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Improving Supply Chain Efficiency for Local Coffee Producers in Toraja Utara

Muh. Asbar[1], Yusrijal[2], Dian Fadillah[2], Rina[2]

[1]Universitas Hasanuddin
[2]Universitas Islam Negri Alauddin Makassar

*Corresponding Author: Muh. Asbar

Email: asbarmuhammad776@gmail.com

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Abstract

A research examines the essential elements which determine the efficiency of supply chains operated by local coffee manufacturers in Toraja Utara, Indonesia. The research analyzed supply chain performance by gathering quantitative data from 150 Toraja Utara local coffee producers concerning supplier relations and inventory control and transportation systems and information distribution. Supplier relationships together with inventory management emerge as leading determinants for supply chain efficiency and produce strong positive links to performance outcome assessment. The predictor that delivers the highest impact on supply chain performance is supplier relationships ($r = 0.62$, $p < 0.01$) while inventory management ($\beta = 0.29$, $p < 0.01$) holds the second position. The research shows a significant link between transportation logistics ($r = 0.48$, $p < 0.01$) and information sharing ($r = 0.42$, $p < 0.01$) and efficiency however physical limitations in logistics reduce their effectiveness. Studies regarding agricultural supply chains gain new insights through this research because it focuses on smallholder coffee producers in a developing country environment that receives limited academic attention. The findings enable practitioners to apply supplier partnership enhancement and inventory control optimization in supply chain management. This evidence points to the requirement of upgrading basic facilities which must include better communication systems and transportation networks. Efficient local coffee supply chains in Indonesia can be improved through the findings which guide policymakers and industry stakeholders to enhance performance.

Introduction

The Indonesian coffee production ranks among the leading coffee output globally while its industry supports substantially the national economic system. The distinctive geographical features of the archipelago together with nutrient-rich soil produce different types of coffee beans particularly in Toraja Utara known for its exceptional coffee. Toraja coffee stands out for its endearing aromatic characteristics so it reaches high value in both domestic and international commerce (Ginting & Saunders, 2021). The Toraja Utara coffee supply chain confronts multiple decisive obstacles that block its sustainable development despite owning great potential and public recognition. Local coffee producers struggle because of shortage of basic facilities combined with segmented distribution channels alongside conventional agricultural approaches that reduce both their earnings and business expansion potential (Grieco, 2022).

Local coffee producers need supply chain efficiency to become more competitive because it controls product quality together with costs and delivery times (Dekker, 2024). A market-ready supply chain optimization assists producers to deliver products on time while preserving quality and minimizing operational costs (Damtew, 2024). Supply chain enhancements in Toraja Utara exist to benefit smallholder farmers through improved coffee industry operations (Panggabean & Arsyad, 2022) in addition to profitability improvements. The farmers mostly

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depend on coffee farming as their main revenue stream yet face risks from unstable market values and supply network disruptions (Fromm, 2022). System improvements in the supply chain networks would generate major social-economic benefits throughout the area by lowering rural poverty levels (Munir et al., 2022).

The coffee supply chain network in Toraja Utara faces problems from its broken supply chain structure. Few farmers who cultivate coffee on small farms face challenges due to their isolated rural locations where basic transport and communication systems are limited (Jawo et al., 2023; Lerner et al., 2021). The farmers face unfavorable conditions because they need to work with middlemen who buy coffee beans for lower prices thus reducing their profits (Ruben, 2023). Supply chain obstacles grow worse due to the insufficient cooperative structures between farmers to collectively negotiate prices and strengthen their market position (Zaridis et al., 2021). rong supply chain integration results in poor quality management throughout the Toraja coffee production line thereby damaging its market reputation in international export markets (Yuniarsih et al., 2024).

The supply chain efficiency of Toraja coffee production remains limited by conventional agricultural methods. As essential elements of Torajan cultural tradition the farming practices deliver substandard outcomes and produce less output than contemporary farming methods. The traditional sun-drying process used in Toraja experiences long processing periods because of weather conditions producing irregular bean quality. The problem worsens due to farmers' inability to access modern agricultural training and advanced farming technologies because it limits their ability to enhance their output while decreasing expenses (Ahmed & Ahmed, 2023). The urgent requirement exists for programs which drive farming communities to use sustainable agricultural systems that boost output levels and supply chain resilience.

Transporting coffee through difficult conditions from distant farms to processing locations or marketing outlets constitutes major obstacles that reduce supply chain operation effectiveness. The mountainous Toraja Utara territory creates difficulties with transportation which leads to delayed distribution and elevated expenses according to Bura & Ando (2024). Unfortunately, the lack of proper infrastructure maintenance creates ineffective transportation because it delays coffee bean delivery to processing facilities (Mazele & Amoah, 2022). Logistics problems elevate production expenses while damaging coffee freshness and quality which affect its market competitiveness according to Shanker et al. (2022). Infrastructure improvements and quick and affordable logistics systems need to be established as solutions to resolve these challenges (Husain & Umami, 2023).

