



Design of a Green SCOR-Based Performance Assessment Model for an Organic Skincare Supply Chain

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ABSTRACT

This study aims to evaluate the supply chain performance at PT Nectars Natura Karya, an organic skincare manufacturer, using the Green Supply Chain Operations Reference (SCOR) model approach combined with the Analytic Hierarchy Process (AHP) method for determining the weight of key performance indicators (KPI). A total of 15 KPIs were used in the measurement, covering general operational aspects and environmental sustainability. The evaluation was conducted by calculating the actual value, normalization, and combining the AHP weights to obtain the final score of each indicator. The measurement results show that the final value of the company's supply chain performance is 42.59 from a maximum score of 77.77, with an actual achievement rate of approximately 54.76%. Based on the classification of the Snorm de Boer method, this value is included in the category of average performance, which shows that the company has sufficient performance; however, there is still room for improvement. The largest contribution came from general operational KPIs (91.69 %), while KPIs classified as green supply chains only accounted for 8.36% of the total score. The results of the assessment using the traffic light system (TLS) method show that there are seven KPIs that are still in the red category and need immediate improvement, and four KPIs are in the yellow category that are close to the target but still need periodic monitoring. The managerial implications of these results emphasize the importance of strengthening environmental aspects in the supply chain, including waste measurement, improved employee training, and compliance with sustainability standards by suppliers.

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1. INTRODUCTION

Public awareness of environmentally friendly and healthy products is increasing, especially for organic products that provide more benefits. Green consumers are generally women aged 18–24 years with a minimum of high school education. Consumer decisions to purchase environmentally friendly products are influenced by various social, psychological, and marketing factors, such as family influence, lifestyle, perception, product attributes, promotion, motivation, service quality, and price (Chrisvinlya & Cokki, 2023). Indonesia's skincare and beauty industry has experienced rapid growth and has become an important contributor to national economic development (Saparuddin et al., 2025). The trend of natural or organic cosmetics is growing globally, with Indonesia having great potential (Mileneo, 2024; Kashuri, 2025), and young people (64.16 million people or 23.18% of the population) are the main targets (Aliena, 2024).

PT Nectars Natura Karya, established in 2020 and located in Bogor City, West Java, Indonesia, produces skin care products made from natural and environmentally friendly ingredients. The company emphasizes sustainability throughout its operations, from raw material sourcing to packaging. Its supply chain encompasses procurement, manufacturing,

distribution, and reverse logistics, including programs for returning reusable and recyclable packaging.

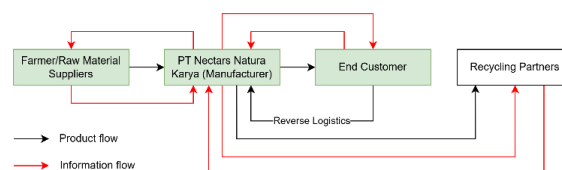


Fig. 1. PT Nectars Natura Karya supply chain structure

As illustrated in Fig. 1, the supply chain begins with farmers or raw material suppliers who provide natural ingredients to PT Nectars Natura Karya as the manufacturer. The company processes these materials into skincare products and distributes them to end customers. After consumption, the system incorporates reverse logistics, in which customers can return used packaging to recycling partners for further processing or recycling. This flow demonstrates the company's commitment to a circular and environmentally responsible supply chain system.

From a process perspective, supply chain activities can also be analyzed using the cycle view, which includes the procurement and manufacturing

cycles. As illustrated in Fig. 2, these activities operate under a push-process approach, in which procurement and production activities are initiated based on internal planning and demand forecasting. In the procurement cycle, the manufacturer acquires raw materials from suppliers according to the planned production requirements. These materials then enter the manufacturing cycle, where they are processed into finished skincare products and distributed to customers. This push-based system allows the company to prepare inventory in advance to meet anticipated market demand.

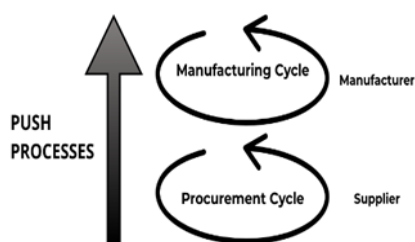


Fig. 2. Cycle view of PT Nectars Natura Karya

Given that procurement activities involve close collaboration with suppliers, environmental considerations across the supply chain become an important aspect of operational sustainability. The concept of green supply chain management (GSCM) integrates environmental aspects into the entire supply chain process (Kodrat, 2022). PT Nectars Natura Karya already has ISO 9001:2015 certification and cosmetic production certificates; however, it faces major challenges because it does not have a supplier that implements environmental standards, such as ISO 14001. Zhu & Sarkis (2004) identified that the implementation of ISO 14001 is an important indicator of the adoption of GSCM internal practices, such as environmental training, waste reduction, and internal awareness of environmental issues. Without the support of certified suppliers, the achievement of ISO 14001 will be hampered, which in turn can reduce product quality, disrupt the sustainability of green production, and damage brand reputation and customer satisfaction (Rahman et al., 2014; Seman et al., 2012).

