

## VALUE CHAIN ANALYSIS AND FACTORS AFFECTING THE ECONOMIC EFFICIENCY OF SHRIMP FARMING IN CA MAU

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ARTICLE INFO	ABSTRACT
<p><i>Received:</i> 12/01/2026</p> <p><i>Revised:</i> 27/01/2026</p> <p><i>Published:</i> 28/02/2026</p> <hr/> <p><b>KEYWORDS</b></p> <p><i>Shrimp farming;</i> <i>Value chain;</i> <i>Economic efficiency;</i> <i>Multiple regression;</i> <i>Ca Mau.</i></p>	<p>This study analyzes the value chain and factors affecting the economic efficiency of shrimp farming in Ca Mau, based on a survey of 120 stakeholders including farmers, traders, purchasing agents, and processing enterprises (from November 2025 to February 2026). The results show that added value is mainly concentrated in the farming and processing stages, while linkages between stakeholders remain limited. The multivariate regression model indicates that farmer experience and production area have a positive impact, while feed and seed costs negatively affect profitability. Average profit reached VND 34 million/ha/crop. The study proposes technical improvements, scale optimization, and strengthening of value chain linkages to enhance efficiency and ensure sustainable development of the local shrimp farming industry.</p>

### 1. INTRODUCTION

Aquaculture has increasingly become a key economic sector in many coastal countries worldwide. According to [1], global aquaculture production reached over 122 million tons, of which farmed shrimp accounted for approximately 5 million tons, contributing significantly to exports and livelihoods.

In Vietnam, the shrimp industry is a major export commodity, with a farming area of about 740,000 hectares, production exceeding 1 million tons, and export value surpassing USD 4.3 billion [2]. In Ca Mau province, shrimp farming covers approximately 280,000 hectares, with an annual output of nearly 220,000 tons, playing a crucial role in local economic development [3].

However, the economic efficiency of farming households is still affected by input costs, disease outbreaks, and market fluctuations. A study by [4] indicates that feed costs have a substantial impact on profitability, while experience, technical capacity, and production scale positively influence farming efficiency [5].

In this context, value chain analysis is an important tool for assessing value distribution and linkages among stakeholders [6]. Therefore, this study aims to analyze the shrimp value chain and identify factors affecting the profitability of shrimp farming households in Ca Mau province, thereby proposing policy implications to enhance economic efficiency and promote the sustainable development of the local shrimp industry.

## 2. RESEARCH OBJECTIVES

The objective of this study is to analyze the shrimp value chain in Ca Mau Province and to evaluate the factors affecting the profitability of shrimp farming households. Specifically, the study focuses on:

- (1) Analyzing the value chain structure and the roles of actors involved in shrimp production and marketing;
- (2) Assessing costs, revenues, and value added of actors within the chain;
- (3) Identifying factors influencing farmers' profitability using a regression model;
- (4) Proposing policy implications to enhance economic efficiency and promote the sustainable development of the local shrimp industry.

## 3. RESEARCH METHODOLOGY

### 3.1. Study area

The study was conducted in major shrimp farming areas of Ca Mau Province, including Dam Doi, Cai Nuoc, Nam Can, Phu Tan, Vinh Phuoc, Hong Dan, Hoa Binh, and Dong Hai. These locations are characterized by diverse shrimp farming systems such as extensive, rice-shrimp, mangrove-shrimp, and intensive farming models. The selection of these areas ensures representativeness of the shrimp value chain from production to consumption.

### 3.2. Data collection

The study employs both secondary and primary data. Secondary data were compiled from industry reports, statistical yearbooks, and relevant studies. Primary data were collected through structured questionnaires administered to value chain actors. A total of 120 observations were surveyed from November 2025 to February 2026, including 80 farming households, 20 traders, 10 collectors, and 10 processing enterprises.

The survey focused on costs, revenues, profits, and linkages among actors.

### 3.3. Analytical methods

The economic efficiency of shrimp farming households was evaluated using cost-profit analysis, with the following formula:

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost}$$

Where Total Revenue represents income from product sales, and Total Cost includes expenditures on breeding stock, feed, labor, and other inputs.

Value chain analysis was applied following the approach of [6] to identify key actors, product flows, information flows, and the distribution of value added along the chain.

### 3.4. Regression model

The study uses a multiple linear regression (OLS) model to determine the factors affecting shrimp farming profits:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

Where: Y: Profit (million VND/ha); X<sub>1</sub>: Farming experience (years); X<sub>2</sub>: Farming area (ha); X<sub>3</sub>: Feed cost (million VND/ha); X<sub>4</sub>: Breeding stock cost (million VND/ha); ε: Random error.

