

SUPPLY CHAIN ANALYSIS OF NATURAL RUBBER IN TUAH NEGERI DISTRICT, MUSI RAWAS REGENCY, SOUTH SUMATRA PROVINCE, INDONESIA

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ABSTRACT

The natural rubber supply chain plays a crucial role in marketing efficiency and farmers' income. However, information on supply chain flows and profit margins among stakeholders in Tuah Negeri Subdistrict, Musi Rawas Regency, remains limited. This study is important for supporting improvements in supply chain efficiency and farmers' welfare. This research was conducted in Tuah Negeri District, Musi Rawas Regency, to determine the flow of the rubber latex supply chain from farmers to processing factories and the profit margins of each supply chain actor. The study employed qualitative and quantitative descriptive approaches. The qualitative approach was used to analyze product, information, and financial flows, while the quantitative approach was used to calculate marketing margins, farmers' share, and profit margins. Samples were selected using stratified random sampling, involving 97 farmers, while snowball sampling was used for 6 intermediaries and 5 collectors. The results showed that the rubber latex supply chain comprised four patterns: pattern I (farmer–factory), pattern II (farmer–middleman–factory), pattern III (farmer–middleman–collector–factory), and pattern IV (farmer–collector–factory). The highest marketing margin was found in pattern III at Rp1.800, while the highest *farmer's share* was found in pattern I at 100%. The Hayami value-added analysis indicated a value added of Rp11.561,36/kg with a value-added ratio of 99,92%.

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INTRODUCTION

The agricultural sector, particularly the plantation subsector, plays a vital role in supporting Indonesia's economy. One of the plantation commodities with high economic value

is the rubber tree (*Hevea brasiliensis* Muel. Arg.), which is the primary source of natural rubber (latex) and a major contributor to the country's foreign exchange earnings. Natural rubber (*Hevea brasiliensis*) is Indonesia's leading commodity, playing a vital role in the global economy—

particularly for producing countries like Indonesia, both as a source of revenue and for job creation. One of the agricultural subsectors is rubber plantation farming, which plays a vital role in driving economic growth in new centers in the surrounding areas. Rubber (*Hevea brasiliensis*) is the primary source of livelihood for many farmers and contributes to the country's foreign exchange earnings (Salsabila et al., 2025). Imansyah et al. (2022) state that the success of rubber agribusiness is determined not only by cultivation practices but also by a supply chain system that ensures the smooth distribution of products from farmers to processing industries. South Sumatra Province is one of the nation's major rubber production centers, with Musi Rawas Regency as a leading producing region. The following are rubber production data for South Sumatra Province, 2022–2024.

Table 1. Rubber Production Data by Regency in South Sumatra Province, 2022–2024.

No	Regency	Persentase %
1	Ogan Kemiring Ulu	5%
2	Ogan Kemiring Ilir	16%
3	Muara Enim	9%
4	Lahat	7%
5	Musi Rawas	19%
6	Banyuasin	22%
7	OKU Selatan	0%
8	OKU Timur	2%
9	Ogan Ilir	1%
10	Empat Lawang	1%
11	Pali	5%
12	Musi Rawas Utara	13%

(Source: Central Statistics Agency of South Sumatra Province, in Figures 2022–2024).

According to data from the South Sumatra Provincial Central Statistics Agency for 2022–2024, Musi Rawas Regency accounts for approximately 19% of the province's rubber production and ranks second after Banyuasin Regency. In Musi Rawas Regency, Tuah Negeri Subdistrict is one of the rubber-producing areas, with 3,590 farmers and a production volume of 9,258 metric tons in 2025 (Musi Rawas Regency Plantation Office, 2025).

Despite its significant production potential, the natural rubber supply chain still faces various challenges, such as long marketing channels, suboptimal information flow, and disparities in profit margins among market participants. These conditions can reduce distribution efficiency, increase transaction costs, and result in low farmer incomes.

