# Supply chain performance of robusta coffee produced in the mountainous areas of Temanggung Indonesia

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**Abstract.** The highlands of Temanggung, situated between Mount Sindoro and Mount Sumbing, are extensively planted with robusta coffee. The region's climate and rainfall conditions are very suitable for robusta coffee production. The distribution of robusta coffee from these mountainous areas in Temanggung is inherently linked to the concept of the supply chain..This research aims to identify the supply chain and performance in by examining product flow, money flow, and information flow. The respondents at the farmer level were located in Gesing, while those at higher levels of the supply chain resided in Temanggung. A total of 171 participants were involved in this study, including 105 farmers, five collectors, two wholesalers, four roasteries, five cafes, and 50 consumers. Descriptive analysis and supply chain performance evaluations were conducted, using a 1 to 5 scale for product and money flows, and a 1 to 2 scale for information flow. The analysis disclosed five chains composed of six distinct actors: farmers, collectors, wholesalers, roasteries, cafes, and consumers. The research results show that the overall performance of robusta coffee supply chain is running well, seen from the smooth of products flow, money flow and information flow.

## 1 Introduction

Plantations are one of the leading agricultural sectors contributing to the national economy's development. Coffee is one of the staple commodities in Indonesia's plantations. Coffee has a significant role in the economy, serving as a source of foreign exchange and income and a generator of jobs spanning from processing to international trading [1]. There are three business scales in the coffee processing industry in Indonesia, including major, middle, and small businesses [2]. Good processing and marketing practices can boost economic returns for farmers [3].

The coffee produced in Indonesia is not only exported but also consumed domestically. According to the International Coffee Organization (ICO) [4], the domestic consumption of coffee in Indonesia has continued to rise over the past five years. Temanggung Regency is one of Central Java's main coffee-producing regions. The highlands in Temanggung area are flanked by Mount Sindoro and Mount Sumbing, which are widely planted with Robusta

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coffee as a specialty coffee commodity from Temanggung. In addition to the high yields of Robusta coffee in Temanggung Regency, coffee consumption is also rising, as demonstrated by the proliferation of coffee shops in this regency.

Prior to reaching customers in the form of coffee powder, Robusta coffee goes through several steps, beginning with cultivation. In this process, the supply chain plays an essential role. According to[5], a supply chain consist of people who collaborate to transmit agricultural products from producers to final consumers. [6] contended that a supply chain organizes multiple activities to obtain completed, semi-finished, and even raw items for distribution to consumers. The supply chain can be defined as an integrated activity involving a flow of data on sources, production processes, and distribution activities [7]. There is a link between product, money, and information flows from all supply chain actors [8]. [9] described the supply chain as market information for a country with strong economic and social potential.

There are differences between agricultural and non-agricultural supply chains due to the distinctive characteristics of agricultural products. According to [10] in [11], there are certain characteristics of the agricultural supply chain that must be examined. Agricultural product prices change due to product qualities such as perishability, seasonality, and location from consumers. It occasionally results in losses at the producer level among farmers [12]. In addition here are two types of agricultural supply chains: traditional and modern [13].

The performance of the supply chain encompasses all efforts made by supply chain actors to fulfill consumers' needs and desires. According to Hanugrani et al. in [14], supply chain performance can be effectively and systematically managed. Three streams must be handled in the supply chain: the flow of products, the flow of money, and the flow of information. The smoothness of the three flows indicates supply chain success. Multiple factors, including sourcing, inventory, facilities, pricing, and transportation, can impact supply chain effectiveness [15]. Performance measurement is essential for evaluating past performance, establishing goals, and determining subsequent programs. [16] have identified many supply chain performance measures, covering product quality, competitiveness, profit level, and market share. The two key indicators of supply chain performance are efficiency and responsiveness [17].

Temanggung Regency has 20 districts producing robusta coffee. Robusta coffee production in 2018 was 9,545 tons and in 2019 the total was 8,728.39 tons. There are three largest coffee producing areas in Temanggung Regency, namely Bejen District, then followed by Kandangan District, and after that Gemawang District [18]. Based on this statement, its means Kandangan District is one of Temanggung Regency's coffee-producing centers. In addition, the 2017 award for the First Winner of Robusta Coffee in Indonesia demonstrates that the coffee in Kandangan District is of superior quality.

Uncertain annual coffee production creates a shifting supply and fluctuating prices. Even though its harvest season occurs solely once a year, coffee is in continual demand. The coffee harvest season begins in June and ends in September, with the peak harvest between July and August. Therefore, it impacts the performance of the robusta coffee supply chain in Kandangan District in Temanggung Regency. Accordingly, it is required to research the performance of the robusta coffee supply chain in Kandangan District, Temanggung Regency, based on product, money, and information flows. This study seeks to (i) determine the performance of the robusta coffee supply chain in Kandangan District, Temanggung Regency, and (ii) examine the performance of the robusta coffee supply chain based on product, money, and information flows.

