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Supply Chain Management Analysis in the Palm Oil Industry: A Case Study at PT. Sempurna Sejahtera, Nunukan

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Abstract. This study examines the implementation of supply chain management in the palm oil processing industry through a case study of PT Sempurna Sejahtera, a commercial palm oil mill located in a border region of Indonesia. Using a qualitative case study approach, data were collected through direct observation, in-depth interviews, and documentation during fieldwork activities. The findings reveal that the company operates within a multi-tier and highly fragmented supply chain, characterized by strong dependence on smallholders and intermediaries. This structure creates significant vulnerabilities, including unstable raw material supply, inconsistent quality of fresh fruit bunches (FFB), and inefficient financial flows due to delayed payment systems. In addition, centralized decision-making at the head office limits operational responsiveness at the plant level, exacerbating supply disruptions and weakening relationships with suppliers. A critical insight from this study is the emergence of cross-border supply leakage, where local suppliers prefer selling to buyers in neighboring countries due to faster payment systems, despite lower prices. This highlights the role of governance and institutional inefficiencies as key determinants of supply chain performance in smallholder-based industries. This study contributes to the literature by demonstrating how supply chain dependency and centralized governance structures jointly create structural inefficiencies in palm oil supply chains in peripheral and border regions. Practically, the findings emphasize the need for improved supplier integration, accelerated payment mechanisms, and greater decentralization of operational decision-making to enhance supply chain resilience and competitiveness.

Keywords: supply chain management, palm oil industry, smallholders, supply chain dependency, governance, qualitative case study

I. Introduction

Indonesia is widely recognized as an agrarian country where a significant portion of the population depends on agriculture and plantation sectors for their livelihoods. Among the various commodities produced, palm oil has emerged as one of the most strategic and economically significant industries. Indonesia is currently the largest producer of palm oil in the world, contributing substantially to national export revenues and economic growth. In 2025, Indonesia's production of crude palm oil (CPO) and palm kernel oil (PKO) reached approximately 56.55 million tons, reflecting a steady increase compared to the previous year. The industry also plays a crucial role in generating foreign exchange, contributing more than USD 35 billion to the national economy.

Beyond its national importance, the palm oil industry also has significant regional economic impacts, particularly in areas such as Nunukan Regency in North Kalimantan. This region has experienced rapid growth in palm oil plantation development, with total plantation areas exceeding 110,000 hectares, dominated by private estates and smallholder plantations. Palm oil accounts for more than 98% of the total plantation area in the region, highlighting its dominant role in the local economy. The industry not only drives economic activity but also provides employment opportunities for thousands of workers in both large-scale and smallholder plantations.

The expansion of palm oil processing facilities in Nunukan reflects the increasing importance of downstream activities in the industry. Currently, several palm oil mills operate in the region, including both vertically integrated firms with their own plantations and commercial mills that rely entirely on external suppliers. One notable case is PT Sempurna Sejahtera, which operates the Bambangan Palm Oil Mill in Sebatik Island, a strategic border area between Indonesia and Malaysia. Unlike integrated firms, this company does not own plantations and depends fully on fresh fruit bunch (FFB) supply from independent smallholders and intermediaries.

This dependency creates a unique and complex supply chain structure that differs significantly from vertically integrated palm oil companies. The supply chain involves multiple actors, including smallholders, collectors, and suppliers, resulting in a multi-tier system with limited control over upstream activities. Such conditions often lead to challenges related to supply uncertainty, quality inconsistency, and coordination inefficiencies. These issues are further compounded by the geographical context of the border region, where competition with buyers from neighboring countries intensifies supply chain pressures.

In addition, institutional and managerial factors play a critical role in shaping supply chain performance. In many cases, centralized decision-making structures limit the ability of local operational units to respond

quickly to supply disruptions and market dynamics. This creates governance-related inefficiencies that can weaken supplier relationships and reduce overall operational performance.

Despite the strategic importance of smallholder-based supply chains in the palm oil industry, limited research has examined how dependency on external suppliers and centralized governance structures interact to influence supply chain performance, particularly in border regions. Therefore, this study aims to analyze the implementation of supply chain management at PT Sempurna Sejahtera and to explore how structural dependency and managerial governance affect supply chain effectiveness.

This study contributes to the existing literature by providing empirical insights into the dynamics of palm oil supply chains in peripheral regions, highlighting the role of supply chain dependency, cross-border competition, and governance structures in shaping operational outcomes. The findings are expected to offer both theoretical and practical implications for improving supply chain resilience and competitiveness in similar industry contexts.

