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Factors affecting shrimp farming development: A case study of Tra Vinh Province, Vietnam

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Abstract
This study contributes to clarifying the theory on factors affecting the development of shrimp farming, quantifying the impact of the factors affecting shrimp culture development, and successfully building a research model for the relationship between the factors affecting shrimp culture development applied within a region or the whole country. This study aims to identify and evaluate factors affecting shrimp farming development to then suggest some policy changes to improve shrimp farming models, thus raising farmer household income and contributing to the development of the local economy. To supplement the lack of secondary data, primary data is used along with the author's choice of sampling conditions and size of the study: 300 observations. The study surveyed 300 farmers with linear structural equation modeling (SEM) to analyze factors in the research model, and the result showed that the proposed factors in the research model - except labor factors, which are not sufficient to determine the impact - did have an influence on shrimp farming development; therefore, further research with a larger sample of the labor force in shrimp farming is needed.

Keywords: Development, shrimp farming, affecting factors

1. Introduction

With a coastline of 3,260 kilometers, Vietnam is geographically ideal for the seafood industry, including both aquaculture and open ocean fishing. Vietnam's seafood export turnover reached over 8.4 billion USD, in which shrimp is the main export product for seafood, with a turnover of over 3.73 billion USD, accounting for about 44%, and white leg shrimp accounting for 72.7% of total shrimp production of Vietnam, reaching a turnover of $2.715 billion. Aquaculture is concentrated in the Mekong River Delta provinces, accounting for around 75% and 80% respectively of the total national pangasius and shrimp production. Along with the country's renovation, the shrimp farming industry has expanded and gotten more dynamic, overcoming difficulties and challenges to become a key industry that contributes greatly to agriculture and to the whole country socio-economy. Right now, Vietnam's shrimp industry is finding it difficult to penetrate new foreign markets, as 100% of shrimp shipments from Vietnam must be inspected by Japan's customers authorities instead of the usual test volume of 30%. Korea has also dispatched a warning about the presence of residual *Nitrofurans* in Vietnam's shrimp products (VASEP, 2020).

Shrimp farming in Tra Vinh province was established about 20 years ago. It started with extensive farming, stocking seed with low density on natural shrimp and fish dams in saltwater areas. From the beginning, the farming model was gradually upgraded to extensive, semi-intensive and intensive farming. Currently, shrimp farming is considered one of the main industries that bring high income to people in Tra Vinh province (Aquaculture Department of Tra Vinh province). Recently however, the development of shrimp farming in the province is facing some difficulties. Small-scale shrimp farming areas are typically 0,49ha/household within a range of at least 0,12ha/household to 3ha/household - about 50,52% total agricultural land area, scattered with no planning, low yield, low shrimp development, low spontaneous development and movement. The market has no requirement for product, especially regarding tracing of origin. The low infrastructure results in low quality & ineffective production organization.

The main objective of the paper is to contribute to clarifying the theory on factors affecting the development of shrimp farming, quantifying the impact of factors affecting shrimp farming development and successfully building a research model on the relationship between factors affecting shrimp farming development applied within a region or the whole water area. The study will estimate the impact of factors affecting the development of shrimp farming in Tra Vinh province. The research results will be the scientific and practical arguments for proposing solutions to the development of shrimp farming in Tra Vinh province.

Through substratal researches, the authors have found that there are many factors affecting the development of aquaculture, which includes that of shrimp farming. Therefore, to have a basis to upon which determine the local strengths, research is needed to evaluate the factors affecting the development of shrimp farming in Tra Vinh province.

2. Research methodology

The Cronbach's alpha reliability coefficient is used by the author to find out which items to keep and which items to omit from the items to be tested, or in other words, to help eliminate observed variables. When the Cronbach's alpha coefficient varies in the range [0,1], the scale is considered to have good reliability. Many researchers agree that when Cronbach's alpha is from 0.80 or higher to close to 1, it is considered a good scale, and from 0.60 to close to 0.80 it is usable. In this study, the author took a standard Cronbach's alpha coefficient greater than 0.60 and less than 0.90. In addition, the correlation coefficient between the variable and the total variable must be greater than 0.30.

Factor analysis is mainly used to evaluate convergent and discriminant validity in order to reduce a set of many interdependent observed variables into a smaller set of variables, so that they are more significant but still contain most of the information content of the original variable set. The KMO (Kaiser-Meyer-Olkin measure of sampling adequacy) index is used to consider the appropriateness of factor analysis. The value of KMO must be within the range of (0.50; 1) which is a sufficient condition for the appropriate factor analysis. Bartlett's test examines the hypothesis of the correlation between the observed variables in the population. If this test is significant (Sig Barleet's test < 5% and Eigenvalue > 1), then the observed variables are correlated with each other in the population (D.W. and Anderson Gerbing, J.C. 1988). The scale is accepted when the total variance extracted 50% (D.W & Anderson Gerbing, J.C, 1988). Factor loading is used to evaluate the significance level between variables in exploratory factor analysis. According to Hair & ctg (1998), a coefficient greater than 0.30 is considered to be the minimum level, and a loading factor > 0.40 is considered important. A loading factor > 0.50 is considered to be of practical significance. After a number of variables from EFA results, Cronbach's alpha was recalculated for each concept of the theoretical model in order to re-test the reliability of the scales again.