The model’s reliability was tested using the Variance Inflation Factor (VIF), indicating no multicollinearity. The error term  $\epsilon$  is assumed to have zero and constant variance.

**3.5. Value chain analytical framework**

The value chain framework is developed based on the approach of [6], including: (i) identification of actors; (ii) analysis of product flows; (iii) assessment of costs, revenues, and profits; and (iv) evaluation of value-added distribution among actors.

The analytical results provide a basis for clarifying the roles of each actor and proposing solutions to improve economic efficiency and strengthen linkages within the shrimp value chain.

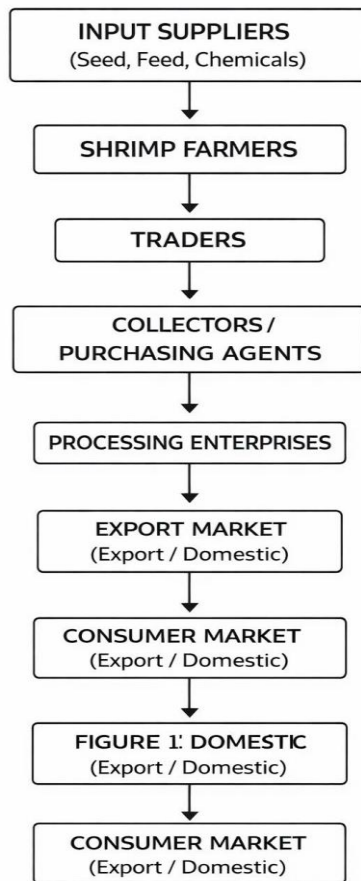


Figure 1: Shrimp Value Chain

**4. RESEARCH RESULTS**

**4.1 Characteristics of shrimp farming households**

The socio-economic characteristics of shrimp farming households are presented in Table 1 as follows:

**Table 1. Socio-economic characteristics of shrimp farming households**

Indicator	Mean value
Age of household head (years)	47
Farming experience (years)	12
Farming area (ha)	1.8
Labor per household	3.2

Source: Author’s survey, 2026.

The survey results indicate that shrimp farming household heads have an average age of 47 years, reflecting a middle-aged labor group with relatively stable experience and production resources. This finding is consistent with [5], where the age of household heads in the Mekong Delta ranges from 45 to 50 years.

The average farming experience is 12 years, suggesting that shrimp farming has been maintained over the long term and plays an important role in household livelihoods. According to [7], production experience is a key factor in improving efficiency by enhancing management capacity and reducing risks.

The average farming area is 1.8 ha per household, which is higher than the approximately 1.5 ha per household reported in [4], indicating a trend toward expansion of production scale in the locality.

The average labor force is 3.2 workers per household, mainly consisting of family labor, which helps reduce costs and improve economic efficiency. However, in the context of increasing technological adoption, the technical skill requirements for labor are becoming more important.

Overall, the results show that shrimp farming households in Ca Mau are characterized by relatively high experience, medium-scale production, and strong reliance on family labor, providing a favorable foundation for improving efficiency and promoting sustainable development.

#### 4.2 Cost structure analysis of shrimp production

The cost structure of shrimp farming households is presented in Table 2 as follows:

**Table 2. Cost structure of shrimp farming**

Cost Item	Cost (million VND/ha)	Ratio (%)
Feed	27	42
Breeding stock	14	21
Labor	9	14
Medicine	7	11.5
Others	7	11.5
<b>Total</b>	<b>64</b>	<b>100</b>

*Source: Author's survey, 2026.*

The results in Table 2 show that the average total cost of shrimp farming is approximately 64 million VND/ha per crop. Among these, feed cost accounts for the largest share at 27 million VND/ha (42%), confirming that it is the most influential factor affecting farmers' economic efficiency. This finding is consistent with [4], where feed costs account for about 40-50% of total shrimp farming costs in the Mekong Delta. According to [7], feed is typically the largest expense due to the high nutritional requirements during shrimp growth.

Breeding stock cost ranks second at 14 million VND/ha (21%), directly affecting survival rates and productivity, but also posing risks if breeding stock quality is not ensured. Labor cost accounts for 9 million VND/ha (14%), relatively low because households mainly rely on family labor.

In addition, medicine and chemical costs account for about 11.5%, used for environmental treatment and disease prevention. Other costs also represent a similar proportion (11.5%).

In summary, the cost structure indicates that shrimp farming in Ca Mau is highly dependent on input factors, particularly feed and breeding stock. Therefore, controlling these costs is crucial for improving economic efficiency and reducing production risks.

