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Palm Oil Supply Chain Performance Analysis in Muara Takung-Kamang Baru Transmigration Area Sijunjung Regency

Andiny Azzahra[1]✉ , Veralianta Br Sebayang[2]
[1,2] School of Vocational, IPB University

Abstract

This study aims to analyze the supply chain performance and value-added of oil palm commodities in the Muara Takung-Kamang Baru Transmigration Area, Sijunjung Regency. This research utilizes a quantitative approach with the Supply Chain Operation Reference (SCOR), Analytical Hierarchy Process (AHP), and Hayami methods. Sampling was conducted using the snowball sampling technique. The results show that the supply chain structure involves five main actors: input providers, oil palm farmers, collectors (*tokei*), Koperasi Unit Desa (KUD), and palm oil mills (PKS). Based on the SCOR and AHP analysis, PKS achieved maximum performance levels, while inefficiencies were found upstream, specifically in the asset management efficiency of input providers, as well as the cost and agility aspects of farmers. Most actors prioritize the *reliability* attribute, except for the *tokei*, who prioritizes *responsiveness*. Hayami's value-added analysis indicates that PKS generates a value-added ratio of 10.53%. Additionally, farmers obtain a higher profit margin when selling their harvest to the *tokei* (36.60%) compared to the KUD (34.33%). This study recommends the need for regular coordination among actors, increasing plantation productivity upstream, and optimizing yield rates downstream.

Keywords: *Palm oil; Supply chain performance; Hayami method; SCOR model; AHP; article.*

✉ Corresponding author :
Email Address : andiny.azzahra2612@gmail.com

INTRODUCTION

The agricultural sector plays a significant role in Indonesia's national economy, evidenced by its contribution to the gross domestic product (GDP), which reached 12.53 percent in 2023 (Statistics Indonesia 2024). This places the agricultural sector in third position, following the manufacturing industry sector at 18.67 percent and the wholesale and retail trade and motor vehicle repair sector at 12.94 percent. Based on the 2023 Indonesian palm oil statistics, the plantation subsector within the agricultural sector is one of the most potential, contributing 3.88 percent to the total national GDP and 30.97 percent to the agriculture, forestry, and fisheries sector. This makes it the largest subsector within that group. One of the main commodities of the plantation subsector is palm oil, which plays an important role in the economy because it produces vegetable oil that is highly needed in various industrial sectors. As the world's largest palm oil producer, Indonesia has great opportunities in marketing crude palm oil (CPO) and palm kernel oil (PKO) products in both domestic and global markets, as shown by the plantation area in the following Figure 1.

Figure 1. Indonesian palm oil area and production 2019–2023 (BPS, 2024)

Source: BPS (2024)

Figure 1 shows that palm oil production in Indonesia briefly declined in 2020 and 2021 but increased again in 2022 to 46.82 million tons and in 2023 to 47.08 million tons. Meanwhile, the area of palm oil plantations in Indonesia based on land use continues to increase every year. These palm oil plantation areas are spread across 26 provinces, one of which is West Sumatra Province. This gives the palm oil industry an important role in regional development, especially in transmigration areas aimed at opening productive land and creating new economic growth centers.

Based on the Integrated Map Information System for Transmigration Areas (SIPUKAT) website, the Muara Takung - Kamang Baru transmigration area in Sijunjung Regency, West Sumatra, is included in the 45 national priority transmigration areas as part of the 2025-2029 National Medium-Term Development Plan, with a Transmigration Area Development Index status of "developing" and a score of 43.80. This transmigration area has potential for palm oil commodity development due to geographical and social support for integrated supply chain development. This potential is evident from the production data of smallholder plantation crops by sub-district and crop type in Sijunjung Regency for 2022 and 2023 in Table 1.

