



**Food and Agriculture
Organization of the
United Nations**

FIAA/C1194 (En)

**FAO
Fisheries and
Aquaculture Circular**

ISSN 2070-6065

**RISK MANAGEMENT PRACTICES OF SMALL INTENSIVE SHRIMP
FARMERS IN THE MEKONG DELTA OF VIET NAM**

RISK MANAGEMENT PRACTICES OF SMALL INTENSIVE SHRIMP FARMERS IN THE MEKONG DELTA OF VIET NAM

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Required citation:

Pongthanapanich, T., Nguyen, K.A.T. & Jolly, C.M. 2019. *Risk management practices of small intensive shrimp farmers in the Mekong Delta of Viet Nam*. FAO Fisheries and Aquaculture Circular No. 1194. Rome, FAO.

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ISBN 978-92-5-131887-4

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PREPARATION OF THIS DOCUMENT

This survey-based study was initiated after the review in 2016 of the aquaculture insurance pilot programme of Viet Nam. The review is available at www.fao.org/3/a-i6559e.pdf. The analysis is based on the data from surveys of shrimp farms in Bac Lieu, Ben Tre and Ca Mau provinces. The study was initiated and guided by Tipparat Pongthanapanich of FAO Rome. Field work was carried out by a research team of Nha Trang University, led by Kim Anh Thi Nguyen. The survey was facilitated by the local government staff of the Fisheries Department of Ben Tre, Agriculture Department of Dam Doi district in Ca Mau and Fisheries Department of Bac Lieu. The background information and insights obtained from the interviews and focus group discussions with Vinh An Shrimp Cooperative in Ben Tre and Bao Minh Insurance Company in Ben Tre also informed the design and preparation of the survey.

The definitions of insurance terms used in this document are from the glossary of common terms used in crop, livestock and aquaculture insurance, in Annex 5 of the FAO Agricultural Services Bulletin 164 – *Livestock and aquaculture insurance in developing countries* – by Roberts (2007).

ABSTRACT

Viet Nam is one of the top producers and exporters of farmed shrimp. More than 80 percent of the total production comes from small intensive farms, which occupy less than 10 percent of the land area devoted to shrimp farming. It is the main source of income for many rural households in the Mekong Delta provinces.

This study examines the characteristics of small intensive shrimp farms and socio-economic status of the farm households, and farming practices and performance that are associated with the strategies and preferences for managing production risks. The analysis was based on primary data from a survey of farms raising the whiteleg shrimp (*Penaeus vannamei*) conducted in Bac Lieu, Ben Tre and Ca Mau provinces from September 2017 to February 2018.

The results show that shrimp farming contributes significantly to poverty alleviation. The average income per capita of a shrimp farm household member was seven times higher than the national average. It generates employment in rural areas both from the hiring of farm workers and by the self-employment of household members. The study, however, also highlights the risk of relying on a single income source from shrimp, as many of the responding households do.

Increasing productivity, i.e. improving yield, and keeping unit cost low, are significant factors affecting a farm's competitiveness. This is clearly a result of an efficient use of farm inputs. The study found that a proper farm design and layout to ensure good management of water supply and pond effluent improved the performance of the farms.

Most farms suffered from disease outbreaks during 2013–2016; some events were not controllable and caused total loss of stock. This supports the widely held view that shrimp farming is a high-risk-high return enterprise. Adoption of good farm practices, following certain guidelines, could help mitigate the risks. In addition, insurance may be developed to help shrimp farmers mitigate the risk impacts of an 'act of God' or an uncontrollable event. It may be designed specifically for individual farms or a group of small farms that can comply strictly with the required farm practices or standards.

The farmers expressed interest in buying insurance that covers loss from disease outbreaks as well as bad weather that causes wide fluctuation in water parameters. Presented three scenarios to find out their willingness to pay, a majority of the farmers preferred two schemes: a maximum compensation rate (sum insured) of 80 percent and of 50 percent of total production cost. With the 80 percent scheme, the willingness to pay for a premium was VND 10 852 per kilogram of shrimp (USD 0.49). This was 9.2 percent of the farm gate price received, 11.0 percent of total production cost, or 17.8 percent of the net farm profit. This scenario would earn for the insurer VND 14.7 million (USD 670) per pond per crop. With the 50 percent scheme, the willingness to pay for a premium was VND 2 765 per kilogram of shrimp (USD 0.13). This was 2.3 percent of the farm gate price received, 4.2 percent of the total production cost, or around 4.6 percent of the net farm profit. The insurer would earn VND 9.6 million (USD 438). Nearly all of the Ben Tre province respondents were interested in buying insurance, preferring the 50 percent scheme. Those who participated in the Government's shrimp insurance pilot programme of 2011–2013 would be willing to pay a higher premium than those who did not.

Overall, the results can inform national development programmes that promote sustainable intensification, especially in countries where small-scale farms predominate and natural hazards continue to be a serious threat to farming.

Keywords: intensive shrimp farming, good aquaculture practice, risk management, shrimp insurance, Mekong Delta, Viet Nam

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ABBREVIATIONS AND ACRONYMS

AHPND	Acute hepatopancreatic necrosis disease
ASC	Aquaculture Stewardship Council
BAP	Best Aquaculture Practices
GSO	General Statistics Office of Viet Nam
VASEP	Vietnam Association of Seafood Exporters and Producers
VietGAP	Vietnam good aquaculture practices
WFS	White feces syndrome
WSSV	White spot syndrome virus
YHV	Yellow head virus

Unit of measure

USD 1 = Average of VND 22 000 at time of study

1. INTRODUCTION

Shrimp farming in Viet Nam has been expanding rapidly since 2000, particularly in the Mekong River Delta (Figure 1). The region contributed more than 80 percent of total production, mostly from Ca Mau, Soc Trang, Bac Lieu, Kien Giang, Ben Tre and Tra Vinh (Figure 2). The Directorate of Fisheries (D-Fish) estimated that in 2018 the total farmed area was around 720 000 ha with a production of 745 000 tonnes. Giant tiger prawn (*Penaeus monodon*) had been the main species produced in Viet Nam for many years at around 300 000 tonnes per year. It is now whiteleg shrimp (*Penaeus vannamei*) with a 2018 production of around two-thirds of the total farmed shrimp output. In the same year, Viet Nam's shrimp export valued at USD 3.6 billion was around 40.9 percent of that of the total seafood export. The major importers of Vietnamese shrimp include the European Union, the United States of America, Japan, China, South Korea, Canada, Australia, ASEAN countries, Taiwan Province of China and Switzerland, collectively accounting for 96 percent of the total export value (VASEP, 2019a).

