permitted level, and has no microbial contamination, health and safety of consumers are ensured.
- High quality food which are more likely to be accepted by domestic and foreign consumers.
- GAP production processes are part of protecting the ecological environment, reducing the health care costs of society, improving the quality of life for the community, ensuring the sustainable development of society.

Each country can develop its own GAP standard according to the international standards, for instance USGAP (USA) and EUREPGAP (European Union). ASEAN countries have implemented GAP from adjusting EUREPGAP standards to suit the production situation of each country such as: SALM system of Malaysia, INDONGAP of Indonesia, VFGAP of Singapore, GAP of Thailand...

The Union of Southeast Asian Nations (ASEAN) and the Australian Government developed a draft ASEANGAP standard representing 10 countries in Southeast Asia in

November 2005. ASEANGAP standards were issued in 2006 with the aim of facilitating the application of GAP to countries in the region, creating a competitive advantage for products. Facilitate regional and international trade. Harmonization within ASEAN through a common language for the GAP. Increasing the food safety of fresh products for consumers. Increasing the sustainability of resources in ASEAN countries.

In Vietnam**,** the state-sponsored GAP certification scheme – VietGAP - was launched on January 28, 2008. MARD is mainly in charge of the development of this scheme, providing guidelines for its implementation in different sectors (aquaculture, cultivation and husbandry). In aquaculture, code of good aquaculture practice in Vietnam (VIETGAP) was issued in July 2011 (Decision No.1503/QD-BNN-TCTS) and amended in 2014 (Decision No. 3824/QĐ-BNN-TCTS). This code applies to domestic and foreign organizations and individuals participate in aquaculture activities (regardless of object, form of farming) and VietGAP consultancy, evaluation and certification in aquaculture (not applicable to aquarium fish). Subjects who apply VietGAP to aquaculture need to comply with the following principles:

General requirements:

Farming place: The culture area must be located in the local aquaculture planning area. Farming facilities should be built in areas less affected by pollution or controlled sources of pollution. The site of culture must be outside of national or international protected areas. If the farm is located in an area, the written consent of the protected area authority is required. Farming sites constructed after May 1999 must be outside of ecologically important natural wetlands (RAMSAR).

Land/water use rights: Farmers must have land/water use rights for aquaculture in accordance with current regulations.

Aquaculture registration: The farms must register production activities with the competent management agency in accordance with current regulations.

The infrastructure: Farming facilities must be designed, operated and maintained to prevent the contamination of food, epidemic safety and occupational safety hazards. Farming establishments must have signs in each farming unit, auxiliary works in accordance with the ground plan and reality.

Warning of unsafe risks: The farms must have warning signs at places where there is a risk of labor safety and food safety.

Tracking aquatic moves: The farms must record the movement of farmed fish from outside to, or inside out, or between culture units from stocking to harvesting and selling the produce.

Distinguishing products applying VietGAP: The farms must have an identification system to ensure there is no confusion between the cultured species and the non-applicable VietGAP (including the geographic location of the farm according to the reference system and coordinate system. country VN-2000).

Human resource requirements: Farm operators must be trained in hazard analysis, preventive measures and control of hazards in aquaculture. Workers who work in the farm must be trained and properly adhere to safe and good aquaculture practices.

VietGAP Documentation: The farms must develop, implement, maintain and update practical guidelines for the aquaculture process.

VietGAP Profile: The farms must establish, maintain, and have a record of the activities performed during aquaculture practices. Records relating to fishery products must be kept for at least 24 months after harvest. Legal, human resources, and environmental records must be kept until there is a change.

Food safety:

Aquaculture operations must be controlled to ensure food safety by complying with applicable Vietnamese regulations and FAO / WHO Codex Guidelines.

Quality of supply water: Water used for aquaculture must be suitable for each specific cultured species and meet the current regulations of the Ministry of Agriculture and Rural Development.