## 2 Research Method

This study employed a descriptive method. The technique for determining the location was performed intentionally in Kandangan District of Temanggung Regency. Kandangan District is 8 km from the capital of Temanggung Regency with an altitude of 657.31 meters above sea level, making it suitable for planting robusta coffee. Using proportional random selection, 105 farmers with a 5% error rate were selected among 152 farmers who were members of the Farmer Group Association of Manunggal in Gesing Village, Kandangan District, to determine farmer-level respondents. Meanwhile, the supply chain actors comprised five collectors, four roasteries, five cafes, and 50 customers, gathered with snowball sampling.

This study utilized primary data collected through questionnaires and interviews and secondary data obtained from the Temanggung Regency Agriculture Department, the Kandangan District Agricultural Extension Center, and the Gesing Village Head Office.
A descriptive analysis was run to examine the robusta coffee supply chain and the activities of supply chain actors. Meanwhile, supply chain performance analysis applied a score between 1 and 5 for product and money flows and 1 to 2 for information flow. The product flow employed five indicators: product quality [19], number of products, availability of storage facilities [20], means of transportation [21], and delivery time. Four indicators were utilized to determine the flow of money: the transaction system, the transaction method [22], the site of the transaction [19], and the time of the transaction [19]. Moreover, five indicators were employed to measure the flow of information: production information, demand information, price information [19], payment information, and quality information.

The three streams were determined using the Sturges formula, categorized as rough and smooth [19].

$$Z = \frac{X-Y}{K} \tag{1}$$

Description:

Z = Class interval

X = Highest score

Y = Lowest score

K = Number of classes

a. Product Flow

$$Z = \frac{25-5}{2} = 10 \tag{2}$$

**Table 1.** Categorization of Product Flow

| Average Score | Product Flow Category |
|---|---|
| 5.00 – 14.5 | Unsmooth |
| 14.6 – 25.0 | Smooth |

b. Money Flow

$$Z = \frac{20-4}{2} = 8 \tag{3}$$

**Table 2.** Categorization of Money Flow

| Average Score | Product Flow Category |
|---|---|
| 4.00 – 11.5 | Unsmooth |
| 11.6 – 20.0 | Smooth |

c. Information Flow

$$Z = \frac{20-4}{2} = 8 \quad (4)$$

**Table 3.** Categorization of Information Flow

| Average Score | Information Flow Category |
|---|---|
| 5.00 – 7.40 | Unsmooth |
| 7.50– 10.0 | Smooth |

# 3 Results And Discussion

## 3.1 Supply Chain of Robusta Coffee

### *3.1.1 Supply Chain Actors of Robusta Coffee*

Actors contributing to the supply chain formation of robusta coffee were examined. Supply chain actors have distinct roles and activities. Each actor in the robusta coffee supply chain participated in three streams: product, money, and information flows. There are 5 chain in the supply chain of robusta coffee in Kandangan District. Six actors in the robusta coffee supply chain in Kandanga District, Temanggung Regency, covered farmers, collectors, wholesalers, roasteries, cafes, and consumers. This result is different from the research by [23] which showed that there were 3 chains in the robusta coffee supply chain in Rejang Lebong Regency.The following actors contributed to forming five distinct supply chain patterns of robusta coffee.

1. Farmers – Collectors – Wholesalers – Roasteries (3 Tjangkir, Coffee X Roastery, and Temanggung Coffee House) – Cafes/Coffee Shops (MeCafe, The Praya, and Kaki Bumi) – Consumers
2. Farmers – Collectors – Wholesalers – Roasteries (3 Tjangkir, Coffee X Roastery, and Temanggung Coffee House) – Consumers
3. Farmers – Collectors – Roastery (Morojiwo) – Cafe/Coffee Shop (Angkringan Nyawiji) – Consumers
4. Farmers – Collectors – Roastery (Morojiwo) – Consumers
5. Farmers – Collectors – Cafe/Coffee Shop (Kartini Cafe) – Consumers

Figure 1 illustrates the overall robusta coffee supply chain and its details.