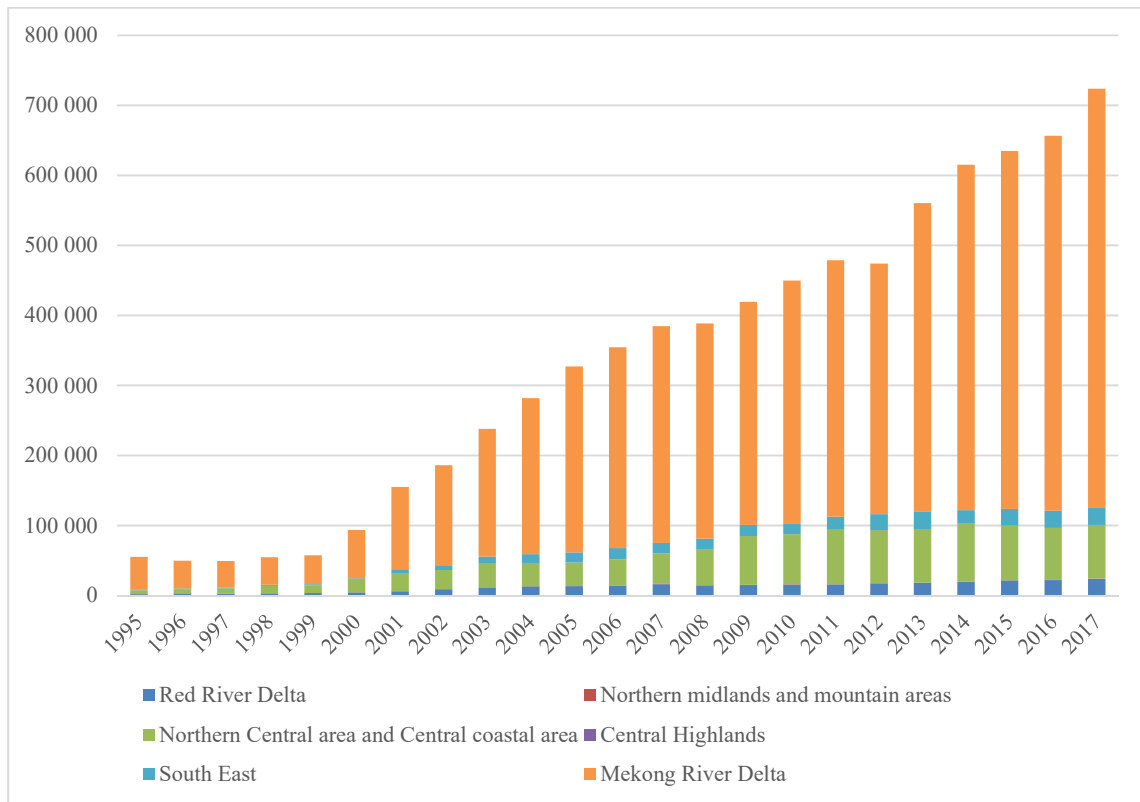


Figure 1. Shrimp production (in tonnes) by region in Viet Nam, 1995–2017

Source: data from GSO (2019)

Decision 79/QĐ-TTg of the Prime Minister dated 18 January 2018 promulgated a national plan for the development of the shrimp industry through 2025. It set the target of USD 10 billion in shrimp export for 2025 (Nguyen, 2019). The plan aims to develop the shrimp industry into a key economic sector with sustainable development that is adaptable to climate change and friendly to the environment (Viet Nam News, 2017).

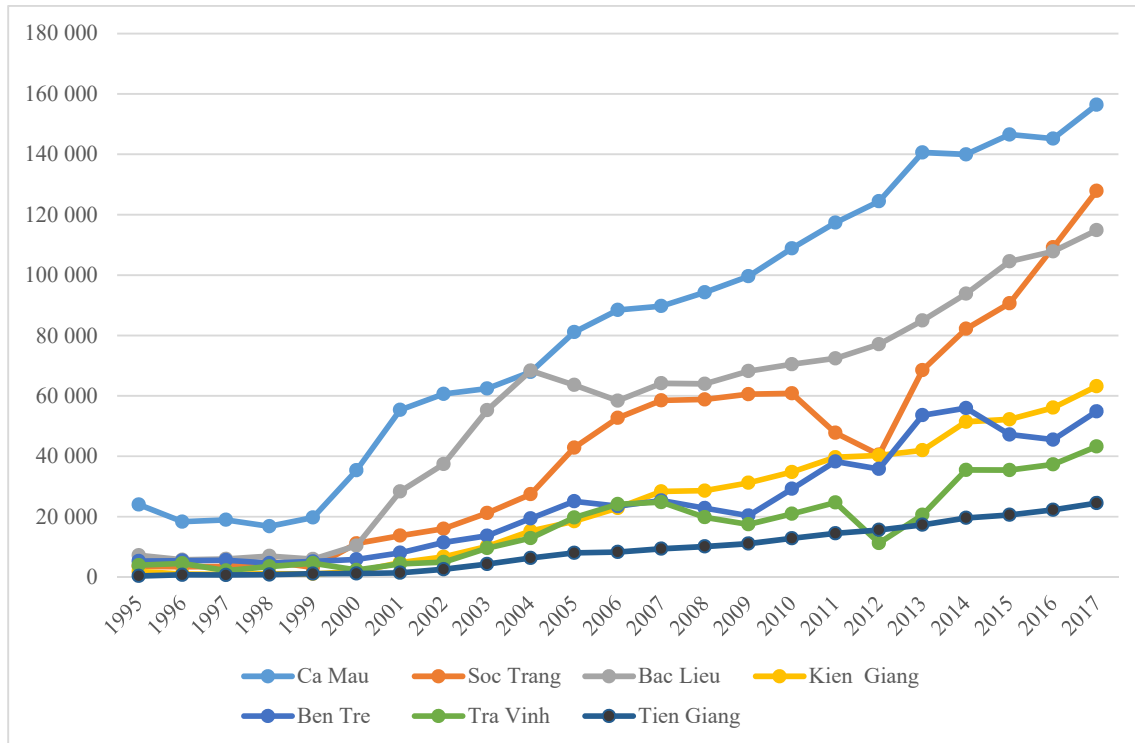


Figure 2. Shrimp production (in tonnes) by main provinces in the Mekong Delta, 1995–2017
Source: data from GSO (2019)

To achieve the target, the government has encouraged production intensification. The country's target relies on the outputs from a large number of small intensive farms. They contribute around 80 percent of total production and occupy less than 10 percent of the land area devoted to shrimp farming (Osborne, 2018). A less intensive farming system, the 'improved-extensive shrimp farming' in Viet Nam, occupies around half of the total country's shrimp farming area. Integrated farming systems such as rice-shrimp farming and mangrove-shrimp farming are also promoted. It was estimated that the integrated mangrove-shrimp farming area is around 8 percent, predominantly in the Mekong Delta region. Super-intensive farming, with closed and water recycling system, is adopted mostly by large corporate farms. A modification of the system that can be applicable to small operations is being developed.

The trend towards increasing intensification is likely driven by economies of scale (Engle *et al.*, 2017). The greater yields spread annual fixed costs across greater production volumes. This results in a decreased cost per tonne of shrimp produced. The same study found that in most cases intensive shrimp operations in Thailand and Viet Nam use land and energy much more efficiently than less intensive ones. However, intensification increases requirements for both capital and management skills. Even if strong economic incentives exist to improve productivity, farmers without adequate capital or management skills would be unable to benefit from productivity gains (Waite *et al.*, 2014). The intensification could also render the stock more susceptible to disease. In 2012, one-sixth of the total area (100 776 ha) suffered serious losses from the infectious disease, acute hepatopancreatic necrosis syndrome (AHPNS) or early mortality syndrome (EMS) (Nguyen, 2015). Recent calls for sustainable intensification signal an increased understanding of the potential environmental, economic and social effects of intensification of aquaculture production. The government and a number of international development partners have been working together to improve the way the country farms shrimp, with an emphasis on small-scale operators (Osborne, 2018).

To ensure the sustainable development of the sector, several new measures were developed, one of which is the voluntary national guidelines for good aquaculture practice or VietGAP standard.¹ It has been promoted to shrimp farmers since 2012 but the rate of adoption is low.² The international standards such as Aquaculture Stewardship Council (ASC), Best Aquaculture Practices (BAP) and GLOBALG.A.P. have also been promoted in Viet Nam. Most of the certified farms are corporate farms.³

The government also developed a financial measure, insurance, to help farmers manage the production risks. During 2011–2013, an aquaculture insurance programme was piloted in Ben Tre, Bac Lieu, Ca Mau, Soc Trang and Tra Vinh. However, it operated at a loss, mainly because of the large number of shrimp disease claims (Nguyen and Pongthanapanich, 2016).

This study examines the characteristics of small-scale intensive shrimp farms, their farming practices and performance. It identifies the types of perils and losses experienced by farmers as well as their strategies and preferences for managing the risks. The socio-economic characteristics of the farm households were documented. The analysis was based on the survey data of whiteleg shrimp farms. The farm survey was conducted in three selected provinces, Bac Lieu, Ben Tre and Ca Mau. These are among the main shrimp producing provinces and the three of five provinces in the Mekong Delta that the government had implemented the pilot insurance programme. The results could provide farm-level background information for shrimp aquaculture development programmes that promote sustainable intensification, which is necessarily founded on good aquaculture practices and effective risk management strategies.

The next section describes the survey methods and the characteristics of the selected respondent farms. This is followed by the Results section, which has nine sub-sections: (1) general information of the sample farms, (2) the farm households' socio-economic characteristics, (3) farm structure, (4) post larvae and stocking, (5) grow-out pond, feed and health management, (6) shrimp harvest and revenue, (7) economic performance, (8) perils and losses experienced and (9) farmers' interests in buying insurance. The results were then discussed. The conclusion and recommendations complete the report.