The novelty of this study lies in the development and application of a green SCOR-based performance measurement framework integrated with the analytic hierarchy process (AHP) specifically for the organic skincare manufacturing sector in Indonesia, with an explicit focus on supplier-related environmental gaps and reverse logistics practices. Previous studies have applied the green SCOR model in various sectors. For example, research in the Indonesian palm oil industry (Primadasa & Sokhibi, 2020) determined the importance level of environmental indicators. Another study applied green SCOR to measure supply chain performance in small manufacturing enterprises (Adelino et al., 2024), identifying performance gaps across the main supply chain processes. Additionally, the green SCOR approach has also been implemented in sectors such as leather tanning (Ismadhia et al., 2018), pharmaceutical manufacturing (Raga et al.,

2021), and broiler chicken production and distribution (Hidayatuloh et al., 2024) to evaluate environmental performance and operational efficiency in supply chain activities.

While earlier studies have demonstrated the applicability of the green SCOR model across various industrial contexts, most have focused on traditional manufacturing sectors or general supply chain performance evaluations. In contrast, this study applies a green SCOR-based supply chain performance measurement approach integrated with AHP in the context of the organic skincare manufacturing industry in Indonesia, a sector that has received limited attention in previous studies. This study evaluates both operational and environmental KPIs to assess the balance between operational efficiency and sustainability performance.

This research provides empirical evidence from a Small and Medium-sized Enterprise (SME) that has implemented green production and reverse logistics initiatives but still faces limitations in supplier environmental compliance, particularly the absence of formal environmental certifications such as ISO 14001. Research on green supply chain management in SMEs highlights that small and medium-sized enterprises face significant barriers when implementing green practices, including supplier readiness and a lack of formal environmental management systems (Yadav & Yadav, 2024; Tsikada et al., 2025). This condition represents a critical and relatively underexplored challenge in the implementation of GSCM, especially in emerging economies, where supplier environmental readiness is often limited.

Furthermore, this study contributes by designing context-specific green SCOR KPIs for processes up to Level 3 (Plan, Source, Make, Deliver, Return, and Enable) that capture both operational performance and environmental sustainability, rather than relying on generic indicators. The integration of AHP allows for the systematic weighting of KPIs, reflecting managerial priorities and operational realities within the organic skincare industry. By combining green SCOR, AHP weighting, Snorm de Boer normalization, and TLS analysis, this research provides a diagnostic and actionable performance evaluation approach that not only measures green supply chain performance but also identifies critical improvement priorities, particularly in supplier environmental compliance, waste management, and employee environmental awareness. This integrated framework offers a replicable decision-support tool for organic skincare manufacturers and similar SMEs seeking to strengthen GSCM practices and prepare for future ISO 14001 adoption. By emphasizing sector-specific environmental gaps and operational priorities, this study provides a novel contribution to both the literature and practical applications of green SCOR in emerging-market SMEs.

2. RESEARCH METHODS

This study uses a quantitative approach with the green SCOR model to measure the performance of the green supply chain and combines it with AHP to determine the weight of each KPI. The focus of measurement includes a cycle view from raw material

ordering to planning and production using a push process view approach. Because PT Nectars Natura Karya does not have a structured GSCM performance indicator, this study compiles it systematically as the basis for strategic decision-making that supports the company's vision as an environmentally friendly organic skincare provider.

To overcome these challenges, a thorough evaluation of green supply chain performance is needed through the design of KPIs based on the green SCOR model and the AHP method, such that performance measurement can be carried out systematically and measurably. This study aims to identify and determine relevant performance indicators for GSCM measurement in the organic skincare industry and evaluate GSCM performance based on KPIs that have been set using the AHP method to provide applicable recommendations to improve the effectiveness and efficiency of the company's green supply chain.

2.1. Data Collection

The research process began with problem identification, followed by a literature review on SCOR and green SCOR, problem formulation, determination of research objectives, limitations, and assumptions, and initial data collection for analysis (Fig. 2). Data for this study were collected using three main techniques:

1. Expert interviews were conducted to obtain in-depth information regarding the supply chain processes, operational constraints, and sustainability strategies implemented by the company.
2. The documentation study involved reviewing internal company documents, such as quality guidelines, organizational structure, and operational reports, to understand the company's supply chain activities and sustainability practices.
3. Questionnaires were used to assess GSCM performance based on green SCOR indicators and to collect pairwise comparison judgments required for the AHP.

Respondents were selected using a purposive sampling technique combined with expert judgment, as recommended for the application of AHP (Saaty, 2008). The selection criteria were based on respondents' level of understanding, professional experience, and direct involvement in supply chain activities and sustainability-related decision-making within the company (Peniwati, 2017; Okoli & Pawlowski, 2004).

The respondent population in this study consisted of internal personnel of PT Nectars Natura Karya who were functionally and technically relevant to the research context. Nine internal experts representing key supply chain functions participated in the study, including the President Director, Operational Director, and personnel responsible for operations control, production, quality control, procurement and PPIC, logistics, research and development, and marketing. All respondents held supervisory or decision-making roles and were directly involved in supply chain operations and sustainability-related activities. Given the small and fully accessible population of qualified experts, all eligible individuals were included to ensure comprehensive and representative input for the green SCOR-AHP performance evaluation.