Previous studies have generally focused on marketing channels or the marketing efficiency of rubber as a commodity, but have not comprehensively examined the relationships among product, information, and financial flows, as well as the distribution of profit margins among supply chain actors at the regional level. In fact, a comprehensive understanding of the interrelationships among these flows is necessary to identify inefficiencies in the supply chain and formulate appropriate improvement strategies. Therefore, this study is necessary to provide a comprehensive overview of the natural rubber supply chain system in Tuah Negeri Subdistrict, Musi Rawas Regency.

This study aims to analyze product, information, and financial flows within the natural rubber supply chain from farmers to processing plants, and to identify the profit margins received by each participant in the supply chain in Tuah Negeri Subdistrict, Musi Rawas Regency.

Supply Chain

The supply chain plays a crucial role in the procurement of raw materials through to the delivery of products to customers. It serves as the backbone that supports the entire business process (Nasution et al., 2024). The concept of a supply chain is a management system encompassing the flow of products, information, and financial resources (Tubagus et al., 2016). Although supply chains are dynamic, they consist of three primary flows that continuously interact: information, product, and financial flows. These three flows occur continuously and determine the effectiveness and efficiency of a commodity's distribution (Supriyadi & Waliyullo, 2025). In the

case of rubber, effective supply chain management not only ensures the smooth distribution of products but also influences price formation, marketing efficiency, and farmers' incomes.

Marketing Efficiency

Marketing efficiency is an indicator used to assess the performance of a supply chain system, analyzed through the marketing margin, the farmer's share, and the profits earned by each marketing actor. The lower the marketing margin and the higher the farmer's share, the more efficient the marketing channel tends to be. Marketing involves various marketing channels that create price and margin differentials; therefore, efficient marketing is necessary to reduce costs and improve market efficiency (Solin et al., 2025).

Value added

Value added is the increase in the economic value of a commodity achieved through processing, handling, or marketing, resulting in a higher selling price than the value of its raw materials. Value-added analysis is used to determine the economic value created at each stage of the process and the distribution of benefits among supply chain participants. Zedha et al. (2023) used the value-added method to analyze the value added generated through the processing of agricultural commodities. The results of the study show that each stakeholder makes a different contribution to the creation of value added and profits.

MATERIALS AND METHODS

The farmer respondents were selected using stratified random sampling. The study population consisted of 3,590 rubber farmer households spread across 11 villages in Tuah Negeri Subdistrict. The stratification was based on village areas to ensure the representation of farmers from all villages included in the study. The sample size for each stratum was determined proportionally based on the number of farmers in each village, resulting in a total of 97 respondents. The sample distribution included 8 respondents from Jaya Bakti

Village, 6 from Jaya Tunggal, 10 from Remayu, 25 from Lubuk Rumbai, 14 from Dharmasakti, 4 from Banpres, 7 from Leban Jaya, 6 from Sukamulya, 4 from Air Beliti, Petunang (1 respondent), and Bamasco (12 respondents).

Furthermore, respondents within each stratum were selected at random (simple random sampling). Respondents in the marketing sector were selected using the snowball sampling method. Data collection began with the initial respondent, a middleman recommended by farmers as a key player in the marketing of natural rubber latex. Subsequently, this respondent recommended the next marketing actors until all actors in the supply chain had been successfully identified. Through this process, six middlemen, three collectors, and one processing plant were identified as research respondents. The snowball sampling process was halted once all actors in the supply chain had been identified, and the information obtained from respondents began to repeat (data saturation), indicating that no new actors or information relevant to the research objectives were found. The supply chain was traced from farmers as producers, through intermediaries, to collectors, and finally to the processing plant, the final actor in Tuah Negeri Subdistrict's natural rubber supply chain.

Research Population and Sample

The population in this study consists of all farmers involved in the natural rubber supply chain in Tuah Negeri Subdistrict, Musi Rawas Regency. This population includes rubber farmers as the primary producers, as well as marketing institutions that play a role in the distribution of natural rubber. The marketing institutions in question include intermediaries, collectors, and factories. A population is the domain of generalization consisting of objects or subjects that share specific characteristics (Sugiyono, 2019). Sampling in this study used the stratified random sampling method to determine the farmer sample; subsequently, the rubber farmer sample was selected purposively, with the criterion that

respondents must own at least 1 hectare of rubber plantation land and have trees that are already producing. Using the Slovin method, with the following formula:

$$N = \frac{N_0}{1 + Ne^2}$$

n = jumlah sampel

N = jumlah populasi

e = tingkat error

Thus, the sample obtained using this formula comprised 97 respondents.

