



White shrimp production systems in central Vietnam: Status and sustainability issues

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ABSTRACT

White shrimp has become a major export product for Vietnam in recent years due to the fact that upgrading structures for white shrimp production is part of the Vietnamese development strategy. However, the sector suffers from various sustainability issues that hinder development and contribute to soil and water pollution. This article aims to explore production systems for white shrimp in the central Vietnamese Thua Thien Hue province and outline existing sustainability issues as well as possible approaches to address them. Thus, an explorative study, in which primary data was collected from semi-structured interviews with 24 respondents including white shrimp farmers, local government representatives and white shrimp buyers, was conducted. In addition, secondary data such as documents and statistics were used. This study identified inconsistent seed quality, low professional expertise among smallholders, high dependence of smallholders on middlemen and diminishing water quality as major challenges which constrain further development in the sector. In the current study, the underlying reasons for those issues lie in high informality of relationships, low access of smallholders to capital and generally weak implementation of existing regulations and standards were all under argument. These issues needed to be addressed in order to enable further development in the white shrimp sector.

INTRODUCTION

Aquaculture has made a significant contribution to national economic growth, food security and income generation in Vietnam, especially in rural areas (Rimmer *et al.*, 2013). In value terms, shrimp and prawns are the main species exported, and the major producing countries are in Latin America and East and Southeast Asia. Wild shrimp still covers a large proportion of the total production, but an increasing share is produced as farmed shrimp (FAO, 2018). International demand for shrimp is predicted to increase in the future and farmed shrimp can be viable solution to respond to this demand (Bush *et al.*, 2010).

Vietnamese aquaculture is a source of foreign exchange and economic development. It is one of the strongest contributors to the national economy and about 50% of fish production is coming from aquaculture. The contribution of aquaculture to Vietnam's economy is estimated to be among the highest in the world (**Hishamund *et al.*, 2009b**). As a consequence of declining fish production and increasing revenues from aquaculture, the Vietnamese government regard aquaculture as a high priority sector for development (**Hishamund *et al.*, 2009a**). Vietnam is the world's third largest exporter of fish and fish products. The value of exports has increased from 3.8 billion USD in 2007 to 8.5 billion USD in 2017. The main revenue from export comes from Pangas catfish and shrimp (**FAO, 2009; FAO, 2019**).

In Vietnam, shrimp farming concentrates on two main species: black tiger shrimp (*Penaeus monodon*) and white shrimp (*Litopenaeus vannamei*) (**Van Duijn *et al.*, 2012**). In 2017, the total brackish water shrimp farming area was 721.1 thousand hectares, of which 622.4 thousand hectares were black tiger shrimp farms, and the rest was white shrimp farming area. At this time, shrimp production reached about 700 thousand tons. Shrimp products were exported to 99 markets and generated 3.85 billion USD (**VASEP, 2018**). Hence, shrimp farming proved its importance in the socio-economic development of Vietnam.

There are constraints to the development of aquaculture in general and shrimp farming in particular, that are caused by the limited capacity of farmers in adopting new technologies and approaches (**Rimmer *et al.*, 2013**). Such shortcomings led to occasional production losses in shrimp farming due to disease and environmental degradation (**Hishamund *et al.*, 2009a**). Another major challenge in aquaculture is the impact of climate change, which leads to destruction of facilities, loss of stock, loss of business, increase of harmful algae blooms, and increased virulence of dormant pathogens (**De Silva and Soto, 2009**). The major share of domestic shrimp production is located in the Mekong Delta (**Tran *et al.*, 2013; Lan, 2013**). While various studies have focused on interaction patterns between actors of aquaculture value chains in Vietnam (**such as Tran *et al.*, 2013; Lan, 2013; Ha *et al.*, 2013**), the conditions under which unsustainable production processes evolve in the aquaculture sector in Vietnam have received relatively little attention. Hence, this study aimed to outline the production processes and sustainability issues of white shrimp farming in Vietnam and the framework conditions causing such issues. The present study applied an explorative approach, using the central Vietnamese Thua Thien Hue province as a case example.

