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DEVELOPING A SHRIMP SUPPLY CHAIN QUALITY MANAGEMENT SYSTEM IN THE MEKONG DELTA, VIETNAM

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Abstract

The implementation of a shrimp quality management system requires clearly defined rules and standards, the establishment of an appropriate shrimp control system, and the provision of proper training services. In the shrimp supply chain, the processing/export firms are generally the most powerful stakeholders, playing a leading role in organizing chain quality management. It is vital for small-scale shrimp farmers to develop business relations with processing/export firms through flexible contract farming. To develop a well-organized shrimp supply chain, it is crucial to encourage small-scale farmers to develop horizontal coordination among farmers. Small-scale shrimp farmers are aware of the importance of proper shrimp disease prevention and shrimp disease treatment as well as changing the production practices to upgrade the commercial shrimp quality (by reducing anti-biotic residue violation). However, they need more training and extension services to assist them. The willingness to invest in advanced farming system such as such as certification application of Viet-GAP is high among the farmers who are aware of the potential improvements. This paper focused on the quality management pratices in the shrimp supply chain.

Key words: quality management, shrimp supply chain, Mekong Delta

1. Introduction

The Mekong Delta (MD) covered more than 93% of the total shrimp production area and shared over 82% of the total shrimp production of the country (GSO, 2015). Vietnamese shrimp product has been exported to more than 95 countries in the world, over 7 billion people in the world are consuming Vietnamese shrimp, in which, US, Japan, EU and China are main markets for such product (VASEP, 2016). Shrimp farming in the MRD diversifies in terms of farming level (intensive, semi-intensive, extensive, advanced extensive, integrated mangrove forest-shrimp and alternative rice-shrimp). Of which, intensive shrimp farming occupied 5.6% of the total production area; semi-intensive and advanced extensive farming model shared 35.9%; the corresponding numbers for organic extensive farming and alternative rice-shrimp farming model were 30.5% and 28% respectively (Vietnam Institute of Economics and Planning, 2015).

The Vietnamese government concerns with compliance of standards set by the importing nations under the SPS agreements. Most of those standards involved the use of Hazard Analysis and Critical Control Points (HACCP) standards for ensuring food safety. Like some developing countries, the HACCP has not yet been introduced at the primary production level, just only implemented in seafood companies (SFCs). In addition, the HACCP

The Seybold Report
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implementation of Vietnam's SFCs (96.9%) is facing constraints in terms of management and technological investment.

There is a lack of strict quality management by the government, industry, support organizations, SFCs, and chain stakeholders from "water to table". Moreover, restrictions on quality knowledge, techniques, infrastructure, and technological and equipment investment throughout the chain are a big challenge for seafood quality and safety (Quyen et al., 2019). Therefore, to deal with SPS regulation, it is necessary to increase awareness at primary level of production, help the farmers and agents involved during transportation and storage to maintain the standards (required under HACCP rule) to avoid further intensification of the shrimp farming practices.

Quality management practices are closely correlated with the supplier selection strategy (Lin et al, 2005). Whereas the majority of seafood processing enterprises have their own quality management process (ISO 9001, HACCP, TQM) to adapt to increasingly demand from import markets, their challenges lie on the suppliers – farmers. Quality management practice and quality assurance in primary production determine the success of export chains and business performance (Suwanrangsi, 2000; Lin et al, 2005). In addition, quality assurance for shrimp product from this system has involved many challenges when quality of shrimp is affected by other nodes of the chain such as shrimp seeds, preservation and transportation in post-harvest stages, whereas farmers have no experience and knowledge about process of quality control and assurance. To meet requirement from export markets (EU, US and Japan – three main markets of shrimp products), shrimp farmers have been encouraged to culture their shrimp following standards as GlobalGAP, ASC, Naturland, VietGAP. However, there have been several obstacles in applying these standards, especially characteristic of small-scale shrimp farming in the Mekong Delta. Thus, what are the problems in farming practices of shrimp products; and where and how much they need to improve to increase quality of shrimp products for export.

2. Literature review

Practitioners of the use the term "quality" to describe the notions of function, suitability, reliability, conformance with specifications, satisfaction with actual performance and high price. But this is highly confusing and quality is defined as the ability of the vendor to provide goods in conformance with specifications and may also refer to whether the item performs in actual use with the expectations of the original requisitioner, regardless of conformance with specification (Leeders etal, 1988). Most of the time, quality is measured by the close users of the product or service. To emphasize this relationship, Juran and Gryna (1995) defined quality as customers satisfaction and fitness for use. A customer is anyone who is impacted by the product. Customer satisfaction can be achieved through product features and freedom from deficiencies.

