

Supply Chain Efficiency and Its Impact on the Income of Oil Palm Farmers in Terawas Village, Musi Rawas Regency, South Sumatra Province

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ABSTRACT

Oil palm is a strategic commodity in Indonesia, contributing significantly to rural income and regional economic development. However, inefficiencies in the supply chain, particularly at the village level, often reduce the economic benefits farmers receive. This study aims to analyze the supply chain structure and the effect of marketing channels on the income of oil palm farmers in Terawas Village, Musi Rawas Regency. This study employed a quantitative descriptive approach, using a survey, with a purposive sample of 60 farmers. Data were collected from primary and secondary sources and analyzed using descriptive methods, combined with marketing margins, farmers' shares, and benefit-cost ratio (R/C) models. This study offers novelty by providing empirical evidence at the village level that integrates multiple efficiency indicators simultaneously, a feature that remains limited in previous research. The results show three main marketing channels: farmers–middlemen–palm oil mills, farmers–collectors–palm oil mills, and farmers–direct to mills. Shorter marketing channels are more efficient and generate higher income for farmers. The highest marketing margin occurs in the longest channel (Rp700/Kg), while the lowest is in the direct channel (Rp400/Kg). The highest farmer's share is found in the direct channel (84%), compared to 72% in the middlemen channel. The R/C ratio indicates that all channels are profitable, with the highest efficiency in the direct channel (1.75). This study recommends strengthening farmer institutions, improving access to market information, and promoting direct marketing channels to reduce dependency on intermediaries and enhance supply chain efficiency.

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INTRODUCTION

Oil palm is one of Indonesia's leading commodities, playing a strategic role in driving both national and regional economic growth.

As the world's largest producer of palm oil, Indonesia relies on this sector not only as a major source of foreign exchange but also as a key driver of rural development. Oil palm plantations make a significant contribution to

employment generation, increasing community income, and regional development, particularly in areas with extensive land potential such as Musi Rawas Regency (Lestari et al., 2025).

Musi Rawas Regency, located in South Sumatra Province, is one of the regions with considerable potential in the oil palm plantation sector. One of the villages actively engaged in oil palm cultivation is Terawas Village (Singh et al., 2025). The majority of the community in this village depends on agriculture for their livelihood, particularly as oil palm farmers. Their economic activities are highly influenced by plantation productivity, the selling price of fresh fruit bunches (FFB), and the distribution system of harvests, which is integrated into a supply chain (Hamzah, 2024).

The oil palm supply chain is a complex system involving multiple actors, ranging from farmers as primary producers to collectors, agents, and palm oil mills (POM) as the final processors. Each link in the chain plays an important role in determining distribution efficiency and the economic value received by farmers. From the perspective of value chain efficiency, an effective supply chain should minimize costs while maximizing value distribution among actors. However, in practice, this supply chain often does not operate optimally. Information asymmetry, the dominance of certain actors in price determination, and limited market access for farmers are common issues (Chen & Zou, 2024). These conditions also reflect market power asymmetry, where intermediaries tend to have stronger control over pricing compared to farmers.

These supply chain problems directly affect the income level of oil palm farmers. Farmers are often in a weak position within the market structure, lacking strong bargaining power in determining the selling price of their harvest (Yeshiwas et al., 2024). In addition, long distribution chains increase transaction costs, including transportation, coordination, and information costs, which ultimately reduce farmers' net income. This condition is a significant concern, considering that farmers' welfare largely depends on the returns from their oil palm farming activities.

On the other hand, supply chain efficiency is influenced not only by the distribution structure but also by factors such as infrastructure, transportation access, harvest quality, and government policies. Inadequate road infrastructure, for instance, can increase transportation costs and reduce the quality of fresh fruit bunches due to delays in delivery to mills (Yin et al., 2024). This ultimately affects the selling price received by farmers. Therefore, analyzing the supply chain is essential to identify constraints and opportunities in improving distribution efficiency and farmers' income.

Despite the growing body of literature on oil palm supply chains, a clear research gap remains. Previous studies have predominantly focused on regional or national-level supply chain performance, often emphasizing macro-level efficiency and policy analysis. However, micro-level, village-based analyses that simultaneously integrate marketing margin, farmer's share, and benefit-cost (R/C) ratio to assess income distribution and efficiency remain limited. In addition, few studies explicitly incorporate perspectives of value chain efficiency, transaction cost theory, and

market power asymmetry in explaining disparities in farmer income (Azzahro & Hanoum, 2024).

