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Evaluating WTA (Willingness to Accept) a Subsidy for Getting a VietGAP Certificate in Shrimp Farming: A Case Study in Tra Vinh Province, Vietnam.

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ABSTRACT

Along with the developing shrimp industry, the problems of environmental pollution and food safety are also important concerns. To develop sustainable shrimp farming, an eco-environmental certification is often considered by stakeholders (government, exporters and farmers). In this article, the benefits and limitations of the current incentive scheme of the VietGAP certification were explored. By using the contingent valuation method, this study surveyed 300 shrimp farmers in 10 villages in Tra Vinh province to find out what factors affect the farmers' decisions on following the VietGAP certification ($WTA_{Decision}$) and how much subsidy value they are willing to accept ($WTA_{Subsidy}$) to pursue the VietGAP standard. The results showed that $WTA_{Decision}$ had a positive relationship with farmer's education levels, environmental perceptions and attitudes toward the VietGAP certificate. While those factors having negative effects on $WTA_{Subsidy,}$ the annual income also had a slight effect on farmer's willingness to accept the amount of the subsidy. The study's findings suggested that the authorities should increase the subsidy at the first phase of the scheme and improve the farmers' environmental perceptions and publicize the benefits of the VietGAP certificate to attract farmers to participate in it.

INTRODUCTION

Since 1990 the brackish shrimp industry has been in development and now plays a vital role in Vietnam's aquaculture sector. In the past 30 years, the brackish shrimp practice was remarkably thriving in both horizontal and vertical dimensions. The shrimp industry is more and more intensified: from extensive to super-intensive practices. The impressive results are thanks to changing technology, methodology and species that are compatible with the seasons, environmental conditions and market demand. There are many shrimp export companies, which have promoted shrimp products, accounting for an average of 43.9% of total aquaculture exports in recent years. During the recent years, the related authorities supported shrimp farmers through training courses where they can learn about environment fluctuation and diseases. However, an increase in density of stock and expanding area caused some uncontrollable problems such as disease outbreaks, polluted water resources and abuse of drugs and chemicals in shrimp practice. Overuse of drugs and chemicals is not only harmful to natural ecosystems but also affects customers' health due to the residual

substances in shrimp products. This adversely affected the image of Vietnam's aquatic products on the international market. According to **MARD (2015)**, in recent years shrimp export products have been rejected by many importers due to food security issues and residual antibiotics. Therefore, Vietnam's shrimp industry is finding it difficult to penetrate new foreign markets. For instance, now 100% of shrimp shipments from Vietnam must be inspected by Japan's customers authorities, instead of testing 30% of the volume as usual; and Korea has also dispatched a warning about the presence of residual *Nitrofurans* in Vietnam's shrimp products **(VASEP, 2020)**.

The aquatic industry in Vietnam developed dramatically. But its quick rise to prominence led to a polluted environment, disease outbreaks and affectedness of export aquatic quality. According to **MARD (2015)**, for semi-intensive and intensive shrimp farming systems, each 1 kg of shrimp production discharges 1.12 kg solid effluence in the environment, not including other contaminated substances such as H_2S, NH_3 and phosphate. Hence, the annual total solid effluence is estimated to be more than 700,000 tons in the Mekong Delta, where accounts for 90% of the total national shrimp production. The Tra Vinh shrimp industry had an area of 32,976 ha and 55,330 tons in 2019, accounting for approximately 8% of the Mekong Delta's productivity (Aquaculture Department of Tra Vinh province). It means that a significant volume of that discharge was from shrimp production. Moreover, 40% of surveyed shrimp farms are without reservation ponds for treating wastewater. So, the current environment could get worse, which adversely affects shrimp health and causes disease outbreaks and crop loss. In recent years, due to the neglection of environmental management and epidemic disease control such as shortage of environmental testing systems; improper shrimp farming systems; low quality of seed; and crop timetables not followed, the state of mass mortality has been ongoing in many farms. To mitigate the risk of crop loss due to disease outbreaks, most shrimp farmers rely on heavy use of chemicals, many of which are used improperly and end up contaminating the shrimp products. This leads to a loss of trust from customers, especially international importers. Shrimp farmed in Vietnam has difficulty penetrating tightly controlled markets like Japan and Europe. Under the VietGAP standard, the quality of wastewater from shrimp ponds must achieve the indexes stated in **Table 1**. The actual status of wastewater of non-VietGAP shrimp farming was outside the permitted levels of the VietGAP standard. Hence, the application of VietGAP in shrimp farming is essential for preserving the environment.

Table 1. Quality of discharge water permitted by the VietGAP standard

Indicators	**Unit**	**Permitted value [(1)]**	**Actual value [(2)]**
NH_3 (ammonia)	mg/l	<=0.3	0.7 (0.56-0.84)
PO_4^{3-} (Phosphate ion or *Orthophosphate*)	mg/l	<10	n.a.
H_2S (Hydrogen sulfide)	mg/l	<=0.05	n.a.
NO_2 (Nitrogen dioxide)	mg/l	<0.35	n.a.
BOD_5 (Biochemical oxygen demand)	mg/l	<30	41 (22-59)

[(1)] The permitted value of VietGAP standard. [(2)] The actual value of intensive shrimp farming (non-VietGAP) in Can Gio district, Ho Chi Minh City, Vietnam **(Anh *et al.*, 2010)**.

Hence, in 2011 the Ministry of Agricultural and Rural Development (MARD) promulgated the Vietnam Good Aquaculture Practice (VietGAP) standard to address the aquatic industry's sustainable development. The VietGAP is the guideline of aquaculture practice comprising five fundamental criteria: safe food, safe shrimp, safe environment, social responsibility and traceability information. The core of VietGAP is the list of criteria relating to ecological and environmental requirements adopted by the process of shrimp farming. The purpose is to maximize the regulatory functions of nature by making environmental conditions as favorable as possible for the sustainable development of shrimp farming. VietGAP has joined the Global Aquaculture Alliance (GAA), the Aquaculture Stewardship Council (ASC) and GlobalGAP. VietGAP is also looking forward to collaboration with GlobalGAP to be recognized in the international market **(Angus McEwin *et al.*, 2014)**. Although by now, it is still recognized in the domestic market and not yet accepted in international export markets, the quality of shrimp products under the VietGAP would meet all requirements of import countries. The content of VietGAP is similar to other international aquatic certificates which control the process of farming, from the inputs like seed, food, chemicals and water use to output like wastewater and product quality (shrimp, catfish, etc.). However, the cost of VietGAP certification is much lower than other certifications. For instance, the cost of the MSC (Marine Stewardship Council) certificate is US$100,000, about US$4,000 for ASC (Aquaculture Stewardship Council) and US$5,000 for the GlobalGAP certificate. Moreover, there are several benefits VietGAP offers to all stakeholders including farmers, exporters and customers. At present, the government encourage's farmers to apply for the VietGAP standard in shrimp farming. Specifically, there were several promulgated documents such as **Circulate No. 48/2012**/TT-BNNPTNT dated 26 September 2012, **Decision No. 4835/2015** QĐ-BNN-TCTS dated 24 November 2015 promulgated by the Ministry of Agriculture and Rural Development (**MARD**), and **Decision No. 28/2015**/QĐ-UBND dated 9 November 2015 of People's Committee of Tra Vinh province. These decisions approved the policy of supporting and subsidising shrimp farmers who want to apply for the VietGAP standard. Because of the limited budget for the subsidy scheme, the purpose of this scheme is to encourage the big farms (minimum 5ha farm-size) participate into VietGAP in the initial stage, afterward the small-scale farms would be inspired by the successful pioneers to volunteer applying VietGAP. However, over more than 8 years the number of farms got VietGAP certificate was still modest (with only 128 shrimp farms in national total [Vietgap.tongcucthuysan.gov.vn]). In particular, currently there is only one shrimp farmer getting a VietGAP certificate in Tra Vinh province. It is far different to the MARD's expectation that 80% of shrimp farmers would apply for the VietGAP certificate by 2020. Whereas, the environment is more and more affected seriously by uncontrollable wastewater, abusing chemicals; and other problems mentioned above. Hence, it is necessary to promote the application VietGAP as soon as possible.

With a hypothesis of dropping the farm-size (5 ha) criterion, the aims of this study are to determine the main factors influencing a farmer's decision whether to accept a subsidy for the VietGAP certificate and to estimate an expected minimum subsidy value for investment in construction, facilities and equipment for shrimp farms under the VietGAP standard. This study will also suggest some solutions for the successful application of this standard.

