

Revealing the Arcs of Integration in the Coffee Supply Chain

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ABSTRACT

The coffee industry plays a vital role in Indonesia's rural economy, engaging millions of smallholder farmers and various downstream actors across the supply chain. However, the level of integration among these stakeholders remains uneven, influencing both efficiency and competitiveness. This study examines the integration levels within the coffee supply chain in Indonesia, utilizing the concept of Arcs of Integration. By analyzing the relationship between stakeholders within the supply chain, we identify five integration categories: inward-facing, periphery-facing, supplier-facing, customer-facing, and outward-facing. Data collected from 192 farmers and 40 downstream stakeholders from four provinces were analyzed using factor analysis, and discriminant analysis was employed to validate the classification of stakeholders based on their level of integration. The results indicate that the majority of stakeholders fall within the periphery-facing category, indicating moderate integration with suppliers and customers. This suggests that stakeholders in the Indonesian coffee supply chain often engage in transactional relationships rather than strategic, long-term collaborations. The study highlights the need for deeper integration among all stakeholders to enhance the efficiency, innovation, and competitiveness of the coffee supply chain, by working more closely together through joint business groups, cooperatives, and partnerships between farmers and lead firms.

Key words: Arcs of integration; coffee; Indonesia; periphery-facing, supply chain integration.

1 INTRODUCTION

As one of the largest coffee producers in the world, Indonesia plays a vital role in the global coffee supply chain. In 2022, Indonesia was the world's fourth-largest coffee exporter, with exports generating over USD 1.14 billion, highlighting the sector's significant contribution to the national economy (UN Comtrade, 2025). Domestically, the coffee sector supports the livelihoods of approximately 1.86 million farmers spread across the archipelago (MoA, 2024). The coffee sector is not only a driver of foreign exchange earnings and rural employment, but also a key contributor to Indonesia's socioeconomic development on both national and international levels (Suryana et al., 2023a).

The complexities of global consumer preferences and the rising demand for premium coffee have made efficiency and integration within the country's coffee supply chain more crucial than ever. The coffee supply chain in Indonesia involves various stakeholders, including farmers, intermediaries, cooperatives, processors, exporters, retailers, and end consumers, domestic and abroad. The complexity of relationships among these stakeholders creates challenges in information flow, logistical coordination, and consistent product quality assurance (Grabs; Ponte, 2019).

One of the main issues faced is the mismatch between the quality specifications desired by end consumers and the products produced by farmers. This gap is often caused by weak coordination and integration among the stakeholders in

the chain (Suryana et al., 2023b). Critical information regarding market preferences and quality standards often fails to reach producers adequately, which affects the competitiveness of Indonesian coffee in the international market. When compared to Vietnam, which—like Indonesia—is one of the world's largest producers of robusta coffee, Indonesia's coffee competitiveness is significantly lower. This is reflected in both productivity and the level of comparative advantage across key product categories, including green beans, roasted coffee, and instant coffee (Suryana et al., 2024).

In supply chain management theory, integration is recognized as a key driver of efficiency, transparency, and competitiveness. The Arcs of Integration framework, developed by Frohlich and Westbrook (2001), classifies integration levels based on the extent to which collaboration extends upstream with suppliers and downstream with customers. While this model has been widely applied across manufacturing and service industries (Bhakoo; Singh; Chia, 2015; Bimpizas-Pinis; Calzolari; Genovese, 2022; Molina-Quintana; Quintana-León, 2021; Wong; Wong; Boon-itt, 2017), its application in the food sector—and particularly in Indonesia's coffee industry—remains limited (Ali et al., 2016). Existing studies on the coffee supply chain (Azis; Irijayanti, 2023; Irijayanti; Mulyono, 2023; Krisnamurthi; Muflikh; Chalil, 2023; Mauladi; Mulyo; Darwanto, 2022; Nuraisyah et al., 2025; Permatasari; Basith; Mulyati, 2018; Umaran et al., 2022) have yet to incorporate this model.

This absence represents a critical knowledge and policy gap. Without an evidence-based understanding of the actual

integration levels in Indonesia's coffee supply chain, efforts to improve coordination risk being temporary and ineffective. Addressing this gap is essential to realigning production with market demands, enhancing operational performance, and securing Indonesia's strategic position in the global coffee trade. This study, therefore, applies the Arcs of Integration framework to assess the degree of stakeholder integration across four coffee-producing provinces in Indonesia, providing actionable insights for building a more integrated and adaptive coffee supply chain system.

