Design of Strategy to Improve the Supply Chain Performance of Marine Fish through Seahood Fresh Market with SCOR-AHP Model Approach

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ABSTRACT

The marine fish supply chain (MFSC) exhibits inherent vulnerabilities due to rapid product deterioration, fluctuating price dynamics, and weak inter-actor coordination, all of which constrain overall operational performance. This research pursues three primary objectives: (1) to assess MFSC performance, (2) to examine MFSC performance through key metrics grounded in the Supply Chain Operations Reference (SCOR) framework, and (3) to develop performance enhancement strategies by integrating SCOR with the Analytical Hierarchy Process (AHP) in the context of the Seahood Fresh Market (SFM). The empirical investigation was undertaken across Sleman Regency, Kobong Market in Semarang, and Jepara. Findings indicate that the MFSC comprises multiple interconnected stakeholders, including fishermen, fish auction intermediaries, assembling traders, wholesalers, and SFM. Evaluation across SCOR dimensions—reliability, responsiveness, cost efficiency, and asset utilisation—demonstrated that fish auction intermediaries attained the highest performance rating (3.55 on a five-point scale), underscoring their pivotal role in coordinating supply chain activities. Furthermore, SFM in Sleman Regency emerged as a critical node within the MFSC network. To strengthen overall system performance, several strategic interventions are proposed, including optimisation of inventory control practices, establishment of long-term collaborative partnerships, provision of fuel-related financial support, and implementation of regulatory guidance alongside capacity-building initiatives.

Keywords: Performance Measurement, Supply Chain, SCOR-AHP

INTRODUCTION

Fishery denotes a broad spectrum of economic activities centred on aquaculture, capture-based harvesting, and the transformation of fishery outputs. The fishery enterprise system integrates all sequential stages, encompassing pre-production, production, processing, and marketing functions. Fishery may be conceptualised as deliberate human efforts to regulate and exploit aquatic biological assets(Hastuti & Jumardi). Marine fish inhabit saline environments, whereas freshwater species exist in aquatic systems where salinity levels remain below those of their internal fluids. As noted by Salindeho (2022), the osmotic composition of marine fish body fluids is lower than that of surrounding seawater. Species such as snapper, sardine, pomfret,

tuna, and skipjack exemplify commercially significant and widely consumed varieties (Inara, 2020).

Marine fisheries constitute a critical pillar of food security and economic advancement. Nevertheless, the MFSC is inherently complex, shaped by perishability constraints, climatic uncertainty, spatial dispersion, and price instability, which collectively intensify coordination difficulties and reduce system efficiency. Accordingly, the establishment of an integrated supply chain architecture is essential to ensure product dependability, cost optimisation, and responsiveness to market requirements. A supply chain may be defined as a network of interlinked entities involved in sourcing inputs, production, and distribution processes for goods or services(Maulani et al., 2014). It encompasses organisational linkages, resource origins, and operational processes that collectively generate and deliver outputs to final consumers. In structural terms, it includes all facilities, functional units, and activities associated with transforming inputs into finished goods and delivering them downstream. Within the MFSC, the flow initiates with primary suppliers—fishermen—and extends to final consumers as the terminal node (Susanawati & Aida, 2024). Marine-based commodities exhibit distinctive attributes relative to other goods, particularly due to their sensitivity to environmental conditions and limited shelf life. Consequently, specialised handling and processing protocols are required throughout harvesting, storage, and distribution stages to preserve product integrity(Jakaria & Rini, 2017). Inefficiencies in distribution frequently generate operational challenges for supply chain participants, particularly where transit duration and geographical barriers impede timely delivery (Abdelaziz & Munawaroh, 2026). Addressing these constraints necessitates the design of a logistics system that is both effective and efficient. Logistics represents a structured framework governing procurement, storage, and transportation of raw materials, intermediate goods, and finished products (Domnik et al., 2022). The adoption of supply chain management principles provides an appropriate mechanism for achieving logistical optimisation (Sembiring et al., 2012). Empirical evidence suggests that well-coordinated supply chains contribute to reduced logistics costs while enhancing both efficiency and product quality (Fan et al., 2013).

Despite their dynamic nature, supply chains operate through three fundamental and interrelated flows: material, informational, and financial (Chopra & Meindl, 2004). As articulated by Susanawati (2019), supply chain functionality is defined by the physical movement of goods from producers to consumers, reciprocal financial exchanges among actors, and continuous information transfer across the network. The SFM constitutes a key distribution network within the MFSC, specialising in marine fish supply. It operates two outlets: a primary facility in Candi Gebang, Wedomartani, Ngemplak District, Sleman Regency, and a secondary branch located at Colombo Market, Jalan Kaliurang KM 7. While both outlets offer comparable varieties of marine fish, the primary branch additionally provides fresh vegetables and general grocery items. SFM sources its marine fish predominantly from Kobong Market in Semarang and suppliers in Demak, procuring stock from major traders at two-day intervals. In instances of supply shortages in Semarang, procurement is redirected to Demak to maintain continuity.

Semarang and Demak, situated along the northern coastal corridor, are recognised for supplying fish with superior taste and quality attributes. Given the perishable nature of marine fish, rapid distribution is imperative to mitigate quality degradation over time. A defining characteristic of MFSC management is the progressive decline in product quality, necessitating accelerated handling and delivery mechanisms. Sustained alignment with consumer demand

requires continuous improvement of MFSC performance to ensure both service reliability and profitability. Therefore, this study seeks to: (1) delineate the MFSC structure through SFM, (2) assess MFSC performance within the SFM context, and (3) formulate strategic interventions to enhance MFSC performance at SFM. The findings are expected to provide practical value for fishery enterprises and fresh seafood markets in designing strategies that improve distribution efficiency, preserve marine fish quality, and strengthen coordination among supply chain actors. Additionally, the outcomes aim to benefit consumers by ensuring consistent availability of high-quality marine fish, greater price stability, and more efficient distribution systems.

RESEARCH METHOD

This investigation was carried out in Semarang, Jepara, and Sleman Regency. Site selection followed a purposive logic based on functional relevance. Semarang and Jepara were chosen as primary supply origins feeding SFM, whereas Sleman Regency was included due to its inland setting, which necessitates external sourcing to satisfy consumer demand for marine fish. In addition, SFM represents a major trading node within Sleman Regency and maintains a relatively stable customer base. A snowball sampling approach was applied to map MFSC actors, progressing from downstream (retail level) towards upstream participants (fishermen). The identification process was initiated at the initial point of the MFSC and subsequently extended by tracing linkages across involved stakeholders. The owner of SFM served as the principal informant, facilitating the identification and verification of relevant actors. In total, sixteen respondents were interviewed, comprising eight fishermen, two fish auction intermediaries, one wholesaler, four assembling traders, and the SFM owner. The performance of the MFSC operating through SFM in Sleman Regency was evaluated using three sequential analytical stages.

Determination of Performance Metrics

Supply chain performance was assessed using the SCOR framework, which offers a standardised structure for organisations to evaluate operational effectiveness in this domain (Ginantaka, 2017; Jansen & Jacky, 2016). Paul (2014) indicates that SCOR integrates 134 performance metrics designed to measure supply chain process outcomes (Paul, 2014). The selection of relevant metrics was based on the interpretation of in-depth interview data obtained from key informants (Thakkar et al., 2009).