II. Literature Review

2.1 Supply Chain

A supply chain refers to a series of relationships among companies and activities involved in delivering goods and services, encompassing the continuous flow of materials, information, and financial resources from the point of origin to the final customer, both upstream and downstream (Indrajit and Djokopranoto, 2002 in Kodong et al., 2015). It is also defined as a network of facilities and distribution options that perform the functions of procuring raw materials, transforming them into intermediate and finished goods, and distributing the final products to end consumers (Ganeshan and Harrison in Kodong et al., 2015).

According to Anatan (2008 in Rahmasari, 2011), a supply chain represents the interconnected flows of materials or services, financial resources, and information across various actors, including suppliers, manufacturers, distributors, warehouses, retailers, and final customers. In this sense, the supply chain can be understood as a collaborative network of organizations working together to create and deliver products to end users. Furthermore, supply chain activities transform natural resources, raw materials, and basic components into finished goods that are subsequently delivered to consumers. In line with the evolution of this concept, Pujawan and Mahendrawathi (2017) emphasize that supply chain effectiveness largely depends on coordination and information visibility among all stakeholders within the network.

2.2 Supply Chain Management

Supply chain management is defined as the coordination of all supply chain activities, starting from raw materials and ending with customer satisfaction. It involves suppliers, manufacturing or service firms, distributors, wholesalers, and retailers that collectively deliver products or services to end users (Heizer and Render, 2014). Rahmasari (2011) describes supply chain management as a set of approaches designed to efficiently integrate suppliers, manufacturers, warehouses, and distribution systems, ensuring that products are produced and delivered in the right quantity, at the right location, and at the right time, while minimizing costs and maximizing customer satisfaction.

Fundamentally, the supply chain represents a network that illustrates the transformation of raw materials into products, which are then distributed through various channels until they reach the final consumer. Supply chain management, therefore, is an integrated approach to sourcing, production, and distribution, encompassing the management of material flows, information flows, and financial flows (Raturi and Evans in Maulida, 2018). In the context of the palm oil industry, the efficiency of supply chain management plays a critical role in determining both competitiveness and the sustainability of raw material supply (Pujawan and Mahendrawathi, 2017).

2.3 Components and Functions of Supply Chain Management

There are three main types of flows in supply chain management that must be effectively managed. The first is the upstream supply chain, which involves interactions between a manufacturing firm and its suppliers, including second-tier suppliers, with procurement as its primary activity. The second is the internal supply chain, which includes all processes related to transforming inputs from suppliers into organizational outputs, with a focus on production management, manufacturing processes, and inventory control. The third is the downstream supply chain, which encompasses all activities related to delivering products to end customers, including distribution, warehousing, transportation, and after-sales services (Turban, Rainer, and Porter, 2005 in Kodong et al., 2015).

According to Klapper et al. (in Rahmasari, 2011), supply chain management consists of four main functions. Planning involves balancing aggregate demand and supply to determine the best course of action. Sourcing refers to the procurement of goods and services to meet planned or actual demand. Making involves transforming goods into finished products. Delivering includes processes related to order

management, transportation, and warehousing to ensure that products reach customers as required. These functions must operate in an integrated and coordinated manner to ensure that the supply chain remains efficient and responsive to market changes (Heizer and Render, 2014).

2.4 Supply Chain Processes

In supply chain management, several key actors share interconnected roles, including suppliers, manufacturers, distributors, retail outlets, and customers (Ariani and Dwiyatno, 2013). The supply chain process begins with suppliers as the primary source of raw materials, followed by manufacturers who process these materials into finished goods. These products are then distributed in bulk to distributors, passed on to retailers, and ultimately delivered to final consumers. The supply chain cycle is considered complete only when the product reaches the end user (Ariani and Dwiyatno, 2013).

Efficient information flow and smooth movement of goods are essential for optimizing supply chain performance and achieving customer satisfaction (Rachmawan, 2018). Pujawan and Mahendrawathi (2017) highlight that one of the major challenges in supply chain management is dealing with demand and supply uncertainty simultaneously. This requires integrated information systems and strong partnerships among all supply chain participants.

2.5 Palm Oil Industry and Its Supply Chain

Oil palm (Elaeis guineensis Jacq.) is a tropical crop that produces vegetable oil and plays a crucial role in Indonesia's economy. It generates fresh fruit bunches as the primary raw material for producing crude palm oil and palm kernel oil. The palm oil processing industry is considered a strategic agro-based industry and is widely developed in tropical countries such as Indonesia and Malaysia (Masykur, 2013). Indonesia is the largest producer of palm oil globally, contributing more than 53 percent of total world CPO production (Purba and Sipayung, 2017).