2 MATERIAL AND METHODS

Data for this study were collected through a survey conducted in 2023 across four major coffee-producing provinces in Indonesia: Aceh, South Sumatra, West Java, and East Java. These provinces were purposively selected based on their significant roles in national coffee production. In South Sumatra, Pagar Alam City was chosen as the research site due to its position as one of the province's coffee production center and its notably high productivity. In Aceh, the study was conducted in Central Aceh Regency, the leading production area for arabica coffee. In West Java and East Java, Bogor Regency and Malang Regency were selected respectively, as both are prominent centers for robusta coffee production within their provinces. The survey involved 232 stakeholders within the coffee supply chain, including farmers, intermediaries, cooperatives, processors, exporters, roasteries, retailers, and coffee houses. Farmers were selected using purposive sampling, with the criterion that they produce and sell coffee to the processing industry. The types of coffee produced by these farmers included both robusta and arabica. For downstream supply chain stakeholders, a snowball sampling technique was

employed to obtain accurate information regarding the flow and the key stakeholders involved in the supply chain.

To measure the degree of supply chain integration, the Arcs of Integration concept was employed. The Arcs of Integration describe the extent to which each actor in the chain integrates their business activities with other stakeholders in the supply chain (Frohlich; Westbrook, 2001). This integration process is assessed both upstream with suppliers (backward integration) and downstream with customers (forward integration). The arcs are categorized into five levels of integration based on the area depicted in Figure 1. In simple terms, a narrow arc refers to a situation in which stakeholders engage in limited integration, neither with suppliers nor with customers. In contrast, a wide arc signifies a high level of integration, encompassing both upstream and downstream activities.

Frohlich and Westbrook (2001) classify supply chain integration into five levels: (1) Inward-facing, where supply chain members do not or only minimally integrate their activities; (2) Periphery-facing, where stakeholders integrate their activities with either suppliers or customers, but not extensively; (3) Supplier-facing, where stakeholders extensively integrate their activities with suppliers, but to a lesser degree with customers; (4) Customer-facing, where stakeholders extensively integrate their activities with customers, but only slightly with suppliers; and (5) Outward-facing, where stakeholders extensively integrate their activities with both suppliers and customers.

The integrated activities assessed in this study are based on several literature (Frohlich; Westbrook, 2001; Wong; Wong; Boon-itt, 2017), and they include ten activities: sharing information on prices, demand, and market supply, sharing production plans, sharing non-production-related

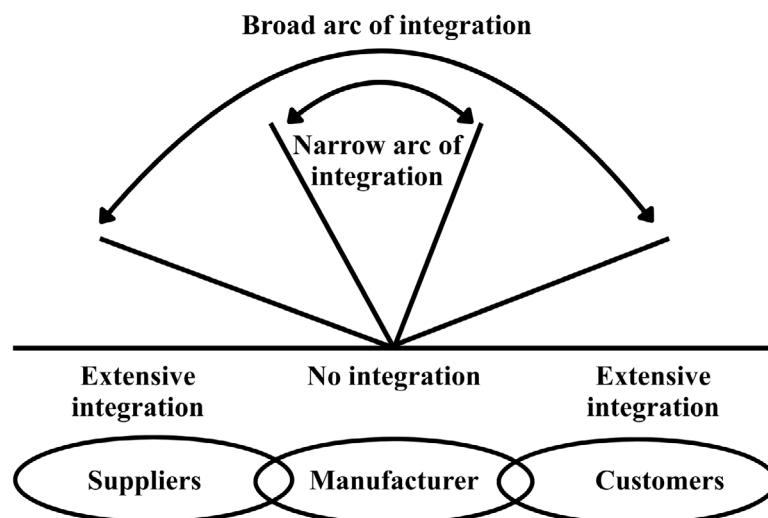


Figure 1: Arcs of integration.

Source: Frohlich dan Westbrook (2001).

plans, sharing information on inventory levels, facilitating transportation or distribution, collaborative problem solving, sharing technology, joint monitoring and adjustment of input or output quality, financial transparency and cost reduction, as well as transferring information and knowledge related to production methods, processing, and product quality. Integration was measured based on ten activities reflecting both upstream (supplier) and downstream (customer) collaboration. Each integration activity was measured using a Likert Scale ranging from 1 (very low integration) to 5 (very high integration). The Likert scores served as input for factor analysis. Factor analysis was employed to measure the degree of integration by generating factor scores that classify supply chain stakeholders into specific quadrants based on their level of integration. Factor analysis is a technique used to reduce a large number of correlated variables into several factors, each representing a particular underlying dimension or concept (Firdaus; Harmini; Farid, 2013). The equation used in this analysis is as follows.

$$Z_i = a_{i1}F_1 + a_{i2}F_2 + \dots + a_{ij}F_j + \dots + a_{iq}F_q + e_i$$

where:

Z_i : Standardized value of the i -th observed variable

i : 1, 2, 3, ..., p

p : Number of observed variables

F_j : j -th common factor

q : Number of factors formed

e_i : Unique factor of the i -th variable

a_{ij} : Factor loading for the i -th observed variable on the j -th factor (i.e., the Pearson correlation between the i -th variable and the j -th factor)

The ten integration indicators were grouped into a single factor based on responses concerning integration with suppliers. Likewise, the same indicators were grouped into a single factor for customer integration. Factor scores were generated using Principal Component Analysis (PCA) with the regression method. These scores represent the weighted average of the original variables, with factor loadings serving as weights. The resulting supplier and customer integration scores were used as the basis for classifying the degree of integration among stakeholders. To ensure the validity and reliability of the dataset, standard validity and reliability tests were conducted. The validity test employed Pearson correlation to measure the relationship between each item and the total score. An item was considered valid if the calculated r value exceeded the critical r value from the table. The reliability test was performed using Cronbach's Alpha coefficient, with a threshold value of 0.70 as the minimum criterion for acceptable instrument reliability. This study's purposive sampling approach may limit the generalizability of the factor and discriminant analysis results, and future research

employing probability-based sampling could strengthen the robustness of the findings.

Furthermore, discriminant analysis was applied to confirm the validity of the factor analysis results. Validity was assessed based on the percentage of correctly classified cases; higher percentages indicate stronger validity in capturing the level of supply chain integration among respondents. The final factor scores were then used to classify each supply chain actor into specific quadrants representing their integration level. This classification followed the quartile approach outlined by Frohlich and Westbrook (2001), dividing stakeholders into the top quartile (75th percentile), median (50th percentile), and bottom quartile (25th percentile). Based on these thresholds, the five categories of integration—inward-facing, periphery-facing, supplier-facing, customer-facing, and outward-facing—were applied to reflect the extent to which each actor integrates their activities with suppliers and customers.

3 RESULTS

Measuring integration within Indonesia's coffee supply chain is crucial for understanding stakeholder connectivity, evaluating performance, and enhancing competitiveness in a dynamic market. Using the arcs of integration framework, factor analysis identified two main dimensions, which are Factor 1 (backward integration) and Factor 2 (forward integration), based on stakeholder responses, with results validated through discriminant analysis. Factor scores, calculated for each respondent, indicate the degree of integration with suppliers or customers, where higher scores reflect stronger integration.

Supplier and customer integration scores were each used to classify stakeholders into upper, middle, or lower quartiles. Their combined positions on Factors 1 and 2 enabled mapping into five levels of supply chain integration in the Indonesian coffee sector. Integration was measured through ten activities (Table 1) typically occurring between producers and their suppliers or customers, with descriptive statistics also presented in Table 1. Before constructing the final scales, data were examined for normality and outliers.

As shown in Table 2, the Kaiser-Meyer-Olkin (KMO) measure for supplier integration was 0.931, while for customer integration it was 0.860. A minimum KMO value of 0.50 is required for the use of factor analysis, and values above 0.80 are considered very good. Bartlett's test of sphericity produced values of 1742.2 for suppliers and 1267.1 for customers. Higher Bartlett values indicate stronger justification for factor analysis. Additionally, both results were statistically significant at $p < 0.00000$.

Confirmatory factor analysis was used to ensure the reliability of the scale. The SPSS principal component

procedure was applied to examine whether the ten integration measures were unidimensional, as shown in Table 2. The factor scores represent the weighted averages of the values of all the original variables, with the factor loadings serving as the weights. Internal consistency analysis was conducted for each factor using SPSS reliability procedures, yielding a value of 0.935 for suppliers and 0.887 for customers. The reliability of each scale met the accepted standards, with Cronbach's alpha exceeding 0.70. The Eigenvalue for both the supplier and

customer integration scales exceeded the minimum threshold of 1.0, confirming the dimensionality of each factor, indicating good construct validity.

As noted earlier, combining factor scores and quartile positions for Factors 1 and 2 enables the mapping of stakeholders into five conceptual levels of supply chain integration, reflecting their engagement with suppliers and customers. Each actor is subsequently classified according to their factor scores and quartile positions, as presented in Table 3.

Table 1: Descriptive Statistics of Integration Activities in Indonesia's Coffee Supply Chain.