Food, drugs, products for environmental treatment and improvement: The farm must make a list of feed, drugs, products for treatment and improvement of the environment in the warehouse and carry out monthly inventory. The farm only uses drugs, feed, and products for environmental remediation permitted for circulation in Vietnam, under the guidance of professional officials or the manufacturer. The farm does not use chemicals and antibiotics in the banned list set by the Ministry of Agriculture and Rural Development. In case of using homemade feed, it is required to record the ingredients and origin of the ingredients as feed. Farming establishments must preserve food, drugs, and products for environmental improvement in accordance with the manufacturer's instructions. The farm must discard and treat food, drugs, and

products for environmental treatment that are out of date and of poor quality. The farm must compile, update, store import and export records, use and preserve food, drugs, and products for environmental remediation and product handling.

Sanitary: The farm must collect, classify and promptly treat ordinary solid wastes and hazardous wastes generated in the daily life and aquaculture in accordance with current regulations, must establish, update and keep records of hazardous waste disposal. It is necessary to ensure the hygiene of the workers' farming and working and resting areas in order to avoid the risk of arising and contaminating food unsafe agents. Farmers and visitors must comply with the hygiene requirements prescribed by the farm to prevent environmental pollution and pathogen generation in the farming area.

Harvest and transport: the farm must harvest fishery products at the appropriate time and in appropriate methods to ensure food safety; transportation conditions must be applied to ensure food safety in the case of product self-transport; and must prepare and maintain records relating to harvest and transport.

Aquatic health management:

Should be done to ensure the health of aquatic animals by maintaining good and suitable habitats at all stages of the production process, as well as minimizing risks of disease

Aquatic health management plan: Farms must develop a health management plan for farmed aquatic products in consultation with professional staff

Aquatic breeds: Seeds have clear origins and are produced from qualified hatcheries; Aquatic breeds to be stocked must ensure the quality according to the respective QCVN, TCVN and other regulations of the competent authority; Farmers must compile and maintain records of the purchase and use of aquatic breeds including quarantine papers.

Feeding regime: The farm must determine and implement a feeding regime appropriate to the nutritional needs and age of the aquatic animals raised. No hormones or growth promoters are used during the culture process and feeding regimen should be established, updated and maintained.

Feeding: Feeding regime: the farm must determine and implement a feeding regime suitable for the nutritional needs and age of the farmed aquatic animals. Do not

use hormones, growth stimulants in the culture process. and must compile, update and maintain feeding records.

Monitor aquatic health and prevent the spread of disease:

Health monitoring: The farm must regularly monitor for signs of shock or sickness in the farmed aquatic animals and take the necessary measures to prevent pathogens; Must periodically check the average volume, survival rate, total aquaculture biomass of each farming unit depending on the species of culture and must prepare, update and keep records related to the health of farmed aquatic products.

Isolation and prevention of disease transmission: When detecting a disease, the farm must implement isolation measures to prevent the spread of the disease between the farming units and from the culture to the outside.

Water quality monitoring and management: Farming establishments must regularly monitor and manage water quality depending on species and prepare, update and keep records of this.

Epidemic and epidemic notification: When a disease occurs on the list of diseases subject to outbreak declaration, the farm must notify the nearest aquatic or veterinary authority and take measures to put the epidemic in place. Perform disinfection at the place where the epidemic occurs.

Handling dead seafood: the farm must properly handle dead fish to avoid environmental pollution and disease spread.

Use of antibiotics: In case of using antibiotics, the farm only uses the prescription or treatment regimen of professional staff; Stop using antibiotic before harvest as recommended by the manufacturer or regulator and record of antibiotic use should be established, updated and maintained.

Post-harvest treatment: the farm must ensure the downtime between two crops, disinfect and improve the culture area before the new crop and establish and keep records of the above activities.

Environmental protection:

Aquaculture activities must be conducted in a planned and environmentally responsible manner, in accordance with State regulations and international commitments.

Commitment to environmental protection: must have an environmental protection commitment or an environmental impact assessment report in accordance with the current regulations and take environmental protection measures.