Benefits of VietGAP standard

If a shrimp farmer gets a VietGAP certificate, it means then that his shrimp satisfied the criteria for exporting markets. The VietGAP farmers can command higher shrimp prices than the non-VietGAP shrimp farmers. The discrepancy of the price is about 0.14 USD/kg for the average size of 79 individuals per kg **(Quyen *et al.*, 2020)**. The VietGAP farming system improves shrimp farmers' prestige and customers' trust due to reinforced food security. Hence, there are always plenty of aquaculture exporter companies that are ready and waiting for hedging all these products. Moreover, under the VietGAP standard, the farmers could reduce farming costs with good management of input costs like food and chemicals. And farmers would decrease the risk of disease outbreaks and preserve the environment with properly treated wastewater. According to **Quyen *et al.* (2020)**, VietGAP shrimp farmers reported have fewer shrimp diseases than non-VietGAP shrimp farmers as well as lower probability of crop loss. VietGAP helps shrimp farming practices become not only stable and profitable but also enhances positive externalities such as improving Vietnam's image in the international market, promotion of a friendly environment in farming, restoring and reserving ecosystems around shrimp areas, which avoids conflicts between agricultural and aquaculture sectors.

Besides, shrimp processors save time and money on testing the input shrimp samples if they have quality materials that meet the importers' required standards . They mitigate the risk of having their shipments rejected due to violations of antibiotic residue or related food safety issues. In addition, a VietGAP certificate also creates traceability information for shrimp products; this is also one of the requirements of import countries.

The VietGAP farmers would help create a positive image of Vietnam's shrimp products. When the shrimp product is accepted world wide, this helps the Vietnamese economy to become increasingly integrated with international economies. Applying for the VietGAP certificate in farming would change the traditional aquaculture practice and would give farmers an image of environmental responsibility and social health. This contributes to the quality of social life and sustainable development. The value of this certificate is not only in its economic aspects but also indicates the farmer's responsibility in terms of environmental conservation in the future and at present for himself. The certificate is also a requirement for the sustainability of shrimp farming. Finally, customers feel secure to use safe, high quality shrimp products, which is the core aim of the VietGAP standard.

Although the incentive scheme began in 2015, as stated before there is currently only one farmer getting a VietGAP certificate in Tra Vinh province. Below is the story of the pioneer farmer who pursued VietGAP successfully.

Le Van Hoc, who owns more than 5ha of shrimp farms located in Thanh Hoa Son hamlet, Cau Ngang district, Tra Vinh province. He is a young man, 34 years old, with a high school education. He started shrimp farming in 2011 with a 1ha shrimp farm which he inherited from his father. After many years of success with intensive shrimp practice, he bought adjacent land around his farms to expand his farm's area. With the purpose of achieving the VietGAP certificate, all of his current facilities met the VietGAP standard, with the exception of the farm area being less than 5ha, to get the subsidy from the Tra Vinh

authority. In 2017 his brother left him more than 1ha of shrimp ponds. At last, his farm area met the requirements for VietGAP's subsidy scheme. He got a VietGAP certificate at the end of 2018, and after one year he looked into the procedure for submitting to the provincial authority. He said that farming under the VietGAP plan is not as difficult as many farmers' think. There were many farms around his that could meet a part of or completely fulfill the VietGAP standard. The main drawback that causes shrimp farmers to be afraid of participating in VietGAP is that it is a complicated procedure that requires much documentation, which is not their strong point. The current benefits of the VietGAP farming system are the first-time subsidy investment costs and being offered higher shrimp prices than non-VietGAP shrimp from collector or processor shrimp businesses. In the long term, it is a positive trend of sustainable shrimp farming because of the lighter impact on the environment and increased food safety. Based on his actual practice costs, the farmer revealed that the average costs of construction, facilities and equipment is approximately 70 million VND per 1,000 m^2 for the VietGAP standard compared to about 30 million VND for non-VietGAP standard. (**Appendix C**)

The current incentive subsidy scheme for application VietGAP standard

To encourage shrimp farmers to work toward sustainable development, Tra Vinh authority approved the policy of supporting and subsidising shrimp farmers who want to apply for the VietGAP standard (**Decision No. 28/2015**/QĐ-UBND). If the shrimp farmer gets a VietGAP certificate, they would receive four categories of subsidy as follows.

Sub1: Subsidy for 100% of the fee for examination of land and water. The fee is not excess of 5 million VND (approximately 200 EUR).

Sub2: Subsidy for 50% of the post-larvae cost and 30% of the costs of building, reconstructing ponds and warehouse (where stores food, medicines and medicals), machines and other facilities, toilets, sewage systems, waste treatment systems based on the VietGAP standard. Total cost does not exceed 150 million VND/household (approximately 5,700 EUR).

Sub3: Subsidy for 100% of the first-time training and consulting fee. The total fee does not exceed 40 million VND/household (approximately 1,500 EUR).

Sub4: Subsidy for 100% of the fee for an organisation responsible for testing for and issuing a certificate of VietGAP.

According to Sub2, the maximum subsidy value for costs of construction, facilities and equipment is always less than 150 million VND per farm. But the minimum required farm size to apply for this incentive program is 5ha. Hence, farmers could get a maximum subsidy for those costs lower than 30 million VND per ha or 3 million VND per 1,000 m^2. While the average costs of construction (ponds, warehouse, sewage system, wastewater treatment system), facilities and equipment (aeration fans, electric line, machines, etc.) under VietGAP standard is approximately 70 million VND per 1,000 m^2 (0.1 ha). This number is provided by a pioneer VietGAP farmer. Therefore, this study focuses on this category of subsidy (Sub2) to investigate how much a minimum subsidy the shrimp farmers are willing to

accept within threshold of 70 million VND per 1,000 m^2. According to expert opinions, the other categories of subsidy are quite reasonable.

The process of getting a subsidy for VietGAP certificate

The process of getting a subsidy for VietGAP certification was illustrated in **Fig. 1**. There are four stakeholders in this process that are farmer, authority, VietGAP consultant and VietGAP certified organisation.

The first step is that shrimp farmers must have a minimum farm size of 5ha. To register for the VietGAP farming system, the farmers can contact the VietGAP consultant or themselves to prepare all required documents for submission to the local district or city authority.

In the second step, shrimp farmers contact the Department of Quality Management of Agriculture-Forest-Aquatic, Department of Aquaculture and the VietGAP consultant to come up with the quality management system and participate in the VietGAP training courses. Then the farms must be reconfigured to conform to VietGAP requirements.

The third step is that farmers apply the quality management system in practice. The farmers gather all documentation relating to farming activities such as invoices for seeds, food, chemicals, aquatic drugs, labour contracts and so on. After that, someone from the VietGAP organisation is invited to inspect the farming methods and certify that they meet VietGAP standards. In the final step, shrimp farmers prepare the necessary documents to apply for a subsidy from the district authority.

MATERIALS AND METHODS

This study employed the contingent valuation method (CVM) to investigate shrimp farmers' willingness to accept a subsidy value for applying the VietGAP standard in shrimp farming. This method is the standard measure for the value of the environment and natural resources which are non-marketed goods and services. To elicit valuation under the CVM, there are four widely used formats such as open-ended questions, bidding game, payment card and single- or double-bounded dichotomous choice **(Pearce *et al.*, 2002)**. Each elicitation format has its own advantages and disadvantages, but all of them require the respondents to pay money for benefits (willingness to pay-WTP) or accept money for changing (willingness to accept-WTA). In this study, VietGAP is innovative method should be applied in shrimp farming, so the government encourages shrimp farmers apply it (changing the current method farming to VietGAP farming) and offers them a subsidy. Hence, the study used WTA to know a minimum of subsidy that farmers require to adopt VietGAP.

The study used open-ended questions (**Appendix B**) to find out from shrimp farmers how much a minimum subsidy they require to adopt VietGAP standards. Although this choice of format is simpler than others, it allows the respondents some flexibility in gauging the amounts they need without trapping bias by given amounts **(Pearce *et al.*, 2002)**. Hence, they offered reliable values for the research.

