



Assessing the Integration of Environmental Management Systems and Green Supply Chain Management for Sustainable Supply Chains: A Green SCOR Gap Analysis

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Abstract: Environmental Management Systems (EMS) have been widely implemented to improve organizational environmental performance; however, their integration with Green Supply Chain Management (GSCM) remains limited, particularly in the seafood processing industry. This study aims to evaluate the gap between operational-level EMS implementation and integrated GSCM practices at PT. IAMBEU Mina Utama while identifying priority improvement areas to strengthen sustainable supply chain performance. A quantitative-evaluative case study approach was employed using the Green Supply Chain Operations Reference (Green SCOR) framework covering the Plan, Source, Make, Deliver, and Return processes. Data were collected through Likert-scale questionnaires, interviews, field observations, and document analysis. Gap analysis and priority assessment based on environmental and operational impacts were applied to determine critical Key Performance Indicators (KPIs). The results show that EMS implementation (4.20) exceeds GSCM implementation (3.89), indicating a moderate integration gap. The largest gaps were identified in the Return, Deliver, and Plan processes, while priority KPIs include waste management monitoring, circular economy implementation, supplier environmental evaluation, transportation emission monitoring, energy efficiency, and production waste management. The findings indicate that although the company has established a strong internal environmental management system, sustainability practices have not been fully integrated across the supply chain. This study contributes to the development of EMS-GSCM integration using the Green SCOR framework and provides practical recommendations to support sustainable supply chain performance in line with the Sustainable Development Goals, particularly SDG 12 (Responsible Consumption and Production).

Keywords: Environmental management system; Green supply chain management; Green SCOR; Sustainable development goals; Sustainable supply chain

Introduction

Environmental sustainability has become one of the most critical strategic priorities in industrial development due to the escalating challenges of climate change, environmental degradation, resource depletion, and increasingly stringent environmental regulations. Over the past decade, industries have been expected not only to achieve economic growth but also to minimize the environmental impacts generated throughout their

production systems. This paradigm shift has transformed sustainability from a voluntary corporate initiative into an essential component of organizational competitiveness and long-term business resilience. Consequently, manufacturing companies are increasingly required to integrate environmental considerations into operational decision-making and supply chain management to support sustainable industrial development. According to Centobelli et al. (2023), industrial sustainability can only be achieved

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through the integration of environmental management, resource efficiency, technological innovation, and collaboration across supply chain networks. Furthermore, Zhang (2022) emphasized that environmental sustainability has become a fundamental element of modern industrial management because stakeholders, including governments, customers, and international markets, increasingly demand environmentally responsible production systems. In the fisheries sector, these challenges are even more significant due to the industry's dependence on natural resources, intensive energy consumption, complex cold-chain logistics, and increasing international requirements for product traceability and sustainable sourcing.

Recent studies also demonstrate that digital technologies and organizational innovation have become important enablers of sustainable fisheries supply chains. For example, Prananta et al. (2025) found that blockchain technology significantly improves transparency, traceability, and collaboration among stakeholders within fisheries supply chains, while Rachman et al. (2025) highlighted that green innovation enhances sustainable organizational performance by strengthening environmental responsibility and organizational competitiveness. Collectively, these findings indicate that environmental sustainability should no longer be viewed as an isolated operational responsibility but rather as a strategic approach integrating environmental, technological, and supply chain management principles throughout the entire value chain.

Within this context, the Environmental Management System (EMS) has become one of the most widely adopted management frameworks for systematically improving organizational environmental performance. Based on the ISO 14001:2015 standard, EMS provides organizations with a structured approach for identifying environmental aspects, ensuring legal compliance, minimizing pollution, improving resource efficiency, and promoting continuous environmental improvement through the Plan-Do-Check-Act (PDCA) cycle.

According to Govindan et al. (2021), EMS serves as the foundation for establishing an organizational culture that supports environmental governance by integrating environmental planning, implementation, monitoring, evaluation, and continual improvement into routine business operations. Similarly, Fiqra et al. (2023) demonstrated that organizations implementing ISO 14001-based EMS achieved better environmental performance through systematic waste management, stronger environmental policies, continuous monitoring, and improved organizational commitment toward environmental protection.

Nevertheless, despite these advantages, numerous studies have argued that EMS implementation often remains focused on internal organizational activities and administrative compliance rather than extending environmental responsibility throughout the supply chain. Nazir et al. (2024) reported that many organizations continue to implement EMS primarily as a compliance-oriented management system, limiting its effectiveness in addressing environmental impacts associated with procurement, supplier management, logistics, product distribution, and reverse logistics. Similarly, Marisa et al. (2024) observed that many fisheries processing companies in

Indonesia have implemented EMS mainly to satisfy certification and regulatory requirements, while its integration into broader sustainable supply chain practices remains relatively limited. These findings suggest that although EMS provides a strong foundation for internal environmental management, its effectiveness in achieving comprehensive sustainability largely depends on how successfully environmental principles are integrated into operational supply chain activities.

To overcome the limitations of conventional Environmental Management Systems, Green Supply Chain Management (GSCM) has emerged as a strategic approach that integrates environmental considerations into every stage of supply chain activities, including product planning, raw material procurement, manufacturing, distribution, and reverse logistics. Unlike EMS, which primarily emphasizes internal environmental governance, GSCM extends sustainability principles beyond organizational boundaries by promoting collaboration among suppliers, manufacturers, distributors, customers, and other stakeholders to minimize environmental impacts throughout the product life cycle.

