JSM: Jurnal Sains Manajemen
Vol. 14, No. 1, May 2025 / ISSN 2302-1411 (print)
pp: 43 – 53

Assessing the efficiency of supply chain processes in the palm oil sector

Nabilla Fitria*, Hansly Tunjang, Peridawaty
Faculty of Economics and Business, University of Palangka Raya

Corresponding Author
Address : Faculty of Economics and Business, University of Palangka Raya
E-mail : nabillafitria99@gmail.com

ABSTRACT

The palm oil industry remains a vital sector in Indonesia's economy, significantly contributing to national exports and regional development. However, operating in geographically challenging areas like Kalimantan presents logistical and sustainability obstacles that demand adaptive supply chain strategies. This study aims to evaluate the supply chain efficiency of PT Triputra Agro Persada from 2019 to 2023 using the SCOR (Supply Chain Operations Reference) model, which encompasses five performance dimensions: reliability, responsiveness, agility, cost, and asset management. A quantitative descriptive-analytical method was used, supported by secondary data obtained from internal company records. The analysis shows fluctuating performance across years, with Perfect Order Fulfillment (POF) reaching 101.69% in 2019, declining sharply in 2022 to 65.30%, and recovering to 92.69% in 2023. Order Fulfillment Cycle Time (OFCT) remained relatively stable, although it slightly increased in 2023. Agility metrics improved in 2022 but weakened again in 2023 due to increased demand. The most cost-efficient year was 2022, although logistics costs rose in 2023. Meanwhile, Cash to Cash Cycle Time (C2C) improved significantly over the five-year period, indicating better asset management. The results suggest that while PT Triputra Agro Persada has achieved notable gains in supply chain performance, continued investment in technology, stakeholder collaboration, and sustainability initiatives is essential. Strategic recommendations include enhancing logistics through digital tools, strengthening inter-unit coordination, and optimizing asset utilization. This research contributes insights for palm oil companies operating in similar remote areas to balance operational efficiency with sustainability. Future studies are encouraged to integrate qualitative data and assess broader supply chain ecosystems.

Keywords: *SCOR model, supply chain efficiency, palm oil industry, asset management, operational performance.*

Article history
Received : March 5 th, 2025
Revised : April 20 th, 2025
Accepted : May 6 th, 2025

1. INTRODUCTION

The palm oil industry has emerged as one of the most influential sectors in both the global and Indonesian economies, contributing significantly to employment, regional development, and national exports. As the world's largest producer and exporter of palm oil, Indonesia relies heavily on this commodity to support rural livelihoods and boost foreign exchange. According to data from the Indonesian Ministry of Agriculture (2023), palm oil accounted for more than 11% of national exports and contributed around 3.5% to the Gross Domestic Product (GDP) in 2022. However, while the industry's economic contribution is substantial, it is also accompanied by a complex set of challenges, especially in managing an efficient, resilient, and sustainable supply chain.

Supply chain efficiency is crucial for the long-term competitiveness of palm oil companies operating in geographically complex regions like Central Kalimantan. This region is known for its vast plantation areas and difficult logistics conditions, where poor infrastructure, long distances, and extreme weather often hamper transportation and production activities. According to Purwanto (2020), one of the primary bottlenecks in Kalimantan's palm oil supply chain is the inadequacy of road infrastructure, which contributes to delays in transporting fresh fruit bunches (FFB) and increases operational costs. Furthermore, seasonal floods and isolated plantation locations intensify the challenge of timely delivery and cost-efficient processing.

PT Triputra Agro Persada (TAP), as one of the key players in Central Kalimantan's palm oil sector, represents a case that illustrates how companies are responding to these challenges. Despite operating in a region with infrastructure and geographical limitations, TAP has managed to maintain high levels of performance in critical areas of the supply chain. For instance, internal reports show a supply chain reliability score of 96% and cost efficiency of 92%, along with relatively strong flexibility (87%). However, TAP still faces issues such as long delivery cycle times, which average around 6.5 days higher than industry benchmarks. This underlines the importance of ongoing optimization efforts to enhance responsiveness and asset utilization.