2. METHODOLOGY

The analysis is mainly based on primary data source, i.e. shrimp farm survey. The survey was conducted in Bac Lieu, Ben Tre and Ca Mau from September 2017 to February 2018 by a research team of Nha Trang University. These three provinces were selected from the five provinces in which the government implemented the pilot insurance programme during 2011–2013. In 2017, the three provinces contributed 46 percent of Viet Nam's total shrimp production (GSO, 2019). Their respective shares were 114 865 tonnes (16 percent) for Bac Lieu, 54 870 tonnes (8 percent) for Ben Tre, and 156 400 tonnes (22 percent) for Ca Mau. Ca Mau was the largest producer of farmed shrimp in Viet Nam. The analytical results were validated with farmers in the three provinces in October 2018. The results were presented to them for comments and discussion in various meetings.

A structured questionnaire was drafted, pretested and revised. The final version used for the survey contains the topics as presented in the Results section. The related production data were asked by

¹ Vietnam good agricultural practices or VietGAP are the national standards, of which the guidelines have been issued for crop, livestock and aquaculture. For aquaculture, the guidelines and certification systems are available for whiteleg shrimp, giant tiger prawn, pangasius and red tilapia (more information is available at www.vietgap.com). They were developed based on the Code of Conduct for Responsible Fisheries of the Food and Agriculture Organization. The structure of VietGAP is divided into five parts: (1) general requirements, (2) food safety and quality, (3) animal health and welfare, (4) environmental integrity and (5) socio-economic aspects.

² From 2012 to 2018, the numbers of certified VietGAP farms were 11 giant tiger prawn farms (350 ha), 80 whiteleg shrimp farms (1 105 ha) and 255 pangasius farms (1 743 ha) (Nguyen Tan Sy, personal communication, 2018).

³ Up to 2019, there are 192 BAP certified facilities and 348 ASC certified farms, comprising 50 pangasius farms, 233 shrimp farms, and 65 farms of other species (VASEP, 2019b).

referring to the most successful crop in 2016 as perceived by each respondent farm. This is referred to as ‘the 2016 best crop’.

The following characteristics were used as criteria for selecting the sample farms:

- grow whiteleg shrimp only (monoculture and no intercropping/no rotation);
- individual small-scale intensive farm (excluded were large individual and corporate farms);
- use earthen pond; and
- had at least one successful crop in 2016.

The sample size from each province was planned to be 50 farms. The local authorities arranged for the research team to meet the farm owners. During the survey, the interviewer would read aloud each question to the respondent and filled in the answers in the questionnaire. The raw data of 148 observations were obtained. Responses were reviewed and edited on site by the interviewer and later tabulated in Excel. After the data cleaning, 138 completed observations were used in the analysis. This number comprises 47 farms (34 percent) from Bac Lieu, 37 (27 percent) from Ben Tre and 54 (39 percent) from Ca Mau. The respondent farms are located in the following districts: Đông Hải (5 farms), Giá Rai (8 farms), Hòa Bình (14 farms) and Tp. Bạc Liêu (20 farms) of Bac Lieu province; Ba Tri (8 farms), Bình Đại (14 farms) and Thạnh Phú (15 farms) districts of Ben Tre province; and Đầm Doi district (54 farms) of Ca Mau province. Figure 3 shows the main survey sites.

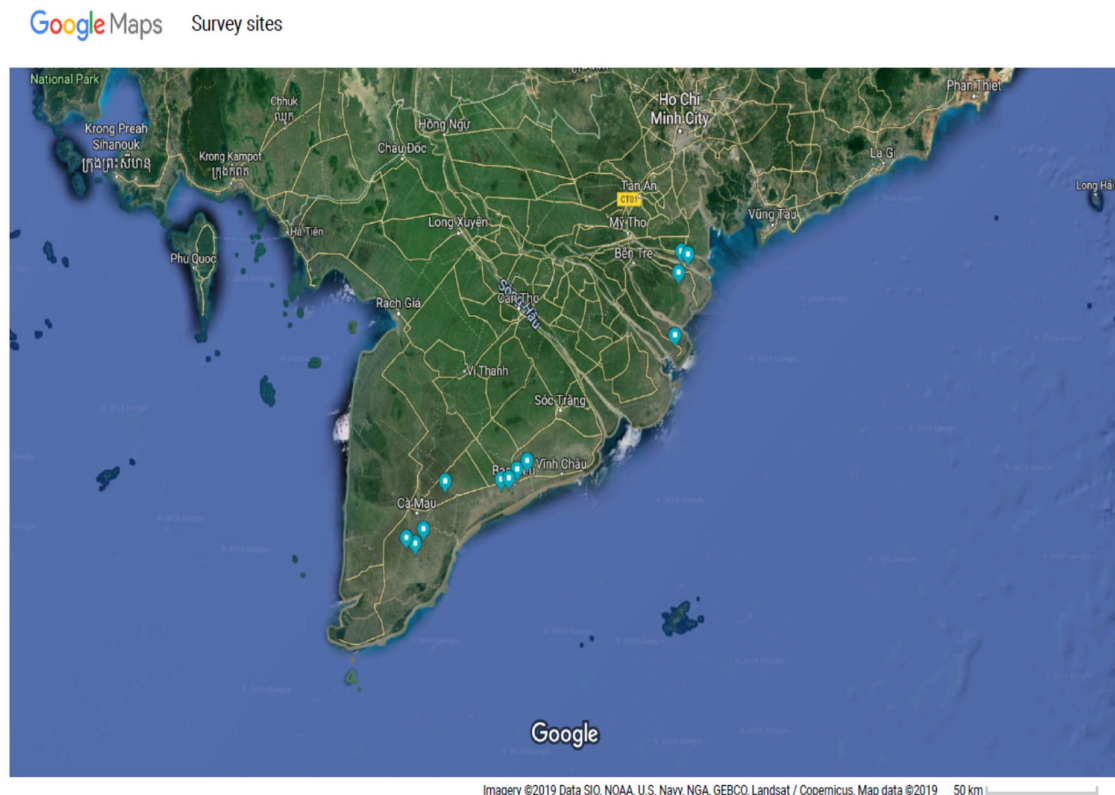


Figure 3. Survey sites
Source: NOAA (2019).

3. RESULTS

This section presents the results from the survey data. It is divided into nine sub-sections. The first two summarize the general characteristics of the samples and their socio-economic characteristics. Based on the 2016 best-performing crop data, sub-sections three to six describe the farm size and structure and the management practices, from stocking to pond management, including feeding and health

management, to harvesting. The production costs and farm profits are presented in sub-section seven. Information on the farmers' experiences on perils and losses as well as their risk management preferences are described in sub-sections eight and nine.

3.1 General information

Most respondents, from 135 of the 138 farms (97.8 percent), were men. They have been operating their own farms for several years before the survey. The newest farm has been operated since 2013 while the oldest was established in 1998. Overall, about 58.0 percent of the farms are relatively new farms; they started during 2009–2012 (Table 1).

Table 1. Number of sample farms by starting year of operation

Year	Bac Lieu	Ben Tre	Ca Mau	Total
1998	1	0	0	1
1999	1	0	0	1
2000	4	0	0	4
2001	7	0	0	7
2002	5	0	2	7
2003	3	0	0	3
2004	1	1	0	2
2005	3	6	1	10
2006	2	0	1	3
2007	2	2	9	13
2008	1	3	1	5
2009	6	4	5	15
2010	9	14	10	33
2011	0	2	12	14
2012	2	5	11	18
2013	0	0	2	2
Total	47 (34%)	37 (27%)	54 (39%)	138 (100%)

Source: survey

The number of crops per year ranges from one to three crops. In 2016, a majority of the farms in Bac Lieu grew only one crop (63.8 percent) while 73.0 percent of the farms in Ben Tre and 57.4 percent in Ca Mau grew two crops per year. The overall average was 1.7 crops per year (Table 2).

