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House of Risk Model for Mitigating Supply Chain Risks for Trash Fish Type of Tuna

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ABSTRACT

Mitigation of supply chain risks is an effort in minimizing the risks present in the production and supply of trash fish that belong to tuna types. This can be done through the adoption of traceability and sustainability in the management of fishery supply chain. Various mitigation strategies can be adopted to achieve this purpose effectively. The current research seeks to mitigate supply chain risks in Trash fish industry using House of Risk (HOR) approach. To begin with, business activities must be mapped in order to identify the risks involved. This study recommends investment in agencies in order to mitigate risks along the seafood supply chains. Moreover, it talks about traceability schemes and the supply chain of Trash fish in Indonesian fishing ports. Wild seafood supply chains are characterized by producers starting up activities while the activities end when consumers get products after passing through many intermediaries. Results of the study revealed 13 risk events and 16 risk agents along the supply chain, especially during fish auctions. Seven mitigation actions were proposed based on three dominant risk agents identified in this research. Four major mitigation strategies were also identified in order to make the strategy effective in mitigating supply chain risks.

1. Introduction.

Supply chain risk mitigation in the trash fish type of tuna industry refers to systematic efforts to reduce the likelihood and impact of disruptions across production and distribution activities (Misbah and Muyasaroh, 2019). These risks include supply chain disruptions, Illegal Unreported and Unregulated (IUU) fishing, economic instability among fishers, and product loss and waste throughout the supply chain (Qureshi et al., 2020; Shahbaz et al., 2019). Due to the perishable nature of fishery products and the complexity of multi-actor supply chains, effective risk management is essential to ensure product quality, supply continuity, and economic sustainability.

Various mitigation strategies have been proposed in previous studies. These include adopting digital technologies such as blockchain to enhance transparency, diversifying fishermen's income sources to improve resilience, and reducing post-harvest losses (Abdullahi et al., 2025; Cromwell et al., 2025). In addition, proactive risk assessment throughout the supply chain lifecycle is essential to identify critical risk sources and determine appropriate mitigation actions (Mostaghel et al., 2019; Turukay et al., 2021). Advanced decision-support approaches, such as fuzzy-based prioritization models, have also been developed to improve the effectiveness of risk mitigation strategies in agri-food supply chains (Ibrahim et al., 2026). Furthermore, integrating innovative risk mitigation strategies with sustainability-oriented approaches has been shown to enhance supply chain resilience and long-term performance in food processing industries (Mustaniroh et al., 2025).

In the fisheries sector, risk mitigation is closely related to the implementation of traceability systems and sustainability-based supply chain management practices (Hopkins et al., 2024;

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Nguyen et al., 2021). These approaches enable better monitoring of product flows, reduce fraud risks, and improve coordination among supply chain actors. In addition, strengthening institutional roles and regulatory oversight is critical to ensure effective risk governance, particularly in seafood supply chains characterized by uncertainty, seasonality, and dependence on natural conditions. Previous studies have also highlighted the importance of sustainability assessment in tuna fisheries, particularly in coastal areas such as Pasuruan, where ecological, economic, and social dimensions are closely interconnected (Munir and Misbah, 2025).

In Indonesia, several studies have explored risk management approaches in fisheries product and supply chains. Sucipto et al., (2018) analyzed the quality of vacuum packaging of frozen fish. These include risk identification and monitoring in supply chains (Oyanedel et al., 2024; Sumrit and Srisawad, 2022), as well as the implementation of traceability systems to enhance transparency and coordination within supply chains (Cordova and Aguirre, 2022; Cromwell et al., 2025). In addition, structured risk assessment methods such as the House of Risk (HOR) have been applied to improve risk management performance (Purwaningsih and Hermawan, 2021). Other studies have emphasized the importance of institutional support and governance mechanisms in improving supply chain resilience (Love et al., 2021; Lu et al., 2023). These approaches indicate that both technological and managerial strategies are essential in addressing risks in fisheries supply chains

However, previous research on the trash fish type of tuna supply chain has primarily focused on sustainability performance and general supply chain management, such as the application of sustainable supply chain management (SSCM) approaches using multidimensional scaling methods (Misbah et al., 2025). While these studies provide important insights into sustainability dimensions, they have given limited attention to structured and quantitative risk mitigation frameworks that systematically link risk identification, prioritization, and mitigation actions. In particular, empirical studies addressing small-scale, auction-based fisheries supply chains remain scarce, despite their high exposure to uncertainty and operational risks.

