



Research Articles

Risks Management the White Leg Shrimp (*Litopenaeus Vannamei*)

Supply Chain Leam Sing District Chanthaburi Province

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Received: December 24, 2025; Revised: February 2, 2026; Accepted: February 10, 2026

Abstract

The study examined the operational process, risks, and management capacity in the white-leg shrimp (*Litopenaeus vannamei*) supply chain in Laem Sing District, Chanthaburi Province. The purpose was to analyze problems, identify potential risks, and propose appropriate risk management strategies. Data were collected from 37 stakeholders, including farmers, middlemen, and retailers, using snowball sampling. Semi-structured interviews and non-participant observation were applied to gather in-depth information about the upstream, midstream, and downstream processes. Results revealed eight types of risks and 27 related factors affecting the shrimp supply chain. The main risks included high fuel and energy costs, fluctuating prices of production inputs, volatile shrimp trading prices, reduced market demand, and increased prices of feed and medicine. Risk management capacity was analyzed through four strategies: risk reduction, risk impact reduction, risk transfer, and risk coping. Despite applying these strategies, several vulnerabilities remained, such as natural disasters, untimely delivery and communication, and policy uncertainty regarding shrimp price compensation. The findings suggest that stakeholders in Chanthaburi Province should prioritize high-impact risks and strengthen management measures to ensure greater stability, resilience, and sustainability in white-leg shrimp supply chain. Future research is recommended to expand sample groups and assess long-term risk mitigation outcomes across other aquaculture regions.

Keywords: Risk Factors, White-Leg Shrimp Supply Chain, Chanthaburi Province, Risk Management

Introduction

Thailand is a major producer of white-leg shrimp (*Litopenaeus vannamei*), which is an important part of the country's aquaculture and seafood export business. The sector generates jobs and cash for coastal towns, with the southern and eastern regions serving as the primary production zones. Chanthaburi Province remains one of the leading producers in the east, with the highest output in 2012 at 60,628 tons and the lowest in 2020 at 25,707 tons (Department of Fisheries, Ministry of Agriculture and Cooperatives, 2025). Its combination of coastal plains, mangrove forests, and hills makes it suitable for aquaculture. Laem Sing District is a key farming area due to its proximity to natural water resources. Most farmers in this area use semi-intensive or intensive systems that necessitate close monitoring of pond conditions, water quality, and feed, making them very exposed to environmental and financial threats. Disease outbreaks, price instability, and increased market competitiveness have all contributed to fluctuations in Chanthaburi shrimp production during the last decade. Epidemics such as Early Mortality Syndrome (EMS), Enterocytozoon hepatopenaei (EHP), and White Spot Disease (WSD) have resulted in significant losses, while variable feed and fuel prices, as well as the COVID-19 pandemic, have increased financial strain and disrupted supply chains. These issues have compelled some farmers to temporarily halt operations or switch to other aquaculture species such as sea bass, grouper, or mud crab. Risks exist at every stage of the white-leg shrimp supply chain: upstream farmers are affected by environmental variations and infections, middlemen face transportation delays and high energy costs, and retailers deal with price volatility, reduced demand, and storage concerns. Such interrelated risks limit efficiency and profitability, stressing the need of efficient risk management in assisting stakeholders in minimizing losses, stabilizing supply, and ensuring the sustainability of Thailand's shrimp aquaculture business.

Research of Objective

1. To study the processes and current conditions in the white-leg shrimp supply chain of Chanthaburi Province.
2. To examine the risks and the capacity for risk management within the white-leg shrimp supply-chain of Chanthaburi Province.
3. To propose guidelines for effective risk management in the white-leg shrimp supply chain of Chanthaburi Province.