Supplier		Integration Activities	Customer		Paired Samples t-test	
Mean	Standard Deviation		Mean	Standard Deviation	t	Significance
2.10	1.360	Sharing information on prices, demand, and market supply	3.74	0.844	-20.165	< 0.001
1.81	1.131	Sharing production plans	3.27	1.014	-19.231	< 0.001
1.63	1.058	Sharing non-production-related plans	3.01	0.860	-22.328	< 0.001
2.19	1.396	Sharing information on inventory levels	3.48	0.967	-16.636	< 0.001
1.98	1.231	Facilitating transportation or distribution	3.13	0.881	-13.595	< 0.001
1.80	1.145	Collaboratively solving problems	3.26	1.078	-15.090	< 0.001
1.66	1.098	Sharing technology	3.05	1.156	-14.511	< 0.001
2.01	1.197	Jointly monitoring and adjusting the quality of inputs or outputs	3.53	0.784	-20.428	< 0.001
1.70	0.895	Being transparent in financial matters and reducing costs	2.83	0.965	-14.566	< 0.001
2.22	1.143	Transferring information and knowledge on production methods, processing, and product quality	3.62	0.946	-15.158	< 0.001

Table 2: Factor Analysis of Integration Activities in Indonesia's Coffee Supply Chain.

Factor 1 Supplier	Integration Activities	Factor 2 Customer
<i>Factor loadings</i>		
0.783	Sharing information on prices, demand, and market supply	0.554
0.826	Sharing production plans	0.833
0.906	Sharing non-production-related plans	0.747
0.782	Sharing information on inventory levels	0.691
0.803	Facilitating transportation or distribution	0.615
0.884	Collaboratively solving problems	0.832
0.732	Sharing technology	0.761
0.846	Jointly monitoring and adjusting the quality of inputs or outputs	0.540
0.688	Being transparent in financial matters and reducing costs	0.649
0.736	Transferring information and knowledge on production methods, processing, and product quality	0.783
<i>Factor analytic and reliability statistics</i>		
0.931	Kaiser-Meyer-Olkin measure of sampling adequacy	0.860
1742.214	Bartlett's Test of Sphericity	1267.109
0.000	Significance	0.000
> 0.5	Measure of sampling adequacy (MSA)	> 0.5
6.421	Eigenvalue	1.429
0.935	Cronbach's alpha	0.887

Table 3: Groups of Integration Stakeholders in Indonesia's Coffee Supply Chain.

Degree of Integration	Number of Stakeholders	Percentage
Inward-facing	66	28.45
Periphery-facing	123	53.02
Supplier-facing	11	4.74
Customer-facing	28	12.07
Outward-facing	4	1.72
Total	232	100.00

As shown in Table 3, the 232 stakeholders were classified into five integration groups. Inward-facing integration—low integration with both suppliers and customers—accounts for 28.45% (66 stakeholders). Outward-facing integration, indicating extensive upstream and downstream integration, comprises only 1.72% (4 stakeholders). The largest group, periphery-facing integration, represents 53.02% (123 stakeholders) and reflects moderate integration in at least one direction, above the lower quartile but below the upper quartile for both suppliers and customers. Fewer than 5% exhibit extensive integration with suppliers but not customers (supplier-facing), while 12.07% have extensive integration with customers but not suppliers (customer-facing).

Discriminant analysis was conducted to validate the five supply chain integration groups, using twenty activities as independent variables and the classifications from Table 3 as the dependent variable. As shown in Table 4, 81.5% of respondents were correctly classified, indicating strong differentiation among the groups and supporting the validity of the classifications.

The operationalization accuracy of the arcs of integration in classifying respondents into the periphery-facing group was 70%, the lowest among all groups (Table 4). This relatively low accuracy highlights challenges in clearly distinguishing moderately integrated stakeholders from those with lower or higher levels of integration. The likely cause is the inclusive and less discriminative nature of the periphery-facing category, which tends to overlap with inward-facing as well as supplier and customer-facing groups. For instance, respondents just

above the lower quartile for supplier or customer integration are categorized as moderately oriented, while those just below are grouped as inward-facing. This blurred boundary increases the risk of misclassification, which may lead to inaccurate analysis and misaligned policy interventions. In contrast, the model performs well for more clearly defined categories: supplier-facing (91%), customer-facing (90%), inward-facing (97%), and outward-facing (100%)—with the latter two showing the highest classification accuracy. To enhance the reliability of classification, future research may consider refining operational definitions, adjusting threshold values, or introducing additional variables to better capture the nuances of moderate integration.

4 DISCUSSION

4.1 Coffee Supply Chain Flow and Stakeholder Roles

Every activity in the coffee supply chain is closely tied to the roles of various stakeholders, including smallholder farmers, small and large-scale collectors, regional traders, cooperatives, small and large-scale processing industries, exporters, retailers, roasteries, and coffee shops. Each stakeholder plays a critical role in ensuring that coffee products reach the market with the desired quality, consistent availability, and cost efficiency. Each of these stakeholders tends to exhibit its own *Arc of Integration*, shaped by its functional position in the chain, market orientation, access to resources, and capacity for innovation. The flows of products, finances, and information within the coffee supply chain are illustrated in Figure 2.