Table 1. Production of smallholder plantation crops by sub-district and type of crop in Sijunjung Regency in 2022 and 2023

Subdistrict	Rubber (ton)		Coconut (ton)		Palm oil (ton)	
	2022	2023	2022	2023	2022	2023
1. Kamang Baru	19.685	19.917	364	363	100.150	116.900
2. Tanjung Gadang	4.442	4.448	175	203	760	781
3. Sijunjung	5.915	5.911	399	402	1.275	1.422
4. Lubuk Tarok	3.230	3.273	142	143	4.361	4.766
5. IV Nagari	4.468	3.391	152	127	1.558	1.487
6. Kupitan	6.910	7.059	124	128	520	539
7. Koto VII	12.878	14.174	101	110	1.587	1.079

8. Sumpur Kudus	5.860	5.860	174	174	52	58
Total	63.388	64.035	1.631	1.649	110.263	127.032

Source: BPS (2024)

Based on Table 1, palm oil production in Sijunjung Regency reached a total of 127,032 tons in 2023. This indicates that palm oil production is the largest in the plantation crop sector compared to rubber and coconut commodities. In 2023, the largest palm oil production was generated by Kamang Baru Sub-district at 116,900 tons, accounting for 92.02 percent of the total palm oil production in Sijunjung Regency. Therefore, palm oil is one of the leading commodities in the plantation subsector in Sijunjung Regency, particularly in Kamang Baru Sub-district. However, the palm oil commodity in this area still faces various challenges, especially in supply chain management. According to Marliyana et al. (2023), supply chain management is a holistic approach and strategy regarding demand, operations, purchasing, and logistics process management. Within the supply chain, there is a need for cooperation among various mutually committed parties who play a role in maintaining production continuity (Kembauw et al. 2021). The current state of the palm oil supply chain in the Muara Takung-Kamang Baru Transmigration Area still faces challenges such as an inefficiently integrated supply chain structure, suboptimal logistics performance due to infrastructure limitations, and added value that is not evenly distributed at each stage of the process. Inefficiency in the coordination of the flow of goods, information, and finance not only harms actors at the upstream level but can also hinder competitiveness. Therefore, research on supply chain performance analysis and palm oil added value in this region is crucial as it ensures the business sustainability of all actors involved. The research is expected to identify gaps between field conditions and appropriate strategic interests in the Transmigration Area.

METHODOLOGY

This research uses a quantitative approach conducted in 11 villages (*nagari/desa*) within the Kamang Baru District, Sijunjung Regency, West Sumatra, from August to December 2025. The study utilizes both primary and secondary data. Secondary data was obtained from literature studies, scientific journals, and documentation from related institutions. Primary data were obtained from direct observation, focus group discussions (FGDs), interviews, and questionnaires.

This study used a snowball sampling technique. Sampling technique is one way of collecting data by taking samples considered representative of the population. This study used a non-probability sampling technique. In this study, the selection of research locations was done intentionally (purposive). The selection of respondents to analyze the condition of the palm oil supply chain was carried out using the snowball sampling technique. This technique is used to trace the flow or channel of the palm oil supply chain at the research location based on information obtained from previous supply chain members starting from farmers to consumers. Meanwhile, to determine respondents for the assessment of palm oil supply chain performance measurement also used a purposive sampling technique, namely by considering the objectives of the research to be achieved. Experts play a crucial role in providing assessments and directions for improvements to problems that occur in the palm oil supply chain.

RESULTS AND DISCUSSION

Supply Chain Structure

The palm oil supply chain structure in the Muara Takung-Kamang Baru Transmigration Area involves supply chain members such as palm oil seed input providers, palm oil farmers, collecting traders such as tokei and cooperative, palm oil mills, refineries, and downstream industries. Three types of flows exist: product flow, financial flow, and information flow, as shown in Figure 3 below.