Supply chain efficiency can be understood through the SCOR (Supply Chain Operations Reference) model, which identifies five key performance dimensions: reliability, responsiveness, agility, cost, and asset management (APICS, 2022). Within this framework, reliability refers to the ability to deliver the right product at the right time, responsiveness measures speed, and agility assesses adaptability to change. Cost and asset management focus on minimizing expenses and optimizing resource usage. According to Chopra and Meindl (2021), achieving efficiency requires minimizing uncertainties, time, and costs across these dimensions, especially in sectors like palm oil where operations are spread across vast and rural landscapes.

Recent advances in technology have opened new avenues for improving supply chain performance. The integration of Internet of Things (IoT), big data analytics, and artificial intelligence (AI) allows companies to monitor operations in real-time, anticipate disruptions, and improve forecasting accuracy. Simchi-Levi et al. (2020) note that such technologies can reduce operational costs by up to 30% and improve planning accuracy by 25%. In the palm oil context, drone-based monitoring, remote sensing, and digital mapping are being used to detect anomalies in plantation areas, plan logistics routes, and optimize harvesting schedules. For companies like TAP, adopting these innovations not only supports cost reduction but also aligns with sustainability targets.

Sustainability has become a critical factor in the global competitiveness of palm oil companies. The industry has long faced criticism for its links to deforestation, biodiversity loss, and land-use conflicts. To address these issues, initiatives such as the Roundtable on Sustainable Palm Oil (RSPO) provide certification standards that companies must meet to access premium international markets. Research by Seuring and Müller (2020) emphasizes that sustainable supply chain practices can enhance corporate reputation, improve environmental compliance, and open up new market opportunities. TAP, therefore, must ensure that efficiency gains do not come at the cost of environmental or social harm.

In addition to environmental concerns, maintaining strong relationships with local communities and plasma farmers is vital for raw material security and long-term social license to operate. Studies have shown that fair partnership programs with smallholders improve supply reliability and promote inclusive development (Firmansyah, 2021). Christopher (2021) highlights that collaborative and transparent supply chains foster mutual trust, reduce conflict, and promote alignment of goals among stakeholders. For companies operating in sensitive regions like Central Kalimantan, these partnerships are instrumental in ensuring both operational resilience and community support.

Given these dynamics, this study seeks to investigate how PT Triputra Agro Persada can optimize its supply chain efficiency while addressing geographical and infrastructure challenges and meeting global sustainability standards. Specifically, the research aims to: (1) identify the key efficiency drivers within TAP's supply chain in Central Kalimantan; (2) evaluate how the company can align operational performance with RSPO sustainability principles; and (3) assess the effectiveness of TAP's partnership strategies with local communities and plasma farmers. Through this analysis, the study contributes to a deeper understanding of integrated supply chain strategies that balance economic, environmental, and social objectives in the palm oil sector.

2. LITERATURE REVIEW

Supply Chain Efficiency in the Palm Oil Industry

Supply chain efficiency refers to the ability of a company to deliver goods and services in the most cost-effective and timely manner (Chopra & Meindl, 2021). In the palm oil industry, efficiency is often influenced by logistics infrastructure, processing capacity, and coordination between actors (Putra et al., 2022). Efficient supply chains are essential in commodity sectors where margins are tight and volumes are high (APICS, 2022). According to Simchi-Levi et al. (2020), the integration of digital tools can significantly reduce inefficiencies, particularly in transportation and inventory control. In the case of palm oil, delays in transporting fresh fruit bunches (FFB) can degrade quality and reduce oil yield (Purwanto, 2020). Therefore, the performance of each node in the supply chain has a direct impact on output quality and financial outcomes (Nugroho & Wijaya, 2022).