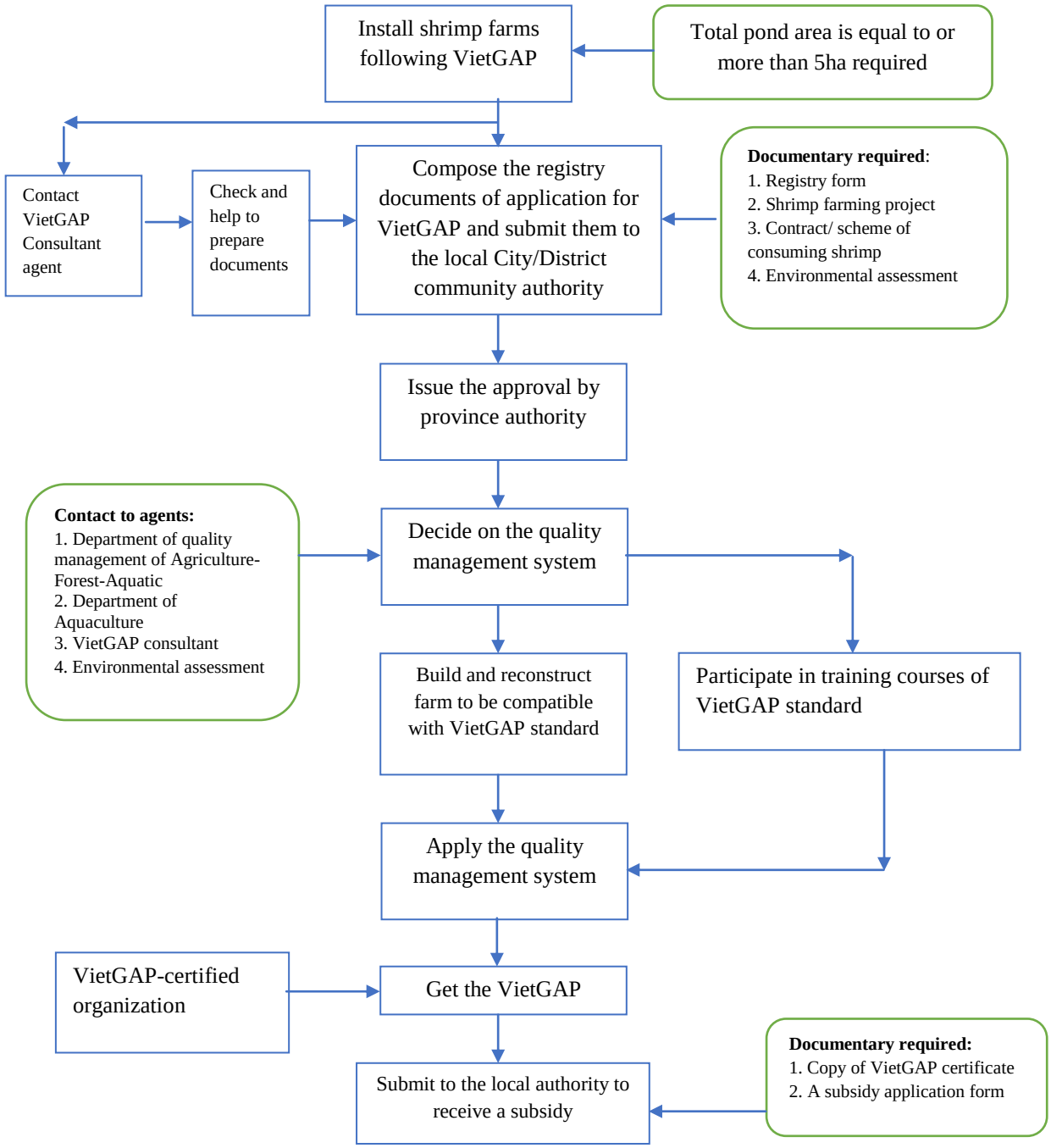

Fig. 1. The process of getting a subsidy for VietGAP certificate in shrimp farming.
Source: Department of Science and Technology & Center for Statistics and Science and Techonology Information of Tra Vinh province

Because the questionnaire provided the information of the VietGAP standard relating to the current incentive subsidy for application of VietGAP standard from the government, as well as the estimated average investment costs of construction, facilities and equipment per hectare under the VietGAP standard (as mentioned above section). Therefore, the farmers find it easy to calculate the additional investment costs basing on their existing farming method compared to the VietGAP standard. Moreover, the open-ended questions are also suitable for shrimp farmers who have little time for interfacing with an interviewer.

Survey design

In order to answer the two major questions of the study which are, whether shrimp farmers are willing to accept the changeover from traditional shrimp farming systems to the VietGAP standard, and what is the minimum subsidy they require to conform with the VietGAP standard, a direct face-to-face interview was carried out. The VietGAP standard might be unfamiliar to the majority of shrimp farmers, thus before starting the survey, the interviewers have to introduce the basic information related to the VietGAP and the current incentive, as well as explain the benefits of it to respondents.

In order to guarantee that the questionnaire is reliable, the trial survey was conducted to find out how comfortable respondents feel and to avoid the pressure of having to give accurate answers as well as to calculate the average time for completing the questionnaire. After the trial survey, some adjustments were made for the final questionnaire which consisted of four parts **(Appendix B)**.

The first part explores farmers' personal characteristics, including age, shrimp-farming experience, average annual income, farm size and education of respondents which are detailed in many articles **(He *et al*., 2016; Xie *et al*., 2017; Zheng *et al*., 2019** and **Wang *et al*., 2020)**.

In part 2, farmers' environmental perspectives were measured by two observation variables that include: current status of polluted water resources (1= definitely not polluted, 2= slightly polluted, 3= generally polluted, 4= highly polluted, 5= very high polluted); and a question on whether shrimp farming is the main cause of polluted river water (1=strongly disagree; 2=disagree; 3= neither agree nor disagree; 4= agree; 5= strongly agree). This environmental questionnaire was used to measure respondents' assessment of the condition of the environment. This is the factor that gauges a farmer's willingness to pay for improving or accepting compensation for changing their farming techniques. This factor variable was also used by **He *et al*. (2016)** and **Zheng *et al*. (2019)**.

Part 3 explored the farmers' attitudes toward the VietGAP standard with four questions relating to an increase in the price of shrimp, contribution to sustainable shrimp farming, enhancing shrimp exporting, and benefit to the environment (a five-point Likert scale was used for the four questions, 1=strongly disagree; 2=disagree; 3=neither agree nor disagree; 4=agree; 5=strongly agree). This factor reflects respondents' intentions to adopt an innovative technology **(He *at al*., 2016)** and whether they will adopt the VietGAP standard **(Tinh *et al*., 2019)**.

Part 4 looks at respondents' WTA for VietGAP. With a hypothesis that the subsidy scheme of VietGAP drops out the criterion of farm size (5 ha). The government would support finance to farmers who adopt VietGAP standard in shrimp farming. There are two main questions in this section. The first question relates to whether the respondents are willing to accept a subsidy for VietGAP certification or not. The question is: *"Would you be willing to accept the subsidy scheme for changing from tradition farming system to VietGAP?"* If the answer is yes, the survey would continue with the second question, which is: *"Suppose that total costs of investment of construction and all necessary facilities, equipment under VietGAP standards about 70 million VND per 1,000 m^2 of shrimp pond. How much a minimum amount of subsidy would you be willing to accept to do shrimp farming under VietGAP standard?*" This is to find out the minimum amount of subsidy required.

Estimation methods

- **Regression for household's WTA a subsidy for VietGAP standard ($WTA_{Decision}$)**

In analyzing factors affecting farmers' decisions on the willingness to accept ($WTA_{Decision}$) a scheme subsidy for implementation of the VietGAP standard in shrimp farming, the maximum likelihood estimation (MLE) was employed to estimate the parameters with a binary regression. And the log-likelihood function (binary logit regression model) is denoted as follows:

$$\mathbf{WTA_{Decision} = 1 \text{ with probability is } P}$$
$$\mathbf{WTA_{Decision} = 0 \text{ with probability is } (1\text{-}P)}$$
$$\mathbf{P} = \frac{e^{\mathbf{a + ßkXki + \mu i}}}{\mathbf{1 + } e^{\mathbf{a + ßkXki + \mu i}}}$$

$$\mathbf{1\text{-}P} = \mathbf{1} - \frac{e^{\mathbf{a + ßkXki + \mu i}}}{\mathbf{1 + } e^{\mathbf{a + ßkXki + \mu i}}} = \frac{\mathbf{1}}{\mathbf{1 + } e^{\mathbf{a + ßkXki + \mu i}}}$$

$$\mathbf{Odds} = \frac{P}{1\text{-}P} = e^{\mathbf{a + ßkXki + \mu i}}$$
$$\mathbf{Ln\ (Odds) = Ln\ (}\frac{P}{1\text{-}P}\mathbf{) = a + ß_kX_{ki} + \mu_i}$$

$\mathbf{P_i}$ is the probability of respondent i^{th} willing to accept a subsidy scheme for following the VietGAP standard.

$\frac{P}{1\text{-}P}$ is an odds of the probability of WTA a scheme subsidy for VietGAP compared to the probability of not WTA of respondent i^{th}.

$\mathbf{X_{ki}}$ are the explanatory variables, which include respondents' characteristics, environmental perception and attitudes toward the VietGAP standard.

a is the intercept parameter.

$\mathbf{ß_k}$ is coefficient of X_{ki} that affecting on the Ln (odds) or the log-odds

When X_k increases one-unit (X_k +1), then:

$$\mathbf{X_k \rightarrow Ln\ (odds_1) = a + ß_kX_{ki} + \mu_i}$$
$$\mathbf{X_k + 1 \rightarrow Ln\ (odds_2) = a + ß_k\ (X_{ki} + 1) + \mu_i = Ln\ (odds_1) + ß_k}$$
$$\mathbf{ß_k = Ln\ (odds_2) - Ln\ (odds_1) = Ln\ (}\frac{odds2}{odds1}\mathbf{)}$$
$$\frac{odds2}{odds1} = \mathbf{e}^{\mathbf{ß_k}} \rightarrow \mathbf{odds_2 = e}^{\mathbf{ß_k}} * \mathbf{odds_1}$$

Therefore, when X_k increases one-unit (X_k +1), the odds of WTA a scheme subsidy for VietGAP would change $e^{ßk}$ times.