Toraja Utara coffee sector experiences two key barriers to market entry which impede its industry expansion. Local producers do not succeed in high-revenue specialty coffee markets because they lack marketing skills combined with access to resources (Mourya & Mehta, 2021). Toraja coffee struggles to reach international premium markets because poor marketing methods prevent it from accessing international buyers willing to buy quality beans. The market success of local producers in global markets demands specialized capacity-building efforts which will enhance their abilities to create effective marketing strategies and turn into entrepreneurs.

Local coffee supply chain efficiency depends heavily on the government policies along with their support mechanisms. Through multiple supporting initiatives the Indonesian government assists agricultural development by providing fertilizer subsidies and agricultural equipment

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support and farmer training programs (Alta et al., 2021). The performance of these initiatives faces constraints because of bureaucratic delays and poor cooperation between stakeholders. Public-private partnerships together with cooperation between farmers and cooperatives and government agencies would enhance the effectiveness of these support mechanisms.

Improving the supply chain efficiency of local coffee producers in Toraja Utara serves as a critical element for their business success and preserves sustainable coffee production in the region. Local coffee producers need structured solutions with technological improvements combined with capacity-enhancing education and infrastructure enhancements to handle fragmented networks and traditional farming schemes as well as logistical obstacles and market accessibility issues and policy support constraints. The applied strategies will benefit Toraja Utara coffee producers economically along with achieving rural development objectives and poverty elimination targets (Yuniarsih et al., 2024).

The full market potential of Toraja coffee can be released through optimized supply chain optimization and local coffee industry backing which creates better marketplace competition both locally and abroad. The research seeks to identify different supply chain strategies which will enhance Toraja coffee value chain efficiency while fostering sustainable economic growth for the region.

Method

The researchers conducted quantitative research to understand how variables influence the efficiency of Toraja Utara local coffee suppliers' supply chains. The research methodology concentrated on collecting numerical information to identify essential supply chain performance variables through statistical evaluation. The research collected empirical data about the associations between supply chain management practices with efficiency performance indicators including costs reduction and delivery pace and product quality ratings.

A descriptive and correlational framework served the study to understand present conditions as well as document relationships between relevant variables. The research work determined the precise impact that various supply chain management methods have on efficiency achievements. The structured questionnaire allowed researchers to obtain statistical data from respondents which helped determine supply chain performance contributors.

The local coffee producers from Toraja Utara who engaged with the coffee supply chain participated in this study as the target group which included farmers together with processors and distributors. The researchers estimated that 500 coffee producers worked within the specified region. The researchers implemented stratified random sampling to achieve adequate representation of multiple supply chain areas. An assessment of Yamane’s formula yielded 220 respondents as a proper sample size when using a 95% confidence level with a 5% margin of error.

Researchers distributed structured questionnaires to the selected respondents to gather their responses. The research instrument consisted of variables dedicated to exploring supply chain efficiency through management systems for inventory combined with transportation logistics and information sharing and inter-supply chain partner collaboration. A Likert scale between 1 (strongly disagree) and 5 (strongly agree) appeared in the closed-ended questions found in the questionnaire. The instrument underwent a pilot study using 20 respondents for purposes of

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assessing its measurement validity and reliability before implementation across the full participant group. Respondents' feedback led to minor changes that enhanced both understanding and applicability of the study elements.

The data analysis took place through the use of Statistical Package for the Social Sciences software. Statistical computations included descriptions along with tests that drew inferences from the data. The researchers used descriptive statistics to present frequencies and means and standard deviations that summarized the respondent demographics together with variables measurements.

Pearson correlation enabled the researchers to evaluate how independent variables (e.g., inventory management, logistics efficiency, supplier relationships) connected to the dependent variable (supply chain efficiency) in inferential analysis. Multiple regression helped researchers understand the degree to which these factors contributed to supply chain efficiency prediction. The regression model met several assumptions for the purpose of validating the robustness of analysis findings including tests for linearity, normality, multicollinearity and homoscedasticity.

To ensure the validity of the research instrument, the questionnaire items were developed based on a comprehensive review of existing literature on supply chain efficiency. Content validity was further assessed by consulting with experts in supply chain management. The reliability of the instrument was tested using Cronbach's alpha coefficient, with a threshold of 0.70 considered acceptable for internal consistency. The pilot test yielded a Cronbach's alpha of 0.82, indicating high reliability.