Recent studies have further demonstrated that supply chain sustainability depends not only on environmental initiatives but also on the effectiveness and efficiency of supply chain operations. Putri et al. (2024) emphasized that an efficient supply chain enables organizations to distribute environmental and economic benefits more equitably among all stakeholders while improving operational performance through better coordination, responsiveness, and resource utilization. Their study also highlights that performance measurement is essential for identifying inefficient operational processes and supporting evidence-based improvement strategies across supply chain networks. These findings reinforce the importance of integrating environmental management with systematic supply chain performance evaluation to ensure that sustainability objectives are consistently achieved throughout the value chain.

According to Govindan et al. (2018), GSCM aims to improve resource efficiency, reduce emissions and waste generation, strengthen environmental compliance, and enhance organizational competitiveness without compromising economic performance. Similarly, Sarkis et al. (2022) emphasized that effective GSCM implementation requires the integration of green purchasing, eco-design, green manufacturing, green logistics, waste management, and reverse logistics into a unified environmental management strategy. Furthermore, Khan et al. (2022) argued that GSCM contributes significantly to the achievement of the triple bottom line by simultaneously improving environmental quality, economic performance, and social responsibility.

Recent empirical evidence also supports the strategic role of GSCM in promoting organizational sustainability. Rachman et al. (2025) demonstrated that green innovation enhances sustainable organizational performance by encouraging environmentally responsible operational practices, while Mahdi and Jonny (2025) found that digitalization and supply chain resilience strengthen organizational adaptability and operational performance under dynamic business environments. Likewise, Prananta et al. (2025) highlighted that blockchain-based traceability systems improve transparency, stakeholder trust, and sustainability within fisheries supply chains. Collectively, these studies suggest that environmental sustainability can no longer rely solely on internal environmental management but requires integrated green practices throughout the entire supply chain.

The importance of integrating Environmental Management Systems and Green Supply Chain Management is particularly evident in the fisheries processing industry, where production activities depend heavily on natural resources and involve complex supply chain networks. Fisheries processing companies consume substantial amounts of water and energy, generate organic waste and wastewater, rely on temperature-controlled logistics, and face increasingly stringent international requirements regarding food safety, environmental compliance, and product traceability.

Consequently, environmental sustainability within this sector depends not only on improving internal operational performance but also on strengthening environmental responsibility across procurement, production, logistics, distribution, and product recovery activities. Casino et al. (2019) emphasized that traceability systems have become essential for ensuring seafood sustainability and maintaining access to international markets, particularly in Europe and North America. Likewise, the Food and Agriculture Organization (FAO, 2024) reported that sustainable

fisheries increasingly require integrated environmental management and transparent supply chain governance to respond to global market demands. In Indonesia, however, Marisa et al. (2024) found that many fisheries processing companies remain at the compliance maturity stage, where Environmental Management Systems are primarily implemented to satisfy regulatory and certification requirements rather than to support comprehensive Green Supply Chain Management practices. Similar challenges are also observed at PT. IAMBEU Mina Utama, which has implemented Environmental Management Systems to improve operational environmental performance through waste management, efficient water and energy utilization, and compliance with environmental standards.

Nevertheless, based on the background presented in this study, several challenges remain, including limited environmental traceability systems, inconsistent implementation of environmental standard operating procedures across operational processes, insufficient environmental awareness among small-scale suppliers, and weak environmental monitoring throughout the supply chain. These conditions indicate that although the company has established a relatively strong Environmental Management System, the integration of sustainability principles into Green Supply Chain Management practices has not yet been fully optimized, highlighting the need for a comprehensive evaluation of the implementation gap between internal environmental management capabilities and sustainable supply chain practices.

Recent studies have extensively investigated environmental sustainability from various perspectives, including Environmental Management Systems (EMS), Green Supply Chain Management (GSCM), green innovation, digital transformation, and supply chain resilience. Fiqra et al. (2023) demonstrated that the implementation of an ISO 14001-based Environmental Management System significantly improves environmental performance through systematic environmental planning, waste management, continuous monitoring, and organizational commitment to environmental protection. These findings confirm that EMS provides an effective foundation for strengthening internal environmental governance and ensuring regulatory compliance.

However, the study primarily focused on environmental management within organizational boundaries and did not evaluate how internal environmental capabilities influence sustainability performance throughout supply chain activities. In contrast, Rachman et al. (2025) argued that green innovation serves as a critical driver of sustainable organizational performance by encouraging environmentally responsible operational practices and

enhancing organizational competitiveness. Similarly, Prananta et al. (2025) demonstrated that blockchain-based traceability systems improve transparency, stakeholder trust, and operational efficiency in fisheries supply chains, thereby supporting the achievement of sustainable fisheries management.

Meanwhile, Mahdi et al. (2025) emphasized that digitalization and supply chain resilience enhance organizational adaptability and operational performance under increasingly dynamic business environments, whereas Djohar et al. (2025) highlighted the importance of ecosystem resilience in maintaining logistics continuity and minimizing environmental risks.