Confirmatory factor analysis CFA is used to confirm the scales and shed some light on: (1) Measurement of unidirectionality; (2) The assessment of the reliability of the scale; (3) Convergence value; (4) Discriminant value; (5) Theoretical relational value.

Unidirectionality: is used to measure the fit of the data with the information of Chi-square parameters adjusted for degrees of freedom (CMIN/df); integrated index that compares CFI (comparative Fit Index), TLI (Tucker & Lewis index) and RMSEA (Root Mean Square Error Approximation) index and MI (Modification Indices) index is used. If a model receives a TLI value, a CFI $\geq$ 0.90; CMIN/df $\leq$ 2; or in some cases CMIN/df $\leq$ 3; RMSEA $\leq$ 0.08, the data is considered to be in line with the market (Hair & ctg, 1998). However, according to the recent view of researchers, it is still acceptable to accept GFI values less than 0.90 (Hair J. F.; Black W. C.; Babin B J & Anderson R. E., 2009).

Evaluating the reliability of the scale: The reliability of the scale is assessed through: (1) composite reliability; (2) total variance extracted and (3) Cronbach's alpha.

Convergent value: The scale achieves convergent value when the normalized weights of the scales are all high (greater than 0.50) and statistically significant (p_value < 0.05) (DW and Anderson Gerbing, JC, 1988).

Discriminant value: It is possible to test the discriminant validity of concepts in a critical model, a model in which free research concepts relate to each other. This value is reached when the correlation between two components of the concept or two concepts is actually different from 1.

The goal of CFA analysis is to test the appropriateness of the scale with: composite reliability, extracted variance, unidirectionality, convergence and discriminant. A good CFA result will ascend the progress to the next step, which is using SEM to test the proposed hypotheses in the theoretical model.

The SEM linear structural model analysis method used for testing the research model, the hypotheses and the multivariate analysis method is applied to determine the level of impact of each group of independent factors on the dependent variable. SEM consists of one or more linear regression equations describing how endogenous structures depend on exogenous and other endogenous structures (B.M. Byrne, 2010). SEM is a very suitable method for the analysis of factors affecting the development of shrimp farming, as it shows cause-and-effect relationships among a multitude of variables related to the effects of a single growth factor. The development is expressed with 2 variables, namely operational efficiency and market efficiency. The model is suitable when the coefficients are CMIN/df $\leq$ 2 or CMIN/df $\leq$ 3, CFI index, TLI $\geq$ 0.9; RMSEA index $\leq$ 0.08. The degree of influence of the independent variable is determined by the estimated coefficient with the corresponding significance level.

To check the reliability of the estimations, the bootstrap method will be conducted to re-estimate the parameters in the model. The ML estimation results will be used to test the hypotheses.

Factors affecting shrimp farming development

The development of shrimp farming is influenced by many factors. In this study, the authors have grouped factors that influence the development of shrimp farming using Michael E. Porter's theory including criteria of macro and microenvironment.

Labour force

The labor force has a great influence on shrimp farming development, but only through some main factors such as gender, education, qualification, age, experience, training, etc. in shrimp farming. It is necessary to consider its influence to see the extent of its impact on shrimp farming

development, thereby proposing solutions to promote shrimp farming development (Kim Anh Thi Nguyen, Tram Anh Thi Nguyen, Curtis Jolly and Brice Merlin Nguelifack, 2020).
H_1: Natural conditions have a positive impact on the development of shrimp farming.

Supporting and related industries
In the aquatic product processing industry, people conduct research and apply scientific and technological advances to produce aquatic products with high nutritional value and contribute to increasing the proportion of exports in high export-value industries of the whole country. To develop shrimp farming, it is necessary to have a synchronous technical infrastructure system, especially with irrigation (Wang J.; Chenchen Y.; Wanglin M. and Jianjun T., 2020).
H_2: Investment capital has a positive impact on the development of shrimp farming.

Direct inputs
Seed quality determines the success or failure of farming activities (Patrícia Moraes-Valenti, Priscila Atique de Morais, Bruno de Lima Preto, Wagner C. Valenti, 2010). Good quality shrimp seeds will ensure productivity as well as the reliable capacity to supply raw materials for processing plants, limiting material shortage which is seriously increasing (Engle C, Mc Nevin A, Racine P *et al*, 2017). Feed also contributes to a significant degree in the process of shrimp farming. The effectiveness of shrimp farming depends heavily on the choice of food and feeding methods (Tien Tan Pham and Hiep Doan Do, 2006). However, the price of feed affects the feeding decision for shrimp farmers.
H_3: Labor force has a positive impact on the development of shrimp farming.