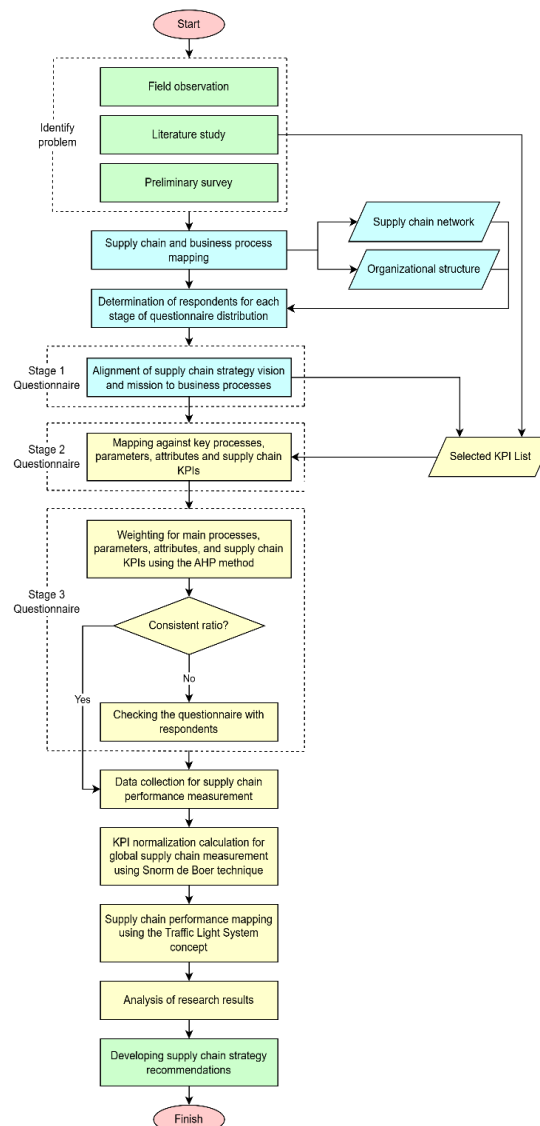


Fig. 3. Research flow diagram

The data collection and analysis processes were conducted in three stages based on the green SCOR framework:

1. **SCOR Process Identification and Alignment**
At this stage, the company's supply chain business processes were identified and mapped to the main processes of the SCOR model: plan, source, make, deliver, return, and enable. A validation process was conducted using a Likert scale to assess the suitability of the identified business processes and the company's mission. The results of this stage produced a graphical representation showing the alignment between the company's mission and its supply chain business processes.
2. **KPI Identification and Green SCOR Mapping**
This stage focused on identifying and validating the KPIs used to measure GSCM performance. The KPIs were initially identified through a literature review and subsequently validated through respondent assessment to ensure their relevance to

the company's operational context. The validated KPIs were then mapped to the green SCOR performance attributes, forming the basis for the performance measurement framework.

3. KPI Weighting Using AHP

After the KPIs were determined, the AHP was applied to determine the relative importance of each indicator. The weighting process was conducted at three hierarchical levels: Level 1 (SCOR main processes), Level 2 (SCOR performance attributes), and Level 3 (KPIs), using a pairwise comparison scale. The resulting weights represent the relative contribution of each KPI to the overall evaluation of green supply chain performance.

2.2. Data Processing and Result Analysis

The collected data were processed and analyzed to evaluate the green supply chain performance of PT Nectars Natura Karya. The analysis was conducted using the green SCOR framework integrated with the AHP method. The data processing procedure consisted of several steps, including mapping the company's supply chain processes, determining the relative importance of KPIs, calculating performance scores, and classifying the results to identify areas requiring improvement.

1. Mapping business processes to the main processes of the SCOR (plan, source, make, deliver, return) model
2. Preparation of the KPI importance assessment questionnaire and weighting with AHP using Expert Choice software.
3. The actual value of the KPIs was calculated, normalized with Snorm de Boer, and the final value of the supply chain performance was calculated.
4. Classification of performance results using the *traffic light* system, where green, yellow, and red indicate good performance, performance that requires monitoring, and areas that require immediate improvement, respectively.

3. RESULTS AND DISCUSSION

3.1. Mapping of PT Nectars Natura Karya's Business Process Based on the Main Process of the SCOR Model

The mapping of PT Nectars Natura Karya's business processes with the main process of the SCOR model, which has been validated using a questionnaire, is shown in Table 1.

3.2. Alignment of the Company's Mission with PT Nectars Natura Karya's Business Process

To design an effective company strategy, a thorough understanding of the direction of the mission and the business processes being carried out is required. Accurate performance indicators can only be designed when there is a clear link between the company's strategic objectives and the business processes taking place in the field. Therefore, it is important to conduct an alignment process between the company's mission and business processes as a basis for identifying and developing relevant performance indicators, as shown in Table 2.