During the last half of the 20th century the complexity of agro-food supply chains has increased considerably. Raw materials are obtained from sources worldwide, an ever-increasing number of processing technologies are used, and a broad range of products is

The Seybold Report
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produced. In addition, consumer expectations are continuously changing, demanding more convenience, and fresher foods with more natural ingredients. Food quality management has become increasingly important in the agro-food sector (Spiegel et al., 2003), due to changing consumer requirements, increasing competition, environmental concern, and governmental interests. Higher consumer demands regarding the quality, traceability and environmental friendliness pose challenges for primary producers, especially smallholders in developing countries (Henson et al. 2000; Humphrey and Oetero, 2000).

The implementation of quality management has evolved from quality control to quality assurance. At this moment, the food industry applies various (combinations of) quality assurance systems such as Good Practices (e.g. GMP, GHP, GAP), HACCP, ISO, BRC, etc., (Luning et al., 2006).

* *Quality control*

Quality control (QC) involves determining what to control, establishing units of measurement for gathering data, establishing standards of performance, measuring actual performance, interpreting the difference between actual performance and the standard, and taking action on the difference in order to prevent quality problems in the next batch/production. Improvement is a form of control in the control process, where attention is paid to structural causes and solutions (Luning et al., 2006).

Luning et al. 2006 defined quality control as a combination of technological and managerial quality functions. In an established food supply chain the quality control should be implemented in the process and product of each member. To guarantee quality, these control activities have to be directed to critical control points (CCPs). According to Reilly and Kaferstein (1997), important CCPs in quality control at aquaculture farm level are: site selection, water management, the use of feeds, the use of antibiotics for shrimp disease treatment, and harvest.

* *Quality assurance*

Quality assurance (QA) encompasses all planned and systematic actions required to ensure that a product complies with the expected quality requirements. It also provides customers and consumers with the assurance that quality requirements will be met. Quality assurance focuses on system quality instead of product quality. The system must be audited to ensure that it is adequate both in the design and use. Food products are not only tested on their product characteristics, but also on production, packaging, handling and distribution. Quality control is embedded in quality assurance. Control activities form the basis of QA systems, such as HACCP (safety guarantee by using critical control points). The implementation of quality assurance systems, especially in the agricultural-food business, is an issue of the greatest importance. There are several characteristics of food chains posing challenges to the QA system: agricultural products are often perishable and subject to rapid decay due to physiological processes and/or microbiological contamination; most agricultural products are harvested seasonally; products are often heterogeneous with respect to desired quality parameters, such as size,

The Seybold Report
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DOI 10.5281/zenodo.6596849

and color, diseases have to be prevented and cured and it is not simple to establish which measures to allow and how to check its use. Cultivation differences and seasonal variables are hard to control. Moreover, primary production of agricultural products is undertaken for an important part by farms operating on a small scale, e.g. fish culture (Khoi, 2007). It is against this background that the total food supply chain has to assure and demonstrate that the highest standards of quality and safety are maintained (Hoogland et al., 1998).

* *Quality assurance systems and food safety*

Food quality management has become increasingly important in food industry which is demonstrated in an increase of applied QA system and higher requirements on these systems by consumers (Spiegel, 2004, Luning et al., 2006). Moreover, consumer perceptions towards food safety and quality have increased, which is reflected in the media attention given to a variety of food safety and quality issues (Luning and Marcelis, 2007). To meet these trends, quality assurance has focused on the fulfillment of quality requirements and proving confidence in meeting customer requirements. In essence, all parties involved must apply quality assurance measures in order to control all aspects through the chain that may influence product quality.

In the agro-food industry, QA systems like GMP, HACCP and ISO are widely applied. GMP aims at combining procedures for manufacturing and quality control in such a way that products are manufactured consistently to a quality appropriate to their intended use (IFTS, 1991). HACCP aims to assure the production of safe food products by identifying and controlling the critical production steps (Leaper, 1997; NACMCF, 1998). ISO aims to achieve uniformity in products and/or services, and to prevent technical barriers to trade through the world.

At the moment, the basic QA systems are often combined to assure several quality aspects, e.g. the combination of HACCP and ISO 9000 (Barendsz, 1998, Robert, 1999). Moreover, QA systems are often developed specifically for an industry like e.g EUREP-GAP (Euro Retailer Produce- Good Agricultural Practice), which is integrated into new systems such as BRC (British Retail Consortium) and SQF (Safe Quality Food) (EUREP-GAP, 2001). However, total quality cannot be realized by using these specific quality systems, because they each cover only a part of a quality system. See Table 3.1 for an overview of the characteristics of the QA systems that are most important for the food supply chains. A quality system is defined here as the organizational structure, responsibilities, processes, procedures, and resources that facilitate quality management. Quality management includes the total activities and decisions performed in an organization, to produce and maintain a product with a desired quality level at minimal cost.