Table 2. Number of crops per year in 2016

Province	Number of farms						Total number of farms	Average (crops per year)
	One crop		Two crops		Three crops			
Bac Lieu	30	63.8%	14	29.8%	3	6.4%	47	1.4
Ben Tre	7	18.9%	27	73.0%	3	8.1%	37	1.9
Ca Mau	19	35.2%	31	57.4%	4	7.4%	54	1.7
Total/average	56	40.6%	72	52.2%	10	7.2%	138	1.7

Source: survey

All respondents in Ben Tre were members of farmers' associations or cooperatives but only 38.9 percent in Ca Mau and 8.5 percent in Bac Lieu. Most farms did not obtain any kind of good farm practices standard or certification. Some farms participated in the pilot insurance programme during 2011–2013 (57.4 percent in Ca Mau, 54.1 percent in Ben Tre and 8.5 percent in Bac Lieu).

3.2 Socio-economic characteristics of the households

The respondents in Ben Tre and Ca Mau have had an average of eight years of experience in shrimp farming while those in Bac Lieu had 11 years. Before changing to intensive shrimp farming, most farmers either grew rice (41.3 percent) or had no main occupation other than engaging in improved-extensive or semi-intensive shrimp farming (42.0 percent). The former, i.e. rice farming, was particularly the case in Bac Lieu and Ca Mau.

Most respondents were the household heads and had formal education at least at the primary school level or up to high school. A few respondents had a university degree. The average household size was 4.5 persons, comprising 2.1 female and 2.4 male members. The youth dependency ratio was 19.7 percent and the old-age dependency ratio was 7.8 percent.⁴ The ratios imply that ten working-age persons support 2–3 children and/or retired persons. The youth dependency ratio of almost 20 percent indicates a good reservoir of future farmers who can take over the family enterprise.

Shrimp farming was the main source of income of most households; 47.1 percent of the households earned only from shrimp farming and 52.9 percent had other income sources such as from growing fish and crab, raising livestock, running a grocery shop and working in a company or government office. In 2016, the average annual income per household was around VND 1 213 million (USD 55 119). In comparison, the average income per capita of the shrimp farm household member was seven times higher than the national average.⁵

The majority of farmers used their own land for shrimp farming. All the respondents in Ca Mau owned their farm land while some farms in Bac Lieu (10.6 percent) and in Ben Tre (13.5 percent) rent the land for shrimp farming.

An average of 46.7 percent of the households borrowed money for shrimp farming. The highest proportion was in Ben Tre (66.7 percent). In Ca Mau and Bac Lieu, it was 46.3 percent and 31.9 percent, respectively.

3.3 Farm design and layout

The farm sizes ranged from 0.2 ha to 7.0 ha, with the average of 1.5 ha (± 1.2). The average farm size in Ca Mau was the smallest, i.e. around half that of Bac Lieu and one-third of Ben Tre's (Table 3).

Table 3. Shrimp farm design

Province	Total farm area (ha)	Grow-out pond			Availability (number of farms)		
		Number of ponds	Pond size (ha)	Total area (ha) and percentage of total farm area	Reservoir for stocking water supply	Effluent treatment pond	Place for sludge deposit
Bac Lieu	1.6	4.5	0.27	1.2 (74.2%)	19 (40.4%)	6 (12.8%)	15 (31.2%)
Ben Tre	2.3	3.9	0.27	1.1 (45.9%)	37 (100.0%)	11 (29.7%)	24 (64.9%)
Ca Mau	0.8	2.0	0.21	0.4 (50.6%)	50 (87.7%)	52 (96.3%)	54 (100.0%)
Average	1.5	3.3	0.25	0.9 (60.0%)	106 (76.8%)	69 (50.0%)	93 (67.4%)

Source: survey

Overall, the grow-out pond area was around 60 percent of total farm area. The number of grow-out ponds was 3.3, each pond with an area of 0.25 ha (± 0.08). In Ca Mau and Ben Tre, around half or less

⁴ The youth dependency ratio was calculated from the number of children aged 0–14 per 100 persons aged 15–64. The old-age dependency ratio is the number of persons aged 65 or over per 100 persons aged 15–64.

⁵ The data of monthly average income per capita at current prices by province from the General Statistics Office of Viet Nam (www.gso.gov.vn) was used for the calculation.

of the total farm area was used for grow-out ponds. In Bac Lieu, a much bigger portion (74.2 percent) of the farm land was used for grow-out ponds so that only a small area is left for water stocking, effluent treatment and sludge deposit; many farms have no reservoir. The farms that do not have a reservoir pump in water directly from the public canals or rivers into the grow-out ponds. They filter and treat the water in the grow-out ponds before stocking shrimp.

In Ca Mau, most farms have an effluent treatment pond and recycle the treated water. They also have places in their farms for sludge deposit. In Ben Tre, only 11 of 37 farms (29.7 percent) have an effluent treatment pond. The farms without a treatment pond either release tilapia in the grow-out ponds after harvesting shrimp to clean up the waste and re-use the water (51.3 percent) or discharge the effluent directly to the public watercourse (19.0 percent). In Bac Lieu, only 6 of the 47 farms (12.8 percent) had an effluent treatment pond. Many farms treat the effluent in the grow-out ponds before discharging it to the public watercourse (34.0 percent). Some farms treat the effluent and re-use the water (10.6 percent). A number of farms do not treat the effluent and discharge it directly to the public watercourse (31.9 percent).

3.4 Post larvae and stocking

All the farmers bought post larvae from private hatcheries. They paid in cash. The size of post larvae used ranged from PL10 to PL15; PL12 was mostly used. The average stocking density was 816 906 PLs per hectare. In Ben Tre, all farms did the health screening prior to stocking. They used the government laboratory services of the province. The farmers in Bac Lieu and Ca Mau relied more on private laboratories and fewer farms did screening (Table 4). Some farmers said the hatcheries offered the PCR test at no extra cost (15.9 percent). Most farmers said they did not know if the hatcheries they bought the seeds from have obtained any kind of standard or certification (81.2 percent).

Table 4. Stocking density and post larvae health screening

Province	Stocking rate (PLs/ha)	Price (VND/PL)	Number of farms that obtained health screening
Bac Lieu	604 957	98	28 (59.6%)
Ben Tre	889 189	108	37 (100.0%)
Ca Mau	951 852	103	18 (33.3%)
Average	816 906	103	82 (59.4%)

Source: survey

3.5 Grow-out pond, feed and health management

The top three practices that most farmers adopted for the preparation of grow-out ponds prior to stocking were: (1) cleaning and drying the ponds, (2) using filter and water treatment and (3) preparing the water until it attains the proper colour. During the grow-out period, the main practices adopted were: (1) monitoring water quality parameters in the grow-out ponds, (2) using microbiological treatment and (3) preparing the settling water. For health management and disease control, the most common strategies applied were: (1) good management of pond environment, (2) use of probiotics and nutrient supplement and (3) monitoring the health status of the stock.

All the farmers bought shrimp feed from feed agents through the local shops in their provinces. Most obtained feed on credit. In Ben Tre, the additional charge for purchase on credit was 1.0–1.5 percent of the feed price, excluding delivery service. The rates had a wider variation in Bac Lieu and Ca Mau. They ranged from 1 to 10 percent with an average of 5.9 percent in Bac Lieu and 8.3 percent in Ca Mau. Some farmers in Bac Lieu also availed of the feed dealers' delivery and technical services. In Ca Mau, most farmers did not use the delivery service but they generally used the technical support services provided by the dealers. The average FCRs were 1.3 in Bac Lieu, and 1.2 in Ben Tre and Ca Mau.

The farmers obtained knowledge and advice on shrimp farming from many sources. The main sources were the local government extension service, friends and feed dealers. They also cited their own experiences. In Bac Lieu, they relied on themselves and their friends while in Ben Tre most farmers relied heavily on the government extension service (Table 5).

Table 5. Sources of knowledge and advice on shrimp farming

Province	Number of farmers			
	Government extension service	Friend	Feed dealer	Experience
Bac Lieu	17 (36.2%)	29 (61.7%)	23 (48.9%)	41 (87.2%)
Ben Tre	36 (97.3%)	12 (32.4%)	1 (2.7%)	2 (5.4%)
Ca Mau	40 (74.1%)	50 (92.6%)	43 (79.6%)	36 (66.7%)
Total	93 (67.4%)	91 (65.9%)	67 (48.6%)	79 (57.2%)

Source: survey

For shrimp health screening, most farmers generally used a test kit and some also sent the samples to laboratories. In Ben Tre, most farmers used the service provided by the provincial fisheries department. In Bac Lieu, they used the private laboratories (38.2 percent). In Ca Mau, the farmers availed of the laboratory services of Tan Long Cooperative and other private companies (57.4 percent).