Terawas Village presents a unique case for such analysis. Unlike large-scale plantation areas, oil palm farming in this village is dominated by smallholders with varying land sizes, limited direct access to palm oil mills, and a high dependence on intermediaries. The village also faces specific logistical challenges, including transportation constraints and information gaps, which significantly influence supply chain dynamics. These local characteristics make Terawas Village an important setting for examining how micro-level supply chain structures affect farmer income and welfare.

Furthermore, this study aims to analyze the relationship between supply chain efficiency and the income level of oil palm farmers. Through this analysis, it is possible to determine the extent to which supply chain factors influence farmers' welfare. The results of this study are expected to contribute to the formulation of policies and strategies that can strengthen farmers' bargaining position, reduce transaction costs, shorten distribution channels, and improve the efficiency of the oil palm marketing system (Toiba et al., 2020).

Moreover, this research is expected to provide both theoretical and practical benefits. Theoretically, it contributes to the development of agribusiness knowledge by integrating value chain efficiency, transaction cost theory, and market power analysis into supply chain studies at the village level. Practically, the findings are expected to serve as a consideration for local governments, business actors, and farmers in making

decisions related to oil palm supply chain management.

Therefore, the study entitled "*Supply Chain Efficiency and Its Impact on the Income of Oil Palm Farmers in Terawas Village, Musi Rawas Regency*" is important to conduct in order to provide a clear overview of supply chain conditions and their impact on farmers' income. Through this research, it is expected that appropriate and evidence-based solutions can be identified to improve supply chain efficiency and enhance the welfare of oil palm farmers in Terawas Village, Musi Rawas Regency.

MATERIALS AND METHODS

This study employs a quantitative descriptive approach using a survey method. The quantitative descriptive approach is chosen because the study aims to systematically and factually describe the condition of the supply chain and the income level of oil palm farmers in Terawas Village, Musi Rawas Regency. The survey method is used to collect data directly from respondents through structured instruments, ensuring that the data obtained are accurate and relevant to the research objectives (Sunil et al., 2025).

The population of this study consists of all oil palm farmers in Terawas Village. The sampling frame includes registered and active smallholder oil palm farmers listed in village administrative records and local farmer groups. The sampling technique used is purposive sampling, in which respondents are selected based on specific and relevant criteria. The criteria include: (1) farmers who actively cultivate oil palm and regularly harvest fresh fruit bunches (FFB); (2) farmers who participate in market transactions, either

through intermediaries or direct sales to palm oil mills; (3) farmers with a minimum farming experience of 3 years to ensure adequate knowledge of production and marketing practices; and (4) farmers with varying landholding sizes (small, medium, and relatively large) to capture differences in production capacity and income levels (Akanke et al., 2023).

The total number of respondents in this study is **60 farmers**. This sample size is considered adequate to represent the population based on field conditions, the relative homogeneity of farmer characteristics, and the feasibility of in-depth data collection. The justification for this sample size follows common practices in village-level quantitative studies, where a sample of 30–100 respondents is sufficient to provide reliable descriptive and comparative analysis (Hu et al., 2022). In addition, the selected sample allows for proportional representation across different marketing channels and farm characteristics, ensuring that the findings reflect actual supply chain conditions in the study area.

Data collection techniques include questionnaires, interviews, and field observations. Questionnaires are used as the primary instrument to obtain quantitative data related to farmers' socio-economic characteristics, farm size, production levels, marketing channels, and income. Interviews are conducted to gain deeper insights into supply chain mechanisms, transaction processes, and challenges such as price determination and market access. Meanwhile, observations are carried out to directly examine field conditions, including harvesting

practices, transportation processes, and supporting infrastructure.

The collected data are then analyzed using quantitative descriptive analysis techniques. This analysis is conducted by processing the data into tables, percentages, and averages to provide a clear overview of supply chain patterns and farmers' income levels. Furthermore, analytical tools such as marketing margin analysis, farmer's share, and benefit-cost ratio (R/C ratio) are applied to evaluate supply chain efficiency and profitability. The results of the analysis are then interpreted to identify relationships between marketing channels, efficiency levels, and farmer income, and to draw conclusions in line with the research objectives.

RESULTS AND DISCUSSION

The results of this study are presented systematically to highlight: (1) the supply chain structure, (2) marketing margin, (3) farmer's share, and (4) R/C ratio, followed by an integrated interpretation of their implications on farmer income and supply chain efficiency in Terawas Village, Musi Rawas Regency.