Although these studies collectively reinforce the importance of integrating environmental management, technological innovation, and resilient supply chain systems, they predominantly examine these dimensions independently without explicitly evaluating the relationship between internal Environmental Management Systems and operational Green Supply Chain Management practices. This indicates that current sustainability research has yet to provide a comprehensive understanding of how organizational environmental capabilities are translated into environmentally responsible supply chain operations.

A review of previous empirical studies also reveals that research on Green Supply Chain Management has primarily concentrated on evaluating environmental performance, green manufacturing, green procurement, or organizational sustainability without comprehensively assessing the integration between Environmental Management Systems and operational supply chain processes. For instance, Pambayun (2024) reported that the implementation of Green Supply Chain Management in Indonesian manufacturing industries remains at a moderate level, indicating that considerable opportunities for improvement still exist. Likewise, Hasibuan et al. (2025) identified green manufacturing as the most influential dimension affecting GSCM performance, while Aziz et al. (2025) emphasized that internal organizational capabilities represent critical enablers of successful GSCM implementation.

From a technological perspective, Internet of Things (IoT)-based systems enable real-time monitoring, optimize energy consumption, and improve operational efficiency through continuous data acquisition and intelligent resource management (Jaharudin, 2023). Furthermore, adopting a systems-thinking approach allows organizations to better understand the interdependencies among operational, environmental, and managerial processes, thereby enhancing organizational effectiveness and supporting sustainable environmental performance (McAlister et al., 2022).

Furthermore, Centobelli et al. (2023) argued that industrial sustainability can only be achieved through the integration of resource efficiency, technological innovation, and collaborative supply chain management, while Govindan et al. (2018) emphasized that Green Supply Chain Management should be implemented through interconnected processes involving planning, sourcing, manufacturing, distribution, and reverse logistics.

Nevertheless, despite the substantial development of sustainability literature, previous studies have rarely measured the extent to which Environmental Management Systems support Green Supply Chain Management implementation using a structured operational framework. Moreover, empirical studies employing the Green Supply Chain Operations Reference (Green SCOR) model to quantitatively identify implementation gaps and prioritize environmental performance improvements remain very limited, particularly within Indonesia's fisheries processing industry. Consequently, a comprehensive evaluation integrating Environmental Management Systems, Green Supply Chain Management, Green SCOR, and gap analysis is required to provide both theoretical insights and practical recommendations for strengthening sustainable supply chain performance.

Despite the considerable advancement of sustainability research, several important knowledge gaps remain unresolved. Existing studies have predominantly examined Environmental Management Systems (EMS), Green Supply Chain Management (GSCM), green innovation, blockchain technology, digital transformation, and supply chain resilience as independent research domains. For example, Fiqra et al. (2023) primarily evaluated the effectiveness of ISO 14001-based EMS in improving internal environmental performance, whereas Rachman et al. (2025) focused on the contribution of green innovation to sustainable organizational performance. Similarly, Prananta et al. (2025) emphasized blockchain-enabled traceability in fisheries supply chains, while Mahdi et al. (2025) investigated digitalization and supply chain resilience as determinants of operational performance.

Although these studies have significantly enriched sustainability literature, they provide limited empirical evidence regarding how internal environmental management capabilities are translated into operational Green Supply Chain Management practices across supply chain processes. Furthermore, previous studies have generally evaluated sustainability performance at the organizational level without systematically identifying implementation gaps across individual operational activities. Consequently, organizations still lack practical guidance for determining which supply chain processes require priority improvement to achieve

effective integration between Environmental Management Systems and Green Supply Chain Management. This limitation is particularly evident in Indonesia's fisheries processing industry, where empirical studies evaluating the operational alignment between EMS and GSCM remain scarce despite increasing international demands for sustainable seafood production and transparent supply chain management.

To address these limitations, this study proposes an integrated analytical framework that combines Environmental Management Systems (EMS), Green Supply Chain Management (GSCM), and the Green Supply Chain Operations Reference (Green SCOR) model through a quantitative gap analysis approach. Unlike previous studies that independently assessed environmental management, organizational sustainability, or supply chain performance, this research evaluates the degree of alignment between internal environmental management capabilities and environmentally responsible practices throughout the Plan, Source, Make, Deliver, and Return processes.

The Green SCOR framework enables a process-oriented assessment that systematically identifies implementation gaps across each operational stage while simultaneously evaluating the environmental performance of individual supply chain activities through Key Performance Indicators (KPIs). Furthermore, by integrating KPI prioritization with gap analysis, this study not only identifies the magnitude of implementation gaps but also determines strategic improvement priorities based on their environmental significance and operational impact.

Therefore, this research extends the theoretical understanding of EMS-GSCM integration while providing a practical decision-support framework for strengthening sustainable supply chain management within fisheries processing industries. This integrated approach distinguishes the present study from previous research that primarily focused on evaluating either environmental management systems or Green Supply Chain Management separately without quantitatively assessing their operational interrelationship.

