



ANALYSIS OF RICE SUPPLY CHAIN STRUCTURE AND DISTRIBUTION EFFICIENCY IN TANAH LAUT REGENCY TO SUPPORT FOOD SECURITY

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ABSTRACT

This study analyzes the rice supply chain in Tanah Laut Regency, South Kalimantan, to support regional food security. While extensive agricultural supply chain research focuses on major production hubs in Java, empirical evidence from outer-island regional frameworks remains critically understudied. This research employs a qualitative descriptive approach to map and evaluate the multidirectional flows of products, finances, and information. Data collection was conducted from September to October 2025 across several key rice-producing areas within the regency. Utilizing a snowball sampling technique, 20 key stakeholders were interviewed, including rice farmers, collectors, large-scale agents, and traditional retailers. Source triangulation and cross-validation among entities were utilized to ensure empirical data validity and methodological rigor. The findings indicate that the regional rice supply chain is predominantly conventional, fragmented, and lacks full integration, operating through three distinct distribution channels dominated by intermediary collectors. The mapping of the bidirectional flows uncovers critical operational bottlenecks, specifically high logistical risks of post-harvest quality degradation, severe price information asymmetry, and an uneven distribution of profit margins that disadvantages smallholder farmers. Consequently, the overall efficiency of the distribution network remains low, creating localized price fluctuations and supply vulnerabilities that threaten regional food security. To mitigate these systemic inefficiencies, this study recommends targeted strategic interventions, including the institutional strengthening of farmer cooperatives to improve collective bargaining power, the deployment of transparent digital information platforms to eliminate price manipulation, and public capital investments in localized post-harvest facilities.

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INTRODUCTION

Rice is a staple food and the primary source of carbohydrates for many Indonesians. Rice availability is not only related to consumption but is also closely linked to social, economic, and political stability. Therefore, the management of the rice production and distribution system must be optimized to ensure sustainable food security. Tanah Laut Regency, as one of the rice-producing regions in South Kalimantan, has significant potential to support regional food security. However, this potential has not yet been fully matched by an efficient supply chain system.

In practice, the rice supply chain in this region is still dominated by traditional distribution patterns. Farmers generally sell their harvest in the form of paddy to collectors, who then distribute it to various other entities such as agents and retailers before it finally reaches consumers. Agricultural supply chains are essential for ensuring the efficient distribution of agricultural products from producers to consumers (Wang et al., 2024). The integration of digital technologies improves transparency and traceability in agricultural supply chains (Sathiya et al., 2024). This situation results in a lengthy distribution chain and has the potential to cause inefficiencies. Additionally, limited access to price and market information often places farmers at a disadvantage. Resilient supply chains contribute significantly to strengthening food security during disruptions and crises (Harris et al., 2024).

Extensive research has been conducted on rice supply chains in Indonesia; however, the existing literature is heavily skewed toward major production regions in Java, which typically exhibit mature logistical infrastructure, structured institutional mechanisms, or complex price transmission integrations (Saragih et al., 2017; Sima & Simamora, 2023; Supartiningrum et al., 2025). Conversely, empirical evidence regarding ex-Java rice-producing regions such as Tanah Laut Regency in South Kalimantan remains critical yet understudied. Outer-island supply chains face fundamentally different constraints, including distinct off-Java transport logistics, localized agroclimatic vulnerabilities, and deeply entrenched informal socio-economic dependencies. Furthermore, while contemporary global literature aggressively champions digital transformation and smart agri-food supply chains (Wang et al., 2024; Yu et al., 2025), a significant knowledge gap exists in understanding how these idealized digital expectations clash with the granular, traditional realities of sub-regional food security hubs that still rely entirely on multi-tiered middleman networks.

To address this gap, this study provides a comprehensive, localized empirical mapping of the rice supply chain in Tanah Laut Regency. The novelty of this study lies in its holistic and simultaneous analysis of the bidirectional flows—product, finance, and information—within a traditional outer-island distribution framework, explicitly capturing how localized price asymmetry and informal middleman dominance actively bottleneck regional food security initiatives. By documenting these empirical bottlenecks, this study bridges the theoretical promises of modern supply chain management with the practical, baseline socio-economic challenges of decentralized agricultural networks, offering targeted insights for sustainable food security policy in developing regions.