Supply Chain Structure

The oil palm supply chain in Terawas Village consists of several interconnected actors, namely farmers as primary producers, middlemen, collectors, and palm oil mills (POM) as final processors. These actors form a distribution network that determines how fresh fruit bunches (FFB) move from production to processing stages. Based on field findings, three main marketing channels are identified: Channel I (Farmers → Middlemen → POM), Channel II (Farmers → Collectors → POM), and Channel III (Farmers → POM directly).

Channel I represent the longest and most complex structure, where farmers rely on middlemen to sell their harvest. This dependence is mainly caused by limited access to transportation, lack of capital, and the inability to meet administrative requirements set by palm oil mills. Middlemen play a role in collecting, transporting, and selling FFB, but they also take a portion of the profit, which reduces the price received by farmers.

Channel II is relatively shorter, involving collectors instead of multiple intermediaries. Collectors usually purchase FFB in larger volumes and have better access to mills compared to individual farmers. Although this channel is more efficient than Channel I, farmers still do not fully benefit from the final market price due to the presence of intermediaries.

Channel III is the shortest and most efficient channel, where farmers sell directly to palm oil mills. This direct interaction allows farmers to obtain higher prices, as there are no intermediary margins deducted. However, only a limited number of farmers can access this channel due to constraints such as transportation costs, distance to mills, and institutional limitations.

Overall, the structure of the oil palm supply chain in Terawas Village reflects a dominance of indirect marketing channels. Longer chains tend to increase transaction costs and reduce efficiency, while shorter chains improve farmers' income. Therefore, the supply chain structure plays a critical role in shaping the economic outcomes and welfare of oil palm farmers.

Marketing Margin Analysis

Marketing margin analysis is a crucial component in evaluating the efficiency of agricultural supply chains, particularly in

understanding how the final price of a product is distributed among actors involved in the marketing process. In the context of oil palm farming in Terawas Village, Musi Rawas Regency, marketing margin is defined as the difference between the price received by farmers at the farm gate and the price paid by palm oil mills (POM). This indicator reflects not only the cost incurred during distribution but also the level of profit captured by intermediaries.

Table 1. Oil Palm Marketing Margin in Terawas Village

Marketing Channel	Price at Farmer Level (IDR/Kg)	Price at POM (IDR/Kg)	Margin (IDR/Kg)
Channel I	1,800	2,500	700
Channel II	1,950	2,500	550
Channel III	2,100	2,500	400

Source: Processed Primary Data, 2026

Based on Table 1, there are clear differences in marketing margins across the three identified marketing channels. Channel I shows the highest margin at IDR 700/Kg, followed by Channel II at IDR 550/Kg, and Channel III at IDR 400/Kg. These variations indicate differences in the length of the supply chain and the number of intermediaries involved. The results clearly demonstrate a consistent pattern: the longer the marketing channel, the higher the marketing margin.

Channel I represent the longest and most complex distribution channel, involving middlemen as intermediaries between farmers and palm oil mills. In this channel, farmers sell their fresh fruit bunches (FFB) to middlemen, who then transport and resell them to mills. The involvement of multiple actors leads to the

accumulation of various costs, including transportation costs, labor costs, loading and unloading fees, and risk-related costs such as product deterioration. In addition, each intermediary seeks to obtain profit, which further increases the total margin. As a result, although the final price at the mill level reaches IDR 2,500/Kg, farmers only receive IDR 1,800/Kg. This large price gap indicates that a significant portion of the added value is captured by intermediaries rather than by farmers as primary producers.

From an economic perspective, the high margin in Channel I reflects low value chain efficiency. The presence of multiple transaction layers increases transaction costs, which ultimately reduces the share of income received by farmers. This condition is often associated with information asymmetry and weak bargaining power among farmers, where they have limited access to price information and depend heavily on middlemen for market access. Consequently, farmers are often unable to negotiate better prices and must accept prices determined by intermediaries.

In contrast, Channel III demonstrates the lowest marketing margin at IDR 400/Kg. This channel involves direct sales from farmers to palm oil mills, thereby eliminating the role of intermediaries. The shorter distribution chain significantly reduces transportation and handling costs, as well as intermediary profit margins. As a result, farmers receive a higher price of IDR 2,100/Kg out of the IDR 2,500/Kg paid by the mill. This smaller price gap indicates that a larger portion of the final price is retained by farmers, reflecting a more efficient and equitable distribution system.