From a supply chain perspective, the product flow begins at the upstream level with smallholder farmers who produce green beans. These green beans are then sold to middlemen or cooperatives and continue downstream through layers of processing—from small-scale to industrial processing—until they reach roasteries, retailers, and ultimately, consumers. In this context, the flow of physical products reflects the transformation of coffee from raw agricultural output to finished consumer goods. However, inefficiencies often emerge due to inadequate post-harvest handling and limited access to processing technology, particularly among upstream stakeholders.

Table 4: Discriminant Analysis Classification on Arcs of Integration.

Degree of Integration	Predicted Group Membership ^a				
	Inward-facing	Periphery-facing	Supplier-facing	Customer-facing	Outward-facing
Inward-facing	64 (97%)	2 (3%)	0 (0%)	0 (0%)	0 (0%)
Periphery-facing	15 (12%)	86 (70%)	7 (6%)	15 (12%)	0 (0%)
Supplier-facing	1 (9%)	0 (0%)	10 (91%)	0 (0%)	0 (0%)
Customer-facing	0 (0%)	3 (10%)	0 (0%)	25 (90%)	0 (0%)
Outward-facing	0 (0%)	0 (0%)	0 (0%)	0 (0%)	4 (100%)

^a81.5% of original grouped cases correctly classified.

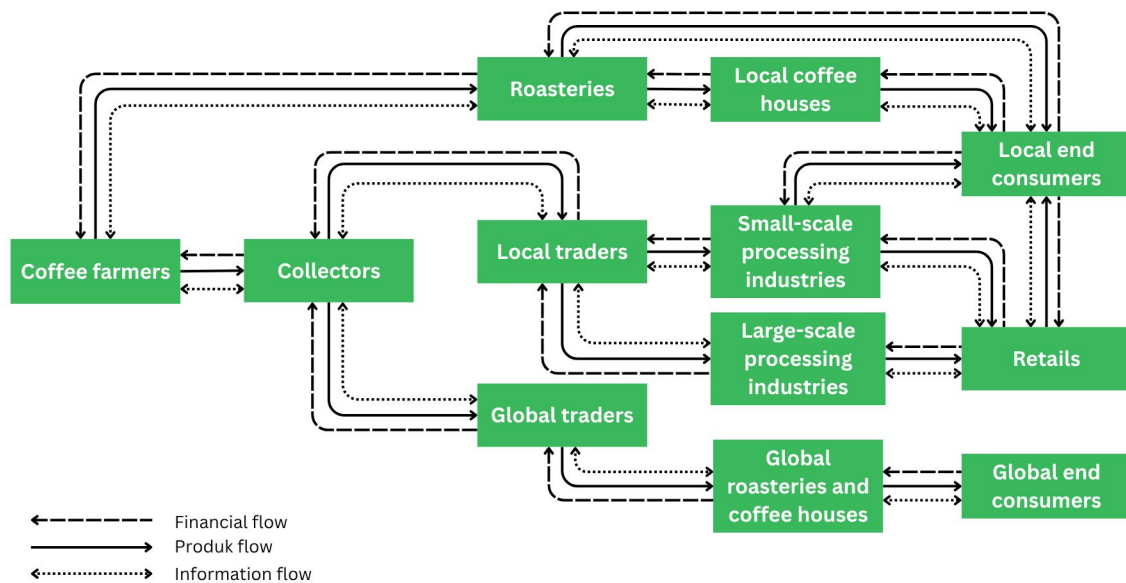


Figure 2: Coffee supply chain flow.

Financial flow in the coffee supply chain is often unbalanced, with upstream stakeholders receiving the least economic benefit. Farmers typically operate with limited capital and have little bargaining power, often selling their coffee beans at low prices. Cooperatives can help mitigate this through collective marketing and access to financing. However, in practice, many farmers still rely on middlemen who offer immediate payment but at lower prices. Downstream stakeholders—particularly large-scale processors and exporters—capture a larger share of the value due to their ability to control quality, access high-value markets, and invest in technology. Processing industries and roasteries play a customer-facing role by determining quality standards and specifications for coffee beans in local market. Focal firms, including global roasteries, multinational brands, or global Indonesian brands such as Nestlé, Mayora, and Kapal Api, leverage outward-facing integration strategies to meet international standards while maximizing profitability.