Literature Review

1. Aquaculture Supply Chain and Economic Importance

The global aquaculture industry plays a critical role in food security, employment, and international trade, particularly in developing countries. In Thailand, white-leg shrimp (*Litopenaeus vannamei*) is one of the most economically significant export commodities, contributing substantially to coastal livelihoods and national income. The shrimp supply chain typically consists of upstream (farmers), midstream (collectors or middlemen), and downstream (retailers and exporters) actors, all of whom are interdependent (Department of Fisheries, 2021). Previous studies have shown that aquaculture supply chains are highly sensitive to both internal and external disruptions, including environmental variability, disease outbreaks, and market fluctuations. According to the Food and Agriculture Organization of the United Nations, aquaculture systems are increasingly exposed to complex risks due to globalization, climate change, and market integration (Pongthanapanich et al., 2019). These risks can affect productivity, profitability, and long-term sustainability.

2. Concept of Supply Chain Risk Management

Supply chain risk management (SCRM) refers to the systematic identification, assessment, and mitigation of risks that may disrupt supply chain operations. Steven Jaffee and colleagues define agricultural supply chain risk as uncertainties that can negatively affect

production, distribution, and market performance (Jaffee et al., 2010). Risks in supply chains are commonly categorized into environmental, biological, operational, market, financial, and institutional risks (Kanishkan et al., 2020; Jaffee et al., 2010). This classification aligns closely with the eight risk categories identified in this study, demonstrating consistency with existing theoretical frameworks. However, previous studies often focus on specific risk types rather than providing a comprehensive, multi-stakeholder perspective across the entire supply chain (Chalermphon Phumpuang, 2019). This represents a key gap that this research aims to address.

3. Risk in Shrimp Aquaculture Systems

Shrimp farming is particularly vulnerable to risk due to its biological and environmental sensitivity. Disease outbreaks such as Early Mortality Syndrome (EMS) and White Spot Disease (WSD) have caused significant production losses worldwide. Studies in the Mekong Delta by Olivier M. Joffre indicate that shrimp farmers often operate under high uncertainty and rely on adaptive strategies rather than formal risk management systems (Joffre et al., 2018). Similarly, research by WorldFish Center highlights that aquaculture risks are interconnected, where environmental stress can trigger disease outbreaks, which in turn affect production and market supply (Lind et al., 2015). These findings support the results of this study, where biological and environmental risks interact with economic and operational risks, creating compounded impacts. However, most previous studies focus primarily on farm-level risks (Pongthanapanich et al., 2019), whereas this study extends the analysis to include middlemen and retailers, providing a broader supply chain perspective.

4. Application of the SCOR Model in Supply Chain Analysis

The Supply Chain Operations Reference (SCOR) model, developed by APICS, is widely used to analyze supply chain processes through five key components: Plan, Source, Make, Deliver, and Return (APICS, 2017). Previous research suggests that the SCOR model is effective in identifying operational inefficiencies and risks across supply chain stages (Kanishkan et al., 2020). However, its application in aquaculture—particularly in small-scale shrimp farming

contexts—remains limited. This study contributes to the literature by applying the SCOR framework to systematically classify risks across all supply chain stages. For example:

- 1) Market demand forecasting errors relate to Plan
- 2) Input price fluctuations relate to Source
- 3) Disease outbreaks relate to Make
- 4) Transportation delays relate to Deliver

This structured approach helps reveal how risks are distributed and interconnected across the supply chain.

5. Risk Assessment and Prioritization

Risk assessment typically involves evaluating both the likelihood of occurrence and the severity of impact. According to World Bank frameworks, prioritizing high-impact and high-probability risks is essential for effective management (Jaffee et al., 2010). In agricultural supply chains, economic risks—such as price volatility and rising input costs—are often identified as the most critical. This aligns with the findings of Thongchai Pongthanapanich, who found that financial and market risks significantly influence farmers’ decision-making and investment behavior (Pongthanapanich et al., 2019). Consistent with these studies, the findings of this research show that rising fuel costs, feed price fluctuations, and shrimp price volatility are the most severe risks, indicating that economic pressures outweigh environmental risks in terms of overall impact.