The low margin in Channel III also indicates reduced transaction costs and improved price transmission from mills to farmers. In this channel, farmers are more directly exposed to

market price signals, allowing them to make better production and marketing decisions. However, despite its efficiency, not all farmers can access this channel due to constraints such as limited transportation facilities, distance to mills, and administrative requirements imposed by mills, such as minimum quantity standards.

Channel II occupies an intermediate position, with a marketing margin of IDR 550/Kg. In this channel, farmers sell their harvest to collectors, who then deliver the products to palm oil mills. Although intermediaries are still involved, the number of actors is fewer compared to Channel I. This results in lower accumulated costs and margins, making Channel II more efficient than Channel I but less efficient than Channel III. Farmers in this channel receive IDR 1,950/Kg, which is higher than in Channel I but still lower than in Channel III.

The comparative analysis of these three channels highlights the direct relationship between supply chain length and marketing efficiency. Longer chains tend to generate higher margins due to increased costs and profit-taking by intermediaries, while shorter chains minimize these components and allow farmers to capture a greater share of the final price. This finding is consistent with value chain theory, which emphasizes that efficiency is achieved when unnecessary intermediaries are reduced and coordination among actors is improved.

In addition to structural factors, marketing margins are also influenced by dynamic conditions such as fluctuations in production levels, weather conditions, and changes in global and domestic palm oil prices. For instance, during periods of high demand or limited supply, margins may increase as mill prices rise more rapidly than farm-gate prices.

Conversely, during peak harvest periods, increased supply may lead to lower margins due to downward pressure on prices. However, despite these fluctuations, the

relative differences between channels remain consistent, with Channel I always having the highest margin and Channel III the lowest.

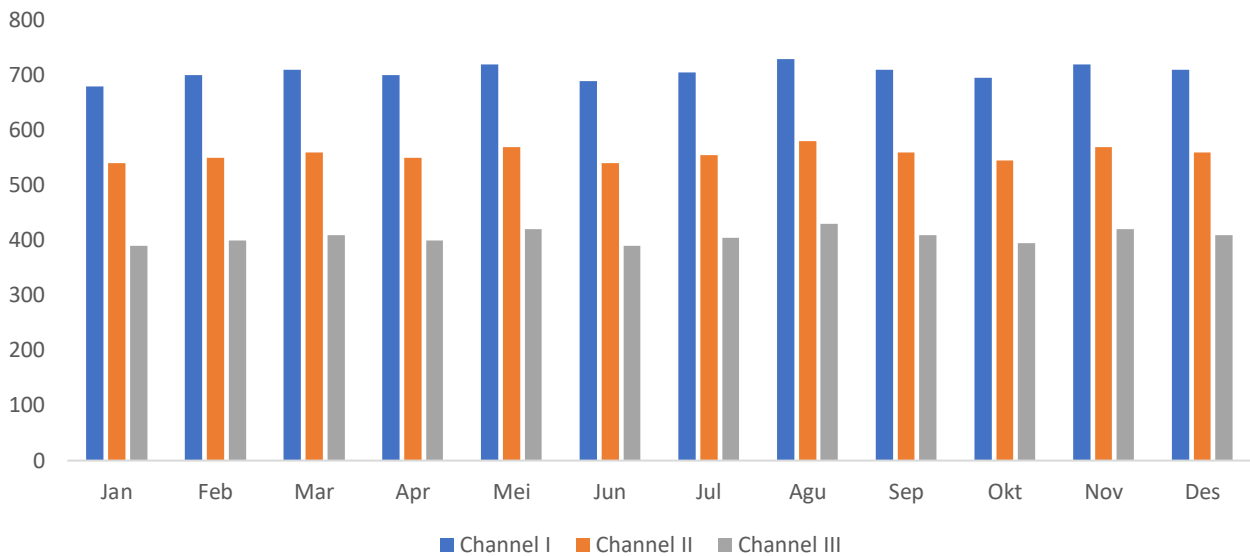


Figure 1. Oil Palm Marketing Margin Graph (IDR/Kg)

The graph shows that the margins across the three marketing channels are relatively stable, although there are fluctuations in certain months. Channel I consistently has the highest margin, ranging from IDR 680 to 730/Kg. This confirms that a longer distribution chain contributes to higher margins.

Channel II shows margins ranging between IDR 540 and 580/Kg, with relatively small fluctuations, indicating a fairly stable distribution system. Meanwhile, Channel III has the lowest margin, ranging from IDR 390 to 430/Kg. The stability of margins in this channel indicates that direct marketing to mills provides higher efficiency and lower risk of fluctuation.