In past cases of disease outbreaks, most farmers in Ben Tre also obtained advice and assistance from the provincial fisheries department. In Bac Lieu and Ca Mau, the farmers obtained advice and assistance not only from the local authorities (36.2 percent in Bac Lieu and 61.1 percent in Ca Mau) but also from the dealers of therapeutants (40.4 percent and 59.3 percent) and friends in nearby farms (29.8 percent and 37.0 percent).

3.6 Shrimp harvest and revenue

Based on the 2016 best crop data, the overall average yield was 10.1 tonnes per hectare. The harvest size was 62 pieces per kg from an 89-day average culture period. The farm gate price was VND 126 500 per kg (USD 5.75 per kg). The gross revenue in the 2016 best crop was around VND 905 million per farm (USD 41 162). This translates to VND 295 million per grow-out pond (USD 13 445) and VND 610 million per hectare of farm area (USD 27 730) (Table 6).

Table 6. Shrimp harvest and sale revenue in the 2016 best crop

Province	Yield (tonnes per ha of grow-out area)	Culture period (days)	Size (pieces/kg)	Farm price (VND/kg)	Gross revenue per crop		
					Million VND per farm	Million VND per pond	Million VND per ha of farm area
Bac Lieu	6.6	89	63	128 192	784	225	532
Ben Tre	13.3	90	61	122 649	1666	423	690
Ca Mau	10.8	89	63	127 667	489	269	622
Average	10.1	89	62	126 500	905	295	610

Source: survey

The farmers sold the shrimp ex-farm to local collectors or agents of seafood companies. The farmers negotiated the price and most of them chose to sell their harvest to the buyers that offered them the highest price; less than half or only 42.7 percent of the buyers was the same person that the farmer sold shrimp to in previous crop.

3.7 Production cost, profit and employment

The overall average total production cost per kilogram of shrimp produced was VND 83 443 (USD 3.79). This comprises the fixed cost of 12.2 percent and the variable cost of 87.8 percent. The top three cost items were feed (48.8 percent), seed (13.0 percent) and labour (11.3 percent).⁶ The total cost per kilogram was lowest in Ben Tre, followed by Ca Mau and Bac Lieu. The average price per kilogram that the farmers received was VND 126 500 (USD 5.75). The farm gate price in Ben Tre was the lowest (VND 122 649 or USD 5.57). The average net profit per kilogram was VND 43 057 (USD 1.96). The net profit per kilogram was highest in Ben Tre, lower in Ca Mau, and lowest in Bac Lieu (Table 7). The same net profit ranking was found when the calculation was made on the basis of one grow-out pond per crop (Table 8) and one hectare of farm area per year (Table 9).

In addition, when the annual net profit per farm (per household) was considered, the average profit was around VND 660 million (USD 29 980). The highest was in Ben Tre at VND 1 466 million (USD 66 623). In Bac Lieu, it was VND 445 million (USD 20 247) and in Ca Mau VND 376 million (USD 17 086). Ca Mau's having the lowest annual net profit per household is consistent with its having the smallest average farm size (0.8 ha compared to 1.6 ha in Bac Lieu and 2.3 ha in Ben Tre).

Household labour was used intensively in shrimp farming, particularly in Ca Mau and Bac Lieu. In both provinces, most household male members made the decisions on farm management and operations and worked full time on their own farms. The female members helped either full time or part time. It is different in Ben Tre, where only the household male members worked in their own farms and they worked part time more than full time. They hired workers to help manage and take care of the farm. Overall, the farm manager was paid a salary for around 4.3 months per year at the rate of VND 6.7 million (USD 306) per month. The farm assistant was hired for 3.7 months per year and paid VND 5.2 million (USD 237) per month (Table 10). The salary rates were highest in Ben Tre. In addition, the workers in Ben Tre received a bonus after harvest. It was not the case in Bac Lieu and Ca Mau.

⁶ The total labour cost includes the cash cost on hired labour and the opportunity cost of own household labour used.

Table 7. Average production cost and profit per kilogram of shrimp produced in the 2016 best crop

Item	Bac Lieu			Ben Tre			Ca Mau			Overall average		
	VND/kg	USD/kg		VND/kg	USD/kg		VND/kg	USD/kg		VND/kg	USD/kg	
1. Land*	6 873	0.31	7.0%	1 122	0.05	1.7%	9 029	0.41	10.8%	6 175	0.28	7.4%
2. Capital*	3 868	0.18	4.0%	1 183	0.05	1.8%	1 672	0.08	2.0%	2 289	0.10	2.7%
3. Depreciation cost	2 338	0.11	2.4%	1 089	0.05	1.7%	1 586	0.07	1.9%	1 709	0.08	2.0%
Total fixed cost (TFC) = 1+2+3	13 079	0.59	13.4%	3 394	0.15	5.2%	12 287	0.56	14.8%	10 172	0.46	12.2%
4. Feed	47 156	2.14	48.2%	35 401	1.61	54.1%	38 762	1.76	46.6%	40 720	1.85	48.8%
5. Seed	12 850	0.58	13.1%	7 751	0.35	11.8%	11 284	0.51	13.6%	10 870	0.49	13.0%
6. Labour*	10 161	0.46	10.4%	9 471	0.43	14.5%	8 769	0.40	10.5%	9 431	0.43	11.3%
7. Drug and chemical	5 235	0.24	5.4%	4 338	0.20	6.6%	5 416	0.25	6.5%	5 066	0.23	6.1%
8. Energy	6 455	0.29	6.6%	2 517	0.11	3.8%	3 875	0.18	4.7%	4 390	0.20	5.3%
9. Bonus	11	0.00	0.0%	1 426	0.06	2.2%	143	0.01	0.2%	442	0.02	0.5%
10. Probiotics	1 348	0.06	1.4%	475	0.02	0.7%	188	0.01	0.2%	660	0.03	0.8%
11. Others	1 561	0.07	1.6%	672	0.03	1.0%	2 506	0.11	3.0%	1 692	0.08	2.0%
Total variable cost (TVC) = 4+5+6+7+8+9+10+11	84 777	3.85	86.6%	62 051	2.82	94.8%	70 944	3.22	85.2%	73 271	3.33	87.8%
Total cost (TC) = TFC+TVC	97 855	4.45	100.0%	65 445	2.97	100.0%	83 231	3.78	100.0%	83 443	3.79	100.0%
Total revenue (TR)	128 191	5.83		122 649	5.57		127 667	5.80		126 500	5.75	
Revenue over variable cost = TR-TVC	43 415	1.97		60 598	2.75		56 723	2.58		53 229	2.42	
Profit = TR-TC	30 336	1.38		57 203	2.60		44 436	2.02		43 057	1.96	

Note: * The item includes cash and non-cash costs (opportunity costs of own inputs used).

Source: The calculation was based on the survey data.

Table 8. Average production cost and profit per grow-out pond in the 2016 best crop

Item	Bac Lieu			Ben Tre			Ca Mau			Overall average		
	Thousand VND	USD		Thousand VND	USD		Thousand VND	USD		Thousand VND	USD	
1. Land*	7 485	340	5.3%	3 347	152	1.5%	16 587	754	10.3%	8 035	365	4.7%
2. Capital*	4 056	184	2.9%	3 316	151	1.5%	2 860	130	1.8%	3 439	156	2.0%
3. Depreciation cost	2 484	113	1.8%	3 210	146	1.5%	2 790	127	1.7%	2 761	126	1.6%
Total fixed cost (TFC) = 1+2+3	14 025	638	9.9%	9 873	449	4.5%	22 238	1 011	13.8%	14 235	647	8.3%
4. Feed	80 301	3 650	56.8%	116 979	5 317	53.3%	79 935	3 633	49.5%	91 447	4 157	53.6%
5. Seed	17 259	784	12.2%	27 379	1 245	12.5%	21 888	995	13.6%	21 540	979	12.6%
6. Labour*	11 033	501	7.8%	31 753	1 443	14.5%	15 751	716	9.8%	19 149	870	11.2%
7. Drug and chemical	7 714	351	5.5%	14 293	650	6.5%	9 938	452	6.2%	10 380	472	6.1%
8. Energy	8 441	384	6.0%	8 889	404	4.1%	6 346	288	3.9%	7 942	361	4.7%
9. Bonus	91	4	0.1%	5 752	261	2.6%	350	16	0.2%	2 123	97	1.2%
10. Probiotics	1 131	51	0.8%	2 114	96	1.0%	370	17	0.2%	1 273	58	0.7%
11. Others	1 493	68	1.1%	2 399	109	1.1%	4 568	208	2.8%	2 499	114	1.5%
Total variable cost (TVC) = 4+5+6+7+8+9+10+11	127 413	5 792	90.1%	209 558	9 525	95.5%	139 147	6 325	86.2%	156 338	7 106	91.7%
Total cost (TC) = TFC+TVC	141 438	6 429	100.0%	219 431	9 974	100.0%	161 385	7 336	100.0%	170 573	7 753	100.0%
Total revenue (TR)	224 054	10 184		427 360	19 425		272 035	12 365		301 852	13 721	
Revenue over variable cost = TR-TVC	96 641	4 393		217 802	9 900		132 888	6 040		145 514	6 614	
Profit = TR-TC	82 616	3 755		207 929	9 451		110 650	5 030		131 279	5 967	