Several studies have shown that palm oil supply chain efficiency varies widely depending on location and infrastructure quality (Handayani & Astuti, 2023). In remote areas such as Kalimantan, poor road access and long distances between plantations and mills are common barriers (Supriyadi, 2021). These inefficiencies often lead to increased transportation costs and delivery delays, which negatively impact competitiveness (Firmansyah, 2021). Seuring and Müller (2020) emphasized the importance of adopting context-specific strategies to address such logistical challenges. Companies that operate in difficult terrain must invest in planning systems, route optimization, and local infrastructure improvements (Suryani & Wijayanti, 2023). As a result, regional dynamics should be considered in any evaluation of supply chain performance (Dewi & Gorda, 2022).

Technology adoption is increasingly recognized as a key enabler of efficiency in palm oil logistics and processing (Lo, 2021). For instance, real-time tracking, digital mapping, and IoT-based monitoring help identify bottlenecks and inform decision-making (Kusuma & Lestari, 2023). According to Hair et al. (2021), the integration of big data analytics improves supply chain visibility and enables predictive planning. Drone and satellite technologies are also being used to optimize harvesting schedules and resource allocation (Sawitri & Fathihani, 2023). These tools not only reduce lead time but also minimize losses from spoilage and idle capacity (Hasibuan, 2021). Thus, digital transformation plays a critical role in enhancing efficiency across the palm oil supply chain (Aji et al., 2021).

SCOR Model in Supply Chain Analysis

The Supply Chain Operations Reference (SCOR) model is a standardized framework used to evaluate and improve supply chain performance (APICS, 2022). It focuses on five core dimensions: plan, source, make, deliver, and return, which are further measured through performance indicators such as reliability, responsiveness, agility, cost, and asset management (Chopra & Meindl, 2021). This model provides companies with a systematic approach to identifying inefficiencies and benchmarking against best practices (Hair et al., 2021). In the palm oil industry, the SCOR model is increasingly applied to assess the effectiveness of end-to-end processes from plantation to export (Putra et al., 2022). According to Lo (2021), adopting SCOR helps align strategic goals with operational metrics. It also assists in diagnosing gaps in planning, logistics, and supplier collaboration (Simchi-Levi et al., 2020).

The reliability dimension in the SCOR model relates to delivering the correct product, in the correct quantity, at the correct time, and with the correct documentation (APICS, 2022). In palm oil, this includes consistent delivery of high-quality crude palm oil (CPO) to refineries or export ports (Dewi & Gorda, 2022). Responsiveness measures the speed at which the supply chain can fulfill orders, which is critical in perishable goods like palm fruit (Purwanto, 2020). Agility reflects the company's ability to adjust to fluctuations in demand or disruptions such as floods or transportation breakdowns (Kusnadi & Nugraha, 2025). Cost and asset metrics, meanwhile, relate to how efficiently resources and finances are managed across the chain (Handayani & Astuti, 2023). By tracking these five performance dimensions, firms can create a balanced scorecard for continuous improvement (Seuring & Müller, 2020).

Studies show that companies in the palm oil sector that apply the SCOR model report significant gains in operational efficiency and sustainability performance (Suryani & Wijayanti, 2023). In Malaysia and Indonesia, SCOR-based assessments have helped identify key issues in procurement, warehouse management, and last-mile delivery (Putri & Winarto, 2022). According to Sawitri and Fathihani (2023), using SCOR indicators also facilitates compliance with international certifications like RSPO and ISPO. Moreover, integrating SCOR with digital dashboards allows real-time tracking of performance indicators (Kusuma & Lestari, 2023). This integration enhances transparency and decision-making across the supply chain network (Lo, 2021). Therefore, SCOR serves not only as a performance evaluation tool but also as a strategic roadmap for sustainable supply chain transformation (Christopher, 2021).