Information flow across the coffee value chain remains fragmented, despite relatively high levels of information exchange. Field data indicate that most traders and processors share information with farmers on prices, green bean demand, and inventory levels, while many processors and roasteries also communicate their production and non-production plans to other stakeholders. Nevertheless, farmers often still have limited access to detailed market intelligence, quality standards, or technical knowledge, constraining their ability to meet downstream requirements consistently. Cooperatives and NGOs attempt to fill this gap, but their effectiveness varies. In some cases, partnerships between small-scale processors and academic institutions have led to successful innovations—such as temperature and airflow-regulated roasting equipment in West Java—demonstrating the benefits of targeted information

exchange. However, field observations show that relatively few stakeholders engage in technology sharing, highlighting that while the dissemination of market-related information is relatively strong, technology transfer within Indonesia's coffee supply chain remains limited. Meanwhile, downstream stakeholders increasingly dictate quality parameters and sustainability requirements, which are not always effectively communicated back to producers, resulting in mismatches between supply and demand expectations.

Focal companies that adopt both upstream and downstream-oriented strategies play a pivotal role in integrating the supply chain. In Bandung, West Java, for example, a processor that employs 80% women and implements environmentally friendly farming practices demonstrates a strong commitment to both inclusivity and sustainability. These stakeholders not only provide incentives for high-quality production but also facilitate knowledge transfer, creating value at the farm level and aligning local practices with global market demands. Conversely, certain upstream stakeholders—such as leaders of farmer groups or associations—may hinder integration by prioritizing personal or organizational gains over broader chain development. As highlighted by Vicol et al. (2018), as observed in the coffee sectors of South Sulawesi, Bali, and West Java, such institutions often lack inclusivity and long-term vision, limiting their contributions to pro-poor and sustainable value chain transformation.

4.2 Integration in the Coffee Supply Chain

Based on the results of the arcs of integration analysis, the most dominant integration level in the Indonesian coffee supply chain is periphery-facing (Figure 3). According to Frohlich and Westbrook (2001), periphery-facing integration represents a balance point in supply chain integration, where

stakeholders' activities are only moderately linked to others in the chain. In the coffee supply chain, this level reflects weak backward and forward integration, with relationships that are largely transactional rather than strategic, and limited long-term collaboration or deep information exchange. Only a small portion stakeholders advance into the more robust integration types (outward-facing, supplier-facing, and customer-facing) due to a combination of structural, institutional, and capacity-related barriers. These advanced types of integration require strong backward (supplier) or forward (customer) linkages, high levels of coordination and communication, mutual trust and long-term collaboration, and strategic alignment of goals and activities across the supply chain. Such conditions are rarely met across most of the Indonesian coffee supply chain, especially among smallholders and SMEs.

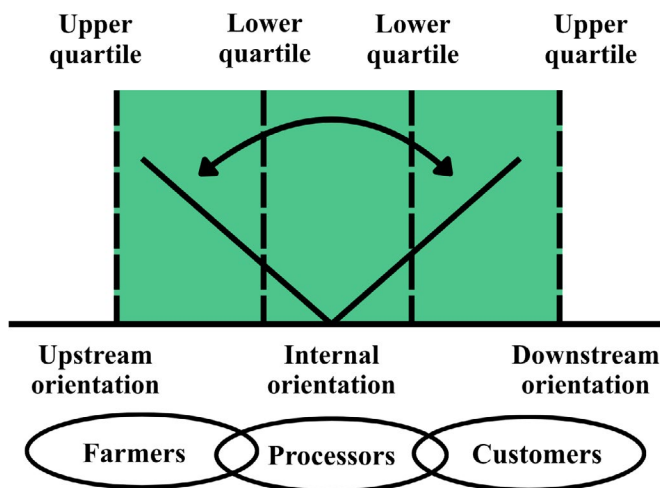


Figure 3: Level of Integration in Indonesia's Coffee Supply Chain: Periphery-Facing Arcs of Integration.

Field data indicate that, in terms of integration activities, over 75 percent of traders and processors share information with farmers regarding the price and demand for green beans, as well as their inventory levels. Approximately 55 percent of processors and roasteries, also communicate their production and non-production plans to other stakeholders within the supply chain. These enable them to understand and produce coffee products in accordance with the required specifications. However, only about 25 percent of all stakeholders engage in technology sharing. These findings suggest that while information exchange within Indonesia's coffee supply chain is relatively high, the level of technology transfer remains limited.

In the periphery-facing integration, farmers are in a position of low bargaining power, often selling green beans to traders without understanding market demand, consumer preferences, or opportunities for value addition through further processing. This limited knowledge and innovation, mainly

due to weak connections with downstream stakeholders such as roasteries or coffee shops, restricts improvements in production techniques and quality. Strengthening these connections could facilitate product development and processing initiatives, which, when combined with targeted promotional activities in domestic and global markets, would create greater added value for farmers and other stakeholders in the domestic supply chain.

Traders and cooperatives in this integration category also tend to engage in relatively simple transactions, with relationships between traders, farmers, and buyers centered mainly on price and volume. Limited integration efforts reduce opportunities to improve efficiency, enhance quality, or develop product differentiation that could boost value creation and competitiveness.