Research Method

This study employed both qualitative descriptive and quantitative research approaches. The qualitative approach was used to describe the characteristics of the natural rubber supply chain in Tuah Negeri District, Musi Rawas Regency, including the flow of products, information, and financial resources among supply chain actors. According to Sugiyono (2019), descriptive research aims to describe actual conditions through the systematic collection, organization, and analysis of data. Meanwhile, a quantitative approach was used to calculate marketing margins, farmers' share, and profit margins for each participant in the supply chain. Therefore, this study not only describes the structure and performance of the natural rubber supply chain but also evaluates the level of profit earned by each supply chain actor (Rahmatullah et al., 2023).

Data Analysis

Data analysis was conducted using both qualitative descriptive and quantitative approaches based on primary and secondary data. The descriptive approach was employed to describe the actual conditions of the study area and to identify the structure of supply chain actors and the operational mechanisms of the natural rubber supply chain (Pongoh, 2016). Meanwhile, a quantitative approach was used to analyze profit margins in the rubber supply chain in Tuah Negeri District.

The descriptive analysis focused on three major components of the supply chain, namely product flow, information flow, and financial flow. The quantitative analysis was conducted to determine price differences and profit distribution between farmers and final consumers in the natural rubber supply chain. Furthermore, marketing margin analysis was used to measure the difference between the price paid by the final consumer and the price received by the producer. The marketing margin was calculated using the following formula proposed by Aulia et al. (2025):

$$MP = Pr - Pf$$

Description:

MP = Marketing margin (IDR/kg)

Pr = Price at the consumer level (IDR/kg)

Pf = Price at the farmer level (IDR/kg)

The calculation of farmers' share is intended to determine the proportion of the price received by farmers relative to the price paid by the final consumers. Farmer's share can be calculated using the following formula:

$$\frac{Pf}{Pr} \times 100\%$$

Description:

F = Farmer's share (%)

Pf = Price received by farmers (IDR/kg)

Pr = Price paid by consumers (IDR/kg)

Profit margin analysis was used to determine the difference between total revenue and total cost. The profit calculation formula proposed by Tilaar, Mandei, and Laoh (2023) is presented as follows:

$$\pi = TR - TC$$

Description:

π = Profit

TR = Total Revenue

TC = Total Cost

The profit margin analysis was calculated using the Hayami Method as proposed by Zedha et al. (2023).

RESULTS AND DISCUSSION

The respondents in this study consisted of rubber farmers, local collectors, and wholesalers in Tuah Negeri District, Musi Rawas Regency. Each supply chain actor has distinct characteristics that influence their role in the natural rubber supply chain. The characteristics analyzed in this study include age, educational level, business experience, number of family dependents, landholding size, and other socio-economic characteristics.

Table 3. Characteristics of Rubber Farmers

No	Range	Average
1	Age (Years)	50
2	Education Level (Years of Schooling)	6
3	Farming Experience (Years)	26
4	Number of Family Dependents	3
5	Farm Size (Ha)	1

Source: Processed Primary Data, 2026

Based on Table 3, the characteristics of rubber farmers in Tuah Negeri Subdistrict include age, educational level, farming experience, number of family dependents, and land area. The majority of respondents were aged 41–60 years, with an average age of 50 years, thus still falling within the productive age group (Mohammad Shoimus Sholeh et al., 2021).