Sustainability in Palm Oil Supply Chains

Sustainability in the palm oil industry refers to the integration of environmental, social, and economic principles into supply chain practices (Seuring & Müller, 2020). Key sustainability issues include deforestation, land rights conflicts, greenhouse gas emissions, and fair labor conditions (Firmansyah, 2021). To address these, companies adopt standards such as the Roundtable on Sustainable Palm Oil (RSPO), which outline criteria for responsible production (APICS, 2022). Compliance with such standards is increasingly required by global buyers, especially in Europe and North America (Lo, 2021). Research by Rachmawati et al. (2021) indicates that sustainability certification not only improves environmental impact but also enhances market access. Therefore, integrating sustainability into supply chain design is no longer optional but essential for long-term viability (Kusnadi & Nugraha, 2025).

Environmental sustainability practices include using drones to monitor deforestation, applying precision agriculture to reduce chemical usage, and implementing land rehabilitation programs (Sawitri & Fathihani, 2023). These efforts aim to minimize biodiversity loss and reduce the ecological footprint of palm oil operations (Purwanto, 2020). In addition, companies are investing in methane capture systems in mills to lower carbon emissions (Supriyadi, 2021). Adopting circular economy principles, such as reusing palm biomass for energy, also supports environmental goals (Handayani & Astuti, 2023). According to Seuring and Müller (2020), companies that lead in environmental innovation often gain reputational advantages and investor confidence. As sustainability becomes a competitive differentiator, environmentally responsible operations offer both risk mitigation and value creation (Christopher, 2021).

Social sustainability involves building equitable partnerships with smallholders, ensuring safe working conditions, and respecting indigenous land rights (Firmansyah, 2021). Studies show that plasma farmer programs can enhance supply stability while improving rural livelihoods (Rachmawati et al., 2021). Transparent pricing mechanisms and access to technical support are critical for fostering long-term cooperation (Putra et al., 2022). Moreover, community development programs such as education and health initiatives further solidify stakeholder relations (Lo, 2021). Failure to address social concerns can lead to reputational damage and legal challenges (Kusuma & Lestari, 2023). Thus, sustainability must be addressed holistically, combining environmental and social governance (ESG) pillars (APICS, 2022).

Role of Technology in Supply Chain Optimization

Technological innovation plays a pivotal role in transforming palm oil supply chains into more agile and data-driven systems (Simchi-Levi et al., 2020). The adoption of digital tools such as ERP systems, AI, IoT, and blockchain has improved transparency, traceability, and operational decision-making (Lo, 2021). IoT sensors are used in plantations to monitor soil moisture, detect pests, and optimize fertilizer application (Kusnadi & Nugraha, 2025). Meanwhile, digital transport management systems help optimize delivery routes and reduce cycle time (Kusuma & Lestari, 2023). According to Hair et al. (2021), companies that digitize their supply chains report improved efficiency, lower costs, and better risk management. Thus, technology is a catalyst for overcoming both geographical and operational constraints (Chopra & Meindl, 2021).

Blockchain technology has also been introduced to ensure transparency and traceability in palm oil supply chains (Putri & Winarto, 2022). By providing a secure and immutable ledger of transactions, blockchain allows buyers to verify the source and sustainability of raw materials (Sawitri & Fathihani, 2023). This is particularly important in light of increasing consumer demand for ethical and traceable products (Seuring & Müller, 2020). In Indonesia, pilot projects have shown that blockchain implementation improves trust among stakeholders and reduces transaction errors (Firmansyah, 2021). However, challenges such as infrastructure readiness and user training remain obstacles to full-scale adoption (Lo, 2021). As the technology matures, its integration is expected to become more widespread and impactful (Christopher, 2021).

Artificial intelligence and predictive analytics are being used to forecast demand, optimize inventory levels, and reduce waste in palm oil operations (Simchi-Levi et al., 2020). Predictive models enable companies to respond to market fluctuations with greater agility (Handayani & Astuti, 2023). Machine learning algorithms are also used in mill operations to regulate pressure and temperature for optimal oil extraction (Purwanto, 2020). According to Dewi and Gorda (2022), AI integration has led to measurable improvements in processing efficiency and yield. These tools are especially valuable in regions where supply chain disruptions are common due to weather or infrastructure issues (Kusnadi & Nugraha, 2025). Therefore, investing in technology enhances both resilience and responsiveness in supply chain management (Lo, 2021).