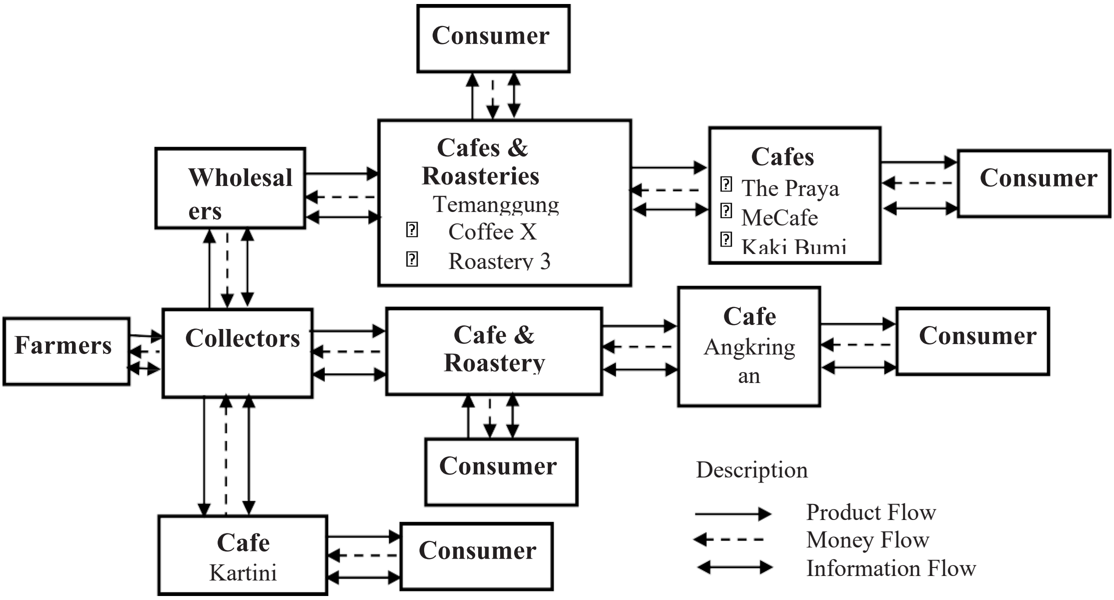


**Fig 1.** Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

### *3.1.2 Activities of Supply Chain Actors*

Supply chain actors coordinated their efforts to bring Robusta coffee to consumers. Each actor performed the following activities.

1. Farmers

The supply chain began with the farmers, who are responsible for the entire lifecycle of coffee production. This includes preparing the soil, sowing the seeds, managing crop maintenance, harvesting the coffee beans, and processing the coffee beans post-harvest. Farmers usually performed natural coffee processing and dry processing or skin cracking after harvest. The processing carried out by farmers is natural and dry processing. After that the coffee is milled to separate the coffee beans with coffee skin into greenbean coffee or commonly called coffee rice. During the coffee-making process, 4 kg of green beans were extracted from 1 kg wet logs. At harvest season, the price of ose or green bean coffee varied from Rp 20,000/kg to Rp 22,000/kg. However, it could rise to Rp 28.000/kg if not harvested in time. Thus, farmers kept some of their coffee rather than selling it all at once to the collectors.

2. Collectors

Collecting began when collectors purchased wet coffee logs from farmers for Rp 5,000 to Rp 6,000/kg. These logs were part of the farmers' garden produce. The collectors were compensated not just in coffee logs but also in green beans, a byproduct of the crop, which sold for Rp 21,000 to Rp 22,500/kg. Collectors purchased coffee from farmers and distributed it after sorting it. Collectors stored coffee in the form of green beans.

Wholesalers, roasteries, cafes or coffee shops, coffee resellers, and even international markets were all potential destinations for the green and roasted beans that collectors sold. Collectors in Temanggung Regency offered green and roasted coffee to wholesalers and roasteries. The number of green and roast beans sold might be either wholesale or retail.

3. Wholesalers

Often referred to as coffee sack wholesalers purchased coffee in bulk from collectors. Ngadirejo District in Temanggung Regency has become home to those coffee wholesalers. Coffee was sold to wholesalers in the form of green beans from all of Temanggung Regency's coffee-growing regions. Average monthly coffee purchases by wholesalers were measured in tons.

Wholesalers engaged in a wide variety of business activities. As a first step, they welcomed green beans from all over the region. They also protected the coffee's freshness by packing it in airtight containers made of plastic and then again using sacks. They sold coffee to consumers in various areas, from small towns to metropolitan centers, and they also exported vast quantities of coffee to other nations. In addition, several coffee factories sourced their beans from wholesalers. Several roasteries in Temanggung Regency also relied on coffee supplied by wholesalers.

4. Roastery

A roastery refers to a roasting or frying facility where green coffee beans are transformed into roasted beans. The robusta coffee industry in Temanggung Regency owns four roasteries: Coffee X Roastery, Temanggung Coffee House, 3 Tjangkir, and Morojiwo. A roastery's primary function is to acquire green beans, from which all other activities stem. Coffee roasting became the primary focus after that. The roaster sorted the beans before they were packaged. The sortation was determined by the degree of the bean's color change. Subsequently, zip-lock bags were utilized to pack the roast beans.

Bean roasting was another activity. The same attention to detail was applied while packing ground coffee, packaged tightly. After the coffee had been packaged and tagged, the labels were applied to each roast bean and ground coffee package. Coffee roasteries sold roasted beans and ground coffee to cafes in Temanggung Regency and other cities, as well as to direct consumers and through various e-commerce platforms.

5. Cafes

The Praya, MeCafe, Kaki Bumi, and Angkringan Nyawiji were all cafes playing a role in distributing robusta coffee in Temanggung Regency. The first step in the cafe's activities was purchasing green or roast beans. Different stages of coffee's maturation affected the taste; hence, some cafes preferred roasting their own beans. Furthermore, a grinder was employed to turn whole beans into ground coffee when an order came in. Subsequently, the ground coffee went through further steps to be prepared for the desired beverage for customers.