Therefore, this study aims to identify, assess, and prioritize risk mitigation strategies in the trash fish type of tuna supply chain using the House of Risk (HOR) approach. By integrating risk mapping with quantitative prioritization, this study contributes to bridging the gap between conceptual risk management approaches and their practical application in small-scale fisheries supply chains.

2. Material and Method.

2.1. Data Collection.

This study took place in the coastal area of Pasuruan Regency, East Java, Indonesia, a key hub for processing trash fish, particularly the cob type. The House of Risk (HOR) method was used to identify, assess, and develop strategies to mitigate risks in the trash fish supply chain throughout 2023.

The data were collected from 30 respondents across the supply chain, including fishermen, fish processors, and fish traders. In-depth interviews is to get insight into the prevailing conditions in actual supply chains, and questionnaires were used to assess risk probability and the impact of different risks. The research method employed a mixed-methods approach, combining quantitative and qualitative methods. The HOR model was used in two steps: risk identification and the formulation of risk mitigation strategies.

2.2. Data Analysis.

The analysis of risks in the supply chain of trash fish-type tuna industries in the Regency of Pasuruan will be undertaken using the HOR approach. Key participants include fishermen, micro-enterprise processors, collectors, and traders to conduct risk analysis and mitigate risks.

1. Risk Identification and Prioritization (HOR Phase 1).
   (a) Risks for fishermen include fluctuations in catches, weather uncertainties, and price instabilities caused by reliance on intermediaries.
   (b) Risks for collectors include logistics inefficiency, variations in demand and unreliable suppliers.
   (c) Risks for processors of micro-enterprises include fluctuating supplies, inadequate handling, and a lack of capital resulting in low quality products.
   (d) Calculation of Aggregate Risk Potential (ARPj) will be done based on the stakeholder's assessment to identify crucial risks.
2. Risk Mitigation and Strategy Formulation (HOR Phase 2).
   (a) Cold storage improvement for fishermen and cooperative - based pricing model.
   (b) Quality control improvement and micro-finance for processors.
   (c) Digital traceability system and demand forecasting for collectors.
   (d) Use of the Effectiveness to Difficulty Ratio (ETDk) in prioritizing interventions.

2.3. Data Processing Stage.

In this analysis, risk events across the four major stages of the supply chain will be evaluated using the HOR approach. The scale used to determine risk severity ranges from 1 to 10, with 10 being the most severe.

1. Planning Stage.
   Identified Risks:
   (a) Inaccurate forecasting of fish demands can lead to shortage or excess of stocks which affects operations.
   (b) Inadequate warehouse capacity may affect inventory management.
   (c) Mistakes in the fish delivery plans result in delays and losses.
   (d) Ice shortage impacts the freshness of fish products.

   Risk Implications:

(a) Inaccurate forecasting of fish demands can lead to shortage or excess of stocks, which affects operations.
(b) Inadequate warehouse capacity may affect inventory management.
(c) Mistakes in the fish delivery plans result in delays and losses.
(d) Ice shortage impacts the freshness of fish products.

2. Sourcing Stage.
Identified Risks:
(a) Fluctuation in price of fish products due to fluctuation in volume of catches.
(b) Orders by collectors may be cancelled thus accumulating inventory and losses.
(c) Weather conditions may disrupt fish catch and availability of fish products.
Risk Implications:
(a) Risk factors such as price fluctuations and order cancellations affect the supply chain and cost management.
(b) The effects of weather conditions require the development of a flexible supply chain.

3. Production Stage.
Identified Risks:
(a) Spoiling of fish through inefficient handling impacts their quality and value.
(b) Inconsistency in the process of packaging impacts quality perception.
(c) Delaying in packaging impacts costs and efficiency.
(d) Insufficient unloading area impacts production.
Risk Implications:
(a) Spoiling of fish products and insufficient unloading area are the most important factors to be considered for production and quality assurance.
(b) Factors like inconsistent packaging and delays in the packaging process create inefficiencies.