LITERATURE REVIEW

Supply chain management is a systematic approach used to manage the integrated flow of goods, information, and finances from upstream to downstream. According to Chopra and Meindl (2019), the supply chain encompasses all parties involved, directly or indirectly, in meeting consumer needs, from raw material suppliers to end consumers. This approach emphasizes the importance of coordination among stakeholders to achieve operational efficiency and increased value added. Recent studies highlight that modern supply chain management also emphasizes resilience, sustainability, and digital integration to improve overall supply chain performance in uncertain environments (Amentae & Gebresenbet, 2021; Wang et al., 2025). Supply chain integration enhances coordination, information sharing, and operational efficiency among stakeholders, thereby improving overall supply chain performance (Singh & Dey, 2023).

In line with this, Heizer et al. (2017) explain that the primary objective of supply chain management is to maximize the total value generated, that is, the difference between the product's value to the customer and the costs incurred to produce and distribute it. In the agricultural context, the implementation of supply chain management faces more complex challenges due to the perishable nature of products, their seasonal dependence, and the involvement of many small-scale entities.

The supply chain for agricultural products, particularly rice, has a relatively long structure and involves various entities such as farmers, collectors, mills, wholesalers, and retailers. Pujawan and Mahendrawathi (2017) states that the length of the distribution chain can lead to price distortions and unequal distribution of profits among stakeholders. This situation often disadvantages farmers as the primary producers. Strengthening farmer organizations and collective marketing can improve farmers' bargaining power and increase their share of supply chain value (Bekolli et al., 2025). Digital technologies and integrated information systems can improve transparency, coordination, and market access among agricultural supply chain actors, thereby enhancing efficiency and reducing transaction costs (Rejeb et al., 2022; Sharma et al., 2022). Market information systems help reduce information asymmetry by providing farmers with timely data on prices, demand, and market opportunities (Singh & Dey, 2023). Digital platforms facilitate direct market access and strengthen linkages between farmers, traders, and consumers (Wang & Gao, 2024).

Additionally, Saptana and Daryanto (2019) point out that the main weaknesses in Indonesia's agricultural supply chain lie in low integration among stakeholders, a lack of information transparency, and limited supporting infrastructure. This results in an inefficient distribution system that is vulnerable to price fluctuations. The adoption of technologies such as IoT, blockchain, and big data analytics has been shown to strengthen supply chain resilience and support food security through improved traceability and decision-making processes (Wang et al., 2024; Rahman et al., 2025). Therefore, improvement efforts are needed through institutional strengthening, improved access to information, and the utilization of technology to support a more

modern and efficient supply chain system. Efficient agricultural logistics, including transportation, storage, and distribution systems, plays an important role in maintaining product quality and reducing post-harvest losses (Perdana et al., 2022).

MATERIALS AND METHODS

This study employs a qualitative descriptive approach aimed at obtaining a comprehensive overview of the rice supply chain system in Tanah Laut Regency. This approach was chosen because it can explain the relationships among entities as well as the dynamics of product, information, and financial flows in a contextual and in-depth manner. The fieldwork and data collection were carried out over a two-month period, from September to October 2025, in several key rice-producing areas within the regency, including Desa Ujung Batu 1, Desa Pulau Sari, and Desa Gunung Melati. The data used consists of primary and secondary data. Primary data was obtained through direct, semi-structured interviews and field observations conducted to directly observe distribution activities and post-harvest conditions. Secondary data was obtained from scientific literature, institutional reports, and references related to agro-industrial supply chains.