Empirical material for this article was obtained in a field study in Thua Thien Hue province, which is located in central Vietnam. The province has 120 km of shoreline and an area of 5,000 km². The population of Thua Thien Hue province was 1.1 million people in 2017, of which 51.2% live in rural areas. Thua Thien Hue is one of the provinces, which has strong development in aquaculture sector in central Vietnam with diversity in aquaculture types such as freshwater aquaculture, brackish water aquaculture and marine aquaculture (**Thua Thien Hue portal, 2019**).

White shrimp farming is well developed in this locality, the province started to use white shrimp in aquaculture on sandy land in 2002 and focused on coastal communities. Consequently, the area of white shrimp farming has increased significantly and achieved 470 hectares in 2017. The provincial government has a plan to reach 1,000 hectares devoted to white shrimp production in 2030 (**MARD, 2015**). White shrimp farming has

significantly contributed to socio-economic development and poverty reduction at coastal communities in particular and the province in general. At the research site, shrimp farmers typically use intensive farming and the participation of smallholder farmers is popular.

MATERIALS AND METHODS

Qualitative research was applied for the present study. Primary data was collected from semi-structured interviews with 24 participants including white shrimp farmers, representative of local government from village to provincial level and white shrimp buyers. The field research aimed at obtaining a picture of the real situation of white shrimp farming, developmental processes, marketing channels as well as current challenges and ways to solve them. The research was also based on collecting secondary information from reports from various levels of government, previous researches and statistics of functional units in Vietnam. Hence, this study attempted to reconstruct the situation of white shrimp farmers as complete as possible. The study site and locations of interview partners were outlined in Fig. 1.

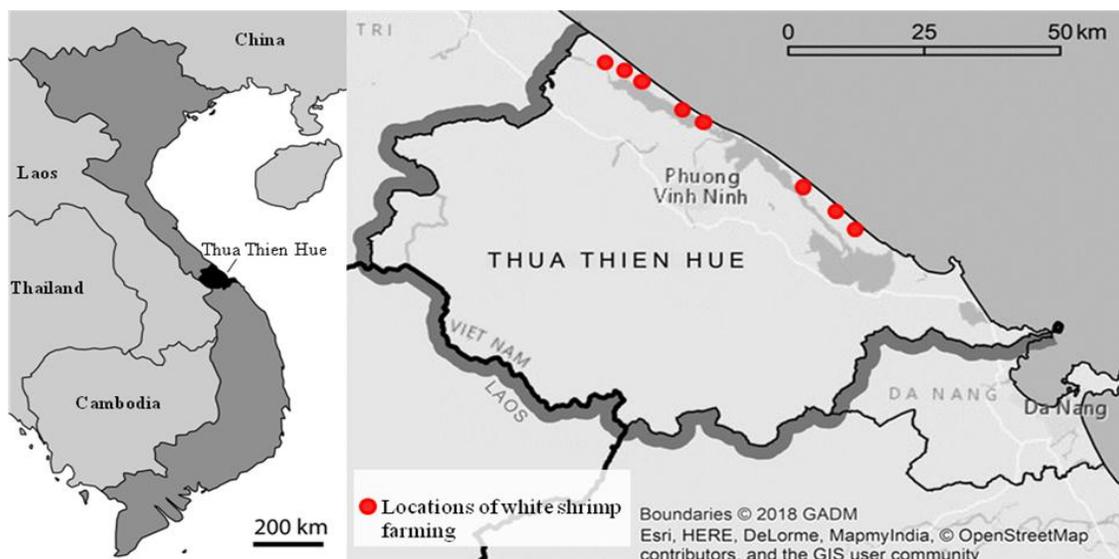


Fig. 1. Location of Thua Thien Hue province and white shrimp farming

Source: Own adaption

For the choice of interview partners, the snowball approach was applied so that the next interviewee was verified through the information of the previous one (Noy, 2008; Etikan *et al.*, 2015). Interview partners were selected based on relevance for the research questions. The interview information was recorded, then transcribed and synthesized. The results of this study were presented in the following sections.