4. Delivery Stage.
Identified Risks:
(a) Delay in fish shipment results in spoilage and decline in market value.
(b) Delay in docking of ships interrupts the logistics process.
Risk Implications:
(a) Shipping delays have high operational impact, affecting fish freshness and customer satisfaction.
(b) Docking delays, while less severe, can cause scheduling disruptions.

3. Results.

Two elements are analyzed: identifying potentially risky events and potentially risky agents. In the case of risk events, the goal is to identify risk events and assess their significance. As for risk agents, the goal is to determine the source of risk and provide a value that represents the likelihood of each risk agent occurring. Additionally, potential risks or errors are identified for each activity in the process based on their respective probabilities.

3.1. Supply Chain Activity Mapping.

Results were obtained through a detailed mapping of the planning, sourcing, production, shipping, and return processes at the Pasuruan fish auction site during this study. This achievement is made possible by identifying risk events and the underlying causes (risk agents) of each occurrence. A weighting procedure is carried out after data is collected from the field. This step involves distributing questionnaires to 25 respondents, which provide information about risk events, their severity, risk agents, and their respective event rate values. Respondents include those involved in risk events, severity values, risk causes, and occurrence values (Table 1).

Table 1 describes the risk events identified in the planning, sourcing, production, and delivery processes. This information was obtained through interviews with fishermen, collectors, and retailers. A total of 13 risk events were identified and further processed based on supply chain activity mapping. After determining the risk events, an impact assessment (severity) is conducted using a scale of 1-10. The average value is then calculated to determine the severity value. The next step is to identify the sources of risk (risk agents), obtained through interviews, observations, and brainstorming sessions with experts: fishermen and collectors. The following provides an overview of the identified risks responsible for these risk events, along with the event rate or probability of each occurrence (Table 2).

Table 1: Identification of Risk Events.

Process	Activity	Risk Event	Code	Severity
Plan	Fish demand forecasting	Inaccuracy of fish forecasting	E1	7
	Warehouse capacity planning	Cargo mismatch in the warehouse	E2	7
	Fish delivery planning	Inaccuracies in fish delivery	E3	8
	Ice material planning	Mismatch in the amount of ice that arrives	E4	7
Source	Uncertaint y of fish catch	Instability of fish prices	E5	7
		Collector cancels the order	E6	7
		Bad weather	E7	7
Make	Fish quality control	Fish damage	E8	7
	Fish packaging	Packaging discrepancies	E9	5
		Duration of fish packaging	E10	7
		Limitations of fish loading and unloading area	E11	7
Delivery	Fish delivery	Delays in fish delivery	E12	7
		Delay in ship docking	E13	6

Source: Authors.

Table 2: Identification of Risk Agents.

Code	Risk Agent	Occurrence
A1	Fluctuating demand	5
A2	Fluctuating fish stocks	6
A3	Lack of fish stock in one storage unit	5
A4	Communication with ice sellers is less effective	8
A5	Unstable fish prices	5
A6	Fishermen catch no fish	6
A7	High storms	5
A8	Duration of fishermen at sea	6
A9	Unloading techniques not following procedures	4
A10	Fish storage technique does not follow procedures	7
A11	Packaging damage	5
A12	Unloading techniques not following procedures	6
A13	Limited weighing equipment	5
A14	Older workers in selecting fish	5
A15	Inadequate transportation	9
A16	Waiting for another loading and unloading plan	5

Source: Authors.

The identification process resulted in 16 risk causes (risk agents). In addition, an event value was assigned to each risk cause. After understanding the risk incidents and the factors that trigger them, and evaluating their severity and frequency, the next step is to perform calculations for Phase 1 of the HOR and assign a relationship score.

3.2. House of Risk Phase 1.

After recognizing the risks and assessing their severity and frequency, the relationship between each risk event and its triggering factor will be determined using the relevant correlation value. Furthermore, the overall potential risk value will be calculated to prioritize handling risk sources. These risk sources will be ranked by their Aggregate Risk Potential (ARP) from highest to lowest (Table 3).