6. Consumers

The ultimate recipient at the end of the supply chain was the consumers. Consumers are those who purchase products in relatively small amounts for personal use or home stock. Cafes and roasteries made up the bulk of the robusta coffee supply chain in Kandangan District of Temanggung Regency. Consumers purchased coffee either as ground coffee to store at home or as cups of brewed coffee.

## 3.2 Supply Chain Performance

Our study revealed the performance of the robusta coffee supply chain in Kandangan District, Temanggung Regency. The performance of the robusta coffee supply chain in this study was analyzed through product flow, money flow, and information flow. The following is an analysis of the performance of each segment of the robusta coffee supply chain.

#### *3.2.1 Chain 1: Farmers – Collectors – Wholesalers – Roasteries (3 Tjangkir, Temanggung Coffee House, Coffee X Roastery) – Cafes (MeCafe, The Praya, Kaki Bumi) – Consumers*

1. Product Flow

The flow of products or goods is not only a physical movement from suppliers to consumers, but is also a complex network involving various entities in the supply chain [24].There was a continuous flow of products from the coffee farmers in Kandangan District to the final consumers in Temanggung Regency. The following are the conclusions drawn from the product flow analysis of chain 1.

**Table 4.** Product Flow of Chain 1 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Wholesalers | | Wholesalers – Roasteries | | Roasteries – Cafes | | Cafes – Consumers | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Farmers** | **Collectors** | **Collectors** | **Wholesalers** | **Wholesalers** | **Roasteries** | **Roasteries** | **Cafes** | **Cafes** | **Consumers** |
| Number Of Products | 4.9 | 4 | 4.6 | 4 | 5 | 4.3 | 4.3 | 4.7 | 5 | 4.2 |
| Product Quality | 4.4 | 4.4 | 4.8 | 4 | 5 | 4 | 5 | 4 | 4.3 | 4 |
| Means Of Transportation | 2.4 | 5 | 4.2 | 5 | 4.5 | 4 | 3.3 | 3.3 | 3.3 | 4 |
| Delivery Time | 4.88 | 5 | 5 | 4.5 | 4.5 | 3.7 | 4 | 4.3 | 4.7 | 4.7 |
| Availability Of Storage Facilities | 4.65 | 4.6 | 4.6 | 5 | 5 | 4 | 4.7 | 4.3 | 4.3 | 3.7 |
| **Total Score** | **21.23** | **23** | **23.2** | **22.5** | **24** | **20** | **21.3** | **20.6** | **21.6** | **21.1** |
| **Average Score** | **21.12** | | **22.85** | | **22** | | **20.95** | | **21.1** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

The analysis disclosed the smooth product flow of chain 1 for each supply chain actor, with an average score of 14.6 to 25. The collectors-wholesalers depicted the smoothest product flow since they obtained the highest average score of 22.85.

2. Money Flow

The money flow went from coffee consumers in Temanggung Regency to coffee farmers in Kandangan District. The analysis results on the money flow of chain 1 are as follows.

**Table 5.** Money Flow of Chain 1 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Wholesalers | | Wholesalers – Roasteries | | Roasteries – Cafes | | Cafes – Consumers | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Wholesalers | Wholesalers | Roasteries | Roasteries | Cafes | Cafes | Consumers |
| Transaction System | 4.9 | 5 | 4.4 | 5 | 5 | 4.3 | 4.7 | 5 | 5 | 4.4 |
| Means Of Transaction | 4.76 | 5 | 4.6 | 5 | 4.5 | 4.3 | 4 | 5 | 4.7 | 4.8 |
| Transaction Time | 4.82 | 4.8 | 3.6 | 4 | 4 | 3.7 | 4.7 | 4.3 | 5 | 4.4 |
| Place Of Transaction | 4.86 | 5 | 4.6 | 4 | 5 | 4.3 | 4.7 | 4 | 5 | 4.4 |
| **Total Score** | **19.33** | **19.8** | **17.2** | **18** | **18.5** | **16.6** | **18.1** | **18.3** | **19.7** | **18** |
| **Average Score** | **19.57** | | **17.6** | | **17.55** | | **18.2** | | **18.85** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

The analysis also unveiled the smooth money flow of chain 1. Each supply chain actor acquired an average score between 11.6 and 20. The farmers-collectors exhibited the smoothes money flow for obtaining an average score of 19.57.

3. Information Flow

Information flowed from coffee farmers in Kandangan District to end consumers in Temanggung Regency, and vice versa. The analysis of the information flow of chain 1 yielded the following results.