Monthly fluctuations in margins are influenced by several factors, including the production of fresh fruit bunches (FFB), weather conditions, and the dynamics of global and domestic market prices. In August, margins tend to reach their highest levels

across all marketing channels. This is likely due to increased demand or reduced supply, causing mill-level prices to rise faster than farm-level prices. Conversely, in June and October, margins tend to decline, possibly due to increased production or less favorable market conditions.

The implications of this analysis are significant for improving the welfare of oil palm farmers in Terawas Village. Reducing marketing margins through supply chain optimization can directly increase farmers' income. One effective strategy is to shorten the distribution chain by promoting direct sales to mills. This can be facilitated through the establishment of farmer cooperatives, which can collectively meet the volume and quality requirements of mills while reducing transportation costs.

Furthermore, improving access to market information is essential to reduce information asymmetry and strengthen farmers'

bargaining power. Infrastructure development, particularly road access and transportation facilities, also plays a critical role in enabling farmers to access more efficient marketing channels.

In conclusion, marketing margin analysis clearly demonstrates that supply chain efficiency is a key determinant of farmer income. Shorter and more integrated marketing channels result in lower margins, higher price transmission, and greater benefits for farmers. Therefore, efforts to improve the oil palm supply chain in Terawas Village should focus on reducing intermediary dependence, enhancing institutional support, and improving market access to ensure a more equitable distribution of value.

Analisis Farmer’s Share

Farmer’s Share is an important indicator in agricultural marketing analysis that measures the proportion of the final price received by farmers compared to the price paid by the end buyer, in this case the palm oil mill (POM). This indicator reflects the fairness of income distribution within the supply chain and serves as a benchmark for evaluating marketing efficiency. A higher Farmer’s Share indicates that farmers receive a larger portion of the final price, suggesting a more efficient and equitable marketing system. Conversely, a lower Farmer’s Share implies that a significant portion of the value is captured by intermediaries, reducing the income received by farmers.

Based on Table 2, the Farmer’s Share across the three marketing channels in Terawas Village shows clear variation. Channel I has a Farmer’s Share of 72%, Channel II 78%, and Channel III 84%. These results indicate that Channel III provides the highest benefit to farmers, while Channel I provide the lowest.

The differences in Farmer’s Share across channels highlight the influence of supply chain structure on income distribution.

Table 2. Farmer’s Share in Each Marketing Channel

Marketing Channel	Farmer Price (IDR/Kg)	POM Price (IDR/Kg)	Farmer’s Share (%)
Channel I	1,800	2,500	72.00
Channel II	1,950	2,500	78.00
Channel III	2,100	2,500	84.00

Source: Processed Primary Data, 2026

Channel I, which involves farmers selling to middlemen before the product reaches the palm oil mill, has the lowest Farmer’s Share at 72%. This means that out of the IDR 2,500/Kg paid by the mill, farmers only receive IDR 1,800/Kg, while the remaining 28% is distributed among intermediaries as marketing margins. The relatively low Farmer’s Share in this channel reflects the long distribution chain and the involvement of multiple actors, each of whom incurs costs and seeks profit. As a result, the share of value captured by farmers is significantly reduced.

This condition also illustrates the existence of **market power asymmetry** within the supply chain. Middlemen often have greater control over pricing due to their access to market information, transportation facilities, and established relationships with mills. Farmers, on the other hand, tend to have limited bargaining power and depend on intermediaries to sell their products. This imbalance forces farmers to accept prices determined by middlemen, even when those prices are relatively low. Consequently, the income distribution becomes skewed, disadvantaging farmers as primary producers.

Channel II shows a higher Farmer’s Share of 78%, indicating a more favorable distribution

of income compared to Channel I. In this channel, farmers sell their products to collectors, who then deliver them to palm oil mills. Although intermediaries are still present, the number of actors involved is fewer, resulting in a smaller reduction in the price received by farmers. Farmers in this channel receive IDR 1,950/Kg, which represents a larger portion of the final price.

The improvement in Farmer's Share in Channel II suggests that reducing the number of intermediaries can enhance marketing efficiency and increase the portion of income retained by farmers. However, despite this improvement, farmers are still not able to capture the full value of their products due to the continued presence of collectors. This indicates that while Channel II is more efficient than Channel I, it still falls short of achieving optimal income distribution.

Channel III represents the most efficient and equitable marketing channel, with a Farmer's Share of 84%. In this channel, farmers sell their fresh fruit bunches directly to palm oil mills, eliminating the role of intermediaries. As a result, farmers receive IDR 2,100/Kg out of the IDR 2,500/Kg paid by the mill. This high Farmer's Share indicates that most of the final price is directly transferred to farmers, reflecting a highly efficient supply chain.