In terms of education, most farmers have only completed elementary school (SD). This indicates that farmers' educational levels remain relatively low, consistent with the findings of Sholeh et al. (2021), who noted that the majority of farmers in rural areas have only a basic education. The respondents' average farming experience was 26 years. This indicates that farmers have considerable experience in managing rubber farming operations, which could enhance their ability to run their businesses (Setiaji & Fatuniah, 2018). Most respondents have dependents, with

an average of three people. The number of dependents influences household economic needs and the allocation of income derived from farming (Purwanto & Taftazani, 2018; Wardani & Amala, 2025). By land area, the majority of farmers—65 (67%)—own 1 hectare. Land area is a key factor influencing farmers' production capacity and income; the larger the area of land managed, the greater the potential for increased production (Pradnyawati & Cipta, 2021).

Table 4. Business Experience of Local Collectors

No	Range	Average
1	business experience	8

Source: Processed Primary Data, 2026

Based on Table 4, most local collectors had been engaged in their business for 5–8 years, with an average of 8 years of business experience. This indicates that local collectors have considerable experience in the marketing of natural rubber. Longer business experience is generally associated with greater skills and knowledge in managing business operations effectively (Fadillah et al., 2024).

Table 5. Business Experience of Rubber Collectors

No	Range	Average
1	business experience	10

Source: Processed Primary Data, 2026

Based on Table 5, the majority of wholesalers had been engaged in their business for 8–10 years, with an average business experience of 10 years. This relatively long business experience indicates that wholesalers have developed the capacity to manage their businesses effectively, expand their marketing networks, and better understand product quality requirements and market price fluctuations (Setiaji & Fatuniah, 2018).

Rubber Supply Chain Mechanism

The results of this study indicate that the rubber supply chain in Tuah Negeri District comprises four main actors: farmers, middlemen, collecting traders, and processing factories. The results of this study are consistent with the findings of Rahayu et

al. (2021), which indicate that there are four palm oil fresh fruit bunch (FFB) supply chain networks in Bengkalis: Network I (farmers–collectors–large palm oil traders–industry), Network II (farmers–large palm oil traders–industry), Network III (farmers–collectors–cooperatives–industry), and Network IV (farmers–cooperatives–industry). The supply chain mechanism consists of three main flows: the product flow, financial flow, and information flow. The product, financial, and information flows within the rubber supply chain in Tuah Negeri District, Musi Rawas Regency. This study identified four supply chain patterns in the research area: Pattern I (farmers–processing factory), Pattern II (farmers–middlemen–processing factory), Pattern III (farmers–middlemen–collecting traders–processing factory), and Pattern IV (farmers–collecting traders–processing factory). According to Tubagus et al. (2016), there are three types of supply chain flows: the product flow, which moves from upstream to downstream, from farmers as the primary producers to the final consumers; the financial flow, which moves from downstream to upstream; and the information flow, which occurs in both directions among supply chain actors. The differences among these supply chain patterns are influenced by farmers' ability to meet the quality standards required by processing factories, transportation accessibility, production volume, and the partnership relationships established with marketing institutions.

Rubber Product Flow

The product flow analysis was conducted to trace the movement of natural rubber along the supply chain from farmers to the processing factory. Product flow in a supply chain begins with suppliers and continues through each stage of distribution until it reaches the end user (Dewi & Suprapti, 2022). In this study, the product flow starts from rubber farmers and ends at the processing factory located in Tuah Negeri District, Musi Rawas Regency. The product flow patterns are described as follows:

1. Flow Pattern 1: Farmers sell natural rubber directly to the processing factory, with an average monthly sales volume of 500 kg. This model is the most efficient supply chain because farmers receive the highest selling price. However, this model is still rarely implemented in Tuah Negeri Subdistrict due to limited access to processing plants, quality requirements that must meet certain standards, and challenges related to distance and transportation costs, leading farmers to prefer selling through intermediaries.
2. Flow Pattern 2: Farmers sell natural rubber to middlemen, who then deliver it to the processing factory. The average sales volume through this pattern is 4,733 kg. This model was chosen because middlemen are more accessible, purchase rubber latex in small quantities, do not impose quality standards as strict as those of factories, and make cash payments. These conditions benefit farmers who face limitations in terms of access, transportation, and production volume.
3. Flow Pattern 3: This pattern involves four supply chain actors, namely farmers, middlemen, collecting traders, and the processing factory, with an average sales volume of 8,000 kg. This model was chosen because farmers have limited access to processing plants due to low sales volume, poor rubber latex quality, and high transportation costs. Middlemen collect the farmers' tapped latex and sell it to wholesalers who can meet the plants' needs.
4. Flow Pattern 4: Farmers sell natural rubber to collecting traders, who subsequently sell it to the processing factory. The average sales volume through this pattern reaches 6,200 kg. This model was chosen because collectors can purchase larger quantities of natural rubber and have direct access to mills. In addition, collectors provide collection, storage, and transportation facilities, so farmers do not have to bear transportation costs or meet the requirements for selling directly to mills.