RESULTS

1. White shrimp farming in Vietnam

The role of shrimp farming has become increasingly important for the socio-economic development of Vietnam's coastal areas (Hai *et al.*, 2015). In the beginning of

the 1990s, the Vietnamese government realised that shrimp is a high value export product, which has the potential to increase national export revenues (**Ha and Bush, 2010**). Shrimp farming exists in the forms of extensive, semi-intensive and intensive farming. The main actors are small-scale household producers, whereas cooperatives and companies are also involved in shrimp farming and seed production (**Hai *et al.*, 2015**). In Vietnam, two main shrimp species are cultured including black tiger shrimp and white shrimp, with white shrimp production showing a significant increase relative to black tiger shrimp in recent years (**Van Duijn *et al.*, 2012**).

Vietnam started to culture white shrimp in the 2000s and production quickly developed in the central provinces. Advantages of white shrimp include short culture duration, high production density, low risk of disease and loss; however, it requires high investment in both technology and capital (**Lan, 2013; Hai *et al.*, 2015**). The farmed white shrimp production from 2002 to 2017 was illustrated in Fig. 2 below:

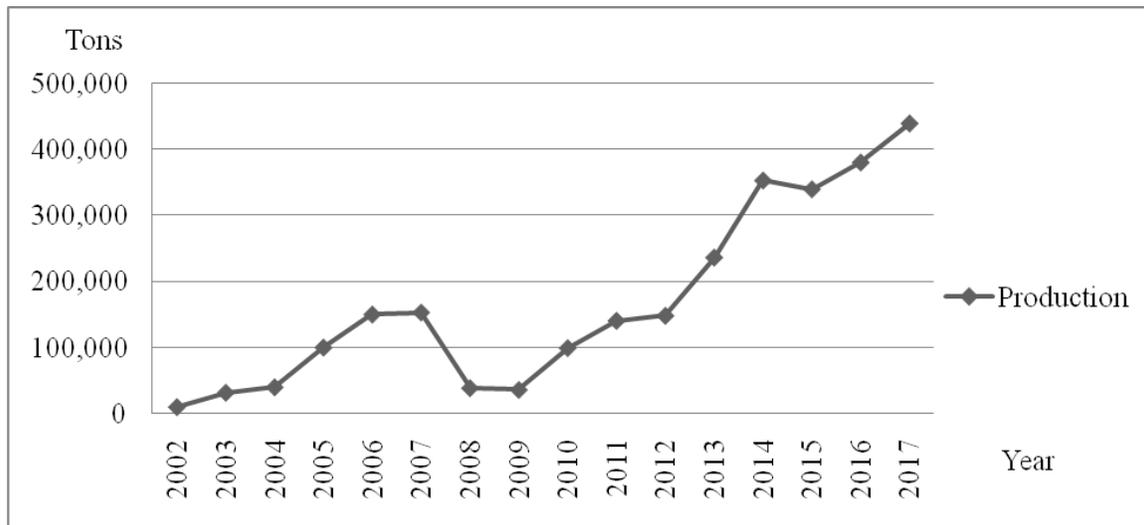


Fig. 2. Farmed white shrimp production of Vietnam from 2002 to 2017

Source: FAO statistics

As shown in Fig. 2, white shrimp production in Vietnam increased multifold during the period of 2002 to 2017. Due to outbreak of diseases, the production dropped sharply between 2007 and 2009, but it has developed dynamically since then.