Table 3: Identification Risk Agent.

Risk Event	Risk Agent																
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	Si
E1	9	3	3			1											7
E2		9										1		1			7
E3	3	3	9														8
E4				1													7
E5					3	1											7
E6						3										1	7
E7						9	9										7
E8								9	1	9	3	1					7
E9									1	3	9	1					5
E10										3			1	3			7
E11														3			7
E12														1	1		7
E13																9	6
Oi	5	6	5	8	5	6	5	6	4	7	5	6	5	5	9	5	
ARP	435	648	465	56	105	588	315	378	48	693	330	114	35	280	63	305	
Pj	5	2	4	14	12	3	8	6	15	1	7	11	16	10	13	9	

Source: Authors.

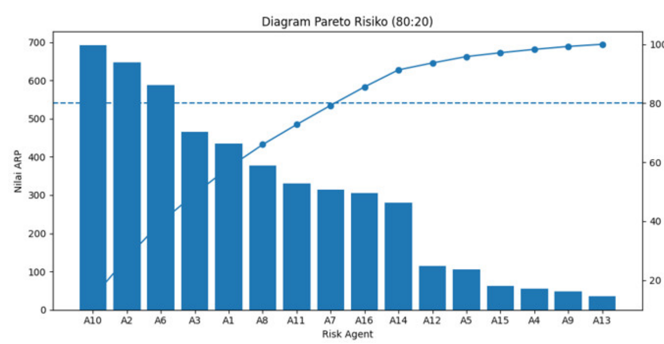
Referring to the HOR Phase 1 table above, the risk agent with the highest accumulated potential risk score is A10, which relates to fish storage techniques that do not follow proper procedures. In contrast, risk agent A13, which handles a few scales, has the lowest accumulated potential risk value. The identification of the dominant risk agent is followed by risk assessment.

Risk Evaluation.

The main objective of this risk assessment is to identify the key triggers for risks that must be addressed, taking into account the previously determined risk value. This risk assessment will use Pareto diagrams to establish problem-solving priorities. The 80:20 rule assumes that addressing 20% of the major risk sources reduces 80% of the remaining risks (Figure 1).

Based on the Pareto analysis in the graph, three risk agents with the highest ARP are A10, A2, and A6. These agents contribute most significantly to the overall risk impact in the supply chain. The cumulative curve further indicates that a small number of risk agents account for the majority of the total risk impact. This finding is consistent with previous studies highlighting that improving supply chain performance requires prioritizing critical risk factors that contribute most significantly to operational inefficiencies (Manggala et al., 2024).

Figure 1: Risk Evaluation Pareto Diagram.



Source: Authors.

The top 20 percent of risk agents produce 80 percent of the risk impact in the supply chain. According to the Pareto principle, managing the top three risk agents (A10, A2, and A6) will reduce a considerable amount of risk impact in the supply chain.

If we want to develop an effective risk mitigation strategy, priority should be given to addressing these key risk agents, as they have the greatest potential to disrupt supply chain operations. The principal ARP values of these three risk-triggering factors are presented in Table 4.

3.3. House of Risk Phase 2.

In this phase, decisions are made regarding further actions to mitigate risks and minimize potential losses. Experts from various fields are involved in this process. Phase 2 of the House of Risk involves designing a risk management plan evaluating the relationship between the risk management plan and risk agents using data from Phase 1 of the House of Risk and Calculating Total Effectiveness (TEk) Degree of Difficulty (Dk), and Effectiveness to Difficulty (ETDk) to determine which actions

Table 4: Dominant Risk Agents.

Ranking ARP	Code	Risk Agent	ARP	Oj	Si
1	A10	Fish storage technique is not according to the procedure	693	7	7
2	A2	Fluctuating fish stocks	648	6	8
3	A6	Fishermen obtain no fish	588	6	7

Source: Authors.

are the most important to take. In the previous stage, treatment was focused on the three dominant risk agents. From these risk agents, seven mitigation measures have been planned. The recommended risk mitigation strategies are presented in Table 5.

Table 5: Risk Mitigation Ranking.