Based on the identified research gaps and the need to strengthen the integration of environmental management and sustainable supply chain practices, this study aims to analyze the implementation gap between Environmental Management Systems (EMS) and Green Supply Chain Management (GSCM) practices at PT. IAMBEU Mina Utama using the Green Supply Chain Operations Reference (Green SCOR) framework. Specifically, the objectives of this research are (1) to evaluate the consistency between internal environmental management capabilities and Green Supply Chain Management practices across the Plan,

Source, Make, Deliver, and Return processes; (2) to identify the Key Performance Indicators (KPIs) that exhibit the most significant implementation gaps and should therefore be prioritized for improvement; and (3) to formulate evidence-based strategic recommendations for enhancing the integration of Environmental Management Systems and Green Supply Chain Management practices within the company's supply chain. The findings are expected to contribute theoretically by advancing the understanding of operational integration between EMS and GSCM and to contribute practically by providing an evidence-based framework that supports environmental performance improvement, sustainable supply chain governance, and long-term competitiveness within Indonesia's fisheries processing industry.

Method

This study employed a quantitative–evaluative approach using an applied case study design to assess the integration gap between the operational implementation of the Environmental Management System (EMS) and Green Supply Chain Management (GSCM) practices at PT. IAMBEU Mina Utama, a seafood processing and export company in Bali, Indonesia. A case study approach was selected because it enables an in-depth evaluation of environmental management practices within their actual organizational context while allowing the identification of operational strengths, weaknesses, and opportunities for improvement across the supply chain. The quantitative–evaluative approach was adopted to objectively measure the implementation level of EMS and GSCM using standardized indicators and to compare the observed conditions with the expected level of sustainable supply chain performance.

The analytical framework employed in this study was the Green Supply Chain Operations Reference (Green SCOR) model proposed by Morana (2013), which extends the conventional SCOR model by integrating environmental performance indicators into five principal supply chain processes: Plan, Source, Make, Deliver, and Return. This framework was selected because it enables a systematic assessment of environmental performance throughout the entire supply chain rather than limiting the evaluation to internal organizational activities. Consequently, Green SCOR provides an appropriate framework for identifying implementation gaps between internal EMS practices and broader GSCM activities.

The study involved respondents who were directly engaged in environmental management and supply chain operations within the company. Respondents

were selected using purposive sampling, considering their responsibilities and knowledge regarding operational activities related to environmental management and supply chain decision-making. The respondents consisted of personnel representing production management, environmental management, procurement, logistics, quality assurance, and operational supervision. These positions were selected because they actively participate in planning, implementing, monitoring, and evaluating environmental management practices throughout the supply chain.

Primary data were collected through structured questionnaires, semi-structured interviews, direct field observations, and document analysis. The questionnaire served as the principal instrument for evaluating EMS and GSCM implementation. The questionnaire items were developed by adapting the principles of ISO 14001:2015 Environmental Management System requirements and Green SCOR environmental performance indicators. Each indicator was classified according to one of the five Green SCOR processes (Plan, Source, Make, Deliver, and Return). All questionnaire items were assessed using a five-point Likert scale, where a score of 1 indicated "not implemented" and a score of 5 indicated "fully implemented and consistently integrated." Interviews and field observations were conducted to validate questionnaire responses and to obtain additional qualitative information regarding environmental management practices implemented within the company.

Prior to data collection, the research instrument underwent content validation through expert judgment involving academic supervisors with expertise in environmental management and sustainable supply chain management. The expert review ensured that each indicator appropriately represented the concepts of EMS implementation and Green Supply Chain Management while remaining consistent with the Green SCOR framework. Revisions were subsequently incorporated into the questionnaire before field implementation.

Data analysis consisted of three sequential stages. The first stage involved measuring the implementation level of EMS and GSCM for every indicator using the arithmetic mean of respondents' assessments. The actual implementation score for each indicator was calculated as:

$$X = \frac{\sum X}{n} \tag{1}$$

where X represents the actual implementation score, $\sum X$ denotes the total score obtained from all respondents, and n represents the number of respondents.

The implementation gap for each indicator was subsequently determined by comparing the ideal implementation score with the observed implementation score using the following equation:

$$Gap_i = S_i - S_a \tag{2}$$

where S_i represents the ideal score and S_a represents the actual implementation score. Larger gap values indicate greater discrepancies between expected and actual implementation levels. Average gap scores were then calculated for each Green SCOR process to identify the supply chain activities exhibiting the greatest implementation deficiencies.

The second analytical stage focused on determining priority Key Performance Indicators (KPIs) requiring immediate improvement. The priority level of each indicator was determined by considering both the magnitude of the implementation gap and its potential organizational impact. Four impact dimensions were evaluated, namely environmental impact, operational impact, regulatory compliance, and organizational reputation. Each dimension was scored using a three-point scale, where 1 represented low impact, 2 represented moderate impact, and 3 represented high impact. The average impact score was calculated as:

$$Impact_{avg} = \frac{E+O+C+R}{n} \tag{3}$$

where E represents environmental impact, O operational impact, C compliance impact, and R reputational impact.

The overall significance score of each indicator was subsequently determined by combining the implementation gap and the impact score:

$$Priority = Gap \times Impact \tag{4}$$

Indicators with higher significance scores were considered higher priorities for corrective action because they simultaneously exhibited substantial implementation deficiencies and considerable environmental and operational consequences.