The Vietnamese Government determined that shrimp is a key export product of the aquaculture sector. In the national development planning from 2021-2025, the shrimp industry is encouraged to invest in establishing key farming areas and organic shrimp farming. The aim is to increase production and export revenues from shrimp respectively to 700,000 tons and 5.5 billion USD by 2025. In addition, quality of production would be improved by introducing more efficient production processes and banning chemical antibiotics. The position of smallholders would be improved by reducing the number of intermediate layers and promoting vertical integration of shrimp value chains (**Government of Vietnam, 2018**).

2. Practices and circumstances of white shrimp farming in Thua Thien Hue province

2.1. Seasonality of white shrimp farming

In Thua Thien Hue, the main actors in white shrimp farming are the smallholder farmers who are directly managed and supported by local governments. However, each farmer has a different strategy for feeding the white shrimp, and has his own decision whether to farm two or three seasons in a year. Farmers are also individually deciding on the specific date for seeding, harvest and renovation of their ponds. Local farmers do not often follow the guidelines provided by the seasonal calendar, because they stock shrimp seed based on traditional spiritual beliefs and advise from fortune-tellers.

In recent years, most white shrimp farmers have chosen to farm two seasons in a year (instead of three seasons per year which was common in the beginning), mainly in winter season (August to December) and summer season (January to April), with winter considered as the main season for white shrimp farming activity. There were numerous differences between the winter and summer season which are outlined in table 1.

Table 1. Difference between winter and summer season in white shrimp farming

No.	Criteria	Winter season	Summer season
1	Stocking density	High	Low
2	Culture period	Long	Short
3	Number of participants	High	Low
4	Rate of losses	Low	High
5	Risk aversion-level	Low	High
6	Selling price	High	Low
7	Size of shrimp	Big	Small
8	Likelihood of disease	Low	High

Source: Stakeholder interviews

In general, farmers can benefit more from farming in winter season rather than in summer. Stocking density is entirely dependent upon the decisions made by each farmer, based on their experience, production strategy and the investment capacity of each household. Additionally, white shrimp farmers tend to stock 160-350 white shrimps/m², which is higher than the allowed local government regulations that range from 100 to 150 white shrimps/m². Density in summer is lower than that in winter, because white shrimp grows faster in summer, which, combined with high density, high temperature and a large amount of industrial feed, can create the conditions for spreading diseases.

“Farmers had high stocking density because they hoped that they can earn high profit, if the survival rate of white shrimp is high. From this perspective, many farmers think of white shrimp farming as a form of gambling; they have the freedom to decide on stocking density and then hope that they will be successful”.
Head of Hoa My village, Dien Loc community.

On the other hand, diseases occur less in winter due to the low temperature of air and water, thus the possibility of culturing shrimp at a higher density becomes more probable. As a result of the lower risks and better conditions in winter, the number of people involved in farming activities increases.

As mentioned above, though the rate of stock loss and level of risk in winter is lower than in summer, yet culturing shrimp in winter takes more time due to low degrees of temperature, leading to a lower growth comparing to summer. On the other hand, farmers are able to sell shrimp at a higher price in winter because of its big size of shrimp. In addition, due to the impossibility of white shrimp farming activities in Northern provinces of Vietnam at this time, the demand tends to be higher in winter, thus basically eliminating part of the competition.

There is a difference in total area of white shrimp farming of each farm, but the area of each white shrimp pond is about 2,500-3,000 m². The shrimp pond system is developed on sandy area, and water is pumped from the sea combining fresh water system from the underground. Thus, to set up shrimp ponds consumes significant initial investment, but, in return, the profits can be relatively high: The average production of white shrimp farming is 14-20 tons/hectare and the profit margin ranges from 4.5% to 10%. From this perspective, white shrimp farming has attracted the participation of stakeholders and concentration of local government.