Performance Metrics Weighting

Weight assignment was carried out through the construction of a pairwise comparison matrix, followed by the derivation of eigenvalues from the matrix, computation of eigenvector scores for each comparison, and subsequent evaluation of the consistency ratio (CR). The judgement set is considered consistent when the CR is below 10%, whereas values exceeding 10% indicate inconsistency (Febryanti et al., 2016).

Performance Calculations

The metric weights derived through AHP were utilised to compute MFSC performance. Aggregation commenced at the lowest hierarchical tier (Level-3), where individual metric scores were assigned using a five-point rating scale aligned with observed operational

conditions. Subsequently, the computed Level-3 values were aggregated to obtain Level-2 and Level-1 metrics by applying the following formulation (adapted from (Arin, 2013)):

$$M2 = \sum_{i=1}^{n} (M3 \times M3 \text{ weight})$$

$$M1 = \sum_{i=1}^{m} (M2 \times M2 \text{ weight})$$

$$\text{Total Performance} = \sum_{i=1}^{p} (M1 \times M1 \text{ weight})$$

Description:
M3 = Level 3 metrics n = Level 3 metrics that exist in level 2 metrics
M2 = Level 2 metrics m = Level 2 metrics that exist in level 1 metrics
M1 = Level 1 metrics p = Number of level 1 metrics

RESULTS AND DISCUSSION

Marine Fish Supply Chain Structure and Coordination Patterns

Figure 1 illustrates the MFSC configuration supplying SFM in Sleman Regency. The structure comprises five principal tiers of actors: (i) fishermen located in Kedungmalang and Ujung Batu, (ii) fish auction entities (TPI) operating in Demaan and Ujung Batu, (iii) assembling traders, predominantly based in Jepara, (iv) large-scale traders/wholesalers at Kobong Market in Semarang, and (v) SFM as the focal retail node serving final consumers in Sleman Regency. In alignment with established supply chain theory, the system operates through three mutually dependent flows: physical product movement, information exchange, and financial transactions (Domnik et al., 2022; Song et al., 2016).

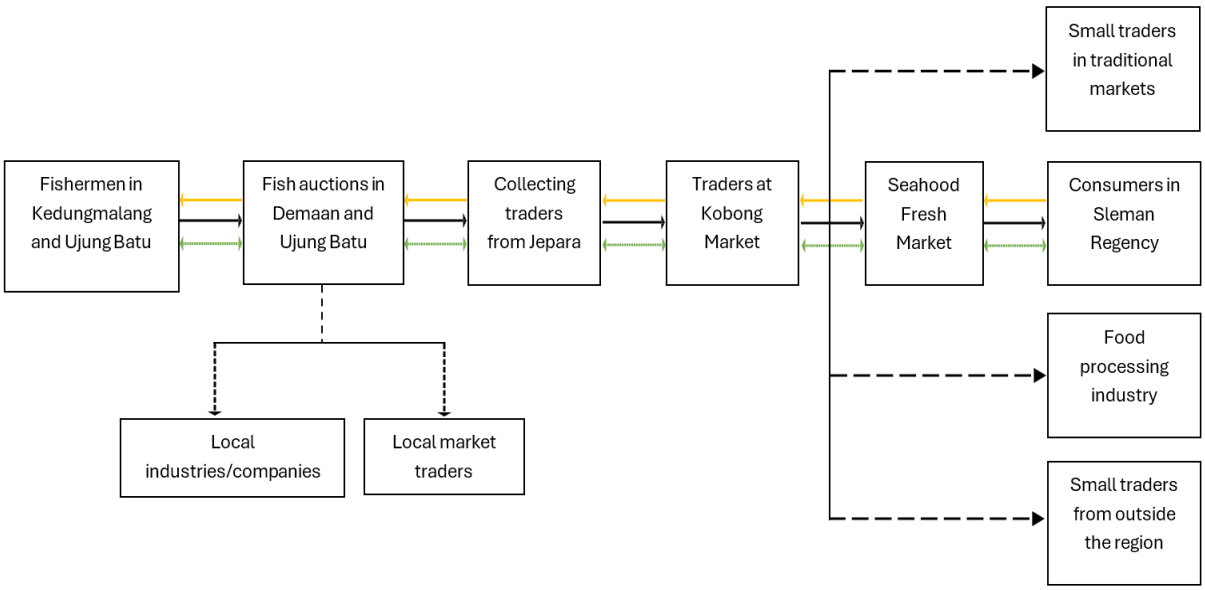
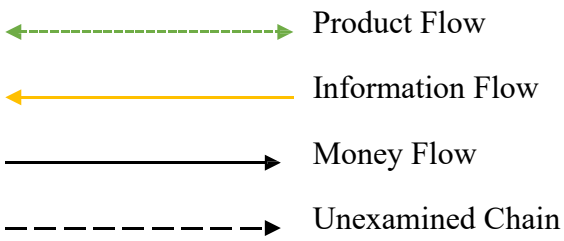


Figure 1: Marine Fish Supply Chain

Description



Vertical and horizontal coordination within the MFSC remains largely underdeveloped. In practice, each actor performs a distinct functional role along the chain. The primary upstream suppliers are fishermen, who constitute the initial source of marine fish supply. The majority of fishermen channel their catch through fish auction systems, although a proportion also sell directly to wholesalers and collecting traders as part of alternative distribution pathways. Fish auctions represent organised marketplaces where fishermen may sell their catch either through structured bidding mechanisms or non-auction transactions (Acharjee et al., 2023). These institutions play a central role in supporting fish marketing efficiency by facilitating buyer discovery and enabling competitive price formation (Bjørndal et al., 2015; Lahiru Sandaruwan et al., 2026). The auction mechanism is designed to attract potential buyers, strengthen market transparency, and allow fishermen to dispose of their catch rapidly under relatively favourable pricing conditions. Operational control within the auction process is managed by designated agents responsible for coordination and transaction facilitation (Bjørndal et al., 2015; Bush et al., 2019). The next tier in the MFSC consists of collecting traders, who procure fish primarily from auction centres for subsequent resale to wholesalers. These actors typically maintain established market linkages that support the distribution process. Following this stage, wholesalers function as bulk intermediaries, purchasing marine fish in large volumes and redistributing them across different consumer markets and regions. At the downstream end of the chain, SFM operates as the retail entity purchasing marine fish from wholesalers. The primary supply source for SFM is Kobong Market. Due to relatively low consumption volumes, procurement activities are generally conducted on a bi-daily cycle. Flow dynamics within the MFSC are dynamic and interdependent, comprising three core components: product flow, information flow, and financial flow (Arief et al., 2025; Gelsomino et al., 2016). Product flow moves unidirectionally from upstream to downstream, beginning with fishermen and terminating at end consumers via SFM (Yang et al., 2023). In contrast, information flow operates bidirectionally, encompassing upstream and downstream exchanges (Lee & Ha, 2018). This includes market price signals and fluctuations in fish prices, necessitating continuous access to updated information among all actors to mitigate transactional disadvantage. Information dissemination also occurs horizontally, where actors operating at the same hierarchical level exchange relevant market intelligence (Jafari & Naghdi Khanachah, 2025). Financial flow moves in the opposite direction to product flow, from downstream to upstream, and is primarily executed through payment transactions corresponding to the exchange of goods (Abbasi et al., 2024).