6. Risk Management Strategies in Aquaculture

Risk management strategies in supply chains can be broadly categorized into risk reduction, risk impact reduction, risk transfer, and risk coping (Lind et al., 2015). In practice, farmers reduce risk by improving water quality management and disease prevention, while middlemen manage logistics risks through flexible transportation arrangements. Retailers cope with price fluctuations by adjusting purchasing strategies. However, previous studies indicate

that small-scale stakeholders often face limitations in implementing formal risk management strategies due to financial constraints, limited access to information, and policy uncertainty (Joffre et al., 2018; Pongthanapanich et al., 2019). This is consistent with the findings of this study, which reveal that despite applying multiple strategies, stakeholders remain vulnerable to natural disasters, communication breakdowns, and uncertain government policies.

7. Research Gap and Contribution

Although prior studies have examined risk in aquaculture and agricultural supply chains, several gaps remain. First, there is a lack of an integrated supply chain perspective, as most studies focus primarily on farmers (Chalermphon Phumpuang, 2019). Second, the application of structured frameworks such as the SCOR model in aquaculture remains limited (APICS, 2017). Third, empirical studies in Thailand's eastern region, particularly Chanthaburi Province, are scarce. Finally, there is limited understanding of how different stakeholders prioritize risks within the same supply chain. This study addresses these gaps by providing a comprehensive analysis of risks across farmers, middlemen, and retailers, using the SCOR framework.

Research Methodology

The study aimed to examine risk management in the shrimp supply chain of Laem Sing District, Chanthaburi Province. It used a qualitative technique based on the SCOR Model to investigate the planning, sourcing, production, delivery, and return processes. Data were gathered through document analysis and field interviews with key stakeholders to identify and assess potential supply chain risks.

Research Design

The study employed a qualitative research design to investigate risk management processes in the shrimp supply chain of Laem Sing District, Chanthaburi Province. To identify and analyze important operational risks, the design combined documentary research with field interviews using the SCOR Model.



Population and Sample

The participants in the shrimp supply chain were divided into three groups: 30 farmers, 2 middlemen, and 5 retailers, for a total of 37. Purposive and snowball sampling were used to guarantee that samples were representative of the supply chain.

Variables of the Study

The independent variables were shrimp supply chain risk factors, whereas the dependent variables focused on the levels of detected hazards and the efficacy of existing risk management strategies.

Research Instrument

A semi-structured interview and non-participant observation were the key tools. The interview guide has four sections: general information, SCOR Model processes, risk factors, and business overview.

Data Collection

Data collection comprised two stages: document analysis and field investigation. To gain thorough qualitative insights on supply chain hazards, the researcher conducted in-depth interviews with stakeholders and made firsthand observations at chosen sites.

Data Analysis

The study used qualitative data from interviews and observations to assess risk management practices in Laem Sing District, Chanthaburi Province's shrimp supply chain. The analysis classified risks using the SCOR framework: Plan, Source, Make, Deliver, and Return. To determine the level of severity, each identified risk was evaluated based on likelihood and

impact. The findings were then synthesized to assess stakeholders' overall risk management capacities in terms of cost efficiency, effectiveness, and sustainability. The findings were utilized to identify important risks and recommend actionable steps to improve supply chain resilience and operational stability.

Research Results

The study aims to identify and analyze risk factors in the white shrimp (*Litopenaeus vannamei*) supply chain in Laem Sing District, Chanthaburi Province. The SCOR model framework was used to identify key risks to the efficiency, cost, and sustainability of shrimp production and delivery. The findings are provided in three sections: (1) identification of risk variables, (2) risk assessment among farmers, and (3) comparison of significant risks among supply chain participants.

1. Risk Factors in the White Shrimp (*Litopenaeus vannamei*) Supply Chain

The researcher gathered information through document analysis and field interviews with farmers, middlemen, and retailers in Laem Sing District, Chanthaburi Province. The research revealed eight major categories and twenty-seven distinct elements representing various sorts of risks in the shrimp supply chain.