Viet GAP is an abbreviation for Good Aquaculture Practice in Vietnam - a national standard applied in aquaculture to provide insurance for the farming of safe and hygienic products, while reducing disease and pollution in the environment and promoting animal health and

The Seybold Report
ISSN 1533-9211
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social responsibilities, as well as the traceability of products (MARD, 2015). The Viet GAP standard was first established in 2008. It was created with the Food and Agriculture Organization's (FAO's) Technical Guideline for Aquaculture Certification and the Association of Southeast Asian Nations (ASEAN) shrimp GAP (10 GAPs for ASEAN countries), as it has instructed member countries to establish their own national GAPs (UNEP, 2016; Amundsen et al., 2019). There are four modules under the ASEAN GAP, i.e., quality products and food safety, disease reduction, environmental safety, and social safety and welfare. Each country in the ASEAN GAP is required to meet the food safety module at the first step and to be benchmarked with each other step, therefore making the 10 GAPs compatible with each other.

As for the commercial brackish shrimp culture, Viet GAP sets guidelines consisting of five principles, 24 control points, and 45 compliance criteria, which are meant to cover a wide range of farm management issues.

- **Principle 1**: *Legislation—includes six control points with 10 compliance criteria.*
- **Principle 2**: *Food safety and quality—includes four control points with 10 compliance criteria.*
- **Principle 3**: *Animal health and welfare—includes six control points with 11 compliance criteria*.
- **Principle 4**: *Environmental integrity—includes four control points with seven compliance criteria*.
- **Principle 5**: *Socio-economic aspect—includes four control points with seven compliance criteria.*

The issued guideline covers 26 pages of main content and 12 pages of appendices. The original document is Decision No. 4835/QĐ-BNN-TCTS approved on 24, November, 2015 by the MARD (in Vietnamese). The clear emphasis on food safety and disease control is in Principle 2, Principle 3, and Principle 4. Shrimp farms have to consider control points mentioned in the VietGAP, with seven control points that must have been taken care of pre-harvest, including seed and stocking, feeding, water monitoring, chemical/pesticide usage, reporting of disease to authorities, sanitation, etc. with the guidance of compliance criteria (Table 3.3).

The VietGAP certification could be obtained either for a group or for an individual. However, there are perceived limitations for small-holders in terms of the high transaction cost and low market competition. Without a better financial incentive, it becomes harder and less desirable for small-holders to pursue VietGAP (Ha et al., 2013). The FAO-recommended cooperative approach and collective action help in the governance of small-scale aquaculture and fisheries (FAO, 2012). Individual certification will be awarded to separate farms that submit evaluation applications themselves after the official audit. The VietGAP group standard is issued for groups of farmers organized under collective forms, such as cooperatives *(Hợp tác*

The Seybold Report
ISSN 1533-9211
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xã) or small-farmer clusters *(Tổ hợp tác).* This means that a group of farmers who are listed in the member list of the cooperative will own a common certification. The certification is issued by an authorized certifier and is granted after all members of the cooperatives or clusters undergo an auditing process. Cooperatives are collective economic organizations formed from seven or more individuals, households, and/or legal entities. The founders have mutual needs and receive the same benefits. They voluntarily contribute capital and labor to carry out certain work to increase production efficiency and improve the livelihoods of members. Clusters are defined as economic organizations based on a cooperation contract under authentication of a communal People Committee, which is formed by three or more individuals who jointly contribute capital and labor to carry out certain work for mutual benefit and responsibility. Clusters represent a lower level of organization and management than cooperatives (FAO, 2012; Ha et al., 2013).

Table3.3. Brief explanation of control points regarding shrimp health and safety in Good Aquaculture Practices (GAP) in Vietnam (VietGAP)

Control Points	Principle[2]	Compliance Criteria[3]
Farm and pond sanitation/hygiene pre- and post-culture	Prin. 2 Prin. 3 Prin. 4	Farm sanitary activity must be done before releasing Post-Larvae (PL). Predator control: Use equipment, chemicals, and instruments during pond preparation; preventive methods such as purse seines, puppets… Dredged bottom sludge—after harvesting. Farm must apply disinfection procedures and/or allow appropriate fallowing periods between harvests and re-stocking (30 days minimum). Separate grow-out ponds apart from living area, prominent locations with clear signs (with illustrations). Assessment of hazards to food safety can be done once a year by self-evaluation or by a consultant.
Seed and stocking	Prin. 3	Certified hatchery; documents related to seed purchasing must be kept and recorded. Transportation time: Does not exceed 8 hours. Size: PL12–PL15 (9–11 mm in length); density: 40–150 PLs/m^2; Negative results for white spot, yellow head, Taura syndrome, slow growth syndrome, and other new infectious diseases with a document announcing testing.
Feed use and feeding regime	Prin. 2 Prin. 3	Dosage and feeding based on producers' instructions or guidelines from professional staff with systems to ensure the amount of feed given in accordance with the needs and appetite.