The high Farmer's Share in Channel III can be attributed to several factors. First, the absence of intermediaries reduces marketing costs and eliminates intermediary profit margins. Second, direct interaction with mills improves price transparency and allows farmers to access more accurate market information. Third, farmers have greater bargaining power when they engage directly with mills, enabling them to negotiate better prices. These factors collectively contribute to

a more equitable distribution of value within the supply chain.

The comparison of Farmer's Share across the three channels reveals a clear inverse relationship with marketing margins. Channels with higher marketing margins, such as Channel I, tend to have lower Farmer's Share, while channels with lower margins, such as Channel III, have higher Farmer's Share. This relationship confirms that marketing efficiency and income distribution are closely interconnected. When margins are high, a larger portion of the final price is absorbed by intermediaries, reducing the share received by farmers. Conversely, when margins are low, more value is retained by farmers, improving their income.

From a theoretical perspective, this finding is consistent with the concept of **value chain efficiency**, which emphasizes the importance of minimizing unnecessary costs and ensuring fair value distribution among actors. It also aligns with **transaction cost theory**, where longer supply chains with multiple intermediaries lead to higher transaction costs, ultimately reducing the net benefits for producers. By shortening the supply chain, transaction costs can be minimized, resulting in a higher Farmer's Share.

Despite the advantages of Channel III, not all farmers in Terawas Village can access this channel. Several constraints limit their ability to sell directly to mills, including inadequate transportation infrastructure, long distances to processing facilities, and strict administrative requirements such as minimum volume standards. In addition, some farmers lack the organizational capacity to coordinate collective sales, which is often necessary to meet mill requirements. These limitations explain why many farmers continue to rely on

intermediaries despite the lower Farmer’s Share.

The implications of this analysis are significant for improving farmer welfare. Increasing Farmer’s Share should be a key objective in developing a more efficient and equitable supply chain. One potential strategy is the formation of farmer cooperatives or groups that can collectively market their products. By pooling resources and production, farmers can meet the requirements of mills and reduce dependence on intermediaries.

Furthermore, improving access to market information is essential to strengthen farmers’ bargaining power. When farmers have accurate and timely information about market prices, they are better positioned to negotiate with buyers and avoid exploitation by intermediaries. Infrastructure development, particularly in transportation, is also critical to enable farmers to access more efficient marketing channels.

In conclusion, the Farmer’s Share analysis demonstrates that supply chain structure plays a crucial role in determining income distribution in oil palm farming. Shorter and more direct marketing channels significantly increase the share of the final price received by farmers, leading to improved welfare. Therefore, efforts to enhance supply chain efficiency, reduce intermediary dependence, and empower farmers are essential to achieving a more equitable and sustainable agricultural system in Terawas Village.

Efficiency Analysis (R/C Ratio)

The efficiency of oil palm farming in Terawas Village, Musi Rawas Regency, is analyzed using the Revenue-Cost Ratio (R/C Ratio), which is a widely used indicator to assess the financial feasibility of agricultural

enterprises. The R/C Ratio is calculated by comparing total revenue to total production costs. A value greater than one ($R/C > 1$) indicates that the farming activity is profitable and economically feasible, while a value less than one ($R/C < 1$) indicates that the activity is not profitable. Therefore, the higher the R/C Ratio, the more efficient and beneficial the farming operation is for farmers.

Table 3. R/C Ratio of Oil Palm Farming

Marketing Channel	Revenue (IDR/Ha)	Cost (IDR/Ha)	R/C Ratio
Channel I	18,000,000	12,000,000	1.50
Channel II	19,500,000	12,000,000	1.62
Channel III	21,000,000	12,000,000	1.75

Source: Processed Primary Data, 2026

Based on Table 3, all three marketing channels demonstrate R/C Ratio values greater than one, indicating that oil palm farming in Terawas Village is profitable regardless of the marketing channel used. However, there are significant differences in efficiency levels across the channels. Channel I has an R/C Ratio of 1.50, Channel II has 1.62, and Channel III has the highest value at 1.75. These variations reflect differences in revenue generation rather than production costs, as the cost component remains relatively constant at IDR 12,000,000 per hectare across all channels.