Note: * The item includes cash and non-cash costs (opportunity costs of own inputs used).

Source: The calculation was based on the survey data.

Table 9. Average shrimp production cost and profit per hectare of farm area per year in 2016

Item	Bac Lieu			Ben Tre			Ca Mau			Overall average		
	Thousand VND	USD		Thousand VND	USD		Thousand VND	USD		Thousand VND	USD	
1. Land*	20 426	928	4.3%	10 189	463	1.5%	55 572	2 526	8.6%	31 434	1 429	5.3%
2. Capital*	12 928	588	2.7%	10 599	482	1.6%	10 443	475	1.6%	11 331	515	1.9%
3. Depreciation cost	7 929	360	1.7%	9 804	446	1.4%	9 979	454	1.5%	9 234	420	1.5%
Total fixed cost (TFC) = 1+2+3	41 283	1 877	8.6%	30 592	1 391	4.5%	75 994	3 454	11.8%	51 999	2 364	8.7%
4. Feed	273 033	12 411	57.0%	372 489	16 931	54.6%	323 089	14 686	50.1%	319 286	14 513	53.4%
5. Seed	58 168	2 644	12.2%	82 030	3 729	12.0%	84 212	3 828	13.1%	74 757	3 398	12.5%
6. Labour*	41 704	1 896	8.7%	97 011	4 410	14.2%	69 937	3 179	10.8%	67 580	3 072	11.3%
7. Drug and chemical	26 114	1 187	5.5%	45 397	2 063	6.7%	42 889	1 950	6.6%	37 848	1 720	6.3%
8. Energy	29 341	1 334	6.1%	27 035	1 229	4.0%	27 366	1 244	4.2%	27 950	1 270	4.7%
9. Bonus	91	4	0.0%	15 236	693	2.2%	792	36	0.1%	4 426	201	0.7%
10. Probiotics	3 755	171	0.8%	5 438	247	0.8%	1 384	63	0.2%	3 279	149	0.5%
11. Others	5 147	234	1.1%	7 423	337	1.1%	19 408	882	3.0%	11 338	515	1.9%
Total variable cost (TVC) = 4+5+6+7+8+9+10+11	437 353	19 880	91.4%	652 059	29 639	95.5%	569 077	25 867	88.2%	546 463	24 839	91.3%
Total cost (TC) = TFC+TVC	478 636	21 756	100.0%	682 651	31 030	100.0%	645 071	29 321	100.0%	598 462	27 203	100.0%
Total revenue (TR)	757 216	34 419		1 309 596	59 527		1 101 513	50 069		1 040 043	47 275	
Revenue over variable cost = TR-TVC	319 863	14 539		657 537	29 888		532 437	24 202		493 580	22 435	
Profit = TR-TC	278 580	12 663		626 945	28 497		456 442	20 747		441 580	20 072	

Note: * The item includes cash and non-cash costs (opportunity costs of own inputs used).

Source: The calculation was based on the survey data.

Table 10. Hired and own household labour used in shrimp farming in the 2016 best crop

Province	Hired manager (all male)			Full-time household labour (male)		Part-time household labour (male)	
	No. of farms	No. of managers per farm	Average salary (VND/month)	No. of farms	No. of members per farm	No. of farms	No. of members per farm
Bac Lieu	6 (12.8%)	1.0	4 833 333	44 (93.6%)	1.4	18 (38.3%)	1.5
Ben Tre	20 (54.1%)	1.1	7 290 400	14 (37.8%)	1.0	21 (56.8%)	1.0
Ca Mau	-	-	-	52 (96.3%)	1.4	4 (7.4%)	1.0
Total/average	26 (18.8%)	1.1	6 723 385	110 (79.7%)	1.4	43 (31.2%)	1.2
Province	Hired workers (all male)			Full-time household labour (female)		Part-time household labour (female)	
	No. of farms	No. of workers per farm	Average salary (VND/month)	No. of farms	No. of members per farm	No. of farms	No. of members per farm
Bac Lieu	11 (23.4%)	2.1	4 363 636	13 (27.7%)	1.2	12 (25.5%)	1.2
Ben Tre	30 (81.1%)	3.7	5 966 667	-	-	1 (2.7%)	1.0
Ca Mau	18 (33.3%)	1.2	4 444 444	18 (33.3%)	1.0	20 (37.0%)	1.2
Total/average	59 (42.8%)	2.7	5 203 390	31 (22.5%)	1.1	33 (23.9%)	1.2

Source: survey

3.8 Perils and losses

This section describes the results of the main perils experienced by the farmers during 2013–2016. The respondents were asked to recall the perils that occurred during this period that affected their shrimp stock. The perils are classified into three groups: (1) disease outbreaks, (2) natural disasters and (3) human-related and other external effects.

3.8.1 Disease outbreaks

During 2013–2016, all respondents said their farms suffered from disease outbreaks. The common diseases that affected the stock are presented in Table 11. The most severe events came from acute hepatopancreatic necrosis disease (AHPND) or early mortality syndrome (EMS) and white spot syndrome virus (WSSV). Generally, the farmers noticed the occurrence of EMS outbreaks within 30 days after stocking. By that time, the disease would inevitably cause a total loss of stock. In the case of WSSV, the farmers noticed the occurrence over a wider range of culture period, i.e. from 25 to 60 days after stocking. The white spot virus also caused total loss. Considering the number of farms affected, the prevalence of EMS outbreaks appeared to be getting less, except in Bac Lieu. That of WSSV was stable in Bac Lieu, increased suddenly in 2016 in Ben Tre, and decreased significantly in 2016 in Ca Mau.

Other main disease outbreaks were white feces syndrome (WFS) and yellow head virus (YHV). The farmers in Ca Mau and Bac Lieu also reported significant losses from the YHV outbreaks while those in Ben Tre said they were not affected. The farmers said the EMS, WSSV and YHV outbreaks were not controllable while the WFS outbreaks were manageable. The most common practices that the farmers adopted to reduce the risks of diseases were buying quality seeds from reputable hatcheries and proper pond preparation and disinfection.

