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Analysis of Supply Chain Performance and The Efficiency of Dairy Product Suppliers at PT XYZ, Subang Sub Province

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ABSTRACT

Dairy farming in West Java plays a crucial role in rural livelihoods, yet faces declining productivity due to limited feed and infrastructure. PT XYZ, a dairy processing company in Subang, encounters internal inefficiencies and external supply inconsistencies from smallholder farmers. This study aims to (1) analyze PT XYZ's dairy supply chain using the SCOR model, (2) determine the priority weights of supply chain performance metrics, and (3) assess the efficiency of its two major suppliers KUD Larasati and KUD Parongpong using the DEA method. Data were collected via observations, interviews, literature review, and expert judgment. Performance parameters such as planning (weight 0.397), perfection (0.662), and quality (0.378) were found most critical. Efficiency analysis revealed that neither cooperative achieved consistent 100% efficiency across semesters, with issues stemming from delivery delays, inadequate infrastructure, and fluctuating milk quality. Recommendations include optimizing logistics, implementing ERP systems, and enhancing supplier coordination. Findings emphasize the need for integrated performance measurement to boost supply chain responsiveness, reduce costs, and maintain high product quality. The study highlights the importance of strategic planning and continuous evaluation to improve competitiveness and ensure sustainable milk supply chain operations.

KEYWORDS *DEA, Efficiency, Performance supply chain, SCOR-AHP*

INTRODUCTION

Dairy farming is primarily aimed at milk production and supports rural livelihoods, especially among small-scale farmers in low- and middle-income countries (Jahroh et al., 2020). In contrast, large-scale farms are still limited. Livestock farming has become a new growth driver for agriculture and the national economy (Aziz et al., 2021). In West Java, a key milk-producing region in Indonesia, dairy cow populations and milk production declined by 10.62% and 9.26% from 2019 to 2023, mainly due to limited feed availability and quality (Usmiati & Abubakar, 2009). The dairy supply chain begins with suppliers who ensure raw material availability, followed by distribution to cooperatives and industries under quality and quantity standards.

Table 1. Dairy Cattle Population and Milk Production in West Java Province 2019-2023

Description	2019	2020	2021	2022	2023	Average
Population (Cows)	122.505	118.434	119.939	120.794	111.191	118.573

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Production (Ton)	300.337	281.199	290.473	300.278	268.467	288.151

Source: Ministry of Agriculture and BPS, processed (2024)

PT XYZ, headquartered in Subang, West Java, processes fresh cow's milk into various dairy products and faces both internal and external challenges. Internally, the company struggles with suboptimal supply chain performance assessments, while externally, it faces issues such as inconsistent milk quality and supply from small-scale farmers through KUD Larasati and Parongpong. Infrastructure limitations, like poor road conditions and long distances, further complicate logistics. Established in 2018 and operational since mid-2019, PT XYZ sources milk from 1,600 imported cows and has a vision to become a leading FMCG company in the dairy sector. However, inefficiencies in transportation, inadequate cooling units, and the vulnerability of small farmers to feed shortages contribute to disruptions in the fresh milk supply chain (Gunasekaran & Bulent Kobu, 2007; Sethanan & Pitakaso, 2016; Huang et al., 2019).

To address these challenges, PT XYZ must adopt robust performance measurement systems. According to Monczka et al. (2011), performance metrics provide critical data for initiating continuous improvement. Supply chain performance directly affects productivity and customer satisfaction, as noted by Marimin et al. (2013) and Suhong et al. (2014). Measuring supply chain performance requires defining key performance indicators (KPIs) that align with operational goals and involve all stakeholders from suppliers to distributors (Hasibuan et al., 2018). Efficient supply chain management reduces logistics costs, optimizes resources, and boosts profitability. Conversely, an inefficient supply chain increases operational expenses and reduces competitiveness (Fan et al., 2013). Putri et al. (2019) emphasized that effective supply chain systems maintain quality, reduce costs, and ensure fast service, thus delivering greater value and competitive advantage.