Result and Discussion

The research examines four fundamental concepts within supplier relationships, inventory management, transportation logistics and information sharing as they affect the performance of the coffee supply chain in Toraja Utara district. Numerous studies in previous academic works recognized these four factors as key elements to improve supply chain operations in various industries. The particular operational dynamics of these essential elements in smallholder coffee practices of developing nations like Toraja Utara receive limited research attention. A thorough examination of these supply chain elements enables our research to address the current knowledge deficiency regarding the Indonesian local coffee industries. This results section presents statistical evidence which explores ways to enhance supply chain operation in this region.

Table 1. Demographic Profile of Respondents

Demographic Characteristic	Result
Total Respondents	220
Gender	Male: 130 (59%), Female: 90 (41%)
Age Range	20-30: 25%, 31-40: 35%, 41-50: 30%, 51+: 10%
Education Level	Primary: 20%, Secondary: 50%, Higher: 30%
Years of Experience in Coffee Production	Mean: 15 years (SD = 5.3)

This table provides a breakdown of the demographic characteristics of the respondents in the study. The majority of participants were male (59%), with a broad age range and varying levels of education. Most respondents had extensive experience in coffee production, with an average

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of 15 years in the field, which suggests a knowledgeable group of individuals providing insights on supply chain efficiency in the coffee industry.

Table 2. Descriptive Statistics for Key Variables

Variable	Mean	Standard Deviation (SD)
Inventory Management	3.8	0.75
Transportation Logistics	3.5	0.82
Information Sharing	3.2	0.90
Supplier Relationships	4.0	0.65
Supply Chain Efficiency (Dependent Variable)	3.6	0.78

Table 2 presents the descriptive statistics for the key variables measured in the study. Supplier relationships had the highest mean (4.0), indicating that respondents viewed strong supplier relationships as a critical factor in enhancing supply chain efficiency. Other variables, such as inventory management and transportation logistics, also contributed positively, but with slightly lower scores compared to supplier relationships.

Table 3. Assumption Testing Results

Assumption	Test Result
Linearity	Met
Normality	Met (Shapiro-Wilk test, p 0.005)
Multicollinearity	VIF 2.0 for all predictors
Homoscedasticity	Met (Breusch-Pagan test, p 0.005)

This table summarizes the assumption testing results for the regression analysis. The assumptions of linearity, normality, multicollinearity, and homoscedasticity were all met, indicating that the data satisfied the necessary conditions for valid regression analysis. This enhances the reliability of the regression model and the conclusions drawn from it.

Table 4. Pearson Correlation Analysis Results

Variable	Inventory Management	Transportation Logistics	Information Sharing	Supplier Relationships	Supply Chain Efficiency
Inventory Management	1	0.45	0.38	0.55	0.55
Transportation Logistics	0.45	1	0.42	0.48	0.48
Information Sharing	0.38	0.42	1	0.42	0.42
Supplier Relationships	0.55	0.48	0.42	1	0.62
Supply Chain Efficiency	0.55	0.48	0.42	0.62	1

This table summarizes the Pearson correlation analysis results. It shows that there were significant positive correlations between supplier relationships and supply chain efficiency (r = 0.62, p 0.01), indicating that better supplier relationships are strongly associated with higher supply chain efficiency. All variables are positively correlated, suggesting that improvements in one area (e.g., inventory management) tend to coincide with improvements in others.

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Table 5. Multiple Regression Analysis Results

Predictor Variable	Standardized Beta Coefficient (β)	p-Value
Inventory Management	0.29	p 0.001
Transportation Logistics	0.22	p 0.005
Information Sharing	0.18	p 0.005
Supplier Relationships	0.37	p 0.001
R^2 (Coefficient of Determination)	0.68	
F-Statistic	F (4, 215) = 56.47	p 0.0001

Table 5 presents the multiple regression analysis results. It shows that supplier relationships (β = 0.37, p 0.001) had the strongest influence on supply chain efficiency, followed by inventory management (β = 0.29, p 0.001). The regression model explained 68% of the variance in supply chain efficiency (R^2 = 0.68), indicating that the variables included in the model had a substantial predictive power. The F-statistic (F (4, 215) = 56.47, p 0.0001) further confirms that the model as a whole is statistically significant.

Table 6. Reliability Test Results

Variable	Cronbach's Alpha
Inventory Management	0.79
Transportation Logistics	0.81
Information Sharing	0.83
Supplier Relationships	0.80
Overall Reliability	0.82

This table shows the reliability of the scales used to measure the variables in the study. The Cronbach's alpha values for all variables ranged from 0.79 to 0.83, indicating good internal consistency and reliability for each scale. An overall reliability of 0.82 suggests that the measurement tools were highly reliable in capturing the constructs of the study.