Table 1. Business process mapping based on the key processes of the SCOR model

SCOR Model Key Processes (Level 1)	Business Process of PT Nectars Natura Karya
Plan	Compile production estimates Compile RAB and production timeline Compiling a schedule for ordering raw materials Develop a schedule for delivering products to consumers
Source	Placing orders for raw materials with suppliers Receiving and inspecting raw materials
Make	Execute the production process according to the timeline Monitoring the quality of the finished product Finished product packaging (Packing) Recapitulation and quarantine of finished products
Deliver	Storing raw materials in the warehouse Storage of finished products in the warehouse Verification of customer orders by the admin Arrangement of product delivery to the customer Delivery of products to customers through the expedition
Return	Receipt of used packaging from customers Quality inspection and sterilization of packaging Classification of packaging (reuse/recycle) Proper packaging reuse Packaging recycling is not feasible for third parties Giving free vouchers and products to customers
Enable	Management of RAB data, production reports, and distribution Coordination with expeditions and recycling packaging management partners

3.3. Identification of Key Performance Indicators

After analyzing the supply chain process through the alignment stage between the company's mission and the business processes being carried out, the next step is to identify KPIs that can be used to measure the level of the company's supply chain performance objectively. This identification process refers to the results of the alignment that has been carried out previously and is strengthened by literature from 10 previous studies that are relevant to performance indicators in the context of supply chain and environmental sustainability.

Table 2. Business process mapping based on the SCOR model

Main Process of the SCOR Model	Company Mission	Business Process
Plan Plan Plan	Provide safe, natural, and satisfying organic products to customers	1. Compile production estimates 2. Compile RAB and production timeline 3. Arrange a schedule for ordering raw materials
Source Make		6. Receiving and inspecting raw materials 11. Recapitulation and quarantine of finished products
Deliver Deliver		7. Storing raw materials in the warehouse 12. Storage of finished products in the warehouse
Source Make Return		5. Order raw materials from suppliers 10. Finished product packaging (Packing) 16. Receipt of used packaging from customers
Return Return Return		18. Classification of packaging (reuse/recycle) 19. Reuse of decent packaging 20. Recycling packaging is not feasible for third parties
Plan Deliver Deliver	Prioritize customer satisfaction and responsive service	4. Develop a schedule for delivering products to consumers 13. Verification of customer orders by admin 14. Arrangement of product delivery to the customer
Return		21. Giving free vouchers and products to customers
Make Return Deliver Enable		9. Quality control of finished products 17. Quality inspection and sterilization of packaging 15. Delivery of products to customers through the expedition party 23. Coordination with expeditions and recycling packaging management partners

Based on the identification results, 19 main KPIs were obtained, including six green performance indicators (green KPIs). All indicators are presented in Table 3, focusing on the procurement and manufacturing processes at PT Nectars Natura Karya, and the design of the indicators was carried out by considering the main activities in green procurement and green manufacturing.

3.4. Validation and Mapping of Key Performance Indicators with Green SCOR Model Performance Attributes

After the identification stage, the KPI was carried out, and the next step was to conduct a validation process for these indicators. The purpose of this validation is to ensure that the indicators that have been designed are indeed appropriate and suitable for use by PT Nectars Natura Karya in measuring the performance of the supply chain that is being run. The validation process was carried out by distributing questionnaires to nine respondents from the company's internal parties who understood the business process directly (Table 4). The questionnaire was compiled using a five-point Likert scale (1 to 5), focusing on assessing the relevance of each indicator. Based on the approach

proposed by a KPI, it was considered valid if most respondents gave an assessment of four or more, which indicated that the indicator was considered appropriate or very suitable for use in the context of the company's operations (Chotimah et al., 2020).

Once the KPIs that measure supply chain performance have been successfully identified and validated, the next stage is to map those KPIs into performance attributes based on the green SCOR model framework. The performance attributes in this model include five main aspects: reliability, responsiveness, flexibility, cost, and assets, which are at Level 2 in the green SCOR hierarchical structure. The preparation of these attributes is directly related to indicators at Level 3 (KPI) and plays a role in the evaluation process of the main activities at Level 1 (core business processes such as plan, source, make, deliver, return, and enable). Through these linkages, performance attributes (Level 2) serve as a logical link that represents each KPI (Level 3); therefore, careful mapping is required between attributes and indicators that have been previously validated. The results of this mapping process are presented in Table 5, which shows the fitness between each KPI and the relevant performance attributes in the Green SCOR model.

Table 3. Identify key performance indicators

SCOR Process (Level 1)	Model	Key Performance Indicators (Level 3)	Definition	Category
Plan		KPI-01 Production Forecasting Accuracy	An indicator that measures the accuracy of forecast results compared with actual production realization.	Common
		KPI-02 Stock Availability Rate	Measuring the efficiency of ensuring the availability of goods in the warehouse as needed	Common
		KPI-03 Planning Cycle Time	The time required to develop an overall production and distribution plan.	Common
Source		KPI-04 Defect-Free Products from Suppliers	The percentage of goods from suppliers that arrive in perfect condition, without damage.	Common
		KPI-05 Accuracy of Documents & Labels from Suppliers	Measure the completeness and accuracy of the supplier's shipping and product labeling documents.	Common
		KPI-06 Percentage of ISO 14001 Certified Suppliers	Measure the percentage of suppliers with environmental management system certifications, such as ISO 14001/EMS.	Green
Make		KPI-07 Percentage of Suppliers That Meet Environmental Standards	The percentage of suppliers that comply with environmental requirements, such as being free of hazardous materials, having waste management programs, and conducting environmental audits.	Green
		KPI-08 Timeliness Supplier Delivery	Measure the supplier's ability to deliver goods on schedule.	Common
		KPI-09 Reliability of Production Employees	Measure the skills and effectiveness of the workforce in the production line.	Common
		KPI-10 Production Waste	Amount of waste (solid/liquid) generated during the production process.	Green
		KPI-11 Percentage of Recyclable Materials	The extent to which raw materials or production residues can be reused or recycled is determined.	Green
Deliver		KPI-12 Production Lead Time	The duration from the beginning to the end of the production process.	Common
		KPI-13 Delivery Accuracy	Measure the accuracy of quantity and time in the process of delivering products to customers.	Common
		KPI-14 Accuracy of Shipping Documents	Availability and accuracy of shipping documents (invoices, road sheets, etc.) at the time the product is received.	Common
Return		KPI-15 Product Return Rate	The percentage of products returned by customers due to defects or non-conformities.	Common
		KPI-16 Complaints about Environmental Requirements	The number of customer complaints related to non-conformity of the product's environmental specifications.	Green
		KPI-17 Complaint Handling Time	The time it takes to resolve consumer complaints from the time the report is received.	Common
Enable		KPI-18 Availability of SOPs & Internal Regulations	Measure the existence and completeness of standard operating procedures and company policies related to the supply chain.	Common
		KPI-19 Percentage of Employees Who Have Been Trained in the Environment	The percentage of employees who have attended training on environmental and sustainability standards.	Green