Table 1 Risk Factors in the White Shrimp (*Litopenaeus vannamei*) Supply Chain

| Type of Risk | Risk Factors in the White Shrimp (<i>Litopenaeus vannamei</i>) Supply Chain |
|---------------------------------------|--|
| 1. Weather-Related Risks | 1.1 Variability of Weather Conditions and Natural Disasters 1.2 Sudden Changes in Water Temperature 1.3 Floods 1.4 Storms 1.5 Droughts |
| 2. Biological and Environmental Risks | 2.1 Shrimp Diseases and Environmental Conditions 2.2 Terrestrial Vectors |



| Type of Risk | Risk Factors in the White Shrimp (<i>Litopenaeus vannamei</i>) Supply Chain |
|---------------------------------------|---|
| 3. Logistics and Infrastructure Risks | <ul style="list-style-type: none">3.1 Sudden Changes or Damage to Transportation Routes Due to Weather Conditions3.2 Rising Fuel and Energy Costs3.3 Mortality of Post-Larvae During Transportation to Farmers3.4 Delays in Delivering Post-Larvae Due to Accidents or Traffic Congestion3.5 Delayed or Lack of Communication Between Farmers and Collectors, Such as Sudden Harvests3.6 Delays in Unloading Shrimp to Retailers |
| 4. Management and Operational Risks | <ul style="list-style-type: none">4.1 Fluctuation in Production Input Prices, Such as Fresh and Processed Feed Costs4.2 Inaccurate Market Demand Forecasting or Planning Errors4.3 Inefficient Storage Areas Causing Equipment Damage or Limited Accessibility4.4 Shortage of Labor for Shrimp Farming Operations |
| 5. Market-Related Risks | <ul style="list-style-type: none">5.1 Fluctuation in Shrimp Trading Prices5.2 Decrease in Market Demand for Shrimp5.3 High Cost of Production Inputs, Such as Feed and Medication |
| 6. Financial Risks | <ul style="list-style-type: none">6.1 High Levels of Debt Obligations6.2 Increasing Loan Interest Rates6.3 Low Ability to Repay Loans6.4 Limited Access to Financial Institutions or Credit Sources |

| Type of Risk | Risk Factors in the White Shrimp (<i>Litopenaeus vannamei</i>) Supply Chain |
|--|---|
| 7. Public Policy and Institutional Risks | 7.1 Uncertainty in Government Compensation Policies for Shrimp Prices |
| 8. Personal Risks | 8.1 Accidents, Injuries, or Illnesses Occurring During Work Operations 8.2 Human Errors Made During the Work Process |

The study analyzed the identified risk categories and their levels of relevance within the supply chain. The results showed that market-related risks, particularly variable shrimp prices, were the most crucial, followed by rising feed, fuel, and other production expenses. Environmental and biological concerns, such as inclement weather and shrimp infections, were also discovered to have a significant impact on productivity and survival rates. Management risks, such as a lack of manpower and inadequate planning, caused production delays and interruptions. Overall, the findings showed that economic, environmental, and managerial risks are critical in determining the stability and profitability of the white shrimp supply chain.

2. Assessment of Key Risk Factors Among Shrimp Farmers

The study focuses on identifying main hazards to shrimp producers in Chanthaburi Province, using the SCOR framework as a foundation for analysis. The evaluation takes into account both the frequency of occurrence and the severity of the impact when determining major risk priorities.

Table 2 Prioritization of Farmers' Risk Factors

| | | | | | | |
|---------------------------------------|--------------|--|----------|----------|-----------------------|-----|
| ผลกระทบ จากความ เสี่ยง | Severe | | | | 3.2, 4.1, 5.2, 5.3 | 5.1 |
| | Quite Severe | | 1.1, 1.2 | 2.1, 4.2 | | |
| | Moderate | | 3.5 | | | |



| | | | | | | |
|-------------------------------|----------|--|-----|----------|--------------|--------|
| | Low | 3.1, 6.1 | | | | |
| | Very Low | 1.3, 1.4, 1.5, 2.2, 3.3, 3.4, 3.6, 4.3, 4.4, 6.2, 6.3, 6.4, 7.1, 8.1, 8.2 | | | | |
| | | Very Low | Low | Moderate | Quite Severe | Severe |
| Likelihood of Risk Occurrence | | | | | | |

The study analyzed eight types of risk across 27 elements in the shrimp supply chain. Rising production costs (3.2), varying feed prices (4.1), and market volatility (5.1, 5.2, 5.3) were identified as the riskiest elements, showing high economic susceptibility. Moderate risk risks included unexpected weather changes (1.1, 1.2) and farm management forecasting errors (4.2), whereas low-risk elements included transportation delays (3.1) and high debt levels (6.1). The data show that economic and market-related factors have a larger overall impact than environmental or operational risks among shrimp farmers.