Code	Risk Mitigation	Dk
PA1	With the weather forecast, the fisherman's schedule to go to sea must be adjusted	3
PA2	Operational procedures for storing fish are provided with standards	4
PA3	Conduct regular reviews of fish storage techniques carried out	4
PA4	Provides cold storage	5
PA5	Establish cooperation with fishery managers	4
PA6	Set appropriate fishing limits and adhere to quotas set by fisheries authorities	5
PA7	Selection of the right time and location	3

Source: Authors.

After assessing the level of difficulty (Dk), the next step is to determine how correlated the treatment strategy is with the identified priority risk sources. After obtaining the correlation value, the Total Effectiveness (TEk) value is calculated, representing the effectiveness of the risk management strategy. Next, the Effectiveness to Difficulty Ratio (ETDk) is calculated by dividing the Total Effectiveness (TEk) by the Difficulty Level (Dk). The final step involves determining the order of importance of the identified coping strategies (ETDk). This is done based on the effectiveness relative to difficulty. The table below presents the calculation results of Phase 2 of the House of Risk (Table 6).

The HOR Phase 2 calculation results show that the risk mitigation measure arrangement is based on the highest ETDk

Table 6: House of Risk Phase 2.

Code	Risk Agent	Preventive Action (PA)							ARP
		PA1	PA2	PA3	PA4	PA5	PA6	PA7	
A10	Fish storage technique is not according to the procedure		9		9	3			693
A2	Fluctuating fish stocks	3		9		9	3	1	648
A6	Fisherman cannot fish	3			9		1	3	588
Total Effectiveness of Action		3708	6237	5832	11529	7911	2532	2412	
Degree of Difficulty (DK) Performing Action		3	4	4	5	4	5	3	
Effectiveness to Difficulty (ETD)		1236	1559.25	1458	2305.8	1977.75	506.4	804	
Rank of Priority		5	3	4	1	2	7	6	

Source: Authors.

value. The order or ranking of risk management strategies is presented in Table 7.

Table 7: Risk Agent Ranking.

Code	Risk Agent	Ranking
PA4	Provide cold storage.	1
PA5	Establish cooperation with fishery managers.	2
PA2	Provide standard operating procedures for fish storage.	3
PA3	Conduct regular reviews of fish storage techniques carried out by employees.	4
PA1	Create a fishing schedule for fishermen based on weather forecasts.	5
PA7	Ensure proper timing and location of fish capture.	6
PA6	Set appropriate fishing limits and comply with quotas established by fisheries authorities.	7

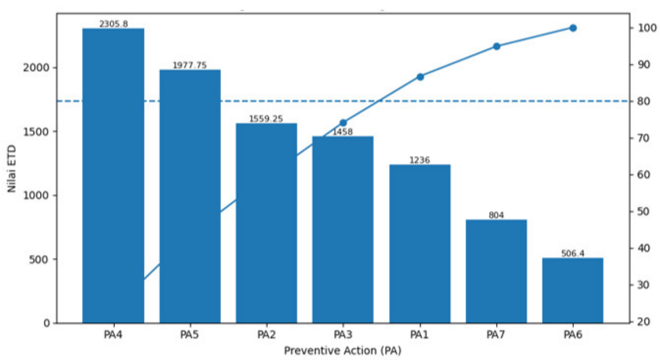
Source: Authors.

The priority order of the seven risk mitigation measures is determined based on the table. After that, the primary mitigation determination is made based on the highest ETDk value, as a higher ETDk indicates greater effectiveness in its implementation. The ETDk value is displayed in a Pareto graph (Figure 2).

Based on the Figure, four main mitigation strategies were selected based on their implementation effectiveness. These four strategies resulted in an effectiveness of 74.70% of the total accumulated ETDk value. Therefore, here are the four key mitigation strategies that can be implemented:

1. Prioritize the Implementation of PA4 and PA5 Strategies.
   (a) With the highest ETDk values (PA4 = 2305.8 and PA5 = 1977.75), these two strategies should be the main focus of improvement efforts.
   (b) This can be achieved by allocating more resources, both financially and technically, to ensure that cold storage (PA4) and collaboration with fishery managers (PA5) operate optimally.

Figure 2: Pareto Risk Mitigation Diagram.