Table 4. Validated key performance indicators

SCOR Model (Level 1)	Key Performance Indicators (Level 3)
Plan	KPI-01 Production Forecasting Accuracy
Source	KPI-03 Planning Cycle Time
	KPI-04 Defect-Free Products from Suppliers
	KPI-06 Percentage of ISO 14001 Certified Suppliers
	KPI-07 Percentage of Suppliers That Meet Environmental Standards
Make	KPI-08 Timeliness Supplier Delivery
	KPI-09 Reliability of Production Employees
	KPI-10 Production Waste
	KPI-11 Percentage of Recyclable Materials
Deliver	KPI-14 Accuracy of Shipping Documents
Return	KPI-15 Product Return Rate
	KPI-16 Complaints about Environmental Requirements
	KPI-17 Complaint Handling Time
Enable	KPI-18 Availability of SOPs & Internal Regulations
	KPI-19 Percentage of Employees Who Have Been Trained on the Environment

Table 5. Pairing performance attributes with key performance indicators

Attributes (Level 2)	Key Performance Indicators (Level 3)
Reliability	KPI-01 Production Forecasting Accuracy
Reliability	KPI-04 Defect-Free Products from Suppliers
Reliability	KPI-06 Percentage of ISO 14001 Certified Suppliers
Reliability	KPI-07 Percentage of Suppliers That Meet Environmental Standards
Reliability	KPI-09 Reliability of Production Employees
Reliability	KPI-10 Production Waste
Reliability	KPI-11 Percentage of Recyclable Materials
Reliability	KPI-14 Accuracy of Shipping Documents
Reliability	KPI-15 Product Return Rate
Reliability	KPI-16 Complaints about Environmental Requirements
Reliability	KPI-18 Availability of SOPs & Internal Regulations
Responsiveness	KPI-03 Planning Cycle Time
Responsiveness	KPI-08 Timeliness Supplier Delivery
Responsiveness	KPI-17 Complaint Handling Time
Asset	KPI-19 Percentage of Employees Who Have Been Trained on the Environment

3.5. Weighting of Green SCOR Model Levels with the Analytic Hierarchy Process Method

In the process of designing performance-based indicators, the final stage of green SCOR is an assessment of the interest level comparison scale. The purpose of this stage is to establish the relative weight of each indicator at each level in the green SCOR structure (levels 1, 2, and 3). This assessment is carried out using AHP, which adopts a paired comparison matrix approach to systematically compare the levels of importance between indicators. Weight determination is performed by comparing the dominance or importance of one indicator against another indicator at the same level. The rating scale used is a numerical scale of 1–9 (Table 6), corresponding to the paired comparison scale (Saaty, 2008).

Table 6. Paired comparison scale

Identity of Interests	Information
1	Both attributes or indicators are equally important and have the same influence
3	One attribute or indicator is slightly more important and influential than the attribute or indicator of its partner
5	One attribute or indicator is more important and influential than the attribute or indicator of its partner
7	One attribute or indicator is very important and influential compared to the attribute or indicator of its partner
9	An attribute or indicator that is one is absolutely very important and influential compared to the attributes or indicators of its partner
2, 4, 6, 8	The importance of the two attributes or indicators is close to each other

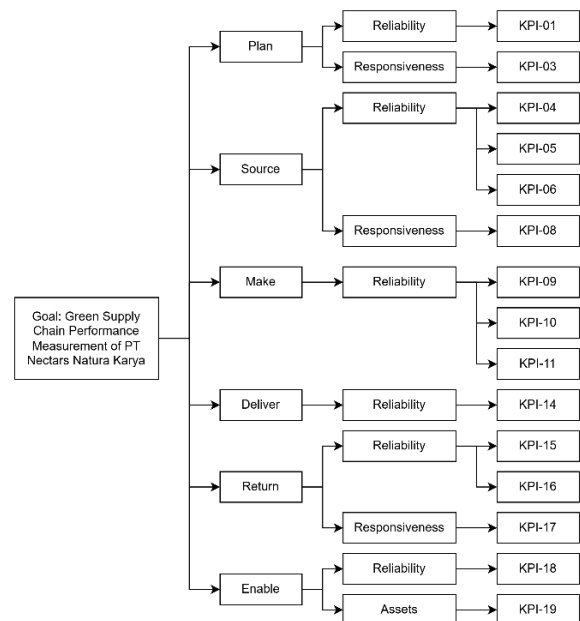
**Fig. 4.** Green SCOR weighting hierarchy structure