3. Prioritization of Significant Risk Factors among Farmers, Middlemen, and Retailers

The researcher investigated the prioritizing of key risk variables in the white shrimp supply chain by three stakeholder groups: farmers, middlemen, and retailers.

Table 3 Prioritization of Significant Risk Factors among Farmers, Middlemen, and Retailers

| Risk Factors | Farmers | Middlemen | Retailers |
|--------------------------------------|-------------------------|-----------|-----------|
| Risk Factor Ranked 1st in Importance | 3.2, 4.1, 5.1, 5.2, 5.3 | 3.2 | 3.2 |
| Risk Factor Ranked 2nd in Importance | 1.1, 1.2, 2.1, 4.2 | | 5.1 |



| | | | |
|--------------------|--------------------------|--------------------------|--------------------------|
| Risk Factor Ranked | 1.3, 1.4, 1.5, 2.2, 3.1, | 3.1, 3.5, 3.6, 4.1, 4.2, | 3.1, 3.6, 4.1, 4.2, 4.3, |
| 3rd in Importance | 3.3, 3.4, 3.5, 3.6, 4.3, | 4.3, 4.4, 5.1, 5.2, 5.3, | 4.4, 5.2, 5.3, 6.1, 6.2, |
| | 4.4, 6.1, 6.2, 6.3, 6.4, | 6.1, 6.2, 6.3, 6.4, 7.1, | 6.3, 6.4, 7.1, 8.1, 8.2 |
| | 7.1, 8.1, 8.2 | 8.1, 8.2 | |

The primary risks were examined and contrasted using likelihood and impact scores. Farmers faced the greatest risks from fuel, feed, and input price variations (3.2, 4.1, 5.1), whereas middlemen faced logistics and operational risks such as transportation delays and misunderstanding (3.1, 3.5, 3.6). Retailers were impacted by market price volatility and supply fluctuations (3.1, 3.6, 4.1). Overall, production and market-related challenges were the most pressing for all groups, highlighting the need for enhanced management techniques and communication throughout the shrimp supply chain.

Research Discussion

1. Supply Chain Processes and Current Conditions (Objective 1)

The findings reveal that the white-leg shrimp (*Litopenaeus vannamei*) supply chain in Chanthaburi Province operates through interconnected stages involving farmers, middlemen, and retailers, consistent with typical aquaculture supply chain structures described by the Department of Fisheries (2021). Using the SCOR framework, the study confirms that activities across Plan, Source, Make, Deliver, and Return are closely linked, where inefficiencies or disruptions in one stage can significantly affect the entire system (APICS, 2017).

In the Plan stage, inaccurate demand forecasting and poor coordination between stakeholders were observed, leading to mismatches between supply and market demand. This reflects similar issues identified in agricultural supply chains, where planning uncertainty is a key source of inefficiency (Kanishkan et al., 2020). In the Source stage, fluctuations in input prices, particularly feed and fuel, were found to directly affect production decisions and cost structures. In the Make stage, farmers faced biological risks such as disease outbreaks and environmental variability, which are widely recognized as critical constraints in shrimp

aquaculture (Lind et al., 2015). Meanwhile, the Deliver stage was characterized by logistical challenges, including transportation delays and communication gaps among stakeholders.

These findings demonstrate that the shrimp supply chain in the study area is highly sensitive to both operational and external disruptions, supporting previous research that highlights the vulnerability of aquaculture systems to environmental and market uncertainties (Pongthanapanich et al., 2019). Overall, the current conditions reflect a system that is operationally functional but structurally vulnerable, particularly due to limited coordination and high dependency on external inputs.