The Seybold Report
ISSN 1533-9211
DOI 10.5281/zenodo.6596849

		Feeding monitoring systems in place could be feeding trays or visual observation. Storage in solid shed; inspection monthly, expired products are not used. Actively adjusting the pellet dosage size to the age of the shrimp. All the related information on feed and feeding must be recorded.
Water use	Prin. 2 Prin. 3 Prin. 4	Check quality of in-take, in-pond, and discharge water by themselves or services regularly or based on results of authorities. The list of water quality indicators that need to be checked was provided with guidelines (temperature, salinity, clarity, dissolved O, pH, alkalinity, NH_3). Tap water and groundwater should not be used to reduce salinity in rearing ponds. Making records of water quality test results. Reservoirs have to account for at least 15% of the area. Discharge water is not allowed to discharge directly into the river or irrigation system to avoid contamination of the water supply system.
Drug/chemical use	Prin. 2 Prin. 3	Only use products (especially antibiotics) approved by the relevant competent authority. Using limited products: Stopping use at least two weeks prior to harvest for normal chemical compounds and earlier for veterinary drugs. Dosage based on producers' instructions or guidelines from a professional. Stored in a secure lockable store and under conditions. Expired products are discarded in an appropriate manner and recorded. Medicines, chemicals, and probiotics in stock must be listed and periodically checked on a certain day of the month. In the case of using anti-biotics: + Only use when identifying shrimp bacterial diseases. + Must follow the treatment regimen of professional staff. + Do not use anti-biotics for prophylactic use or to stimulate growth. + Discontinue use as recommended by the manufacturer.
Collection, classification, and dissolving of farming	Prin. 2 Prin. 3	Wastes: + Tabulation of waste classification. + Collecting and storing wastes/garbage according to specific types in safe and specialized containers.

The Seybold Report
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wastes and diseased shrimp		+ Waste treatment must be done in a timely manner and clearly. + Hazardous wastes must be dissolved or returned to suppliers. + Do not bury expired products; do not burn solid waste on the pond banks. Diseased shrimps: + Do not discharge infected water to the environment without treatment. + Once dangerous disease breaks out, farmers must announce it to the veterinary agency and adjacent farmers to prevent spreading. + Dead shrimp should be removed and documented. + The veterinary staff of the commune must be informed as soon as any epidemics occur.
Harvest transportation	Prin. 2	Harvest and transportation are undertaken in an appropriate manner to ensure food safety; this is the responsibility of the farmer. Documented harvest and transport are in place where applicable.

(Source: Synthesized from the Decision of the Guidelines for application of VietGAP issued by the Ministry of Agriculture and Rural Development, 2015)

3. Research methodology

The secondary data will be collected from documented reports by local agencies, newspapers, magazines, scientific articles and related website,... The primary data will be interviewed direct and indirect actors of shrimp value chain.

The secondary information will be collected including: i) conditions of socio-economic in research areas; ii) the current aquaculture and shrimp production, including statistical data in the study sites; iii) available documents of quality standards and guidelines for practices; iv) information on shrimp value chain; v) shrimp export and market requirements.

Collected information from authority managers, experts and shrimp farmers thought checklists and questionnaires. Primary data will be collected via in-depth interview, case studies and questionnaire survey.

In-depth interviews: in order to show the general picture and to identify different stakeholders of the shrimp value chain, officers from local authorities, knowledgeable people and experts in shrimp product (at least 10 knowledgeable persons) will be consulted to get their own perspective about the major problems such as current status of the matter; how to develop this system; identify actors participated in the chain; the importance of shrimp farmers in the chain and recommendations for quality management mechanism for shrimp industry.

The Seybold Report
ISSN 1533-9211
DOI 10.5281/zenodo.6596849

The main objective of this study focused to smallholder shrimp farmers due to vital role that such group contributes to the country. Additionally, due to limitation of research budget, the study is limited to several provinces in the MD where dominate the shrimp production in Vietnam. Most of the smallholders do not have a written track record of their daily activities. Hence, the answers to most of the questions were based on estimates and the memories of the respondents.

Semi-structure checklists with an open and accessible character will be used in in-depth Interviews. The selection of the agencies based on literature review. The leaders of the selected authorities will suggest the informants who play an essential role in shrimp industry for interviews.