Table 7. Weighting results at each level of PT Nectars Natura Karya's green SCOR model

Level 1	Weight of Level 1	Level 2	Weight of Level 2	Level 3	Weight of Level 3	KPI Weight	Global
Plan	0.33	Reliability	0.58	KPI-01	1.00		0.19
		Responsiveness	0.42	KPI-03	1.00		0.13
		Reliability		KPI-04	0.63		0.09
Source	0.27	Reliability	0.52	KPI-06	0.21		0.03
		Reliability		KPI-07	0.16		0.02
		Responsiveness	0.48	KPI-08	1.00		0.13
		Reliability		KPI-09	0.59		0.12
Make	0.20	Reliability	1.00	KPI-10	0.25		0.05
		Reliability		KPI-11	0.16		0.03
Deliver	0.10	Reliability	1.00	KPI-14	1.00		0.10
		Reliability		KPI-15	0.74		0.02
Return	0.07	Reliability	0.49	KPI-16	0.26		0.01
		Responsiveness	0.51	KPI-17	1.00		0.03
Enable	0.04	Reliability	0.50	KPI-18	1.00		0.02
		Asset	0.51	KPI-19	1.00		0.02
Total KPI Weight							1.00

The level of importance of each indicator at each level of the green SCOR was assessed through data collection using questionnaires. The questionnaire was filled out by 9 respondents who were internal parties of PT Nectars Natura Karya. Each indicator in the model is assessed using the importance comparison scale as listed in Table 6. Based on the results of the assessment, weighting was performed using the AHP method with the help of Expert Choice software. Fig. 4 shows the hierarchical structure of each level that will be assessed by respondents.

Green SCOR uses the software Expert Choice to weight the results of each level, as shown in Table 7. Each criterion that does not have a comparison criterion receives a score of 1.00. The performance attribute that receives a score of 1.00 is reliability in the process making and delivering. As for the KPIs that received a

score of 1.00, they consisted of KPI-01 Production Forecasting Accuracy, KPI-03 Planning Cycle Time, KPI-08 Delivery Timeliness Supplier, KPI-14 Accuracy of Delivery Documents, KPI-17 Complaint Handling Time, KPI-18 Availability of SOPs & Internal Regulations, and KPI-19 Percentage of Employees Who Have Been Trained on the Environment.

3.6. Normalization of Key Performance Indicators

The performance scores obtained through the Snorm de Boer normalization process are classified using color indicators in the TLS system. This TLS shows whether the performance of an indicator requires improvement or is already in a condition that requires maintenance. The results of the calculation of the KPI values after normalization by the Snorm de Boer method are presented in Table 8.

Table 8. Results of KPI value calculation with Snorm de Boer normalization

KPI	Month (Year 2025)				Characteristics	Actual Value (Si)	Smin	Smax	Normalization Values	Traffic Light System
	Jan	Feb	Mar	Apr						
KPI-01	53.79%	72.74%	48.10%	74.75%	Nominal is Better	62.34%	48.10%	100 %	27.44	
KPI-03					Smaller is Better					
KPI-04	100%	95.83%	100%	100%	Larger is Better	98.96%	95.83%	100%	75.00	
KPI-06					Larger is Better					
KPI-07	3.85%	5.26%	5.08%	3.64%	Larger is Better	4.46%	3.64%	5.26%	50.48	
KPI-08	100%	100%	85.71%	100%	Larger is Better	96.43%	85.71%	100%	75.00	
KPI-09	96.83%	98.33%	95.45%	98.48%	Larger is Better	97.27%	95.45%	98.48%	60.06	
KPI-10					Smaller is Better					
KPI-11	0%	0%	31.06%	53.45%	Larger is Better	42.25%	31.06%	53.45%	50.00%	
KPI-14	100%	80%	100%	100%	Larger is Better	95.00%	80%	100%	75.00	
KPI-15	0%	1.28%	1.58%	0%	Smaller is Better	0.72%	0%	1.58%	54.81	
KPI-16					Smaller is Better					
KPI-17	100%	100%	75%	0%	Smaller is Better	91.67%	75.00%	100%	33.33	
KPI-18	92%	92%	94%	98%	Larger is Better	94%	92.00%	98%	33.33	
KPI-19	30%	0%	55%	0%	Larger is Better	21.25%	0.00%	55%	38.64	

3.7. Calculation of the Overall Supply Chain Performance

The overall score of PT Nectars Natura Karya's supply chain is obtained by multiplying the global weight of each KPI by the normalization value of the corresponding KPI. When calculating the final value of supply chain performance, KPI-03, KPI-06, KPI-10, and KPI-16 were excluded due to insufficient data to measure them. Nevertheless, these four KPIs are still considered in the design of performance indicators because they have been considered relevant and important for the company through the KPI validation process that has been carried out previously. Table 9 presents the total contribution of KPIs to the final value of supply chain performance.