Market conditions
Consumer markets regulate the size and structure of aquaculture. Manufacturers always gauge supply-demand to adjust production and business behaviour accordingly to minimize risks due to market impacts (Angus McEwin and Richard McNally, 2014). Whether market conditions are favourable or difficult is determined by consumption scales and demand growth rates (Michael E.Porter, 2012).
H_4: Direct inputs have a positive impact on the development of shrimp farming.

Investment capital
According to the research by Nguyen Van Long and Huynh Van Hien (2015), intensive white leg shrimp farming in Ca Mau costs nearly VND 400 million/ha/crop (Long Van Nguyen and Hien Van Huynh, 2015), and intensive black tiger shrimp farming was nearly VND 500 million/ha/crop (Long Van Nguyen, 2016). The capital affects reproduction when facing risks or the development of a highly effective model that requires more capital. This confirms the important role of capital in shrimp farming development (Hoa TTT, Zwart MP, Phuong NT, Vlak JM, de Jong MCM, 2011).
H_5: Market conditions have a positive impact on the development of shrimp farming.

Natural condition
Shrimps farmed in Vietnam have difficulties penetrating tightly controlled markets like Japan and Europe due to excessive use of substances in disease treatment (Dat Nguyen Tan, 2021). Factors such as water surface area, water resources, climate, etc. all create specific characteristics for shrimp farming development. It is necessary to understand the water environment, the climate cycle, the rules of coastal tides and to master the characteristics of farming animal, etc. so as to adjust seasonality to achieve high efficiency in production (Anh, P.T.; Kroeze, C.; Bush, S.R.; Mol, A.P.J, 2010). The community of small-scale shrimp farmers is among those who are the most climate-change-sensitive in terms of economic, social and adaptive capacity (M. C. Badjeck Kam S. P., L. The and N. Tran, 2012); (Thanh Ngoc Nguyen, 2015). In the development of shrimp farming, water body plays an important role; the quality of water body is measured through the diversity of the ecosystem, the degree of openness of the water system, depth, turbidity, content of organic matter, flow rate and shoreline (Xie X.; Hualin X.; Cheng S.; Qing W. and Hua L., 2017).
H_6: Chain linkages have a positive impact on the development of shrimp farming.

Industry structure and competition
Shrimp export-related industries include shrimp supplier, seed supplier and shrimp feed supplier. The structure of the industry is shown as the link among participants within the industry; the competition is referred to as market competition (L A Wati, 2018).
The development of the shrimp industry cannot be separated from the influence and development of the international shrimp market. The position of shrimp exports from countries in the international market is affected by their ability to compete with other exporters and the condition of other exporters' considered competitors (Xie X.; Hualin X.; Cheng S.; Qing W. and Hua L., 2017).
H_7: Competition has a positive impact on the development of shrimp farming.

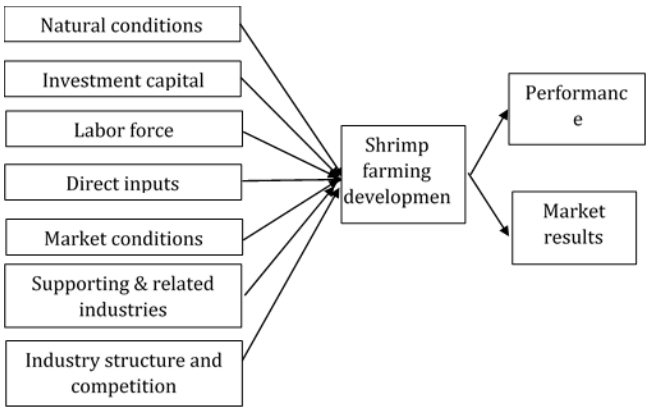


Fig 1: Research model

3. Results
3.1 Results of building a preliminary scale
Based on the concepts and scale of previous studies as well as through discussions with experts, the study object was the farmer, the observed variables were adjusted to suit the context and content to conduct the preliminary quantitive survey, as a premise for formal research.

Cronbach's alpha reliability analysis results
The results of the scale analysis of factors affecting shrimp farming development include seven factors corresponding to

34 observed variables. In which, the scale of natural conditions includes four measured variables, with Cronbach's alpha reaching 0,811, total correlation coefficient from 0,542 – 0,718> 0,3, the scale achieves reliability for the study.

For the scale of investment capital with four observed variables with Cronbach's alpha reaching 0,814, the total correlation coefficient ranging from 0,603 – 0,668> 0,3, the scale achieves reliability for the study.

The labor force scale (LFO) with six observed variables has a Cronbach's alpha coefficient of 0,813, if the observed variable LFO5 "The timely access to information" is removed, the reliability will increase to 0,848. Meanwhile, this variable is considered to be omitted in the research concept, because currently information about input prices is taken from shops/dealers and information about output prices is taken from traders/granaries. Therefore, this observed variable is removed in factor analysis. The scales have a correlation coefficient of total variables greater than 0,3, thus achieving a reliable value.