The final stage involved developing strategic recommendations based on the priority ranking of KPIs identified through the Green SCOR gap analysis. Recommendations were formulated by considering current environmental management practices, Green Supply Chain Management principles, ISO 14001 requirements, and sustainable supply chain literature. The proposed recommendations focused on strengthening supplier environmental evaluation, improving waste management and circular economy implementation, enhancing transportation emission

monitoring, increasing energy efficiency, and integrating sustainability indicators into strategic supply chain planning.

Result and Discussion

The implementation of the Environmental Management System (EMS) at PT IAMBEU Mina Utama demonstrates that environmental management practices have been integrated into several operational activities, particularly regulatory compliance, waste management, environmental monitoring, and resource efficiency. According to ISO (2015), an Environmental Management System should function as a systematic framework for controlling environmental aspects while continuously improving organizational environmental performance. Likewise, Govindan et al. (2018) emphasized that EMS should not merely ensure regulatory compliance but should also become an integral component of sustainable organizational management.

The assessment results indicate that PT IAMBEU Mina Utama has successfully implemented several EMS components, including operational environmental procedures, hazardous waste management, energy conservation, and employee environmental awareness. These findings are consistent with Putro et al. (2025), who reported that organizations with well-established internal environmental management systems generally demonstrate stronger environmental performance because environmental considerations are incorporated into routine operational decision-making. However, Nazir et al. (2024) argued that many organizations still experience difficulties extending internal environmental initiatives toward supply chain integration, resulting in sustainability practices that remain operationally oriented rather than supply-chain oriented.

The descriptive analysis further indicates that the Make process obtained the highest implementation score among all Green SCOR dimensions. This result suggests that the company has focused primarily on environmentally friendly production activities through waste reduction, pollution prevention, and efficient resource utilization. Similar findings were obtained by Putro et al. (2025), who found that green manufacturing generally achieves higher implementation levels than green logistics because manufacturing activities are directly controlled by the organization and therefore easier to improve. Moreover, Fadlillah et al. (2026) explained that production efficiency contributes substantially to economic sustainability; however, environmental sustainability can only be achieved when upstream and downstream supply chain activities are simultaneously improved.

Table 1. Average Implementation Score of EMS and Green SCOR

Variable	Mean Score	Category
Environmental Management System	4.21	High
Plan	3.95	High
Source	3.72	Moderate-High
Make	4.28	High
Deliver	3.61	Moderate
Return	3.18	Moderate

Conversely, the Return dimension exhibited the lowest implementation score, indicating that reverse logistics, product recovery, recycling, and post-consumer waste management have not yet been comprehensively incorporated into company operations. According to Fadlillah et al. (2026), sustainability assessment should encompass the entire product life cycle because environmental impacts frequently occur beyond manufacturing activities. Similarly, Prananta et al. (2025) emphasized that transparent product traceability and reverse information flow are fundamental components of sustainable supply chain management, particularly in fisheries industries that require high levels of product accountability.

The relatively moderate score obtained in the Source dimension indicates that procurement decisions remain primarily based on operational requirements, including product quality, availability, and cost considerations. Although supplier selection has supported production continuity, environmental evaluation criteria have not yet been fully incorporated into procurement policies. Susandi et al. (2025) demonstrated that supplier collaboration significantly improves export competitiveness because environmentally responsible suppliers enhance both product quality and supply chain resilience. Likewise, Putro et al. (2025) concluded that Green Procurement serves as one of the strongest predictors of corporate sustainability performance because procurement decisions influence environmental performance throughout subsequent supply chain processes. To provide a clearer comparison among Green SCOR dimensions, Figure 1 presents the average implementation score obtained from the assessment.

Overall, these findings indicate that PT IAMBEU Mina Utama has established a strong internal Environmental Management System; however, the integration of sustainability principles across the entire supply chain remains incomplete. As highlighted by Fadlillah et al. (2026), sustainability performance cannot rely solely on production improvements but requires environmental integration from procurement through reverse logistics. Furthermore, Prananta et al. (2025) suggested that strengthening digital traceability and

stakeholder collaboration could substantially improve Green Supply Chain Management implementation, thereby supporting long-term organizational sustainability.

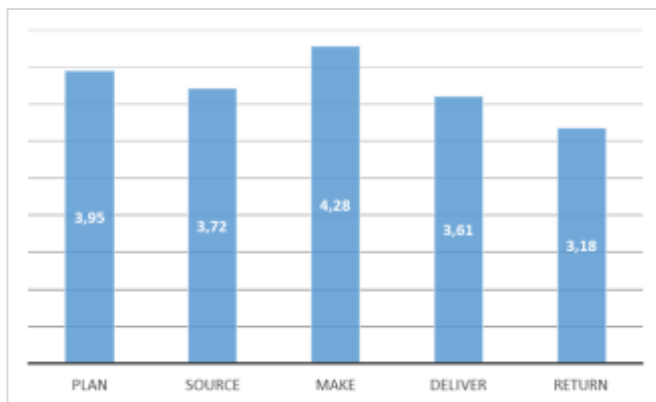


Figure 1. Average green SCOR implementation score

The implementation of digital traceability systems also represents an important opportunity for improving sustainable fisheries supply chains. Shamsuzzoha et al. (2024) demonstrated that blockchain-enabled traceability significantly enhances transparency, information reliability, and stakeholder trust while supporting environmentally responsible decision-making throughout the fisheries supply chain. By providing real-time monitoring of product origin, environmental compliance, and logistics activities, blockchain technology strengthens coordination among supply chain actors and facilitates the implementation of Green Supply Chain Management. Therefore, integrating digital traceability into PT IAMBEU Mina Utama's supply chain would contribute to reducing the implementation gaps identified in the Source, Deliver, and Return processes.