Based on Table 9, it can be concluded that the four KPIs not included in the calculation contributed 22.23% to the total final value of supply chain performance. Therefore, the maximum value of supply chain performance that can be achieved is 77.77. Table 10. Breakdown of the calculation of the final value of PT Nectars Natura Karya's supply chain performance.

Based on the supply chain performance measurement using the green SCOR model weighted by the AHP, PT Nectars Natura Karya achieved a final performance score of 42.59 out of a maximum score of 77.77, corresponding to an actual achievement level of approximately 54.76%. This result indicates that the company's supply chain performance falls within the

moderate category, with strong operational capabilities but suboptimal integration of environmental sustainability principles across the supply chain.

In the plan process, KPI-01 (production forecast accuracy) obtained a normalized score of 27.44 and a final performance value of 5.14 (global weight 0.19), indicating weak forecast performance that may lead to mismatches between production capacity and actual demand. This condition highlights the need for immediate improvement through more systematic demand forecasting methods and better utilization of historical data. Meanwhile, KPI-03 (planning cycle time) could not be measured because of data unavailability, despite having a relatively high global weight (0.13). This finding emphasizes the importance of developing a structured planning cycle recording system to enable objective evaluation in the future.

Within the Source process, KPI-04 (Defect-Free Products from Suppliers) demonstrated strong performance, with a normalized score of 75.00 and a final value of 6.56, reflecting consistent raw material quality. However, environmental performance at the upstream level remains weak. KPI-06 (Percentage of ISO 14001-certified suppliers) lacked measurable data, while KPI-07 (Suppliers Meeting Environmental Standards) achieved a moderate score of 50.48, indicating low environmental compliance among suppliers. These results suggest the need for stricter supplier selection criteria, regular environmental audits,

Table 9. The contribution of KPI values is not included in the calculation of the overall green supply chain performance

Level 1	Level 2	Level 3	Global Weight KPI	Total Weight	Total Contribution to Overall Value
Plan	Responsiveness	KPI-03 Planning Cycle Time	0.13		
Source	Reliability	KPI-06 Percentage of ISO 14001 Certified Suppliers	0.03		
Make	Reliability	KPI-10 Production Waste	0.05	0.22	22.23%
Return	Reliability	KPI-16 Complaints about Environmental Requirements	0.01		

Table 10. Calculation of the overall green supply chain performance

Level 1	Level 2	Level 3	Global Weight KPI	Normalization Value (Snorm de Boer)	Performance end Value
Plan	Reliability	KPI-01	0.19	27.44	5.14
	Responsiveness	KPI-03			
Source	Reliability	KPI-04	0.09	75.00	6.56
	Reliability	KPI-06			
	Responsiveness	KPI-07	0.02	50.48	1.14
	Responsiveness	KPI-08	0.13	75.00	9.61
Make	Reliability	KPI-09	0.12	60.06	6.93
	Reliability	KPI-10			
	Reliability	KPI-11	0.03	50.00	1.62
Deliver	Reliability	KPI-14	0.10	75.00	7.73
Return	Reliability	KPI-15	0.02	54.81	1.30
	Reliability	KPI-16			
	Responsiveness	KPI-17	0.03	33.33	1.10
Enable	Reliability	KPI-18	0.02	33.33	0.68
	Asset	KPI-19	0.02	38.64	0.80
Overall Supply Chain Performance					42.59

and supplier development programs. In contrast, KPI-08 (Supplier Delivery Timeliness) recorded a high final value of 9.61, reflecting reliable upstream logistics that should be continuously monitored and maintained.

In the Make process, KPI-09 (reliability of production employees) achieved a normalized score of 60.06 with a final value of 6.93, indicating stable workforce performance but with room for improvement through better scheduling and skill development. KPI-10 (production waste) could not be evaluated because of the lack of data, despite its critical role in environmental sustainability. This highlights the urgency of establishing waste measurement systems for solid, liquid, and chemical waste. KPI-11 (percentage of recyclable materials) recorded a low score of 50.00, signaling limited adoption of circular economy practices and the need for product redesign and environmentally friendly material selection.

For the Deliver process, KPI-14 (Accuracy of Shipping Documents) demonstrated strong performance, with a normalized score of 75.00 and a final value of 7.73. Although this reflects high documentation accuracy, further digitalization and system validation are recommended to minimize manual error.

In the Return process, KPI-15 (Product Return Rate) achieved a normalized score of 54.81, indicating that product quality consistency still requires improvement through enhanced quality control and structured customer feedback mechanisms. KPI-16 (Environmental Complaints) could not be measured because of data limitations, suggesting the need to establish dedicated environmental complaint reporting channels. KPI-17 (Complaint Handling Time) recorded a low score of 33.33, reflecting inconsistent responsiveness to customer complaints. To address this issue, companies should implement stricter standard operating procedures (SOPs), define measurable response time targets, and strengthen the capacity of the complaint-handling team.

In the Enable process, KPI-18 (Availability of SOPs and Internal Regulations) and KPI-19 (Employee Environmental Training) achieved normalized scores of 33.33 and 38.64, respectively, indicating weak supporting systems and insufficient employee competency in environmental management. Management should prioritize the completion and standardization of operational documents and expand structured environmental training programs.