Source: Authors.

This is in line with findings from modern fish market management studies, which emphasize that effective governance, infrastructure development, and stakeholder coordination are key factors in improving operational efficiency and supply chain performance in fisheries (Wulandari et al., 2022).

2. Optimize PA2 and PA3 Strategies.
   (a) The PA2 (SOP for fish storage) and PA3 (evaluation of fish storage techniques) strategies play a crucial role in sustaining risk mitigation efforts.
   (b) SOP development should align with industry standards and best practices, and fish storage evaluation should be conducted periodically by competent personnel.

3. Reassess Strategies with Lower ETDk Values (PA1, PA7, PA6).
   (a) These strategies have a lower overall impact on risk reduction. Therefore, before allocating resources to PA1, PA7, and PA6, ensure that high-ETDk strategies have been well-executed.
   (b) These strategies can serve as additional support to strengthen the existing mitigation system.

4. Regular Evaluation and Monitoring.
   (a) Conduct periodic monitoring of the effectiveness of implemented mitigation strategies.
   (b) Use data from initial implementation to adjust methods or policies to enhance efficiency and effectiveness.

Conclusions.

In the supply chain process at the fish auction, 13 risk events and 16 risk agents were identified. Among the 16 risk agents, three were identified as dominant: improper fish storage techniques (A10), fluctuations in fish stock (A2), and fishermen failing to catch fish (A6).

Based on three dominant risk agents, seven mitigation actions were proposed. Considering the effectiveness of each mitigation action, four key mitigation strategies were determined: providing cold fish storage (PA4), collaborating with fishery managers (PA5), establishing standard operating procedures for fish storage (PA2), and conducting regular evaluations of fish storage techniques performed by employees (PA3).

This study employs the House of Risk (HOR) framework to analyze risk identification and mitigation in the tuna-type trash fish supply chain in Indonesia. A total of 13 risk events and 16 risk agents that consult stakeholders at fish auction sites; three dominant risk agents are: improper fish storage practices, fluctuating catch volumes, and unsuccessful fishing operations.

Seven mitigation measures were proposed to address these key risk agents. Four primary strategies were prioritized: (1) developing cold storage facilities, (2) strengthening collaboration with fisheries authorities, (3) implementing standard operating procedures (SOPs) for fish handling, and (4) conducting regular evaluations of storage practices. These strategies are expected to benefit fishermen, processors, and collectors by reducing spoilage, improving product quality, and stabilizing supply.

The findings provide important practical and policy implications. Stakeholders are encouraged to support infrastructure development, capacity building, and institutional collaboration to ensure effective implementation. For example, investing in storage facilities and establishing cooperatives can enhance operational efficiency, while training programs are essential to ensure compliance with established procedures.

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Conflict of Interest.

The authors declare that there is no conflict of interest.

References.

Abdullahi, A., Muhammed, U.N., Nworie, C.C., Nwangwu, D.C., Zakari, Y., 2025. Digital transformation for small-scale fisheries: an integrated framework to overcome adoption barriers and enhance economic sustainability. International Journal of Science and Business 48, 55–74.

Cordova, M., Aguirre, K.M.N., 2022. Achieving transparency through blockchain: sustainability of fishery supply chain management. Revista Eletrônica de Negócios Internacionais: Internext 17, 398–412.

Cromwell, J., Turkson, C., Dora, M., Yamoah, F.A., 2025. Digital technologies for traceability and transparency in the global fish supply chains: A systematic review and future directions. Marine Policy 178, 106700.

Hopkins, C.R., Roberts, S.I., Caveen, A.J., Graham, C., Burns, N.M., 2024. Improved traceability in seafood supply chains is achievable by minimising vulnerable nodes in processing and distribution networks. Marine Policy 159, 105910.

Ibrahim, M.F., Santoso, I., Mustaniroh, S.A., Astuti, R., Rau, H., 2026. Prioritizing proactive risk mitigation strategies in agri-food supply chains: an integrated fuzzy decision-support framework. Journal of Industrial and Production Engineering 1–27. https://doi.org/10.1080/21681015.2026.2653968.