Effectiveness and efficiency played a crucial role in decision-making to ensure that supply chain management goals are achieved (Hadiguna, 2016). Furthermore, improving efficiency and effectiveness enables continuous improvements in the overall supply chain structure (Taticchi et al., 2015). The purpose of efficiency measurement is to assess how efficiently a company manages its business operations (Kaltsum & Nurzi, 2019). Companies aim to enhance productivity, efficiency, and service speed through innovation and product development. Understanding consumer needs and establishing a competitive advantage are essential for gaining market share. Efficiency and effectiveness strategies are crucial for maintaining a competitive edge (Hasibuan et al., 2018; Y.D. Putri et al., 2019). Supply chain performance between suppliers, companies, and consumers can be assessed using the SCOR (Supply Chain Operations Reference) model. This model encompasses business processes, benchmarks, and a cross-functional framework. Companies can leverage the SCOR model to evaluate supply chain effectiveness, communicate organizational goals, assess their competitive position, and identify improvement opportunities (Y.D. Putri et al., 2019).

In this context, research on supply chain performance and supplier efficiency in the dairy industry is highly relevant. Supply chain optimization focuses not only on improving transportation efficiency and raw material handling but also on utilizing relevant and measurable performance metrics. By adopting this approach, companies can proactively identify weaknesses in the supply chain and implement strategic measures to enhance service quality, reduce operational costs, and ensure a continuous milk supply. Additionally, with appropriate metrics, PT XYZ Subang can adapt more effectively to market changes and ensure operational sustainability despite various challenges. The urgency of this research lies in the need to design a more efficient, integrated, and responsive supply chain system to help the company succeed in a competitive market and achieve long-term business goals. This study aims to 1) Identify and analyze the dairy milk supply chain at PT XYZ with SCOR. 2) Determined the priority weight of each chain performance metric at PT XYZ. 3) Analyzing the efficiency level of KUD Larasati and Parongpong as the company's major dairy suppliers.

RESEARCH METHOD

This research was conducted at PT XYZ in Subang Regency, West Java, from June to August 2024, including several partner cooperatives such as KUD Larasati and Parongpong. Data were collected through observation, interviews, literature review, and expert judgment from eight professionals, including PT XYZ's division heads and cooperative leaders, using questionnaires to determine AHP weights. PT XYZ, which sources milk from smallholder farmers, faces challenges in milk quality and quantity, as well as a lack of supply chain performance measurement. The study mapped the milk supply chain and applied the SCOR model to identify performance metrics, with weights calculated using AHP and efficiency analyzed using the DEA method via Banxia Frontier Analyst and Microsoft Excel. Input-output variables, such as overhead cost, transportation cost, and inventory days of supply, were determined from the SCOR-aligned performance model. Performance assessments were carried out for two semesters in 2023 to evaluate efficiency and benchmark sensitivity among Decision Making Units (DMUs). The results served as a basis to guide operational improvements and cost efficiency across the milk supply chain.

RESULT AND DISCUSSION

Dairy Supply Chain PT XYZ Subang

Frisian Holstein cows imported from Australia are raised on a 50-hectare farm with climate conditions similar to their natural habitat and are treated with great care. The fresh milk produced is processed in a high-tech, environmentally friendly factory that utilizes biogas energy and advanced Japanese milk processing technology, including a waste treatment system that converts solid waste into fertilizer and cow resting areas. PT XYZ in Subang supports the government in improving the quality and availability of fresh milk in Indonesia while also benefiting the surrounding community. Since April 2020, the company has

managed its commercial products, launching its first fresh milk in July 2020 and Ultra High Temperature milk with various flavors in April 2021. These products cater to diverse consumer needs, including children, adults, and individuals requiring high-calcium or low-fat nutrition.