**Table 6.** Information Flow of Chain 1 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Wholesalers | | Wholesalers – Roasteries | | Roasteries – Cafes | | Cafes – Consumers | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Wholesalers | Wholesalers | Roasteries | Roasteries | Cafes | Cafes | Consumers |
| Production Information | 1.62 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1.7 | 1.5 |
| Price Information | 1.58 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Request Information | 1.45 | 1.6 | 1.4 | 2 | 1.5 | 1.7 | 1.7 | 2 | 1.7 | 1.8 |
| Payment Information | 1.72 | 1.6 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Quality Information | 1.93 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1.7 |
| **Total Score** | **8.3** | **9.2** | **9.4** | **10** | **9.5** | **9.7** | **9.7** | **10** | **9.4** | **8.9** |
| **Average Score** | **8.75** | | **9.7** | | **9.6** | | **9.85** | | **9.15** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

Table 6 displays that the information flow of chain 1 belonged to the smooth c0ategory since each supply chain actor obtained an average score between 7.5 and 10. The roasteries-cafes demonstrated the smoothes information flow with an average score of 9.85. The other research show the flow of information that occurs between supply chain members is price, coffee-related information, distribution techniques, and application of technology [25].

### *3.2.2 Chain 2: Farmers – Collectors – Wholesalers – Roasteries (3 Tjangkir, Temanggung Coffee House, Coffee X Roastery) – Consumers*

1. Product Flow

The product flow began with coffee farmers in Kandangan District and ended with consumers in Temanggung Regency. Table 7 describes the analysis results of the product flow of chain 2.

**Table 7.** Product Flow of Chain 2 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Wholesalers | | Wholesalers – Roasteries | | Roasteries – Cafes | |
|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Wholesalers | Wholesalers | Roasteries | Roasteries | Cafes |
| Number Of Products | 4.9 | 4 | 4.6 | 4 | 5 | 4.3 | 5 | 4.4 |
| Product Quality | 4.4 | 4.4 | 4.8 | 4 | 5 | 4 | 5 | 4.7 |
| Means Of Transportation | 2.4 | 5 | 4.2 | 5 | 4.5 | 4 | 2.7 | 3.3 |
| Delivery Time | 4.88 | 5 | 5 | 4.5 | 4.5 | 3.7 | 4.3 | 4.8 |
| Availability Of Storage Facilities | 4.65 | 4.6 | 4.6 | 5 | 5 | 4 | 4.7 | 3.6 |
| **Total Score** | **21.23** | **23** | **23.2** | **22.5** | **24** | **20** | **21.4** | **20.8** |
| **Average Score** | **22.12** | | **22.85** | | **22** | | **21.1** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

Following Table 7, each actor of the product flow of chain 2 acquired an average score between 14.6 and 25, thereby falling in the smooth category. With the highest average score of 22.85, collectors-wholesalers ensured the smoothes product flow.

2. Money Flow

Money flowed from Temanggung Regency coffee consumers to Kandangan District coffee farmers. The analysis findings of the money flow of chain 2 are as follows.

**Table 8.** Money Flow of Chain 2 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Wholesalers | | Wholesalers – Roasteries | | Roasteries – Cafes | |
|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Wholesalers | Wholesalers | Roasteries | Roasteries | Cafes |
| Transaction System | 4.9 | 5 | 4.4 | 5 | 5 | 4.3 | 5 | 4.3 |
| Means Of Transaction | 4.76 | 5 | 4.6 | 5 | 4.5 | 4.3 | 4.3 | 4.4 |
| Transaction Time | 4.82 | 4.8 | 3.6 | 4 | 4 | 3.7 | 5 | 4.5 |
| Place Of Transaction | 4.86 | 5 | 4.6 | 4 | 5 | 4.3 | 5 | 4.3 |
| **Total Score** | **19.33** | **19.8** | **17.20** | **18** | **18.5** | **16.6** | **19** | **17.5** |
| **Average Score** | **19.57** | | **17.6** | | **17.55** | | **18.25** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

Table 8 portrays the smooth money flow of chain 2 since each supply chain actor acquired an average score of 11.6 to 20. Farmers-collectors demonstrated the smoothes money flow for generating the greatest average score of 19.57.

3. Information Flow

Information traveled from coffee farmers in Kandangan District to final consumers in Temanggung Regency, and vice versa. Table 9 displays the analysis results of the information flow of chain 2.

**Table 9.** Information Flow of Chain 2 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Wholesalers | | Wholesalers – Roasteries | | Roasteries – Cafes | |
|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Wholesalers | Wholesalers | Roasteries | Roasteries | Cafes |
| Production Information | 1.62 | 2 | 2 | 2 | 2 | 2 | 2 | 1.6 |
| Price Information | 1.58 | 2 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Request Information | 1.45 | 1.6 | 1.4 | 2 | 1.5 | 1.7 | 2 | 1.9 |
| Payment Information | 1.72 | 1.6 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Quality Information | 1.93 | 2 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| **Total Score** | **8.3** | **9.2** | **9.4** | **10** | **9.5** | **9.7** | **10** | **9.2** |
| **Average Score** | **8.75** | | **9.7** | | **9.6** | | **9.6** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

Each supply chain actor acquired an average of 7.5 to 10, depicting the smooth information flow of chain 2. With the highest average score of 9.7, collectors-wholesalers illustrated the smoothes information flow.