2. Risk Factors and Risk Management Capacity (Objective 2)

The study identified eight major categories of risks and twenty-seven specific risk factors, which align with established classifications of supply chain risks, including environmental, biological, operational, market, financial, and institutional risks (Jaffee et al., 2010; Kanishkan et al., 2020). However, the findings extend previous research by demonstrating how these risks interact across multiple stakeholders within the same supply chain.

The results indicate that economic and market-related risks, particularly rising fuel costs (3.2), feed price fluctuations (4.1), and shrimp price volatility (5.1–5.3), are perceived as the most critical risks. This supports the findings of Pongthanapanich et al. (2019), who reported that market and financial risks significantly influence farmers' decision-making and investment behavior. The dominance of economic risks suggests that shrimp farming in the study area has become increasingly market-driven, where profitability is highly sensitive to price fluctuations and input costs.

In contrast, environmental and biological risks, such as weather variability and disease outbreaks, were assessed as moderate to high risks but were not ranked as the most critical. This finding differs slightly from earlier studies (Lind et al., 2015), which emphasize environmental risks as primary threats. A possible explanation is that farmers in Chanthaburi have developed adaptive practices (e.g., water quality management, disease monitoring),

reducing the perceived severity of these risks. However, these risks remain significant due to their potential to cause sudden and severe losses.

The study also highlights differences in risk perception among stakeholders. Farmers are primarily affected by production and cost-related risks, while middlemen face logistical and communication challenges, and retailers are more concerned with market demand and price fluctuations. This variation reflects the role-specific exposure to risk within the supply chain, consistent with the concept of distributed risk in supply chain systems (Jaffee et al., 2010).

Regarding risk management capacity, stakeholders apply a combination of strategies, including risk reduction, impact reduction, risk transfer, and coping mechanisms (Lind et al., 2015). However, the effectiveness of these strategies is limited by several factors, including financial constraints, lack of access to information, and policy uncertainty. This finding aligns with Joffre et al. (2018), who found that shrimp farmers often rely on informal and reactive strategies rather than systematic risk management approaches.

3. Implications for Risk Management Strategies (Objective 3)

Based on the findings, effective risk management in the shrimp supply chain requires a system-wide and integrated approach rather than isolated actions by individual stakeholders. The prioritization of high-impact risks, particularly economic and market-related risks, is essential, as suggested by risk assessment frameworks emphasizing likelihood and severity (Jaffee et al., 2010).

First, improving planning and coordination mechanisms is critical. Enhancing communication between farmers, middlemen, and retailers can reduce uncertainty in demand forecasting and minimize inefficiencies in harvesting and distribution. This aligns with SCOR-based recommendations for strengthening the Plan and Deliver processes (APICS, 2017).

Second, strategies to mitigate input cost volatility should be developed, such as collective purchasing, contract farming, or government support programs. These measures can help stabilize production costs and reduce financial risks, which are identified as the most critical in this study.

Third, strengthening risk information systems and early warning mechanisms can improve stakeholders' ability to respond to environmental and biological risks. Although these risks were not ranked as the most severe, their potential impact remains high, particularly in the case of disease outbreaks.

Fourth, the study highlights the need for policy support and institutional stability, especially regarding shrimp price compensation and financial assistance. Uncertainty in government policies was identified as a key institutional risk, limiting stakeholders' confidence in long-term planning.

Finally, capacity building and knowledge transfer are essential to enhance stakeholders' ability to implement formal risk management strategies. This is particularly important for small-scale farmers, who often lack the resources and expertise required for proactive risk management (Joffre et al., 2018).

From a theoretical perspective, this study contributes to the literature by integrating supply chain risk management theory with the SCOR model in the context of aquaculture. Unlike previous studies that focus primarily on farm-level risks, this research provides a multi-stakeholder analysis, highlighting the interconnected nature of risks across the supply chain.

From a practical perspective, the study offers empirical evidence on risk prioritization and management capacity in a key shrimp-producing region of Thailand. The identification of 27 risk factors provides a comprehensive framework that can be used by policymakers and practitioners to design targeted risk management strategies.