μ_i is the residue consisted of other unobserved variables.

- **Regression for household's WTA the value of subsidy for farming under the VietGAP standard ($WTA_{Subsidy}$):**

The OLS (Ordinary Least Squares) regression used to estimate the parameters affecting the minimum amount of subsidy required by shrimp farmers.

$$WTA^{i}_{Subsidy} = a + ß_k X_{ki} + \mu_i$$

$WTA^{i}_{Subsidy}$ = the accepted value of subsidy for costs of investing in construction and all necessary facilities, equipment under VietGAP standard.

X_{ki} are the explanatory variables, which encompasses respondents' characteristics, environmental perception and attitudes towards the VietGAP standard.

$ß_k$ is estimated parameter; **a** is the intercept parameter.

RESULTS AND DISCUSSION

The study was conducted with a total of 300 shrimp farmers in 10 villages in two districts of Tra Vinh province. There were about 30 respondents surveyed randomly in each village. The study started at the beginning of December 2018 and was finished by the end of January 2019.

Statistical description of farmers' characteristics

Out of the 300 farmers surveyed **(Table 2)**, the age of the respondents ranged from 24 to 66 years old, whereas 31% were over 50 years old, 44.33% of them were in the 41 to 50 age group, and the members of the remaining group were under 40 years old. Average years of experience in shrimp farming were approximately 7 years. Only 10% of shrimp farmers had more than 10 years' experience. A majority of them (54%) had between 6 and 10 years' experience, and a lower percentage (36%) had no more than 6 years' experience. In terms of education, the largest proportion consisted of farmers who had secondary school degrees (43.33%). Farmers with a primary school education came second (33.33%), and a modest percentage had a high school education (23.33%). So, it could be considered an advantage in being young and literate, as these types of people can often relate to environmental responsibility. The average shrimp production area was approximately 1.6 ha with a minimum of 0.1 ha and a maximum of 16 ha. A majority of shrimp farmers operate on a smaller scale, and the survey data recorded that 59% of households own a farm size of less than 0.5 ha, while households with 0.6-2 ha of farm size accounted for 13%, and the remaining 28% of households had a farm size from 2 ha to 5 ha. In terms of household annual income, the survey showed that the mean was 130 million VND (equivalent to 5,000 EUR, reference exchange rate of 26,000 VND/EUR). The annual income distribution ranged between 20 million VND and 600 million VND. Forty percent of shrimp farmers had yearly incomes of 51 to 100 million, and 33% had incomes of 101 to 200 million VND, respectively. The lowest and highest household groups accounted for a minority proportion, with 14.33% and 12.67% respectively.

Farmers' environmental perception

With regard to environmental perception, shrimp farmers mostly believed that, in general, highly polluted water resources accounted for 42% and 38% of the total samples. The remaining supposed that it was inconsiderably polluted. In general, shrimp farmers were aware of the adverse environmental conditions surrounding their farms. However, a minority of farmers (14%) agreed that polluted river water was mainly due to shrimp farming. The rest of the farmers surveyed were not sure or did not agree with this result **(Table 2)**. Water resources can become polluted from shrimp farming, rice farming, fish farming, vegetable farming, and residential areas and so on. However, shrimp farming is the main cause of polluted water in rivers or canals around shrimp-farming areas **(MARD, 2015)**. Shrimp farmers might not recognize all the contaminated substances in wastewater from shrimp ponds. While the survey recorded that 40% of farms were without reservation ponds for treating discharge water, the remaining farms fulfilled the treatment without a post-test for safety limitations of discharge water.

Farmers' attitudes towards VietGAP standard

With respect to farmers' attitudes towards the VietGAP standard, there are four main observations. The surveyed shrimp farmers mostly expressed agreement or strong agreement with the benefits gained from the implementation of VietGAP standard with regard to environmental preservation principles, the sustainability of shrimp farming and the prospect of easily exporting shrimp as well as fetching higher shrimp prices if the VietGAP certificate is obtained **(Table 2)**. Specifically, 80% of respondents believed VietGAP farming would be beneficial to the environment or promote sustainable shrimp farming in the future. In terms of shrimp price, 81% of surveyed farmers agreed and strongly agreed with the benefits of higher shrimp prices with VietGAP farming compared to non-VietGAP farming. According to **Baumgartner *et al*. (2016)**, 57.5% of shrimp farmers' opinions on higher shrimp prices are under the eco-environmental certification.

Almost the surveyed shrimp farmers agreed that VietGAP's shrimp would meet the export criteria. They also knew the required criteria for exportation of shrimp: no overuse of antibiotics, as well as acceptable-sized and healthy-looking shrimp. And they believed that VietGAP certification will bring those benefits relating to the environment, economics and sustainability.

Descriptive $WTA_{Decision}$ and $WTA_{Subsidy}$

The survey recorded 72 shrimp farmers (30 extensive farmers; 14 semi-intensive farmers, and 28 intensive farmers) who were unwilling to accept a subsidy to follow the VietGAP standard, which accounted for 24% of interviewed households. The main reasons for this reluctance to adopt the VietGAP were revealed. Firstly, majority of them are with a small farm size, there is not enough area for a reservation pond as required by

VietGAP standards. However, there are 20 extensive farms equal to and over 5ha that is satisfied with the VietGAP criteria, but they found it difficult with financial problems. If they follow the VietGAP standard, they have to invest a large amount of money than that of two other systems. The infrastructure of extensive farming system is simple and low initial cost investment. While VietGAP standard requires the basic investment is more compatible with the semi-intensive or intensive farming systems. Secondly, some of the farmers thought that the difference between the shrimp prices commanded by VietGAP farming compared with non-VietGAP farming was insignificant, while the investment cost was prohibitively higher for refurbishing the farm according to the VietGAP standard. The average costs of construction, facilities and equipment for conventional farming systems are from 20 to 30 million VND per 1,000 m^2 **(MARD, 2015; JICA, 2013**; survey data), while the average costs of those for VietGAP farming systems are approximately 70 million per 1,000 m^2 (a VietGAP farmer provided). Thirdly, these farmers were afraid of VietGAP standards being not applied consistently the in the same areas, which would be difficult to make controlling the common environment. Lastly, a lack of information related to VietGAP standards caused some farmers to lose interest in the idea.

In contrast, total of 228 (76%) farmers (13 extensive farmers; 48 semi-intensive farmers, and 167 intensive farmers) were willing to accept the VietGAP standard with a specific subsidy, but only 6 extensive farms are equal to or over 5ha meeting the VietGAP criteria, the remaining semi-intensive and intensive farms are smaller than 5ha. Although almost them are small size, with inspired environmental responsibility, expected high shrimp prices, and support from the government they would like to apply VietGAP standard in shrimp farming. Furthermore, they expect the new shrimp process help them control disease better than the current systems.

The data reported that the expected amount of the subsidy ranged from 10 to 40 million VND per 1,000 m^2 (0.1 ha) compared to the projected cost of 70 million VND per 1,000 m^2. Farmers willing to accept a subsidy of 20 million VND accounted for 38.6% of the total, and 27.19% of farmers accepted lower than 20 million VND. The sum of 25 million VND was also accepted by 22.37% of respondents. The small remaining percentage had a WTA subsidy range of 26 to 40 million VND **(Table 2)**. The difference in investment costs between VietGAP farming and non-VietGAP farming is approximately 40 million VND. Therefore, it is reasonable for the maximum subsidy amount required by the shrimp farmers.

The study used Stata MP version 14.0 to run a regression test, and the results are stated in **Table 3**.