Community and Stakeholder Engagement in Supply Chains

Effective stakeholder engagement is essential for sustainable supply chain operations, particularly in sensitive sectors like palm oil (Rachmawati et al., 2021). Building long-term relationships with farmers, suppliers, regulators, and consumers ensures operational continuity and social license to operate (Firmansyah, 2021). According to Christopher (2021), inclusive stakeholder collaboration strengthens information flow and reduces the risk of conflict. In palm oil, this involves integrating smallholders into formal supply chains and ensuring fair economic returns (Kusuma & Lestari, 2023). Transparent communication and participatory decision-making enhance trust and commitment (Seuring & Müller, 2020). Thus, stakeholder alignment is a key element of strategic supply chain management (Hair et al., 2021).

In practice, companies engage stakeholders through forums, feedback sessions, and joint development programs (Putra et al., 2022). Plasma farmer schemes have proven effective in improving productivity and supply chain reliability (Handayani & Astuti, 2023). According to Lo (2021), partnership programs that include training, financing, and input provision benefit both producers and processors. Studies also suggest that stakeholder partnerships contribute to RSPO compliance and enhance sustainability certification outcomes (Sawitri & Fathihani, 2023). However, maintaining stakeholder engagement requires consistent effort, resource allocation, and mutual respect (Kusnadi & Nugraha, 2025). Therefore, companies must institutionalize engagement processes as part of core business strategy (APICS, 2022).

Conflict management is another important aspect of stakeholder relations in palm oil supply chains (Firmansyah, 2021). Disputes over land use, benefit sharing, and environmental impacts can disrupt operations and harm reputations (Seuring & Müller, 2020). Proactive conflict resolution mechanisms, such as mediation and community grievance platforms, are increasingly being adopted (Rachmawati et al., 2021). Engaging local leaders and NGOs in these processes improves legitimacy and effectiveness (Kusuma & Lestari, 2023). Moreover, integrating social performance indicators into supply chain dashboards can help track progress and identify red flags (Christopher, 2021). Ultimately, effective stakeholder engagement is not only a social responsibility but also a business imperative for resilient supply chain operations (Lo, 2021).

3. METHOD

This study employs a quantitative research approach with a descriptive-analytical design, aiming to evaluate the efficiency of the palm oil supply chain through the lens of Value Chain Analysis (VCA). The research focuses on the operations of the palm oil mill managed by PT Triputra Agro Persada in Central Kalimantan, a region known for its rich palm oil production yet challenged by logistical and environmental constraints. The study analyzes secondary data from the company's internal reports covering the period from 2019 to 2023, allowing for the observation of changes and developments in operational efficiency over time.

The analytical framework of this research is grounded in three key theoretical perspectives. First, the Supply Chain Management Theory by Chopra and Meindl (2021) is used to conceptualize how integrated processes from sourcing to delivery affect overall performance. Second, the study incorporates the Operational Efficiency Theory by Heizer and Render (2020), which emphasizes productivity, cycle time, and cost optimization as pillars of performance measurement. Third, the Sustainability Theory developed by Elkington (1997) serves as a normative foundation to assess whether efficiency is achieved in tandem with environmental and social responsibility.

The research applies five performance dimensions derived from the SCOR model, adapted from Rasyid (2015): reliability, responsiveness, capability (agility), cost, and asset management. Each of these dimensions is operationalized through three measurable indicators. Reliability is assessed through customer service levels, the percentage of on-time deliveries, and the accuracy of order fulfillment. Responsiveness is measured using order-to-delivery cycle time, discrepancies between promised and actual delivery times, and the ability to adjust delivery schedules based on customer requests.

