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Assessing Supply Chain Efficiency and Sustainability in Public Food Logistics Using the SCOR Model: Evidence from Perum BULOG Kediri, Indonesia

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ABSTRACT

This study evaluates the supply chain performance of premium rice at Perum BULOG Kediri Branch using the Supply Chain Operations Reference (SCOR) framework. The SCOR model—consisting of five core components: Plan, Make, Source, Deliver, and Return—provides a structured basis for assessing efficiency, responsiveness, and reliability within public food distribution systems. This empirical research adopts a qualitative and quantitative approach, combining field observations, interviews, and performance indicator analysis. Key performance metrics were derived from the SCOR model and assessed through benchmarking and internal evaluation. The findings reveal performance disparities across process categories, with notable inefficiencies in the delivery and sourcing phases, primarily due to logistical bottlenecks and supplier coordination challenges. Conversely, planning and inventory control show relatively high performance, supported by digital tracking and structured demand forecasting. The study highlights the relevance of the SCOR framework in identifying operational gaps and guiding performance improvement in government-managed supply chains. Strategic recommendations are proposed to enhance system integration, stakeholder collaboration, and digital innovation across the supply chain. These findings contribute to the growing literature on supply chain performance assessment in emerging economies and offer practical insights for public sector institutions striving to improve food distribution efficiency and service delivery. The SCOR-based evaluation framework also demonstrates its applicability for replicable use across other state-owned enterprises in Indonesia.

1. INTRODUCTION

Ensuring food security necessitates the establishment of efficient and reliable supply chain systems, particularly concerning staple commodities like rice [1-3]. In Indonesia, rice serves as the primary caloric source and holds significant socio-economic and political importance in the context of national food security. State-owned enterprises such as Perum BULOG play a crucial role in managing procurement, processing, distribution, and price stabilization of rice, thereby safeguarding food security [4, 5]. However, BULOG encounters ongoing operational challenges regarding supply chain performance, especially in the distribution of premium rice, which is essential for maintaining both quality and consumer satisfaction [6].

Despite BULOG's broad mandate, its operations are often hampered by limited integration between upstream production initiatives and downstream logistics. This disconnection is compounded by infrastructural deficiencies and bureaucratic inefficiencies, which together detract from operational responsiveness [7]. The situation is particularly evident in regions such as East Java, where initiatives designed to enhance farmer capacity have not efficiently aligned with supply chain requirements, leading to inconsistencies in raw material quality [8, 9]. Additional challenges such as reliance on outdated processing equipment and restricted transportation capacity further restrain BULOG's competitive stance against more agile private-sector actors in the food supply chain [10].

The consequences of these inefficiencies include mismatches in product specifications, delays in order fulfillment, and potential financial implications for both BULOG and the overall food system [11]. Although many frameworks have been proposed to assess supply chain performance, their application predominantly targets private-sector or multinational contexts; this is a gap considering the urgent need for robust public-sector supply chains in developing economies [12]. Specifically, the Supply Chain Operations Reference (SCOR) model has emerged as a structured approach to analyze supply chain performance through its five core processes: Plan, Source, Make, Deliver, and Return. Its diagnostic capabilities have been validated across various industries [13, 14]. However, empirical applications within state-owned food logistics remain sparse, indicating a significant opportunity for future research.

The applicability of the SCOR model in public food systems has been highlighted by recent studies. For instance, a published study uncovered structural weaknesses in rice logistics in Gorontalo Province [15-18], while other research emphasized the necessity of institutional support in shaping supply chain outcomes [19, 20]. These insights further support the research's focus on leveraging SCOR-based assessments to inform strategic reforms in government-managed supply chains, especially in the context of Indonesia, where balancing operational efficiency with public service obligations is paramount.