2.2. Quality of white shrimp seed

Most white shrimp farmers selected shrimp seed from companies in different provinces of Vietnam. They chose companies based on their experience, established trust-based relationships and exchange of information with other white shrimp farmers. If a farmer makes a profit during harvesting, they will continue buying shrimp seed from the same company, whereas if they confront a loss, they will change the supplier. The amount of capital available to a farmer is also relevant; more affluent farmers buy from professional feed suppliers while farmers with less available capital would buy lower quality feed from other farmers.

Buying shrimp seed from a company is supposed to be of high quality. But, it is unreliable insofar as documents and certifications of professional suppliers about quality and origin of the seeds were oftenly been feigned, a condition that creates uncertainty about the true quality of supply. In some instances, the shrimp seed died shortly after they were purchased.

Notably, white shrimp farmers choose shrimp seeds, owing to their inability to determine the quality of shrimp seed, depend totally on their experience and judgement. Thua Thien Hue province does not have any local companies producing white shrimp seed, which makes it difficult for farmers to evaluate the quality of the seed before buying. Thua Thien Hue province possesses only small scale production facilities that produce white shrimp seeds of relatively poor quality.

When buying white shrimp seeds from production facilities in Thua Thien Hue province, farmers can control or test the quality of shrimp seeds with the support of the provincial Government (using Polymerase Chain Reaction, PCR, which is used to determine latent pathogens). This method is used to check for diseases and assess the health of the shrimp. However, white shrimp farmers are often reluctant to use this technique, because they have to spend time getting the shrimp seeds to Hue city and wait for the results. Moreover, the accuracy of the test has been questioned because in some

cases shrimp seeds died shortly after purchase even when the test had showed good results.

*“Determining the quality of white shrimp seeds is very hard, because farmers have used white shrimp seeds from different companies or production facilities and many have had their seeds die. Therefore, nobody can say that the white shrimp seeds from any particular company are the best. They will choose the white shrimp seeds from one company or another company when those seeds were stable during culturing”*A farmer, Hai Dong village, Phong Hai commune.

These aspects, which are based on previous experiences rather than on formal standards and documentations, contribute to highly informal relationships among farmers and suppliers, a state that may hinder further development towards implementing general production standards in formalized relationships.

2.3. Adopting production technologies

In the early stage of shrimp farming, farmers did not have sufficient knowledge about production techniques. They learnt about shrimp farming and the related technology through training courses provided by functional departments in the government, and workshops set by the Industrial Feed Companies and the Aquatic Medicine Company. The most important feedback that farmers have is often learnt from other farmers and their technical knowledge regarding shrimp farming that accumulated throughout time.

Although the white shrimp farmers have developed their experience and knowledge over years, most white shrimp farmers were not yet satisfied with the levels of their technical skills owing to their struggle confronting diseases in their shrimp ponds. However, they usually try to solve their problems using their own experience and do not trust the technical advice provided in books or experts. They are reluctant to incorporate technical advice not only because of the exerted high costs of time and money installing new production technology and changing the existing habits, but also because previous attempts of changing production techniques were unsuccessful and therefore may pose an incalculable risk.

Therefore, changing and applying technological advances seems to be difficult while traditional production routines are the dominant mode in white shrimp production. Many farmers simply assume that production success depends on luck.

2.4. Using aquatic medicine

Aquatic medicines are popularly used in white shrimp farming. They are used to treat pond water and to renovate their ponds. White shrimp farmers also use vitamins, minerals and antibiotics to improve the health of the shrimp during the culturing process. When diseases do occur, or when there are drastic changes in weather, farmers can buy various aquatic medicines to mitigate the impact of such instances. Buying aquatic medicine is convenient for white shrimp farmers as various agents in Thua Thien Hue province offer it.