Marine Fish Supply Chain Performance Measurement

The performance assessment was conducted across five supply chain actors using the SCOR–AHP framework. Table 1 presents the performance measurement results for fishermen, who achieved an overall score of 3.38. The performance score for "perfect order fulfillment" is 3.62,

indicating that the fishermen demonstrate a reasonably good level of performance in meeting consumer orders. This is supported by the assessment of the specific metrics within the perfect order fulfillment category; the "orders delivered as specified" metric scored 3.79, reflecting the fishermen's strong performance in ensuring the correct product type, accurate quantity, precise delivery location, and timely delivery. The "orders in perfect condition" metric scored 3.45, suggesting that the fishermen are quite capable of ensuring that products arrive with minimal damage and in good, acceptable condition. Regarding the "responsiveness" attribute, the fishermen show good performance, as evidenced by an order fulfillment cycle time score of 4.35. This indicates that the fishermen are able to fulfill orders promptly, in line with consumer expectations. This is further reflected in the procurement cycle time metric, which scored 3.91, demonstrating the fishermen's proficiency in managing their marine catch—encompassing aspects such as site selection, preparation of fishing gear, and the actual fishing process. The handling cycle time scored 4.77, highlighting the fishermen's strong capability in processing their catch, specifically in terms of sorting and storage. In the "flexibility" attribute—represented here by supply chain flexibility—the fishermen achieved a score of 3.67, indicating a reasonable degree of flexibility in meeting consumer demand capacity. The ability of the fishermen to fulfill consumer demand is, however, contingent upon the weather conditions present at the time of fishing. The performance assessment for the cost attribute—measured via supply chain cost metrics (total cost)—at the fisher level yields a score of 2.27. This figure indicates high expenditure, which signifies a low level of efficiency. Some fishers perceive supply chain costs to be quite substantial, particularly those incurred during handling processes. Because fish are highly perishable, they require specialized handling, which drives up costs. Regarding the cash-to-cash cycle, the performance score for fishers is 3.00. This indicates that it takes a relatively long time for fishers to complete their cash cycle, a situation stemming from their rather weak bargaining position. Based on the aggregate of all level-one metrics, the overall performance score for fishers within the marine fish supply chain is 3.38.

The delivery cycle time metric scored 3.00, indicating a satisfactory ability to deliver products according to consumer requirements. Delivery generally takes one day, comprising approximately one hour for loading the products into vehicles, followed by a transit process that takes less than a full day—though longer distances may require additional time. The supply chain flexibility metric scored 3.30, suggesting that participants at the fish auction are reasonably flexible in accommodating increases in consumer demand. This flexibility is contingent upon the availability of products from the fishermen. Finally, the supply chain cost metric for the fish auction participants received a score of 3.62. This value indicates the level of efficiency with which fish auction operators manage their expenditures to cover all activities within the marine fish supply chain. It suggests that the costs associated with handling within the marine fish supply chain are relatively low. The costs incurred by fish auction operators include handling costs (with a score of 4.00) and shipping costs (with a score of 3.14). The cash-to-cash cycle—or the turnover of funds—at the level of fish auction operators is relatively long, as reflected by a score of 3.00. Based on the performance evaluation calculations, the overall performance score for fish auction operators within the marine fish supply

Table 1: Performance Measurement Results of Fishermen

Level Number	Metrics	Weight	Score	Weighted Score
RELIABILITY				
RL 1	Perfect order fulfilment	0.203		**3.62**
RL 2.1	Order sent accordingly	0.526		**3.79**
RL 3.1	Accuracy of product type	0.217	3.38	
RL 3.2	Accuracy of the amount sent	0.232	4.00	
RL 3.3	Accurate delivery location	0.266	3.62	
RL 3.4	On-time delivery	0.285	3.63	
RL 2.2	Order perfect condition	0.474		**3.45**
RL 3.5	Damage free	0.447	3.00	
RL 3.6	Product eligibility	0.553	3.00	
RESPONSIVITY				
RP 1	Order fulfilment cycle time	0.191		**4.35**
RP 2.1	Procurement cycle time	0.50		**3.92**
RP 3.1	Time to select a fishing location	0.288	4.38	
RP 3.2	Fishing gear preparation time	0.403	4.00	
RP 3.3	Arrest time	0.308	3.38	
RP 2.2	Handling cycle time	0.500		**4.77**
Rp 3.4	Sorting time	0.516	3.00	
RP 3.5	Storage time	0.484	3.38	
FLEXIBILITY				
FL 1	Top supply chain flexibility	0.222		**3.67**
FL 2.1	Procurement flexibility	0.484	3.38	
FL 2.2	Delivery flexibility	0.516	4.00	
CHAIN COST				
B1	Supply chain costs	0.206		**2.27**
B 2.1	Handling costs	0.328		**3.76**
B 3.1	Storage costs	0.409	3.63	
B 3.2	Purchase costs	0.263	3.00	
B 3.3	Packaging costs	0.500	3.00	
B 2.2	Shipping costs	0.500		**3.00**
B 3.4	Rental costs	0.516	3.00	
B 3.5	Carriage costs	0.484	3.00	
	ASSET			
A1	Cash-to-cash cycle	0.178		**3.00**
A 2.1	Length of debt repayment	0.500	3.00	
A 2.2	Length of receipt of debt	0.500	3.00	
	Total Performance			**3.38**

Table 2 presents the performance assessment of fish auction agents, who achieved an overall score of approximately 3.55, the highest among the supply chain actors. Based on the performance measurement results, the reliability attribute for fish auction participants—specifically regarding the "perfect order fulfillment" metric—received a score of 3.38. This indicates a reasonably good performance in meeting consumer needs; this is further supported by a score of 3.50 for the "perfect condition order" metric, reflecting a high standard of product quality, free from damage. Regarding the responsiveness attribute, the level-one metric for "order fulfillment cycle time" scored 4.43, demonstrating that fish auction participants are efficient in fulfilling consumer orders. This level-one metric is derived from two level-two metrics: procurement cycle time and delivery cycle time. The procurement cycle time consists of the time taken to select fishermen and the time required to receive products. While the selection of fishermen can occur on an ad-hoc basis, many auction participants have established partnerships with specific fishermen. Typically, product receipt occurs daily or every two days, with the volume of catch varying based on prevailing weather conditions.