Channel I, with an R/C Ratio of 1.50, represents the lowest level of efficiency among the three channels. This means that for every IDR 1.00 spent on production, farmers earn IDR 1.50 in revenue, resulting in a net return of IDR 0.50. Although this channel is still profitable, its efficiency is relatively low compared to the others. The lower efficiency can be attributed to the marketing system used, where farmers

rely on middlemen to sell their fresh fruit bunches (FFB). The involvement of intermediaries leads to lower selling prices at the farm level, which reduces total revenue and ultimately lowers the R/C Ratio.

Channel II shows a moderate level of efficiency, with an R/C Ratio of 1.62. In this channel, farmers sell their products to collectors, resulting in slightly higher prices compared to Channel I. With total revenue of IDR 19,500,000 per hectare and the same production cost of IDR 12,000,000, farmers achieve a net return of IDR 0.62 for every IDR 1.00 invested. This improvement indicates that reducing the number of intermediaries can positively affect farm profitability. However, since intermediaries are still involved, the efficiency level does not reach its maximum potential.

Channel III demonstrates the highest level of efficiency, with an R/C Ratio of 1.75. This means that every IDR 1.00 spent generates IDR 1.75 in revenue, resulting in a net return of IDR 0.75. This channel involves direct sales from farmers to palm oil mills, eliminating intermediaries and allowing farmers to receive higher prices for their products. With total revenue reaching IDR 21,000,000 per hectare, Channel III provides the highest profit among all channels. This finding clearly shows that direct marketing systems significantly enhance farm efficiency and income.

The differences in R/C Ratio values across the three channels highlight the critical role of marketing systems in determining farm profitability. Since production costs are relatively similar, variations in efficiency are primarily driven by differences in revenue, which are influenced by the selling price of FFB. Higher selling prices in Channel III lead to higher revenue and, consequently, a higher

R/C Ratio. In contrast, lower prices in Channel I reduce revenue and efficiency.

From a broader perspective, these findings are closely related to the concept of **transaction cost efficiency**. Longer marketing channels, such as Channel I, involve more actors and processes, which increase transaction costs, including transportation, coordination, and information costs. These additional costs reduce the net income received by farmers. On the other hand, shorter channels like Channel III minimize transaction costs, resulting in higher net returns and improved efficiency.

In addition, the results also reflect differences in farmers' access to markets. Farmers who are able to sell directly to mills typically have better access to transportation, capital, and market information. This enables them to choose more efficient marketing channels and achieve higher profitability. Conversely, farmers who lack these resources are more likely to depend on intermediaries, which limits their ability to maximize income.

Despite the higher efficiency of Channel III, not all farmers can adopt this channel due to various constraints. These include limited infrastructure, long distances to mills, and strict requirements imposed by mills, such as minimum quantity and quality standards. As a result, many farmers continue to rely on less efficient channels, even though they generate lower returns.

The implications of this analysis are important for improving the efficiency and sustainability of oil palm farming in Terawas Village. Efforts should be made to encourage farmers to access more efficient marketing channels, particularly direct sales to mills. This can be achieved through the development of farmer cooperatives, which can help farmers

meet volume requirements and reduce transportation costs. In addition, improving infrastructure and providing better access to market information can support farmers in transitioning to more profitable marketing systems.

In conclusion, the R/C Ratio analysis confirms that oil palm farming in Terawas Village is economically viable across all marketing channels, but efficiency levels vary significantly. Channel III is the most efficient and profitable due to higher selling prices and lower transaction costs. Therefore, improving marketing systems and reducing dependence on intermediaries are key strategies to enhance farm efficiency, increase farmer income, and promote sustainable agricultural development.

Discussion

The results of this study indicate that the length of the supply chain has a highly significant effect on the income level of oil palm farmers in Terawas Village. The longer the marketing channel through which products pass, the greater the marketing margin formed due to additional distribution costs and profits taken by each marketing institution. This condition directly reduces the share of the price received by farmers as primary producers. Conversely, shorter marketing channels have been proven to provide greater benefits to farmers by reducing distribution costs and minimizing the involvement of intermediaries.

These findings are consistent with various national studies on oil palm supply chains in Indonesia. For example, research by Lestari et al. (2025) in Lampung Province shows that smallholder farmers who have direct access to palm oil mills tend to receive higher prices and experience better welfare outcomes

compared to those relying on intermediaries. Similarly, Toiba et al. (2020) emphasize that improving market access and reducing inefficiencies in the agricultural supply chain significantly contribute to increasing farmers' income and food security. This indicates that the pattern observed in Terawas Village reflects a broader national trend, where supply chain structure is a key determinant of farmer welfare.