The supply chain of smallholder palm oil plantations has unique characteristics due to the involvement of multiple actors, including small farmers, collectors or middlemen, suppliers, and palm oil mills. Hidayat et al. (2021) identify several common challenges in this supply chain, such as uncertainty in raw material supply, low quality of fresh fruit bunches due to suboptimal harvesting practices, and delayed payment systems that encourage farmers to sell to alternative buyers. This is consistent with Rifin (2022), who argues that weak vertical integration between farmers and processing mills is a major constraint on supply chain efficiency in Indonesia's palm oil industry.

One important quality indicator in the palm oil supply chain is the level of free fatty acids in crude palm oil. High-quality CPO typically requires a free fatty acid content below 3.5 percent (Masykur, 2013). Poor-quality fresh fruit bunches, often caused by premature harvesting or prolonged storage before processing, lead to higher free fatty acid levels and reduced market value. Therefore, quality management throughout the supply chain is a critical factor that cannot be overlooked (Hidayat et al., 2021). Furthermore, Siagian et al. (2020) emphasize that fast and transparent payment systems for farmers are crucial for maintaining supplier loyalty and ensuring the sustainability of raw material supply in commercial palm oil mills.

III. Research Method

3.1 Research Design and Approach

This study employs a qualitative approach using a case study method. The qualitative approach is selected to gain an in-depth understanding of how supply chain management is implemented at the Bambangan Palm Oil Mill of PT. Sempurna Sejahtera within its real operational context. According to Creswell and Poth (2018), qualitative research is appropriate for exploring and understanding the meanings that individuals or groups ascribe to social or human problems through inductive reasoning and context-based data collection.

The research design adopts a single embedded case study, focusing on one unit of analysis with predefined research objectives and questions (Yin, 2018). This design is chosen because PT. Sempurna Sejahtera represents a unique case as a commercial palm oil mill operating without its own plantation in a border area between Indonesia and Malaysia. This characteristic makes it particularly relevant for examining specific and contextual dynamics of supply chain management.

3.2 Research Location and Period

The study was conducted at PT. Sempurna Sejahtera, Bambangan Palm Oil Mill, located in Bambangan Village, West Sebatik District, Nunukan Regency, North Kalimantan Province, Indonesia. The site was selected purposively due to its distinctive operational characteristics, namely its full dependence on fresh fruit bunch supply from smallholder farmers without owning plantations, making it a rich source of relevant data (Sugiyono, 2020). Field data collection was carried out during an internship (Praktik Kerja Lapangan) from March 12 to April 12, 2020.

3.3 Data Sources and Data Collection Techniques

This study utilizes both primary and secondary data. Primary data were obtained through three main techniques. First, participatory observation was conducted to directly examine operational activities, including fresh fruit bunch weighing, raw material sorting, truck flow management, production processes, and waste management conditions. Second, unstructured interviews were carried out informally with key personnel, including the Mill Head, Quality Control Supervisor, Marketing Staff, and Sorting Foreman, to gain in-depth insights into supply chain mechanisms, raw material issues, and managerial practices. Third, documentation was collected in the form of daily weighing reports, sorting records, fresh fruit bunch delivery data, work schedules, and other operational documents (Creswell and Poth, 2018). Secondary data were obtained from academic literature, official institutional reports, and relevant company documents.

In this study, the researcher acts as the primary instrument, utilizing direct observation, interviewing, and analytical skills in the field (Moleong, 2021). During the internship, the researcher was assigned to the Quality Control department and actively involved in various operational activities, including recording raw material truck reports at the security post, operating a 100-ton capacity weighing system, documenting sorting records, compiling crude palm oil loading data, and conducting sampling and free fatty acid testing in the quality control laboratory.

3.4 Data Analysis Technique

Data analysis follows the interactive model proposed by Miles, Huberman, and Saldana (2020), which consists of three concurrent and iterative stages. The first stage is data condensation, involving the selection, simplification, and transformation of raw data obtained from field notes, observations, and interviews. The second stage is data display, where organized information is presented in the form of descriptive narratives, tables, and supply chain flow diagrams to facilitate interpretation. The third stage is conclusion drawing and verification, which involves interpreting findings and continuously validating them throughout the research process.

The analysis focuses on three main dimensions identified from the field data. The first is the structure and flow of the fresh fruit bunch supply chain from farmers to final products such as crude palm oil and palm kernel. The second is raw material supply issues, including availability, quality, and influencing factors. The third is managerial aspects, particularly decision-making span of control and its impact on operational efficiency. The analysis is guided by the theoretical framework of supply chain management developed in the literature review.