4. Research findings and discussion

Quality control practices at the shrimp hatcheries and nursing sites

According to NAFIQAD (2018), there were approximately 1,200 black tiger and white-leg shrimp hatcheries in the MD that produced more than 10 billion post-larvae black tiger prawns and 300 million post-larvae white-leg prawns, altogether accounting for over 60 percent of the total demand in the MD region. Through the survey (2019), almost all hatcheries in the MD are of small-medium size (two-thirds) and are managed under private ownership (95%). The hatcheries' activities are simple – low construction and operation costs, and low technical input. The operation is flexible, depending on the season and supply of wild seed. This type of hatchery often has disease and water quality problems, but they are easily and quickly disinfected and re-opened without serious losses. Some hatcheries use large tanks, low stocking densities, and low rates of water exchange. These issues lead to difficulty for governmental support organizations to give helps in seed quality and safe assurance due to tattered production without control. The hatcheries can have five to six cycles a year. The nursery sites can have about 50 cycle a year, each cycle being about three to five days. For the large companies operating post larvae providing, they owned their private technique to produce high quality post larvae. Most of them have the production process that was registered and published to the government.

In order to better manage the shrimp seed, there have been several regulations and government policies concerning hatchery development in order to provide high shrimp seed quality and quantity, but these have had minimal effect. The regulations on the production of shrimp seed and on nurseries for post larvae from PL12 to PL35- 45 have been implemented since 1998 (Ministry of Fisheries, 1998). However, the management of post larvae quality and trading has not been improved. A lack of 'high-tech' checking methods and facilities is associated with those problems caused by the special transportation network involved (MOF, 2017).

As a result, policies and regulations set by the government have been changed so as to accept the import of shrimp broodstock and shrimp seed from neighbouring countries. In 2002, a total of 10,919 shrimp broodstock were imported from Singapore, China, Myanmar and

The Seybold Report
ISSN 1533-9211
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Australia. However, 2,668 shrimp died immediately upon reaching Vietnam for various reasons. Import of a diversity of shrimp species is being given consideration along with the import and artificial propagation of *Penaneus vanamei*. Starting in 2003, the production of about 3 billion post larvae of this species is expected per year, of which 2 billion in the Central Region, and 1 billion in the MD (MOF, 2013). The demand for shrimp seed may vary for many reasons. The changes in the international market for shrimp products is particularly variable, and the level of intensification of shrimp farm development, as well as the success of both shrimp seed production and breeding activities, can change rapidly over time.

The Ministry of Fisheries (2011) explained that there are around 110,000 hectares of rice fields were converted into rice-shrimp areas in the coastal provinces of the region, mainly in Ca Mau, Bac Lieu, Soc Trang, and Kien Giang provinces. But shrimp crop losses were observed in 50%-70% of these areas in the first crop of the year with about 3 billion shrimp seed being washed away. This was thought to be a result of the low level of shrimp seed quality and lack of technical skills, in addition to possibly unsuitable conditions in the new ponds. The large increase in the culture areas and the big loss of shrimp seed has raised the demand for shrimp seed. This has increased the risk in shrimp production, since pressure is placed on the quantity and quality of the shrimp seed supplied. At the same time, the development of the shrimp industry is strongly dependent on the quantity and quality of the shrimp seed supplied. Many attempts have been made by different institutions to improve both shrimp seed production and grow-out, but the results are still varied and risky.

In short, the improvement of the quality of larvae depends on the quality and the reproductive capacity of the shrimp brood-stock, and on a number of other factors relating to the stocking of broodstock and the rearing of larvae in the shrimp hatcheries. In addition, quality control knowledge and hatchery staff responsibility are still limited. Several methods have been designed to check the quality of post larvae before buying and stocking them into the breeding ponds. Quality testing of post larvae using the Polymerase Chain Reaction Method (the PCR test) has become very important for intensive breeding farms along with the government's support in management and quality control assurance of shrimp seed.

Quality practices at the feed and drug supplier

Through the interview results (2019) in during visits to the feed and chemical shops in the selected provinces, all shop owners informed that they had to pay directly for all feed, drugs and chemical products purchased from different suppliers. In the past 5 years, shop owners said that they could obtain credit from their suppliers and pay for products purchased typically after the shrimp harvest when farmers were able to pay the shops. Due to financial constraints for the farmers, mainly caused by losses due to diseases, farmers now had to pay immediately when purchasing products as shop owners had experienced that farmers were not able to pay for their products if provided credit. Some large product suppliers had sale representatives in the shops who also acted as technical assistants providing advisory services free of charge. The sale representatives furthermore recommend to farmers which products should be used for disease control and aquaculture management. Such advice was also provided during visits to the farm if the company saw the farmers as a potential key account

The Seybold Report
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customer. However, all shops gave some kind of advice on the use of their products. Shops often obtained their products from one or a few large suppliers from which they received bonuses according to the quantity of products sold. The drug suppliers already mentioned that farmers choose shops based on previous positive experiences and recommendations from other farmers (Expert interview, 2019). Based on observations, the products were sold in the shops in three provinces including disinfectants; antimicrobials; probiotics; vitamins and minerals; herbal extracts and a number of unidentified products. A antimicrobial products belonging to the classes of phenicols, tetracyclines, fluoroquinolones, sulphonamides and rifamycins were sold by the shops. Through the interview, farmers typically described the symptoms of the diseased shrimp and the shop owner then instructed the farmers on which products to buy and how they should be used. Farmers were generally little aware and concerned about the type of products purchased and, just like the shop owners, saw little need for product labels in Vietnamese. The prime concern for the farmer was that the drugs could solve their disease problems.