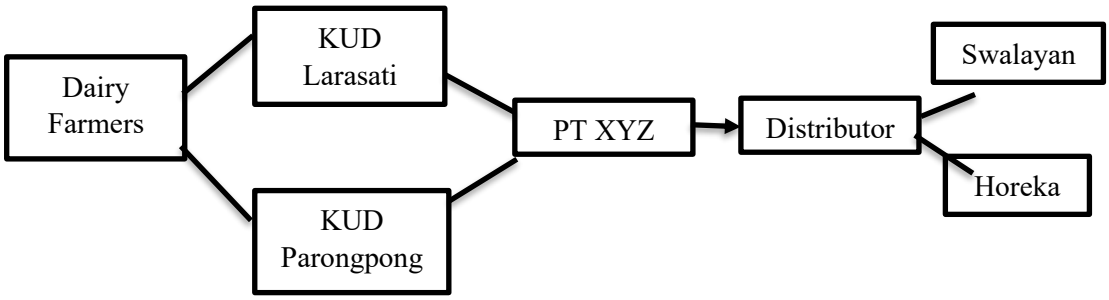

Figure 1. The Flow of Dairy Supply Chain

A performance measurement design was developed using the SCOR model, supported by expert input to establish a hierarchical structure for selecting dairy supply chain indicators. The SCOR model consists of four levels: Level 1 outlines top-level metrics across five core processes—plan, source, make, deliver, and return; Level 2 defines process categories to implement operational strategies; Level 3 details process elements that align with business strategy in specific markets; and Level 4 focuses on implementation. Effective supply chain planning involves forecasting raw material needs, selecting suppliers based on price, quality, and reliability, planning transportation routes and schedules to reduce time and costs, managing transport modes, and ensuring timely delivery of materials that meet specifications to prevent production delays.Predicting the number of raw materials or goods that will be needed.

Weight and Priority of Performance Parameters Supply Chain Based on SCOR

Table 2. Weight and Priority of Business Process Supply Chain Dairy

Business Process	Weight	Priority
Plan	0,397	1
Source	0,251	2
Make	0,163	3
Deliver	0,138	4
Return	0,052	5

Source: Resesarch analysis, 2024

The plan process holds the highest priority with a weight of 0.397, highlighting its critical role in ensuring accurate demand forecasting, timely procurement, and efficient resource allocation. Errors at this stage can significantly disrupt overall supply chain performance. The source process ranks second with a weight of 0.251, emphasizing the importance of effective procurement in securing

quality raw materials such as cow's milk from reliable suppliers. Efficient sourcing ensures timely deliveries, supports uninterrupted production, and minimizes the risk of delays or quality issues.

Table 3. Weight and Priority of Performance Parameters Supply Chain

Performance Parameters	Weight	Priority
Perfection	0,662	1
Lean logistic	0,249	2
Efficiency	0,104	3

Source: Resesarch analysis, 2024

Based on expert choice v11, perfection ranks highest among performance improvement factors with a weight of 0.662, indicating it as the top priority for PT XYZ Subang. This focus on perfection reflects the company's commitment to producing high-quality, defect-free dairy products that meet safety standards, enhance customer loyalty, and strengthen brand reputation amidst industry competition. Quality is also emphasized in performance attributes, alongside productivity, effectiveness, and logistics costs. Maintaining quality across the supply chain through proper temperature control, handling, and delivery is crucial for overall efficiency, requiring investments in monitoring technology, staff training, and strict SOPs.

Table 4. Weight and Priority of Performance Attributes Supply Chain

Performance Attributes	Weight	Priority
Quality	0,378	1
Effectiveness	0,230	2
Productivity	0,204	3
Logistic cost	0,189	4

Source: Resesarch analysis, 2024

Quality is the most critical factor in the dairy supply chain performance of PT XYZ, as it directly influences overall efficiency. Key elements affecting quality include temperature control, handling, and product integrity during logistics until it reaches the processing facility. High standards must be maintained in all logistics phases, supported by investments in quality monitoring, staff training, and standard operating procedures. On the other hand, logistics costs are considered the least significant and receive lower priority. However, quality, effectiveness, and productivity must still guide cost control efforts to avoid compromising other essential aspects. To ensure optimal and efficient supply chain operations, performance indicator metrics are categorized into parameters such as quality, productivity, effectiveness, and logistic costs.