Table 2. Descriptive statistics

Variables	Mean	Category	Sample	Percentage (%)
Age (year age)	46.5	<=40	74	24.67
		41-50	133	44.33
		>50	93	31
Education of respondents	1.9	1 (primary school)	100	33.33
		2 (secondary school)	130	43.33
		3 (high school)	70	23.33
Experience (year)	7.2	<=5	108	36
		6-10	162	54
		11-20	30	10
Farm size (hectare)	1.6	<0.5 ha	177	59
		0.6-2 ha	39	13
		2h-4.9 ha	58	19
		>=5 ha	26	9
Average annual income (million VND)	130	20-50	43	14.33
		51-100	120	40
		101-200	99	33
		201-600	38	12.67
Shrimp farming is a main cause of polluted river water (a five-point Likert scale)	2.75	<3	102	34
		3	156	52
		>3	42	14
Degree of polluted river water (a five-point Likert scale)	3.2	<3	60	20
		3	126	42
		>3	114	38
VietGAP standard is beneficial to environment (a five-point Likert scale)	4.16	3	53	17.67
		4	145	48.33
		5	102	34
VietGAP standard contributes to sustainable shrimp farming (a five-point Likert scale)	4.3	3	47	15.66
		4	107	35.67
		5	146	47.67
VietGAP certificate helps to improve exporting of shrimp (a five-point Likert scale)	4.24	3	54	18
		4	118	39.33
		5	128	42.67
Shrimp price is higher with VietGAP standard (a five-point Likert scale)	4.2	2	11	3.67
		3	44	14.67
		4	120	40
		5	125	41.66
$WTA_{Decision}$ (yes/no)		**Without willingness**	72	24
		Willingness	228	76
$WTA_{Subsidy}$ (Million VND/0.1 ha)	20.4	<20	62	27.19
		20	88	38.6
		25	51	22.37
		26-40	27	11.84

Table 3. Result of regression $WTA_{Decision}$ and $WTA_{Subsidy}$ for VietGAP

VARIABLES	$WTA_{Decision}$	$WTA_{Subsidy}$
Age	-0.0467 (0.0377) NS	0.00104 (0.0386) NS
Education	0.875 (0.496) *	-2.563 (0.435) **
Experience	0.0601(0.0857) NS	0.151 (0.0968) NS
Farm size	-1.88e-05 (1.47e-05) NS	6.16e-06 (2.27e-05) NS
Income	0.00701 (0.00593) NS	-0.0309 (0.00364) ***
Env_perception	2.047 (0.579) ***	-1.344 (0.492) ***
Attitude	5.330 (0.743) ***	-2.569 (0.952) ***
Constant	-26.08 (4.460) ***	44.25 (4.739) ***
Observations	300	228
R-squared	0.437	

Standard errors in parentheses - ***: p<0.01; **: p<0.05; **: p<0.1; NS: p≥0.1

Cronbach's Alpha test was conducted to analyse the reliability of the scale of two qualitative variables: environmental perception (Env_perception) and attitude toward VietGAP standard (Attitude). The result showed that the scale reliability coefficients were 0.7 for the 'Env_perception' variable and 0.83 for the 'Attitude' variable, which were reliable at more than 0.6 **(Nunnally & Brunstein, 1994).** Moreover, all observation variables had an item rest correlation >0.4 which means they are high correlation with each other in the factor variables **(Appendix A)**. Therefore, no observation variable was omitted.

To guarantee all independent variables are not collinear with each other, a multicollinearity test was used to calculate the variance inflation factor (VIF) for both MLE and OLS regressions. The results showed that VIF=1.24 and 1.15 for the MLE and OLS estimate, respectively. There was no multicollinearity found between explanatory variables. Besides, test of correction prediction of logistic model stated that the model predicts correction of 96.3% **(Appendix A)**.

The two dependent variables are the shrimp farmers' WTA in participating VietGAP ($WTA_{Decision}$) and the shrimp farmers' WTA amount subsidy for a VietGAP certificate ($WTA_{Subsidy}$). **Table 3** shows that both households' $WTA_{Decision}$ and households' $WTA_{Subsidy}$ were significantly influenced by education, environmental perceptions and attitudes toward VietGAP. Moreover, households' $WTA_{Subsidy}$ also correlated with annual average income. The remaining factors such as age, experience and farm size did not affect the $WTA_{Decision}$ or $WTA_{Subsidy}$.

The result showed that education has a positive, significant influence on farmers' $WTA_{Decision}$, which means that highly educated respondents are more probability to participate in the VietGAP standard certification, ceteris paribus. For every one-unit increases in education, for example going from primary school degree to secondary

school degree, we expect a 0.875 increase in the log-odds of the dependent variable ($WTA_{Decision}$) and holding all other independent variables constant. In other words, the odds of WTA a scheme subsidy for VietGAP would increase about 2.4 times [$odds\ ratio = \frac{odds2}{odds1} = e^{0.875}$ =2.4] if farmers' education increases one-unit (from primary school to secondary school, or from secondary school to high school), keeping all other independent variables unchanged. It could be said that higher educated farmers are more adventurous and easy to be take-riskers, pioneers in implicating a new technology into their work. They will also be more likely to integrate new technology into their work.

Furthermore, the more highly educated farmers were also willing to accept a smaller subsidy amount for the VietGAP standard than the less educated farmers, which is illustrated by a negative coefficient and significant level at 1% of the education variable in the $WTA_{Subsidy}$ regression. Specifically, farmers who have secondary school degree would be willing to accept a decrease of 2.563 million VND compared with farmers having primary school degree, ceteris paribus and similar interpretation for high school farmers.

The annual average income has a negative coefficient and is significant at 1%, which implies that the required amount of subsidy would decrease 0.03 million VND if annual average income increases one million VND, with all other variables unchanged. In other words, if a farmer's annual income is more, he would be willing to accept a smaller subsidy for investment in construction, facilities and equipment under the VietGAP standard. Hence, the subsidy amount has a negative relationship with annual income.

Environmental perception has a positive impact on $WTA_{Decision}$ and a negative impact on $WTA_{Subsidy}$ at a significant level of 1%. Holding all other explanatory variables constant, if the environmental perception increases one point, the log-odds of $WTA_{Decision}$ would be expected to increase 2.047 or the odds of WTA a scheme subsidy for VietGAP would increase about 7.74 times [$odds\ ratio = \frac{odds2}{odds1} = e^{2.047}$ =7.74], and the accepted subsidy amount ($WTA_{Subsidy}$) would decrease 1.344 million VND for pursuing VietGAP. Shrimp farmers are more responsible for the environment, who believed that the current state of river water is a serious issue and that traditional shrimp farming activity had a negative effect on the environment in general. They had a stronger propensity to WTA participation in the VietGAP system and were generally willing to accept a smaller subsidy for VietGAP farming. A negative assessment of the environment could be seen as a pessimistic view, but it also could lead to more environmentally responsible actions and inspire farmers to change their behavior and farming processes to sustain their livelihoods.

Farmers' attitudes toward the VietGAP standard have a strong correlation and positive coefficient with $WTA_{Decision}$ but a negative coefficient with $WTA_{Subsidy}$. This result means that farmers are more interested in the benefits of the VietGAP standard, the higher probability of WTA participating in VietGAP and the lower subsidy required following the VietGAP standard. Specifically, if the attitudes toward increases one point,

the log-odds of $WTA_{Decision}$ would be expected to increase 5.33 or the odds of WTA a scheme subsidy for VietGAP would increase about 206.3 times [$odds\ ratio = \frac{odds2}{odds1} = e^{5.33} = 206.3$], and the accepted subsidy amount ($WTA_{Subsidy}$) would decrease approximately 2.57 million VND for pursuing VietGAP, holding all other explanatory variables unchanged.

Drawbacks of applying the VietGAP standard

Although application for the VietGAP standard is encouraged, hardly any Vietnamese shrimp farmers have done so. They usually follow the processes of companies that supply formulated food or biochemical products used in aquaculture. Those companies prompted farmers to use their products as much as possible. As a result, use of chemicals and residual food not only led to higher farming costs but also posed a risk to the environment. There are obvious benefits from VietGAP, but an increase in investment costs under the VietGAP process dampened shrimp farmers' enthusiasm in applying for it. Although higher shrimp prices can be fetched under the VietGAP farming system than in non-VietGAP farming **(Quyen *et al.*, 2020)**, the cost of investing in construction, facilities and equipment is beyond the means of small-scale farmers. Moreover, the current incentive scheme of VietGAP only gives grants for farms 5 ha or larger, while more than 90% of shrimp farms have less than 5 ha of land in Tra Vinh province. Therefore, many small-scale farmers were not interested in obtaining the VietGAP standard. Another of the farmers' concerns is the fragmental application of VietGAP farms or a sole VietGAP farm located around non-VietGAP farms, which is a disadvantage for the VietGAP farms because of common water resource use. The current scheme of VietGAP certification seems unfavorable to small-scale shrimp producers because it requires compliance with several technical criteria such as a warehouse for storing food and chemicals and daily recorded documentation **(Marschke *et al.*, 2014)**. Those requirements are not necessary for small-scale farms because they could use their homes for food and chemical storage. In addition, the financial requirements may be an obstacle for small producers perusing this certificate **(Quyen *et al.*, 2020)**.

Status quo of exporting shrimp

In the last five years, Vietnam shrimp export revenue achieved an average growth of 4.1% **(VASEP, 2020)**. The three main global importers of Vietnamese shrimp are Japan, the EU and the US, who together accounted for approximately 60% of the total shrimp export value **(Table 4)**. The EU was the biggest importer of Vietnamese shrimp, accounting for more than 20% annually. The export value has slightly fluctuated over the years, but in general, had an increasing trend. In particular, 2019 due to disease outbreak occurred in the first quarter causing small shrimp-size and lower export prices, and Vietnam was competitive from other exporters like India, Thailand, Indonesia, Malaysia and so on.