It is unlikely that current antimicrobial use practices of shrimp farmers will lead to sufficient antimicrobial concentrations in the diseased aquatic animals needed for effective therapeutic treatment. Farmers prepared their own medicated feed for shrimp by mixing the antimicrobial powder or solution with clean water without acknowledging that some antimicrobials are hydrophobic, e.g. rifamycin, trimethoprim and sulfamethoxazole (Quyen et al. 2019). The practice of applying antimicrobial solutions to feed pellets and subsequent mixing by hands is likely to cause large variations in antimicrobial concentration in the feed. Furthermore, shrimp feed pellets will in contrast to medicated feed provided to fish not be immediately consumed, but rather the shrimp will eat the pellets at the bottom of the pond over a prolonged time period during which the added antimicrobial will dissolve into the pond water, e.g. ampicillin and oxytetracycline.

Through the survey of 5 feed shops, they mentioned there are many public and private companies were producing and trading feed for shrimp in Vietnam, with a total capacity of 200,000 tons of feed for shrimp production per year (MOFI, 2019). Feed, chemicals and other compounds used by aquaculture farmers in Northern Vietnam are provided and distributed by so-called feed and chemical shops that are typically located in district towns. These premises are owned by Vietnamese families except a few shops owned by Chinese. Products sold may be produced by Vietnamese companies or produced outside Vietnam and then imported by local companies supplying the products to the shops. It was not possible to obtain information about the total number of shops in the study areas, but according to information from the local Departments of Agriculture and Rural Development between 20 and 30 shops operated in each of the three provinces. Some shrimp farmers also operated their own small shops selling feed and chemicals to nearby shrimp farms. All shops were registered by provincial and district government authorities and were occasionally inspected, e.g. to check on appropriate and safe storage conditions of chemical products.

Therefore, feed management was considered as an important part of shrimp farming in feed sources, quality of feed, time and way of feed being used. Good feeding practice is essential

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to control water quality and ponds' environment. However, in order to meet the feed demand of shrimp farmers, approximately 100,000 tonnes of feed were imported from Thailand, Hong Kong, Taiwan, and the USA. To ensure environmental principles, there was a restriction on the use of antibiotics in feed. Some feed mills produced organic feed for shrimp farmers who want to get a high quality of shrimp. The feed suppliers indicated that shrimp farmers purchased pellet feed mainly from local feed agents with the priority of common branch. The feeding dose and time were complied fully to guidance as shown on the package. However, farmers prefer high ratio of protein feed to accelerate growth rate, but such feed is usually expensive according to them (Survey, 2019). Moreover, high ratio of protein feed to accelerate growth rate; however, increasing protein intake by increasing the daily ration does not lead to better growth, but raises feed conversion ratio as well as the pollution loading of the system (Survey, 2019). Through the survey, 2019, shrimp farmers have chosen various feed types rely on their experience and neighbors' and relatives' recommendations but quality of most of kinds were evaluated at good quality due to standardization of commercial feed industry.

Quality practices at the intensive shrimp farming stage

As the rapid growth of whiteleg shrimp intensive farming, Vietnam has received many warnings on quality and food safety from import markets.

In Vietnam, a number of shrimp farmers have sought to improve food safety by culturing shrimp according to VietGAP, while others still practice intensive farming without any certification (Quyen, et al., 2019). The number of shrimp farmers who have given up farming VietGAP is increasing notwithstanding efforts of functional branches to maintain the certification. There are many reasons behind that issue. The appropriate farming practices for disease control and quality management in the VietGAP system have not been fully identified or fully understood by farmers (Quyen, et al., 2019; Bryand, et al., 2006). Therefore, the objective of the paper is that to clarify the status of disease outbreak control and quality management between VietGAP and non-GAP systems as reported by shrimp farmers.