The third dimension, capability, reflects the system's flexibility and is evaluated through indicators such as the ability to scale production capacity, accommodate product design changes, and respond swiftly to market demand fluctuations. The cost dimension evaluates operational efficiency using metrics like production cost per unit, distribution cost per unit, and total logistics costs as a percentage of sales. Lastly, asset management is examined through asset utilization rates, inventory turnover, and return on assets (ROA), capturing the company's ability to optimize its physical and financial resources.

Data analysis is conducted using descriptive statistical methods to map performance trends across the five-year period. In addition, a comparative approach is applied to identify gaps or improvements across each performance indicator. The integration of value chain analysis allows for a structured breakdown of each operational stage from raw material sourcing to product distribution highlighting where efficiency gains or losses occur. This method supports a holistic understanding of the company's internal dynamics and their alignment with external sustainability requirements. Overall, this methodological approach enables a comprehensive assessment of supply chain performance at PT Triputra Agro Persada, situating the findings within broader theoretical and industry frameworks. The study also provides strategic insights into how palm oil companies operating in infrastructure-limited regions can optimize operations while maintaining environmental and social accountability.

4. RESULT AND DISCUSSION

In measuring reliability, the metric used for this dimension is Perfect Order Fulfillment (POF) which indicates the percentage of orders fulfilled without errors. In the context of production at PT Triputra Agro Persada, reliability is very important to ensure that all customer orders, both in the form of finished products and raw materials are delivered on time without defects or shortcomings where the results are as follows:

Table 1. Perfect Order Fulfillment (POF)

Year	Perfect Order Fulfillment (POF) (%)	On-Time and Accurate Orders	Total Orders
2019	101.69	5.815.59	5.718.67
2020	88.97	5.300.75	5.957.64
2021	101.18	6.062.74	5.991.94
2022	65.30	4.502.36	6.894.46
2023	92.69	6.361.13	6.862.82

Source: Primary data processed (2024)

Based on the results of PT Triputra Agro Persada's Perfect Order Fulfillment (POF) calculation data for the period 2019 to 2023. POF is calculated by dividing the number of orders fulfilled on time and accurately by the total orders, then multiplied by 100%. In 2019, POF reached a high of 101.69%. Demonstrate excellent performance in fulfilling customer orders on time and according to specifications. But in 2020, POF decreased to 88.97%. which may be caused by the impact of the COVID-19 pandemic on logistics operations. In 2021, it showed an improvement with POF increasing again to 101.18%. A significant decline occurred in 2022 where the POF only reached 65.3%, indicating serious disruptions in the supply chain such as logistical constraints or imbalances between order volume and capacity. In 2023, POF has increased again to 92.69%, reflecting a recovery in operational efficiency. Overall, this POF trend illustrates the dynamics of a company's supply chain performance which is influenced by various external and internal factors.

Table 2. Reliability

Year	On-Time and Accurate Orders	Total Orders	POF (%) (2) / (3) x100%
2019	5,815.59	5,718.67	101.69
2020	5,300.75	5,957.64	88.97
2021	6,062.74	5,991.94	101.18

2022	4,502.36	6,894.46	65.3
2023	6,361.13	6,862.82	92.69

Source: Primary data processed (2024)

The reliability dimension is measured using the Perfect Order Fulfillment (POF) metric which indicates the percentage of orders that are successfully fulfilled on time and according to specifications. Based on the recapitulation table, POF values fluctuate with a significant decrease in 2022 of 65.30% before increasing again to 92.69% in 2023. The decline in 2022 could be caused by logistical disruptions or an increase in order volumes that are not balanced with adequate capacity.

Responsiveness in the supply chain refers to a company's ability to respond quickly to customer requests which is measured through Order Fulfillment Cycle Time (OFCT). OFCT reflects the average time it takes to fulfill an order from receiving orders to delivering products to customers. In the context of PT Triputra Agro Persada's production. This dimension is crucial to ensure that customer demands can be met in minimal time without sacrificing quality.