The gap analysis revealed that although PT IAMBEU Mina Utama has established a relatively mature Environmental Management System (EMS), the implementation of Green Supply Chain Management (GSCM) has not yet reached the same level of maturity. The analysis identified noticeable differences between the company's internal environmental capabilities and the actual implementation of sustainability practices across the Green SCOR dimensions. This finding indicates that environmental management remains predominantly focused on internal operational activities rather than extending sustainability principles to the entire supply chain. According to Govindan et al. (2018), organizations frequently achieve satisfactory EMS performance before successfully integrating sustainability into supplier management, logistics, and reverse logistics. Likewise, Nazir et al. (2024) argued that environmental management systems often become

isolated organizational programs when they are not supported by collaborative supply chain strategies.

Table 2. Gap Analysis between EMS and Green SCOR Dimensions

Green SCOR Process	EMS Score	GSCM Score	Gap	Interpretation
Plan	4.21	3.95	0.26	Low Gap
Source	4.21	3.72	0.49	Moderate Gap
Make	4.21	4.28	-0.07	Integrated
Deliver	4.21	3.61	0.60	Moderate Gap
Return	4.21	3.18	1.03	High Gap

The results presented in Table 2 demonstrate that the Return process exhibits the largest implementation gap, followed by the Deliver and Source dimensions. Conversely, the Make process shows almost no discrepancy between EMS and GSCM implementation, indicating that environmental management practices have been effectively integrated into production activities. This pattern confirms that environmental initiatives at PT IAMBEU Mina Utama are concentrated primarily within operational processes, while downstream and post-production sustainability activities remain underdeveloped. The existence of this implementation gap also supports the concept of gap analysis proposed by Seman et al. (2012), who suggested that comparing current organizational conditions (as-is) with expected sustainability practices (to-be) enables organizations to identify maturity levels and prioritize improvement strategies. Likewise, Zeng et al. (2017) demonstrated that many manufacturing companies remain at the compliance maturity stage, where environmental management focuses primarily on regulatory compliance rather than on comprehensive supply chain integration. Consequently, the present findings indicate that PT IAMBEU Mina Utama is transitioning from internally oriented environmental management toward integrated Green Supply Chain Management, but several operational processes still require substantial improvement.

The gap identified between Environmental Management System (EMS) implementation and Green Supply Chain Management (GSCM) practices indicates that environmental initiatives at PT IAMBEU Mina Utama remain predominantly internally oriented. This finding is consistent with Das et al. (2023), who demonstrated that organizations implementing EMS together with GSCM practices achieve significantly stronger environmental performance and greater market competitiveness than those relying solely on internal environmental management systems. Their study further emphasizes that EMS establishes the organizational foundation for environmental governance, whereas GSCM extends these

environmental commitments throughout the supply chain by integrating suppliers, logistics providers, customers, and reverse logistics activities. Therefore, the moderate implementation gap identified in this study suggests that although PT IAMBEU Mina Utama has established a robust environmental management foundation, further integration of sustainability practices across supply chain actors is required to maximize environmental and competitive performance.

The Make process demonstrated the smallest implementation gap, indicating that environmental management has been successfully incorporated into production activities through resource efficiency, pollution prevention, and waste reduction initiatives. This finding is consistent with Hasibuan et al. (2025), who identified green manufacturing as the most influential GSCM practice affecting environmental performance in manufacturing industries. Similarly, Refinda (2022) concluded that Green Supply Chain Management significantly improves environmental sustainability when green production practices are integrated into routine operational activities. In addition, Agyabeng-Mensah et al. (2020) demonstrated that internal green supply chain practices become more effective when supported by green human resource management and supply chain environmental cooperation. These complementary capabilities encourage continuous operational improvement and strengthen organizational performance by embedding environmental objectives into employees' competencies, organizational culture, and day-to-day supply chain activities.

Although production activities have demonstrated satisfactory environmental performance, the assessment revealed substantially larger implementation gaps in the Deliver and Return processes. The Deliver dimension remains constrained by limited implementation of environmentally friendly transportation, distribution emission monitoring, and sustainable cold chain management. Similar challenges were identified by Wibowo et al. (2024), who emphasized that fisheries industries require sustainable cold supply chain management to minimize energy consumption while maintaining product quality throughout distribution. Furthermore, Fadlillah et al. (2026) demonstrated that transportation activities contribute significantly to greenhouse gas emissions across agro-industrial supply chains, highlighting the importance of integrating environmental considerations into logistics planning.

The findings further indicate that the Return process represents the largest implementation gap within PT IAMBEU Mina Utama. Reverse logistics activities, product recovery, recycling systems, and post-production waste utilization have not yet been systematically implemented despite their importance

for circular economy development. Gunamantha (2025) argued that applying Life Cycle Thinking enables industries to transform production waste into economically valuable resources while simultaneously reducing environmental impacts. Likewise, Centobelli et al. (2023) emphasized that environmental sustainability cannot be achieved without integrating circular resource management throughout the entire supply chain. These findings suggest that strengthening reverse logistics should become one of the company's highest strategic priorities.