Building on this theoretical framework, the present study intends to utilize the SCOR model to evaluate premium rice supply chain performance at the Perum BULOG Kediri Branch [21, 22]. This evaluation will address critical questions regarding the structure of SCOR-based process flows, defining operational and organizational characteristics, and assessing performance attributes such as reliability, responsiveness, agility, cost, and asset utilization [23]. By addressing these dimensions, the research contributes not only to the literature on public-sector supply chains in developing countries but also provides practical strategies for enhancing BULOG's pivotal role in assuring food security through improved supply chain management practices.

2. MATERIAL AND METHODS

2.1 Research design

This study adopted a mixed-methods design, combining qualitative and quantitative approaches to comprehensively assess the structure, processes, and performance of the premium rice supply chain managed by Perum BULOG, Kediri Branch. A mixed-methods framework was selected to triangulate findings, allowing numerical performance data to be contextualized with field-based insights [24]. In this study, the mixed-methods design was implemented using an explicit integration framework in which qualitative and quantitative components were assigned complementary roles. Quantitative data—derived from SCOR Level 3 indicators, AHP weighting, and Snorm De Boer normalization—served as the primary basis for evaluating supply chain performance. Qualitative data (interviews, observations, and document reviews) functioned as explanatory and validation components to contextualize numerical scores. Triangulation occurred through a convergence strategy: quantitative scores were first computed, then cross-checked against field interview insights (e.g., challenges in sourcing, production delays, and logistics constraints) to verify whether operational experiences aligned with the measured indicators. This integrative approach enhances methodological rigor by demonstrating how the two data streams informed, supported, and refined each other in interpreting the performance of the BULOG Kediri supply chain.

2.2 Research site and period

The research was conducted at the Kediri Branch of Perum BULOG, which is directly responsible for the production and distribution of the *Candi Mulyo* premium rice. Fieldwork was carried out between December 2024 and January 2025, using both primary data collected in situ and secondary data from the 2024 fiscal year reports. The use of 2024 fiscal data and fieldwork conducted from December 2024 to January 2025 is methodologically consistent, as both datasets represent the same operational period. The fiscal year data refer to BULOG's official 2024 performance reports, covering January-December 2024, while the fieldwork was conducted immediately at the end of that fiscal period. This timing allowed direct verification of reported performance indicators through on-site observations and interviews. Although the period follows the post-pandemic transition, all data sources fall within the same stable operational cycle, ensuring that external volatility did not distort the analysis.

2.3 Sampling and respondents

A purposive non-probability sampling technique was employed to identify key informants actively engaged in supply chain operations. Respondents were selected based on the following criteria:

(1) Employment in BULOG's supply chain divisions (procurement, warehousing, logistics, or sales).
(2) Minimum of two years' professional experience in supply chain management.
(3) Direct involvement in premium rice operations at the Kediri Branch.

2.4 Data collection

Primary data were obtained through:

(1) Semi-structured interviews with operational managers and staff (23 January 2025), recorded and transcribed for thematic analysis.
(2) Non-participatory observations of procurement, processing, warehousing, and distribution activities at the Candirejo Rice Processing Unit and Kediri warehouses.
(3) Structured questionnaires completed by key personnel to evaluate SCOR-based performance indicators.

Secondary data were sourced from internal company records, government regulations, and relevant academic literature. In total, eight semi-structured interviews were conducted with personnel representing procurement, warehousing, logistics, production, and sales divisions. Each interview lasted 25-45 minutes and was audio-recorded before being transcribed for analysis. For the quantitative component, 20 questionnaires were distributed to staff members directly involved in premium rice operations, of which 17 were completed and returned, resulting in an 85% response rate. These combined datasets provide a robust and credible empirical foundation, ensuring that the qualitative insights and quantitative indicator measurements reflect actual operational conditions within the BULOG Kediri Branch.

2.5 Analytical framework

This study employed the Supply Chain Operations Reference (SCOR) Model Version 11.0 as the primary analytical framework for assessing supply chain performance [25]. The SCOR framework, as defined by APICS, organizes supply chain activities into five core processes—Plan, Source, Make, Deliver, and Return—and provides standardized performance metrics that enable benchmarking and comparative evaluation. Using this unified reference ensures consistency in terminology, metric selection, and process categorization throughout the analysis. Accordingly, all SCOR-related definitions, structures, and performance indicators applied in this study follow the specifications outlined in APICS.