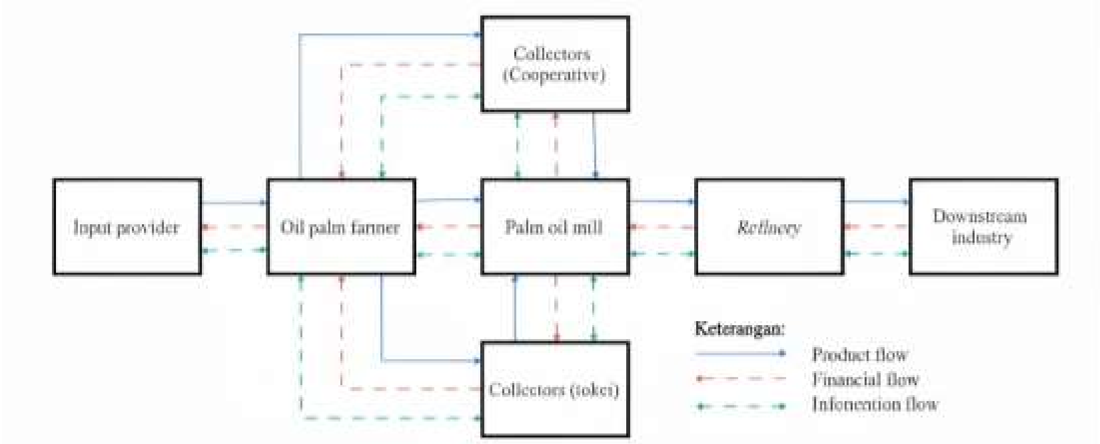

Figure 3. Palm oil supply chain structure in the Muara Takung-Kamang Baru Transmigration Area

Based on Figure 3, there are three palm oil supply chain channels in the Muara Takung Kamang-Baru Transmigration Area as follows:

Channel 1: Input providers - palm farmers - palm oil mills (PKS) - refineries – downstream industries.

Channel 2: Input providers - palm farmers - collectors (tokei) - palm oil mills (PKS) - refineries - downstream industries.

Channel 3: Input providers - palm farmers - collectors (KUD) - palm oil mills (PKS) - refineries - downstream industries.

The main actors in the supply chain are often referred to as chain members. The roles of palm oil supply chain members are explained below:

1. Input Provider

The palm oil input provider in the Muara Takung-Kamang Baru Transmigration Area is a superior palm oil seedling nursery located in Nagari Kunangan Parik Rantang. This nursery supplies palm oil seedlings ranging in age from three months to one year. These seedlings are sourced from officially sourced seedlings ordered through government-owned and private companies.

2. Palm Oil Farmers

Oil palm farmers are evenly distributed throughout each village in the Muara Takung-Kamang Baru Transmigration Area. Oil palm farmers plant, maintain, and harvest fresh fruit bunches (FFB) every 15 days, or twice a month, to sell to collectors, known as tokei (traders) or Koperasi Unit Desa (KUD).

3. Collectors (Tokei)

Oil palm farmers in the Muara Takung-Kamang Baru Transmigration Area typically sell their fresh fruit bunches (FFB) to collectors, known as tokei, to facilitate distribution. The tokei also sort the quality of the FFB before selling it to the mill to ensure it meets standards.

4. Collectors (Koperasi Unit Desa)

KUD Kurnia Timpeh, located in Nagari Kamang, Jorong Timpeh V, acts as an intermediary institution, collecting, weighing, and distributing FFB from farmers to the mill.

5. Palm Oil Mills (PKS)

There are four FFB processing factories in Kamang Baru District: PT Bina Pratama Sakato Jaya, PT Kemilau Permata Sawit, PT Sumatera Karyo Agro, and PT Sawit Makmur Perkasa. They process FFB into high-quality Crude Palm Oil (CPO) and Palm Kernel Oil (PKO).

6. Refinery

Refineries function as processing units that carry out refining, bleaching, and deodorizing processes to convert crude palm oil (CPO) into high-value-added products such as olein and stearin. This transmigration area does not have a refinery. However, the PKS in Kamang Baru District collaborates with a refinery in Padang City.

7. Downstream Industry

Downstream industries process semi-finished products from refineries, such as olein and stearin, into various derivative products such as cooking oil, margarine, soap, cosmetics, or biodiesel to meet consumer needs.

Supply Chain Performance Attribute Analysis Using the SCOR Method

According to APICS (2017), the processes within SCOR (Supply Chain Operations Reference) are plan, source, make, deliver, return, and enable. The SCOR performance section contains SCOR performance attributes, including reliability, responsiveness, agility, cost, and asset management efficiency. The performance attribute values for each member of the palm oil supply chain in the Muara Takung-Kamang Baru Transmigration Area are presented in Table 2 below.