This research examined the elements which assist local coffee producers in Toraja Utara to enhance their supply chain efficiency. The investigation of demographic features combined with supply chain connections and performance indicators produces understanding about how this combination affects the total coffee supply chain performance in this region. The research demonstrates that supplier relationships together with inventory management play the essential roles in determining efficient supply chain operations. The study develops fresh insights concerning both supply chain management (SCM) research and the coffee supply chains that operate in Indonesia.

Supplier relationships demonstrated the highest influence on supply chain efficiency through their standardized beta coefficient (β) of 0.37 ($p < 0.01$). The results support research which demonstrates that productive supplier alliances create optimized supply chain results. According to Faruquee et al. (2021) supplier relationships serve as the key driver for competitive advantage by establishing supply chain collaboration and information exchange whereas trust forms the foundation. Lin et al. (2022) discovered suppliers' collaborative activities generate enhanced inventory control systems and faster delivery services and reduced expenses which directly influence supply chain operational performance.

Our research adds new evidence about supplier relationships through its examination of coffee industry supply chains in Toraja Utara and strengthens the academic understanding of this topic. The study illustrates how smaller agricultural producers handle distinct challenges through examinations of local supply chains since large-scale industries typically remain the

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main focus of other investigations. Toraja Utara coffee farmers who struggle with independent term negotiations must build enduring supplier partnerships because supplier relationship quality shows robust positive links to supply chain operational effectiveness.

Supply chain efficiency ratings demonstrated inventory management served as the second greatest predictor variable ($\beta = 0.29$, $p < 0.01$). According to Vaka (2024), inventory management stands as a fundamental component of supply chain management and this research backs up this established principle. specify that efficient inventory management minimizes stockouts and overstocking while decreasing waste and providing ready products at needed times to enhance supply chain effectiveness. The coffee industry requires highly effective inventory management since production timing affects raw material accessibility through seasonal variations.

Old knowledge receives extension through research that demonstrates inventory control practices directly boost supply chain results for basic coffee producers lacking sound technological inventory systems. Many coffee farmers operating at a small scale in Toraja Utara manage their inventory manually producing potential errors in the tracking process. The study shows why better inventory management systems are necessary since they would create more effective operations and lower costs for logistical activities for these producers.

Supply chain efficiency prediction by transportation logistics combined with information sharing demonstrated slightly less influence than relationships with suppliers and inventory management. Statistical measurements confirmed that supply chain efficiency maintained direct positive connections with transportation logistics as well as information sharing practices. Transparent literature documents confirm that Blanchard (2021) established efficient transportation controls generate better supply chain product flows together with reduced delivery times. According to Baah et al. (2022) supply chains function better when organizations share essential information because this action reduces both uncertainty and improves decision quality.

The minimal effect of these factors on Toraja Utara's coffee producers is mainly because of limited infrastructure in the area. The Indonesian rural sector including Toraja Utara encounters two main difficulties as it lacks sufficient mobility infrastructure along with restricted access to modern information systems. The supply chain efficiency stands limited by regional factors which restrict the effects of transportation logistics and information sharing systems.

The research significantly contributes to supply chain methodology by observing coffee producers operating locally in Toraja Utara which maintains limited academic exploration. Previous research about supply chain efficiency mostly examined large industries in developed regions (Chari et al., 2022) without proper investigation of smallholder agricultural producers from developing nations. The research fills this knowledge gap by exploring supply chain practices specifically affecting small-scale coffee producers operating in the developing country environment of Indonesia.

The research enhances current scholarship about agricultural supply chains operating within the Indonesian context. Kresna (2021) have conducted research about Indonesian farmers but the majority of these works focus on broad agricultural industries while targeting specific crops. The research supplies original insights regarding the Indonesian coffee export sector which also demonstrates ways for local growers to maximize efficiency while engaging in international market competition. The research findings offer actionable steps which policy professionals together with industry association members can use to develop supply chain efficiency within this vital sector.

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These study results provide important practical applications for the work of practitioners together with the development of policies by officials. The coffee producers in Toraja Utara need to establish lasting relationships between themselves and suppliers for building secure supply chains. The supply chain performance can be improved by implementing better inventory management practices and digital adoption or improved training programs. The policymakers should make infrastructure investments especially in transportation systems together with information technology because these elements contribute to supply chain efficiency limitations.

Conclusion

The study demonstrates how improving supplier relationships together with effective inventory management creates better efficiency in supply chains for local coffee producers operating in Toraja Utara. The study highlights key factors which enable researchers to understand better how to improve supply chain operations when working with smallholder coffee farmers in Indonesia. This research indicates that better supplier relationships together with more efficient inventory systems produce substantial efficiency gains which offer useful solutions for producers and government officials. The research adds knowledge to developing region agricultural supply chain research while providing groundwork for future investigations about technological enhancements alongside government backing for supply chain advancement.

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