#### 4.3 Economic efficiency analysis of shrimp farming

The economic performance of shrimp farming households in Ca Mau is presented in Table 3 as follows:

**Table 3. Economic efficiency of shrimp farming households**

Indicator	Value
Yield (kg/ha)	520
Price (thousand VND/kg)	190
Revenue (million VND/ha)	98
Cost (million VND/ha)	64
Profit (million VND/ha)	34

*Source: Author's survey, 2026.*

The results in Table 3 show that the average shrimp yield reaches approximately 520 kg/ha per crop. With an average selling price of 190 thousand VND/kg, the average revenue of farming households is about 98 million VND/ha.

After deducting production costs of around 64 million VND/ha, the average profit reaches 34 million VND/ha per crop. This level of profit indicates that shrimp farming remains a relatively profitable economic activity for households in Ca Mau.

This finding is consistent with [5], where the average profit of shrimp farming households in the Mekong Delta ranges from 30 to 40 million VND/ha per crop.

However, the economic efficiency of shrimp farming still largely depends on factors such as market prices, shrimp survival rates, and input costs.

#### 4.4 Comparison of productivity among farming models

The comparison of productivity among shrimp farming models in the study area is presented in Table 4 as follows:

**Table 4. Productivity of different farming models**

Farming Model	Productivity (kg/ha/crop)
Extensive	410
Improved Extensive	520
Rice-Shrimp	470

*Source: Author's survey, 2026.*

The survey results indicate significant differences in productivity across farming models. The improved extensive model achieves the highest productivity at 520 kg/ha/crop, followed by the rice-shrimp model (470 kg/ha/crop), while traditional extensive farming has the lowest productivity (410 kg/ha/crop).

Compared to traditional extensive farming, the improved extensive model shows a productivity increase of approximately 26.8%, reflecting the effectiveness of applying technical measures such as improved seed, environmental management, and supplemental feeding. This is consistent with [7], which reports that technical advancements can increase productivity by 20-30%.

The rice-shrimp model achieves about 14.6% higher productivity than traditional extensive farming, consistent with [5] (ranging 400-500 kg/ha/crop). However, due to lower stocking density, its productivity remains lower than the improved extensive model.

Differences in productivity also reflect the level of investment and technical access of farmers, aligning with the value chain approach described in [6]. Overall, the improved extensive model has the highest productivity, while the rice-shrimp model offers advantages in stability and sustainability. The choice of model should be aligned with natural conditions, available resources, and farmers' development goals in Ca Mau.

#### 4.5 Value chain analysis

The shrimp value chain in Ca Mau is shown in Table 5 as follows:

**Table 5. Shrimp marketing channels**

Marketing Channel	Ratio (%)
Farmer → Trader → Processing enterprise	65
Farmer → Collector/Agent	22
Farmer → Cooperative	13

*Source: Author's survey, 2026.*

Data shows that up to 65% of shrimp production from farming households is consumed through traders. This is the most common marketing channel due to its flexibility and rapid procurement. However, overreliance on traders may reduce farmers' bargaining power. According to [6], dependence on intermediaries in the value chain often results in lower profits for producers compared to actors in processing and distribution.

In addition, the consumption rate through cooperatives only accounts for 13%, indicating that the level of production linkage between farmers and collective economic organizations is still limited. Strengthening the role of cooperatives in the value chain is considered an important solution to improve competitiveness and income for farmers.

#### 4.6 Profit analysis of value chain actors

The profit distribution among shrimp value chain actors in Ca Mau is shown in Table 6 as follows:

**Table 6. Profit analysis among value chain actors**

Actor	Profit (thousand VND/kg)
Farmer	80
Trader	25
Collector/Agent	25
Processing enterprise	70

*Source: Author's survey, 2026.*

The analysis results from Table 6 show that profits in the local shrimp value chain are unevenly distributed among the actors. Farmers achieved the highest profit level with

approximately 80,000 VND/kg, followed by processing enterprises with approximately 70,000 VND/kg, while traders and purchasing agents only achieved about 25,000 VND/kg.

This result reflects the important role of farmers in creating initial value, and also shows that processing contributes significantly to increasing product value through sorting, preservation, and market access. This is consistent with the observation of [1], when most of the added value of aquatic products is formed in post-harvest stages.

However, it should be noted that these profit levels are formed at different transaction levels and product streams in the chain, therefore they do not have a direct summative meaning per single product unit. The indicators in the table reflect the profit margin at each stage, not the total accumulated profit of the entire chain.