The input condition (DIN) scale with five observed variables has a Cronbach's alpha coefficient of 0,801, if the observed variable DIN5 "Local electricity price" is removed, the reliability will increase to 0,847. Considering the price of electricity is the price applied in accordance with state electricity price regulations, there is no special price for shrimp farming. Therefore, this observed variable will be removed in factor analysis. The scales have a correlation coefficient of total variables greater than 0,3, thus achieving a reliable value.

For the market condition (MCO) scale with four observed variables with Cronbach's alpha reaching 0,837, the correlation coefficient of the total variable from 0,653 to 0,678> 0,3, the scale achieves the reliability for the study.

The scale of supporting & related industries (SRI) with six measured variables has a corresponding Cronbach's alpha coefficient of 0,799 but if the observed variable SRI3 "Water supply-drainage system ensures the shrimp farming process" is removed, the reliability will increase to 0,833; however this increase is not significant. At the same time, it is recognized that in shrimp farming, water is a very important factor, so having a water treatment system in the shrimp farming process is a very necessary issue. Therefore, this observed variable remains in the factor analysis. In addition, the scales have a correlation coefficient of variables greater than 0,3, thus achieving a reliable value.

The scale of industry structure & competition (ISC) with five measured variables has a Cronbach's alpha coefficient of 0,733, but if the observed variable ISC4 "Price competition in export markets" is removed, the reliability will increase to 0,800. The issue of export prices has many determinants. The survey result will be subjective to the interviewee, thus the reliability of the scale will not be high. Hence, this observed variable will be removed in factor analysis to increase the reliability level for the scale. The scales have a correlation coefficient of total variables greater than 0,3, achieving a reliable value.

Ultimately, the influencing factors for shrimp farming development with seven component concepts are NCO, ICA, LFO, DIN, MCO, SRI and ISC, and after analyzing Cronbach's alpha, there are 31 observed variables with high reliability. The scale was further included in the EFA to assess the convergence of each component concept.

For the performance scale with four observed variables with Cronbach's alpha coefficient of 0,867, the total correlation coefficients are greater than 0,3, the scale achieves high reliability for analysis.

For the market performance scale with four observed variables with Cronbach's alpha coefficient of 0,740, the total correlation coefficients are greater than 0,3, the scale achieves high reliability for analysis.

EFA results

The final EFA results showed that seven factors were extracted, corresponding to the extraction variance of 65,322%> 60%, factor loading of variables reached 0,6 or more, Eigenvalue = 1,612 stops at seven factors, all factors achieved convergence and are consistent with the original theoretical model. However, there will be adjustments of the order of variables in the official study and they will be further tested with the greater sample informal research through CFA.

For the SFD scale: EFA results with extraction variance reached 64,133%> 60%. This result shows that the observed variables explaining the concept of shrimp farming development are higher than partial and errors. The scale is extracted into two distinct factors that characterize the two concepts of performance and market results, which is consistent with the research of Delaney *et al* (1996) and Huselid (1995). In particular, performance is expressed through information on product quality, new models, output, life changes; market results represent sales, profits, markets, and customers. Therefore, in the official study, the omnidirectional scale of business results including two component concepts of performance and market results will be further tested in CFA with a larger sample size.

3.2 Official research results

Confirmatory factors analysis-CFA

To consider the correlation of each concept in the research model, and at the same time evaluate the degree of convergence and distinction of each concept, the model that passed the CFA test includes the following components: (1) Factors affecting shrimp farming development, (2) production performance results. Analysis results:

Table 1: The results of the test of discriminant validity of the concepts in the critical model

Correlation			Correlation coefficients (r)	Standard error (SE)	Critical ratio (CR)	p_value
LFO	<-->	SRI	0,262	0,055	13,311	0,000
LFO	<-->	DIN	0,253	0,056	13,440	0,000
LFO	<-->	MCO	0,238	0,056	13,656	0,000
LFO	<-->	NCO	0,205	0,056	14,139	0,000
LFO	<-->	ICA	0,078	0,057	16,098	0,000
LFO	<-->	ISC	0,277	0,055	13,098	0,000
SRI	<-->	DIN	0,047	0,057	16,607	0,000
SRI	<-->	MCO	0,173	0,057	14,616	0,000