Table 2: Performance Measurement Results of Fish Auctions

Level Number	Metrics	Weight	Score	Weighted Score
RELIABILITY				
RL 1	Perfect order fulfilment	0.177		**3.38**
RL 2.1	Order sent accordingly	0.564		**3.30**
RL 3.1	Accuracy of product type	0.186	4.00	
RL 3.2	Accuracy of the amount sent	0.356	3.00	
RL 3.3	Accurate delivery location	0.233	3.00	
RL 3.4	On-time delivery	0.226	3.00	
RL 2.2	Order perfect condition	0.436		**3.50**
RL 3.5	Damage free	0.458	3.50	
RL 3.6	Product eligibility	0.542	3.50	
RESPONSIVITY				
RP 1	Order fulfilment cycle time	0.252		**4.43**
RP 2.1	Procurement cycle time	0.855		**3.00**
RP 3.1	Supplier selection time	0.458	3.00	
RP 3.2	Product receipt cycle time	0.542	3.00	
RP 2.2	Delivery cycle time	0.145		**3.00**
Rp 3.4	Transport cycle time	0.500	3.00	
RP 3.5	Transportation time	0.500	3.00	
FLEXIBILITY				
FL 1	Top supply chain flexibility	0.201		**3.30**
FL 2.1	Procurement flexibility	0.396	3.00	
FL 2.2	Delivery flexibility	0.604	3.50	
CHAIN COST				
B1	Supply chain costs	0.191		**3.62**
B 2.1	Handling costs	0.564		**4.00**
B 3.1	Storage costs	0.269	4.00	
B 3.2	Purchase costs	0.412	4.00	
B 2.2	Shipping costs	0.436		**3.14**
B 3.3	Packaging costs	0.319	4.00	
B 3.4	Rental costs	0.145	4.00	
B 3.5	Carriage costs	0.855	3.00	
	ASSET			
A1	Cash-to-cash cycle	0.179		**3.00**
A 2.1	Length of debt repayment	0.500	3.00	
A 2.2	Delivery time of debt	0.500	3.00	
	Total Performance			**3.54**

The performance measurement results for collecting traders are presented in Table 3. These actors achieved an overall performance score of 3.46, with responsiveness recording the highest score (4.81). Based on the performance measurement of the collecting trader in terms of reliability—specifically the "perfect order fulfillment" metric—their performance can be considered quite good. This is reflected in a perfect order fulfillment score of 3.00, indicating a solid ability to meet consumer demands accurately. This score is supported by a value of 3.00 for both the "orders delivered as requested" metric and the "orders delivered in perfect condition" metric. Regarding the responsiveness attribute, the collecting trader achieved a score of 4.81 for the "perfect order fulfillment cycle time" metric, demonstrating their ability to fulfill consumer requests promptly.

The total time required to fulfill an order is two days: half a day is spent on supplier selection—a process that is typically efficient because the collecting trader already have established partnerships with agents at the Fish Auction Place (TPI). The product receipt cycle takes one day, depending on the availability of fish from the agents at the TPI. The transportation and delivery process is then adjusted based on the destination of the order. The supply chain flexibility metric shows a score of 3.16, indicating that the collecting trader possesses a reasonable degree of flexibility in responding to increases in consumer demand. However, this

flexibility is contingent upon the availability of products from fishermen and the fish auction facilities. In terms of the cost attribute, the supply chain cost metric (total cost) for the collecting trader is 3.15. This relatively high cost suggests a low level of efficiency. The collecting trader perceives their supply chain costs to be significant, particularly those related to handling; because fish are highly perishable, they require specialized handling, which entails higher costs. The cash-to-cash cycle—or the turnover of funds—for the collecting trader is relatively long, as reflected by a score of 3.16. Based on the performance assessment calculations for fish traders, the total performance score for fish auctioneers within the marine fish supply chain is 3.42.

Table 3: Performance Measurement Results of Collecting Traders

Level Number	Metrics	Weight	Score	Weighted Score
RELIABILITY				
RL 1	Perfect order fulfilment	0.196		**3.00**
RL2.1	Order sent accordingly	0.875		**3.00**
RL 3.1	Accuracy of product type	0.228	3.00	
RL 3.2	Accuracy of the amount sent	0.136	3.00	
RL 3.3	Accurate delivery location	0.357	3.00	
Level Number	**Metrics**	**Weight**	**Score**	**Weighted Score**
RL 3.4	On-time delivery	0.279	3.00	
RL 2.2	Order perfect condition	0.125		**3.00**
RL 3.5	Damage free	0.250	3.00	
RL 3.6	Product eligibility	0.750	3.00	
RESPONSIVITY				
RP 1	Order fulfilment cycle time	0.227		**4.81**
RP 2.1	Procurement cycle time	0.875		**3.00**
RP 3.1	Supplier selection time	0.125	3.00	
RP 3.2	Product receipt cycle time	0.875	3.00	
RP 2.2	Delivery cycle time	0.125		**3.16**
RP 3.4	Transport cycle time	0.167	4.00	
RP 3.5	Transportation time	0.833	3.00	
FLEXIBILITY				
FL 1	Top supply chain flexibility	0.188		**3.16**
FL 2.1	Procurement flexibility	0.167	3.00	
FL 2.2	Delivery flexibility	0.833	4.00	
CHAIN COST				
B1	Supply chain costs	0.220		**3.15**
B 2.1	Handling costs	0.875		**3.10**
B 3.1	Storage costs	0.278	3.00	
B 3.2	Purchase costs	0.330	3.00	
B 3.3	Packaging costs	0.391	4.00	
B 2.2	Shipping costs	0.125		**3.56**
B 3.4	Rental costs	0.267	3.00	
B 3.5	Carriage costs	0.833	4.00	
	ASSET			
A1	Cash-to-cash cycle	0.168		**3.16**
A 2.1	Length of debt repayment	0.167	3.00	
A 2.2	Delivery time of debt	0.833	3.00	
	Total Performance			**3.46**

Table 4 summarises the performance assessment of wholesalers, who achieved an overall score of 3.42. Based on the performance measurement of wholesaler's reliability, the "perfect order fulfillment" metric is considered quite good, with a score of 3.26. This indicates a solid capability on the part of the wholesalers to fulfill orders in accordance with consumer requests. This is reflected in the "orders delivered correctly" metric—which scored 3.77—covering the accuracy of the product type, quantity delivered, delivery location, and timeliness. Regarding the "responsiveness" attribute, wholesalers achieved a score of 3.55 for the "perfect order

fulfillment cycle time" metric. This demonstrates a good level of capability in meeting consumer demand. Fulfilling a consumer order takes two days: half a day is spent on supplier selection—a process that is generally quick, as traders typically have established partnerships with wholesalers—while the product receipt cycle takes one day, depending on the availability of fish from the wholesalers. The transportation and delivery process is then adjusted based on the destination of the order. The supply chain flexibility metric yielded a score of 3.50, indicating that wholesalers are sufficiently flexible in accommodating increases in consumer demand. This flexibility is contingent upon product availability from fishermen, fish auction sites, and wholesalers. In terms of supply chain costs, traders received a score of 3.56, reflecting their ability to manage expenditures efficiently across all activities within the marine fish supply chain. This suggests that the costs associated with handling the marine fish supply chain are relatively low. Specifically, the costs incurred by traders include handling costs (scored at 3.50) and delivery costs (scored at 3.62). The cash-to-cash cycle time—or the speed of cash turnover—at the trader level is quite long; this is reflected by a score of 3.25. Based on the performance assessment of wholesalers, the overall performance score for fish auctioneers within the marine fish supply chain is 3.42.