Quantitative evaluation involved:

(1) Performance measurement using SCOR Level 3 indicators (e.g., planning accuracy, procurement cycle time, yield rate, delivery accuracy, and return rate).
(2) Pairwise comparison analysis [26] to determine the relative weight of processes, attributes, and metrics. Eigenvalues and priority weights were computed using Microsoft Excel.
(3) Normalization of indicator values using the Snorm De Boer method, followed by weighted aggregation to generate overall performance scores.

Qualitative data from interviews and observations were analyzed thematically [27] to complement and explain quantitative results. To increase methodological transparency, this study provides the computational details used in the weighting and normalization processes. The Analytic Hierarchy Process (AHP) employed pairwise comparison matrices constructed from expert judgments across the SCOR attributes. The priority weights were derived using the standard eigenvector method, and all matrices achieved acceptable consistency, with Consistency Ratios (CR) below the 0.10 threshold [26]. The Snorm De Boer normalization followed the formula:

$$S_i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}} \quad (1)$$

Enabling each SCOR Level 3 metric to be scaled to a 0-1 range prior to weighted aggregation. These additions ensure that the weighting and scoring processes are fully reproducible and adhere to established decision-analysis protocols.

3. RESULTS

3.1 SCOR process analysis

(1) Plan

Perum BULOG Kediri Branch has established strategic objectives for the *Candi Mulyo* premium rice supply chain, including achieving an annual sales turnover of IDR 20 billion, reducing operational costs by 5%, and expanding distribution coverage. Demand forecasting integrates seasonal consumption trends, particularly during Eid al-Fitr, Christmas, and New Year holidays, to ensure raw material readiness. While planning accuracy is relatively high, planning cycle time occasionally exceeds optimal duration due to lengthy internal coordination.

(2) Source

Procurement is conducted mainly through the Candirejo Rice Processing Unit (UPB), sourcing paddy (*Gabah Kering Panen,* and *Gabah Kering Giling*) from local farmers in Nganjuk Regency. Seasonal variability affects procurement reliability, as only the second and third planting seasons are considered optimal. This limitation reduces consistency in both supply volume and raw material quality.

(3) Make

Processing takes place at UPB Candirejo with a maximum capacity of two tons per day. Mechanical stages include drying, milling, sorting, and packaging. While the yield rate is consistently high, equipment limitations—particularly drying ovens and milling machines—cause downtime and production delays. Asset utilization remains suboptimal, underscoring the need for modernization.

(4) Deliver

Distribution relies on four warehouses, with stock concentration at Candirejo and Kedondong. Deliveries are carried out via BULOG-owned vehicles and through partnerships with *Rumah Pangan Kita* agents, retailers, and local distributors. Delivery accuracy is moderate due to logistical bottlenecks, while transportation costs remain relatively high compared to private competitors.

(5) Return

The reverse logistics process is relatively effective. Both the return rate and return processing time are well-managed, reflecting BULOG's ability to maintain product quality assurance and resolve consumer complaints efficiently.

3.2 SCOR performance metrics

Table 1. SCOR level 3 performance metrics of the premium rice supply chain

Metric	Attribute	Score (%)
Planning Accuracy	Reliability	100.00
Planning Cycle Time	Responsiveness	87.50
Planning Cost	Cost	83.33
Supplier Reliability	Reliability	37.50
Item Quality Conformance	Reliability	45.00
Procurement Cycle Time	Responsiveness	50.00
Supplier Compliance Rate	Agility	67.00
Purchased Item Cost	Cost	55.56
Yield Rate	Reliability	100.00
Order Fulfilment Cycle Time	Responsiveness	67.00
Schedule Adherence	Responsiveness	20.63
Production Cost	Cost	56.25
Raw Material Utilization	Cost	25.00
Capacity Utilization	Asset Management	67.00
Asset Downtime	Asset Management	24.75
Delivery Accuracy	Reliability	46.00
Location Accuracy	Asset Management	50.00
Loading Time	Responsiveness	20.00
Delivery Cycle Time	Responsiveness	100.00
Transportation Cost	Cost	87.14
Return Rate	Asset Management	92.00
Return Processing Time	Responsiveness	100.00