Table 4. Three main shrimp import markets and total shrimp exports *(Unit: million USD)*

Export value	2015	2016	2017	2018	2019	Average
EU	548.6	600.4	862.8	837.8	696.2	709.2
United States	656.9	708.8	659.2	637.7	646.6	661.8
Japan	583.9	599.7	704.1	638.8	626.0	630.5
Total shrimp exports	2,950.0	3,150.0	3,850.0	3,550.0	3,380.0	3,304.0

Source: VASEP, 2020. Report on Vietnam Shrimp Sector 2015-2019

Besides the impressive export numbers, the shrimp export products were facing quality issues. According to Southern Shrimp Alliance, there has been a significant number of Vietnamese shrimp shipments rejected by three main importers in recent years **(Fig. 2)** because of hygienic and residual antibiotic problems. The main causes of these problems include abuse of chemicals and fertilizers as well as environmentally harmful drugs and antibiotics used in the aquaculture to increase productivity and adapt to adverse climate change fluctuations with regardless of harmful to environment or healthy human **(Nhung *et al*., 2017; Zheng *et al*., 2019)**. As a result, residual antibiotics and chemicals may exceed the permitted threshold for importers. From 2012 to 2019, there were many rejected shrimp transactions by the major markets. These rejections caused major financial losses but also loss of trust and negative perceptions of Vietnamese shrimp in international markets. To deal with those problems, collaboration between processors and shrimp farmers is needed. The processer enterprises should offer a competitive price all products from farms having a quality certificate such as ASC, BAP, GlobalGAP or VietGAP. And harvesting shrimp with proper processes in order to ensure hygienic conditions and traceable information enhances companies' prestige and customer trust.

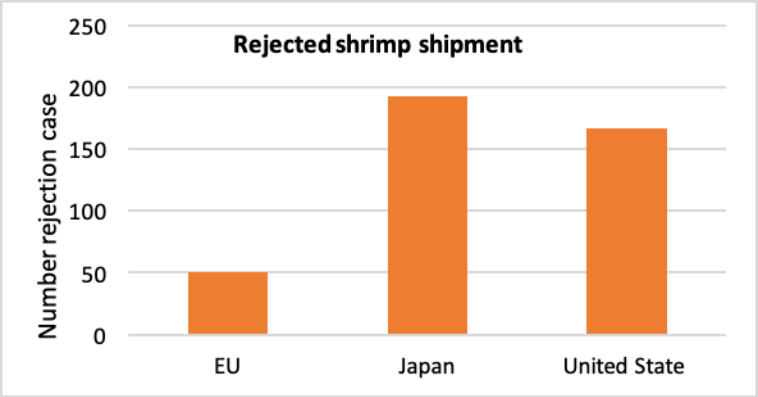

Fig. 2. Number of shrimp shipments rejected by three main importers from 2012 to 2019.

Source: Southern Shrimp Alliance.

However, the forecasted demand for shrimp in those markets is still set to increase in the future. According to **MARD (2015)**, and based on the data of FAO from the period 2013 to 2018, in 2020 demand for shrimp in America would be 643,000 tons, which would account for 15% of the total global demand (if its economy had not been affected by the coronavirus pandemic). In 2030 its demand is predicted to increase by 675,000 tons **(Fig. 3)**. If Vietnam keeps the third rank of countries exporting shrimp to the US by 2030, its export production will be able to reach approximately 202 thousand tons in 2030 (basing on the market share of period of 2010-2014, **MARD (2015)**).

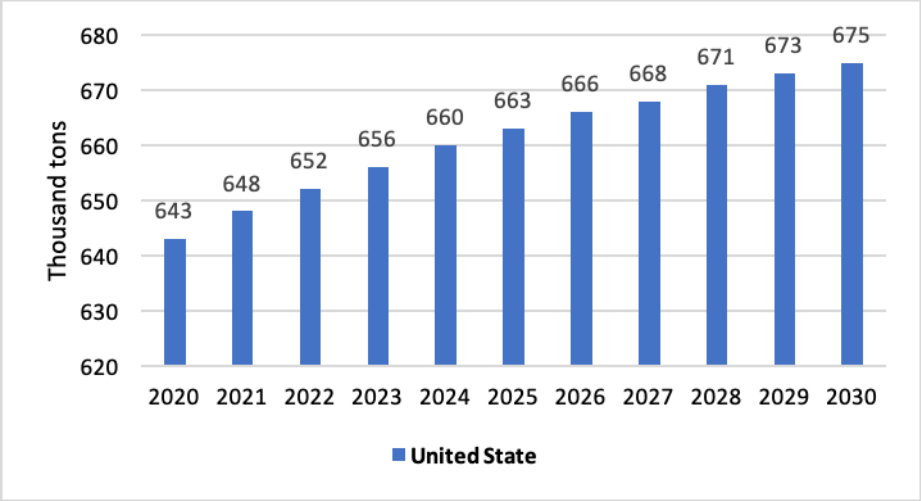

Fig. 3. Forecasted demand for shrimp in United States.

Source: MARD, 2015. Calculation based on the FAO's data.

Similarly, European markets are also predicted to increase shrimp consumption gradually from 2020 to 2030 **(Fig. 4)**. The EU was the biggest importer of Vietnamese shrimp, accounting for more than 20% annually. So, Vietnamese shrimp has a big room in this market if it abides by the strict technical barriers (the permitted residual substances in shrimp products), and it is predicted to reach about 180 thousand tons in 2030.

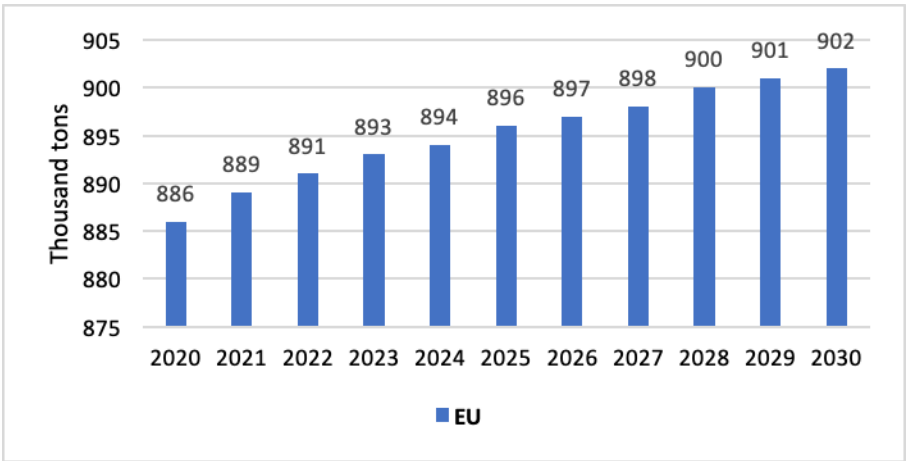

Fig. 4. Forecasted demand for shrimp in Europe.

Source: MARD, 2015. Calculation based on the FAO's data.

While the demand of shrimp in Japan market is predicted to grow significantly with average 10% per year from 2020 to 2030 **(Fig. 5)**. However, this market has become cautious with Vietnamese shrimp due to breaches of quality in recent years. Hence, application of VietGAP in shrimp farming is an essential step forward to strict markets.

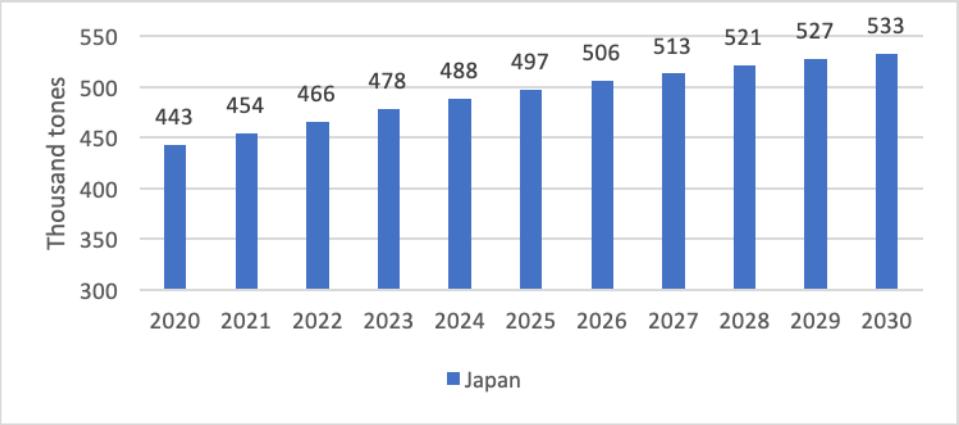

Fig. 5. Forecasted demand for shrimp in Japan.