### *3.2.3 Chain 3: Farmers – Collectors – Roastery (Morojiwo) – Cafe (Angkringan Nyawiji) – Consumers*

1. Product Flow

The product flow began with the coffee farmers and reached the final consumers. The analysis results of the product flow of chain 3 are as follows.

**Table 10.** Product Flow of Chain 3 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Roastery | | Roastery – Cafe | | Café - Consumers | |
|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Roastery | Roastery | Cafe | Roasteries | Cafes |
| Number Of Products | 4.9 | 4 | 5 | 5 | 4 | 5 | 5 | 4.4 |
| Product Quality | 4.4 | 4.4 | 5 | 3 | 5 | 5 | 5 | 4.7 |
| Means Of Transportation | 2.4 | 5 | 4 | 4 | 5 | 5 | 4 | 3.4 |
| Delivery Time | 4.88 | 5 | 5 | 5 | 4 | 5 | 3 | 4.6 |
| Availability Of Storage Facilities | 4.65 | 4.6 | 5 | 5 | 5 | 5 | 5 | 3.2 |
| **Total Score** | **21.2** | **23** | **24** | **22** | **23** | **25** | **22** | **21.3** |
| **Average Score** | **22.12** | | **23** | | **24** | | **21.65** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Table 10 illustrates the smooth product flow of chain 3, as each supply chain actor produced an average score of 14.6 to 25. Acquiring the highest average score of 24, roastery-cafe exhibited the smoothes product flow.

2. Money Flow

Money flowed from consumers to coffee farmers. Table 11 depicts the findings of the money flow analysis of chain 3.

Table 11. Money Flow Chain 3 Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Roastery | | Roastery – Café | | Café - Consumers | |
|---|---|---|---|---|---|---|---|---|
| | Farmers | Roastery | Collectors | Roastery | Roastery | Cafe | Café | Consumers |
| Transaction System | 4.9 | 5 | 5 | 5 | 5 | 5 | 5 | 4.9 |
| Means Of Transaction | 4.76 | 5 | 5 | 5 | 5 | 4 | 5 | 4.9 |
| Transaction Time | 4.82 | 4.8 | 4 | 4 | 4 | 4 | 5 | 4.8 |
| Place Of Transaction | 4.86 | 5 | 5 | 4 | 5 | 4 | 5 | 4.9 |
| **Total Score** | **19.33** | **19.8** | **19** | **18** | **19** | **17** | **20** | **19.5** |
| **Average Score** | **19.57** | | **18.5** | | **18** | | **19.75** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

All supply chain actors obtained an average score of 11.6 to 20, denoting the smooth money flow of chain 3. Generating the highest average score of 19.75, the cafe-consumers depicted the smoothest money flow.

3. Information

Coffee farmers in Kandangan District shared information with end consumers in Temanggung Regency and vice versa. The examination of the information flow of chain 3 yielded the following results.

**Table 12.** Information Flow Chain 3 Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Roastery | | Roastery – Cafe | | Café - Consumers | |
|---|---|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Roastery | Roastery | Cafe | Café | Consumers |
| Production Information | 1.62 | 2 | 2 | 2 | 2 | 2 | 1 | 1.5 |
| Price Information | 1.58 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Request Information | 1.45 | 1.6 | 2 | 2 | 2 | 2 | 2 | 1.9 |
| Payment Information | 1.72 | 1.6 | 2 | 2 | 2 | 2 | 2 | 2 |
| Quality Information | 1.93 | 2 | 2 | 2 | 2 | 2 | 2 | 1.7 |
| **Total Score** | **8.3** | **9.2** | **10** | **10** | **10** | **10** | **9** | **9.1** |
| **Average Score** | **8.75** | | **10** | | **10** | | **9.05** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

Table 12 displays the smooth flow of information in chain 3 since all supply chain actors generated an average score of 7.5 to 10. The collectors-roastery and roastery-cafe demonstrated the smoothest information flow since they produced the greatest average score of 10.

#### *3.2.4 Chain 4: Farmers – Collectors – Roastery (Morojiwo) – Consumers*

1. Product Flow

The product flow ran from coffee farmers in Kandangan District to end consumers in Temanggung Regency. Table 13 portrays the analysis results of the product flow of chain 4.

**Table 13**. Product Flow of Chain 4 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| **Indicators** | **Farmers – Collectors** | | **Collectors – Roastery** | | **Roastery – Consumers** | |
|---|---|---|---|---|---|---|
| | **Farmers** | **Collectors** | **Collectors** | **Roastery** | **Roastery** | **Consumers** |
| Number Of Products | 4.9 | 4 | 5 | 5 | 5 | 4.7 |
| Product Quality | 4.4 | 4.4 | 5 | 3 | 5 | 4.3 |
| Means Of Transportation | 2.4 | 5 | 4 | 4 | 3 | 3.9 |
| Delivery Time | 4.88 | 5 | 5 | 4 | 4 | 4.5 |
| Availability Of Storage Facilities | 4.65 | 4,6 | 5 | 5 | 5 | 3.6 |
| **Total Score** | **21** | **21** | **21** | **21** | **21** | **21** |
| **Average Score** | **22.12** | | **22.5** | | 21.5 | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

All supply chain actors yielded an average score between 14.6 and 25. In short, the product flow of chain 4 was smooth. Obtaining the highest average score of 22.5, the collectors-roastery illustrated the smoothest product flow.