SRI	<-->	NCO	0,175	0,057	14,586	0,000
SRI	<-->	NGV	0,033	0,057	16,842	0,000
SRI	<-->	ISC	0,504	0,050	9,996	0,000
DIN	<-->	MCO	0,208	0,056	14,095	0,000
DIN	<-->	NCO	0,136	0,057	15,181	0,000
DIN	<-->	ICA	0,026	0,057	16,960	0,000
DIN	<-->	ISC	0,020	0,057	17,062	0,000
MCO	<-->	NCO	0,163	0,057	14,767	0,000
MCO	<-->	ICA	0,119	0,057	15,445	0,000
MCO	<-->	ISC	0,132	0,057	15,243	0,000
NCO	<-->	ICA	0,042	0,057	16,691	0,000
NCO	<-->	ISC	0,121	0,057	15,414	0,000
ICA	<-->	ISC	0,095	0,057	15,825	0,000
LFO	<-->	SFD	0,411	0,052	11,246	0,000
SRI	<-->	SFD	0,519	0,049	9,795	0,000
DIN	<-->	SFD	0,268	0,055	13,226	0,000
MCO	<-->	SFD	0,359	0,054	11,955	0,000
NCO	<-->	SFD	0,328	0,054	12,382	0,000
ICA	<-->	SFD	0,221	0,056	13,904	0,000
ISC	<-->	SFD	0,550	0,048	9,379	0,000

***Source**:* Calculated by authors

The model through CFA testing includes the following components: (1) Factors affecting shrimp farming development, (2) production performance. Analysis results: *Unidirectional:* chi-square indicators = 930,585, df = 635, P = 0,000, Chi-square/df = 1,465 < 3 and GFI = 0,865, TLI = 0,931, CFI = 0,937, RMSEA = 0,039 ≤ 0,08. So the data is considered to be suitable for the market.

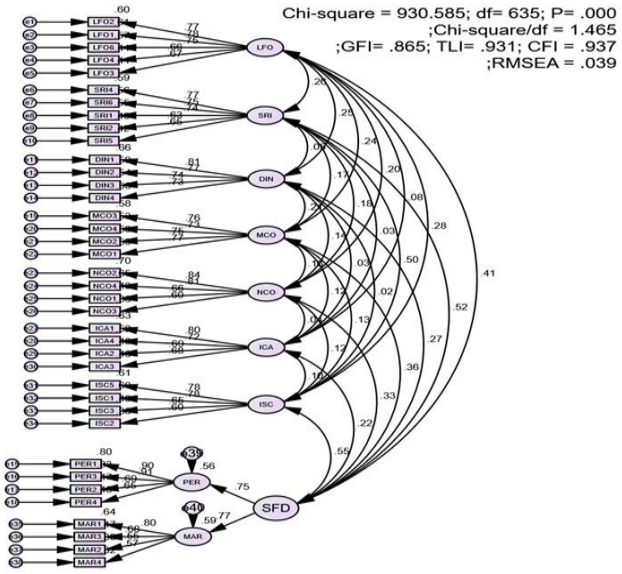
The results of testing discriminant validity of concepts in the critical model (Table 1) show that all correlations between concepts have standard deviations that are significant at 5% (P < 0.05), the correlation between each concept has a different value of 1. Therefore, it is concluded that the concepts in the critical model all have discriminant validity.

Through CFA analysis, together with testing the reliability, extracted variance and discriminant of the concepts in the theoretical model, it shows that the scale of each concept in the research model is unidirectional and has a consistent value. In addition, the combined reliability and extracted variance of the scale are both valid and highly reliable. Therefore, the original theoretical model ensures the appropriateness to include in the estimation test.

Table 2: Total reliability and extracted variance

Factor	CR	AVE
ISC	0,800	0,502
LFO	0,849	0,531
SRI	0,834	0,503
DIN	0,848	0,582
MCO	0,838	0,565
NCO	0,820	0,537
ICA	0,815	0,525
SFD	0,729	0,574

***Source**:* Calculated by authors



Source: Analysis of the author

Fig 2: Results of CFA model in research

Via CFA and the checking of reliability, variance extracted and the confirmation of the concepts in the theoretical model, it can be concluded that the scale of each concept in the research model is unidirectional, convergent and confirmatory. Therefore, the initial theoretical model guarantees the suitability for inclusion in the estimation test.

The results of the CFA demonstrate that the shrimp farming development factors in the model are tier 2 factors built from its two components, PER and MAR. So with nine groups of factors measured by 38 indicators, after CFA it shows that the scale is appropriate and usable for SEM analysis.*Structural equation modeling (SEM)*

SEM results of the standardized theoretical model show that Chi-square = 930,585, degrees of freedom df = 635, Chi-square/df = 1,465 <3, TLI = 0,931, CFI = 0,937 ≥ 0,9 and RMSEA = 0,039 < 0,08. The above values are satisfactory. Thus, the model reached a level consistent with data collected from the market.

The standardized estimation results (Table 3) show that the relationships between the factors in the model are statistically significant (p_value < 0.05), except for the labor factor with p_value > 0.05. Run SEM for the second time, the results are shown in Figure 3.