To participate in this study, respondents had to meet the specific selection criteria of being actively involved as direct actors within the local rice supply chain network. A total of 20 key informants were selected and interviewed, comprising four distinct respondent categories: rice farmers (6 respondents), collectors/middlemen (5 respondents), large-scale agents (1 respondent), and traditional retailers (8 respondents). Respondents were selected using the snowball sampling technique, a non-probability sampling method where initial informants provide recommendations to identify subsequent participants (Naderifar et al., 2017). This technique is highly effective when the population network is informal and difficult to identify precisely. In practice, the snowball sampling was implemented by first establishing contact with key informants at the upstream level, namely the rice farmers in the designated villages. Following the initial interviews regarding their production and sales channels, these farmers provided direct referrals to the specific local collectors who routinely purchased their harvest. The researchers then followed this chain downstream, interviewing the referred collectors, who subsequently directed the researchers to their partner agents and retailers, thereby mapping the entire interconnected supply chain network.

To ensure data validity and methodological rigor, this study utilized source triangulation and cross-validation among the different stakeholders. Information regarding transaction flows, pricing mechanisms, and logistical constraints gathered from the farmers was systematically cross-checked and verified against the accounts provided by their corresponding collectors, agents, and retailers. This explicit triangulation process minimized response bias, resolved discrepancies in price-setting reporting, and ensured a highly reliable depiction of the supply chain dynamics. The data analysis process was conducted through three main stages: data reduction, data presentation, and drawing conclusions. Data reduction involved filtering out key information, while data presentation was done in the form of narratives, tables, and diagrams to facilitate interpretation. To clarify the research stages, Figure 1 is a flowchart of the research process.

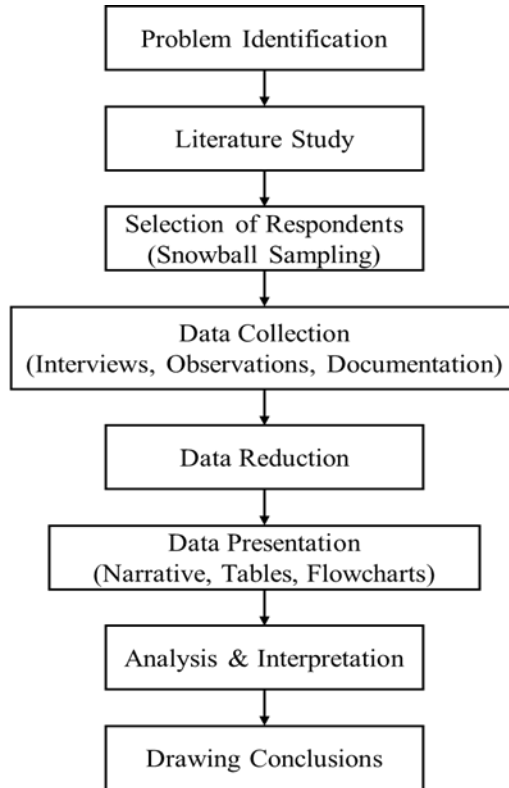


Figure 1. Research methodology

The diagram shows that the research was conducted systematically, from problem identification to concluding, with an emphasis on data validity through methodological triangulation.

RESULT AND DISCUSSION

The research findings indicate that the rice supply chain system in Tanah Laut Regency remains conventional and has not yet been fully integrated. The supply chain structure involves several key players who play different roles in product distribution.

Structure of The Supply Chain

The structure of the rice supply chain can be described in Figure 2.

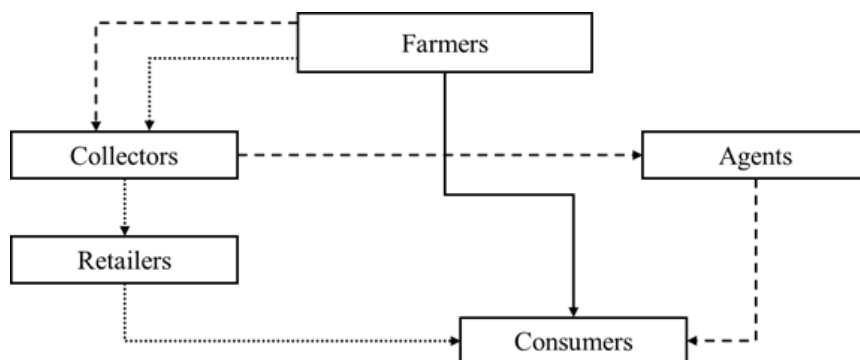


Figure 2. Rice supply chain structure in Tanah Laut Regency

Description:

- : Supply Chain Channel 1 (Rice supply from farmers direct to consumers)
- - - - -→ : Supply Chain Channel 2 (Rice supply chain from farmers to collectors, collectors to agents, then agents to consumers)
- - - - -→ : Supply Chain Channel 3 (Rice supply chain from farmers to collectors, collectors to retailers, then retailers to consumers)

However, in practice, there are variations in distribution channels, such as direct sales from farmers to consumers or through retailers without going through agents. Nevertheless, the most dominant channel remains through middlemen. The diagram shows that the longer the distribution chain, the more parties are involved, which leads to increased distribution costs and a potential decline in product quality.

Analysis of the Role of Each Entity in the Supply Chain

To provide a more systematic overview, the roles of each entity in the supply chain are presented in the following Table 1.

Table 1. Roles and challenges of supply chain entities in the rice supply chain in Tanah Laut Regency

Entity	Main Role	Challenges
Farmers	Producing paddy/rice	Limited market access, weak bargaining power
Collectors	Collecting and distributing the harvest	Price control, farmers' dependence
Agents	Distribute in large quantities	Depending on the supply from collectors
Retailers	Selling directly to consumers	Limited profit margins
Consumers	End users	Prices are volatile

The structural mapping in Table 1 reveals that middlemen (collectors) occupy a highly strategic yet disproportionately dominant position in the supply chain, acting as the primary link between farmers and the market. This structural asymmetry leads to an uneven distribution of profits, where farmers—despite bearing the highest

production risks—receive a smaller economic share.

This structural rigidity mirrors the findings in Lumajang, which highlight that rice supply chains are heavily dictated by informal mechanisms and a high dependency of farmers on collectors for capital, suppressing the farmers' real economic gains despite their high nominal value-added contribution. Conversely, this situation contrasts sharply with the rice supply chain in Cianjur, where farmers exhibit a stronger bargaining position because they possess diverse alternative sales channels and are less reliant on a single middleman structure. The lack of marketing alternatives in Tanah Laut forces farmers into a submissive price-taking position, reinforcing the collector's capacity for price control.

Analysis of Product, Information, and Financial Flows in the Rice Supply Chain

The operational performance of the agricultural supply chain is fundamentally driven by the interaction of three primary flows, namely the flow of products, the flow of finances, and the flow of information, as systematically schematized in Figure 3. The integration and velocity of these three distinct flows serve as the primary determinants of the overall efficiency of the regional rice distribution network.

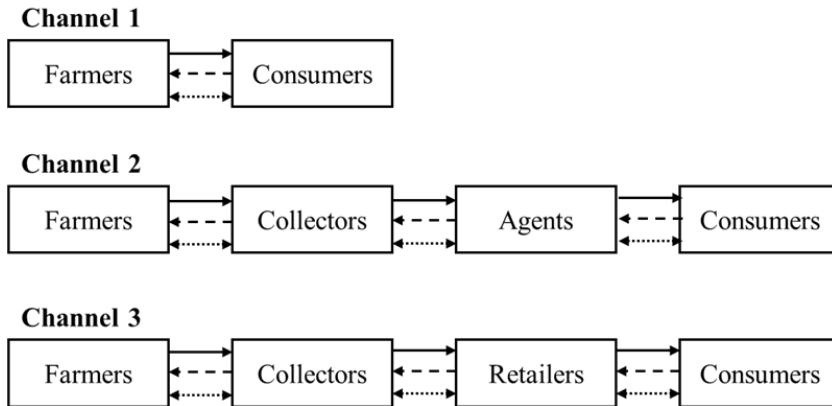
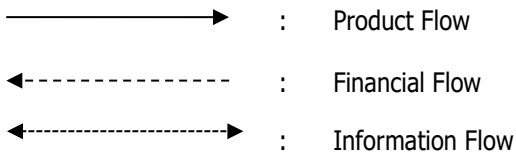