On the downstream side, roasteries and processing industries often face challenges in securing high-quality raw materials due to the absence of strong relationships with suppliers, particularly farmers and cooperatives. This lack of efficiency and collaboration not only hampers the consistency of quality coffee bean supply but also limits coordination across the chain, thereby constraining efforts to build a more efficient and innovative supply chain.

Various barriers can hinder stakeholders from strengthening the integration structure of their supply chains. As noted by Ali et al. (2016), key constraints include business immaturity, the desire to preserve competitive advantages, a limited pool of credible partners, and supply chain complexity. Consistent with Frohlich and Westbrook's (2001) concept of a natural equilibrium in supply chain development, findings from coffee industry case studies reveal a similar tendency toward periphery-facing integration. While this strategy is common, its limited business process integration can reduce overall supply chain efficiency. Achieving an optimal coffee supply chain therefore requires more comprehensive integration across all stakeholders. This aligns with Azis and Irjayanti (2023) observation that the Indonesian coffee supply chain remains complex, with multiple actors, weak information flow, and persistent challenges such as poor internal management, absence of standardized procedures, outdated technology, and limited knowledge transfer.

In addition to challenges and barriers, the composition of stakeholders plays a critical role in shaping supply chain integration strategies. It is therefore important to align industry strategies across the entire supply chain rather than focusing solely on individual organizations. Stakeholders in the coffee industry should therefore pursue integration at multiple levels—upstream with suppliers to secure raw materials of consistent quality, quantity, and continuity, and downstream with customers to enable product and service adjustments in line with market demand and preferences. Such integration can be fostered through joint business

groups, cooperatives, or partnerships between lead firms—whether local or global roasters or traders—and coffee producers.

In the coffee supply chain, stakeholders tend to be more customer-facing than supplier-facing (Table 3). This is consistent with Bimpizas-Pinis; Calzolari; Genovese (2022), who found that forward integration is more common than backward integration in agri-food supply chains. Experience in forward integration can provide a strategic foundation for developing capabilities to manage upstream suppliers since core processes such as production, supply-demand management, and distribution are similar in both forward and backward integration. This can begin with partnerships between roasteries and farmers, or between global brands as lead firms and farmer groups, as evidenced by the higher bean prices and increased profits earned by coffee farmers partnering with Starbucks in South Sulawesi (Sudirman; Nurmalina; Suprehatin, 2021). In coffee supply chains, strong internal and external integration, supported by organizational flexibility, plays a critical role in enhancing agility (Ramos; Patrucco; Chavez, 2023). While agility contributes to better performance, it is the combination of agility with robust integration that truly drives high supply chain performance.

A broader range of integration correlates with higher supply chain performance, reflecting the positive relationship between integration breadth and performance identified by Frohlich and Westbrook (2001). When suppliers, producers, and customers are effectively integrated and well-coordinated, the overall performance of the coffee supply chain improves. This aligns with Nuraisyah et al. (2025), who emphasize that strong stakeholder collaboration enhances operational efficiency and supports the long-term sustainability of the coffee supply chain in West Java. Given that coffee is one of Indonesia's leading export commodities, stakeholders who are still positioned within an inward-facing strategy need to be encouraged to expand their integration efforts. Molina-Quintana and Quintana-León (2021) suggest that food, beverages, and tobacco companies engaged in global trade tend to adopt supplier-facing integration. This is reasonable, as maintaining a stable supply is essential to meet export demands. However, considering that coffee is highly influenced by global consumer preferences—such as certification requirements, traceability, and other value attributes—customer-facing integration is equally critical. Identifying and mapping customer quality standards, as emphasized by Ramos et al. (2019), would allow supply flows to be structured around these expectations. This requires strengthening integration so that information on customer quality requirements is effectively transmitted throughout the supply chain to producers, supported by coordination not only within but also across supply chain networks.

5 CONCLUSIONS

Indonesia's coffee supply chain remains largely periphery-facing, with limited collaboration and mainly transactional relationships, restricting value addition, innovation, and quality improvements at the farm level. Advancing toward outward-facing integration marked by stronger supplier and customer linkages, transparent information flow, and strategic partnerships can enhance competitiveness and sustainability. Collaborative models such as cooperatives, contract farming, and farmer-roaster partnerships, supported by regular coordination and training, can align production with market needs, improve quality, raise farmer income, and strengthen Indonesia's global coffee position.

6 AUTHORS' CONTRIBUTION

Conceptual Idea: Harianto; Suryana, A.T.; Syaukat, Y.; Methodology design: Harmini; Suryana, A.T.; Data collection: Suryana, A.T.; Harmini; Data analysis and interpretation: Suryana, A.T.; Harianto; Yulianti, A.; Istriningsih; and Writing and editing: Istriningsih; Yulianti, A.; Suryana, A.T.; Syaukat, Y.