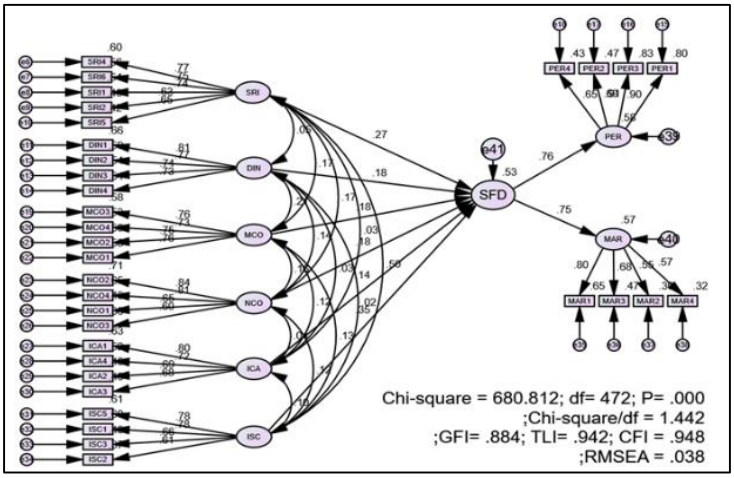
Table 3: Estimation theoretical models results (standardized)

Relationship			Maximum Likelihood (ML)	Standard Error (SE)	Critical Ratio (CR)	p_value	Conclusion
SFD		LFO	0,122	0,068	1,798	0,072	Reject
SFD		SRI	0,227	0,075	3,029	0,002	Accept
SFD		DIN	0,111	0,049	2,271	0,023	Accept
SFD		MCO	0,169	0,071	2,376	0,017	Accept
SFD		NCO	0,174	0,072	2,427	0,015	Accept
SFD		ICA	0,088	0,041	2,133	0,033	Accept
SFD		ISC	0,290	0,075	3,895	***	Accept
PER		SFD	1,000				Accept
MAR		SFD	0,990	0,127	7,829	***	Accept

Source: Summary from authors' analysis

When removing the labor factor from the model due to a lack of statistical significance, we see that the general evaluation indexes of the model such as Chi-square = 680,812, degrees of freedom df = 472, Chi-square/df = 1.442 < 3, TLI = 0.942, CFI = 0.948 ≥ 0.9 and RMSEA = 0.038 < 0.08 are still good. The correlation coefficients in the model have a positive sign and are statistically significant at the 0.05 level because the coefficients p < 0.05.

The labor factor has appeared in many previous studies evaluating the importance of shrimp farming. According to farmers' opinion, the main labor force in the study area are family unites including men, women, the elderly (over working age), and young children (under working age) who can participate in all areas of shrimp farming activities from land preparation to harvesting at different contribution degrees. It is also gathered that the success or failure of shrimp farming does not affect the labor factor. The previous crop of shrimp can provide them with experience for the next crop and they can learn from that as well as from each other. The data and research results of the thesis show that the labor factor has not yet affected rural development; this is also the difference between the thesis and previous studies, and it provides an open direction for future research.



Source: Authors' analysis

Fig 3: 2nd SEM Result

Bootstrap test

Bootstrap analytical results (N= 600) show that the absolute value of CR in the relationship between concepts is small (|CR | ≤ 2). Therefore, it is possible to conclude that the estimates in the theoretical research model are reliable. This method proves that the theoretical model can be trusted in a larger sample.

Table 4: Bootstrap test with N = 600

Relationship			Estimation	SE	SE- SE	Mean	Bias	SE- Bias	CR
NT	<---	PTR	0,227	0,091	0,003	0,264	-0,003	0,004	-0,75
NT	<---	DDV	0,111	0,069	0,002	0,186	0,002	0,003	0,67
NT	<---	TTR	0,169	0,073	0,002	0,173	-0,007	0,003	-2,33

NT	<---	TNH	0,174	0,072	0,002	0,179	0,001	0,003	0,33
NT	<---	NGV	0,088	0,071	0,002	0,149	0,005	0,003	1,67
NT	<---	CTR	0,290	0,098	0,003	0,354	0,003	0,004	0,75
PHS	<---	NT	1,000	0,062	0,002	0,764	0,004	0,003	1,33
PKQ	<---	NT	0,990	0,062	0,002	0,750	-0,004	0,003	-1,33

SE-SE: Standard error of standard error
Mean: of Bootstrap estimations
Bias = Mean – Estimate, SE-Bias: Standard error of bias
CR (Critical ratio) = Bias/SE-Bias

Source: Authors' analysis

Discussion

Table 5: Summary of hypothesis testing results

Hypothesis	Statement	Conclusion
H1	*Natural conditions have a positive impact on the development of shrimp farming*	Accept
H2	*Investment capital has a positive impact on the development of shrimp farming,*	Accept
H3	*The labor force has a positive impact on the development of shrimp farming*	Reject
H4	*Direct inputs have a positive impact on the development of shrimp farming*	Accept
H5	*Market conditions have a positive impact on the development of shrimp farming*	Accept
H6	*Chain linkages have a positive impact on the development of shrimp farming*	Accept
H7	*Competition has a positive impact on the development of shrimp farming*	Accept

***Source*:** Summarized by authors

The summary of hypotheses shows that in seven hypotheses there are six accepted hypotheses (H1, H2, H4, H5, H6, H7) and one unacceptable hypothesis (H3).