The large implementation gap observed in the Return process also reflects the limited adoption of circular economy principles within the company's supply chain. According to Gunamantha et al. (2023), circular economy strategies create environmental and economic value by maximizing the recovery and utilization of waste resources rather than treating them as disposal burdens. Their findings indicate that waste valorization and resource recovery not only reduce environmental impacts but also improve resource efficiency and long-term sustainability. Consequently, strengthening reverse logistics, recycling systems, and by-product utilization would substantially reduce the implementation gap identified in the Return dimension while supporting more sustainable resource management.

The relatively wide implementation gap observed in the Source process indicates that procurement decisions remain primarily based on quality, price, and supplier reliability, whereas environmental criteria have not yet become mandatory requirements. Aziz et al. (2025) emphasized that internal organizational commitment represents one of the strongest enablers of Green Supply Chain Management because managerial support determines the adoption of environmentally responsible procurement practices. Likewise, Ariadi et al. (2024) demonstrated that sustainability performance improves significantly when organizations strengthen collaborative activities and information sharing among supply chain partners. Their findings indicate that supplier environmental evaluation should become an integral component of procurement decisions to improve long-term sustainability performance.

The need to strengthen environmental governance across procurement and supplier management also aligns with the conceptual framework proposed by Kessler et al. (2001), which emphasizes that effective environmental management should extend beyond organizational boundaries through coordinated governance involving multiple stakeholders. Environmental governance requires collaboration among industries, suppliers, regulators, and surrounding communities to ensure that environmental objectives are consistently implemented throughout the

production and distribution system. Therefore, improving supplier environmental evaluation and collaborative environmental planning would strengthen both organizational governance and sustainable supply chain integration.

From a technological perspective, the implementation gap identified in this study also highlights opportunities to strengthen digital environmental management. Muliawan (2023) demonstrated that Internet of Things (IoT)-based monitoring systems significantly improve energy efficiency and operational monitoring, making them highly relevant for environmental performance measurement within EMS implementation. Likewise, Rastyaningsih (2022) concluded that organizational effectiveness is strongly influenced by the quality of system integration, suggesting that digital monitoring systems could enhance coordination among supply chain actors while supporting continuous environmental improvement.

The present findings further support the proposition that sustainability performance depends not only on operational environmental management but also on organizational innovation and governance. Asni et al. (2022) reported that effective corporate governance mechanisms encourage the adoption of green innovation by strengthening strategic decision-making and organizational oversight, thereby supporting corporate sustainability. Furthermore, Samhadi et al. (2024) demonstrated that good corporate governance enhances the effectiveness of green innovation initiatives, enabling firms to generate greater value from environmentally oriented investments. Similarly, environmentally oriented management practices facilitate the adoption of sustainable business models by integrating environmental considerations into strategic decision-making and operational processes. This transformation enhances organizational adaptability, resource efficiency, and long-term competitiveness (Vasylyk, 2025). These findings indicate that integrating green innovation, governance, and digital environmental monitoring would substantially strengthen Green Supply Chain Management implementation at PT IAMBEU Mina Utama.

From a broader sustainability perspective, the findings of this study support the principles of Education for Sustainable Development (ESD), which emphasize the integration of environmental, economic, and social dimensions into organizational decision-making. Gunamantha (2010) argued that sustainable development requires systemic changes in organizational behavior through continuous learning, environmental awareness, and stakeholder participation rather than relying solely on technological improvements. Accordingly, strengthening employee

environmental competence, supplier engagement, and organizational learning should accompany technological and operational improvements to ensure the successful integration of Environmental Management Systems and Green Supply Chain Management. Furthermore, these findings are consistent with the integrated lean-green framework proposed by Kosasih et al. (2023), which highlights that combining operational efficiency with environmental sustainability creates more resilient, competitive, and sustainable supply chains. Integrating lean operational practices with Green SCOR implementation would therefore enable PT IAMBEU Mina Utama to simultaneously improve resource efficiency, reduce environmental impacts, and strengthen long-term organizational competitiveness.

Overall, the results demonstrate that PT IAMBEU Mina Utama has successfully established a solid Environmental Management System foundation; however, the integration of sustainability principles across the Green SCOR processes remains uneven. This finding aligns with Hariyani et al. (2024), who emphasized that supply chain sustainability enhances industrial resilience, while Pambayun (2024) observed that GSCM implementation in Indonesian manufacturing industries generally remains at a moderate level. Therefore, strengthening collaboration with suppliers, implementing digital traceability, improving reverse logistics, and integrating environmental indicators into corporate performance measurement should become strategic priorities for achieving a fully integrated Green Supply Chain Management system.