The Seybold Report
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Table 2. Reason for Rejection of Vietnamese Fishery Products in US, EU and Japan Markets

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

(Source: UNIDO IDE, 2013)

The VietGAP certification could be obtained either for a group or for an individual. However, there are perceived limitations for small-holders in terms of high transaction cost, low market competition. Without a better financial incentive, it becomes harder and less desirable for small-holders to pursue VietGAP (Ha, et al., 2013). FAO recommended cooperative approach and collective action to help governance of small-scale aquaculture and fisheries (FAO, 2012). Individual certification will be awarded to separate farms that submit evaluation applications themselves after the official audit. VietGAP group standard is issued for a group of farmers organized under collective forms such as *cooperatives*, or small-farmer *clusters.* This means that a group of farmers who are listed in the member list of the cooperative will own a common certification. The certification is issued by authorized certifier and is granted after all members of the cooperatives or clusters undergo an auditing process. *Cooperatives* are collective economic organizations formed from seven or more individuals, households and/or legal entities. The founders have mutual needs and receive the same benefits. They voluntarily contribute capital and labor to carry out certain work to increasing production efficiency and improving livelihood for members. *Clusters* are defined as an economic organization based on a cooperation contract under authentication of communal People Committee, which is formed by three individuals or more who jointly contribute capitals and labor to carry out certain work for mutual benefit and responsibility. Clusters represent a lower level of organization and management than Cooperative (FAO, 2012; Ha, et al., 2013).

The Seybold Report
ISSN 1533-9211
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Quality practices at the processing companies

Through survey (2021), the processing companies did not satisfy quality requirements for shrimp materials. On the one hand, this was due to the fact that their plants are located far from the sources of shrimp materials. Moreover, there are not enough control conditions set up for quality control of shrimp materials. The companies realized that the quality of shrimp materials is a very important factor that affects the quality of the finished product. In addition, a company's reputation in terms of business success and flexible policies on price, and quick payment are important elements that the processing/export companies use to maintain suppliers' loyalty. Moreover, almost all processing firms in the MD have to compete fiercely in buying shrimp materials with both internal and external companies in the region. As a result, uncontrolled shrimp materials are still being regularly distributed in the MD.

During the shrimp processing procedure, hazards can occur at any stage from receiving input shrimp to the distribution phase. According to the interviewees (2021), the factors that affected the final shrimp quality in processes are (1) quality of shrimp materials; (2) storage process; (3) processing techniques and (4) inventory time of finished products. To keep final shrimp products free from hazards and to ensure hygiene, safety and quality, HACCP procedures and principles are a crucial tool. At present, the processing firms in the MD have implemented prerequisite programs before applying the HACCP, such as GMP and SSOP, as well as other methods related to initial changes in management and human resources, needing to be adapted to their specific conditions. However, although all of the processing firms applied the procedures and principles of HACCP, they have not been completely implemented inside the company. The reasons for this are a lack of capital to invest in modern technology and testing equipment; a lack of experts or specialists with high capabilities and skills in quality management, supply chain management and statistical knowledge; the low level of employee quality control awareness; and the intransigence of quality control behavior. Also, as we have seen other international standards have hardly been applied at all for application of TQM, ISO, BRC,… As a result, final shrimp products are still not completely free from hazards

Almost all companies in the MD have established an HACCP team. Adapted to the organizational structure of each company, each team includes a quality control specialist, a production specialist, an engineer, a member of the management, and one other specialist (buyers, operators, packaging experts, distribution experts, or hygiene managers). It is the responsibility of the team to describe the product and its distribution, elements such as the composition and physical features of the final product, processing information, method of packaging, required shelf life, storage and distribution conditions along the chain, legislative product requirements, and instructions for use and storage by consumers. In addition, most of the companies have developed process flow diagrams.

At the company level, the survey results showed some supply chain GAP (G) in quality assurance that affect final shrimp products (Figure 1). As for the first GAP, Seafood company (SFC) management has no influence on hatchery management; hence it cannot participate in

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any quality control of shrimp seed supplied to the farmers. The quality of shrimp seed completely depends on conditions within the hatcheries themselves and on State regulations and management including NAFIQAD support on testing shrimp seed quality. GAP 1 cannot be solved by the SFCs at present or in the near future because of managerial and technological conditions.