Therefore, this model serves as an alternative for farmers with limited production or who face difficulties accessing mills.

Financial Flow

Based on the research findings, four financial flow patterns were identified in the rubber marketing channels: Pattern I (farmers–processing factory), Pattern II (farmers–middlemen–processing factory), Pattern III (farmers–middlemen–collecting traders–processing factory), and Pattern IV (farmers–collecting traders–processing factory). These findings are consistent with Athaillah et al. (2018), who stated that financial flows move from downstream to upstream. Financial flows include both cash and credit payment systems, as well as payment-scheduling arrangements.

1. Pattern I: Farmers sell rubber directly to the processing factory for IDR 15,000/kg.
2. Pattern II: Farmers sell rubber to middlemen at IDR 12,000/kg. The middlemen then sell the rubber to the processing factory at an average price of IDR 13,667/kg.
3. Pattern III: Middlemen purchase rubber from farmers at IDR 12,000/kg and sell it to collecting traders at IDR 12,200/kg. The collecting traders subsequently sell the rubber to the processing factory at IDR 14,500/kg.
4. Pattern IV: Farmers sell rubber directly to collecting traders at an average price of IDR 12,950/kg. The collecting traders then resell the rubber to the processing factory at IDR 14,283/kg.

Regarding the payment mechanism, Pattern I applies a cash payment system in which farmers receive immediate payment upon sale. Similarly, Pattern II and Pattern III also use cash payments. In Pattern IV, most collecting traders pay farmers in cash, while one collecting trader uses a bank transfer.

Information Flow

Information flow analysis was conducted to identify the exchange of information related to

rubber prices and quality. Based on the research findings, information flows in both directions, from upstream to downstream and vice versa. This finding is consistent with the study by Prasetya et al. (2019), which found that information flow in a supply chain can follow multiple pathways, enabling new information to be integrated into the system.

In Tuah Negeri District, the information flow is considered to function effectively. Information exchange occurs through online communication channels, such as WhatsApp, telephone calls, and other digital platforms, as well as through direct face-to-face interactions among supply chain actors. The information exchanged among stakeholders in the rubber supply chain in Tuah Negeri District, Musi Rawas Regency, primarily concerns rubber prices, quality standards, and market conditions. This is evidenced by all respondents reporting that they regularly received up-to-date information on rubber prices, quality requirements, and market conditions.

Marketing Margin and Farmer's Share

The marketing margin is defined as the difference between the price received by producers and the price paid by consumers. The calculation of the marketing margin for rubber latex in Tuah Negeri District, Musi Rawas Regency, is presented in Table 6.

Based on Table 6, each marketing actor has different marketing margins and Farmer's share values. Intermediaries obtained a marketing margin of IDR 2,000/kg with a Farmer's share of 85.7%. The marketing channel involving intermediaries and collecting traders generated a marketing margin of IDR 1,800/kg with a Farmer's share of 84.13%. Meanwhile, collecting traders obtained the lowest marketing margin, amounting to IDR 1,333/kg, but achieved the highest Farmer's share of 90.66%—Value-Added Analysis Using the Hayami Method. Based on the analysis results, the output value was calculated to be Rp11,570 per kilogram of natural rubber latex produced. The value added was Rp11,561.36. This value-added

indicates that the natural rubber latex production process can increase the economic value of the raw materials used.