Although traders and agents have lower profit margins, they play an important intermediary role in connecting the market. However, dependence on these agents can reduce the price negotiation ability of farmers, consistent with the results of [4].

Therefore, strengthening the linkage between farmers and processing enterprises through cooperatives or forward contracts is considered an important solution to improve efficiency and benefit distribution in the value chain [6].

#### 4.7 Production scale and profitability

The analysis of production efficiency by scale of shrimp farming households in Ca Mau is shown in Table 7 as follows:

**Table 7. Profitability by farm size**

Scale	Profit (million VND/ha)
< 1 ha	27
1-2 ha	34
> 2 ha	39

*Source: Author's survey, 2026.*

The results from Table 7 show that households with large-scale production generally achieve higher profits than households with small-scale production.

Households with an area larger than 2 ha achieved an average profit of 39 million VND/ha, about 44% higher than households with an area under 1 ha.

This shows that economies of scale exist in shrimp farming. Households with large-scale production usually have better infrastructure investment conditions and apply more effective technical measures.

This result is consistent with the research of [7], in which production scale is considered an important factor affecting the economic efficiency of aquaculture activities.

#### 4.8 Regression model results

The regression analysis results are shown in Table 8. The regression results show that the model has a fairly good fit with the data in Ca Mau. The multiple correlation coefficient  $R = 0.787$  reflects a relatively strong relationship between the independent variables and the profit of the farming households. The coefficient of determination  $R^2 = 0.620$  shows that about 62% of the variation in profit is explained by the variables in the model.

**Table 8. Model summary**

Indicator	Value
R	0.787
R <sup>2</sup>	0.620
Adjusted R <sup>2</sup>	0.598
Std. Error	5.21

*Source: Author's survey, 2026.*

The adjusted  $R^2 = 0.598$  value does not differ much from  $R^2$ , indicating that the model does not include redundant variables. The standard error of 5.21 shows that the forecasting error is at an acceptable level. However, about 38% of the variation is not explained, implying that other factors such as environment, market price and farming techniques still exist, consistent with the findings of [7].

This result is similar to the study of [5], when analyzing the economic efficiency of shrimp farming models in the Mekong Delta region. This study also shows that regression models on the economic efficiency of shrimp farming typically have coefficients of determination ranging from 0.55 to 0.65, indicating that technical and economic factors are likely to explain much of the variation in household profitability.

#### 4.9 Regression model fit test

The goodness of fit of the regression model is shown in Table 9:

**Table 9. ANOVA results for regression model**

Source	Sum of squares	df	Mean square	F	Sig.
Regression	482.3	4	120.6	18.72	0.000
Residual	295.1	115	2.57		
Total	777.4	119			

*Source: Author's survey, 2026.*

Analysis of variance (ANOVA) results were used to test the overall fit of the regression model. The results in Table 9 show an F value of 18.72 with a significance level of Sig. = 0.000 ( $< 0.01$ ), indicating that the regression model is statistically significant at the 99% confidence level. This suggests that the independent variables included in the model influence the profitability of shrimp farmers in Ca Mau.

The total variance of the dependent variable is shown as Total Sum of squares = 777.4, of which the variance explained by the model (Regression sum of squares) is 482.3, representing a significant proportion. This indicates that the model is capable of effectively explaining the variability in profitability.

The residual sum of squares is 295.1, reflecting the existence of factors outside the model, such as market price fluctuations, farming environment conditions, and the management level of the farming households.

The ANOVA test results in this study are similar to the study of [5], which, when analyzing factors affecting the economic efficiency of shrimp farming models in the Mekong Delta, also showed that the regression models had Sig.  $< 0.05$  values, proving that the model is statistically significant and suitable for analyzing factors affecting the profitability of farming households.

#### 4.10 Factors affecting farmers' profitability

The analysis of factors affecting the profitability of shrimp farmers in Ca Mau is shown in Table 10 as follows:

**Table 10. Regression results of factors affecting shrimp farm profit**

Variable	Coefficient (B)	Std. Error	t	Sig.
Constant	12.45	4.12	3.02	0.004***
Farming experience	0.32	0.11	2.91	0.006***
Farm area	0.28	0.09	3.10	0.003***
Feed cost	-0.41	0.12	-3.38	0.002***
Breeding stock cost	-0.21	0.10	-2.05	0.045**

Note: \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$

Source: Author's survey, 2026.

The regression results indicate a statistically significant model. The estimated regression equation is:

$$\text{Profit} = 12.45 + 0.32\text{Experience} + 0.28\text{Area} - 0.41\text{Feed Cost} - 0.21\text{Breeding stock Cost}$$

Farming experience and farm area have a positive effect on profit, whereas feed and breeding stock costs have a negative impact. Feed cost is the most influential factor ( $B = -0.41$ ;  $p < 0.01$ ), reflecting the dominant role of input costs in production efficiency [1].