Table 11. Numbers of farms that experienced main disease outbreaks during 2013–2016

Disease/province	2013		2014		2015		2016	
1. AHPND								
- Bac Lieu	22	46.8%	22	46.8%	26	55.3%	23	48.9%
- Ben Tre	23	62.2%	11	29.7%	11	29.7%	5	13.5%
- Ca Mau	30	55.6%	19	35.2%	20	37.0%	10	18.5%
- Total	75	54.3%	52	37.7%	57	41.3%	38	27.5%
2. WSSV								
- Bac Lieu	16	34.0%	13	27.7%	19	40.4%	18	38.3%
- Ben Tre	9	24.3%	10	27.0%	11	29.7%	18	48.6%
- Ca Mau	14	25.9%	8	14.8%	3	5.6%	2	3.7%
- Total	39	28.3%	31	22.5%	33	23.9%	38	27.5%
3. WFS								
- Bac Lieu	9	19.1%	12	25.5%	15	31.9%	14	29.8%
- Ben Tre	2	5.4%	7	18.9%	6	16.2%	2	5.4%
- Ca Mau	0	0.0%	0	0.0%	9	16.7%	5	9.3%
- Total	11	8.0%	19	13.8%	30	21.7%	21	15.2%
4. YHV								
- Bac Lieu	8	17.0%	6	12.8%	10	21.3%	7	14.9%
- Ben Tre	0	0.0%	0	0.0%	0	0.0%	0	0.0%
- Ca Mau	13	24.1%	12	22.2%	12	22.2%	11	20.4%
- Total	21	15.2%	18	13.0%	22	15.9%	18	13.0%

Source: survey

3.8.2 Natural effects

The only severe natural hazard that the farmers experienced was drought, which occurred in 2015 and 2016. The number of affected farms varied by province, i.e. 51 of 54 (94.4 percent) in Ca Mau, 22 of 37 (59.5 percent) in Ben Tre and 17 of 47 (36.2 percent) in Bac Lieu. The farmers said the event causes slow growth and makes shrimp weak and thus susceptible to disease infection. The farmers in Ca Mau said they cannot apply any mitigation measure during the production cycle. They would avoid losing another crop by not stocking in the next crop if the drought persisted. In Ben Tre and Bac Lieu, most farmers said it is manageable but the mitigation cost can be high. The effective methods commonly used to reduce the risk impact of drought were: (1) carrying out limited water exchange, (2) using a pump to stock freshwater as much as they can, (3) having a reservoir to stock water and (4) following the advice of the local authorities on an appropriate timing for shrimp stocking.

Another hazard is typhoon. In Ben Tre, 22 farmers (59.5 percent) said their farms got affected by a storm in 2009, which damaged machinery and caused electricity outages. This resulted in a very low level of oxygen in the ponds, which compelled the farmers to harvest immediately.

3.8.3 Human-related perils and other external factors

Overall, the farmers said other perils that affected their shrimp stocks during 2013–2016 were those indicated in Table 12. Mechanical breakdown or electrical failure was most common (75.4 percent). The problems of farm predators and poaching were reported in Ca Mau and Bac Lieu. Other perils were those related to water quality parameters such as wide fluctuation of salinity and pH and very high temperature. Poor quality of water supply was also reported because the public watercourses were polluted. The main practices or techniques adopted by the farmers to manage the quality of water supply were building a reservoir to stock water and treating the water before it is fed into the grow-out pond.

Other methods included building netting fence to keep animals out of the ponds, training the farm workers on how best to monitor the water parameters and the status of the stock, installing surveillance camera, and setting up more lights.

Table 12. Numbers of farms affected by human-related perils and other factors during 2013–2016

Province	Mechanical failure		Predator		High fluctuation of water salinity		Low quality water supply		Human act		High fluctuation of pH		Too high water temperature	
	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
Bac Lieu	28	59.6%	16	34.0%	20	42.6%	33	70.2%	15	31.9%	21	44.7%	19	40.4%
Ben Tre	25	67.6%	0	0.0%	8	21.6%	16	43.2%	1	2.7%	9	24.3%	8	21.6%
Ca Mau	51	94.4%	49	90.7%	31	57.4%	0	0.0%	20	37.0%	3	5.6%	1	1.9%
Total	104	75.4%	65	47.1%	59	42.8%	49	35.5%	36	26.1%	33	23.9%	28	20.3%

Source: survey

3.9 Interest in buying insurance and willingness to pay

The farmers believe that the occurrence of shrimp disease outbreaks will likely continue. In addition to the practices and techniques they have adopted, they said they would buy insurance if the product design served their needs. Most farmers in the three provinces expressed interest in buying shrimp insurance that covers stock losses from disease outbreaks (96.4 percent). They were also interested in insurance coverages on bad weather that causes too wide fluctuations in water parameters. However, the interest mostly came from the farmers in Ben Tre (100.0 percent) and Bac Lieu (48.9 percent). Only one farmer in Ca Mau expressed interest in this coverage.

The farmers were also asked about their willingness to pay for the hypothetical shrimp insurance schemes that cover any peril that cause total stock loss (or a loss of more than 80 percent) after 30 days of stocking until harvest. They were presented three scenarios of insurance premium rates and maximum compensation rates (sum insured): compensation rates of 20 percent, 50 percent and 80 percent of total production cost, with low, medium, high premium rates, respectively.⁷

Two of the schemes were of interest by a majority of the farmers, i.e. the ones with compensation rates of 80 percent and 50 percent of total production cost (Table 13). The farmers in Bac Lieu were interested most in the 80 percent scheme at the premium rate of VND 10 852 per kilogram of shrimp (USD 0.49). This was around 9.2 percent of the farm gate price received or 11.0 percent of the total production cost. The premium per pond per crop earned by the insurer was estimated at VND 14.7 million (USD 670), which is around 17.8 percent of the net farm profit. In Ben Tre, most farmers were interested in buying the lower coverage scheme of 50 percent of total production cost at the premium rate of VND 2 765 per kilogram of shrimp (USD 0.13). This was around 2.3 percent of the farm gate price received or 4.2 percent of the total production cost. The premium per pond per crop earned by the insurer was estimated at VND 9.6 million (USD 438), which is around 4.6 percent of the net farm profit. The farmers in Ca Mau were interested in the 50 percent scheme. Their willingness to pay for the premium was estimated at 7.0 percent of the farm price received or 10.7 percent of the total production cost.

Focusing on Ben Tre, where almost all of the farmers were interested in buying insurance, they preferred the 50 percent scheme. Around half of the respondents in the province participated in the shrimp insurance pilot programme; those who did were willing to pay a higher insurance premium than those who did not. The willingness to pay for the premiums was estimated at VND 2 895 per kilogram of shrimp or 4.5 percent of the total cost for the participating farmers, and at VND 2 600 per kilogram of shrimp or 3.8 percent of the total cost for the non-participating farmers. The difference between the preferred premium levels would be VND 295 per kilogram or around VND 2.5 million (USD 113) per grow-out pond per crop.

⁷ In this study, total production cost was used as a basis for the calculation of sum insured. Sum insured is the amount specified in the policy up to which the insurer will pay indemnities, should the insured perils occur and result in a loss to the insured stock.

Table 13. Hypothetical insurance schemes and farmers' willingness to pay for insurance premiums

Scheme	Characteristics of respondent farms								Insurance premium					
	No. of observations	Farm-gate price (VND/kg)	Farm-gate price (USD/kg)	TC (VND/kg)	No. of grow-out ponds	Yield (tonnes/ha)	Average size of growout pond (ha)	Stocking rate (PLs/ha)	VND/kg	USD/kg	% of farm-gate price	% of TC	VND/pond/crop	USD/pond/crop
Sum insured: 50% of total production cost														
Bac Lieu	8	136 500	6.20	109 860	3.8	5.0	0.28	556 625	7 375	0.34	5.9%	7.1%	9 395 833	427
Ben Tre	34	122 441	5.57	65 260	3.8	13.5	0.26	897 059	2 765	0.13	2.3%	4.2%	9 627 187	438
Ca Mau	9	120 333	5.47	77 728	1.2	15.1	0.20	966 667	8 111	0.37	7.0%	10.7%	22 555 556	1 025
Average/total	51	124 275	5.65	74 456	3.3	12.5	0.26	855 941	4 431	0.20	3.7%	5.8%	11 872 373	540
Sum insured: 80% of total production cost														
Bac Lieu	27	125 889	5.72	104 625	3.3	5.3	0.26	588 148	10 852	0.49	9.2%	11.0%	14 742 099	670
Ben Tre	2	122 500	5.57	66 266	5.5	11.0	0.28	800 000	4 000	0.18	3.3%	6.0%	12 000 000	545
Ca Mau	n.a.													
Average/total	29	125 655	5.71	101 979	3.4	5.7	0.26	602 759	10 379	0.47	8.8%	10.7%	14 552 989	661

Source: The calculation was based on the survey data.

4. DISCUSSION

4.1 Generation of income and employment

There have been significant changes in land use in the Mekong Delta area. Converting the rice fields to shrimp farms was deemed by farmers as a better option. Shrimp farming has moved towards higher intensification. Many farms switched from the improved-extensive and semi-intensive systems to the intensive system, driven most likely by the lucrative returns from intensive shrimp farming, which became the main income source for many households. The results provide evidence that the high earnings from intensive shrimp farming significantly contributed to poverty alleviation in rural households. On the other hand, the results also highlight the risk of relying on shrimp farming as the sole source of income, which was the case with many households.