2. Money Flow

Money flowed from coffee consumers in Temanggung Regency to coffee farmers in Kandangan District. The money flow analysis results of chain 4 are as follows.

**Table 14.** Money Flow of Chain 4 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| **Indicators** | **Farmers – Collectors** | | **Collectors – Roastery** | | **Roastery – Consumers** | |
|---|---|---|---|---|---|---|
| | **Farmers** | **Collectors** | **Collectors** | **Roastery** | **Roastery** | **Consumers** |
| Transaction System | 4.9 | 5 | 5 | 5 | 5 | 4.6 |
| Means Of Transaction | 4.76 | 5 | 5 | 5 | 5 | 4.7 |
| Transaction Time | 4.82 | 4.8 | 4 | 4 | 5 | 4.4 |
| Place Of Transaction | 4.86 | 5 | 5 | 4 | 5 | 4.4 |
| **Total Score** | **19.33** | **19.8** | **19** | **18** | **20** | **18.1** |
| **Average Score** | **19.57** | | **18.5** | | **19.05** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

The analysis results unveiled a smooth money flow of chain 4 since all supply chain actors acquired an average score of 11.6 to 20. The smoothest money flow was in the cafe-consumers, possessing the highest average score of 19.75.

3. Information Flow

Information circulated from coffee farmers in Kandangan District to final consumers in Temanggung Regency, and vice versa. Table 15 displays the analysis results of the information flow of chain 4.

**Table 15.** Information Flow of Chain 4 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers - Collectors | | Collectors – Roastery | | Roastery – Consumers | |
|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Roastery | Roastery | Consumers |
| Production Information | 1.62 | 2 | 2 | 2 | 2 | 1.7 |
| Price Information | 1.58 | 2 | 2 | 2 | 2 | 2 |
| Request Information | 1.45 | 1.6 | 2 | 2 | 2 | 1.9 |
| Payment Information | 1.72 | 1.6 | 2 | 2 | 2 | 1.9 |
| Quality Information | 1.93 | 2 | 2 | 2 | 2 | 1.8 |
| **Total Score** | **8.3** | **9.2** | **10** | **10** | **10** | **9.3** |
| **Average Score** | **8.75** | | **10** | | **9.65** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

All supply chain actors generated an average score of 7.5 to 10, indicating the smooth information flow of chain 4. Moreover, the collectors-roastery demonstrated the smoothest information flow with the highest average score of 10.

### *3.2.5 Chain 5: Farmers – Collectors – Cafe (Kartini Cafe) – Consumers*

1. Product Flow

The products moved from coffee farmers in Kandangan District to the end consumers in Temanggung Regency. Table 16 exhibits the product flow analysis results of chain 5.

**Table 16.** Product Flow of Chain 5 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers - Collectors | | Collectors – Cafe | | Cafe – Consumers | |
|---|---|---|---|---|---|---|
| | Farmers | Collectors | Collectors | Cafe | Cafe | Consumers |
| Transaction System | 4.9 | 5 | 5 | 5 | 5 | 4.6 |
| Means Of Transaction | 4.76 | 5 | 5 | 5 | 5 | 4.7 |
| Transaction Time | 4.82 | 4.8 | 4 | 4 | 5 | 4.4 |
| Place Of Transaction | 4.86 | 5 | 5 | 4 | 5 | 4.4 |
| **Total Score** | **21.23** | **23** | **24** | **22** | **21** | **21** |
| **Average Score** | **22.12** | | **23** | | **21** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

The overall supply chain actors yielded an average score of 14.6 to 25, signifying the smooth product flow of chain 5. The smoothest product flow was depicted in the collectors-cafe, with the highest average score of 23.

2. Money Flow

The money moved from coffee consumers in Temanggung Regency to coffee farmers in Kandangan District. Table 17 portrays the analysis results of the money flow of chain 5.

**Table 17.** Money Flow of Chain 5 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicators | Farmers – Collectors | | Collectors – Cafe | | Cafe – Consumers | |
|---|---|---|---|---|---|---|
| | **Farmers** | **Collectors** | **Collectors** | **Cafe** | **Cafe** | **Consumers** |
| Transaction system | 4.9 | 5 | 5 | 5 | 5 | 4.8 |
| Means of transaction | 4.76 | 5 | 5 | 4 | 5 | 4.7 |
| Transaction time | 4.82 | 4.8 | 3 | 5 | 5 | 4.6 |
| Place of transaction | 4.86 | 5 | 5 | 5 | 5 | 4.6 |
| **Total Score** | **19.33** | **19.8** | **18** | **19** | **20** | **18.7** |
| **Average Score** | **19.57** | | **18.5** | | **19.35** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

The average scores of all supply chain actors were between 11.6 to 20, implying the smooth money flow of chain 5. Moreover, the smoothest money flow was on farmers-collectors, acquiring the highest average score of 19.57.