Experience improves technical management, disease control, and optimal input use, enhancing economic efficiency. Larger farm area also positively affects profit due to economies of scale, allowing more efficient cost allocation and adoption of technical advancements, consistent with [4,5].

Conversely, higher feed and breeding stock costs negatively affect profitability. Breeding stock cost ( $B = -0.21$ ;  $p < 0.05$ ) reflects that increasing input costs without improving quality reduces efficiency, highlighting variability in breeding stock quality on the market [5,9].

Relating to the value chain (Table 6), farmers' profits depend not only on production efficiency but also on the distribution of value among actors. While farmers and processing enterprises capture large shares of profit, intermediaries influence market access and pricing [4].

In summary, improving economic efficiency requires: (i) controlling input costs, particularly feed and seed, and (ii) strengthening value chain linkages, especially between farmers and processing enterprises, to improve bargaining power and fair benefit distribution [6].

#### 4.11 Discussion of results

Shrimp farmers' profits in Ca Mau are influenced by both intrinsic factors and value chain structure. Feed cost has the strongest negative impact on profit, reflecting the high-cost nature of aquaculture, consistent with prior studies [1].

Positive effects of experience and farm area highlight the importance of technical capacity and scale in improving efficiency. Experience improves pond management, disease control, and input optimization, while larger farms benefit from economies of scale, consistent with [4,5].

Despite relatively high profits, regression results show instability due to strong sensitivity to input cost fluctuations, reflecting the “value chain paradox,” where primary producers face the highest risk [6].

Processing enterprises capture significant profits, indicating value addition occurs mainly post-production via processing, preservation, and market access, consistent with trends in agricultural and aquaculture value chains [5].

Although traders and collectors earn lower profits, they play a crucial intermediary role. Overreliance on them can reduce farmers’ bargaining power, particularly with rising input costs [4], highlighting the need for direct linkages between farmers and processors to reduce intermediaries and enhance efficiency.

This study provides empirical evidence on the role of input costs and value chain structure in determining shrimp farming profitability in the Mekong Delta. Limitations include sample size, unobserved endogenous factors, and external variables such as market fluctuations and environmental risks. Future studies should expand scope and include additional variables to improve model reliability.

## 5. POLICY IMPLICATIONS

Based on the findings, the following policy recommendations are proposed:

- *Enhance farmers’ technical capacity:* Department of Agriculture and Environment of Ca Mau Province, in collaboration with the Provincial Extension Center for Agriculture, should regularly organize training on pond environment management, feeding techniques, and disease prevention. Demonstration farms should be established to promote best practices.

- *Promote production linkages:* Authorities should facilitate the formation of shrimp cooperatives and associations. Support the establishment of concentrated farming areas with registration and traceability codes to enable integration with processing enterprises.

- *Control input costs:* Market regulators and agricultural authorities should strengthen inspection of feed and breeding stock quality. Farmers should be encouraged to adopt proper feeding practices to reduce waste and optimize production costs.

- *Develop value chain linkages:* Encourage processing enterprises to sign product procurement contracts with farmers via cooperatives. State support in credit and incentives can promote stable production-marketing linkages.

- *Increase product value and market access:* Enterprises should invest in advanced processing technologies and develop value-added products. Local authorities should support the Ca Mau shrimp brand and adopt sustainable farming standards to expand export markets.

## 6. CONCLUSION

This study provides a comprehensive analysis of the shrimp value chain in Cà Mau, highlighting the roles and contributions of key actors, from farmers to processing enterprises. The results indicate that value-added and profits are concentrated primarily in the farming and processing stages, while linkages among actors remain limited, suggesting potential for improving economic efficiency through stronger chain integration. Multivariate regression

analysis identified key internal factors affecting farm-level profitability, including farming experience and production scale, while feed and post-larvae costs negatively impacted profits.

The study contributes empirical evidence for optimizing production scale, enhancing technical capacity, and developing stronger linkages between farmers and processing enterprises to improve economic efficiency and promote sustainable shrimp farming in the region.

However, the research has certain limitations: the sample size was relatively small, the number of variables included in the model was limited, and external factors such as market price fluctuations, survival rates, environmental conditions, and alternative farming models were not considered. Future studies should expand the dataset, incorporate additional technical and economic factors, and assess the influence of external conditions to enhance the reliability, explanatory power, and generalizability of the findings.

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