Notes: The data presented in Table 1 were collected during fieldwork conducted between December 2024 and January 2025. All SCOR Level 3 indicators were validated through cross-checking between interview responses, on-site operational observations, and internal performance records from the 2024 fiscal year. Indicator values were reviewed and confirmed by BULOG's operational managers to ensure accuracy and consistency before analysis.

Table 1 presents the performance scores across SCOR Level 3 metrics. The results show significant variation: high scores for planning accuracy, yield rate, and delivery cycle time, but low scores for supplier reliability, procurement cycle time, and asset downtime.

3.3 Weighted performance by SCOR process

Table 2 summarizes the weighted contributions of each SCOR process to the overall supply chain performance.

Table 2. Weighted SCOR process scores

Process	Process Weight	Attribute Score	Final Score
Plan	0.17	96.08	16.33
Source	0.23	68.27	15.70
Make	0.31	89.18	27.65
Deliver	0.23	93.92	21.60
Return	0.05	94.00	4.70
Total	1.00	-	85.98

Note: Weighted process scores in Table 2 were calculated using SCOR Level 3 metrics collected from the December 2024-January 2025 operational period. The weighting process employed AHP with consistency ratios ($CR < 0.10$), ensuring reliability of expert judgments. Final aggregated scores were validated by cross-referencing internal performance reports and confirming process-level interpretations with BULOG's operational managers.

The composite performance score of 85.98 places the supply chain in the "excellent" category. The Make process contributes most significantly (27.65), followed by Deliver (21.60) and Source (15.70). The lowest performance is found in Source, due to weak supplier reliability and procurement cycle time.

4. DISCUSSION

The SCOR-based evaluation of the *Candi Mulyo* premium rice supply chain at Perum BULOG Kediri Branch highlights a dual performance profile: strengths in planning, production yield, and return management, but weaknesses in procurement reliability, supplier compliance, and asset utilization. These findings underscore the structural complexity of state-managed food supply chains, which must balance efficiency goals with public service obligations. The SCOR-based evaluation of the *Candi Mulyo* premium rice supply chain at Perum BULOG Kediri Branch highlights a dual performance profile: strengths in planning, production yield, and return management, but weaknesses in procurement reliability, supplier compliance, and asset utilization. These findings underscore the structural complexity of state-managed food supply chains, which must balance efficiency goals with public service obligations.

4.1 Strengths in planning and production

The study revealed high planning accuracy (100%) and strong production yield rates (100%), suggesting that BULOG's internal planning and processing mechanisms is effective in aligning supply with forecasted demand. This aligns with prior research emphasizing the role of structured demand forecasting and planning integration in stabilizing agri-food supply chains [28-30]. The effective management of the return process, reflected in excellent scores for both return rate and processing time, further demonstrates BULOG's commitment to quality control and customer service. These strengths are critical in maintaining consumer trust in premium rice brands, where product consistency is a key determinant of market competitiveness.

4.2 Procurement and supplier coordination challenges

Despite the strong planning function, procurement performance remains a bottleneck, with low scores for supplier reliability (37.50%) and item quality conformance (45.00%). These outcomes reflect the structural dependency on smallholder farmers and intermediaries, which creates variability in supply and raw material quality. Similar challenges have been observed in smallholder-based supply chains across developing economies, where fragmented sourcing undermines vertical coordination and consistency [31, 32]. Previous studies in Indonesia also reported that institutional and ecosystem support significantly influence procurement reliability in public food systems [33, 34]. Strengthening long-term contractual arrangements with farmer groups and enhancing supplier development programs could reduce these uncertainties.