3. Information Flow

Information spread from coffee farmers in Kandangan District to final consumers in Temanggung Regency, and vice versa. The following table describes the information flow analysis results in chain 5.

**Table 18.** Information Flow of Chain 5 of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

| Indicator | Farmers – Collectors | | Collectors – Cafe | | Cafe – Consumers | |
|---|---|---|---|---|---|---|
| | **Farmers** | **Collectors** | **Collectors** | **Cafe** | **Cafe** | **Consumers** |
| Production Information | 1.62 | 2 | 2 | 1 | 1 | 1.3 |
| Price Information | 1.58 | 2 | 2 | 2 | 2 | 2 |
| Request Information | 1.45 | 1.6 | 2 | 2 | 2 | 2 |
| Payment Information | 1.72 | 1.6 | 2 | 2 | 2 | 1.7 |
| Quality Information | 1.93 | 2 | 2 | 2 | 2 | 1.7 |
| **Total Score** | **8.3** | **9.2** | **10** | **9** | **9** | **8.7** |
| **Average Score** | **8.75** | | **9.5** | | **8.85** | |
| **Category** | **Smooth** | | **Smooth** | | **Smooth** | |

Source: Primary Data, 2022

Each supply chain actor yielded an average score between 7.5 and 10, signifying the smooth information flow of chain 5. Collectors-cafe attained the greatest average score of 9.5, disclosing the smoothest information flow.
Analyses of product, money, and information flows unveiled the smooth category of all

chains. Figure 2 displays robusta coffee's overall supply chain performance in Kandangan District, Temanggung Regency.

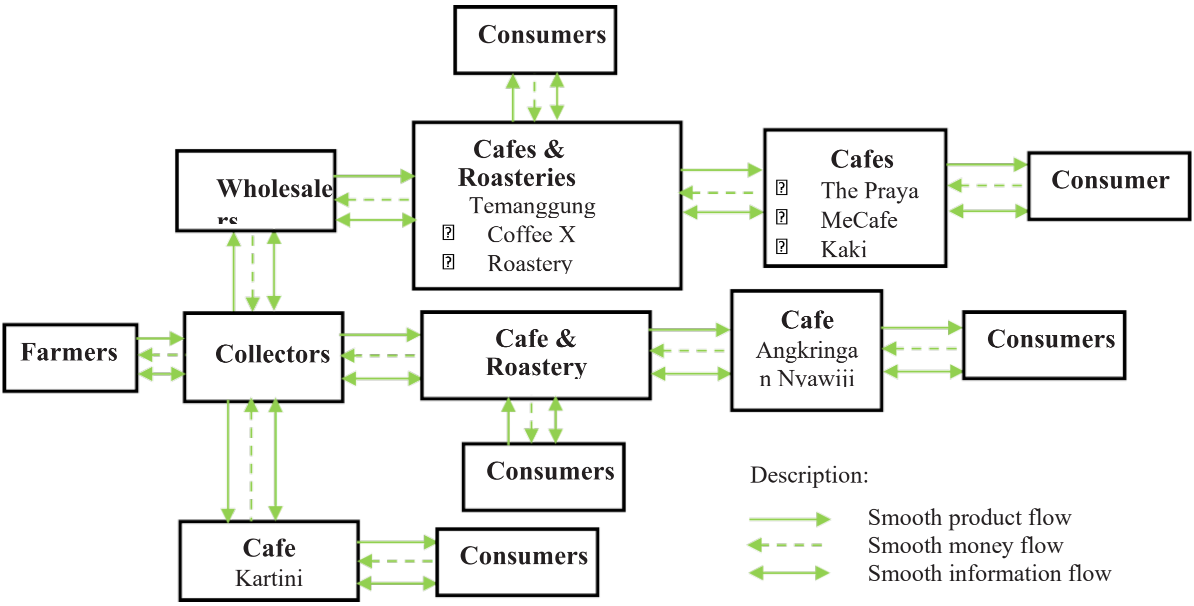


**Fig 2.** Flow of Robusta Coffee Supply Chain in Kandangan District, Temanggung Regency

## 4 Conclusion

In Kandangan District, Temanggung Regency, the robusta coffee supply chain consisted of five distinct chains with six key actors: farmers, collectors, wholesalers, roasteries, cafes, and consumers. Each actor played a crucial role in the overall process. Among the five chains, Chain 1 was the longest, involving all six actors, while Chains 4 and 5 were the shortest, consisting of only four actors. Chain 5 demonstrated the best conditions for the smooth flow of products, while Chain 3 showed optimal performance in terms of the smooth flow of money. Additionally, Chain 4 exhibited the best conditions for the efficient flow of information. Given that no disruptions in the flow of products, money, or information were identified, the robusta coffee supply chain in Kandangan District, Temanggung Regency, exhibited strong overall performance. Further research can be continued on strategies to improve supply chain performance for robusta coffee commodities.

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