Source: MARD, 2015. Calculation based on the FAO's data.

In general, the demand of shrimp is predicted the trend will continue increasing in the future. Therefore, the VietGAP standard plays an important role in paving the way for Vietnamese shrimp to penetrate international markets. Although VietGAP is still not accepted internationally, it is a baseline for improving shrimp farmers' environmental perceptions, which is considered an essential milestone for international recognition.

CONCLUSION

The VietGAP certificate is worth obtaining not only for its positive economic aspects, but also indicates the farmer's continued commitment to fulfilling the requirements related to the sustainability of shrimp farming. Farmers would contribute to creating a good image of Vietnam's shrimp products under the VietGAP standard. When the shrimp product is accepted in the wider world, this helps the Vietnamese economy to interact effectively with international economies. This study could conclude that the purpose of obtaining the VietGAP standard is not beneficial to shrimp farmers for short-term ambitions such as an increase in productivity, helping the financial bottom line or the shrimp being disease free. In the long term, however, farmers can have sustainable development in terms of environmental preservation, creating a good image and reputation and internationalizing the VietGAP certification with a lower cost compared to other international certifications (ASC, GlobalGAP, etc.). Application of the VietGAP standard would help in reducing the risk of rejected shrimp shipments and could secure potential import markets.

The study used the contingent valuation method (CVM) to analyze the factors affecting shrimp farmers' decisions ($WTA_{Decision}$) on whether to accept a subsidy for VietGAP certificate and a minimum subsidy that farmers are willing to accept ($WTA_{Subsidy}$) for pursuing the VietGAP certificate. It found that $WTA_{Decision}$ had a positive relationship with farmers' educational level, environmental perceptions and attitudes toward the VietGAP certificate. In addition, annual income also had a slight effect on farmers' willingness to accept a subsidy value. The findings of this study are not only relevant to Tra Vinh province but also to all provinces engaged to shrimp farming or aquaculture in general.

The limitation of this study is that there is no comparison of shrimp productivity between VietGAP farms and non-VietGAP farms. There is also a shortage of specific information on other international certificates (ASC, GlobalGAP, etc.) to compare with VietGAP shrimp farming. However, this study showed the benefits and drawbacks of the application of VietGAP standards and discovered what factors affected the farmers' WTA following VietGAP certification and the WTA amount of subsidy expected for adopting VietGAP certification, which will help authorities and policymakers to make appropriate decisions.

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REFERENCES

Anh P.T.; Carolien K.; Simon R. B. and Arthur P.J. Mol (2010). Water pollution by intensive brackish shrimp farming in south-east Vietnam: Causes and options for control. Agricultural Water Management, **97**: 872–882.

Angus McEwin and Richard McNally (2014). Organic Shrimp Certification and Carbon Financing: An Assessment for the Mangroves and Markets Project in Ca Mau Province, Vietnam.

Baumgartner U. and Tuan H.N. (2016). Organic certification for shrimp value chains in Ca Mau, Vietnam: a means for improvement or an end in itself? Environment Development Sustainability, 19(3): 987-1002. DOI 10.1007/s10668-016-9781-z

Circulate No 48/2012/TT-BNNPTNT dated 26th Sep. 2012. PRESCRIBING CERTIFICATION OF COMPLIANCE WITH GOOD AGRICULTURAL

PRACTICES ON PRODUCTION AND PROCESSING OF FISHERY, CROP AND LIVESTOCK PRODUCTS.
https://vanbanphapluat.co/circular-48-2012-tt-bnnptnt-certification-good-agricultural-practices-production-fishery-crop

Decision No 4835/QĐ-BNN-TCTS dated 24th Nov. 2015 promulgated by the Ministry of Agriculture and Rural Development.https://vanbanphapluat.co/quyet-dinh-4835-qd-bnn -tcts- huong-dan-ap-dung-vietgap-nuoi-thuong-pham-tom-chan-trang-tom-su

Decision No 28/2015/QĐ-UBND dated 9th Nov. 2015 of People's Committee of Tra Vinh province
https://thuvienphapluat.vn/van-ban/Tai-chinh-nha-nuoc/Quyet-dinh-28-2015-QD-UBND-ho-tro-ap-dung-quy-trinh-thuc-hanh-san-xuat-nong-nghiep-tot-Tra-Vinh-298780.aspx

Directory of Fisheries. https://tongcucthuysan.gov.vn/vi-vn/thương-mại-thủy-sản/xuất-nhập-khẩu/doc-tin/014456/2020-04-17/tom-the-chan-trang-tang-truong-manh-giai-doan-2015-2019

He K.; Junbiao Z.; Yangmei Z. and Lu Z. (2016). Households' willingness to accept compensation for agricultural waste recycling: taking biogas production from livestock manure waste in Hubei, P. R. China as an example. Journal of Cleaner Production, 131: 410-420.

JICA (2013). The project for climate change adaptation for sustainable agriculture and Rural Development in the coastal Mekong Delta in Vietnam. Final report 2013. Japan International cooperation agency, SanYu Consultants Inc., Japan, NewJec Inco., Japan.

MARD- Ministry of Agriculture and Rural Development (2015). General report of the planning for brackish shrimp farming in Mekong Delta by 2020 and vision toward 2030. (In Vietnamese)

Marschke Melissa and Ann Wilkings (2014). Is certification aviable option for small producer fish farmers in the global south? Insights from Vietnam. Marine Policy, 50: 197–206.

Nhung T.T.; Hai T.M. and Kampanat Pensupar (2017). Consumers' Preferences and Willingness to Pay for Viet GAP Vegetables in Hanoi, Vietnam. International Journal of Economic Research, Volume 14 , Number 16 (part 3): 401-419.

Nunnally, J. and Brunstein (1994). Psycometric Theory (3rd ed.). New York, McGrow Hill. pp 405-450.

Pearce D. and Ece Ozdemiroglu *et al.* (2002). Economic Valuation with Stated Preference Techniques Summary Guide. Department for Transport, Local Government and the Regions: London. pp100-150.

Quyen, N.T.K.; Hien, H.V.; Khoi, L.N.D.; Yagi, N. and Karia Lerøy Riple, A. (2020). Quality Management Practices of Intensive Whiteleg Shrimp *(Litopenaeus*

vannamei) Farming: A Study of the Mekong Delta, Vietnam. Sustainability, 12(11): 4520. **https://doi.org/10.3390/su12114520**

Southern Shrimp Alliance releases updated databases documented antibiotic contaminated shrimp import rejections in the European Union, Japan, and the United States.

https://www.shrimpalliance.com/southern-shrimp-alliance-releases-updated-databases-documenting-antibiotic-contaminated-shrimp-import-rejections-in-the-european-union-japan-and-the-united-states/?hilite=%27Vietnam%27%2C%27shrimp%27%2C%27rejection%27

Tinh L.; Hung P.T.M.; Dzung D.G. and Trinh V.H.D. (2019). Determinants of farmers' intention of applying new technology in production: The case of VietGAP standard adoption in Vietnam. Asian Journal of Agriculture and Rural Development, 9(2): 164-178.

VASEP-Vietnam Association of Seafood Exporters and Producers (2020). Report on Vietnam Shrimp Sector 2015-2019.

Wang J.; Chenchen Y.; Wanglin M. and Jianjun T. (2020). Risk preference, trust, and willingness-to-accept subsidies for pro-environmental production: an investigation of hog farmers in China. Environmental Economics and Policy Studies, 22: 405-431

https://doi.org/10.1007/s10018-020-00262-x

Xie X.; Hualin X.; Cheng S.; Qing W. and Hua L. (2017). Estimation of Ecological Compensation Standards for Fallow Heavy Metal-Polluted Farmland in China Based on FarmerWillingness to Accept. Sustainability, 9(10): 1859. doi: 10.3390/su9101859

Zheng R.; Jiasui Z.; Luxing L.; Yanli M.; Zishuai W.; Lianhui X. and Dunchun H. (2019). Factors and Minimal Subsidy Associated with Tea Farmers' Willingness to Adopt Ecological Pest Management. Sustainability, 11: 6190; doi:10.3390/su11226190

VietGAP information. (Vietnamese) http://vietgap.tongcucthuysan.gov.vn/Content.aspx?mode=uc&page=CosonuoitrongThongkeTheoDoituong

Appendix A. Stata do-files

Cronbach's Alpha test for Environmental perception and Attitude toward VietGAP standard variables

```
. alpha env_per1 env_per2, item
Test scale = mean(unstandardized items)
Average interitem covariance:        .3296767
Number of items in the scale:                2
Scale reliability coefficient:          0.7057
. alpha attitude1 attitude2 attitude3 attitude4, item
Test scale = mean(unstandardized items)
```