7 REFERENCES

- ALL, M. H. et al. Augmenting halal food integrity through supply chain integration. **Jurnal Pengurusan**, 48:21-31, 2016.
- AZIS, A. M.; IRJAYANTI, M. How does the coffee supply chain work in Indonesia? **Journal of Optimization in Industrial Engineering**, 16(2):87-97, 2023.
- BHAKOO, V.; SINGH, J. P.; CHIA, A. Supply chain structures shaping portfolio of technologies exploring the impact of integration through the “dual arcs” framework. **International Journal of Physical Distribution and Logistics Management**, 45(4):376-399, 2015.
- BIMPIZAS-PINIS, M.; CALZOLARI, T.; GENOVESE, A. Exploring the transition towards circular supply chains through the arcs of integration. **International Journal of Production Economics**, 250:108666, 2022.
- FROHLICH, M. T.; WESTBROOK, R. Arcs of integration: An international study of supply chain strategies. **Journal of Operations Management**, 19(2):185-200, 2001.
- GRABS, J.; PONTE, S. The evolution of power in the global coffee value chain and production network. **Journal of Economic Geography**, 19(4):803-828, 2019.
- IRJAYANTI, M.; MULYONO, A. How well is the coffee business supply chain performing in west java? **Holistica Journal of Business and Public Administration**, 14(1):173-185, 2023.

- KRISNAMURTHI, B.; MUFLIKH, Y. N.; CHALIL, D.
Bunga rampai rantai pasok pertanian: Specialty kopi Indonesia di pasar global. Jakarta: Penebar Swadaya, 2023.
- MAULADI, M. A. R.; MULYO, J. H.; DARWANTO, D. H. Coffee supply Chain management: A case study in ciamis, west java, Indonesia. **HABITAT**, 33(3):201-211, 2022.
- MOA. **Statistics of Estate Crops Volume I 2023-2025.** Jakarta: Directorate General of Estates Ministry of Agriculture of Indonesia, 2024.
- MOLINA-QUINTANA, B.; QUINTANA-LEÓN, M. B. Comparison of international family business supply chain integration and non-international family business supply chain integration of the food industry sector of Michoacán, Mexico. **European Journal of Family Business**, 11(2):56-71, 2021.
- NURAI SYAH, A. et al. The roles of stakeholders in supply chain sustainability challenges: The case of coffee chain in West Java Province, Indonesia. **Discover Sustainability**, 6:247, 2025.
- PERMATASARI, P. C.; BASITH, A.; MULYATI, H. Model bisnis inklusif rantai nilai kopi arabika di bondowoso jawa timur. **Jurnal Manajemen Teknologi**, 17(2):111-125, 2018.
- RAMOS, E. et al. Organic coffee supply chain source process integration: A peruvian case. **International Journal of Supply Chain Management**, 8(6):133-145, 2019.
- RAMOS, E.; PATRUCCO, A. S.; CHAVEZ, M. Dynamic capabilities in the “new normal”: A study of organizational flexibility, integration and agility in the Peruvian coffee supply chain. **Supply Chain Management: An International Journal**, 28(1):55-73, 2023.
- SUDIRMAN, H.; NURMALINA, R.; SUPREHATIN. The impact of sustainability standard on coffee farm income: The case of the starbucks CAFE practices program in enrekang regency. **Jurnal Agro Ekonomi**, 39(2):81-103, 2021.
- SURYANA, A. T. et al. Geographic scope of the global value chain for Indonesian coffee. **Coffee Science**, 18:e182169, 2023a.
- SURYANA, A. T. et al. The value chain governance of robusta coffee in bogor regency. **Jurnal Manajemen & Agribisnis**, 20(2):175-187, 2023b.
- SURYANA, A. T. et al. Global competitiveness of coffee products: A comparative study of Indonesia and Vietnam. **Coffee Science**, 19:e192237, 2024. .
- UMARAN, T. et al. Co-Creation approach in designing a sustainable coffee supply chain (a Case in Bandung Regency, West Java, Indonesia). **Sustainability**, 14:476, 2022.
- UN COMTRADE. **Trade data.** 2025. UN Comtrade Database. Available in: <<https://comtradeplus.un.org/>>. Access in: October 21, 2025.
- VICOL, M. et al. Upgrading for whom? Relationship coffee, value chain interventions and rural development in Indonesia. **World Development**, 110:26-37, 2018.
- WONG, C. Y.; WONG, C. W. Y.; BOON-ITT, S. Do arcs of integration differ across industries? Methodology extension and empirical evidence from Thailand. **International Journal of Production Economics**, 183:223-234, 2017.