3.5 Data Validity

To ensure data validity, this study applies source and method triangulation techniques (Sugiyono, 2020). Source triangulation is conducted by cross-checking information obtained from the Quality Control Supervisor with other key informants, including the Mill Head, Marketing Staff, and Sorting Foreman. Method triangulation is achieved by comparing findings from direct observation, interviews, and documentation.

In addition, member checking was conducted at the end of the internship period through presentation and discussion sessions with the Mill Head of Bambangan Palm Oil Mill to confirm the accuracy of data interpretation and research findings (Creswell and Poth, 2018).

IV. Result and Discussion

4.1 Supply Chain Flow at PT. Sempurna Sejahtera Bambangan Palm Oil Mill

Based on observations and interviews conducted during the internship period, the supply chain flow of fresh fruit bunches at PT. Sempurna Sejahtera Bambangan Palm Oil Mill consists of five main nodes. These include oil palm farmers as producers and harvesters, collectors or middlemen who aggregate fresh fruit bunches from multiple farmers, suppliers who act as procurement contractors under agreements with the company, the Bambangan Palm Oil Mill as the processing unit, and final products in the form of crude palm oil and palm kernel marketed through the company's head office in Jakarta.

The number of suppliers under long-term contracts with the company is limited to two entities, namely Koperasi Serba Usaha Sejahtera and Koperasi Tani Nelayan. In addition, there are three non-contracted suppliers, namely CV. Nursakinah, CV. Kebalen Jaya, and CV. Shahadah Es Kristal, which supply fresh fruit bunches on a non-binding basis. Payments for fresh fruit bunches are processed every two weeks through the head office in Jakarta rather than directly by the mill.

These findings indicate that the supply chain structure of PT. Sempurna Sejahtera is relatively long compared to palm oil mills that own their plantations. This condition reflects the complexity of distribution channels when firms rely entirely on external suppliers, consistent with the concept of downstream supply chain complexity.

4.2 Supply Chain Issues and Raw Material Availability

The findings reveal that the extended supply chain and the limited number of long-term contracts result in significant uncertainty in raw material supply. Although the total area of smallholder oil palm plantations on Sebatik Island reaches approximately 12,587 hectares and is theoretically sufficient to meet the mill's demand, only a small portion of fresh fruit bunches is actually supplied to the Bambangan mill. Some suppliers prefer to sell their products to other palm oil mills in Seimanggaris, while others export to Malaysia. As a result, the Bambangan mill is unable to operate continuously. On average, the mill operates only two to three times per week, despite having an installed capacity of 30 tons of fresh fruit bunches per hour. Under normal conditions, this capacity would require approximately 600 tons per day, yet the actual supply averages only 50 to 100 tons per day and declines further during the rainy season.

A critical factor influencing farmers' preference to sell to Malaysian buyers is the payment system. At the Bambangan mill, payments are processed every two weeks through the head office in Jakarta, whereas buyers in Malaysia typically complete payments within one to two days, even at slightly lower prices. This finding reflects a common issue in smallholder palm oil supply chains, where payment speed and reliability significantly influence supplier loyalty.

In addition, the lack of long-term contractual arrangements further increases the risk of supply disruption, highlighting the importance of stronger vertical integration in improving supply chain stability and efficiency.

4.3 Raw Material Quality Issues

In addition to quantity-related challenges, the quality of fresh fruit bunches received by the Bambangan mill represents a significant concern. Field observations indicate that a large proportion of fresh fruit bunches from smallholder farmers in Sebatik are harvested from trees aged between 3.5 and 5 years, whereas the optimal harvesting age is above 10 years. Premature harvesting leads to lower oil content and higher levels of free fatty acids.

Furthermore, the fresh fruit bunches often experience prolonged storage, either at the farmer level, during collection, or at the mill before processing. This condition, commonly referred to as restan, contributes to quality deterioration.

As a result, the crude palm oil produced by the Bambangan mill has an average free fatty acid content ranging from 4 to 6 percent, exceeding the acceptable standard of 3.5 percent. High free fatty acid levels reduce market value and frequently result in price penalties imposed by buyers due to non-compliance with quality specifications.

These findings are consistent with broader structural challenges in smallholder palm oil supply chains, where suboptimal harvesting practices and inadequate post-harvest handling significantly affect product quality. This underscores the need for farmer training programs focused on good agricultural practices and improved harvesting techniques.

4.4 Managerial and Span of Control Issues

The third major issue identified in this study relates to managerial aspects, particularly the span of control in decision-making, which is highly centralized at the head office in Jakarta. The Bambangan mill has limited authority to make strategic decisions independently. Key decisions, including raw material procurement, product sales, payment processing, equipment replacement, and financial matters, require approval from the head office and, in some cases, from the main headquarters in Medan.