Item	Obs	Sign	item-test correlation	item-rest correlation	average interitem covariance	alpha
attitude1	300	+	0.7855	0.6267	.3306094	0.7954
attitude2	300	+	0.8518	0.7249	.2862022	0.7510
attitude3	300	+	0.8010	0.6389	.3151877	0.7896
attitude4	300	+	0.8144	0.6353	.2957897	0.7946
Test scale					.3069472	0.8278

Result of regression of $WTA_{Decision}$

```
. logit Decision age education experience farmsize income Env_perception Attitude
Iteration 0:   log likelihood = -165.32398
Iteration 1:   log likelihood = -55.686391
Iteration 2:   log likelihood = -40.672169
Iteration 3:   log likelihood = -38.542775
Iteration 4:   log likelihood = -38.502611
Iteration 5:   log likelihood = -38.502508
Iteration 6:   log likelihood = -38.502508
Logistic regression                             Number of obs     =        300
                                                LR chi2(7)        =     253.64
                                                Prob > chi2       =     0.0000
Log likelihood = -38.502508                     Pseudo R2         =     0.7671
```

Decision	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	-.0466643	.0376917	-1.24	0.216	-.1205387	.02721
education	.8747267	.4960719	1.76	0.078	-.0975563	1.84701
experience	.0600911	.0857378	0.70	0.483	-.1079518	.2281341
farmsize	-.0000188	.0000147	-1.28	0.200	-.0000477	9.97e-06
income	.007008	.0059312	1.18	0.237	-.004617	.0186329
Env_perception	2.047122	.5785588	3.54	0.000	.9131671	3.181076
Attitude	5.329516	.743111	7.17	0.000	3.873046	6.785987
_cons	-26.08084	4.460011	-5.85	0.000	-34.8223	-17.33938

Calculate odds ratio

.logit Decision age farmsize education experience income Env_perception Attitude,or

Iteration 0: log likelihood = -165.32398
Iteration 1: log likelihood = -55.686391
Iteration 2: log likelihood = -40.672169
Iteration 3: log likelihood = -38.542775
Iteration 4: log likelihood = -38.502611
Iteration 5: log likelihood = -38.502508
Iteration 6: log likelihood = -38.502508

Logistic regression Number of obs = 300
LR chi2(7) = 253.64
Prob > chi2 = 0.0000
Log likelihood = -38.502508 Pseudo R2 = 0.7671

Decision	**Odds Ratio**	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.9544077	.0359733	-1.24	0.216	.8864428	1.027584
farmsize	.9999812	.0000147	-1.28	0.200	.9999523	1.00001
education	2.39822	1.189689	1.76	0.078	.9070512	6.34083
experience	1.061933	.0910478	0.70	0.483	.8976709	1.256254
income	1.007033	.0059729	1.18	0.237	.9953937	1.018808
Env_perception	7.745575	4.481271	3.54	0.000	2.492203	24.07265
Attitude	206.3382	153.3322	7.17	0.000	48.08862	885.3537
_cons	4.71e-12	2.10e-11	-5.85	0.000	7.53e-16	2.95e-08

Test of correct prediction

. estat class

Logistic model for Decision

Classified	D	~D	Total
+	224	7	231
-	4	65	69
Total	228	72	300

(-------- True --------)

Classified + if predicted Pr(D) >= .5
True D defined as Decision != 0

Sensitivity	Pr(+| D)	98.25%
Specificity	Pr(-|~D)	90.28%
Positive predictive value	Pr(D| +)	96.97%
Negative predictive value	Pr(~D| -)	94.20%

False + rate for true ~D	Pr(+|~D)	9.72%
False - rate for true D	Pr(-| D)	1.75%
False + rate for classified +	Pr(~D| +)	3.03%
False - rate for classified -	Pr(D| -)	5.80%

Correctly classified 96.33%

Multicollinearity test

. qui reg Decision age education experience farmsize income Env_perception Attitude, vce(r)

. vif

Variable	VIF	1/VIF
farmsize	1.57	0.634933
Attitude	1.40	0.714805
income	1.32	0.756254
education	1.15	0.867139
Env_percep~n	1.13	0.888349
age	1.07	0.933605
experience	1.05	0.955112
Mean VIF	1.24	

Result of regression of $WTA_{subsidy}$

. reg subsidy age education experience farmsize income Env_perception Attitude if Decision==1

Source	SS	df	MS	Number of obs	=	228
				F(7, 220)	=	24.42
Model	3594.43061	7	513.490087	Prob > F	=	0.0000
Residual	4626.24922	220	21.0284055	R-squared	=	0.4372
				Adj R-squared	=	0.4193
Total	8220.67982	227	36.2144486	Root MSE	=	4.5857

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subsidy	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	.0010414	.0385625	0.03	0.978	-.0749577	.0770406
education	-2.563247	.4354573	-5.89	0.000	-3.421448	-1.705045
experience	.150598	.0967515	1.56	0.121	-.0400805	.3412765

farmsize	6.16e-06	.0000227	0.27	0.786	-.0000386	.0000509
income	-.0308817	.0036447	-8.47	0.000	-.0380647	-.0236986
Env_perception	-1.343623	.4918464	-2.73	0.007	-2.312957	-.3742897
Attitude	-2.569475	.9516422	-2.70	0.007	-4.444977	-.6939735
_cons	44.2493	4.739314	9.34	0.000	34.90903	53.58956

Multicollinearity test

. vif

Variable	VIF	1/VIF
farmsize	1.32	0.759983
income	1.30	0.770432
age	1.14	0.875325
education	1.14	0.880616
Attitude	1.08	0.927298
experience	1.04	0.959355
Env_percep~n	1.01	0.990901
Mean VIF	1.15	

Heteroscedasticity test

. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of subsidy

chi2(1) = 0.40

Prob > chi2 = 0.528

Appendix B. Questionnaires

Part 1. Socio-economic characteristics

At the beginning of the survey, interviewer provides the background information of the VietGAP standard such as its major benefits, the current incentive subsidy for application of VietGAP standard from the government, as well as the estimated average costs of construction, facilities and equipment per hectare under the VietGAP standard.

Afterward, ask following questions:

Q1. Please tell us your name and age.

Name: …… Age: ……

Q2. Check on respondent's gender.

Male: □ Female: □

Q3. Please let us information about your education degree.

Primary school: □ Secondary school: □ High school: □

College/University: □ None: □

Q4. How long have you experienced shrimp farming?

……. years

Q5. How is large your farm?

……. (ha)

Q6. How much is average annual income from shrimp farming?

……. million VND

Part 2. Environmental perception

Q7. It is said that shrimp farming is a main cause of river/canal water pollution. What extent do you agree?

① ② ③ ④ ⑤

On scale from 1 to 5, where 1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree; 4=Agree; 5=Strongly agree.

Q8. What is water resource like currently?

① ② ③ ④ ⑤

On scale from 1 to 5, where 1= definitely not polluted, 2= slightly polluted, 3= generally polluted, 4= highly polluted, 5= very high polluted.

Part 3. Attitude toward VietGAP standard

What extent do you agree with the following questions? On scale from 1 to 5, where 1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree; 4=Agree; 5=Strongly agree.

Q9. Shrimp's price is higher than the market price if farmer got a certificate of eco-environment (VietGAP).

① ② ③ ④ ⑤

Q10. It is said that shrimp farming under VietGAP standard is beneficial to environment.

① ② ③ ④ ⑤

Q11. The VietGAP standard contributes to sustainable shrimp farming.

① ② ③ ④ ⑤

Q12. A VietGAP certificate in Shrimp farming is the most important in exporting.

① ② ③ ④ ⑤

Part 4. Willingness to accept a subsidy

Interviewer poses a hypothesis that the current subsidy scheme of VietGAP does not care about the criterion of farm size (minimum 5ha). The government would like to support finance to farmers who adopt VietGAP standard in shrimp farming. Afterward ask two following questions:

Q13: Would you be willing to accept the subsidy scheme for changing from traditional farming system to VietGAP?

□ Yes. (Go to Q14) □ No. (Go to follow-up questions)

Q14. Suppose that total costs of investment of construction and all necessary facilities, equipment under VietGAP standards about 70 million VND per 1,000 m^2 of shrimp pond. How much a minimum amount of subsidy would you be willing to accept to do shrimp farming under VietGAP standard?

…… million VND

Follow-up questions:

Q15. Why don't you accept the subsidy scheme?

……

Q16. What difficulties are you facing if you follow VietGAP standard?

……..

Q17. What would you require any more supports from the Government?

……

Appendix C. Intensive interview with a VietGAP farmer (Mr. Le Van Hoc)

- When did you start shrimp farming?
- Could you please share with us your story of pursuing VietGAP certificate?
- What is your motivition to decide to pursue the VietGAP standard? What are the drawbacks when you do farming under the VietGAP standard?
- Could you please reveal the average investment cost under the VietGAP standard? And how much does it cost for the non-VietGAP standard?