Table 2. Values of palm oil supply chain performance attributes in the Muara Takung - Kamang Baru Transmigration Area

	Performance attribute values

Performance attributes	Input provider	Palm oil farmers	Collectors (tokei)	Collectors (KUD)	Palm oil mill
Reliability	4	4,2	4,6	4,8	5
Responsiveness	4,2	4,4	4	4,6	5
Agility	4,4	3,6	3,6	4,4	4,4
Cost	4,8	3,6	4,2	4,2	5
Asset management efficiency	3	4,4	4,4	4,4	4,6

Source: Data processed (2026)

Table 2 shows the SCOR performance attribute scores, which are the average of five questionnaire items calculated using a Likert scale of 1-5 for each supply chain respondent. Input providers excelled in the cost criterion with a score of 4.8 but scored the lowest in asset management with a score of 3. This indicates that input providers are highly efficient in managing operational costs but face challenges in optimizing asset utilization. Oil palm farmers performed quite well in the responsiveness and asset management efficiency criteria with a score of 4.4, but were low in the agility and cost criteria with a score of 3.6. This indicates that oil palm farmers have limited flexibility to respond to sudden market changes.

Tokei received a score of 4.6 in the reliability criterion, but the lowest score was 3.6 in the agility criterion. This indicates that tokei performance is highly vulnerable to external disruptions and slow in responding to market needs. KUD demonstrated superior performance in the reliability criterion with a score of 4.8 and responsiveness with a score of 4.6, reflecting the professionalism of formal institutional governance in terms of speed of service. PKS performed best on the criteria of reliability, responsiveness, and cost, indicating that PKS was the most efficient and stable in fulfilling orders on time. The radar graph of the performance attribute measurements is visualized in Figure 4.

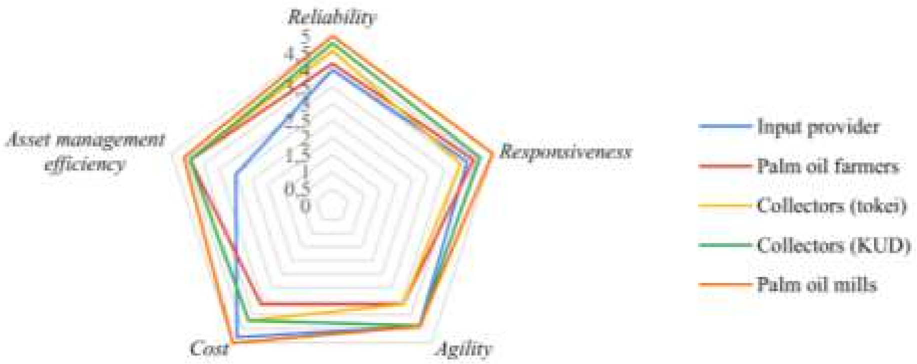

Figure 4. Radar graph of palm oil supply chain performance attribute measurement results
Source: Data processed (2026)

Based on Figure 4, the reliability performance attribute increases in value as the flow of goods moves downstream. In the responsiveness criterion, PKS is the quickest in responding to the market, while collectors, namely tokei, are the slowest members of the palm oil supply chain. Palm oil farmers and tokei have the lowest scores in the agility criterion, indicating that these supply chain members are most vulnerable to sudden changes in the market. In the cost criterion, there is a large disparity between input providers and palm oil farmers, indicating that production costs are still burdensome at the farmer level. Palm oil farmers, tokei, and KUD have similar scores in the asset management efficiency criterion. However, input providers are very low in asset optimization, indicating problems with stock turnover or logistics in production facility warehouses.

Analysis of Supply Chain Performance Attributes Using the AHP Method

The AHP method aims to objectively and systematically determine the relative importance of each indicator so that performance assessments are based on consistent pairwise comparisons (Saaty 2008). This performance attribute weighting uses a questionnaire addressed to expert respondents from each actor in the palm oil supply chain. A comparison of palm oil supply chain performance attributes across input providers is shown in Table 3 below.

Table 3. Comparison of palm oil supply chain performance attributes across input providers

Performance attributes	Weight	*Consistency index* (CI)	*Consistency ratio* (CR)
Reliability	0,405		
Responsiveness	0,209		
Agility	0,187	0,088	0,078
Cost	0,074		
Asset management efficiency	0,125		
Total	1,000		

Source: Data processed (2026)

Table 3 shows that the reliability performance attribute has the highest weighting of 0.405, indicating that reliability is a top priority. The second priority is responsiveness, with a weighting of 0.209, reflecting the input provider's ability to respond to market changes. The pairwise comparison assessment yielded a consistency ratio of 0.078, indicating validity and consistency, as the CR value is less than 0.1. A comparison of palm oil supply chain performance attributes for smallholders is presented in Table 4.