Table 3. Responsiveness

Year	Order Fulfillment Cycle Time (OFCT) (Hours)	Explanation
2019	82.42	Fulfillment time is still quite efficient
2020	82.46	Post-pandemic distribution adjustment
2021	83.38	Increased volume slightly extends time
2022	73.72	Efficiency improves with process optimization
2023	86.09	Slight increase in time due to order volume

Source: Primary data processed (2024).

The responsiveness dimension is assessed using the Order Fulfillment Cycle Time (OFCT) metric which measures the average time to meet customer demand. Based on data, OFCT was relatively stable from 2019 to 2023 with a slight increase in time in 2023 of 86.09 hours compared to the previous year. This increase can be attributed to the increased complexity of distribution due to the increase in order volume.

Agility in production refers to the ability of production systems to respond quickly and efficiently to changes both in terms of increasing demand, reducing production volumes, and adjusting product specifications. This flexibility includes the company's ability to adapt production processes, manage resources, and leverage technology to meet customer needs or overcome operational disruptions.

Table 4. Agility

Year	Upside Supply Chain Flexibility (USCF) (Days)	Explanation
2019	13.16	Response time is still adequate for additional capacity
2020	12.22	Improved efficiency in increasing capacity
2021	11.92	Faster response compared to the previous year
2022	11.65	Optimal response time thanks to integrated systems
2023	12.64	Slight increase due to rising order volume

Source: Primary data processed (2024)

The agility dimension is measured using the Upside Supply Chain Flexibility (USCF) metric. which reflects the supply chain's ability to rapidly increase capacity. The data shows a positive trend with a shorter time from 2021 to 2022. However, there was a slight increase in time in 2023 to 12.64 days, which is still in a good efficiency range.

Cost in production refers to the overall expenditure required to carry out the production process including planning costs, procurement of raw materials, production operations, storage, and distribution of products to customers. In the context of production, efficient cost management aims to minimize waste, optimize resources, and ensure that each stage of the process provides added value at a controlled cost.

Table 5. Cost

Year	Planning Costs (Rp Billion)	Production Costs (Rp Billion)	Storage Costs (Rp Billion)	Transportation Costs (Rp Billion)	Total TSCMC (Rp Billion)
2019	27.72	237.02	48.38	50.86	363.98
2020	24.34	231.67	45.10	45.56	346.67
2021	24.24	229.24	46.13	61.59	361.21
2022	23.55	211.28	50.05	51.73	336.61
2023	20.11	237.00	40.87	56.13	354.11

Source: Primary data processed (2024)

The cost dimension is assessed using the Total Supply Chain Management Cost (TSCMC) metric which includes planning, production, storage, and transportation costs. Data shows cost fluctuations from year to year with a significant decrease in 2022 of IDR 336.61 billion and an increase again in 2023 to IDR 354.11 billion.

Asset management in production refers to the process of managing the company's resources and assets used to support production operational activities including raw materials, machinery, facilities, and working capital. The goal is to ensure efficient use of assets, minimize waste and increase productivity and operational sustainability. In the context of production, good asset management includes controlling the inventory of raw materials to avoid excess or shortage of stock. receivables management that ensures smooth cash flow, as well as debt management to support efficient financing.

Table 6. Asset Management

Year	Inventory Days	Receivable Days	Payable Days	Cash to Cash Cycle Time (C2C)
2019	34.16	16.58	4.88	45.86
2020	29.84	15.55	6.76	38.63
2021	35.23	14.50	4.82	44.91
2022	29.29	15.08	6.89	37.48
2023	28.96	14.96	7.24	36.68

Source: Primary data processed (2024)

Cash to Cash Cycle Time (C2C) which is calculated based on the main components, namely Inventory Days, Receivable Days, and Payable Days during the 2019–2023 period. Thus producing a C2C value that reflects the average duration required to convert investments in inventory and receivables into cash. Based on the data, there is a downward trend in the value of C2C from 2019 (45.86 days) to 2023 (36.68 days). This decline indicates improved asset management efficiency, especially in shortening cash cycle times through inventory optimization, receivables acceleration, and more effective debt management.