At the international level, similar patterns are also found in agricultural supply chains. Studies such as (Li, 2024) on onion supply chains in Ethiopia and (Mazhar et al., 2022) on cocoa supply chains in Nigeria reveal that longer marketing chains tend to increase transaction costs and reduce the income share received by farmers. These studies highlight that the issue of inefficient distribution and unequal value distribution is not unique to oil palm or Indonesia, but is a common challenge in many developing countries. The findings of this study therefore contribute to the global discourse by providing micro-level empirical evidence that reinforces the importance of shortening supply chains to improve farmer income.

Furthermore, this study aligns with broader agricultural supply chain theories, particularly the concept of value chain efficiency. According to (Abushaega et al., 2025), an efficient value chain is characterized by minimal unnecessary intermediaries, transparent information flows, and equitable distribution of value among actors. The results in Terawas Village clearly demonstrate that Channel III, which involves direct sales from farmers to mills, represents a more efficient value chain compared to Channels I and II. This supports the argument that reducing the number of intermediaries can improve both

efficiency and equity in agricultural marketing systems.

In addition, the findings also support the framework of transaction cost theory, where longer supply chains increase costs related to transportation, coordination, and information exchange. As observed in Channel I, the involvement of multiple intermediaries leads to higher transaction costs, which ultimately reduce farmers' net income. Conversely, Channel III minimizes these costs, resulting in higher profitability and efficiency. This pattern is also supported by international research such as Chen and Zou (2024), which highlights how improved supply chain integration and reduced intermediaries can lower transaction costs and enhance economic outcomes for producers.

Another important aspect highlighted in this study is market power asymmetry. Farmers in Terawas Village, particularly those who rely on middlemen, often have weaker bargaining positions due to limited access to market information and infrastructure. This condition is also observed in other agricultural sectors globally. For instance, (Kusmiati et al., 2024) found that cocoa farmers in Nigeria face similar challenges, where intermediaries dominate price determination due to better access to information and markets. This reinforces the finding that improving information access and strengthening farmer institutions are essential to reducing inequality in value distribution.

The role of information access in determining farmer income is also consistent with findings from Yin et al. (2024), which emphasize that better access to market information can significantly improve farmers' decision-making and income levels. In Terawas Village, farmers who have access to price information from palm oil mills are better able

to negotiate prices and choose more efficient marketing channels. This highlights the importance of information transparency in creating a more competitive and fair market environment.

In comparison with other agricultural commodities, such as coffee and cocoa, similar structural challenges are observed. Studies on coffee supply chains (Azzahro & Hanoum, 2024) show that smallholder farmers often depend on intermediaries due to limited access to processing facilities and markets. However, when farmers are organized into cooperatives or have direct market access, their income and bargaining power significantly improve. This suggests that the solutions proposed for oil palm farmers in Terawas Village, such as strengthening farmer institutions and promoting direct marketing, are also applicable to other agricultural sectors.

Moreover, infrastructure remains a critical factor influencing supply chain efficiency across different contexts. Poor transportation infrastructure has been identified as a major barrier in both national and international studies, increasing costs and reducing product quality. In Terawas Village, similar constraints limit farmers' ability to access direct marketing channels, forcing them to rely on intermediaries. This finding is in line with global evidence that infrastructure development is essential for improving agricultural supply chains and enhancing farmer welfare.

Overall, this study not only confirms existing theories and empirical findings but also provides specific village-level evidence that enriches the literature on agricultural supply chains. The consistency between the findings in Terawas Village and those from national and international studies strengthens the validity

of the conclusion that supply chain efficiency is a key determinant of farmer income.

CONCLUSION

This study demonstrates that supply chain structure is a critical determinant of income distribution and efficiency in smallholder oil palm farming. Rather than merely showing differences across marketing channels, the findings synthesize a broader insight: the interaction between supply chain length, transaction costs, and market power asymmetry systematically shapes farmer welfare. Shorter, more integrated channels enable better price transmission, reduce intermediation costs, and improve farmers' bargaining positions, while longer chains tend to concentrate value among intermediaries.

For future research, several directions are recommended. First, further studies could employ larger sample sizes and comparative multi-village or regional analyses to improve generalizability. Second, incorporating econometric or causal models would allow for deeper examination of the magnitude of supply chain effects on income. Third, future research should explore the role of digital platforms, contract farming, and institutional innovations in transforming agricultural supply chains.

In conclusion, improving supply chain efficiency through structural and institutional reforms is essential for achieving sustainable increases in smallholder farmer income and welfare.

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