There are numerous aquatic medicine companies and types of medicine available in the market. Each white shrimp farmer selects an aquatic medicine relying on his experience and his specific circumstances. White shrimp farmers, during culturing period, used to try a number of different aquatic medicines until they prove no longer effectiveness, and thence, would be replaced hereafter. Due to the individual type of

white shrimp farmer decisions, in relation to the duration and the way they use aquatic medicines, a great variance among them has been realized. Thus, a strong prioritization of high production output often makes farmers ignore existing regulatory limits of using medicine, causing antibiotic residues in white shrimp. This is even acknowledged by government officials as the following comment pointed out:

“Using aquatic medicines is now a habit for white shrimp farmers. White shrimp farmers believe that “prevention is better than cure”; so, a large number of white shrimp farmers focus on preventing diseases by using antibiotic aquatic medicines. Farmers will not culture white shrimp without aquatic medicines”. Officer of the Department of Agriculture and Rural Development, Phong Dien district.

Diseases are an ongoing problem in white shrimp farming, while very few farmers were able to control diseases that occurred in their ponds. All white shrimp farmers use aquatic medicines, with the aim of preventing rather than curing diseases. In addition, white shrimp farmers are often not able to find the cause or the reason for a particular disease. Reasons for diseases are thought to be poor water quality, climate change or poor-quality shrimp seed. Farmers try hard to treat diseases, but once diseases inhibit in a shrimp pond, they turn uneasily curable. Moreover, whenever farmers find themselves unable to cure the disease, they tend to sell all the shrimp.

It is the government policy to support white shrimp farmers when their shrimp are affected by disease. Local governments check for diseases and give advices on how to treat the diseases. However, very few white shrimp farmers would actually contact the available various government officers, when they identified diseases in shrimp ponds, baring in mind that the government- involvement would be a time- consuming process that lacks clear benefit, as one farmer explained in an interview:

“Diseases have become common in white shrimp farming. We have tried many methods to control water quality and stop the blooming of algae and we have also tried to increase white shrimps’ resistance to disease. Though when diseases appear, they can cause white shrimp farmers to lose lots of money. Thus, we face many difficulties in trying to deal with diseases. Even the technical staff from the local government could not help us” A farmer, Dien Loc commune.

Rather than involving third parties, farmers tend to hide the disease or try to deal with it by themselves. Hence, diseases are easily spread, while there is a lack of management and control by government.

2.5. Water pollution

Although white shrimp farmers use water drawn from the ocean using water pipes and pumps, they often struggle with poor water quality. Shrimp ponds run along the coast, and most of them do not meet the required standards for managing water quality. Very few production facilities have a wastewater treatment pond to treat the water before it is pumped back out to sea. Due to insufficient enforcement of regulations for wastewater treatment, the majority of white shrimp farmers have no incentive of treating wastewater after it has been used. Therefore, most of the water is discharged back into the sea untreated, creating a vicious circle of gradually decreasing quality of water which could be reused in other shrimp ponds and then farmers might use that water again. This problem has also been confirmed by an interviewed government representative:

“White shrimp farming has been ongoing for many years, while water treatment has not been implemented properly. This has been harmful to the water. White

shrimp farming activity does not only happen in Phong Hai commune, but in a number of communities in Thua Thien Hue province in particular and other provinces in Central of Vietnam in general. Therefore, the amount of wastewater discharged into the sea is increasing over time, while the quality of the water is deteriorating' agricultural officer of Phong Hai community.

White shrimp farmers clearly understand the harmful effect of untreated wastewater, but will not invest in wastewater treatment unless there is a must. As a result, instead of treating wastewater, farmers try to focus on improving water in the shrimp ponds before stocking.

2.6. Monopoly on buying white shrimp

After harvesting, farmers limit options for selling because almost all the produced white shrimp would have always be sold to middlemen. The middlemen in Thua Thien Hue province have a tacit agreement in place in which they divide the territories in which each middleman has the exclusive access to purchase produce from smallholders. This effectively eliminates competition among middlemen and weakens the bargaining positions of farmers. This mode also entrenches existing relationships between middlemen and farmers based on trust informal relationship. Moreover, farmers who sell to a middleman who is not “in charge” of a specific area would spoil the relationship with their previous middleman, a condition that may end with the abstention of the latter to purchase the product in the time to follow.