Figure 3. Flowcharts of product flow, financial flow, and information flow for the rice supply chain in Tanah Laut Regency



The spatial trajectory of these flows indicates that while the product flow moves progressively from upstream agricultural producers to downstream urban consumers, the financial flow conversely moves in reverse, originating from consumer expenditures and traveling back to the farm gate. Simultaneously, the information flow is theoretically bidirectional, moving continuously between both ends of the chain. However, the empirical mapping uncovers severe operational bottlenecks across these channels. The product flow is continually hindered by lengthy logistical nodes that escalate transaction costs and exacerbate the risk of physical commodity damage. The

financial flow is disrupted by margin hoarding at the intermediary levels, while the information flow suffers from severe price asymmetry.

This friction within the three-flow matrix aligns closely with observations from the rice supply chain in Tebing Tinggi, where communication gaps and logistical fragmentation between processing nodes routinely triggered supply mismatches, causing severe vulnerabilities such as localized stock uncertainties and artificial gluts. In Tanah Laut, the bidirectional flow of information fails to achieve functional transparency because intermediary collectors intercept and filter market data, preventing farmers from aligning their harvesting schedules and pricing strategies with actual market demands.

Analytical Discussion of Supply Chain Efficiency

Based on the synthesis of the empirical evidence, the overall efficiency of the rice supply chain in Tanah Laut Regency remains critically low. To transition from a purely descriptive account to a rigorous analytical evaluation, this systemic inefficiency is examined through three interrelated dimensions: its macroeconomic consequences, its direct impact on smallholder income, and its broader implications for regional food security.

Economic Consequences of Long Marketing Channels

The proliferation of intermediary nodes across Supply Chain Channels 2 and 3 introduces significant economic drag into the regional agricultural market. Long marketing channels inherently accumulate compounding transaction and logistics costs at each sequential stage without imparting any structural or intrinsic value to the underlying commodity. From an economic perspective, this operational lengthening distorts vertical market integration. As demonstrated by empirical analyses of the Cianjur rice supply chain using vector autoregression and vector error correction models (VAR/VECM), an over-concentration of intermediary actors like local tengkulak severely compromises price transmission mechanisms. When price shocks occur at major downstream wholesale markets, these extended channels delay or entirely dilute the transmission of those price signals back to the farm gate. Consequently, urban consumers are penalized by inflated retail prices driven by stacked intermediary margins, while upstream farmers remain completely isolated from positive market incentives, culminating in severe allocative inefficiency across the regional economy.

Impacts on Farmer Income and Welfare

The structural deficiencies embedded within the supply chain act as a direct mechanism for depressing farmer income and undermining rural welfare. This economic suppression operates through the twin pressures of constrained bargaining power and high post-harvest losses. Because collectors dominate both credit provisioning and product assembly, they possess the unilateral leverage to dictate paddy purchasing prices. This pattern of economic subjugation is highly consistent with findings from Lumajang, which demonstrate that informal credit arrangements legally or socially lock smallholders into restrictive agreements with specific collectors, thereby eliminating competitive bidding behaviors at the farm gate. Furthermore, the acute

shortage of modern, localized post-harvest infrastructure, such as mechanical grain dryers and climate-controlled storage facilities within Tanah Laut, deprives farmers of temporal flexibility. They are forced to immediately liquidate their harvest, even during seasonal price troughs, to avoid rapid quality degradation. This field reality substantiates the evidence from Tebing Tinggi, which emphasizes that strategic investments in post-harvest processing infrastructure at the milling level are vital to mitigate quality-driven value losses and protect primary producer revenues.