Conclusion

This study evaluated the implementation of the Environmental Management System (EMS) and Green Supply Chain Management (GSCM) at PT IAMBEU Mina Utama using the Green Supply Chain Operations Reference (Green SCOR) framework to identify implementation gaps and determine strategic priorities for improving supply chain sustainability. The results indicate that the company has established a relatively mature Environmental Management System, achieving an overall EMS score of 4.21, which falls within the high implementation category. Among the six EMS dimensions, Environmental Procedures and Standard Operating Procedures demonstrated the strongest performance, reflecting the company's commitment to standardized environmental management, regulatory compliance, waste management, and employee environmental awareness. These findings indicate that environmental management has become an integral component of daily operational activities and provides a

strong internal foundation for organizational sustainability. The Green SCOR assessment revealed different levels of sustainability implementation across supply chain processes. The Make process achieved the highest implementation score (4.28), followed by Plan (3.95), Source (3.72), Deliver (3.61), and Return (3.18). The strong performance of the Make process demonstrates that environmental initiatives have been successfully integrated into production activities through resource efficiency, pollution prevention, and waste reduction. However, lower implementation scores in the Source, Deliver, and Return processes indicate that environmental considerations have not yet been comprehensively incorporated into procurement, transportation, supplier collaboration, reverse logistics, and post-consumer resource recovery. These findings suggest that sustainability initiatives remain predominantly focused on internal operations rather than extending throughout the entire supply chain. The gap analysis further confirms this imbalance. The Make process exhibited an almost fully integrated relationship between EMS and GSCM, with a gap value of -0.07 , indicating that operational environmental management has been successfully translated into environmentally responsible production practices. In contrast, the Return process showed the largest implementation gap (1.03), followed by Deliver (0.60) and Source (0.49), whereas the Plan process demonstrated only a relatively small gap (0.26). These results indicate that although PT IAMBEU Mina Utama has developed strong internal environmental capabilities, sustainability integration across downstream activities—including environmentally responsible distribution, reverse logistics, recycling systems, and circular resource utilization—remains limited. Consequently, the company's current environmental management system has not yet fully evolved into an integrated Green Supply Chain Management system. From a theoretical perspective, this study contributes to the advancement of sustainable supply chain management by integrating the Environmental Management System with the Green SCOR framework to simultaneously evaluate internal environmental performance and supply chain sustainability. Unlike previous studies that primarily examined EMS or GSCM independently, this research demonstrates that combining these approaches enables organizations to identify implementation maturity, quantify operational sustainability gaps, and prioritize improvement initiatives using significance-based Key Performance Indicators (KPIs). The findings therefore provide a practical analytical framework for evaluating environmental management maturity across seafood processing supply chains and other manufacturing sectors facing similar sustainability challenges. The prioritization of improvement initiatives identified

through the Green SCOR gap analysis is also supported by structured decision-making approaches. Gunamantha et al. (2023) demonstrated that the Analytical Hierarchy Process (AHP) provides an effective method for prioritizing environmental management alternatives by simultaneously considering multiple environmental, technical, and operational criteria. Although the present study employs significance scoring based on implementation gaps and impact assessment, the incorporation of AHP in future studies could further strengthen the prioritization process by assigning objective weights to environmental performance indicators and supporting more transparent managerial decision-making. From a practical perspective, the study provides a strategic roadmap for PT IAMBEU Mina Utama to strengthen Green Supply Chain Management implementation. Improvement priorities should focus on integrating environmental criteria into supplier selection, strengthening green procurement practices, improving sustainable transportation and cold-chain management, implementing reverse logistics systems, increasing waste recovery and circular economy initiatives, and utilizing digital environmental monitoring to support decision-making across the supply chain. These strategic improvements are expected to enhance environmental performance, operational efficiency, supply chain resilience, and long-term competitiveness while responding to increasing international sustainability requirements. Furthermore, the findings contribute directly to the achievement of Sustainable Development Goal (SDG) 12: Responsible Consumption and Production by promoting cleaner production, resource efficiency, environmentally responsible procurement, and circular resource management throughout seafood processing supply chains. Therefore, the integration of EMS and Green SCOR not only supports organizational environmental performance but also strengthens the implementation of sustainable industrial development aligned with global sustainability agendas. This study is subject to several limitations. The assessment was conducted in a single seafood processing company and relied primarily on questionnaire-based evaluations supported by interviews and field observations. Consequently, the findings may not fully represent environmental management practices in other fisheries or manufacturing industries. Future research is therefore recommended to expand the analysis across multiple companies, incorporate objective environmental performance indicators such as carbon emissions, energy intensity, water consumption, and waste generation, and integrate the Green SCOR framework with approaches such as Life Cycle Assessment (LCA), Life Cycle Thinking (LCT), or digital environmental monitoring systems to obtain a more comprehensive

evaluation of sustainable supply chain performance. Overall, this study demonstrates that a well-established Environmental Management System provides a strong operational foundation for environmental sustainability; however, achieving a fully sustainable supply chain requires environmental integration beyond organizational boundaries. The Green SCOR framework proved effective in identifying implementation gaps, evaluating sustainability performance across supply chain processes, and determining strategic priorities for continuous improvement. Accordingly, this research offers both a methodological contribution for assessing environmental management maturity and a practical reference for organizations seeking to transform operational environmental management into an integrated and resilient Green Supply Chain Management system.

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Author Contributions

Conceptualization, methodology, data collection, formal analysis, and writing original draft preparation were conducted, P.W.P.D.; Supervision, validation, and review of the manuscript were carried out, I.M.G. and D.M.A. All authors have read and approved the final manuscript.

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Conflicts of Interest

The author declare no conflict of interest regarding the publication of this study.

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