Overall, the findings confirm that the white-leg shrimp supply chain in Chanthaburi Province is characterized by high exposure to economic and market risks, supported by interconnected environmental and operational vulnerabilities. While stakeholders employ various risk management strategies, their effectiveness remains limited due to structural and institutional constraints. Therefore, enhancing coordination, improving access to resources, and strengthening policy support are essential to ensure long-term resilience and sustainability of the shrimp supply chain.

Conclusion

This study investigated the processes, risks, and risk management capacity within the white-leg shrimp (*Litopenaeus vannamei*) supply chain in Laem Sing District, Chanthaburi Province, using the SCOR framework. The findings confirm that the shrimp supply chain operates through interconnected stages involving farmers, middlemen, and retailers, where disruptions in one stage can significantly affect overall system performance.

The study identified eight categories of risks and twenty-seven specific risk factors, reflecting the complex and multi-dimensional nature of supply chain risks in aquaculture. Among these, economic and market-related risks—particularly rising fuel and energy costs, fluctuating feed prices, shrimp price volatility, and declining market demand—were found to have the most significant impact across all stakeholder groups. While environmental and biological risks, such as weather variability and disease outbreaks, remain important, they were perceived as less critical compared to financial pressures in the current context.

The analysis also revealed that different stakeholders experience and prioritize risks differently. Farmers are primarily affected by production and cost-related risks, middlemen by logistical and communication challenges, and retailers by market demand and price fluctuations. This highlights the interdependent and uneven distribution of risks across the supply chain. Although stakeholders employ various risk management strategies—such as risk reduction, impact mitigation, risk transfer, and coping mechanisms—their effectiveness remains limited. Key constraints include inadequate coordination, limited access to financial and informational resources, and uncertainty in government policies. As a result, the shrimp supply chain remains vulnerable to both internal inefficiencies and external shocks.

Overall, this study contributes to both theory and practice by applying the SCOR model to analyze supply chain risks in aquaculture and by providing a comprehensive, multi-stakeholder perspective. The findings emphasize the need for integrated and proactive risk

management approaches to enhance the resilience, stability, and sustainability of the shrimp supply chain in Chanthaburi Province.

Suggestions

1. Practical Recommendations

1.1 Strengthen Supply Chain Coordination

Stakeholders should improve communication and coordination mechanisms across the supply chain, particularly between farmers, middlemen, and retailers. Establishing information-sharing platforms can help reduce uncertainty in demand forecasting and improve planning efficiency.

1.2 Manage Economic and Cost-Related Risks

Given that economic risks are the most critical, stakeholders should adopt strategies such as: Collective purchasing of feed and inputs to reduce costs, Contract farming or price agreements to stabilize income, Energy-saving technologies to reduce fuel dependency.

1.3 Improve Risk Monitoring and Early Warning Systems

Developing systems for monitoring environmental conditions and disease outbreaks can help stakeholders respond more effectively to potential risks. Training programs should also be provided to improve farmers' knowledge of risk prevention and management.

1.4 Enhance Financial and Institutional Support

Government agencies should provide clearer and more consistent policies regarding shrimp price stabilization and compensation mechanisms. Improving access to credit and financial services will also help stakeholders manage financial risks more effectively.

1.5 Develop Capacity for Formal Risk Management

Stakeholders, especially small-scale farmers, should be encouraged to adopt more systematic risk management practices. Capacity-building programs and technical support can enhance their ability to implement proactive strategies rather than relying solely on reactive coping mechanisms.

2. Policy Recommendations



Government agencies should promote integrated supply chain management policies that consider all stakeholders rather than focusing only on producers. Establish risk-sharing mechanisms, such as insurance schemes or price guarantee programs. Support the development of digital platforms for market information and logistics coordination.

3. Suggestions for Future Research

Future studies should expand the sample size, particularly among middlemen and retailers, to improve the robustness of stakeholder comparisons. Quantitative approaches could be used to measure the impact of each risk factor more precisely. Longitudinal studies are recommended to assess the long-term effectiveness of risk management strategies. Comparative studies across different provinces or aquaculture systems could provide broader insights into supply chain resilience.

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