Table 4: Performance Measurement Results of Wholesalers

Level Number	Metrics	Weight	Score	Weighted Score
RELIABILITY				
RL 1	Perfect order fulfilment	0.201		**3.08**
RL2.1	Order sent accordingly	0.604		**3.77**
RL 3.1	Accuracy of product type	0.201	3.50	
RL 3.2	Accuracy of the amount sent	0.242	3.50	
RL 3.3	Accurate delivery location	0.285	4.00	
RL 3.4	On-time delivery	0.272	4.00	
RL 2.2	Order perfect condition	0.396		**2.50**
RL 3.5	Damage free	0.285	4.50	
RL 3.6	Product eligibility	0.272	4.50	
Level Number	**Metrics**	**Weight**	**Score**	**Weighted Score**
RESPONSIVITY				
RP 1	Order fulfilment cycle time	0.207		**3.55**
RP 2.1	Procurement cycle time	0.50		**3.75**
RP 3.1	Supplier selection time	0.50	3.75	
RP 3.2	Product receipt cycle time	0.50	3.75	
RP 2.2	Delivery cycle time	0.50		**3.35**
RP 3.4	Delivery scheduling cycle time	0.468	3.75	
RP 3.5	Transportation time	0.532	3.75	
FLEXIBILITY				
FL 1	Top supply chain flexibility	0.206		**3.50**
FL 2.1	Procurement flexibility	0.500	3.00	
FL 2.2	Delivery flexibility	0.500	4.00	
CHAIN COST				
B1	Supply chain costs	0.201		**3.56**
B 2.1	Handling costs	0.500		**3.50**
B 3.1	Storage costs	0.397	3.50	
B 3.2	Purchase costs	0.302	3.50	
B 3.3	Packaging costs	0.302	3.50	
B 2.2	Shipping costs	0.500		**3.62**
B 3.4	Rental costs	0.500	3.50	
B 3.5	Carriage costs	0.500	3.75	
	ASSET			
A1	Cash-to-cash cycle	0.186		**3.25**
A 2.1	Length of debt repayment	0.500	3.50	
A 2.2	Delivery time of debt	0.500	3.00	
	Total Performance			**3.42**

The performance measurement results for Seahood Fresh Market are presented in Table 5. Based on the performance measurement of Seahood Fresh Market's reliability, the "perfect order fulfillment" metric can be considered quite good, with a score of 3.12. This indicates a solid capability in fulfilling orders in accordance with consumer demands. This is further reflected in the "orders delivered as requested" metric, which scored 3.48—a figure based on the accuracy of product type, quantity, delivery location, and on-time delivery. Regarding the responsiveness attribute, Seahood Fresh Market achieved a score of 3.25 for the "perfect order fulfillment cycle time" metric. This suggests a moderate level of capability in meeting consumer demand. The fulfillment process takes two days, with half a day dedicated to supplier selection—a swift process made possible by existing partnerships, such as with the stall owned by Haji Tain. The product receipt cycle takes one day, contingent upon the availability of fish from wholesalers. Scheduling and delivery processes are then adjusted based on the destination of each order.The supply chain flexibility metric scored 3.17, indicating that Seahood Fresh Market possesses a reasonable degree of flexibility in accommodating increases in consumer demand. This flexibility is contingent upon product availability from various sources, including fishermen, fish auction sites, intermediaries, and traders. In terms of the cost attribute, the supply chain cost metric (total cost) for Seahood Fresh Market yielded a score of 3.13. This relatively high-cost figure points to a lower level of efficiency.

Table 5: Performance Measurement Results of Seahood Fresh Market

Level Number	Metrics	Weigh	Score	Weighted Score
RELIABILITY				
RL 1	Perfect order fulfilment	0.207		**3.12**
RL 2.1	Order sent accordingly	0.250		**3.48**
RL 3.1	Accuracy of product type	0.330	3.00	
RL 3.2	Accuracy of the amount sent	0.194	4.00	
RL 3.3	Accurate delivery location	0.3	4.00	
RL 3.4	On-time delivery	0.279	3.00	
RL 2.2	Order perfect condition	0.125		**3.00**
RL 3.5	Damage free	0.250	3.00	
RL 3.6	Product eligibility	0.750	3.00	
RESPONSIVITY				
RP 1	Order fulfilment cycle time	0.227		**3.25**
RP 2.1	Procurement cycle time	0.875		**3.25**
RP 3.1	Supplier selection time	0.125	3.00	
RP 3.2	Product receipt cycle time	0.875	3.00	
RP 2.2	Delivery cycle time	0.125		**3.25**
RP 3.4	Delivery scheduling cycle time	0.167	4.00	
RP 3.5	Transportation time	0.833	3.00	
FLEXIBILITY				
FL 1	Top supply chain flexibility	0.188	**3.17**	
FL 2.1	Procurement flexibility	0.167	**3.00**	
FL 2.2	Delivery flexibility	0.833	**4.00**	
SUPPLY CHAIN COSTS				
B1	Supply chain costs	0.220	**3.13**	
B 2.1	Handling costs	0.875	**3.16**	
B 3.1	Storage costs	0.278	**2.00**	
B 3.2	Purchase costs	0.330	**3.00**	
B 3.3	Packaging costs	0.391	**3.00**	
B 2.2	Shipping costs	0.125	**3.00**	
B 3.4	Rental costs	0.267	**3.00**	
B 3.5	Carriage costs	0.833		
	ASSET			
A1	Cash-to-cash cycle	0.168	**3.95**	
A 2.1	Length of debt repayment	0.167	**5.00**	
A 2.2	Delivery time of debt	0.833	**4.00**	
	Total Performance		**3.32**	

Seahood Fresh Market identifies its supply chain costs as significant, particularly those incurred during the handling process. The highly perishable nature of fish necessitates specialized handling, which entails high costs. The cash-to-cash cycle—or the turnover of funds—within the Seahood Fresh Market system is relatively long, as reflected by a score of 3.32. Based on performance evaluations, the total performance score for fish auctioneers within the marine fish supply chain is 3.16. An assessment of the performance of participants in the marine fish supply chain—facilitated by Seahood Fresh Market—reveals the individual performance scores for each stakeholder. The overall performance of the marine fish supply chain via Seahood Fresh Market in Sleman Regency is 3.18. This figure is derived from the aggregated performance scores of all supply chain participants: 3.38 for fishers, 3.55 for agents at the Fish Auction Place (TPI), 3.42 for local traders , 3.38 for merchants, and 3.16 for Seahood Fresh Market.

Table 6 provides a comparative summary of the performance of all supply chain actors across the five SCOR dimensions. The overall marine fish supply chain performance score was 3.38, indicating moderate performance with opportunities for further improvement. Based on the recapitulation of performance evaluations for each supply chain participant, as shown in Table 6, agents at the Fish Auction Place (TPI) achieved the highest total performance score of 3.55. They are followed by local traders with a score of 3.46, general traders with 3.42, fishermen with 3.38, and Seahood Fresh Market with 3.32. The performance attributes, represented by level-1 metrics, indicate the capabilities of each supply chain participant. Agents at the TPI scored 3.62 in the supply chain cost category—the highest among all participants—suggesting that they possess a higher level of capital. Furthermore, these agents also hold a strong bargaining position. Conversely, Seahood Fresh Market recorded the lowest total performance score, primarily due to its performance in order fulfillment; specifically, the marine fish were not sufficiently fresh. This lack of freshness stems from the time-consuming transportation process, which leads to a decline in fish quality by the time the products are offered to consumers.