Table 4. Comparison of palm oil supply chain performance attributes for farmers

Performance attributes	Weight	*Consistency index* (CI)	*Consistency ratio* (CR)
Reliability	0,331	0,089	0,079

Responsiveness	0,117
Agility	0,074
Cost	0,261
Asset management efficiency	0,217
Total	1,000

Source: Data processed (2026)

Table 4 shows that the reliability performance attribute has the highest weighting of 0.331, reflecting the ability to deliver palm oil FFB on time and according to standards as the most important factor. The second priority is the cost performance attribute, with a weighting of 0.261, reflecting that operational costs have a significant impact on the sustainability of the farming business. The CR value obtained was 0.079, indicating validity. A comparison of palm oil supply chain performance attributes at Tokei is presented in Table 5.

Table 5. Comparison of palm oil supply chain performance attributes at tokei

Performance attributes	Weight	*Consistency index* (CI)	*Consistency ratio* (CR)
Reliability	0,122		
Responsiveness	0,354		
Agility	0,243	0,091	0,081
Cost	0,166		
Asset management efficiency	0,115		
Total	1,000		

Source: Data processed (2026)

Based on Table 5, the highest performance attribute weighting is responsiveness, with a score of 0.354, reflecting the tokei's top priority in responding to prices and the market. The second priority is agility, with a score of 0.243, reflecting the importance of flexibility in dealing with market fluctuations. The CR value obtained is 0.081, indicating validity. Furthermore, a comparison of palm oil supply chain performance attributes KUD is presented in Table 6.

Table 6. Comparison of palm oil supply chain performance attributes at KUD

Performance attributes	Weight	*Consistency index* (CI)	*Consistency ratio* (CR)
Reliability	0,323		
Responsiveness	0,139		
Agility	0,139	0,059	0,053
Cost	0,323		
Asset management efficiency	0,076		
Total	1,000		

Source: Data processed (2026)

Based on Table 6, the weighted value of the performance attributes reliability and cost have the same level of importance at 0.323, reflecting the role of the

Cooperatives' Cooperative (KUD) in ensuring the absorption of agricultural produce and maintaining operational efficiency. The lowest weighting for asset management is 0.076. The results of the pairwise comparison assessment of performance attributes at the KUD obtained a CR value of 0.053, indicating validity. A comparison of palm oil supply chain performance attributes at the PKS is presented in Table 7.

Table 7. Comparison of palm oil supply chain performance attributes in Palm oil mill

Performance attributes	Weight	*Consistency index* (CI)	*Consistency ratio* (CR)
Reliability	0,429		
Responsiveness	0,140		
Agility	0,095	0,055	0,049
Cost	0,163		
Asset management efficiency	0,174		
Total	1,000		

Source: Data processed (2026)

Based on Table 7, the reliability performance attribute's weighting of 0.429 is the top priority, reflecting the crucial importance of ensuring a reliable and continuous supply of fresh fruit bunches (FFB) that meets quality standards. The lowest weighting is agility, with 0.095. The pairwise comparison of performance attributes at the mill yielded a consistency ratio of 0.049, indicating validity and consistency.

Value-Added Analysis (Hayami Method)

A palm oil value-added analysis was conducted to measure the value added by each actor in the palm oil supply chain, as presented in Table 8.

Table 8. Results of calculating the added value of each actor in the palm oil supply chain

Variable	Formula	Farmer (Sell to tokei)	Farmer (Sell to KUD)	Tokei	KUD	Palm oil mill
I. Output, input, and price						
1. Output (kg/month)	(1)	1500	1500	1500	1500	1.440.000
2. Input (kg/bulan)	(2)	1500	1500	1500	1500	5.760.000
3. Labor (HOK/month)	(3)	15	15	0,75	0,75	1440
4. Conversion factor	(1) / (2)	1	1	1	1	0,25
5. Labor coefficient	(3) / (2)	0,01	0,01	0,0005	0,0005	0,00025
6. Output price (Rp/kg)	(6)	3180	3070	3400	3400	15.200
7. Labor wages (Rp/HOK)	(7)	100.000	100.000	100.000	100.000	150.000
II. Revenue and profits						
8. Price of raw materials (Rp/kg)	(8)	0	0	3180	3100	3400
9. Other input contributions (Rp/kg)	(9)	1016	1016	50	50	0