Table 6. Marketing Margin and Farmer's Share Calculation Results

No	Institution (IDR/kg)	Supply chain Price/kg
1	Farmer	
	a) Selling price	Rp15.000
2	Local Collector	
	a) Purchase price	Rp12.000
	b) Selling price	Rp14.000
	c) Marketing cost	Rp1.636
	d) Profit	Rp31
	e) Marketing margin	Rp2.000
	f) <i>Farmer's share</i>	85,7%
3	Local Collecto-Wholesaler	
	a) Purchase price	Rp12.200
	b) Selling price	Rp14.500
	c) Marketing cost	Rp1.371
	d) Profit	Rp429
	e) Marketing Margin	Rp 1.800
	<i>Farmer's share</i>	84,13%
4	Wholesaler	
	a) Purchase price	Rp12.950
	b) Selling price	Rp14.283
	c) Marketing cost	Rp1.294
	d) Profit	Rp39
	e) Marketing Margin	Rp1.333
	<i>Farmer's share</i>	90,66%

Source: Processed Primary Data, 2026

The greater the value added, the higher the economic benefits generated by the production process. The value-added ratio was 99.92%. This indicates that the majority of the output value comes from the processing stage, meaning that rubber has high economic potential. However, the high level of value added generated does not necessarily translate into an equitable distribution of economic benefits throughout the supply chain. This situation may reflect market inefficiencies if farmers, as suppliers of raw materials, do not receive a share of profits commensurate with the economic value they create.

Furthermore, the limited price information available to farmers can create price asymmetry, thereby weakening their bargaining power relative to other market participants. Transaction costs—such as transportation, collection, and market information search costs—also influence the distribution of profits among supply chain participants. On the other hand, increasing value added can strengthen supply chain resilience by providing economic incentives for each actor to maintain supply continuity and improve product quality. The use of digital marketing can also improve supply chain efficiency by providing more transparent pricing information, expanding market access, and reducing farmers' dependence on intermediaries. Thus, increasing value added not only contributes to economic gains but also fosters a more efficient, transparent, and competitive supply chain.

CONCLUSIONS

1. The natural rubber supply chain in Tuah Negeri Subdistrict involves four main actors: farmers, intermediaries, collectors, and processing plants. Relationships among these actors are facilitated through the flow of products, finances, and information. There are four supply chain patterns: (1) farmer–processing plant, (2) farmer–middleman–processing plant, (3) farmer–middleman–collector–processing plant, and (4) farmer–collector–processing plant.
2. The profit margins in the natural rubber supply chain in Tuah Negeri Subdistrict vary across each marketing pattern. These differences are influenced by several factors, including the customer relationships among supply chain participants, the proximity between sellers and buyers—which can reduce transportation costs—and the differences in purchase and selling prices set at each marketing channel. In Pattern I, there is no marketing margin because there are no intermediaries, with the farmer's share at 100%. In Pattern II, the marketing margin is Rp1,667/kg, with the middleman's profit at Rp31/kg and the farmer's share at

87.8%. In Pattern III, the total marketing margin is Rp1,800/kg, with a total profit of Rp429/kg and the farmer's share at 84.13%, making it the pattern with the highest marketing margin. Meanwhile, in Pattern IV, the marketing margin is Rp1,333/kg, with the collector's profit at Rp39/kg and the farmer's share at 90.66%.

From a scientific perspective, this study contributes by integrating product, information, and financial flows, as well as the distribution of marketing margins, into a single regional-level study of the rubber supply chain. The findings of this study enrich the literature on the rubber supply chain, particularly by explaining the relationship between supply chain mechanisms and the distribution of economic benefits among stakeholders.

From a practical perspective, the findings of this study can serve as a basis for farmers, marketers, and local governments in formulating strategies to improve supply chain efficiency. Efforts such as expanding farmers' access to markets or processing plants, increasing price transparency, improving coordination among stakeholders, and reducing distribution costs are expected to increase the share of the price received by farmers, strengthen the competitiveness of the rubber commodity, and support the sustainability of the supply chain in Tuah Negeri Subdistrict.

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