Based on the aggregated performance evaluation across MFSC actors, fish auction agents recorded the highest overall score (3.55), followed by collecting traders (3.46), wholesalers (3.42), fishermen (3.38), and SFM (3.32). These results, derived from Level-1 metric attributes, reflect the operational capability and effectiveness of each stakeholder within the MFSC structure. In terms of cost-related performance indicators, fish auction agents also recorded the highest value (3.62), indicating comparatively greater capital availability and stronger bargaining leverage within transactions (Mwanjali et al., 2026). Conversely, SFM exhibited the lowest overall performance score, primarily attributed to weaknesses in order fulfilment efficiency. This limitation is closely associated with reduced product freshness, arising from time-consuming transportation processes, which in turn leads to quality degradation of marine fish by the time it reaches end consumers (Zhang et al., 2019).

Table 6: Summary of Assessments for Each Supply Chain Actor

Attribute	Level 1 Metrics	Performance of Supply Chain Actors					Chain Performance
		Fishermen	Fish Auction Actors	Collecting Traders	Wholesalers	Seahood Fresh Market	
Reliability	Perfect order fulfilment	3.62	3.38	3.00	3.08	3.12	3.24
Responsiveness	Order fulfilment cycle time	4.35	4.43	4.81	3.55	3.25	4.08
Flexibility	Top supply chain flexibility	3.67	3.30	3.16	3.50	3.17	3.36
Cost	Supply chain costs	2.27	3.62	3.15	3.56	3.13	3.14
Asset Management	Cash cycle time	3.00	3.00	3.00	3.25	3.12	3.07
Total Performance		3.38	3.55	3.42	3.38	3.16	3.38

Formulation of Strategies to Improve Marine Fish Supply Chain Performance

Gap Analysis

The gap value within the MFSC indicates the extent to which each performance dimension deviates from the desired or target level, thereby identifying areas that require improvement. It also serves as a diagnostic tool for assessing the effectiveness of performance enhancement planning, enabling the formulation of targeted interventions for future MFSC optimisation.

Analysis of Marine Fish Supply Chain Problems

The analysis of MFSC conditions alongside performance measurement outcomes indicates that the performance level of marine fish distribution through SFM is relatively low and does not meet the expectations of supply chain actors. The observed gap between actual and target performance suggests that the MFSC operating through SFM is neither effective nor efficient. Consequently, the core issue requiring attention among all involved stakeholders is the underlying inefficiency and ineffectiveness of the MFSC. To identify the root causes of these inefficiencies, a fishbone (Ishikawa) diagram was employed (Suárez-Barraza & Rodríguez-González, 2019). Based on brainstorming sessions and in-depth interviews with MFSC actors, several contributing factors were identified, including uncertain fish supply availability, high operational costs, volatile fish prices, and inadequate handling or storage of fish waste. These factors constitute the primary (master) fishbone structure. Subsequently, each major causal category was further decomposed into more specific sub-causes in a secondary (child) fishbone diagram. The master diagram is illustrated in Figure 2.

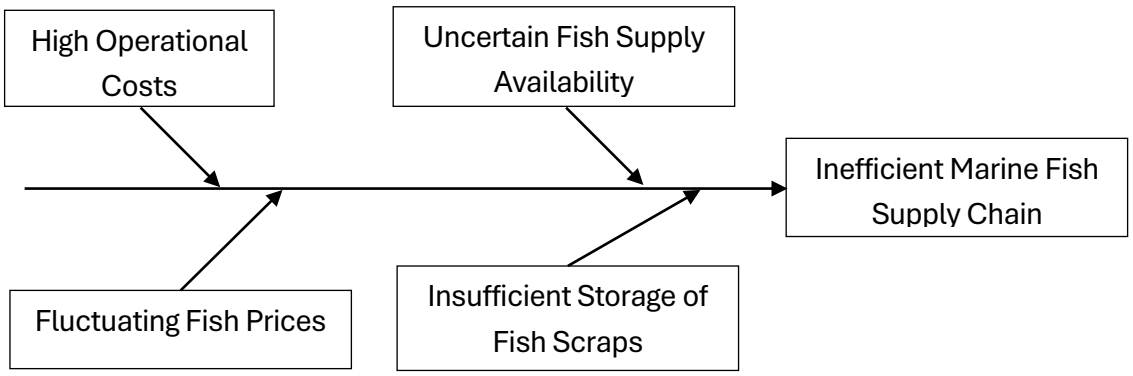


Figure 2: Parent Fishbone Diagram

Uncertain Availability of Marine Fish

The low performance of this attribute is primarily attributable to inadequate marine fish availability within the MFSC(Belton et al., 2021; Nattassha et al., 2019). This shortage is driven by several interrelated factors, including inaccurate fishing location identification, unreliable weather estimation, insufficient fuel supply for fishing operations, and low catch yields, all of which collectively constrain overall fish availability. Poor fishing outcomes resulted in reduced fish supply, leading to overall scarcity within the MFSC. This decline in availability is driven by multiple interrelated factors, including low accuracy in weather forecasting, imprecise

location identification for fishing activities, and disruptions caused by marine ecological imbalance (Samarajeewa, 2023). Consequently, the reduced upstream supply propagated through subsequent MFSC stages, constraining downstream distribution and ultimately contributing to increased market prices for fish.

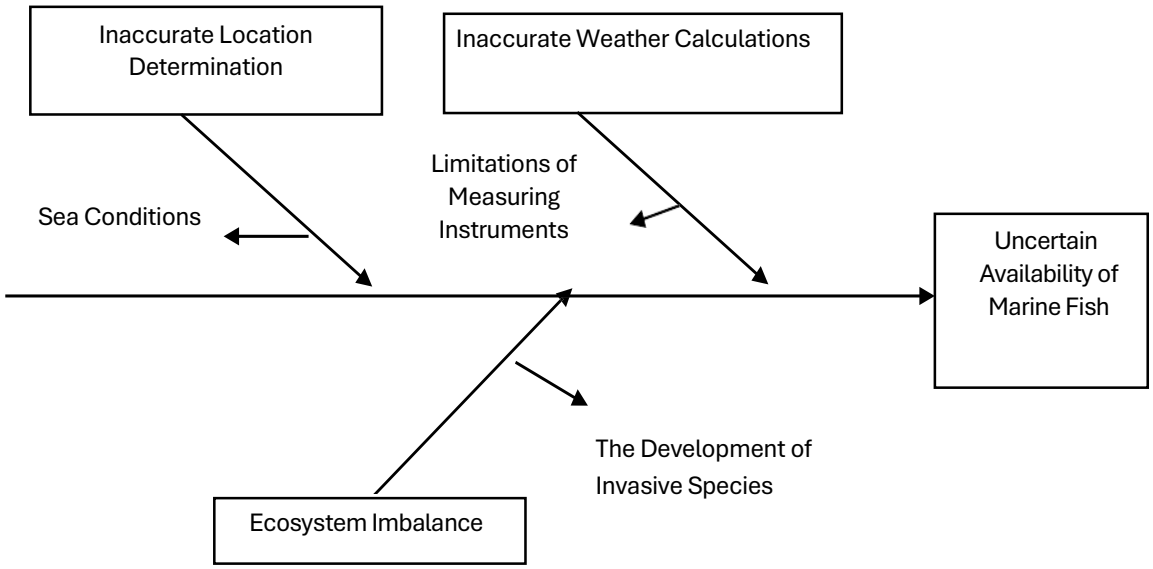


Figure 3: Fishbone Diagram of Uncertain Marine Fish Availability

High Operational Costs

Operational costs exerted a significant influence on MFSC performance and overall efficiency (Zavitsas et al., 2018). These costs comprise multiple interrelated components that directly affect system profitability and operational effectiveness. As illustrated in the fishbone diagram presented in Figure 4, several underlying factors contribute to elevated operational expenditures within the MFSC.