Love, D.C., Allison, E.H., Asche, F., Belton, B., Cottrell, R.S., Froehlich, H.E., Gephart, J.A., Hicks, C.C., Little, D.C., Nussbaumer, E.M., 2021. Emerging COVID-19 impacts, responses, and lessons for building resilience in the seafood system. Global Food Security 28, 100494.

Lu, Q., Wang, X., Wang, Y., 2023. Enhancing supply chain resilience with supply chain governance and finance: the enabling role of digital technology adoption. Business Process Management Journal 29, 944–964.

Manggala, P.W., Machfud, M., Sailah, I., 2024. Analysis of supply chain performance improvement in the fish processing industry. Industria: Jurnal Teknologi dan Manajemen Agroindustri 13, 54–70.

Misbah, A., Muyasaroh, H.F., 2019. Optimalisasi supply chain management produk olahan ikan hasil tangkap di era industri 4.0. AGROMIX 10, 152–162.

Misbah, A., Sucipto, S., Mustaniroh, S.A., 2025. Optimizing SSCM in the supply chain of trash fish type tuna using rapfish in coastal Pasuruan. Jurnal Teknologi Pertanian 26, 223–238.

Mostaghel, R., Oghazi, P., Patel, P.C., Parida, V., Hultman, M., 2019. Marketing and supply chain coordination and intelligence quality: A product innovation performance perspective. Journal of Business Research 101, 597–606. https://doi.org/10-.1016/j.jbusres.2019.02.058.

Munir, M., Misbah, A., 2025. Sustainability analysis of skipjack tuna catch based on multidimensional scaling (MDS) in the coastal area of Pasuruan Regency. AGROMIX 16, 155–167.

Mustaniroh, S.A., Putri, W.D.R., Azhari, M.F., 2025. Analysis of risk minimization strategies in the implementation of Good Manufacturing Practices through the integration of FF-MEA and AHP, in: BIO Web of Conferences. EDP Sciences, p. 02004.

Nguyen, X., Le, T., Nguyen, A., Pham, T., Tran, T., 2021. Supply chain risk, integration, risk resilience and firm performance in global supply chain: Evidence from Vietnam pharmaceutical industry. Uncertain Supply Chain Management 9, 779–796.

Oyanedel, R., Gelcich, S., Milner-Gulland, E.J., Wilcox, C., 2024. Improving detectability of illegal fishing activities across supply chains.

Purwaningsih, R., Hermawan, F.A., 2021. Risk analysis of milkfish supply chains in Semarang using house of risk approach to increase the supply chain resilience, in: IOP Conference Series: Earth and Environmental Science. IOP Publishing, p. 012018.

Qureshi, M.A., Sohu, S., Keerio, M.A., 2020. The impacts of operational risks in the supply chain of construction projects in Malaysia. Tehnički vjesnik 27, 1887–1893.

Shahbaz, M.S., Kazi, S., Bhatti, N.U.K., Abbasi, S.A., Rasi, R.Z.R., 2019. The impact of supply chain risks on supply chain performance: Empirical evidence from the manufacturing of Malaysia. International Journal of advanced and applied sciences 6, 1–12.

Sucipto, S., Astuti, R., Megawati, A., 2018. Analisis kualitas pengemasan vakum ikan beku dengan Metode Six Sigma (Studi kasus di PT X, Pasuruan Jawa Timur). Agrointek: Jurnal Teknologi Industri Pertanian 12, 99–107.

Sumrit, D., Srisawad, S., 2022. Fuzzy Failure Mode and Effect Analysis model for operational supply chain risks assessment: An application in canned tuna manufacturer in Thailand. Logforum. https://doi.org/10.17270/J.LOG.2022.645.

Turukay, E., Esomar, M.J.F., Loppies, L., 2021. The analysis of the influence of running cost, shore cost and labor cost, towards profitability at the purse seine capture fisheries business units in the District of Seram Bagian Barat, in: IOP Conference Series: Earth and Environmental Science. IOP Publishing, p. 012022.

Wulandari, T., Poernomo, A., Irianto, H.E., 2022. Management strategy of Muara Baru modern fish market. Industria: Jurnal Teknologi dan Manajemen Agroindustri 11, 177–189.