Table 5. Weight and Priority of Performance Indicators Supply Chain

Performance Indicators	Weight	Priority	CR Value
Inventory days of supply	0,188	1	0,06

Quality of goods	0,157	2
Perfect delivery	0,125	3
Stock out	0,120	4
Transportation cost	0,089	5
On-time delivery	0,095	6
Goals program	0,077	7
Overhead cost	0,076	8
Cost of backorder	0,073	9

Source: Resesarch analysis, 2024

In the weighted performance metrics of the dairy supply chain, inventory days of supply emerges as the most crucial indicator, reflecting the importance of maintaining an optimal inventory level to avoid shortages and overstocking. Insufficient inventory can disrupt order fulfillment, while excess inventory increases storage costs and the risk of spoilage. Efficient inventory management is therefore essential to operational success. Additionally, maintaining high quality standards throughout all supply chain stages from planning to delivery is critical. To support this, companies are encouraged to invest in quality monitoring technologies, staff training, and implement rigorous standard operating procedures..

Efficiency Cooperatives (KUD) Using DEA Analysis

Performance measurement is applied in 2 KUD partners who consistently produce dairy milk and have their own land or leased land, and the selection of partners is based on approval or recommendation by the company and partner farmers who come from Kuningan and Bandung areas. Performance measurement using DEA is a calculation using linear techniques. In this DEA program has two objectives, namely minimizing inputs and maximizing outputs. Measurement is done using the CRS model. The results can determine which partner farmers must improve their performance, through increasing outputs or minimizing inputs. The following are the results of data analysis between KUD Larasati and KUD Parongpong.

Table 6. Performance KUD Larasati Semester 1 and 2 on 2023

Performance KUD Larasati Semester 1		Performance KUD Larasati Semester 2	
Month	Nilai (%)	Month	Nilai (%)
January	100	July	66,9
February	100	August	47,5
March	100	September	100
April	100	Oktober	100
May	100	November	100
June	100	Desember	100

Source: Resesarch analysis, 2024

The input variables used in this study include transportation cost, overhead cost, and inventory days of supply, calculated using CRS assumptions aligned with the input approach by comparing the performance of PT XYZ Subang's partner farmers. Data Envelopment Analysis (DEA) was processed using Banxia Frontier

Analyst software, with calculations performed in Microsoft Excel. The performance data of KUD Larasati in 2023 shows that most months in the first semester achieved 100% efficiency, indicating consistent and stable operations. However, inefficiencies occurred in July and August, likely due to delivery delays, reduced production, or low milk quality, highlighting the need for further analysis to prevent future performance declines.

Table 7. Total Potential Improvement KUD Larasati

Description		Total Potential Improvement	
		Semester 1	Semester 2
Input	Transportation cost (%)	26,06	-29,86
	Overhead cost (%)	14,19	-15,61
	Inventory days of supply (%)	24,82	-14,78
Output	Stock out (%)	25,73	4,63
	Quality (%)	3,99	3,55
	Perfect order fulfillment (%)	5,22	31,57

Source: Resesarch analysis, 2024
Information: Decrease (-)

The data indicates a notable rise in transportation costs, overhead costs, and inventory days of supply during the first semester, largely due to increased raw material prices, higher production levels, or the implementation of a larger stock-holding strategy. In contrast, the second semester showed a significant decrease in these variables following a shift toward a more efficient operational strategy. Product quality experienced a slight decline from 3.99% to 3.55%, likely due to variations in raw materials, production factors, or supplier management, which suggests the need for breeder training, process improvements, or technological upgrades. Despite this fluctuation, maintaining quality remains critical for safeguarding cooperative reputation and customer satisfaction. A substantial increase in perfect order fulfillment was observed, attributed to improved logistics, supply chain automation, and enhanced customer service. In terms of performance efficiency, calculations from the first semester of 2023 show inefficiencies in February, May, and June, while the second semester achieved full efficiency across all months.