The overall findings from this study demonstrate that PT Triputra Agro Persada has shown considerable progress in managing its palm oil supply chain efficiently, despite being located in a region with notable infrastructure and environmental constraints. The company exhibited strong performance in reliability, especially in 2019 and 2021, where Perfect Order Fulfillment (POF) exceeded 100%, indicating highly synchronized operations. Although there was a sharp decline in 2022, the company recovered in 2023, suggesting the presence of effective corrective mechanisms and adaptive supply chain processes (Chopra & Meindl, 2021; Christopher, 2021). This recovery affirms previous findings that supply chain resilience—driven by responsive planning and operational agility—plays a pivotal role in stabilizing performance during disruptions (Simchi-Levi et al., 2020; Seuring & Müller, 2020). Furthermore, the company's ability to consistently meet customer expectations across fluctuating conditions signals strong internal coordination and system integration (APICS, 2022).

In terms of responsiveness and agility, the results show relatively stable cycle times with only modest variations, which suggests the supply chain remains capable of adjusting to order volumes and external pressures. The improved Upside Supply Chain Flexibility (USCF) in 2021 and 2022 reflects the company's progress in expanding capacity efficiently and implementing process improvements (Kusnadi & Nugraha, 2025). The slight increase in fulfillment time in 2023 is consistent with increased demand, highlighting the need for continued investment in digital logistics and predictive analytics (Hair et al., 2021; Kusuma & Lestari, 2023). Meanwhile, cost performance remained under control, with 2022 recording the most efficient total cost structure, suggesting the effectiveness of lean production and resource optimization strategies (Heizer & Render, 2020; Lo, 2021). These findings align with research indicating that integrated planning and automation significantly contribute to cost reduction in complex supply chains (Putri & Winarto, 2022).

One of the most promising developments is observed in asset management, where the Cash to Cash Cycle Time (C2C) showed consistent improvement from 2019 to 2023. The decline in C2C from 45.86 to 36.68 days indicates more effective inventory turnover, receivables collection, and payables control (Dewi & Gorda, 2022). This reinforces the view that efficient asset utilization not only improves liquidity but also supports greater supply chain agility and sustainability (Firmansyah, 2021; Rachmawati et al., 2021). The findings collectively underscore the importance of adopting SCOR-based performance indicators to evaluate and guide strategic improvements across supply chain functions (APICS, 2022). For PT Triputra Agro Persada, continued investment in digital transformation, collaborative supplier relationships, and sustainability initiatives will be crucial in maintaining competitiveness and meeting international market standards (Seuring & Müller, 2020; Suryani & Wijayanti, 2023). These results also offer valuable insights for other companies in similar geographic contexts seeking to balance operational efficiency with sustainability and stakeholder expectations.

5. CONCLUSION

This study concludes that PT Triputra Agro Persada's supply chain performance from 2019 to 2023 demonstrated varying degrees of efficiency across five SCOR dimensions. Reliability fluctuated significantly, with a notable drop in 2022 but recovered in 2023, showing the company's resilience in addressing operational disruptions. Responsiveness remained stable, although a longer fulfillment cycle in 2023 suggests the need for better handling of increased demand. Agility improved through 2022 but slightly declined in 2023, indicating a need for more adaptive capacity strategies. Cost efficiency peaked in 2022 but rose again in 2023 due to higher logistics costs, while asset management showed a steady decline in Cash to Cash Cycle Time, reflecting improved financial control. To sustain and enhance supply chain performance, the company should strengthen inter-unit coordination, adopt real-time logistics technology, develop flexible production strategies, and improve inventory and cost control systems. This study is limited by its regional scope, reliance on secondary data, short observation period, and lack of qualitative insight, thus future research should include broader data coverage, primary sources, and qualitative analysis to gain deeper understanding.

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