Overall, the performance composition reveals that 91.69% of the total score is contributed by general operational KPIs, whereas green supply chain KPIs account for only 8.36%. This imbalance indicates that the company's supply chain management system remains heavily focused on operational efficiency, reliability, and product quality, whereas environmental sustainability has not yet been systematically integrated into the strategic priority.

Therefore, management should strengthen Green Supply Chain Management initiatives by establishing environmental performance measurement systems, increasing the use of recyclable materials, expanding environmental training for employees, and actively prioritizing collaboration with ISO 14001-certified

suppliers. As noted by [Zhu & Sarkis \(2004\)](#), ISO 14001 implementation is a key indicator of internal GSCM adoption. Furthermore, ([Hassan et al., 2024](#); [Haslinda & Fuong, 2010](#)). emphasizes that ISO 14001 certification improves environmental performance and enhances operational performance and supply chain collaboration.

In the context of PT Nectars Natura Karya, increasing the proportion of ISO 14001-certified suppliers will not only support the company's commitment to environmentally friendly products but also strengthen its managerial foundation for a more sustainable and globally competitive supply chain. Maintaining strong operational performance while systematically improving green performance will be critical for achieving long-term sustainability and meeting future market demands.

3.8. Managerial Implication

The findings of this study provide several practical implications for managers in SMEs implementing GSCM. A comparison with prior studies in manufacturing and SME contexts ([Zhu & Sarkis, 2004](#); [Yadav & Yadav, 2024](#); [Tsikada et al., 2025](#)) shows that while operational performance is relatively strong, environmental KPIs contribute a smaller portion of overall performance. This indicates that managers should strategically integrate sustainability measures alongside operational efficiency, particularly in areas such as supplier environmental compliance, waste management, and internal employee awareness.

The study also highlights the limitations that managers should address. The absence of formal environmental certifications (e.g., ISO 14001) among suppliers and reliance on internal expert judgment may constrain the full realization of green supply chain performance. Consistent with prior research, SMEs often face challenges in implementing supplier-level environmental practices because of resource constraints and limited expertise ([Rahman et al., 2014](#); [Seman et al., 2012](#)). Therefore, managers should focus on building supplier capacity, providing targeted training, and promoting environmental awareness within the organization and across the supply chain.

To address these gaps, management is encouraged to strengthen GSCM initiatives by establishing environmental performance measurement systems, increasing the use of recyclable materials, expanding environmental training for employees, and actively collaborating with ISO 14001-certified suppliers. As noted by [Zhu & Sarkis \(2004\)](#), ISO 14001 implementation is a key indicator of internal GSCM adoption. Furthermore, [Hassan et al. \(2024\)](#) and [Haslinda & Fuong \(2010\)](#) emphasize that ISO 14001 certification not only improves environmental performance but also enhances operational efficiency and supply chain collaboration.

In the context of PT Nectars Natura Karya, increasing the proportion of ISO 14001-certified suppliers will support the company's commitment to environmentally friendly products and strengthen its managerial foundation toward a more sustainable and globally competitive supply chain. By maintaining strong operational performance while systematically improving

green performance, managers can achieve long-term sustainability, meet future market demands, and enhance the overall effectiveness of GSCM initiatives.

Finally, the methodological framework used in this study, which combines green SCOR, AHP weighting, Snorm de Boer normalization, and TLS, provides managers with a practical decision-support tool. This framework allows for systematic evaluation, prioritization of improvement areas, and alignment of operational strategies with sustainability objectives, making it highly relevant for SMEs seeking to strengthen green practices and prepare for the future adoption of environmental standards (Saaty, 2008; Okoli & Pawlowski, 2004).

4. CONCLUSION

This study evaluated the green supply chain performance of SME in the organic skincare sector, using the green SCOR framework integrated with the AHP, Snorm de Boer normalization, and the TLS. The SCOR model structured the main supply chain processes (Level 1), the green SCOR framework defined performance attributes (Level 2), and KPIs (Level 3) were developed and validated. Out of 19 candidate KPIs, 15 were confirmed through expert validation, covering production planning, supplier performance, manufacturing reliability, logistics, return management, and environmental sustainability.

KPI weights were determined using AHP, and overall supply chain performance was calculated and normalized, yielding a score of 42.59 out of 77.77, corresponding to 54.76% achievement and classified as "average performance". TLS analysis identified seven KPIs in the red zone, indicating areas requiring immediate improvement, primarily in environmental management, organizational support, and customer responsiveness. Four KPIs fell in the yellow zone, requiring continuous monitoring and incremental improvements. Overall, operational efficiency outperformed environmental performance, highlighting critical gaps in green supply chain practices.

The study provides actionable management implications, suggesting that management should strengthen environmental initiatives by implementing robust performance measurement systems, increasing the use of recyclable materials, enhancing employee environmental training, and collaborating with ISO 14001-certified suppliers. These actions can improve both environmental and operational performance and align sustainability objectives with business strategy.

The study also acknowledges its limitations, including a small sample of internal experts and the lack of certified suppliers, providing avenues for future research. Future studies could expand the sample to include multiple SMEs, include supplier perspectives, and evaluate the long-term impact of green supply chain initiatives. Overall, this research contributes a sector-specific diagnostic framework that guides SMEs in enhancing green supply chain performance while supporting long-term sustainability and competitiveness.

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