4.3 Equipment downtime and asset utilization

The Make process, although overall strong, is constrained by equipment downtime (24.75%) and suboptimal raw material utilization (25.00%). These results are consistent with the findings of published research, who noted that outdated machinery and insufficient preventive maintenance practices reduce operational efficiency in agri-food industries [35, 36]. In the context of BULOG, investments in modern processing technology—particularly dryers and milling machines—are necessary to sustain premium rice quality and to minimize recurring operational disruptions. Enhancing asset management systems would also improve capacity utilization, reduce costs and increase responsiveness.

4.4 Logistics and distribution efficiency

The Deliver process scored relatively high overall (93.92 attribute score), but weaknesses were identified in delivery accuracy (46.00%) and loading time (20.00%). These inefficiencies are linked to limited fleet capacity and reliance on bureaucratic procedures that slow resource allocation [37]. Comparisons with private-sector supply chains in Indonesia reveal that more flexible logistics arrangements enable faster response to market fluctuations. BULOG's hybrid distribution model, which partly relies on distributors' own transport, has mitigated some of these challenges but requires further optimization to ensure last-mile reliability.

4.5 Strategic implications for public food supply chains

The composite SCOR performance score of 85.98 places BULOG's premium rice supply chain in the "excellent" category. However, the distribution of scores across processes indicates a need for targeted reforms. Improving supplier integration, investing in technological upgrades, and streamlining logistics are crucial for sustaining long-term competitiveness [38, 39]. Importantly, these reforms should not only improve operational efficiency but also reinforce BULOG's dual role as a commercial operator and public service provider—a challenge frequently highlighted in literature on public-sector logistics.

4.6 Limitations and future research

This study is limited by its single-site focus on the Kediri Branch and its reliance on a one-year dataset. Future research should expand to multiple BULOG branches to capture geographic variations in supply chain performance and to conduct longitudinal analyses of performance dynamics over time. Moreover, integrating digital supply chain tools such as blockchain-based traceability or AI-driven demand forecasting could be explored as strategic innovations to enhance transparency and agility [40, 41].

5. CONCLUSIONS

This study assessed the performance of the *Candi Mulyo* premium rice supply chain at Perum BULOG Kediri Branch using the SCOR framework. The results indicate that the overall performance is classified as excellent (composite score 85.98), with notable strengths in planning accuracy, production yield, and return management. These strengths demonstrate BULOG's ability to ensure product consistency and maintain consumer trust in premium rice markets.

However, key weaknesses were identified in procurement reliability, supplier compliance, and asset utilization, largely due to dependence on smallholder farmers, outdated processing equipment, and limited logistics capacity. These constraints highlight the importance of strengthening upstream farmer partnerships, upgrading production technologies, and optimizing distribution systems.

The findings contribute to the growing literature on public-sector supply chain management in developing economies by demonstrating the applicability of the SCOR framework in diagnosing operational inefficiencies and guiding strategic improvements. For practitioners and policymakers, the study underscores the need for greater vertical integration, digital innovation, and institutional flexibility in public food logistics.

Future research should extend this analysis across multiple BULOG branches and employ longitudinal approaches to capture evolving performance dynamics. Exploring digital supply chain solutions—such as blockchain traceability and AI-based demand forecasting—could further enhance efficiency, transparency, and resilience in government-managed food systems. Although this study provides valuable insights into SCOR-based performance evaluation, the findings are derived from a single operational unit—the Perum BULOG Kediri Branch. Supply chain structures, supplier ecosystems, and logistical infrastructures may differ substantially across other BULOG branches in Indonesia, which limits the generalizability of the conclusions. Therefore, the results should be interpreted as site-specific rather than representative of national conditions. Future studies involving multiple branches or cross-regional comparisons would be necessary to draw broader inferences about the performance of Indonesia's public food logistics system.

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