This centralized decision-making structure has significant implications for relationships with farmers and suppliers. Delays in payment processing due to bureaucratic procedures led to a farmer boycott that lasted for eight months, during which the mill ceased operations entirely due to the absence of raw material supply. The impact of this incident persisted even at the time of the study, as many farmers and suppliers shifted to alternative buyers.

This finding highlights the importance of responsiveness and decentralized decision-making in effective supply chain management. A lack of operational autonomy at the mill level reduces the organization's ability to respond quickly to dynamic field conditions and weakens supplier relationships.

4.5 Managerial Implications and Recommendations

Based on the three key dimensions of problems identified, four strategic recommendations can be proposed for PT. Sempurna Sejahtera Bambangan Palm Oil Mill. First, restoring trust with farmers and strengthening partnerships should be prioritized, as supplier trust represents a critical intangible asset in supply chain sustainability. Second, the company should expand its network of long-term contractual relationships with suppliers and large-scale farmers beyond the existing cooperatives to secure and diversify raw material sources.

Third, the payment system for fresh fruit bunches should be accelerated to align more closely with the payment practices observed in Malaysia, ideally within one to two days, in order to improve competitiveness in retaining suppliers. Fourth, the company should reform its internal management system

by granting greater decision-making authority to the mill management, enabling faster and more effective responses to supply chain disruptions and operational challenges.

Strengthening supply chain governance through improved integration, responsiveness, and trust-based relationships is essential for enhancing operational efficiency and maintaining long-term competitiveness in the palm oil industry.

V. Conclusion

5.1 Conclusion

This study examines the implementation of supply chain management at the Bambangan Palm Oil Mill of PT. Sempurna Sejahtera, Nunukan, North Kalimantan, using a qualitative case study approach. Based on the analysis of field data collected during the internship period, four main conclusions can be drawn.

First, PT. Sempurna Sejahtera operates as a commercial palm oil processing company that converts fresh fruit bunches into crude palm oil and palm kernel on Sebatik Island. A key characteristic of the company is the absence of its own plantations, resulting in a complete dependence on smallholder farmers for raw material supply through intermediaries such as collectors and suppliers.

Second, the company's supply chain is relatively long compared to vertically integrated palm oil mills, as it involves multiple intermediaries before raw materials reach the processing unit. This condition is further exacerbated by the limited number of long-term contractual relationships, with only two cooperatives formally engaged, while many farmers and suppliers prefer to sell to competing mills or buyers in Malaysia. This reflects weak vertical integration, which constitutes a structural constraint on supply chain efficiency.

Third, insufficient raw material supply leads to significant production inefficiencies. The mill operates only two to three times per week despite an installed capacity of 30 tons per hour. In addition, limited farmer knowledge regarding proper cultivation and harvesting practices results in low-quality fresh fruit bunches. These are often harvested prematurely, at plant ages between 3.5 and 5 years, and frequently experience prolonged storage. Consequently, the crude palm oil produced contains free fatty acid levels of 4 to 6 percent, exceeding the acceptable standard of 3.5 percent, leading to reduced market prices and frequent penalties from buyers.

Fourth, the company's highly centralized management structure, with decision-making authority concentrated at the head office in Jakarta, results in slow responses to operational challenges. This was evident in the eight-month farmer boycott that halted mill operations entirely due to delayed payments. The long-term impact of this disruption continues to affect supplier relationships and supply stability. These findings underscore the importance of decentralizing operational decision-making to enhance supply chain responsiveness and resilience.

5.2 Recommendations

Based on the findings, four key recommendations are proposed for PT. Sempurna Sejahtera Bambangan Palm Oil Mill. First, the company should prioritize rebuilding trust with farmers who have shifted to alternative buyers, through transparent communication, improved engagement, and concrete commitments to enhancing payment mechanisms.

Second, the company needs to expand its partnership network by increasing the number of suppliers and establishing long-term contractual relationships with larger farmers beyond the existing cooperatives. This would reduce supply risk and strengthen the diversification of raw material sources.

Third, the payment system for fresh fruit bunches should be significantly accelerated, ideally approaching the one- to two-day payment practices observed in Malaysia, in order to improve supplier retention and reduce the outflow of raw materials to external markets.

Fourth, the company should undertake internal management reforms by delegating greater operational decision-making authority to the mill level. This would enable faster, more flexible, and more effective responses to supply chain dynamics and supplier-related issues, without being constrained by prolonged bureaucratic processes.

Strengthening supply chain governance through better integration, responsiveness, and trust-based relationships will be essential for enhancing operational efficiency and sustaining long-term competitiveness in the palm oil industry.

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