Estimated results: the correlation values are positive hence the level of impact on shrimp farming development of the factor groups is positive, being ascendingly ordered as follows: Investment capital (0,141) followed by the input condition (0,156) then the natural condition (0,163) the market condition (0,161) the supporting and related industry conditions (0,224); and the strongest impact is industry structure and competitiveness (0,330) with 95% confidence.

With industry structure and competition factor

The criterion of quality of shrimp products (without impurities, antibiotics,...) competition in foreign markets (0,782) has the most important role in the development of shrimp farming. On the other hand, according to the overall assessment, shrimp quality in the study area is currently at the strongest stage because its mean value (3,33) is the highest. At the same time, the criteria among the farmers with a reasonable link (0,775) were also appreciated by the farmers (mean 3,33> 3).

The criterion of Collaborating with the consumer to ensure benefits for farmers (0,657) also significantly affects development results. In shrimp farming, consumption is very important. In the study area, shrimp consumption is mainly through intermediaries (traders or granaries); very few farmers sell directly to processing enterprises. However, the process of direct sale of shrimp from the farmers is also very easy: traders can buy at the location and even support the harvest of shrimp for farmers. This is also an important criterion because of the mean value (3,30> 3).

The criterion of Collaborating with suppliers to provide materials to ensure benefits for farmers (0,606) ranked fourth in terms of importance, according to the authors' survey. This connection occurred in the study area, which was provided by food stores/agents providing food in postpaid purchase methods until the end of that season. Types of supplies provided include food, medicine, and chemicals. According to farmers, this connection now benefits farmers mean (3,25> 3).

In addition, the transport and irrigation systems have been invested in but not guaranteed for concentrated farming areas. Besides, due to the lack of synchronous association in production, people have to buy prawn seed, feed, aquatic veterinary medicine, etc. at high prices causing investment costs to increase.

With supporting and related industries

The criterion power supply system sufficient for shrimp farming (0,773) is the most important criterion. In intensive shrimp farming, electricity is an essential element for farmers during the farming process and has a mean value (3,43> 3).

The criterion System of specialized agencies (Companies, drug stores, aquatic food) have a good supporting in the disease prevention for development (0,745) ranked second in terms of importance with a mean (3,37> 3). The disease problem in shrimp farming is always a concern of farmers because this factor affects greatly the profit.

The criterion development of aquatic product processing/preliminary processing plants is favourable for shrimp farming development (0,738) has a mean of (3,41> 3). Processing plant system is an important factor since most shrimp products are for export.

The criterion consumption system includes farmers - traders/granaries - processing plants promoting development (0,631) has a mean value of (3,39> 3). According to the general assessment, the selling price in the past had many unusual fluctuations.

The criterion Monitoring system provides timely and accurate information for shrimp farmers (0,647) has mean values of (3,43> 3). In shrimp farming it is very important to control the water environment for salinity, pH, alum, etc. This is a factor leading to disease outbreaks.

With market condition

According to Michael E. Porter, in the industry, the more stringent market conditions are, the more it will cause the industry to change for the better, and the relationship between market conditions and industry development will be more

negative. In this study, market conditions are positively correlated with shrimp farming development, or in other words, favourable market conditions will help better shrimp farming.

Market factors have the third position on the influence continuum (0,1166), with the importance of the four indicators indicated in the following order: MCO3: Prices in recent years have been favourable for the development of shrimp farming (0,762), MCO1: The consumption level of domestic shrimp products has increased over the years (0,761), MCO2: Prices have been favourable for the development of shrimp farming (0,775), MCO4: Consumers demand higher and higher of products' quality (0,727).

Thus, export to international market is the most important factor, because most of the products from aquaculture are used for export. Their mean value is 3,27; 3,30; 3,36 and 3,39 indicating that the provincial demand for shrimp products is increasing.

With natural conditions

The correlation coefficient of natural conditions is 0,163 which is the fourth important factor positively affecting the development of shrimp farming. Aquaculture in general and shrimp farming in particular depend greatly on natural conditions, with each indicator on this descending level of impact: weather, favorable climate for development (0,843), wether the water source condition is suitable for development (salinity, PH, alum...) (0,806), wether the geographical location is suitable for development (0,665), and wether the water surface area is favourable for development (0,599).

According to farmers' assessment, the weather of Tra Vinh province in recent years has changed, causing a fluctuation in pond environment, which caused the development of diseases such as white spot disease, hepatopancreatic necrosis, white feces on black tiger shrimp and white leg shrimp. Water condition: most shrimp farming activities in Tra Vinh are intensive and semi-intensive farming but there is no separate water supply and drainage system, so the wastewater were not managed before being discharged into the environment, making water quality worse.