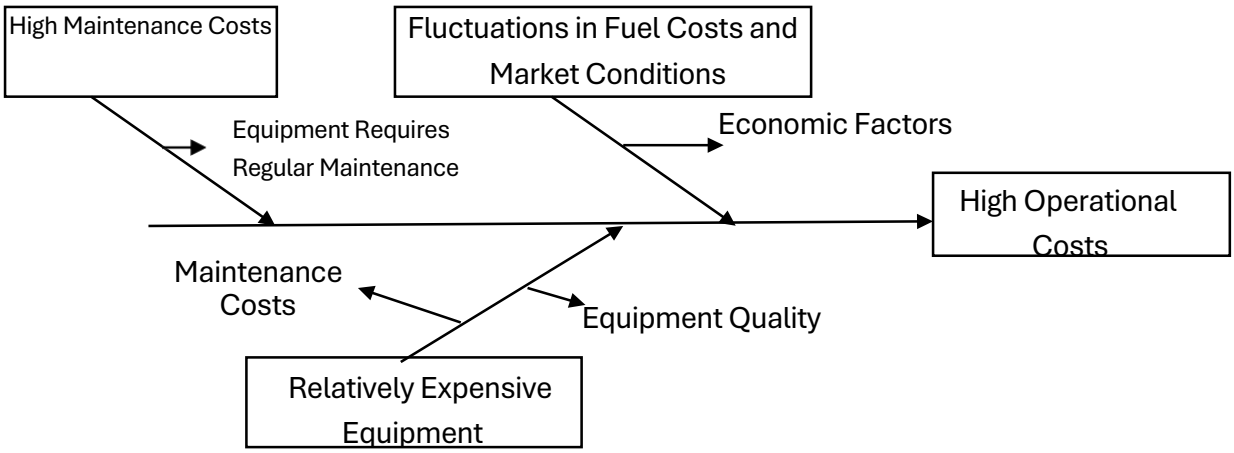


Figure 4: Fishbone Diagram of Causes of High Operational Costs

Inappropriate Inventory Management

Several factors contributed to inefficiency and ineffectiveness within the MFSC, with weak inventory management being a key determinant (Heaver & Atkins, 2024; Yuen & Thai, 2017). Poor planning and control of stock levels resulted in either shortages or excessive accumulation of supply. Such imbalances were largely driven by demand uncertainty and inaccurate forecasting, which disrupted equilibrium between supply and demand (Haslindah et al., 2020). As illustrated in Figure 5, inappropriate inventory management is associated with limited fish stock information, fluctuations in fishing and production, and inadequate storage conditions. These factors collectively contribute to inventory uncertainty and reduce the efficiency of fish distribution throughout the supply chain.

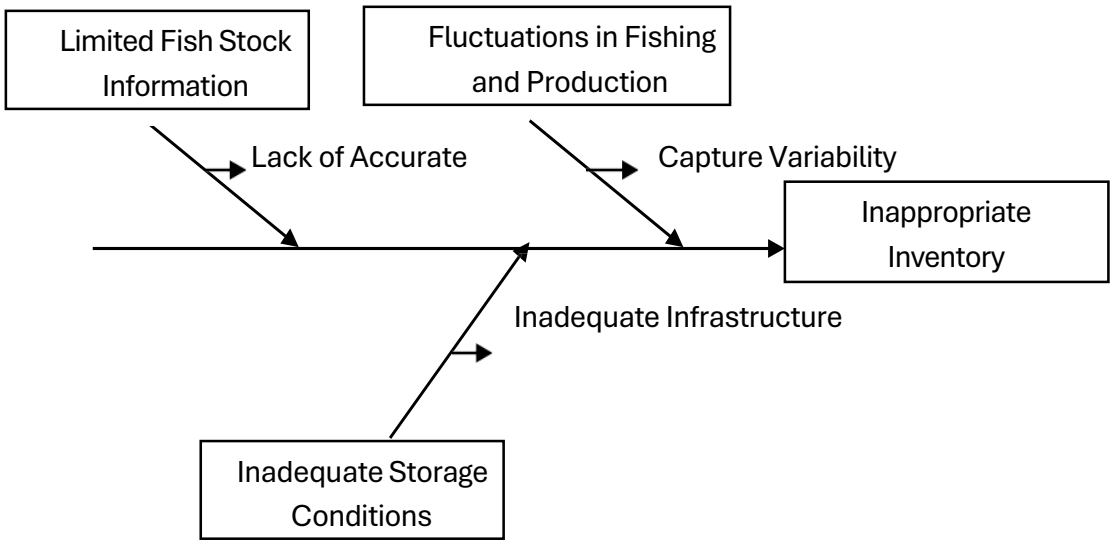


Figure 5: Fishbone Diagram of Causes of Inappropriate Inventory Management

Fluctuating Fish Prices

Price volatility within the MFSC arises primarily from disequilibrium between supply availability and consumer demand. When supply exceeds demand, commodity prices tend to decline; conversely, supply shortages lead to price escalation (Hao & Ki-Seong, 2024). In addition, the highly perishable nature of fish products, combined with limited access to timely market price information, places fishermen in a structurally weak bargaining position (Ferrer-Pérez & Gracia-de-Rentería, 2020). Such price instability is closely associated with suboptimal management of supply availability. Figure 6 illustrates the major factors contributing to fluctuating fish prices, including production costs, market uncertainty, and changes in the external regulatory environment. These interlinked factors form a causal chain that generates adverse effects across the MFSC, ultimately undermining its stability and efficiency.