On the other hand, farmers can sell their products to a processing plant in Thua Thien Hue province, which can buy white shrimp at a higher price compared to the middlemen, but, due to common antibiotic contents and insufficient size of the white shrimp, their produce does not often meet the requirements of the processing plant. An interviewed farmer summarized the dependence of middlemen as follows:

“We only hope that the middleman can buy all of our products whenever we want to sell at suitable price, because we do not have capacity in bargaining, finding out other buyers or improving the quality of our product” A farmer, Hai Dong village, Phong Hai commune.

The de-facto monopolist purchasing structure of white shrimp in Thua Thien Hue province is one of the major constraint for the development of a more sophisticated white shrimp production system in Thua Thien Hue province.

DISCUSSION

The empirical results outlined above highlight significant deficiencies in the sustainability of white shrimp production in the Thua Thien Hue province which need to be addressed in order to make local shrimp production of smallholders eligible for export, as the Vietnamese government anticipates (Tran *et al.*, 2013). Value and export turnover of white shrimp produce of Thua Thien Hue are constrained by antibiotic residues and purchasing monopolies. Current asymmetries in bargaining power between producers and middlemen are the major curtailment for poverty reduction and the development of the sector in central Vietnam. Due to low capital, expertise and bargaining power of smallholders, shrimp production is focused almost entirely on high density and low investments because, in the awareness of farmers, these are the only possibilities of increasing profitability. These findings somewhat stand in contrast to Tran *et al.* (2013),

who concluded in a study about governance of shrimp value chains in the Mekong Delta that “For the most part, shrimp produced by small-scale producers have limited exposure to antibiotics or other prohibited chemicals because the low intensity of their production system does not require such inputs.” (Tran *et al.*, 2013).

The production structures described in Thua Thien Hue province lead to inconsistent quality of the produce, occasional production losses, water pollution economic risk for farmers and high dependence of farmers from middlemen. An important measure for farmers to improve their position and practices would be to horizontally organize to share experiences and improve their bargaining position, but this requires close geographic proximity and the establishment of mutual trust (Joffre *et al.*, 2018). Trust is currently lacking among farmers in Thua Thien Hue and, compared to the Mekong Delta, it is more difficult to achieve because of their lower geographic proximity.

On the institutional level, lacking trust in formal contracts and standards is the core issue which should be addressed by different government levels. Besides building capacities of tracing the origin of shrimp produce (as outlined by Tran *et al.*, 2013), further measures should be focused on *enabling farmers* to adopt more sustainable production practices. These could include the provision of easily accessible financing for smallholders, the facilitation of building trust among farmers to establish cooperatives and, very significantly, an increase of government capacity to reliably enforce existing regulations. However, even with such measures in place, the existing habits of farmers towards more formalized and standardized production practices will take time to change.

CONCLUSION

The farming of white shrimp has developed significantly in the central provinces of Vietnam since 2002 and this article explored in detail the production systems of white shrimp farmers in Thua Thien Hue province. As the case article showed, white shrimp production systems face serious sustainability issues which currently constrain further development, contribute to pollution and lead smallholders into high dependency on middlemen. Although white shrimp farmers have implemented some solutions to adapt or deal with these challenges, these solutions are only temporary and are not very efficient. Quality of seed supply and the emergence of diseases and the behaviour of middlemen are uncertainties which farmers feel relatively powerless to overcome. Significant government efforts are needed in order to improve these conditions. In general, easier access to capital and training for farmers as well as more reliable implementation of formal regulations and standards are needed. This study focused on the circumstances under which white shrimp are produced in Thua Thien Hue. Thus, it is not representative for Vietnam as a whole. A viable area of further research could be the exploration of white shrimp production systems in other Vietnamese provinces which could contribute to developing more nuanced policy advice that takes into account specific regional circumstances.

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