Geographical location: Tra Vinh is a coastal province in the Mekong Delta region with a total natural area of 2.288,09 km2. The province is located between two large rivers Co Chien and Hau, bordering the East Sea (length 65 km) on one side, and with two important estuaries: Cung Hau and Dinh An. Tra Vinh has a system of interlaced rivers, canals, ditches with total length of 578 km, and the natural catchment area is 21.265 ha.

About water surface area: In Tra Vinh, people continue to invest in expanding the area for super-intensive farming of white leg shrimps. Many white leg shrimp farms are practising intensive and have implemented extensive changes into intensive farming.

With direct inputs

With the direct input group there are four remaining elements and in each element, the importance level of each criterion is also different as follows: DIN1: Quality of feed, biological products, veterinary medicine (0,812); DIN2: Reasonable price of industrial feed (0,769); DIN3: Establishments that have provided quality breeds and had quarantine certificates (0,737); DIN4: Price of seed at an appropriate level (0,734).

We can see that criteria Food quality, probiotics, veterinary drugs have the most important role in the development of shrimp farming. The criterion of industrial feed price and seed price significantly affected the production results. The price of industrial feed accounts for a high proportion in the total farming cost, but their prices are currently at a high level, resulting in increased production costs affecting production efficiency. The price of shrimp seed ranges from 80-110 VND/unit (shrimp) depending on the supply source which are mostly from outside of the province. The price of black tiger shrimp varies from 100 to 130 VND/unit (shrimp) which is very high, causing burdens on farmers. Moreover, the breeds supply must be sure to have quarantine certificates, which facilitates the prevention of prawn disease.

According to the general assessment, the direct input factors with remain criteria has a mean > 3.

With investment capital

In very large scale shrimp farming, especially intensive and super-intensive farming, the lack of investment is common, which has caused significant difficulties for rural development in the province with four criteria retained with the importance level as follows: ICA1: The capital is sufficient when there is a need to increase the farming area/change the farming model (0,796); ICA4: The modernization of machinery and equipment meets the development requirements (0,725); ICA2: Quick access to loan capital (0,691); ICA3: Interest rate suitable for development requirements (0,682).

Thus a banking system with low-interest rates is a good choice for farmers and the accessibility to this capital source is also relatively convenient, easy and fast. However, the farming of white shrimp is greatly risky, putting risk pressure on the bank in the ability to recover debts.

Solutions to promote the developing of shrimp farming

Promote planning and management of planning

Reorganizing shrimp farming areas, especially for key farming areas in the direction of creating a close, harmonious link between farmers and processing enterprises.

Group of solutions to improve production technology

In order to deploy the planning: investing in upgrading the irrigation infrastructure and key traffic, as well as three-phase electricity sources in concentrated industrial shrimp production areas; improving farming techniques for farmers; improving the application of science and technology; improving the organizing of production.

Group of solutions to promote restructuring shrimp farming

Attaining the goal of developing shrimp farming model towards high-tech agriculture, selecting animals suitable to the characteristics of each region.

Group of solutions to develop services for shrimp farming

Increasing the percentage of farming areas using quality breeds; supplying quality food, medicine and preparations; improving the accessibility to bank loans; stabilizing the current market and expanding potential markets; strengthening vertical linkages; building a sense of responsibility associated with the benefits of the people involved.

Group of solutions to increase production results and efficiency in shrimp farming

(1) Upgrading the system of ponds and design to ensure the eligibility to adopt Vietgap standard, and improving the system of infrastructure serving shrimp farming; (2) expanding shrimp farming areas on land and on water; (3) aiming to provide sufficient capital for the shrimp breeders to strengthen the official loan source and concessional capital source to reduce the burden of borrowing; (4) stabilizing supply and improving seed quality to reduce loss rate; (5) balancing both the diet for more streamline shrimp quality, stabilizing food supply source to reduce input costs; (6) performing disease prevention and implementing more effective care.

Conclusion

The development of shrimp farming is influenced by many factors. This study concluded according to the theory of Michael E. Porter that the shrimp industry in Viet Nam, in particular the Tra Vinh case, can be classified as "good". At the same time, this study also consulted previous studies on factors affecting shrimp farming development and identified seven factors affecting the development of shrimp farming through estimations and testing. The study assessed all factors affecting shrimp farming development, and the test results show that there are six groups of factors positively affecting the development of shrimp farming in Tra Vinh province. There is no basis to prove the relationship between labor factors and shrimp farming development, but according to the people's assessment, the local labor situation is favourable, visible through: abundant labor force, cheap labor price, and how general qualifications all meet requirements. The labor factor does play a role in the development of shrimp farming, but in this study the indicator is not reliable, hence this factor is removed. A larger sample size for research, such as regional or national, is needed to assess the impact of this factor. The research results are consistent with the study of factors affecting the development of shrimp farming in Indonesia by LA Wati.

Based on the results of Porter's econometric and diamond analysis, the fisheries sector needs to adopt marketing strategies and develop industry structure, as well as to take advantage of related industries and of major shrimp exporters in the world.

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