Use of water and waste water: Domestic water (tap water) must not be used for aquaculture purposes. Wastewater discharged into the environment must meet the quality standards in accordance with current regulations and must prepare, update and archive a record of the amount of water used for each crop and check the quality of wastewater.

Using groundwater: If using groundwater, it must comply with the current regulations.

Salinity of natural freshwater sources: must be designed and managed to protect surface water and groundwater sources, and limit salinity of natural freshwater sources. Do not discharge salt water into natural freshwater sources. Local authorities and communities must be informed when groundwater becomes salty.

Pest control: Take measures to prevent invaders from entering the farm / unit, including terrestrial animals, but to ensure the safety of wild animals and take the necessary measures to protect and not cause death to animals listed in the Vietnam Red Book that are likely to appear in farming areas.

Aquatic resources protection: alien species can only be raised when permitted by the State and must comply with current regulations. The relevant regulations in the Fisheries Law must be complied with when harvesting wild seed for commercial farming purposes. and using genetically modified aquatic breeds must comply with the current regulations.

Socio-economic aspects:

Aquaculture must be carried out in a socially responsible manner, respecting the local community culture, strictly abiding by State regulations and agreements. Labor rights of the International Labor Organization (ILO), do not affect the livelihoods of workers and surrounding communities.

Employer:

Working age: do not use employee under 15 years old. In case the employee is from full 15 years old to under 18 years old, must ensure that the job does not harm their

health, does not affect their learning or impair their ability to absorb knowledge and must have a record of workers

Rights and regimes of employees: Employees are allowed to form or join legal unions to protect their rights and interests and does not assume any liability after exercising this right. Employees have the right to give comments and make complaints on issues related to labor rights and working conditions. Farm owners must consider, respond to or resolve recommendations and difficulties that workers raise. Employees are not discriminated against by gender, religion, or ethnicity from the employer or other employees. Employees working overtime must not exceed the maximum and are paid overtime in accordance with current regulations.

Labor safety and employee health:

Working conditions: The workplace must be arranged and a place to rest between hours to ensure hygiene and safety for employees. Protective equipment must be made available free of charge to workers to prevent occupational accidents and occupational diseases.

Employee health care: must pay insurance premiums and create conditions for employees to enjoy social insurance and health insurance in accordance with the Labor Code, the Law on Social Insurance, and the Law on Insurance. health insurance. must take timely action when an accident occurs and keep documents related to the handling of the accident. and must take similar accident prevention measures.

Contract and salary (wages)

Probation and contract: to ensure that the maximum probationary period for employees must not exceed the time prescribed by the Labor Law. Must sign a written contract with the employee, except for the case of hiring the employee to perform temporary jobs with a term of less than 1 month. There must be a probation agreement and proof of probationary pay.

Wages and salaries: wages must be paid in full, in cash or in the method most convenient for the employee. In case of hiring workers to perform temporary jobs with a term of less than 1 month, the farm must pay full wages right after finishing the work. The monthly salary must not be lower than the minimum wage set by the State at the time of salary payment and must be paid monthly and must have a labor contract and documents on the payment of salaries / wages to employees.

Community problems: Farm must have compromises and solutions to resolve conflicts with adjacent farms and surrounding communities and must keep the results of resolving complaints and conflicts with the surrounding community.

After 10 years of implementing VietGAP, MARD has granted 119 certificates for white leg shrimp farming, with the certified area of 1,664 ha; Black tiger shrimp was 20 certificates, the certified area was 614 hectares (MARD, 2014). However, up to now, the expansion of the area in many places has begun to be difficult due to the requirement that the area for shrimp farming must be in the planned area, the ponds must be adjacent to the other members to create a large area, infrastructure to ensure good maintenance of food safety and environmental protection standards. With these criteria, the infrastructure of many places cannot meet (Sau Nghe, 2020). Many farmers have not actively applied VietGAP standards to aquaculture activities because production costs for VietGAP application in particular and GAPs in general will increase by 20-30% compared to normal, but the product is not easy to sell. VIETGAP is more difficult to apply than other GAPs, VIETGAP has not been recognized internationally and has not been converted equally to other * GAPs, so finding the output for the product is really not easy (Nguyen Manh Hung, 2019). In order to support farmers, especially small-scale shrimp farmers, who do not qualify for any GAPs certification, have the opportunity to connect to markets for their products, ASIC is the right type of certification. consolidation in the current period, can help farmers change their farming practices. However, ASIC does not have specific regulations for shrimp farming. Currently, ASIC's set of shrimp farming criteria has just started piloting and upgrading depending on the conditions of each country. ASIC has the following main characteristics:

3. ASIC standards and implications

According to draft review of Aquaculture Social and Gender Standard and Shrimp standards (ASIC, 2020b, 2020a), ASIC has a range of initiatives to enable the improvement of the seafood industry of Southeast Asia (Indonesia, Myanmar, Philippines, Thailand, and Vietnam) to tackle social and environmental sustainability challenges facing the Asian seafood industry. ASIC stakeholders including producer organizations, processors, environmental NGOs, and local certification bodies work with export market stakeholders, including NGOs, buyers, and certification bodies, to build innovative tools designed to foster improvement for both shrimp aquaculture and fisheries in the region. One of the first efforts of ASIC to create an organization that can give producers a real voice, empower Asian seafood workers, foster inclusive business

models, and facilitate meaningful improvement. By supporting stakeholders to build their own tools that are in line with or coupled to international standards.

ASIC Shrimp in particular present a pathway towards improvement as well as a framework to meet the standards of international ratings that will facilitate market access to places like Europe and the US with a high demand for sustainable seafood. Producers, hatcheries, and feed mills involved in ASIC Shrimp will need to demonstrate compliance with the associated standards via a 3rd party audit to make any market claims on compliance with ASIC Shrimp Yellow or Green standards.

In contrast to other standards, ASIC targets small-scale shrimp farmers, environmental standards and the social standard especially regulates the age of young workers in accordance with the conditions of small-scale shrimp farming households in the region. Specifically, ASIC has the following technical and social standard:

Technical standards/environmental standards:

At farmer level:

ASIC has designed to address key issues associated with grow-out farming practices: Traceability; Shrimp Health Management; Source of Stock; Feed Sourcing and Management and Environmental Impact Management.

Traceability: By providing traceability for seafood products, consumers will know that the choices they make are not encouraging IUU (illegal, unreported and unregulated fishing) fishing, forced labor, or other social or environmental ills that undermine the long-term management of fisheries.

Shrimp Health Management: include directional regulations: Optimizing health, minimizing stress, reducing shrimp disease risks, and maintaining a healthy culture environment at all phases of the production cycle are critical to minimizing the environmental impacts of disease.

Source of Stock: regulations seek to address the use of shrimp species in production and ensure that the species used are from sustainable sources

Feed Sourcing and Management: regulations in this section seeks to address the sustainability and efficient use of wild fish resources in shrimp aquaculture feed that can be verified at the farm level.

Environmental Impact Management: regulations in this section seeks to manage the impacts that shrimp aquaculture operations can have on biodiversity through activities such as farm siting, predator control, or water quality discharges.

Hatchery standard: it is designed to address issues on wild population of shrimp. Ensuring that species used in production are sufficiently domesticated as well as screened for diseases.

Feedmill standard: Designed to ensure that the use of fishmeal and fish oil from illegal, unregulated, or unreported fisheries is minimized or eliminated

Social standards: promotes social responsibility to enhance long-term community benefits and resilience. Fundamental principles are:

- No child labors
- No forced labor, human trafficking or slave-like practices
- Freedom of association
- Equality and non-discrimination
- Fair recruitment and decent working conditions
- Safe working environment
- Respect for local communities
- Gender equality and women's economic empowerment (WEE)

ASIC steps for improvement:

- Optional add-on based on the same fundamental principles
- Provide a way for groups to differentiate themselves in the market
- Improvement-oriented tool seeking to enhance community benefits and well-being.

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