Implications for Regional Food Security

On a macro-analytical scale, an inefficient and fragmented rice supply chain presents a structural threat to regional food security, specifically jeopardizing price stability and supply continuity. The operational bottlenecks and information blockages identified in Figure 3 create highly volatile local market conditions. When product and information flows are distorted by intermediary dominance, it induces an artificial instability in supply availability. This mirrors the specific vulnerabilities observed in Tebing Tinggi, where poor supply chain integration frequently caused extreme market fluctuations, manifesting either as sudden artificial scarcities or severe localized supply gluts. Furthermore, contemporary consumer paradigms are rapidly shifting toward health-conscious lifestyles and premium agro-commodities, as documented in the organic rice supply chain frameworks of West Java. These evolving consumer preferences demand supply chains that are highly responsive, traceable, and agile. A conventional and sluggish supply chain like the one operating in Tanah Laut cannot adapt to these shifting demand curves, and a failure to modernize this network will ultimately result in structural food insecurity, where local production fails to meet modern urban consumption requirements, prompting localized price spikes that penalize vulnerable populations.

Strategic Framework for Supply Chain Optimization

To resolve these interconnected systemic inefficiencies, Tanah Laut Regency must actively transition from its current conventional, fragmented setup toward a modern, integrated supply chain framework. This transition requires a coordinated execution of institutional, digital, and physical interventions. First, institutional strengthening through the establishment and capacity building of farmer cooperatives is imperative to bypass redundant middleman nodes and aggregate smallholder supply, a strategy strongly advocated in both the Lumajang and Cianjur contexts to grant farmers direct market access to large-scale agents or retailers. Second, the deployment of digital marketing and agricultural information systems is essential to dismantle price asymmetries, ensuring that real-time market insights reach the farm gate while simultaneously introducing transparent value chain financing alternatives to dismantle the cycle of informal middleman dependency. Finally, targeted capital investments in modern post-harvest infrastructure, specifically mechanical drying units and standardized warehouse facilities at the village cooperative level, are mandatory to stabilize grain quality and facilitate strategic inventory management, thereby neutralizing seasonal supply shocks and safeguarding the regional food grid.

CONCLUSION

Based on the research findings, it can be concluded that the rice supply chain in

Tanah Laut Regency involves several key actors, namely farmers, collectors, agents, retailers, and consumers. The supply chain is still characterized by a conventional, fragmented structure with low operational and economic efficiency. The disproportionate dominance of intermediary collectors creates severe price asymmetries and structural credit dependencies that suppress smallholder farm-gate prices while inflating retail costs for end-users. This systemic lack of integration not only generates allocative inefficiencies within the regional agricultural economy but also poses a critical threat to long-term regional food security due to market supply volatility and a sluggish response to modern consumer demand shifts. To mitigate these deeply entrenched issues, a coordinated transition toward an integrated supply chain model is mandatory, specifically through the institutional empowerment of farmer cooperatives, the deployment of transparent digital information systems, and targeted capital investments in localized post-harvest infrastructure.

Despite these critical insights, several limitations of this research must be acknowledged. First, this study primarily utilizes cross-sectional data collected within a specific timeframe, which may not fully capture the temporal and seasonal fluctuations in price transmission, production yields, or shifting actor behaviors across different annual harvesting and planting cycles. Second, the geographical focus is strictly confined to Tanah Laut Regency, thereby limiting the direct generalizability of these findings to other regions in Indonesia that may operate under different institutional configurations, infrastructural availability, or market dynamics. Methodologically, while the qualitative and structural mapping of the product, financial, and information flows provides a robust foundational diagnostic, this study lacks highly granular quantitative modeling to measure the exact technical efficiency scores of individual supply chain nodes or the precise mathematical speed of vertical price transmissions.

Based on these identified boundaries, several strategic pathways for future research are highly recommended. Future studies should adopt a longitudinal research design to comprehensively track the dynamic evolution of agricultural supply chains across multiple consecutive years and shifting macroeconomic conditions. Researchers are also encouraged to expand the geographic scope by conducting multi-regional comparative analyses, which would help identify how different regional policies and physical infrastructure levels influence supply chain efficiency.

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DISCLOSURE STATEMENT

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