10.	Output value (Rp/kg)	(4) x (6)	3180	3070	3400	3400	3800
11.	a. Value-added (Rp/kg)	(10)-(9)-(8)	2164	2054	170	250	400
	b. Value added ratio (%)	(11a)/(10)x 100%	68,05	66,91	5	7,35	10,53
12.	a. Labor income (Rp/kg)	(5) x (7)	1000	1000	50	50	37,50
	b. Employee benefits (%)	(12a)/(11a) x 100%	46,21	48,69	29,41	20	9,38
13.	a. Profit (Rp/kg)	(11a)-(12a)	1164	1054	120	200	363
	b. Profit level (%)	(13a)/(10)x 100%	36,60	34,33	3,53	5,88	9,54
III. Remuneration for owners of production factors							
14.	Marjin (Rp/kg)	(10) – (8)	3180	3070	220	300	400
	a. Labor income (%)	(12a)/(14)x 100%	31,45	32,57	22,73	16,67	9,38
	b. Other input contributions (%)	(9)/(14)x 100%	31,95	33,09	22,73	16,67	0
	c. Company owner's benefits (%)	(13a)/(14)x 100%	36,60	34,33	54,55	66,67	90,63

Based on Table 8, the highest value-added ratios are for farmers through the Cooperatives Unitary Enterprises (KUD) (66.91%), farmers through the tokei (68.05%), PKS (10.53%), KUD (7.35%), and tokei (5%). Farmers benefit more from selling their harvests to tokei, with a profit of 36.60% compared to the KUD (34.33%). At the intermediary level, KUDs receive a higher marketing margin of Rp300/kg compared to tokei (Rp220/kg). At the downstream level, PKS, as an industry that processes fresh fruit bunches (FFB) into crude palm oil (CPO), achieves a value-added ratio of 10.53% or Rp400/kg, which is considered low due to the high cost of raw materials. However, the profit of PKS company owners is the highest at 90.63%.

CONCLUSION

Based on the results of the performance analysis using the SCOR method, strategic prioritization using the AHP, and value-added ratio analysis using the Hayami method, the following conclusions were obtained:

1. The palm oil supply chain structure at the research site consists of five main actors: input providers, oil palm farmers, tokei (traders), cooperatives (KUD), and palm oil mills, which carry out procurement, production, and distribution functions. The primary focus of most actors is on the reliability attribute, with the exception of the tokei actor, who prioritizes responsiveness.

2. The SCOR measurement results show varying levels of performance. The palm oil mill (PKS) achieved maximum performance with a score of 5 for almost all performance attributes. However, there were inefficiencies at the upstream level, namely input providers on the asset management efficiency attribute (3) and oil palm

farmers on the cost and agility attributes (3.6). The AHP analysis indicates that the reliability attribute is a key success factor for this supply chain, with a consistency ratio (CR) below 0.1 for all actors, thus validating the formulated priorities for performance improvement.

3. Based on the Hayami method of value-added analysis, PKS produces a value-added ratio of 10.53% or Rp400/kg of raw material in the processing of FFB into CPO. At the intermediary level, KUD obtains a larger marketing margin (Rp300/kg) compared to tokei (Rp220/kg) because it sets a lower purchase price to farmers. As a result, oil palm farmers obtain a higher profit level when selling their harvest to tokei (36.60%) compared to KUD (34.33%).

Some suggestions that can be given are that the relevant agencies and transmigration area managers need to facilitate regular coordination between palm oil farmers, KUD, and PKS to maintain the stability of FFB prices and quality in the field. At the upstream level, farmers are advised to focus on improving plantation productivity and consider the benefits of long-term cooperative membership. At the downstream level, PKS need to optimize the yield rate as well as the processing of by-products to increase the value-added ratio. Furthermore, supply chain actors, namely traders, are advised to start adopting simple digital record-keeping to improve responsiveness and agility in responding to market fluctuations.

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