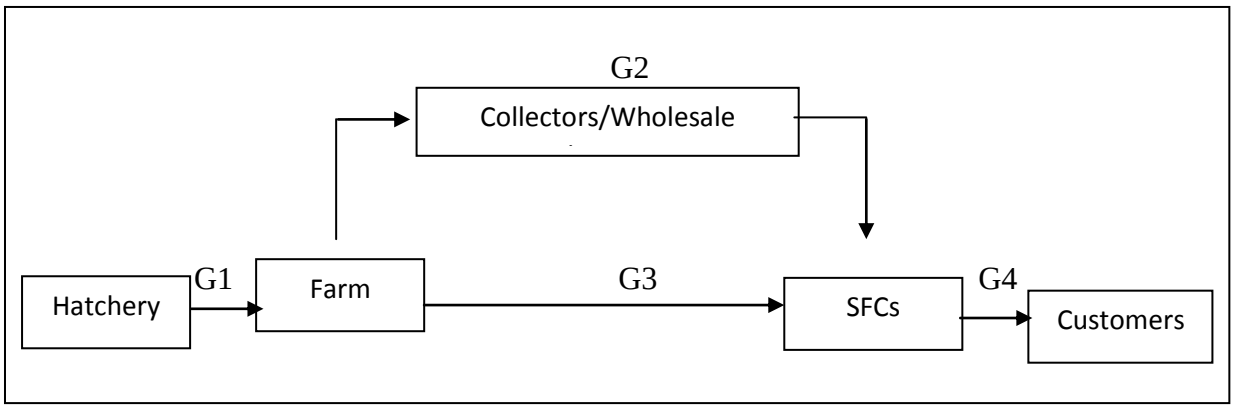

Figure 1. Supply chain GAP in shrimp quality management

In addition, the SFCs cannot control the quality of shrimp materials delivered from the farmers to the company via the collectors/wholesale buyers because it would take too much time and expense to control such vast areas of shrimp culture. Moreover, the companies cannot manage breeding techniques at the farmer level and feed quality at the feed wholesaler level.

GAP 2: wholesale buyers/collectors themselves do not have optimal conditions in the fields of quality and technical knowledge, or sufficient capital to help the farmers guarantee shrimp quality. So far, the companies have not put any effort into stimulating wholesale buyers/collectors to improve their shrimp materials. GAP 2 affects the quality of shrimp materials outside the company the most because most of the shrimp materials are sold to the SFCs through this channel.

GAP 3: although the companies can partly participate in quality assurance of shrimp materials at the farmer level when the company invests in the farm, they cannot also manage the farmer's feed quality and veterinary drugs used during breeding time.

GAP 4: The SFC only has knowledge of customer information and requirements from import companies and agencies or from other companies or from common communication sources, such as websites, magazines and newspapers. The specific indicators on technical barriers to trade and sanitation performance standards are very strict in international business. Moreover, import nations always use modern equipment to inspect and discover hazards from seafood products in the lowest level, while the SFCs and NAFIQAD are unable to eliminate those hazards before export, due to an incomplete program of quality assurance (e.g. HACCP application) and modern equipment shortage.

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Generally speaking, to correct shrimp supply chain deficiencies it is necessary to enhance the role of the government in State management of quality, hygiene, veterinary drugs and feed in fishery production, as well as the role of organization and management within the hatcheries themselves. Likewise, it is necessary to enhance the support of VASEP and NAFIQAD in quality training, inspection and international negotiation.

Moreover, emphasizing the role and responsibilities of the SFCs in the domain of quality improvement not only within the companies (manufacturing process) themselves, but also with their suppliers through supplier quality management is very important. The SFCs should establish a bridge between their quality requirements and the activities of their chain stakeholders, as well as with local governments (provincial agricultural departments). The SFCs and local governments should join forces to guarantee shrimp quality and improve quality throughout the whole chain. In addition, the companies need to enhance quality improvement and assurance (the HACCP programs) inside the company, in addition to making technological improvements, enhancing managerial knowledge and skills, as well as improving organizational behavior in quality control.

Briefly, although the SFCs are supported by the government in terms of priority for capital loans to invest in modern processing technology and equipment, along with VASEP and NAFIQAD support in quality education and training, market information and inspection of final products before exporting, the SFCs are still getting their information on hazard infection after the fact from import markets like EU and the US. In reality, along with support from the government the SFCs need to implement and follow HACCP programs as well as other standards in order to improve their final products just in order to meet market requirements and expectations. However, the HACCP standard cannot be applied at the primary production and supplier level in the MD any time soon due to limiting conditions in companies, suppliers and farmers themselves. The company is only able to use appropriate policies and knowledge of supplier quality management in order to encourage and promote supplier loyalty and quality assurance. Similarly, the SFCs are unable in the next few years to manage and control the distribution stage from port to consumer due to the companies' limited expertise in market research, and due to the fact that agencies are responsible for the distribution of the products to end customers.

4. Conclusion

Shrimp quality improvement in the entire chain is very important for Vietnam's shrimp industry. The shrimp supply chain in the MD includes the primary production stage (hatcheries, farms), the distribution stage (collectors, and wholesale buyers), the processing stage. The focus of the current research has been on the primary production stage, with an emphasis on the implementation of Viet-GAP certification.

The current situation of processing/export companies in the MD is showing progress with respect to ensuring shrimp products quality and safety. All SFCs apply quality control process accepted by importers such as HACPP, TQM, etc.

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Research results show that the application of quality standards such as VietGAP significantly improves the quality of farmed shrimp, especially the use of antibiotics. Moreover, the processing/export companies play an important role in the supply chain.

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