Table 8. Performance KUD Parongpong Semester 1 and 2 on 2023

Performance KUD Parongpong semester 1		Performance KUD Parongpong semester 2	
Month	Nilai (%)	Month	Nilai (%)
January	100	July	100
February	54,9	August	100
March	100	September	100
April	100	Oktober	100
May	85,9	November	100
June	70,8	Desember	100

Source: Resesarch analysis, 2024

The table shows that semester 1 started with excellent performance in January, March and April at 100%. However, there was a significant drop in February, May and June, indicating temporary disruptions or seasonal operational challenges. Meanwhile, semester 2 showed a very significant assessment, with a score of 100% from July to December, indicating significant improvements made by management such as improving operational or management systems, optimizing supply chains, improving human resources and cutting-edge technology, and stabilizing external factors.

Tabel 9. Total Potential Improvement KUD Parongpong

Description		Total Potential Improvement	
		Semester 1	Semester 2
Input	Transportation cost (%)	-16,41	20,9
	Overhead cost (%)	-34,56	21,69
	Inventory days of supply (%)	-19,56	18,09
Output	Stock out (%)	7,67	15,55
	Quality (%)	7,55	11,56
	Perfect order fulfillment (%)	14,26	12,22

Source: Resesarch analysis, 2024
Information: Decrease (-)

The data reveals a notable increase in transportation costs, overhead costs, stock outs, and inventory days of supply during semester 2, suggesting potential issues such as rising fuel prices, inefficient delivery routes, increased operational activity, higher labor costs, or excessive raw material inventory. To enhance the performance of the cow's milk supply chain, it is essential to analyze the gap between current supply chain conditions and development objectives, particularly in improving competitiveness and the welfare of stakeholders from farmers to cooperatives. For KUD Parongpong, several improvements are recommended: optimizing transportation management to lower logistics costs in semester 2, evaluating the causes behind rising overhead costs whether from labor, production, or policy changes and enhancing order fulfillment efficiency through better coordination among suppliers, production units, and distribution channels..

Managerial Implications

Efficiency measurements using Frontier Analysis Banxia software showed that KUD Larasati and KUD Parongpong did not achieve full efficiency in both semesters of 2023, mainly due to delivery delays, fluctuating milk production, and inadequate cooling and transportation facilities. To improve inbound logistics, key strategies include optimizing transportation through efficient route planning, real-time monitoring with GPS and IoT, and partnering with third-party logistics for refrigerated transport. Enhancing stock and demand management can be done with cloud-based systems or ERP, accurate demand forecasting, and synchronized scheduling among farmers, KUDs, and processors. Quality improvements require

external cooling near farms, routine training, and stronger coordination with suppliers. Regular performance evaluation should focus on inventory days and product quality, using KUD Larasati's route optimization as a model for KUD Parongpong. These efforts aim to increase both efficiency and quality in the dairy supply chain.

CONCLUSION

Based on the analysis of the PT XYZ Subang dairy milk supply chain, several conclusions can be drawn. The supply chain begins with raw milk from farmers, cooled at the KUD, and then delivered to the processing industry (IPS) before reaching end consumers via distributors. The SCOR model shows that planning (0.397) and quality (0.378) are dominant, indicating their importance in optimizing overall performance. Key performance indicators such as inventory days of supply (0.188) and product quality (0.157) highlight the need to maintain product availability and quality. However, efficiency measurements using DEA show that cooperatives have not consistently reached full efficiency, due to late deliveries, low production, and poor quality. The study is limited by its short time frame and focus on internal metrics, lacking insights on seasonal trends, market fluctuations, and individual cooperative conditions. Future research should include external factors like market price volatility, risk analysis, and seasonal demand patterns, as well as cooperative-specific analysis for more targeted recommendations and adaptive logistics strategies.

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