The figures show that intensive shrimp farming generates employment for skilled and unskilled workers. It also generates self-employment for the members of the farm household. The contribution of shrimp farming in terms of generating rural employment is evident in Ben Tre, where the male farmers play a strong role in managing the farms. Self-employment was significant in Ca Mau and Bac Lieu, where the household members worked in their own farms, including the female members who performed routine tasks. Shrimp farming can be made an attractive business prospect to keep the rural youth from out-migrating. A well-run profitable small farm would draw the children's interest in taking over its operation when their parents retire, rather than seeking employment in the cities and abandoning the farm. In addition, the farms can serve as a fallback for rural migrants to urban centers, who are laid off or lose their job in the commercial, industrial or service sectors in the event of an economic crisis.

4.2 Farming practices and performance

Overall, the shrimp farms are small scale. The average farm size was around 1.5 ha, with a few grow-out ponds of 0.25 ha in area. On the key factors affecting farm profitability, the results show that the levels of profit by province, based on their best-performing crop of 2016, highly correspond to yields and costs per kilogram of shrimp produced. The farm gate prices received were not much different. This is illustrated by the farmers of Ben Tre: despite receiving a 4 percent lower farm gate price, their performance remained competitive because of their farms' significantly higher yield (23.1 percent and 101.5 percent above the average yields of Ca Mau and Bac Lieu, respectively) and the lower production cost per kilogram (21.4 percent and 33.3 percent lower than those of Ca Mau and Bac Lieu, respectively). These resulted in the significantly higher profit in Ben Tre than in Ca Mau and Bac Lieu.

In Ben Tre, a significant portion of the farm area was allocated for a water management system. This contrasts with Bac Lieu, where most of the farm land was used for grow-out ponds with very little area left for a water treatment system. In comparison to Ben Tre, the higher proportion of grow-out pond area in Bac Lieu did not result in a higher production or better profit earned from the land use. Instead, the farms in Bac Lieu turned out to be less intensive and had lower performance, i.e. fewer number of crops per year, lower yield and lower profit (per kilogram and per hectare) than those in Ben Tre. This implies that the successful performance of intensive shrimp farming relies not only on good management of key inputs such as seed and feed as well as health management, but also on a proper design and layout of the farm that allows good management of water supply and farm effluent. Poor water quality is a critical production risk; the advantages of a healthy seed and good quality feed are easily offset by sub-optimal pond water quality, i.e. polluted, contaminated and/or with the wrong parameters. The shrimp feed poorly, which translates to feed waste and further water pollution from the uneaten feed, and are more susceptible to pathogens.

4.3 Shrimp health management and other supporting mechanisms

The hatcheries and feed companies have a vital role as providers of quality seed, feed, technical knowledge as well as feed on credit. The farmers also rely on their health screening services especially where there is no easily accessible government laboratory. Some hatcheries guarantee the seed quality and provide free PCR tests. However, most farmers admitted they did not know if the hatcheries had any certification or complied with any standard. This indicates a lack of systematic link between farmers and hatcheries in terms of information flow to assure farmers of the quality and health of seeds, i.e. pathogen-free post larvae. This situation would have improved as shrimp seed production is now strictly regulated under the new Fisheries Law (2017), which took effect in 2019. A relevant provision is that hatchery and nursery facilities must obtain certificates of eligibility to operate. The Law also defines a set of requirements to be complied with during the hatchery production process including broodstock management (Bang Tam, personal communication, 2019).

The results show clearly that among the perils, disease outbreaks concerned the farmers most. Some diseases can cause total loss of stock within a short period. Farmers would then need to harvest immediately even when shrimps have not yet reached the desirable size, which obviously fetch a very low price. And when a severe outbreak occurs 50 days or earlier after stocking, the farmer likely incurs a total investment loss as the shrimp would be too small to be sold.

4.4 Risk transfer mechanism

The individual farms adopted various technical-based practices and methods to prevent or reduce the impact of risks on their farms. However, for an uncontrollable event, a market-based instrument such as insurance may be used to transfer or spread the risks.

Some farms have taken part in the shrimp insurance pilot programme, which was implemented by the government during 2011–2013 as a mechanism to transfer the risks from farmers to insurers. However, the assessment of the pilot programme suggests that a more thorough planning and preparation was needed if it were to continue in the next phase (Nguyen and Pongthanapanich, 2016).

The design of insurance schemes for shrimp farming should at least cover the disease outbreak perils that cause total stock loss (an 80 percent production loss can be considered a total loss) to simplify and hasten claim settlement. However, this can be done only when diagnosis of the disease against which the stock is insured is possible and the laboratory service is quickly accessible. In principle, the perils to be covered and the compensation to be paid out require evidence to support the claim process.

To keep the insurance premium low and reduce the motivations to commit moral hazard, the following issues may be addressed:

- The production cost, instead of the value of shrimp stock lost, may be used as a basis for the calculation of sum insured.
- A few major cost items (e.g. feed, seed, energy, labour, etc., depending on the farming techniques applied) instead of total cost, may be used as a basis for the calculation of sum insured.
- The number of culture days covered need not be until the end of a normal crop cycle. The results suggest a coverage period of up to 50 days, as the shrimp size before 50 days is too small and the salvage value minimal.
- Adoption of farm practices, following VietGAP, that help reduce risks associated with the insured perils may be set as a basic condition for being insured. Additional requirements, if not specified in VietGAP, may be identified and agreed to by the farmers and insurance companies.

5. CONCLUSION AND RECOMMENDATIONS

The shrimp industry has been promoted as a key economic driver of Viet Nam. The direct and indirect benefits from shrimp industry are spread throughout the chain that comprises the input suppliers,

primary producers, local traders, domestic consumers, processors and exporters. The government has set the target for 2025 a revenue from shrimp export that is three times that earned in 2018. The ability to achieve this target depends on the performance of small intensive farms, which contribute the largest share to the country's farm output.

Intensive shrimp farming is widely seen as a 'high-risk-high-return' business. The adoption of good farm practices is an essential management strategy to reduce the stock losses particularly from disease perils. In reality, however, the rate of adoption of the national or international standards remains slow. VietGAP as a national standard was launched in 2012. By 2018, the rate of certified VietGAP shrimp farms remained at less than one percent. The assumption was that once farmers became familiar with the national standard, they would find it easier to shift to international standards. However, the 2019 record shows that the certified farms are mostly large corporate farms. Improving the adoption by small-scale farms is underway. To facilitate adoption, these helpful steps have been taken: (1) revision of the VietGAP guidelines, (2) improving the certification evaluation guidelines to cover group certification and (3) strengthening farmers' associations and cooperatives.

This study recommends that incentive-based measures should be developed and used in combination with the existing measures in order to accelerate the adoption of good aquaculture practices. Insurance is highlighted by the results as one of the market-based risk-management tools. It has been used widely to help crop and livestock farmers manage production risks. In Viet Nam, the results of the national pilot insurance programme have shown that the implementation of agricultural insurance was successful in the crop and livestock sectors. It was the opposite in the aquaculture insurance part of the programme, mainly because of the large claims for stock losses from shrimp diseases. This study recommends that if the next phase is to be implemented, a better design and more thorough preparation of the insurance programme are needed. A commercial insurance policy without premium subsidy should be developed for intensive and super-intensive shrimp farming in Viet Nam. The design of insurance schemes should be done in consultation with potential farmer clients, especially on the details of coverages needed, premium rates, requirements and conditions. This includes the development of practical product schemes that are easy for farmers to understand and make the claim process efficient and the payout fair.

Insurance can be used to support the adoption of good aquaculture practices. In practical terms, the certified farms would be the potential clients for the next pilot phase. The target clients may be extended to farmers' associations and cooperatives, which generally follow VietGAP guidelines as advised by the local authorities, but are yet to satisfy all the requirements to obtain group certification. Additionally, insurance could be bundled with a credit scheme. This may be feasible particularly for super-intensive and large farms that receive loans from banks.

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ISBN 978-92-5-131887-4 ISSN 2070-6065



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CA6702EN/1/10.19