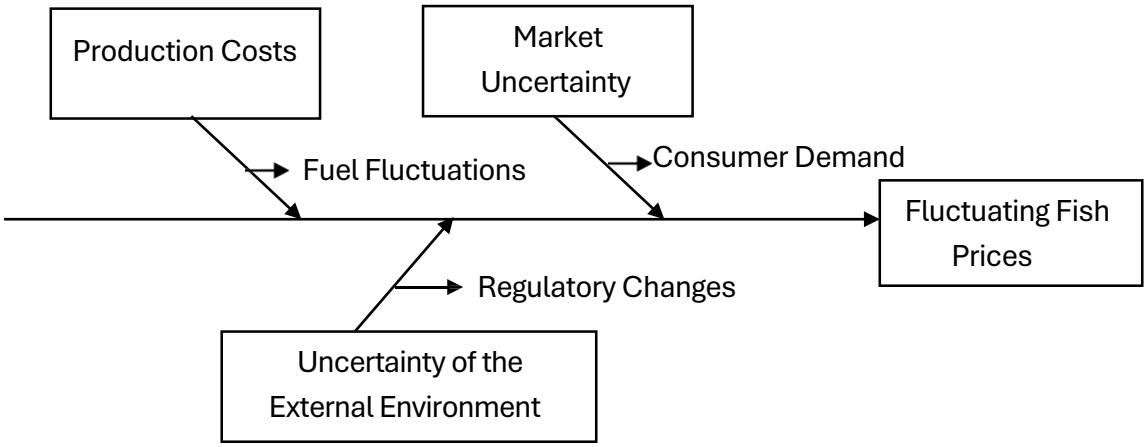


Figure 6: Fishbone Diagram of Causes of Fluctuating Fish Prices

After identifying the causal factors contributing to the inefficiency and ineffectiveness of the MFSC through SFM, a pairwise comparison approach was applied to determine their relative importance. This weighting process was undertaken to prioritise the factors requiring immediate managerial intervention. The resulting weight distribution is presented in Table 7. According to Table 7, weak inventory management, price volatility, elevated operational costs, and uncertain fish availability remain key constraints undermining the effectiveness and efficiency of the MFSC.

Table 7: Results of Weighting the Causes of the Ineffective and Inefficient Marine Fish Supply Chain

Priority	Causative Factors	Weight
1	Inappropriate Inventory Management	**0.317**
2	Fluctuating Fish Prices	**0.247**
3	High Operational Costs	**0.227**
4	**Uncertain Availability of Fish**	**0.208**

Strategy for Improving Marine Fish Supply Chain Performance

Based on the results of the gap analysis, condition assessment, and performance evaluation, a set of improvement measures has been formulated to enhance MFSC performance through SFM in Sleman Regency. These proposed actions are derived from a structured identification of MFSC problems and their underlying causes. The detailed recommendations are presented in Table 8. Effective implementation of these measures requires strong commitment from all MFSC stakeholders through the execution of a comprehensive, measurable action plan supported by continuous monitoring and evaluation. From a governance perspective, regulatory support is essential, particularly the active role of government authorities at both national and regional levels, alongside relevant institutional bodies. In addition, active participation from the community and business actors is crucial to ensure the successful execution and sustainability of the proposed interventions.

Table 8: Strategy for Improving Marine Fish Supply Chain Performance through Seahood Fresh Market

No	Problem	Basic Cause	Root Cause	Strategy
1	Inappropriate inventory management	Fishing and production fluctuations	Fishing variability	Counselling related to consistent fisheries regulations, which includes: a. Implementation of fishing quotas b. Implementation of minimum fishing sizes c. Implementation of fishing season restrictions d. Implementation of environmentally friendly fishing equipment
		Limited fish stock information	Lack of accurate data	Facilitating monitoring and mapping technology
		Inadequate storage conditions	Adequate infrastructure	Revitalization and storage optimization
2	Fluctuating fish prices	Market uncertainty	Changes in consumer demand	a. Development of environmentally friendly products b. Building strategic partnerships c. Using digital technology such as e-commerce platforms
		Production costs	Fuel fluctuations	a. Fuel subsidies b. Facilitating energy-efficient ship technology c. Development of collaboration in fuel purchasing d. Facilitating the use of navigation technology and monitoring
				e.
		Uncertainty of the external environment	Regulatory changes	a. Counselling and training related to regulations b. Building cooperation with related parties (local government, fisheries authorities, and environmental organizations) c. Information technology outreach to follow regulatory updates and obtain real-time information
3	High operational costs	Fluctuations in fuel costs and market conditions	Economic aspect	a. Fuel subsidies b. Building fishermen associations to strengthen their bargaining position in purchasing fuel c. Extension related to government programs
		High maintenance costs	Equipment requires routine maintenance	a. Providing credit with low-interest b. Providing subsidy or financial assistance programs c. Building partnerships with industry and NGOs
		Relatively expensive equipment	Equipment quality	a. Special subsidies b. Equipment supply program c. Creating collaboration with private industry
4	Uncertain availability of marine fish	Inaccurate weather calculations	Limitations of measuring instruments	a. Providing assistance and subsidies b. Extension related to local technology development c. Collaborative training with weather experts
		Incorrect location determination	Sea conditions	a. Counselling and training related to understanding sea conditions and determining the right location b. Providing counselling regarding Geographic Information Systems (GIS)
		Ecosystem imbalance	The development of invasive species	a. Collaborating with research institutions for routine surveillance and monitoring to detect early the presence of invasive species b. Counselling and training to develop control methods for species invasive

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study analysed the structure and performance of the MFSC serving SFM using an integrated SCOR–AHP framework. The findings lead to three main conclusions.

1. The MFSC, extending from upstream suppliers (fishermen) to end consumers, exhibits a relatively short and streamlined configuration due to the perishable nature of fisheries products, which require rapid distribution to prevent quality deterioration. The chain comprises fishermen, fish auction agents, collecting traders, wholesalers, SFM, and final consumers. This network has evolved organically and has been operational for a prolonged period. Its development is largely informal, with the capabilities of MFSC actors being primarily shaped by experience and access to capital in both production and distribution activities.

2. The overall MFSC performance score through SFM in Sleman Regency was 3.38. Comparative results indicate that fish auction agents achieved the highest performance level, followed sequentially by collecting traders, wholesalers, fishermen, and finally SFM, which recorded the lowest performance. The weaker performance of SFM is mainly attributed to suboptimal order fulfilment, reflected in reduced fish freshness. Transport delays further contribute to quality degradation, thereby lowering product value at the point of consumption.

3. Key strategies for improving MFSC performance through SFM include strengthening dissemination of fisheries regulations, enabling monitoring and mapping technologies, improving storage systems through revitalisation and optimisation, promoting environmentally sustainable product practices, establishing strategic partnerships, providing fuel subsidies, enhancing awareness of government programmes, supporting local technological innovation, and delivering training and capacity-building on Geographic Information Systems (GIS).

Recommendations

Based on the findings, MFSC actors operating through SFM in Sleman Regency demonstrate varying levels of performance across the supply network. Accordingly, targeted strategic interventions are required at each stage of the chain to strengthen operational capabilities and improve responsiveness in meeting consumer demand.

Limitations and Future Research Directions

This study is subject to several limitations that should be recognised. First, it is based on a single-case analysis of SFM with a relatively limited number of respondents, which constrains the extent to which the findings can be generalised to other MFSC contexts. Second, parts of the SCOR-based performance evaluation rely on perception-based scoring rather than fully objective operational datasets, which may introduce a degree of response bias. Third, the cross-sectional research design does not account for temporal variability, particularly seasonal fluctuations in catch volumes, price instability, and weather-induced risks that are inherent in marine fisheries systems. Future research should address these limitations by adopting longitudinal and multi-case comparative designs to enhance external validity. It should also incorporate more objective quantitative performance indicators and undertake comprehensive cost–benefit analyses of proposed interventions, particularly in relation to cold-chain

infrastructure investment, digital information system adoption, and alternative governance or contractual arrangements aimed at improving coordination and overall MFSC efficiency.

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